Proposed New Installation of Sewerage Infrastructure in Pienaarstrand, Great Brak, Western Cape.

Specialist Plant Species and Terrestrial Biodiversity Impact Assessment

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GLOSSARY

Desktop Review	Preliminary assessment based on existing data and information, conducted prior to on-site investigations
Ecosystem Type	A classification of areas based on dominant vegetation and ecological processes (e.g., Fynbos, Renosterveld).
Invasive Alien Plant Species	Non-native plants or animals that spread and negatively affect local ecosystems and biodiversity.
Sensitive Species	A category of plant or animal species whose precise location data is restricted or obscured by the South African National Biodiversity Institute (SANBI) to prevent exploitation, illegal collection, or harm. These species are typically rare, endemic, or highly threatened and are considered vulnerable to human activity or commercial trade.
Sensitivity	The degree to which a particular area or ecosystem is susceptible to disturbance or impact, crucial in determining potential environmental consequences.
Site Assessment	On-the-ground survey and evaluation of an area's ecological characteristics, species, and habitat conditions.
Species of Conservation Concern	Species listed under a threat category due to declining populations or habitat.
Terrestrial Biodiversity	Terrestrial Biodiversity in context here refers to the variety and distribution of vegetation types and plant species within a given study area, as identified through mapped ecosystems (e.g., South African National Vegetation Map). In the context of an Environmental Impact Assessment (EIA), terrestrial biodiversity is assessed to determine the ecological sensitivity and conservation value of an area, particularly in relation to the Red List status of vegetation types, Critical Biodiversity Areas (CBAs), and other spatial biodiversity priority areas.
Vegetation Mapping	The process of documenting and categorizing plant communities spatially using GIS and field data.

ABBREVIATIONS

BI	Biodiversity Importance
BPA	Biodiversity Priority Area
CBA	Critical Biodiversity Areas
CD:NGI	Chief Directorate: National Geo-spatial Information
CI	Conservation Importance
SDP	Site Development Plan
CS	Compliance Statement
DFFE	Department of Forestry, Fisheries and the Environment
EA	Environmental Authorisation
ESA	Ecological Support Area
FEPA	Freshwater Ecosystem Priority Area
FI	Functional Integrity
LC	Least Concern (referring ecosystems)
NEMBA	National Environmental Management: Biodiversity Act
NVM	National Vegetation Map
RE	Remainder (of a Portion of land)
RR	Receptor Resilience
SACNASP	South African Council for Natural Science Professionals
SANBI	South African National Biodiversity Institute
SCC	Species of Conservation Concern
SSV	Site Sensitivity Verification
STEP	Subtropical Thicket Ecosystem Programme
SWSA	Strategic Water Source Area
VAST	Vegetation Assets, States, and Transitions
WC BSP	Western Cape Biodiversity Spatial Plan

DECLARATION OF SPECIALIST INDEPENDENCE

The consulting services comprise an assessment of the potential sensitivity of the ecosystems and flora that fall within the development footprint for the site. The following declaration is given by the appointed specialist:

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

Signed: 30 March 2026

BIANKE FOUCHÉ ABRIDGED CV

Qualifications

- B.Sc. Environmental Sciences (Nelson Mandela University),
- B.Sc. Honours in Botany (Nelson Mandela University),
- M.Sc. Conservation Biology (University of Cape Town)

SACNASP Registration No: 141757 (Professional Botanical; Candidate Ecological)

Skills and Core Competencies

- My MSc research will add to our understanding of plant community niche construction and Alternative Stable State (ASS) theory. The knowledge gained will be used to advise landscape stewardship practices, especially regarding reforestation initiatives in the Overstrand.
- I have worked closely with the conservation team of the Grootbos Foundation, where I assisted with vegetation surveys, mounting voucher specimens in the Grootbos herbarium, and taken part in controlled fynbos fires in the Overberg.
- Postgraduate studies of mine included assessing the allelopathic effects of *Eucalyptus* leaves on garden peas and leeks and assessing the accuracy of the climate leaf analysis multivariate programme (CLAMP) in predicting the climate of fynbos vegetation.
- In Cape Town I regularly took part in alien clearing activities and helped to identify relevant listed invasive plants.
- I am currently a member of SACNASP, the International Association for Impact Assessment (IAIA) in South Africa, Botanical Society of South Africa, and the custodians for rare and endangered wildflowers (CREW-Outramps) in George.

References

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1. INTRODUCTION

Confluent Environmental Pty (Ltd) was appointed to undertake an assessment for botanical and terrestrial sensitivity of the proposed new sewer line from Manatoka Lane to Dolphins Creek Golf Estate near Groot Brak, Mossel Bay Municipality. Extensive residential development has already taken place in this area, which at present, is dependent on communal conservancy tanks for wastewater collection.

1.1 Infrastructure Location

The proposed sewer line upgrade falls within the road reserve of Morrison Road, with a small section proposed to run adjacent to the railway, extending a total length of approximately 4 km (Figure 1). The proposed sewer line is situated approximately 200 m south of the N2. The closest perennial river is the Great Brak River, flowing into the Great Brak Estuary, approximately 3.4 km northwest of the proposed sewer line (Figure 1).

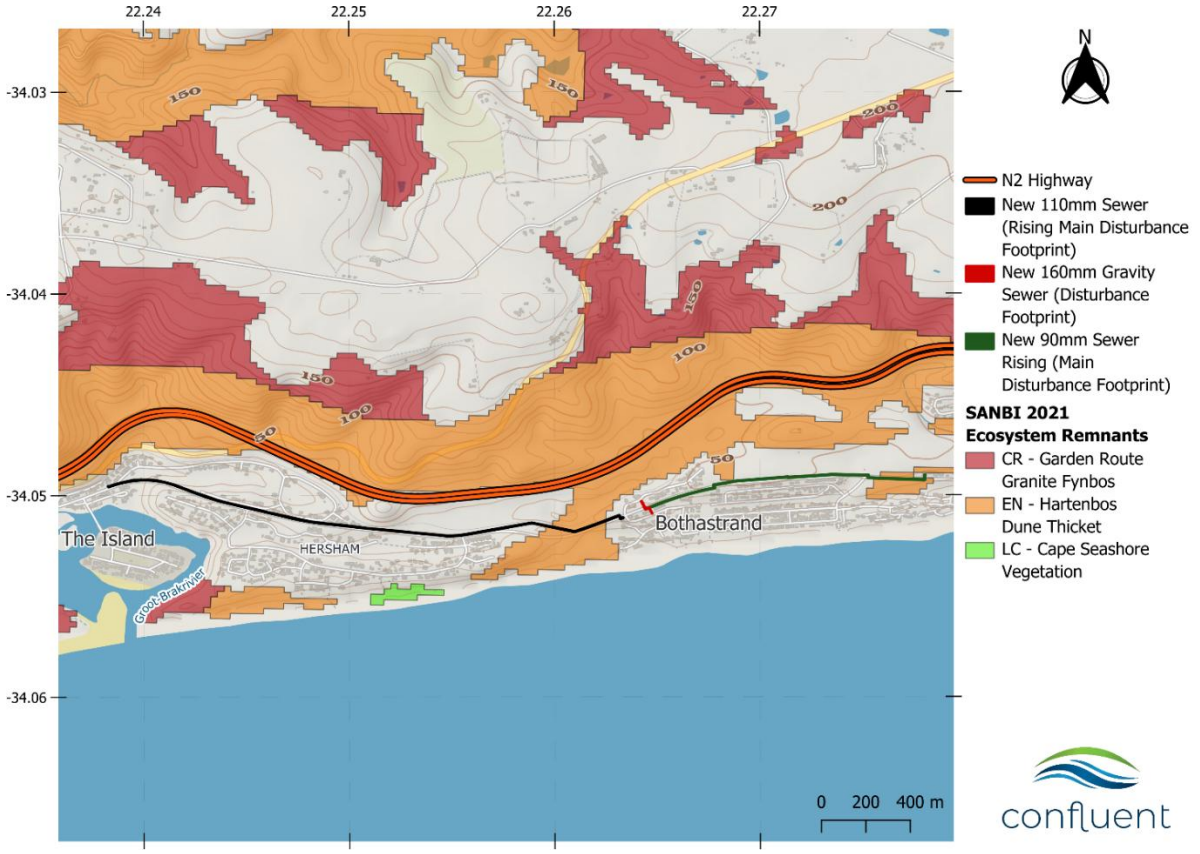


Figure 1: The proposed new sewer line in Pienaarstrand, including modelled ecosystem remnants mapped in 2021 by SANBI.

1.2 Screening Tool Report

According to the Department of Forestry, Fisheries, and the Environment (DFFE) Screening Tool, the SSVR is required because the terrestrial plant species theme has been highlighted as having a **Medium and Low** sensitivity over different sections of the linear infrastructure, and the terrestrial biodiversity has an overall **Very High** sensitivity (Figure 2).

Figure 2: The screening sensitivity maps provided by the Screening Tool report for terrestrial plant species (top) and terrestrial biodiversity (bottom) themes.

The following definitions are given in the Species Environmental Assessment Guideline (Verburgt et al., 2020) for the High and Medium plant species theme sensitivities respectively:

Terrestrial plant species theme High sensitivity

"Recent occurrence records for all threatened (CR, EN, VU) and/or Rare endemic species are included in the high sensitivity level. Spatial polygons of suitable habitat have been produced for each species by intersecting recently collected occurrence records (those collected since the year 2002) that have a spatial confidence level of less than 250 m with segments of remaining natural habitat."

Terrestrial plant species theme Medium sensitivity

"Model-derived suitable habitat areas for threatened and/or rare species are included in the medium sensitivity level. Two types of spatial models have been included. The first is a simple rule-based habitat suitability model where habitat attributes such as vegetation type and altitude are selected for all areas where a species has been recorded to occur. The second is a species distribution model which uses species occurrence records combined with multiple environmental variables to quantify and predict areas of suitable habitat. The models provide a probability-based distribution indicating a continuous range of habitat suitability across areas that have not been previously surveyed. A probability threshold of 75% for suitable habitat has been used to convert the modelled probability surface and reduce it into a single spatial area which defines areas that fall within the medium sensitivity level."

The species flagged for the Plant Species Theme are discussed and listed later in this report. A Very High sensitivity rating for terrestrial biodiversity according to the screening tool is triggered for all Biodiversity Priority Areas (BPAs) and other sensitive features (Stewart et al., 2021). BPAs triggered here include the various management layers of the Western Cape Biodiversity Spatial Plan (WCBSP, 2023), as well as the other sensitive features listed in Table 1 below.

Table 1: BPAs flagged for the Great Brak Sewer line in the Screening Tool Report.

Sensitivity layer	Data included and source
Critical Biodiversity Areas (CBAs)	Most recent terrestrial CBA spatial footprint for metros, provinces, or bioregional plans, combined to create a national data set. The screening tool specifically identifies • CBA 1 for Terrestrial Biodiversity and • CBA 2 for Terrestrial Biodiversity.
Red Listed Ecosystems	Any ecosystem that is listed as Vulnerable, Endangered, or Critically Endangered according to the "Revised National List of Ecosystems that are Threatened and in Need of Protection (NEM:BA Act no.10 of 2004, as amended in November 2022). Two ecosystems were triggered here, namely • Endangered (EN) Hartenbos Dune Thicket and • CR (Groot Brak Dune Strandveld)

1.3 Proposed Infrastructure

The Mossel Bay Municipality (MBM) proposes the installation of new sewer pipelines along Morrison Road, extending from Eekhoring Street in Glentana to Dolphins Creek Golf Estate in Great Brak River. The project includes multiple rising mains, a gravity line, and the upgrade of two existing conservancy tanks to pump stations.

While the majority of the pipeline infrastructure is associated with the existing Morrison Road reserve, the scope of assessment has been expanded to include a broader study area within which alternative pipeline installation methods and alignments may occur. This expanded study area reflects engineering uncertainty and allows for flexibility in final pipeline positioning, particularly where existing underground infrastructure is present but not precisely mapped.

A temporary site camp is proposed on a existing parking lot, part of the Municipal Erf 554 (Bitou Street) for the storage of construction materials (Figure 3).

Figure 3: Temporary storage is indicated in light blue. Pipelines proposed are in yellow.

A maximum 7 m wide disturbance envelope (as mapped) has been defined to accommodate all construction activities, especially where trenching occurs. Installation methods, as set out in the engineering design, include Pipe Cracking, Pipe Jacking at selected road crossings, and standard trenching is limited. Large portions of the new rising main will be installed within an existing redundant potable water pipeline, allowing the project to follow an already-disturbed underground service alignment and thereby significantly reducing new surface disturbance. The disturbance envelope also allows for the movement of construction machinery (e.g., excavators), creation of pipe-jacking access pits, and the temporary stockpiling of material to be backfilled after installation.

Two existing conservancy tanks at Eekhoring Street (PS1) and Pienaar Strand (PS2) will be upgraded to fully operational sewer pump stations as part of the project. At PS1, the existing masonry-and-concrete conservancy tank will be modified internally to create pump chambers and accommodate mechanical pumps and associated pipework, with no expansion of the current footprint. At PS2, the existing tank will be expanded through the construction of an adjacent pump sump and valve chamber, increasing the footprint from approximately 14 sqm to 24 sqm, with associated minor pipework and manhole modifications. Both pump stations will connect to the new rising mains along Morrison Road, with electrical supply provided from existing miniature substations. All works at the pump station sites will occur within municipal property and previously disturbed footprints.

1.3.1 New Ø110mm Rising Main (±2.41km)

This section of pipeline will extend from Manatoka Lane to Dolphins Creek Golf Estate, covering a total length of ca. 2.41 km (Figure 4). A portion of the alignment follows the railway reserve, as the Morrison Road reserve in this area lacks sufficient space to accommodate the new pipeline due to the presence of existing services.

Figure 4. The pipeline alignment from Dolphins Creek Golf Estate (top) to Manatoka Lane (bottom), for ca. 2.41km. 7m disturbance envelope applied.

Expanded Study Area for the Expanded Section Traversing Farm 7/252

The assessment no longer considers a single fixed pipeline alignment. Instead, it evaluates a defined study area within which different installation methods and alignments may be implemented. For assessment purposes, the study area is divided into two environmentally distinct Sections:

Section A Railway Corridor Zone: Characterised by dense thicket vegetation and steep slopes. This area is considered high sensitivity due to intact vegetation structure, presence of protected species, and erosion risk. Option 3 in Figure 5 occurs in this zone. Option 1 likely has a component in this section but may also lie in Section B as the route of the old pipeline is not yet confirmed.

Section B: Morrison Road Corridor Zone: Characterised by transformed or partially disturbed vegetation associated with the existing road reserve. This area is considered moderate to lower sensitivity relative to Section A. Option 2 in Figure 5 occurs within this zone.

Option 1 is the preferred option, and involves Pipe Cracking within an existing redundant water pipeline.Currently, the exact position and depth of the existing pipeline is uncertain, and the pipeline may occur anywhere, including both Section A and B. The final alignment can only be confirmed at a later stage. This introduces a spatial uncertainty component, requiring assessment across the full range of possible locations.

