GAS TRANSMISSION PIPELINE, AND ASSOCIATED INFRASTRUCTURE, NIGEL

Ecological Impact Assessment Report

May 2019

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EXECUTIVE SUMMARY

Iliza Gas (Pty) Ltd. ('ENGP' hereafter) propose the development of a 10km gas pipeline within the Nigel area, to provide gas reticulation services to the Consol glass factory. Should the project proceed, the pipeline will be connected to the nearby Sasol line, the gas decompressed and piped through to the Nigel Consol Glass facility, for use in their ongoing smelting operations. As part of the suite of documents accompanying the BAR application, this Ecological Impact Assessment is required to determine the baseline ecological condition of the site, and to provide the severity and nature of ecological impacts anticipated from the proposed development, along with providing suitable mitigation measures for the ongoing management thereof during both construction and operational phases.

The proposed pipeline will be contained entirely within the road reserve, for the full length of the route (10km), however the development site may fall within areas containing the endangered Tsakane Clay Grassland vegetation, as per the Mucina and Rutherford (2012) classification. Furthermore, based on the Gauteng Conservation Plan (C-Plan), Critical Biodiversity Areas (CBA) or Ecological Support Areas (ESAs) may be impacted by the development of the pipeline, and as such requires ecological assessment prior to implementation. In addition, the pipeline route occurs within close (< 500m) proximity to a variety of surface water features, for which a separate wetland impact assessment is being carried out.

The entire length of the pipeline **will be constructed within the road reserves** of the various roads along which the proposed development corridor is routed, **which exhibit a wide variety of land uses adjacent to the development corridor**. These included power line servitudes for Eskom 400kV lines transmission lines, agriculture in the form of maize and soya beans plantations mainly, but including large number of cattle being grazed within the road reserves, urban homesteads where the pipeline routed near the Dunnottar town (a small portion of the proposed pipeline), the Nigel cemetery, and some industrial complexes including notably the AfriSam cement factory complex, a Coca-Cola bottling plant, a waste transfer station (municipal owned) and one restaurant and accommodation site. While not occurring immediately adjacent to the road, a railroad is located close by the M63 along which the pipeline will route, along the Nigel-Dunnottar road.

According to the Mucina and Rutherford (2012) classification, **the Tsakane Clay Grassland occupies the entirety of the development corridor**. Tsakane Clay Grassland is dominated by a mixture of common highveld grasses such as *Themeda triandra*, *Heteropogon contortus*, *Elionurus muticus* and a variety of *Eragrostis* species (Mucina and Rutherford, 2012). The forbs most common are of the families *Asteraceae*, *Rubiaceae*, *Malvaceae*, *Lamiaceae* and *Fabaceae*. Disturbance in this vegetation group allows for an increase in abundance of *Hyparrhenia hirta* and *Eragrostis chloromelas* (Mucina and Rutherford, 2012). In addition, the **conservation status of Tsakane Clay Grassland is Endangered (EN)**, with only 1.5% of the 24% conservation target conserved in 2012. Furthermore, according to the Gauteng C-Plan, which delineates Critical Biodiversity Areas (CBAs), and Ecological Support Areas (ESA) for the entire Province, the proposed pipeline is **located partially within both CBA and ESA areas** along the length of the development corridor, albeit it that the corridor is within demarcated road reserves.

Field survey results indicated that three distinct vegetation units were observed across the development corridor and project area, namely '**degraded mixed grassland**', '**wetland vegetation**' and '**mixed invasive woodland**', described in detail in sections 6.1.1, 6.1.2 and 6.1.3. A total **of 45 native vegetation species** were identified within the project area, consisting mainly of mixed grass species commonly occurring in the highveld region. In addition, a total of **43 invasive vegetation species** were observed, primarily in regions

where the greatest historical and ongoing disturbance was evident. **All of the native species observed were classified as Least Concern (LC)** according to the SANBI red data list (2019) and were not considered to be sensitive species on that basis.

Due to the highly degraded nature of the site within the road reserves, the frequent disturbance and constant pedestrian foot traffic, very few animal species were observed on site, with only *Trachylepis punctatissima* (speckled rock skink), and *Trachylepis varia sensu lato* (common variable skink) identified on within the development corridor, both of which are **considered as Least Concern** (LC) (SARCA, 2014). Avifaunal species were the exception however, as apart from the above two reptiles, only birds were noted on and near the project area, with a total of **30 avifaunal species were observed**. None of the bird species observed within the project area were regarded as sensitive, with **all considered Least Concern (LC)** in terms of their conservation status.

A sensitivity analysis was conducted for the proposed project area, with four classes being determined as appropriate – **high, moderate, low and negligible**, based on a wide variety of indicators (biodiversity, biophysical and hydrological). Built up areas without vegetation or suitable habitat were deemed negligible, while the **degraded mixed grassland vegetation unit and the mixed invasive woodland vegetation unit were both deemed low sensitivity** based on primarily their highly disturbed nature, their low species diversity, and low conservation status for species found within the project area. No moderate sensitivity features were identified. **The wetland vegetation unit however was determined to be highly sensitive**, due to the presence of water features, which in some instances were present within the development corridor, and subsequently the areas are regarded as important process zones within the broader landscape as they represent unique habitats in an otherwise very degraded landscape (despite being highly degraded themselves), and do currently contribute to species diversity and abundance within the broad study area.

At present, the project area, and in particular the **development corridor, was deemed highly disturbed due to ongoing disturbance through fires, invasive species, grazing, illegal dumping, pedestrian movements, road verge maintenance, historical infrastructure and recent construction.** The development corridor remains unfenced and open to the public which promotes ongoing impacts identical to those just mentioned. **No sensitive Species of Conservation Concern were observed in the project area and development corridor, with the remainder of the species observed regarded as Least Concern (LC) in terms of their conservation status**. Overall the ecological contribution of the development corridor was deemed to be low, with no sensitive species observed and few ecological process areas and habitats due to the small size and highly disturbed character of the development corridor.

A sensitivity map of the study area was developed based on the site characteristic and results, shown below in Figure 1, 2 and 3 below.