Option 2 is an alternative that involves standard trenching along Morrison road alongside a current active bulk water feed (Figure 5). This alternative would avoid dense milkwood thivket and steep slopes, but would require a disturbance corridor of ca. 7m. This alternative may pose a lower ecological risk, but with a higher surface disturbance.

Option 3 is an alternative that follows the previously assessed alignment adjacent to the railway line. This option would cross dense thivket and steep slopes, and would require the clearance of thicket within the 7m disturbance corridor.

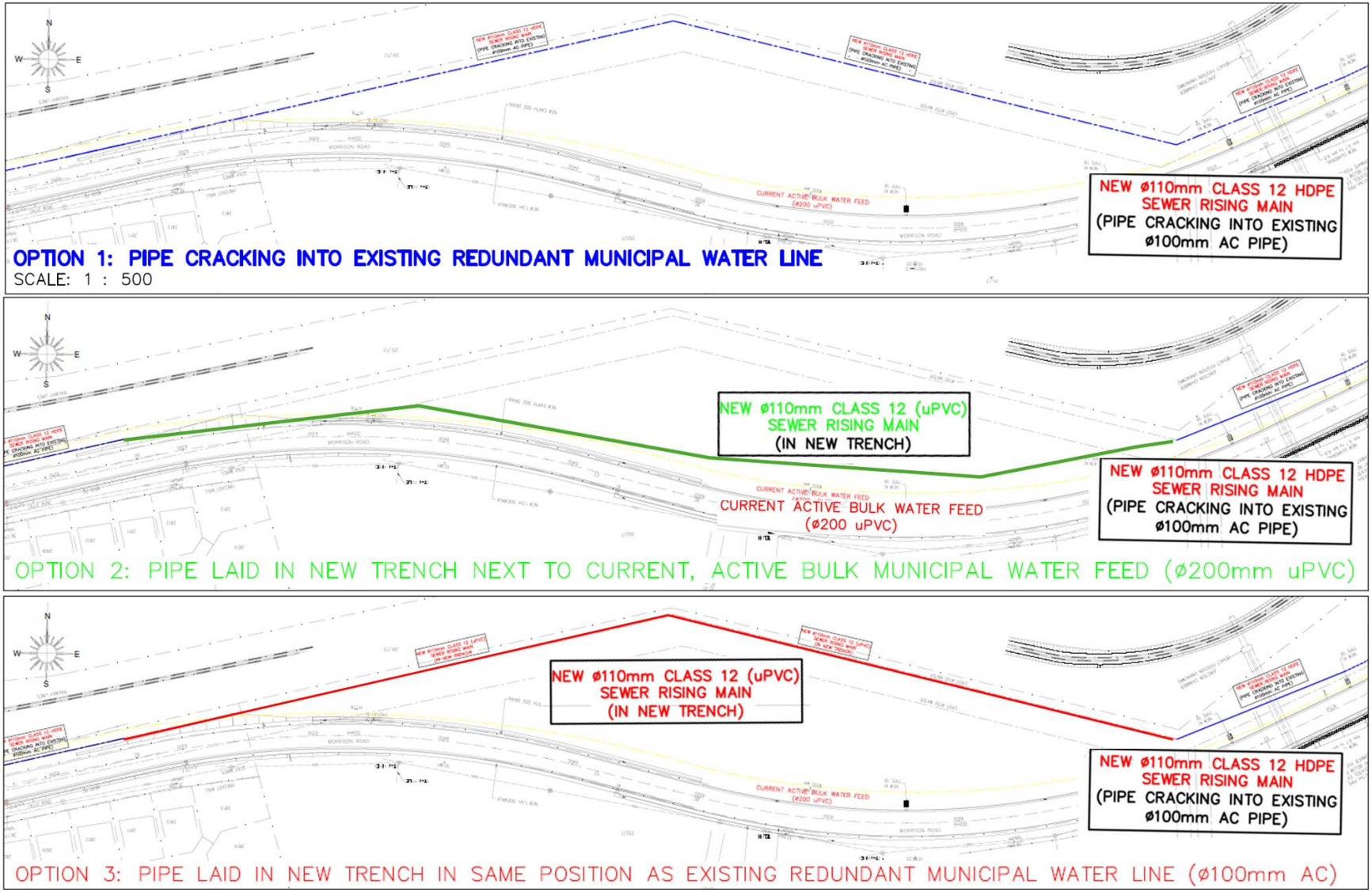


Figure 5: Three alternative options to be assessed for the expanded section traversing Farm 7/252.

1.3.2 New Ø160mm Gravity Line

A new gravity sewer line, ca. 0.1 km in length, will be installed from a new manhole in Pienaar Street to an existing manhole in Manatoka Lane, bisecting Erf 507, Morrison Road, and Erf 516 (Figure 6). Installation will be completed using a combination of methods.

Figure 6. Alignment of the Ø160 mm gravity line from the new manhole in Pienaar Street to the existing manhole in Manatoka Lane (±0.1 km). The 7 m disturbance envelope is shown.

1.3.3 New Ø90mm Rising Main

The Ø90 mm rising main will commence at Pump Station 1 in Eekhoring Street, following the Morrison Road reserve for ca. 1.33 km before connecting into a new transfer manhole at Manatoka Lane, where it will join the existing gravity sewer system (Figure 7).

Figure 7: Alignment of the Ø90 mm rising main following the Morrison Road reserve for ca. 1.33 km, from Pump Station 1 (top) to the connection point at Manatoka Lane (bottom). The 7 m disturbance envelope is shown.

1.4 Project Area of Influence

The proposed upgrade of sewerage infrastructure will have some impact on the surrounding vegetation. The area that will be affected by the upgrades is defined as the project area of influence (PAOI). During the construction phase the PAOI must be clearly demarcated, and staff must be educated & informed about sensitive habitat, treating them as no-go sensitive areas where impacts must be avoided. In this case the PAOI is defined as:

1. The road reserve on the side of the road where the upgraded pipelines will be installed.
2. A disturbance envelope of 7m on either side of the proposed infrastructure. In some sections this extends beyond the road reserve.
3. Protected trees and their associated coastal forest or thicket habitat are included within the PAOI only where the necessary permits have been obtained. All protected trees and associated habitat falling outside of permitted areas are excluded from the PAOI.

2. TERMS OF REFERENCE

This report provides information on Terrestrial and Botanical diversity and sensitivity of the habitats along the proposed infrastructure routes to the sewerage upgrades. The results presented are based on a desktop and field assessment, which includes a consideration of historical photographic records of the site. The assessment presented in this report follows the Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Biodiversity, and Terrestrial Plant Species themes.

This site sensitivity assessment follows the requirements of:

- The Environmental Impact Assessment Regulations, as promulgated in terms of Section 24 (5) of the National Environmental Management Act, 1998 (Act No. 107 of 1998), which includes:
    - The protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial plant species (28 July 2023).
    - The protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial biodiversity (20 March 2020).
- Additional guidelines for the terrestrial biodiversity theme:
    - Ecosystem Guidelines for Environmental Assessment in the Western Cape (de Villiers et al., 2016).
    - The 2023 Western Cape Biodiversity Spatial Plan Handbook and summary booklet(CapeNature, 2024). This Plan is contrasted with the 2017 BSP, which is also discussed in this report (CapeNature, 2017; Pool-Sandvliet et al., 2017).

  - The Subtropical Thicket Ecosystem Programme Handbook: Integrating the natural environment into land-use decisions at the municipal level: towards sustainable development (Pierce & Mader, 2006). This guideline provides more information about Goukamma Dune Thicket.

- Additional guidelines for the terrestrial plant species theme:

  - Species Environmental Assessment Guideline: Guidelines for the implementation of the Terrestrial Flora (3c) & Terrestrial Fauna (3d) Species Protocols for environmental impact assessments in South Africa (Verburgt et al., 2020).

The assessment was undertaken by a specialist registered with the South African Council for Natural Scientific Professionals (SACNASP) with relevant expertise in the field of Botanical and/or Ecological science.

3. METHODOLOGY

3.1 Desktop Assessment

The desktop assessment was performed using Cape Farm Mapper and QGIS version 3.36.0 “Maidenhead”. Plant species data was sourced from the following sources:

- The DFFE screening tool listed SCC.
- Information on plant occurrence prior to the site visit was sourced from SANBIs Biodiversity Advisor, Plant Red List website, and the Botanical Research and Herbarium Management System (BRAHMS) for the Plants of Southern Africa (POSA) database.
- iNaturalist observations of the property and surrounding areas.

Ecosystem/ vegetation type data was sourced from:

- The 2024 updated Beta South African National Vegetation Map from SANBI.
- The National Biodiversity Assessment report of 2018 (Skowno et al., 2018).
- Shapefiles for the Western Cape Biodiversity Spatial Plan (WC-BSP) i.e., information on PAs, CBAs, ESAs, and ONAs were downloaded from BGIS database (CapeNature, 2017; Pool-Sandvliet et al., 2017).
- Cape Farm Mapper for additional spatial information required for the site.
- Chief Directorate: National Geo-spatial Information (CD: NGI) Geospatial Portal and Google Earth for the acquisition of historical aerial imagery of the site.
- The conservation status of ecosystems was found in the Revised National List of Ecosystems that are Threatened and in need of protection, published under the

National Environmental Management: Biodiversity Act (Act No. 10, 2004, as revised in Nov. 2022), and also using the Vegetation of South Africa, Lesotho, and Swaziland (Mucina & Rutherford, 2006).

3.2 Field Assessment

Field work on was undertaken on the 17th of October 2025. The method for identifying species was similar to a BioBlitz, also described as a “timed meander”, where the specialist especially keeps an eye out for rare and threatened species, as well as other dominant species or species that play an important ecological role on the site.

Some Red Listed Plant species are also more easily detected during a site survey than other species. This timed meander survey method is an attempt to account for the short and single survey period, where detection probability of some seasonal, rare and threatened species (e.g., geophytes, small succulents, small perennials etc.) are low (Garrard et al., 2008; Wintle et al., 2012).

During the site assessment other specialists were also present, namely the faunal specialist and Aquatic specialist.

3.3 Assumptions & Limitations

This assessment is subject to a few assumptions, uncertainties, and limitations, as listed below:

- Only one survey took place during spring. The season of the assessment and survey timing always play a role in limiting the findings of a terrestrial habitat and plant species specialist report.
- Some rare and threatened plant species are difficult to locate and easily overlooked in the field (e.g., geophytes, small succulents, small shrubs, and cryptic spp.).
- Many plant species flower seasonally and are therefore difficult to identify outside of their flowering season.
- Environmental factors such as the prevailing disturbance regime and level of alien invasion influence the species visible at the time of assessment (Cowling et al., 2010; Privett et al., 2001).
- Denser vegetation (i.e., the sections covered in Milkwood Thicket / Coastal Forest) makes it hard to gain access to some sections. It is possible that the impenetrable nature of some vegetation in some places caused an SCC to be missed on the site despite high overall effort.

4. RESULTS: DESKTOP ASSESSMENT

4.1 Terrestrial Biodiversity

4.1.1 Climate

Great Brak and Pienaarstrand fall within a Mediterranean climate, which is characterised by summers that are typically warmer and slightly drier compared to the rest of the year. Winters are usually wetter; however, temperatures rarely reach sub-zero. Winters are therefore more mild compared to other South African towns. Annual rainfall in the region varies considerably due to proximity to the coast and differences in elevation, which directly affect vegetation and soil moisture levels. The area's soils range from sandy to loamy, with varying levels of fertility. Coastal areas are predominantly sandy, with lower nutrient content, whereas more fertile loamy soils are found further inland. This variation in soil types, combined with the region's climate, supports a diverse range of fynbos and other native vegetation. However, sandy soils are particularly vulnerable to erosion when disturbed, presenting significant challenges for construction activities.

The local geology mostly consists of sedimentary rocks, such as sandstone and shale. These are common in the Cape Supergroup, and while these geological formations are typically stable, they could potentially complicate excavation and trenching efforts (i.e., where rocks are encountered). The geology also plays a crucial role in determining groundwater levels and flow, which are critical considerations for the design and installation of sewerage infrastructure to prevent seepage or contamination. This is especially relevant to the sections that will occur in close proximity to the Great Brak Estuary.

4.1.2 Vegetation Type(s)

The vegetation types according to the 2024 version of the National Vegetation Map (NVM) is mostly Southeastern Strandveld, which is Least Concern (LC) with small sections of the pipelines crossing endangered (EN) Hartenbos Dune Thicket (Figure 8). This contrasts strongly with the 2018 NVM which included the coastal section of Pienaarstrand as all being EN Hartenbos Dune Thicket. Now these same areas are largely classified as LC, which is a significant shift in the threat status of the vegetation mapped here.

Despite the mapped vegetation types (which does not take habitat fragmentation from urban development into account), Pienaarstrand is mostly transformed and does not represent natural vegetation within the road reserve. Figure 1 of this report illustrates this well, with ecosystem remnants (based on the 2018 NVM) mapped on only a small portion of the site.

The observations discussed above are significant in terms of South African environmental legislation. The new LC classification may reduce the perceived need for immediate conservation actions, potentially influencing prioritization, and legal protections under South Africa's biodiversity legislation, including the National Environmental Management: Biodiversity Act (NEMBA). Vegetation types classified as EN often trigger more stringent environmental impact assessments (EIAs) and higher levels of protection, whereas LC classifications may lead to less oversight and fewer conservation requirements.

It is also important to note that although the updated NVM indicates a shift to LC vegetation, Pienaarstrand is largely modified to transformed due to urban development and infrastructure within the area. This is especially true within the road reserve, where the original natural vegetation is altered, and will remain altered, especially within registered servitudes

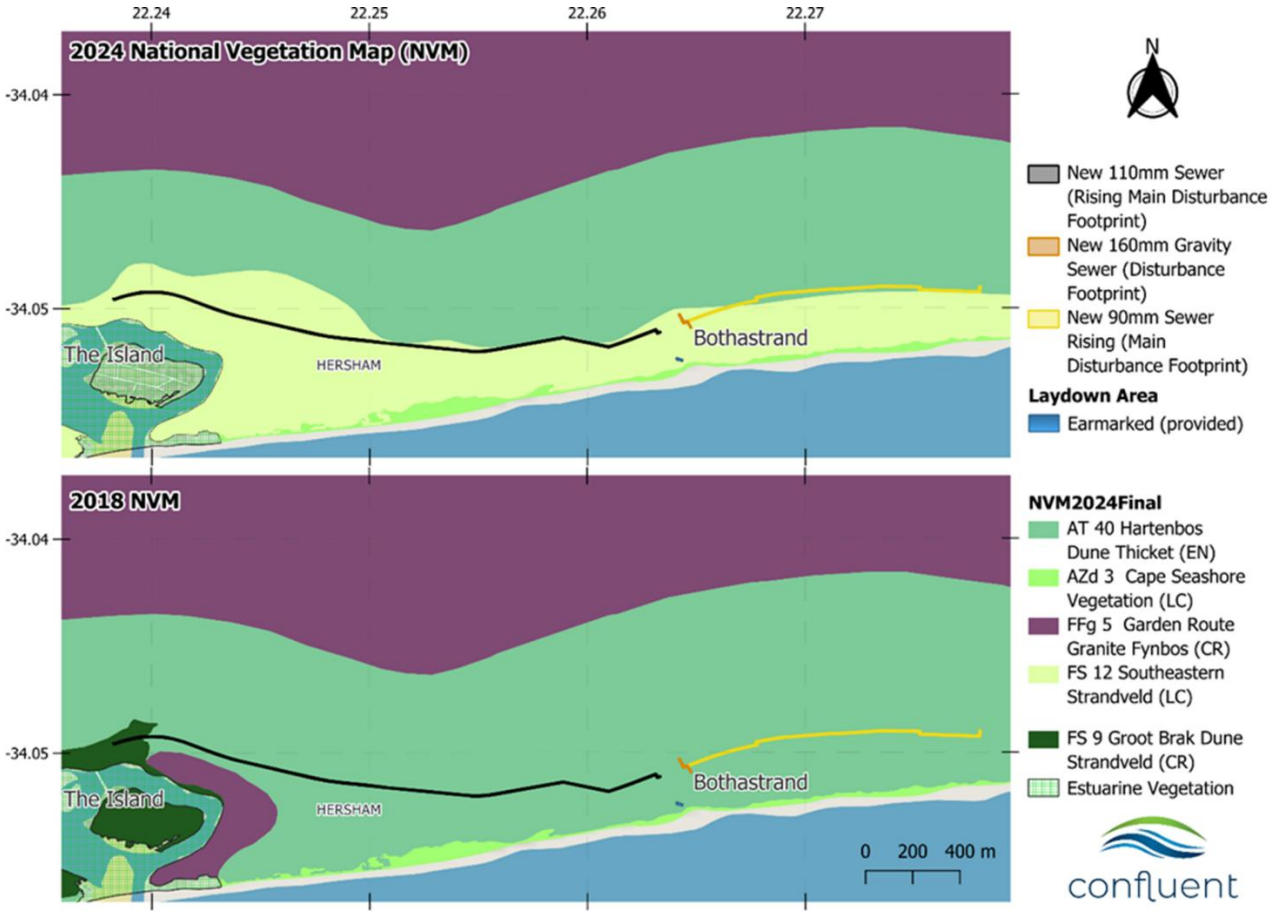


Figure 8: A) The mapped vegetation types according to the latest 2024 (top) and previous 2018 (bottom) National Vegetation Map (NVM) of South Africa (Dayaram et al., 2019; Mucina & Rutherford, 2006). *Both versions are indicated to clearly illustrate areas where the NVM was changed.*

4.1.3 Western Cape Biodiversity Spatial Plan

The Biodiversity Spatial Plan for the Western Cape (WCBSP) provides a series of conservation planning layers that identify priority areas for biodiversity conservation (Figure 9). The WCBSP was recently updated, with the 2023 version replacing the previous 2017 version. While the overall structure and coverage of the two versions appear largely similar, several changes have occurred.

The 2023 WCBSP excludes the majority of urban Pienaarstrand from conservation planning, reflecting the transformed nature of the area. Although terrestrial “threatened ecosystem” CBA 1 areas are still recognised, some areas previously classified as Forest CBAs are no longer designated. Within the project area, certain sections of the proposed sewer alignment do intersect CBA 1 areas, notably:

- Along the railway-adjacent section of Morrison Road, and
- In the easternmost portion of the alignment.

These intersections highlight areas where biodiversity conservation is prioritised and where potential impacts should be carefully considered during project planning, layout and construction.

These observations from the WCBSP align closely with the vegetation mapping from the 2024 NVM. While much of Pienaarstrand is now classified as LC and excluded from the BSP due to urban transformation, the sections of the sewer alignment that intersect CBA 1 areas coincide with remnants of natural vegetation. Together, these layers indicate that while the majority of the project area is of lower biodiversity sensitivity, specific sections require focused attention to minimise potential impacts on the Milkwood Thicket / Coastal Forest.

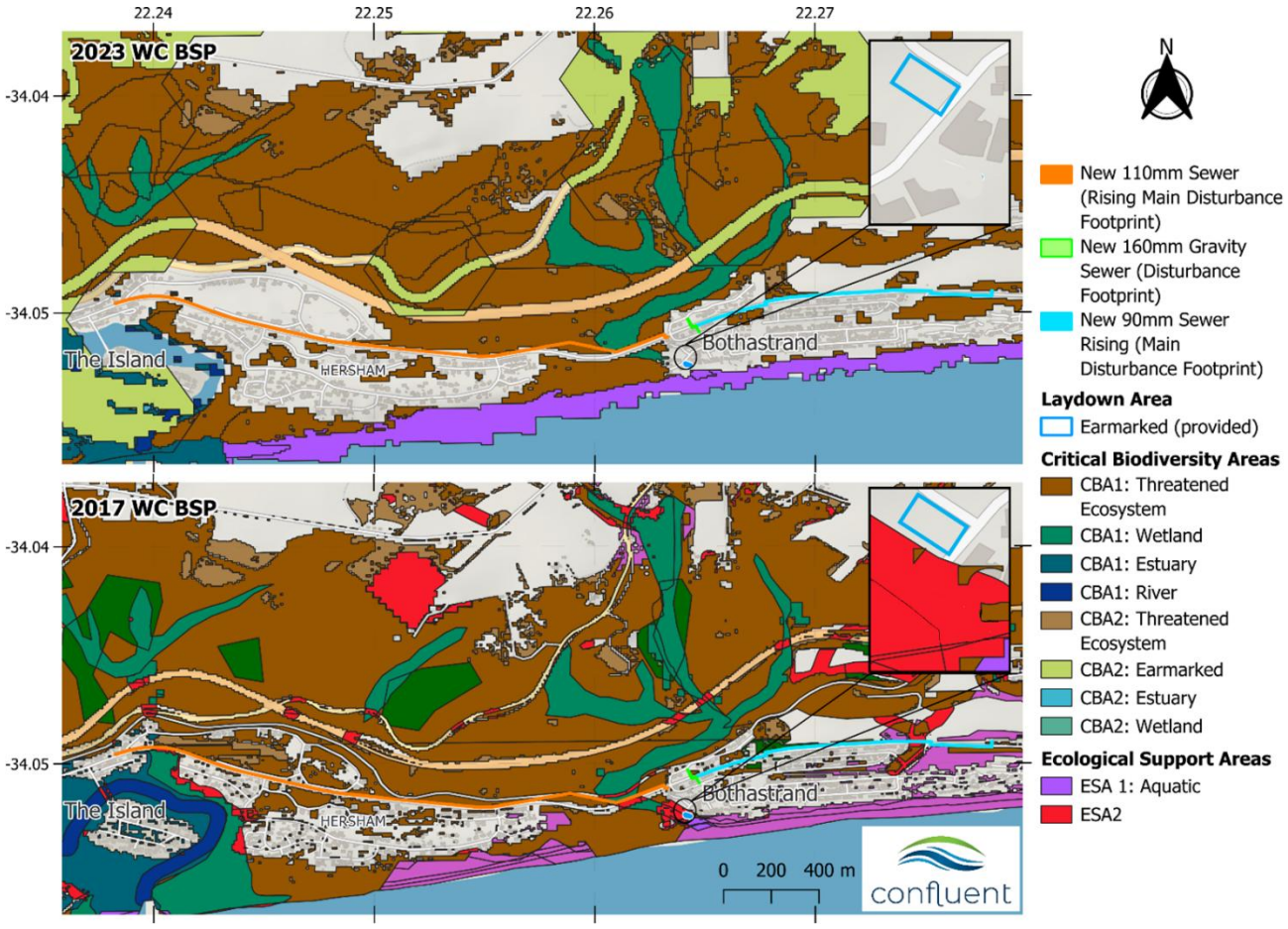


Figure 9: The mapped Western Cape Biodiversity Spatial Plan (WCBSP) for 2023 (above) and 2017 (below) categories around Pienaarstrand

The definition and objectives of the WCBSP layer mapped for the extent of the sewer line is given in BOX 1. Appendix 10.1 illustrates the recommended land-uses associated with the various BSP layers.

BOX 1: The Biodiversity Spatial Plan

Critical Biodiversity Area 1

Definition: Areas in a natural condition. Required to meet biodiversity targets for species, ecosystems or ecological processes and infrastructure.

Objective: Maintain in a natural or near-natural state, with no further loss of habitat. Degraded areas should be rehabilitated. Only low-impact, biodiversity-sensitive land uses are appropriate.

Critical Biodiversity Area 2

Definition: Areas in a degraded or secondary condition. Required to meet biodiversity targets for species, ecosystems or ecological processes and infrastructure.

Objective: Maintain in a functional, natural or near-natural state, with no further loss of habitat. Degraded areas should be rehabilitated. Only low-impact, biodiversity-sensitive land uses are appropriate.

Ecological Support Area 1

Definition: Not essential for meeting biodiversity targets. An important role in supporting the functioning of PAs or CBAs. Often vital for ecosystem services.

Objective: Maintain in a functional, near-natural state. Some habitat loss is acceptable, provided underlying biodiversity objectives/ecological functioning are not compromised.

Ecological Support Area 2

Definition: Not essential for meeting biodiversity targets. Important in supporting functioning of PAs or CBAs. Often vital for ecosystem services.

Objective: Restore/minimise impact on ecological infrastructure functioning, especially soil and water-related services.

4.1.4 Historical Aerial Imagery

Historical aerial imagery from CD:NGI and Google Earth was assessed to document landscape changes in Pienaarstrand over time (Figure 10).

1939: The imagery shows that the area was predominantly covered by natural woody thicket and coastal forest vegetation, with a bare dune field that has since been stabilised. The railway line was already established at this time, while Morrison Road had not yet been constructed. Agricultural activity was visible in large areas that were cleared; however large sections of the landscape was still covered by natural woody vegetation. The area where the proposed sewer line joins the railway reserve was densely vegetated at this time.

1991: By this time, Morrison Road had been constructed, providing access to established residential areas in the easternmost section of Pienaarstrand. The dune field observed in 1939 is no longer visible, having been stabilised. Agricultural fields south of the road that were visible in 1939 had been abandoned and were beginning to revert to woody thicket, although the exact composition (strandveld versus Milkwood Thicket / Coastal Forest) cannot be definitively distinguished from the imagery.

2004: Residential development had increased, particularly in the western section of Pienaarstrand and around Dolphins Creek. Areas north of the railway line that remained agricultural in 1991 were undergoing adventive revegetation, with natural thicket slowly recovering.

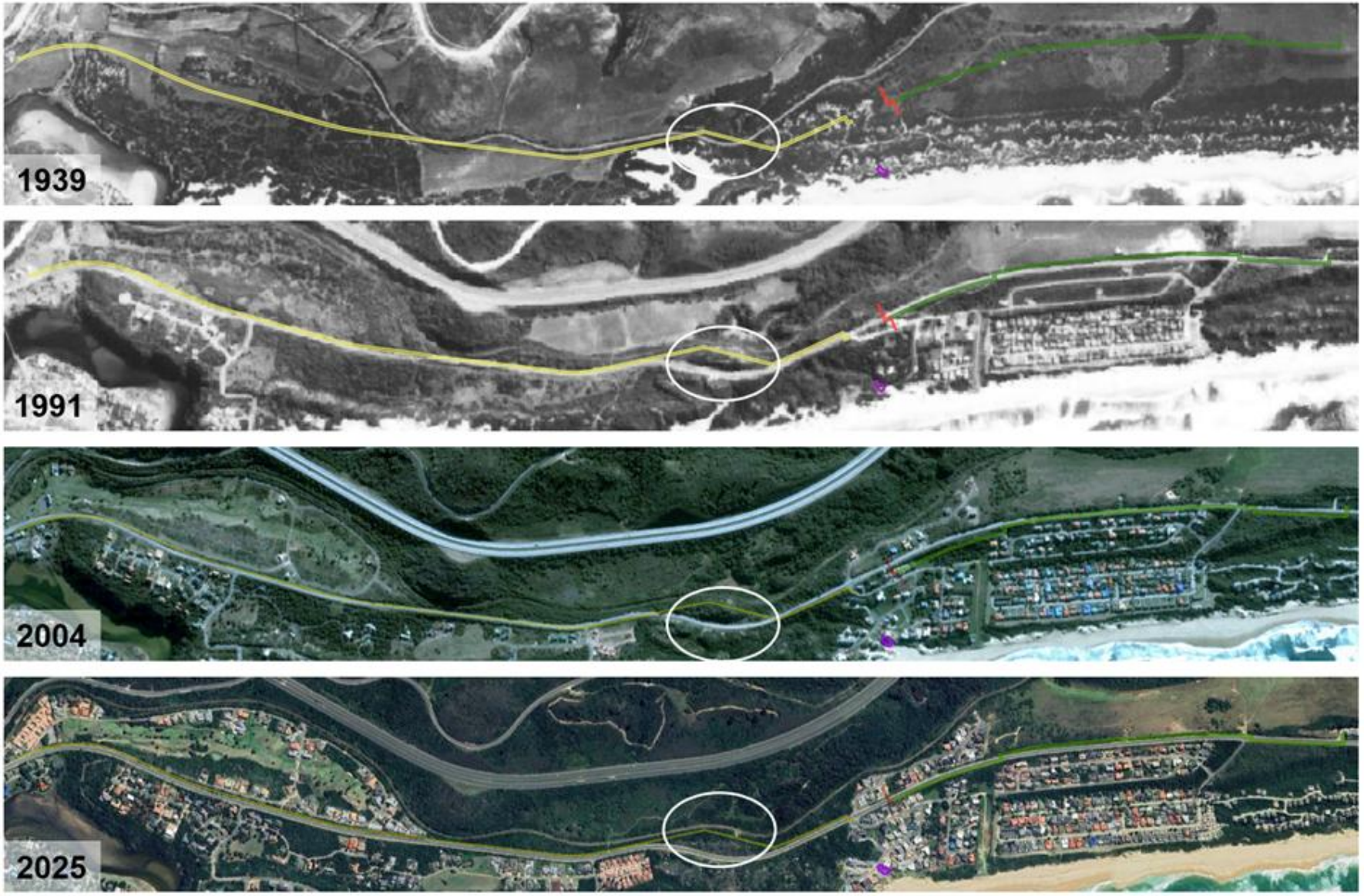


Figure 10: A series of historical imagery for the landscape surrounding the proposed new sewerage infrastructure for Pienaarstrand.

2025: Residential development continued to expand, with much of the project area now urbanised. The only remaining agricultural field within the alignment extent is located in the easternmost section north of Morrison Road. Natural vegetation observed in historical imagery has persisted in remnant patches between urbanised residential areas.

Overall, the historical imagery highlights that Pienaarstrand has experienced progressive urbanisation, alongside partial recovery of abandoned agricultural fields. However, the recovered fields also have a higher incidence of adventive invasive plants such as Rooikrans (*Acacia cyclops*), castor bean (*Ricinus communis*), and large stands of *Eucalyptus spp*. These observations are important for understanding the historical baseline of remnant natural vegetation and assessing potential impacts of the proposed sewer line.

4.2 Plant Species

The plant species theme sensitivity of Medium is dependent on the presence, or likely presence, of several plant species of conservation concern (SCC).

4.2.1 Species of Conservation Concern (SCC) Listed in the Screening Tool

Several SCC have been flagged by the screening tool. The SCC listed in the screening tool report are listed below (Species observed during the site assessment are in green). While more SCC have been observed nearby on iNaturalist, these species are highly unlikely to occur within the footprint and area of influence of the proposed sewerage infrastructure and therefore this assessment does not include species in addition to those listed by the screening tool. The Red List criteria for species is briefly explained in Appendix 10.2

- *Agathosma eriantha*
- *Agathosma microcarpa*
- *Agathosma muirii*
- *Cotula myriophylloides*
- *Diosma passerinoides*
- *Erica glandulosa* subsp. *fourcadei*
- *Erica unicolor subsp. mutica*
- *Euchaetis albertiniana*
- *Hermannia lavandulifolia*
- *Lampranthus fergusoniae*
- *Lampranthus pauciflorus*
- *Lebeckia gracilis*
- *Leucospermum praecox*
- *Muraltia knysnaensis*
- *Nanobubon hypogaeum*
- *Selago villicaulis*
- *Wahlenbergia polyantha*
- *Zostera capensis*
- Sensitive species 153
- Sensitive species 268
- Sensitive species 500
- Sensitive species 516
- Sensitive species 633
- Sensitive species 654
- Sensitive species 800
- Sensitive species 1024

5. RESULTS: FIELD ASSESSMENT

5.1 Vegetation Observed

Observations of vegetation along the proposed new Ø110 mm Rising Main pipeline alignment were made to assess the condition and sensitivity of terrestrial habitats within the 7 m disturbance envelope. Figure 11 presents nine representative photographs along the alignment, illustrating the variation in habitat transformation and thicket integrity. Key observations from the photos are as follows:

Photo 1: Shows a transformed residential area, where natural vegetation has been largely replaced by housing and associated landscaping. Biodiversity sensitivity in this area is very low.

Photos 2–5: Depict the road reserve, which is disturbed but bordered by more intact thicket vegetation beyond the immediate construction footprint. These areas have moderate ecological value and potential for edge effects (e.g., invasion) if not managed carefully.

Photo 6: Taken along the railway, highlighting an open disturbed section where the species *Hermannia lavandulifolia* is present. This species is vulnerable (VU) and this should be considered during construction planning.

Photo 7: Also, along the railway, where the proposed pipeline alignment is to the left of the track over a large hill is dominated entirely by Milkwood trees. This represents a sensitive habitat area with ecological value. Keeping the plan as is in this area may present technical difficulties, and Milkwood thicket will be affected.

Photo 8: Illustrates a sidewalk within the road reserve. Only minor disturbance of thicket is anticipated here due to the narrow construction footprint.

Photo 9: Shows thicket vegetation beyond the road reserve. While there is potential for limited impact, the thicket is largely intact and is expected to experience minimal disturbance.

Overall, the observations indicate that the majority of the alignment crosses transformed or disturbed areas, particularly within the road reserve, while sensitive habitats such as Milkwood-dominated thicket and remnant woody vegetation occur primarily along the railway and in adjacent undisturbed thicket areas. These habitats should be carefully managed to minimise impacts during construction.

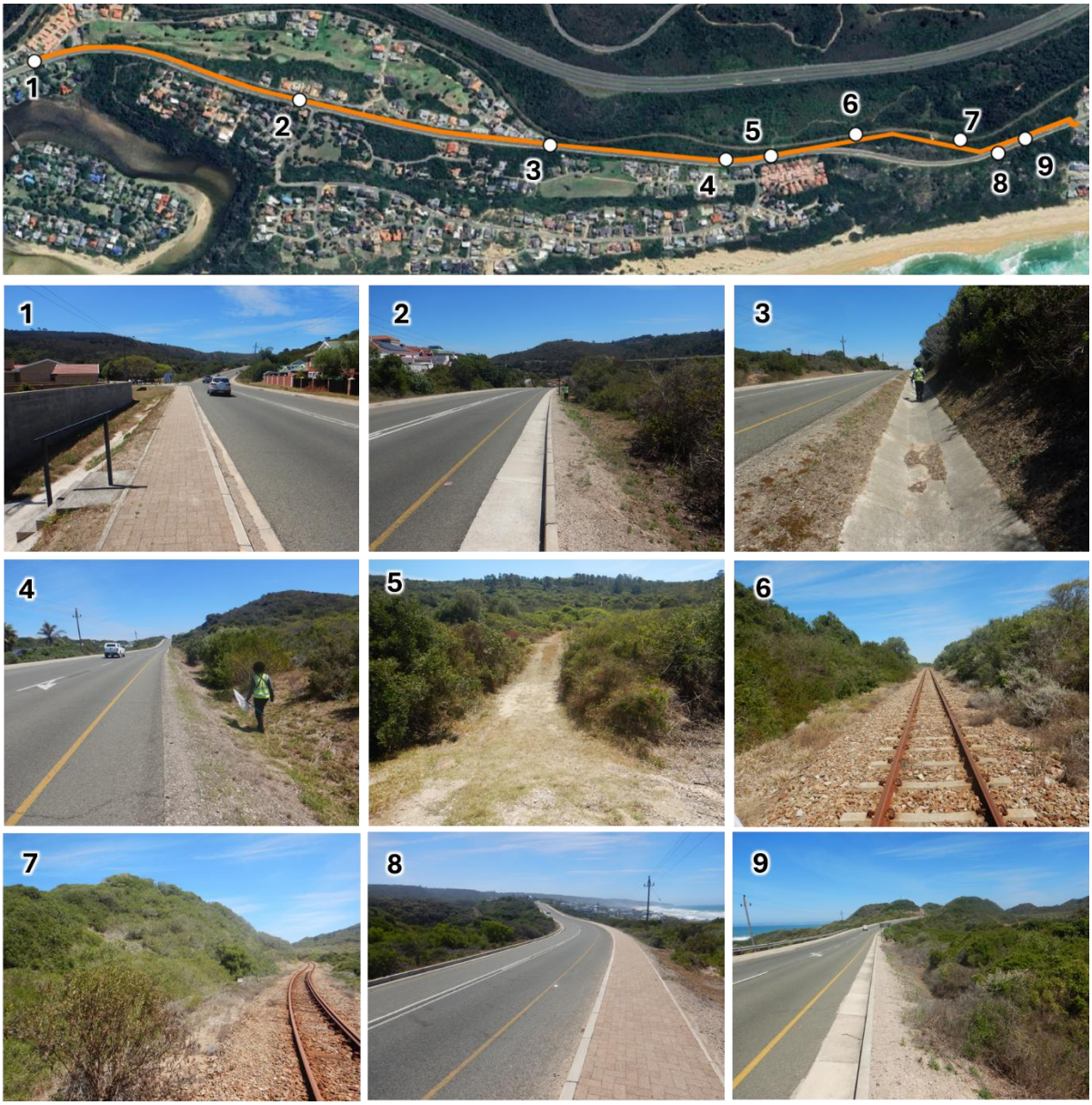


Figure 11: Photos of the proposed New Ø110 mm Rising Main pipeline sewer line alignment along Morrison Road.

Observations along the proposed Ø160 mm gravity sewer alignment were made to assess habitat condition, vegetation integrity, and potential ecological sensitivity within the 7m disturbance envelope. Figure 12 presents six representative photographs along the alignment.

Photos 10 & 11: These show the southern property that is crossed, where patches of recovering thicket are present. The area is largely residential, and no sensitive or threatened species (SCC) were observed. While vegetation here is limited, care should be taken to avoid unnecessary disturbance to the remaining thicket fragments outside of the footprint and PAOI.

Photos 12 & 13: These depict the northern erf section crossed, which is largely mowed grassland with no visible thicket. Ecological sensitivity in this area is very low, and potential impacts from construction are expected to be minimal with regards to the themes assessed in this report.

Photo 14: Shows an open transformed area adjacent to an existing parking lot nearby the proposed laydown area. While this area is outside of the project footprint and on a private Erf, enquiries can be made regarding this area should additional space be required, since the parking lot will be the primary laydown area for materials.

Photo 15: Shows a lawn area also technically part of the municipal Erf, which is currently located behind a currently fenced lawn. This area is highly transformed.

Figure 12: Photos of the proposed New Ø160 mm Gravity sewer line alignment along Morrison Road.

Observations along the proposed Ø90 mm rising main alignment highlight a combination of roadside vegetation including remnant thicket, and strandveld. Figure 13 presents six representative photographs illustrating variation in habitat condition and ecological sensitivity.

- **Photo 16**: Shows vegetation adjacent to the road that is less diverse than thicket elsewhere, though still vegetated. Care is required here due to the downward roadside slope, which presents a risk of sediment or contamination moving beyond the footprint.
- **Photo 17**: Depicts a road crossing section where Horizontal Directional Drilling (HDD) is likely to be used under the road.
- **Photos 18 & 19**: Show sections of road reserve with thicket extending onto steep slopes beyond the cleared footprint. These areas represent sensitive habitats, and disturbance should be limited to the minimum required for construction.

- **Photo 20**: Illustrates strandveld vegetation along the westernmost section of the alignment. This habitat is naturally more open than thicket but still contributes to local biodiversity and should be avoided where possible.

- **Photo 21**: Shows the road reserve with strandveld vegetation beyond the cleared road area. Construction should remain within the footprint to maintain ecological connectivity.

In summary, the Ø90 mm rising main alignment passes through a mix of moderately sensitive roadside vegetation, thicket remnants, and strandveld. While much of the area is transformed by the road reserve, sensitive thicket and steep slopes adjacent to the footprint require careful management. Appropriate construction methods, including HDD and minimising clearing, will be important to reduce impacts on biodiversity.

Figure 13: Photos of the proposed New Ø90 mm Rising Main pipeline sewer line alignment along Morrison Road.

5.2 Vegetation Mapping and Classification

Vegetation within the proposed sewer line alignment was mapped based on field observations, historical aerial imagery, and reference to national and regional vegetation datasets. Along the alignment, a range of vegetation and land cover types was observed. Milkwood Thicket / Coastal Forest occurs primarily adjacent to the railway and along protected slopes or dune remnants, forming dense, closed-canopy thickets dominated by Milkwood Trees (*Sideroxylon inerme*) and associated woody shrubs (see Fig. 14). These patches are generally higher sensitivity as they represent intact natural vegetation. Fragmented Sparse Thicket was observed in partially degraded areas, such as road reserves or cleared properties where thicket has started recovering.

Open asteraceous fynbos was mapped as Strandveld. Areas previously used for agriculture or pasture were mapped as Cleared Fields, some of which are recovering adventively (Fig. 14), particularly north of the railway. Coastal areas with sparse or absent vegetation were mapped as “Beach”, while residential areas, private gardens, and other urban infrastructure were classified as “Suburbs – High Disturbance”. Finally, roads and railway infrastructure were mapped separately to show highly disturbed linear features that influence vegetation patterns along the alignment.

Two vegetation types of particular relevance to this project are Hartenbos Dune Thicket and Southeastern Strandveld. Hartenbos Dune Thicket, added to the NVM through the Subtropical Thicket Ecosystem Project, occurs on coastal dunes and flat to moderately undulating areas and is characterised by a mosaic of low thicket (1–3 m) and asteraceous fynbos (1–2 m) and is considered Endangered (EN). Southeastern Strandveld (FS12) is a new vegetation type which forms a mosaic of closed-canopy thicket with asteraceous fynbos in between thicket patches. While currently classified as Least Concern, the ecological sensitivity of Southeastern Strandveld may be underestimated, as threats have not yet been formally assessed. The description of Hartenbos Dune Thicket and Southeastern Strandveld seems similar enough that detecting a significant difference to distinguish them seems nearly impossible. Structurally and compositionally, the two vegetation types overlap significantly.

Mapping was therefore guided primarily by structural dominance and location. Areas with well-developed thicket were mapped as Milkwood Thicket / Coastal Forest, while asteraceous fynbos was mapped as Strandveld. This approach allowed habitats to be identified while recognising the limitations of field identification in areas where vegetation types overlap.

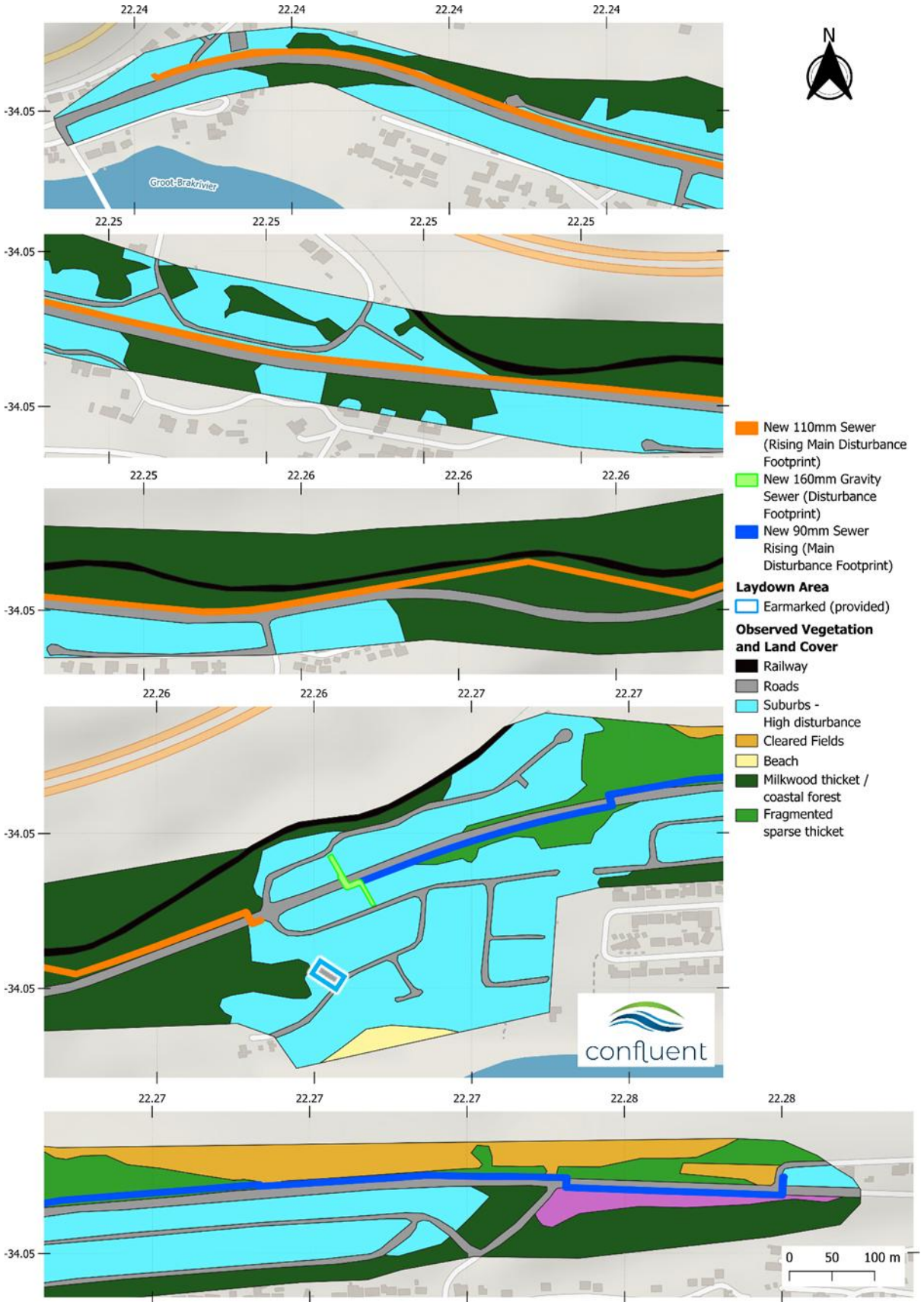


Figure 14: A map of the vegetation and land-cover observed on either side of the road in Pienaarstrand along the proposed sewer line route.

5.3 Plant Species Observed

A plant species accumulation curve was compiled to assess the completeness of the botanical survey within the Project Area of Influence (PAOI; Fig. 15). The curve indicates that while new species were still being recorded toward the end of the site assessment, the trend is beginning to plateau, suggesting that the majority of plant taxa present along the sewer line alignment were captured. Overall, only one fern species was recorded, reflecting the limited presence of shaded or moist microhabitats within the alignment.

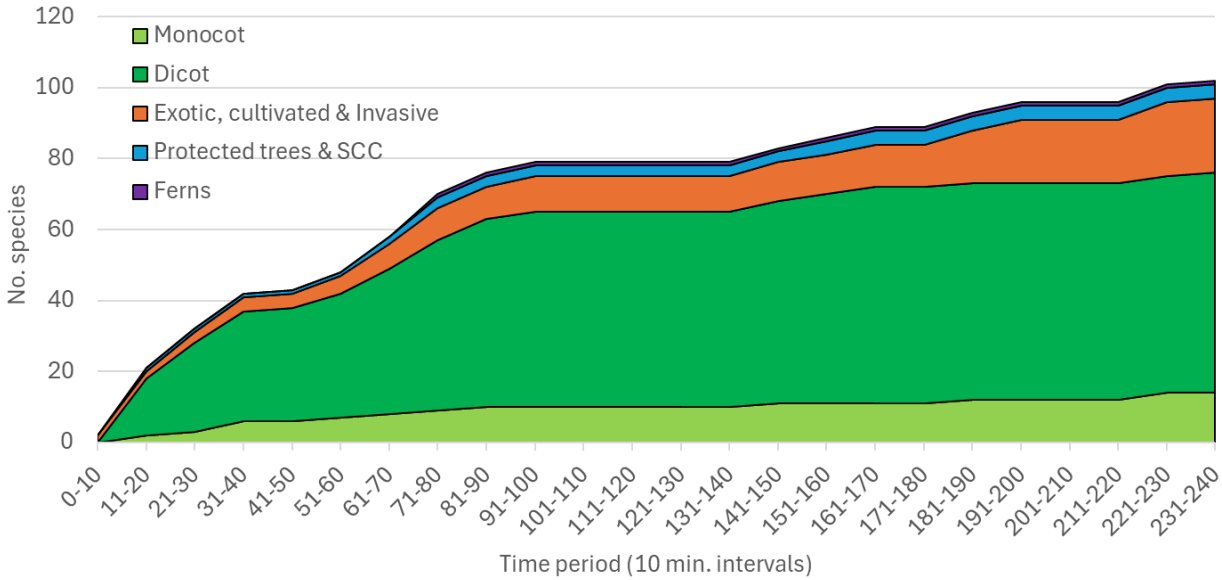


Figure 15: A plant species accumulation curve for the linear sewerage infrastructure of Pienaarstrand.

Of particular relevance, two species of conservation concern (SCC) were observed: *Hermannia lavandulifolia* (Vulnerable) and *Cullumia carlinoides* (Near Threatened), as shown in Figure 16. Another least concern (LC) species was observed, but it is sensitive to poaching and is therefore called sensitive species “no. 1” (location in Fig. 16). In addition, two protected tree species were abundant within the PAOI, Milkwood trees (*Sideroxylon inerme inerme*) and Cheesewood Trees (*Pittosporum viridiflorum*). The full distribution of protected trees, as well as the survey tracks followed during the site assessment, are provided in Appendix 10.3, alongside a mapped overview of their locations.

Figure 16: SCC observed during the site assessment with imagery below the species indicating the locations along the proposed route.

A plant species list for the Pienaarstrand sewerage infrastructure site assessment is provided below (Table 2). The provided species list indicates which species are threatened and the criteria for why they are threatened, unlisted exotic taxa, invasive species according to the National Environmental Management: Biodiversity Act (NEMBA), No. 10 of 2004, and the Conservation of Agricultural Resources Act (CARA), No. 43 of 1983, and protected trees. Images of invasive taxa and protected trees are provided in Table 2, and plant species of conservation concern found in the footprint are also indicated.

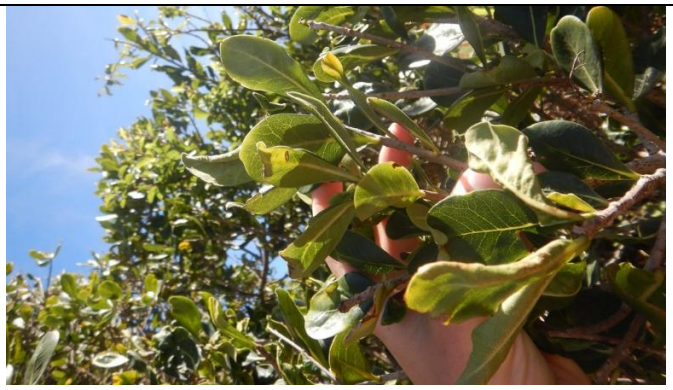
Table 2: Plant species list for the site assessment indicating exotic & cultivated taxa (orange entries), listed invasive taxa (red entries), protected trees (blue), and red listed taxa (green).

Family	Species	Common name	Information
Liliopsida (Monocotyledons)			
Amaryllidaceae	*Brunsvigia orientalis*	candelabra lily	
Asparagaceae	*Albuca cooperi*	Dainty Soldier-in-a-Box	
Asparagaceae	*Asparagus aethiopicus*	African Asparagus	
Asparagaceae	*Asparagus asparagoides*	Cape Smilax	
Asparagaceae	*Ornithogalum thyrsoides*	Chincherinchee	Cultivated
Asparagaceae	*Yucca gigantea*	Spineless Yucca	Exotic. Cultivated
			
Asphodelaceae	*Aloe arborescens*	Candelabra Aloe	
Asphodelaceae	*Aloe maculata*	soap aloe	
Colchicaceae	*Colchicum eucomoides*	Green Men-in-a-Boat	
Cyperaceae	*Carex sp.*		
Cyperaceae	*Cyperus textilis*	Mat Sedge	
Iridaceae	*Bobartia robusta*	Giant Rushiris	
Iridaceae	*Chasmanthe aethiopica*	Cobra Lily	
Orchidaceae	*Bonatea speciosa*	Green Woodorchid	Species on report front cover
Poaceae	*Cenchrus clandestinus*	Kikuyu Grass	Invasive. NEMBA 1b, CARA 1
			
Poaceae	*Cenchrus setaceus*	Fountain Grass	Invasive. NEMBA 1b, CARA 1
			

Family	Species	Common name	Information
Poaceae	*Grass sp.*	grasses	
Poaceae	*Setaria parviflora*	knotroot bristlegrass	Exotic.
Poaceae	*Stenotaphrum secundatum*	Saint Augustine grass	
Strelitziaceae	*Strelitzia nicolai*	giant bird-of-paradise flower	Exotic. Cultivated
Magnoliopsida (Dicotyledons)			
Aizoaceae	*Carpobrotus deliciosus*	Delicious Sourfig	
Aizoaceae	*Carpobrotus edulis*	sea fig	
Aizoaceae	*Mesembryanthemum aitonis*	Coast Solfig	
Aizoaceae	*Tetragonia fruticosa*	Sprawling Seacoral	
Amaranthaceae	*Exomis microphylla*	Brakbosses	
Anacardiaceae	*Schinus terebinthifolia*	Brazilian pepper	Invasive. NEMBA 3, CARA 3
			
Anacardiaceae	*Searsia crenata*	Crowberry	
Anacardiaceae	*Searsia glauca*	Blue Kunibush	
Anacardiaceae	*Searsia lucida*	Glossy Currantrhus	
Apocynaceae	*Carissa bispinosa*	num-num	
Apocynaceae	*Cynanchum obtusifolium*	Roundleaf Buckhorn	
Araliaceae	*Cussonia thyrsiflora*	Cape Coast Cabbagetree	
Asteraceae	*Arctotheca prostrata*	Prostrate Capeweed	
Asteraceae	*Brachylaena discolor*	Coast Silver-oak	
Asteraceae	*Chrysocoma ciliata*	Bitterbush	
Asteraceae	*Cineraria lobata*	Smooth Cineraria	
Asteraceae	*Cullumia carlinoides*	Limestone Snakethistle	Near Threatened B1ab(ii,iii,iv,v)
Asteraceae	*Helichrysum cymosum*	Fume Everlasting	
Asteraceae	*Helichrysum patulum*	Honey Everlasting	
Asteraceae	*Helichrysum teretifolium*	Needle Everlasting	
Asteraceae	*Metalasia acuta*	Pointy Blombush	
Asteraceae	*Metalasia muricata*	White bristle bush	
Asteraceae	*Nidorella ivifolia*	Ivy Vleiweed	
Asteraceae	*Osteospermum moniliferum*	Bietou	
Asteraceae	*Senecio ilicifolius*	Kowanna Ragwort	
Asteraceae	*Tarchonanthus littoralis*	Coastal Camphorbush	

Family	Species	Common name	Information
Boraginaceae	*Echium plantagineum*	purple viper's-bugloss	Invasive. NEMBA 1b, CARA 1
			
Capparaceae	*Capparis sepiaria*	indian caper	
Celastraceae	*Gymnosporia buxifolia*	Common Spikethorn	
Celastraceae	*Lauridia tetragona*	Climbing Saffron	
Celastraceae	*Mystroxylon aethiopicum*	Kooboo-berry	
Celastraceae	*Pterocelastrus tricuspidatus*	Candlewood	
Celastraceae	*Putterlickia pyracantha*	Bastard Spikethorn	
Crassulaceae	*Cotyledon orbiculata*	pig's ear	
Crassulaceae	*Crassula expansa*	Fine Stonecrop	
Crassulaceae	*Crassula multicava*	Fairy Stonecrop	
Ebenaceae	*Diospyros dichrophylla*	Poison Starapple	
Ericaceae	*Erica peltata*	Shield Heath	
Euphorbiaceae	*Ricinus communis*	castor bean	Invasive. NEMBA 2, CARA 2
			
Fabaceae	*Acacia cyclops*	western coastal wattle	Invasive. NEMBA 1b, CARA 2
			

Family	Species	Common name	Information
Fabaceae	*Acacia mearnsii*	black wattle	Invasive. NEMBA 2, CARA 2
			
Fabaceae	*Aspalathus quinquefolia*	Fives Capegorse	
Fabaceae	*Indigofera priorii*	Squashed Indigo	
Fabaceae	*Lotus subbiflorus*	Hairy Bird's-foot-trefoil	Exotic.
Fabaceae	*Rhynchosia caribaea*	Caribbean snoutbean	
Gentianaceae	*Chironia baccifera*	Christmas Berry	
Geraniaceae	*Pelargonium capitatum*	rose-scented geranium	
Geraniaceae	*Pelargonium peltatum*	ivy geranium	
Lamiaceae	*Salvia aurea*	Brown Sage	
Malvaceae	*Abutilon sonneratianum*	Butter and cheese	
Malvaceae	*Grewia occidentalis*	Crossberry	
Malvaceae	*Hermannia flammea*	Flaming Dollsrose	
Malvaceae	*Hermannia holosericea*	Kwaaiman Dollsrose	
Malvaceae	*Hermannia lavandulifolia*	Lavender Dollsrose	Vulnerable A2c
Malvaceae	*Hermannia salviifolia*	Sage Dollsrose	
Meliaceae	*Melia azedarach*	Chinaberry	Invasive. NEMBA 1b (3 in urban areas), CARA 3
			
Metteniusaceae	*Apodytes dimidiata*	White Pear	Cultivated
Myrtaceae	*Eucalyptus cladocalyx*	sugar gum	Invasive. NEMBA 1b, CARA 2
			

Family	Species	Common name	Information
Myrtaceae	*Eucalyptus conferruminata*	spider gum	Invasive. NEMBA 1b.
			
Oleaceae	*Olea europaea africana*	African Wild Olive	
Onagraceae	*Oenothera drummondii*	beach evening-primrose	Exotic.
Onagraceae	*Oenothera stricta*	fragrant evening-primrose	Exotic.
Pittosporaceae	*Pittosporum viridiflorum*	Cape Cheesewood	Protected Tree no. 139
			
Plantaginaceae	*Plantago lanceolata*	ribwort plantain	Exotic.
Polygalaceae	*Muraltia ericoides*	Heathleaf Purplegorse	
Polygalaceae	*Muraltia squarrosa*	Hornless Purplegorse	
Polygalaceae	*Polygala myrtifolia*	Sweet Pea Shrub	
Rhamnaceae	*Phylica axillaris*	Axil Hardleaf	
Rhamnaceae	*Scutia myrtina*	cat-thorn	
Rubiaceae	*Anthospermum aethiopicum*	Tall Flowerseed	
Rutaceae	*Agathosma apiculata*	Garlic Buchu	
Salvadoraceae	*Azima tetracantha*	Needle Bush	
Sapotaceae	*Sideroxylon inerme inerme*	Southern White Milkwood	Protected Tree no. 579
			

Family	Species	Common name	Information
Solanaceae	*Solanum africanum*	drunken berry	
Solanaceae	*Solanum mauritianum*	bugweed	Invasive. NEMBA 1b, CARA 1
			
Solanaceae	*Solanum sp.*	nightshades	
Thymelaeaceae	*Passerina corymbosa*	Common Gonna	
Undisclosed	*Sensitive species no. 1*	Undisclosed	
Vitaceae	*Rhoicissus digitata*	Baboon Grape	
Pinopsida			
Pinaceae	*Pinus radiata*	Monterey pine	Invasive. NEMBA 1b (2 in plantations & windrows), CARA 2
			
Pteridaceae			
Pteridaceae	*Cheilanthes viridis*	Green Cliff Brake	

5.4 Additional SCC that may be found

All SCC that may be present on the site have been identified using the screening tool report for the site. *Hermannia lavandulifolia* (VU) and *Cullumia carlinoides* (NT) are the only confirmed SCC along the sewer line route.

- *Hermannia lavandulifolia* is often found in disturbed landscapes, including the disturbed areas associated with road reserves or railways, as this is a pioneer species.
- *Cullumia carlinoides* was observed in a small section of mapped strandveld in the easternmost section of the proposed sewerage in a section mapped as “Fragmented sparse thicket”, where some strandveld species were also observed. This species is quite common along the Southern Cape coastline but is experiencing ongoing loss due to coastal development and competition from invasive alien plants. And the site also included reference to the plant species diversity of

None of the other SCC flagged in the Screening Tool, not any additional nearby SCC on iNaturalist are likely to occur within the proposed sewerage infrastructure upgrade area in addition to the two species mentioned above.

Zostera capensis (EN) was also flagged by the Screening Tool, and this is a species that is only likely to occur within the intertidal zone of the estuary. Therefore, this aquatic species is not of concern for the proposed sewer line.

6. SITE SENSITIVITY VERIFICATION

6.1 Terrestrial Biodiversity

The Terrestrial Biodiversity sensitivity of the proposed sewer line alignment is considered **Low sensitivity**, as the majority of construction activities will occur within the existing disturbed road reserve within an established residential area. While screening tool outputs flagged portions of Critical Biodiversity Areas and Red-Listed ecosystems, these areas largely fall outside the direct footprint, and intact habitats such as the Milkwood-dominated hill adjacent to the railway represent the primary location of higher sensitivity. For Terrestrial Biodiversity this report can serve as a compliance statement.

6.2 Botanical Diversity

In contrast, the Plant Species Theme is confirmed as a **High sensitivity** in specific locations, particularly where intact thicket and strandveld intersect the alignment. Notable areas include the New Ø90 mm rising main, where remnant thicket and strandveld persist, and the eastern section of the Ø110 mm rising main, along the railway, where *Hermannia lavandulifolia* (Vulnerable) and another sensitive species was recorded. These localized patches of high conservation value will require careful management to minimize impacts during construction, despite the broader alignment being dominated by lower-sensitivity, transformed areas.

7. SITE ECOLOGICAL IMPORTANCE

The site ecological importance (SEI) assessment follows after confirmation that some sections of the site represent sensitive habitats. The species environmental guidelines make use if the SEI to standardise the methodology used to spatially identify areas of importance for a proposed development. The SEI is a function of biodiversity importance (BI) and receptor resilience (RR), which is defined as:

> *"The intrinsic capacity of the receptor (i.e., habitat type in question) to resist major damage from disturbance and/or to recover to its original state with limited or no human intervention."*

The function is as follows: SEI = BI + RR. BI is a function of conservation importance (CI) and habitat functional integrity (FI), so that BI = CI + FI. The definition of CI given by the Species Environmental Assessment Guideline of 2022 is:

> *"The importance of a site for supporting biodiversity features of conservation concern present, e.g., populations of IUCN threatened and Near Threatened species (CR, EN, VU and NT), Rare species, range-restricted species, globally significant populations of congregatory species, and areas of threatened ecosystem types, through predominantly natural processes."*

Most features included in CI are provided by the screening tool but needs to be evaluated at a finer scale from the field work assessment. FI is defined as:

> *"A measure of the ecological condition of the impact receptor as determined by its remaining intact and functional area, its connectivity to other natural areas and the degree of current persistent ecological impacts."*

The criteria for defining RR, CI and FI are provided in the Species Environmental Assessment Guidelines of 2022. BI can be derived from a simple matrix of CI and FI, as illustrated in Table 3 below.

Table 3: The matrix that defines the biodiversity importance (BI) of a given habitat type, as identified from a desktop and field assessment.

Biodiversity Importance		Conservation Importance				
		Very High	High	Medium	Low	Very Low
Functional Integrity	Very High	Very High	Very High	High	Medium	Low
	High	Very High	High	Medium	Medium	Low
	Medium	High	Medium	Medium	Low	Very Low
	Low	Medium	Medium	Low	Low	Very Low
	Very Low	Medium	Low	Very Low	Very Low	Very Low

The SEI can then be derived from a second matrix, as depicted in Table 4. SEI is specific to the proposed development and can therefore only be compared between alternative layouts for the same proposed development, but not between developments.

Table 4: The matrix that defines the site ecological importance (SEI) of a given habitat type, as identified from a desktop and field assessment.

Site Ecological Importance		Biodiversity Importance				
		Very High	High	Medium	Low	Very Low
Receptor Resilience	Very High	Very High	Very High	High	Medium	Low
	High	Very High	Very High	High	Medium	Very Low
	Medium	Very High	High	Medium	Low	Very Low
	Low	High	Medium	Low	Very Low	Very Low
	Very Low	Medium	Low	Very Low	Very Low	Very Low

The overall SEI score is intended to provide a more refined overview of the sensitivity of the various habitats that have been identified on the site. The benchmark for "fully natural" vegetation is defined according to the Vegetation Assets, States, and Transitions (VAST) framework, which considers natural vegetation to be the state pre-European conditions (i.e., period prior to the 1700s or 1600s). The habitats and ecosystems of the property are therefore defined according to the VAST framework, which acts as an aid for the SEI calculation, especially in determining the appropriate receptor resilience (RR). The VAST framework categories are summarised in Appendix 10.4. Table 5 below describes the recommended mitigation for each SEI category based on the Species Environmental Guidelines (Verburgt et al., 2020). The reasoning behind the map is provided in Table 6.

Table 5: The mitigation guidelines for interpreting the various SEI categories for the proposed development activities (Verburgt et al., 2020).

Site Ecological Importance	Recommendation for activities based on the mitigation hierarchy
Very High	Avoidance mitigation – no destructive development activities should be considered. Offset mitigation not acceptable/not possible (i.e. last remaining populations of species, last remaining good condition patches of ecosystems/unique species assemblages). Destructive impacts for species/ecosystems where persistence target remains.
High	Avoidance mitigation wherever possible. Minimisation mitigation – changes to project infrastructure design to limit the amount of habitat impacted; limited development activities of low impact acceptable. Offset mitigation may be required for high impact activities.
Medium	Minimisation and restoration mitigation – development activities of medium impact acceptable followed by appropriate restoration activities.
Low	Minimisation and restoration mitigation – development activities of medium to high impact acceptable followed by appropriate restoration activities.
Very Low	Minimisation mitigation – development activities of medium to high impact acceptable and restoration activities may not be required.

Most of the remaining thicket remnants along the sewer line rote have been identified as Medium SEI according to the themes assessed in this report (see Fig. 17). Transformed and highly degraded sections of the site have all been identified as Very Low sensitivity (including existing roads found during the site assessment). The railway has a Low SEI, because although transformed, it supported SCC.

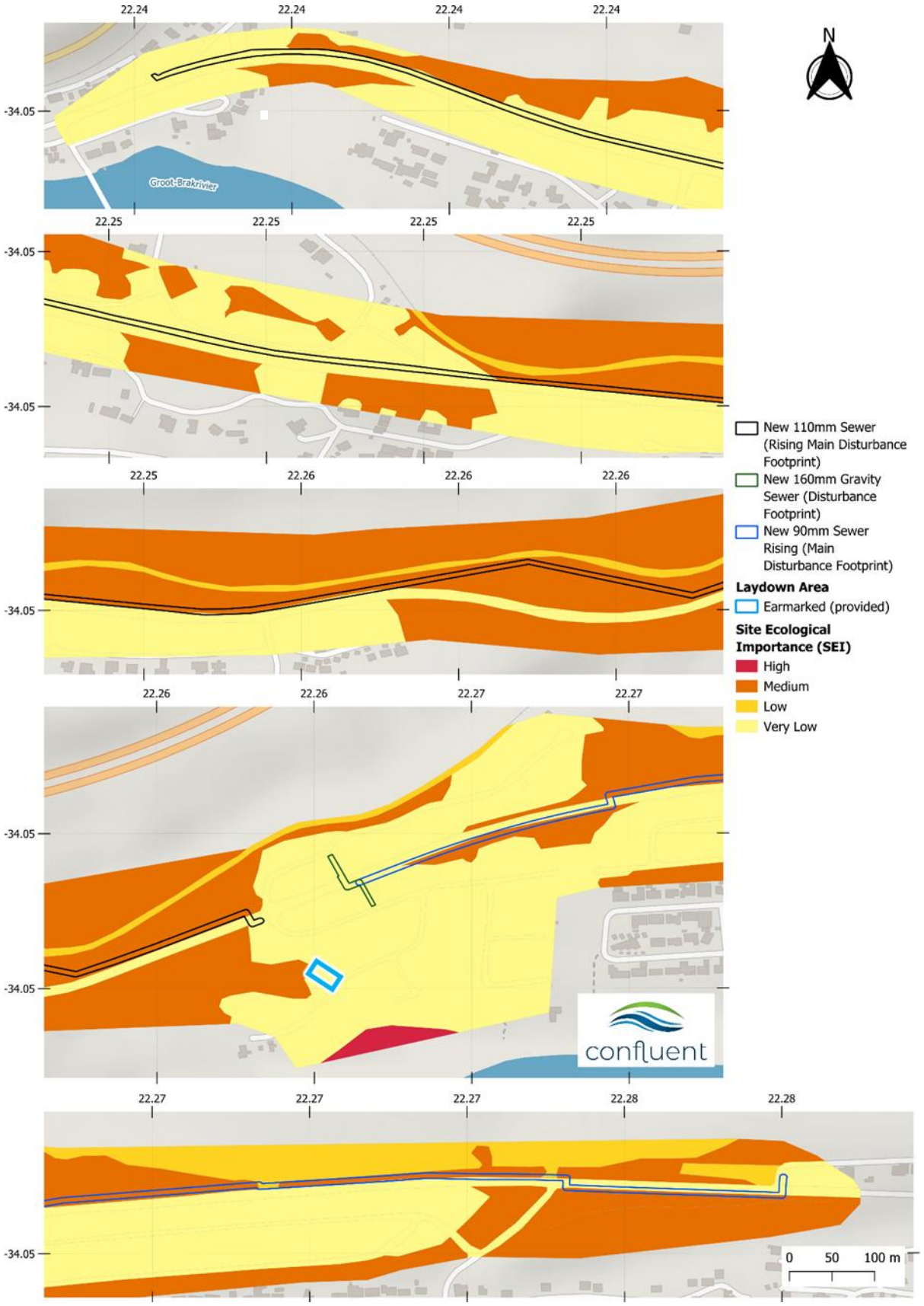


Figure 17: The SEI map for the landscape surrounding the proposed sewerage infrastructure. This SEI only applies to the activity being proposed and may change for other types of development.

Table 6: The evaluation of the SEI for the vegetation/habitats present within and surrounding the proposed development.

Land use / Land cover	Conservation Importance (CI)	Functional Integrity (FI)	Receptor Resilience (RR)	Site Ecological Importance (SEI)
Road VAST Class VI: Removed	**Very Low** No natural habitat remaining.	**Low** Several minor and major current negative ecological impacts.	**Very High** The roads will remain unvegetated.	**SEI: Very Low** BI: Very Low RR: Very High
Suburbs – High disturbance VAST Class IV & V: Replaced – Adventive & Managed	**Low** < 50% contains natural habitat with limited potential to support SCC.		**High** The suburbs will remain highly disturbed and managed.	**SEI: Very Low** BI: Low RR: High
Cleared Fields VAST Class V: Replaced			**Medium** If left to recover, the cleared fields can recover, but this will be a slow process.	**SEI: Low** BI: Low RR: Medium
Railway VAST Class III: Transformed	**Medium** > 50% contains natural habitat with potential to support SCC.	**Medium** Mostly minor current negative impacts with some major impacts. The railway will never be pristine, but it has opened habitat for SCC.	**High** The railway is likely to remain transformed and disturbed.	**SEI: Low** BI: Medium RR: High
Milkwood thicket / coastal forest VAST Class I & II: Largely Residual with Modified areas	**Medium** Protected trees are the dominant species (Milkwood mostly), and there is potential to support SCC.	**High** Good habitat connectivity with potentially functional ecological corridors and a regularly used road network between intact habitat patches.	**Medium** Thicket habitat recovers slowly following human disturbance, especially clearing (i.e., of milkwood trees).	**SEI: Medium** BI: Medium RR: Medium
Fragmented Sparse thicket VAST Class II: Modified		**Medium** Only narrow corridors of good habitat connectivity.		**SEI: Medium** BI: Medium RR: Medium
Strandveld VAST Class II: Modified	**Medium** > 50% contains natural habitat with potential to support SCC.		**Medium** The strandveld is susceptible to disturbance, most especially invasion by invasive species like Rooikrans (*Acacia cyclops*).	**SEI: Medium** BI: Medium RR: Medium
Beach VAST Class 0: Residual Bare	**High** Although naturally bare, beaches have conservation importance.	**Medium** Only narrow corridors of good habitat connectivity.	**Low** The beach is likely to remain a beach. However, despite that resilience, beaches are susceptible to human disturbance, which is why the overall score is low here.	**SEI: High** BI: Medium RR: Low

8. IMPACT ASSESSMENT

The proposed sewerage infrastructure in Pienaarstrand is mainly within the existing road reserve for Morrison Road, which is in a residential area. Pockets of natural vegetation still persist between transformed residential areas, and within these pockets of natural vegetation protected trees (Milkwood and Cheesewood) are abundant, and SCC and other indigenous species were observed.

As a result, an impact assessment is required for disturbance / loss of the plant species along the proposed sewerage line. The impact assessment follows the mitigation hierarchy (Fig. 18; Brownlie et al., 2023; Ekstrom et al., 2015) which is used in the EIA process to ensure due consideration for the environment has been given in a methodical approach. In addition to the mitigation hierarchy, a no-go option is also assessed to better understand the desirability and context of the development. The impact assessment methodology is presented in Appendix 11.4.

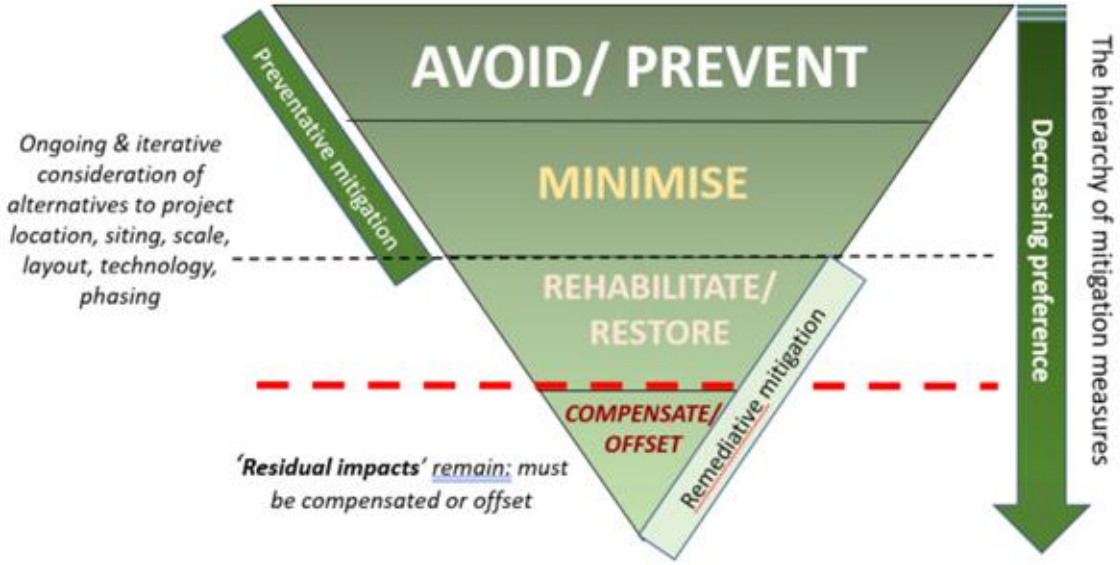


Figure 18: The mitigation hierarchy as presented in (Brownlie et al., 2023). Mitigation steps are illustrated in a hierarchy. The lower steps in the diagram should only be considered once the steps above have been duly considered.

8.1 No-Go Development Option

The current situation for disposal of sewage wastewater in this area is the use of communal conservancy tanks. Some of these tanks were observed to be leaking during the site assessment, which has negative consequences for both human and environmental health due to the presence of pathogens (e.g. E. coli and other faecal coliforms) and nutrients which can promote the growth of undesirable plants and result in species loss. The proposed sewer lines are aligned with an existing pipeline and in most areas, the road reserve, which is already disturbed. The purpose of bulk sewerage infrastructure is to ensure that sewage is effectively drained from the area for treatment at the wastewater treatment works. Therefore, the proposed infrastructure upgrades (i.e., New sewer lines and associated pump stations) should result in long-term reduction of pollution, although there will be a period of more intensive

disturbance during the construction phase, once established, ongoing disturbance will be minimal and most areas should recover mostly to their original condition.

The No-go option is therefore not supported, and the alternative to upgrade to bulk sewerage infrastructure is supported.

8.2 Layout and Design Phase

The layout and design of the pipeline is guided by engineering solutions and the needs of the Pienaarstrand community. Alignment of the pipeline follows gravitational lows where necessary, the road reserve, and an existing redundant water pipeline for the majority of the route. The only area where the alignment could be improved from a plant sensitivity perspective is where it leaves the road reserve and diverts towards the railway line.

8.2.1 Layout Impact: Disturbance to a Milkwood Thicket Adjacent to the Railway

Description: The pipeline alignment currently deviates from the road reserve to traverse a steep dune adjacent to the railway, which is densely vegetated with milkwood trees and associated coastal thicket species (Figure 19). This area represents a high-sensitivity zone (Section A) due to intact vegetation structure, limited natural regeneration, and the presence of mature trees.

Figure 19: A photo of the steep dune adjacent to the railway covered in milkwood trees. Conveniently, the tram is visible for scale in this image.

Crossing this section increases the potential for:

- Physical damage to trees and understorey vegetation
- Soil disturbance and erosion on steep slopes
- Restricted access leading to higher machinery footprint

The exact alignment for the proposed pipeline within this section is uncertain (particularly if pipe cracking within the existing redundant pipeline is implemented), introducing a spatial uncertainty component to the assessment.

Table 7: Mitigation for Disturbance of a Milkwood Thicket Adjacent to the Railway

Outcomes and Actions	Responsibility	Monitoring and Reporting Actions
Reassess pipeline alignment to minimise disturbance to the milkwood thicket and steep dune areas, considering all three layout alternatives (pipe cracking, trenching along Morrison Road, trenching along railway).	Engineers, in consultation with ECO and biodiversity specialists	Document the evaluation of each alternative, justify feasibility or constraints, and update EMPr/impact assessment tables.
Restrict construction footprint strictly to the approved disturbance area, including machinery access, pipe-jacking pits, and temporary storage areas.	Construction contractor under ECO supervision	Reporting requirements to be determined prior to construction.
Protect intact vegetation and mature milkwood trees by erecting temporary no-go fencing around sensitive patches prior to construction.	Contractor, monitored by ECO	Plan for weekly compliance checks and immediate remediation if fencing is breached.
Minimise soil disturbance and erosion on steep slopes using measures such as temporary ground mats, stabilisation of exposed soil, and construction during low soil moisture periods.	Contractor, under supervision of ECO	Erosion monitoring during and after construction included in planning per layout.
Environmental awareness training for construction staff, highlighting sensitive vegetation, no-go areas, and reporting procedures.	Contractor, facilitated by ECO	Attendance records and induction signoffs planned.

8.3 Construction Phase

An Environmental Control Officer (ECO) with knowledge of the protected trees and important taxa along the alignment must be appointed for the duration of the construction phase. The ECO should be present for a site induction at commencement of work and should check on the development progress once a month, or promptly after significant rainfall events during the construction phase. This is especially important after rainfall events to ensure that unnecessary impacts (e.g., erosion etc.) are avoided.

8.3.1 Construction Impact: Loss of Plant Species of Conservation Concern (SCC) and Ecologically Important Plant Taxa Due to Excavation

Description: This impact refers to the physical removal of natural / semi-natural vegetation that could support SCC, due to digging trenches for the proposed pipeline. Prior to construction, standard mitigation measures can be applied to ensure the footprint does not increase without good reason. Mitigation is presented in Table 8.

Table 8: Mitigation for the Loss of Plant Species of Conservation Concern (SCC) and Ecologically Important Plant Taxa Due to Excavation.

Outcomes and Actions	Responsibility	Monitoring and Reporting Actions
Pre-Construction		
Given the presence of protected tree species such as Milkwood (*Sideroxylon inerme inerme*) and Cheesewood (*Pittosporum viridiflorum*), careful planning and adherence to the National Forests Act (No. 84 of 1998) is crucial to avoid greater than necessary impacts.	ECO	1. Delineate the footprint of disturbance and mark protected tree species. 2. Obtain the necessary permits for activities affecting these protected species from DFFE. 3. Integrate effective erosion control and waste management strategies (refer to the aquatic specialist report for further details) where trees will be affected.
Minimise the construction footprint to the smallest area possible	Project manager, guided by the ECO	4. Make use of visible signage and danger tape to indicate the work area. No-Go signage to indicate limits of disturbance. 5. ECO to inspect signage and placement.
Conduct a Plant Search and Rescue Operation within 4 identified areas that the pipeline will cross (see the blue polygons in the image below)	ECO, botanist	1. Rescue **grasses, succulent, and geophyte plant species**, or any species that could have a high likelihood of survival post construction. 2. Monitor staff helping to ensure plants are removed for maximum survivability. 3. Record the species and location of all rescued plants. 4. Preferably store the plants nearby or alternatively at an agreed upon location / nursery where they can be watered regularly 5. Undertake weeding of the rescued plants every second month 6. ECO to record all rescued plants that go missing or that die during their time in the nursery

Outcomes and Actions	Responsibility	Monitoring and Reporting Actions
		
During Construction		
Incorporate a well-planned, phased construction approach to minimize the construction period.	Project manager guided by the ECO	1. Ensure that the construction follows a clear plan. Hold weekly briefing meetings with staff and check ahead for rainfall predictions. 2. Installing erosion control blankets during construction can help manage soil movement in areas identified as vulnerable to erosion and sediment runoff.
Minimize soil disturbance and soil compaction beyond existing roads and areas of disturbance.	Project manager	Turning and parking for construction vehicles and stockpiling of materials must be in areas that are already cleared and disturbed. Avoid activity in natural vegetation outside of the footprint layout.
Topsoil (top 30cm) to be stockpiled separately from subsoils	Project manager guided by the ECO	1. Label topsoil & subsoil stockpiles clearly. 2. Ensure topsoil is appropriately covered and bunded. 3. Halt excavation during significant rainfall events. 4. Once construction is finished, ensure topsoil is replaced on top of subsoils to keep seed bank intact.
Ensure proper waste management to prevent pollution of sensitive areas	Project manager	Have bins and skips on the construction site and ensure that staff remove rubbish weekly. Have weekly inspections to ensure no waste in the surrounding landscape.

8.4 Operational Phase

The operational phase here refers to the ongoing and long-term functional period once the sewerage infrastructure is in place and the topsoil has been replaced.

8.4.1 Operational Impact: The Negative Impact of Edge Effects and Invasive Species on the Natural Vegetation on and Around the Pipeline Route

Description: Because of the disturbance to the topsoil, some opportunistic invasive and exotic taxa may displace recovering natural vegetation if the pipeline route is not routinely monitored and managed for this impact. Mitigation for the operational phase is summarised in Table 9.

Table 9: Mitigation for the Negative Impact of Activity Beyond the Feedlot Footprint That Then Affect Natural Surrounding Vegetation and SCC.

Outcomes and Actions	Responsibility	Monitoring and Reporting Actions
Replant indigenous rescued flora along the route in the replaced topsoil.	ECO with guidance from botanist	1. Record plants successfully replanted & plants that died before replanting 2. Target areas prone to erosion 3. Include results in ECO reporting
Undertake alien clearing along the route.	Municipality & EPWP teams	1. Undertake every 4 months, or when the road reserve maintenance occurs according to an approved clearing plan. 2. Monitor the route to ensure sufficient vegetation cover with indigenous plant species.

8.5 Impact Assessment Tables

The impacts presented above were assessed and ranked as presented in Table 10. This evaluation reflects the anticipated effectiveness of the proposed mitigation measures and identifies the residual impacts remaining after mitigation. For the Sewerage Layout alternatives along the section where the pipeline may traverse Farm 7/252 near the railway line:

Option 1 (Pipe Cracking within Existing Redundant Pipeline) – Residual impact is Minor Negative, reflecting reduced disturbance to sensitive vegetation while maintaining operational feasibility.

Option 2 (Trenching along Morrison Road) – Residual impact is Minor Negative, as this alignment largely avoids the high-sensitivity thicket areas.

Option 3 (Trenching along Railway Line / Dense Thicket) – Residual impact is Moderate Negative, due to unavoidable disturbance of high-sensitivity vegetation and steeper slopes, despite implementation of mitigation measures.

For the **No-Go Option**, residual impact is Minor Negative, representing potential limited indirect effects, such as ongoing edge effects or invasive species, even in the absence of development.

Table 10: The impact ratings table and associated residual impacts for the proposed development versus the no-go scenario.

Alternatives	Sewerage Layout & Option 1 (alignment unknown, Section A or B)		Sewerage Layout & Option 2 (Section B)		Sewerage Layout & Option 3 (Section A)		No-go Option	
Mitigation	**Without Mitigation**	**With Mitigation**	**Without Mitigation**	**With Mitigation**	**Without Mitigation**	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Confidence	High	High	High	High	High	High	High	High
Reversibility	Moderate	Moderate	Low	Low	Low	Low	High	High
Resource irreplaceability	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
8.2.1 Layout & Design: Disturbance of a Milkwood Thicket Adjacent to the Railway								
Duration	Long term	Medium term	Long term	Medium term	Ongoing	Long term	Immediate	Immediate
Extent	Very limited	Very limited	Very limited	Very limited	Limited	Very limited	Very limited	Very limited
Intensity	Moderate	Low	Moderate	Low	Very high	High	Negligible	Negligible
Probability	Certain	Certain	Certain	Certain	Certain	Certain	Almost certain	Almost certain
SCORE	Minor: -63	Minor: -49	Minor: -70	Minor: -56	Moderate: -98	Moderate: -77	Negligible: -18	Negligible -18
8.2.1 Construction: Loss of Plant Species of Conservation Concern (SCC) and Ecologically Important Plant Taxa from Excavation								
Duration	Medium term	Short term	Medium term	Short term	Ongoing	Long term	Immediate	Immediate
Extent	Very limited	Very limited	Very limited	Very limited	Limited	Very limited	Very limited	Very limited
Intensity	High	Low	Moderate	Very low	High	Moderate	Negligible	Negligible
Probability	Certain	Certain	Certain	Certain	Certain	Certain	Almost certain	Almost certain
SCORE	Minor: -70	Minor: -49	Minor: -63	Minor: -42	Moderate: -91	Minor: -70	Negligible: -18	Negligible: -18
8.3.1 Operational: The Negative Impact of Edge Effects and Invasive Species on the Natural Vegetation on and Around the Pipeline Route								
Duration	Ongoing	Medium term	Ongoing	Medium term	Ongoing	Medium term	Ongoing	Medium term
Extent	Limited	Very limited	Limited	Very limited	Limited	Very limited	Very limited	Very limited
Intensity	Moderate	Very low	Low	Very low	High	Moderate	Low	Very low
Probability	Almost certain	Almost certain	Almost certain	Almost certain	Almost certain	Almost certain	Almost certain	Almost certain
SCORE	Minor: -72	Minor: -42	Minor: -66	Minor: -42	Moderate: -78	Minor: -54	Minor: -60	Minor: -42
RESIDUAL IMPACT		**Minor Negative**		**Minor negative**		**Moderate negative**		**Minor negative**

9. CONCLUSION

The proposed sewerage infrastructure in Pienaarstrand is predominantly located within transformed areas of existing residential developments, with the majority of the route following the Morrison Road reserve. These areas generally do not coincide with threatened ecosystems, Critical Biodiversity Areas (CBAs), or Ecological Support Areas (ESAs).

Careful planning and mitigation are required where the pipeline traverses thicket or strandveld beyond the road reserve, particularly along the railway corridor (Section A). Sensitive vegetation occurs in localized patches, most of which fall outside the defined Project Area of Influence (PAOI). Where sensitive vegetation is present within the PAOI, the impact on overall habitat structure and function is limited where Options 1 and 2 are used as part of the layout design, due to the minor residual impact identified. Option 3 will have a moderate residual impact.

Overall, the preferred alternatives (Options 1 and 2) minimise disturbance to high-sensitivity areas while maintaining engineering feasibility. Implementation of the mitigation measures described in this report will effectively reduce residual impacts to acceptable levels, ensuring that ecological integrity is largely maintained along the proposed sewerage route.

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11. APPENDIX

11.1 Land use recommendations according to the WC BSP

Recommended acceptable land-uses for each BSP layer is outlined and summarised in Table 11 below.

Table 11: The land-use planning proposed by the Western Cape Biodiversity Spatial Plan

Yes	Restricted	No
Permissible land uses that are unlikely to compromise the biodiversity objective	Land-uses that may compromise the biodiversity objective and are only permissible under certain conditions	Land-uses that will compromise the biodiversity objective and are not permissible

Map and Land use Categories		Protected Area	Critical Biodiversity Area 1	Critical Biodiversity Area 2	Ecological Support Area 1: Terrestrial	Ecological Support Area 1: Aquatic	Ecological Support Area 2	Ecological Support Area: Species Specific Overlay	ONA: Natural to Near Natural	ONA: Degraded	No Natural Remaining
Conservation	Proclaimed Protected Areas	Land use within proclaimed protected areas is subject to a management plan drawn up for that specific protected area.	Yes	Yes	Yes	Yes	Yes	Restricted	Yes	Restricted	Restricted
Conservation	Conservation Areas		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Restricted	Restricted
Agriculture	Intensive Agriculture		No	No	No	No	No	Restricted	Restricted	Restricted	Yes
Agriculture	Extensive Agriculture		Restricted	Restricted	Restricted	Restricted	Restricted	Restricted	Yes	Yes	Yes
Tourism and Recreational	Low Impact Facilities		No	Restricted	Restricted	Restricted	Restricted	Restricted	Restricted	Yes	Yes
Tourism and Recreational	High Impact Facilities		No	No	No	No	No	No	Restricted	Restricted	Yes
Rural Accommodation	Agri-worker Accommodation		No	No	No	No	No	Restricted	Restricted	Restricted	Yes
Rural Accommodation	Smallholdings		No	No	No	No	Restricted	Restricted	Restricted	Yes	Yes
Urban	Existing settlements and urban expansion		No	No	No	No	No	Restricted	Restricted	Restricted	Yes
Urban	Community Facilities and Institutions		No	No	No	No	No	Restricted	Restricted	Restricted	Yes

Yes Permissible land uses that are unlikely to compromise the biodiversity objective	Restricted Land-uses that may compromise the biodiversity objective and are only permissible under certain conditions	No Land-uses that will compromise the biodiversity objective and are not permissible

Map and Land use Categories		Protected Area	Critical Biodiversity Area 1	Critical Biodiversity Area 2	Ecological Support Area 1: Terrestrial	Ecological Support Area 1: Aquatic	Ecological Support Area 2	Ecological Support Area: Species Specific Overlay	ONA: Natural to Near Natural	ONA: Degraded	No Natural Remaining
Business & Industrial	Rural Business	Land use within proclaimed protected areas is subject to a management plan drawn up for that specific protected area.	No	No	Restricted	No	No	No	Restricted	Restricted	Yes
	Non-place-bound Industry (low-moderate impact)		No	No	Restricted	No	No	Restricted	Restricted	Restricted	Yes
	Non-place-bound Industry (high impact)		No	No	No	No	No	Restricted	Restricted	Restricted	Yes
	Renewable Energy		No	No	Restricted	No	Restricted	No	Restricted	Restricted	Yes
	Extractive Industry (incl. Prospecting)		No	No	No	No	No	Restricted	Restricted	Restricted	Yes
Infrastructure Installations	Linear - roads and rail		No	Restricted	Restricted	Restricted	Restricted	No	Restricted	Yes	Yes
	Linear - pipelines & canals		No	Restricted	Restricted	Restricted	Restricted	Restricted	Restricted	Yes	Yes
	Linear - powerlines		Restricted	Restricted	Restricted	Restricted	Restricted	Restricted	Restricted	Yes	Yes
	Other Utilities		No	No	Restricted	No	Restricted	Restricted	Restricted	Yes	Yes

11.2 The IUCN Species Red List Criteria Summary

This section contains an extra summary explaining the very basics of the five Red List criteria used when assessing the Red List status of species (Figure 20). Note that this summary sheet does not provide detail on the “Near Threatened” category (sometimes also called an “Orange List” category) which comes before the “Vulnerable” category. These are the criteria that are used by the IUCN to assign the extinction threat status for individual plant species. In South Africa there are additional criteria (not shown on Fig. 20) for Rare and Critically Rare plant species.

SUMMARY OF THE FIVE CRITERIA (A-E) USED TO EVALUATE IF A TAXON BELONGS IN AN IUCN RED LIST THREATENED CATEGORY (CRITICALLY ENDANGERED, ENDANGERED OR VULNERABLE).[1]

A. Population size reduction. Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4

	Critically Endangered	Endangered	Vulnerable
A1	≥ 90%	≥ 70%	≥ 50%
A2, A3 & A4	≥ 80%	≥ 50%	≥ 30%

A1 Population reduction observed, estimated, inferred, or suspected in the past where the causes of the reduction are clearly reversible AND understood AND have ceased.

A2 Population reduction observed, estimated, inferred, or suspected in the past where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

A3 Population reduction projected, inferred or suspected to be met in the future (up to a maximum of 100 years) *[(a) cannot be used for A3]*.

A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

based on any of the following:

(a) direct observation *[except A3]*
(b) an index of abundance appropriate to the taxon
(c) a decline in area of occupancy (AOO), extent of occurrence (EOO) and/or habitat quality
(d) actual or potential levels of exploitation
(e) effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

B. Geographic range in the form of either B1 (extent of occurrence) AND/OR B2 (area of occupancy)

	Critically Endangered	Endangered	Vulnerable
B1. Extent of occurrence (EOO)	< 100 km²	< 5,000 km²	< 20,000 km²
B2. Area of occupancy (AOO)	< 10 km²	< 500 km²	< 2,000 km²
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented **OR** Number of locations	= 1	≤ 5	≤ 10
(b) Continuing decline observed, estimated, inferred or projected in any of: **(i)** extent of occurrence; **(ii)** area of occupancy; **(iii)** area, extent and/or quality of habitat; **(iv)** number of locations or subpopulations; **(v)** number of mature individuals			
(c) Extreme fluctuations in any of: **(i)** extent of occurrence; **(ii)** area of occupancy; **(iii)** number of locations or subpopulations; **(iv)** number of mature individuals			

C. Small population size and decline

	Critically Endangered	Endangered	Vulnerable
Number of mature individuals	< 250	< 2,500	< 10,000
AND at least one of C1 or C2			
C1. An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future):	25% in 3 years or 1 generation (whichever is longer)	20% in 5 years or 2 generations (whichever is longer)	10% in 10 years or 3 generations (whichever is longer)
C2. An observed, estimated, projected or inferred continuing decline AND at least 1 of the following 3 conditions:			
(a) **(i)** Number of mature individuals in each subpopulation	≤ 50	≤ 250	≤ 1,000
(ii) % of mature individuals in one subpopulation =	90–100%	95–100%	100%
(b) Extreme fluctuations in the number of mature individuals			

D. Very small or restricted population

	Critically Endangered	Endangered	Vulnerable
D. Number of mature individuals	< 50	< 250	**D1.** < 1,000
D2. *Only applies to the VU category* Restricted area of occupancy or number of locations with a plausible future threat that could drive the taxon to CR or EX in a very short time.	-	-	**D2.** typically: AOO < 20 km² or number of locations ≤ 5

E. Quantitative Analysis

	Critically Endangered	Endangered	Vulnerable
Indicating the probability of extinction in the wild to be:	≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)	≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)	≥ 10% in 100 years

1 Use of this summary sheet requires full understanding of the *IUCN Red List Categories and Criteria* and *Guidelines for Using the IUCN Red List Categories and Criteria*. Please refer to both documents for explanations of terms and concepts used here.

Figure 20: The IUCN summary for the five assessment criteria used during the species Red Listing process.

11.3 Site Assessment Track & Protected Trees Recorded

The site assessment track walked is illustrated in Fig. 21 and 22. In addition to the track, the location of protected trees recorded during the site assessment is also illustrated.

Figure 21: An illustration of the track and protected trees observed during the site assessment for the western half of the sewer line proposed. (S) indicates a seedling.

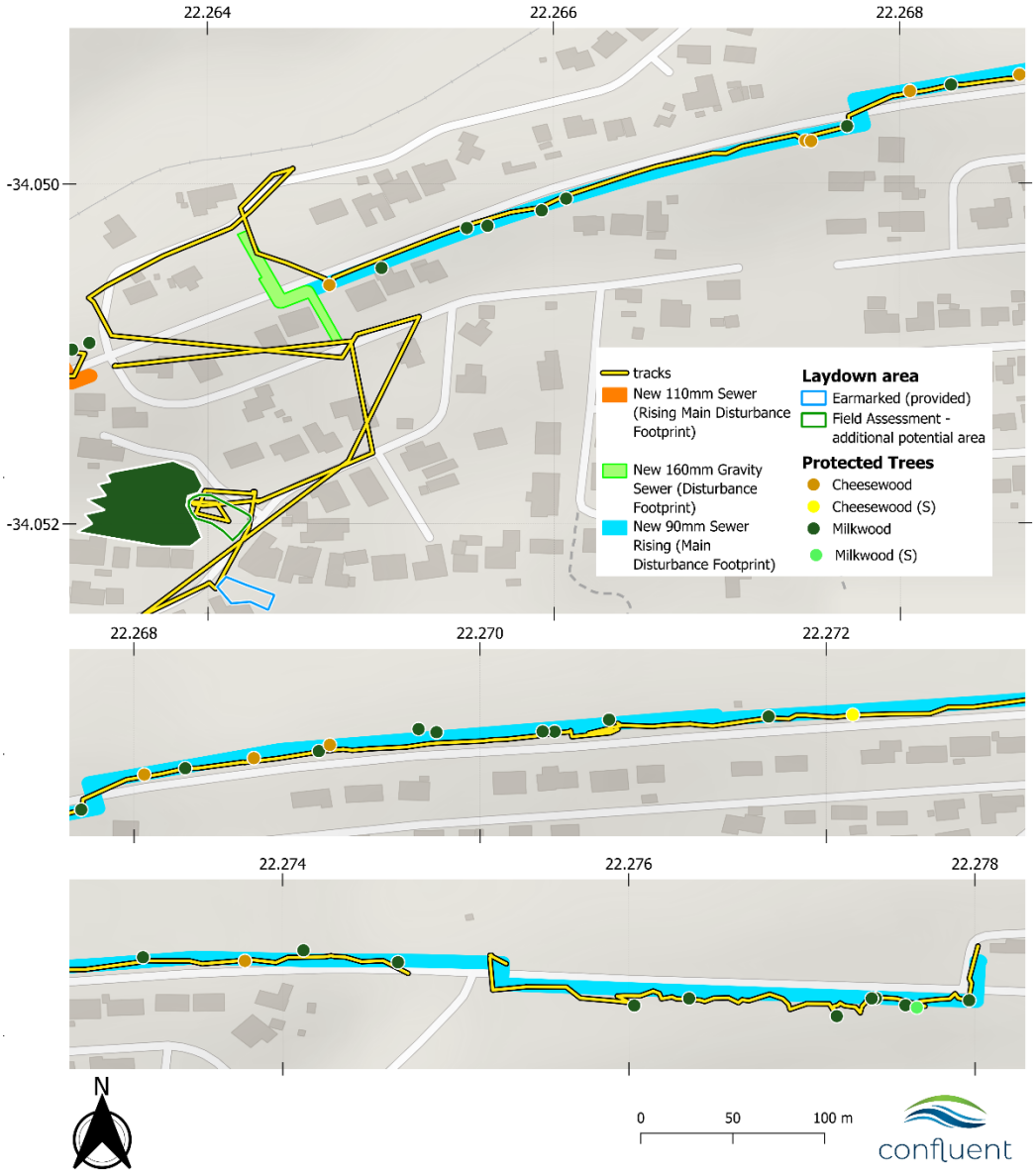

Figure 22: An illustration of the track and protected trees observed during the site assessment for the eastern half of the sewer line proposed. (S) indicates a seedling.

11.4 Vegetation Assets, States, and Transitions

The VAST framework is summarised in Table 12 below. The VAST framework acts as an aid for the SEI calculation as it helps to (Thackway & Lesslie, 2006):

- Describe and accounts for changes in the condition and status of vegetation.
- Make explicit links between land management (current) and vegetation modification.
- Provide a mechanism for describing the consequences of certain land management on vegetation.
- Contribute to the analysis of terrestrial ecosystem services that are provided by vegetation, including comparison between various land-use

Table 12: Vegetation Assets, States, and Transitions (VAST) framework with columns representing states and shifts between them defined as transitions, as laid out in (Lesslie et al., 2010; Thackway & Lesslie, 2006).

Increasing modification

		Native vegetation cover Dominant plant species indigenous to the locality and spontaneous in occurrence, i.e. a vegetation community described using definitive vegetation types relative to estimated pre 1750 types				**Non-native vegetation cover** Dominant structuring plant species indigenous to the locality but cultivated; alien to the locality and cultivated; or alien to the locality and spontaneous		
Vegetation cover classes		**Class 0:** **RESIDUAL BARE**	**Class I:** **RESIDUAL**	**Class II:** **MODIFIED**	**Class III:** **TRANSFORMED**	**Class IV:** **REPLACED -ADVENTIVE**	**Class V:** **REPLACED -MANAGED**	**Class VI:** **REMOVED**
		Areas where native vegetation does not naturally persist	Native vegetation community structure, composition, and regenerative capacity intact—no significant perturbation from land use or land management practice. Class I forms the benchmark for classes II to VI	Native vegetation community structure, composition and regenerative capacity intact—perturbed by land use or land management practice	Native vegetation community structure, composition and regenerative capacity significantly altered by land use or land management practice	Native vegetation replacement—species alien to the locality and spontaneous in occurrence	Native vegetation replacement with cultivated vegetation	Vegetation removed
Diagnostic criteria	Current regenerative capacity	Natural regenerative capacity unmodified—ephemerals and lower plants	Natural regenerative capacity unmodified	Natural regeneration tolerates or endures under past and or current land management practices	Natural regenerative capacity limited or at risk under past and or current land use or land management practices. Rehabilitation and restoration possible through modified land management practice	Regeneration of native vegetation community has been suppressed by ongoing disturbances of the natural regenerative capacity; limited potential for restoration	Regeneration of native vegetation community lost or suppressed by intensive land management; limited potential for restoration	Nil or minimal
	Vegetation structure	Nil or minimal	Structural integrity of native vegetation community is very high	Structure is predominantly altered but intact, e.g. a layer or strata and or growth forms and or age classes removed	Dominant structuring species of native vegetation community significantly altered, e.g. a layer or strata frequently removed	Dominant structuring species of native vegetation community removed or predominantly cleared or extremely degraded	Dominant structuring species of native vegetation community removed	Vegetation absent or ornamental
	Vegetation composition	Nil or minimal	Compositional integrity of native vegetation community is very high	Composition of native vegetation community is altered but intact	Dominant structuring species present—species dominance significantly altered	Dominant structuring species of native vegetation community removed	Dominant structuring species of native vegetation community removed	Vegetation absent or ornamental

11.1 Impact Assessment Methods

Individual impacts for the construction and operational phase were identified and rated according to criteria which include their intensity, duration, and extent. The criteria and their associated ratings are shown in Table 13. The ratings were then used to calculate the consequence of the impact which can be either negative or positive as follows:

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

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

Significance = *consequence x probability*

Table 13: Categorical descriptions for impacts and their associated ratings.

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

Categories assigned to the calculated significance ratings are presented in Table 14.

Table 14: Value ranges for significance ratings, where (-) are negative and (+) are positive impacts

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

Each impact was considered from the perspective of whether losses or gains would be irreversible or result in the irreplaceable loss of biodiversity of ecosystem services. The level of confidence was also determined and rated as low, medium, or high (Table 15).

Table 15: Definition of reversibility, irreplaceability, and confidence ratings.

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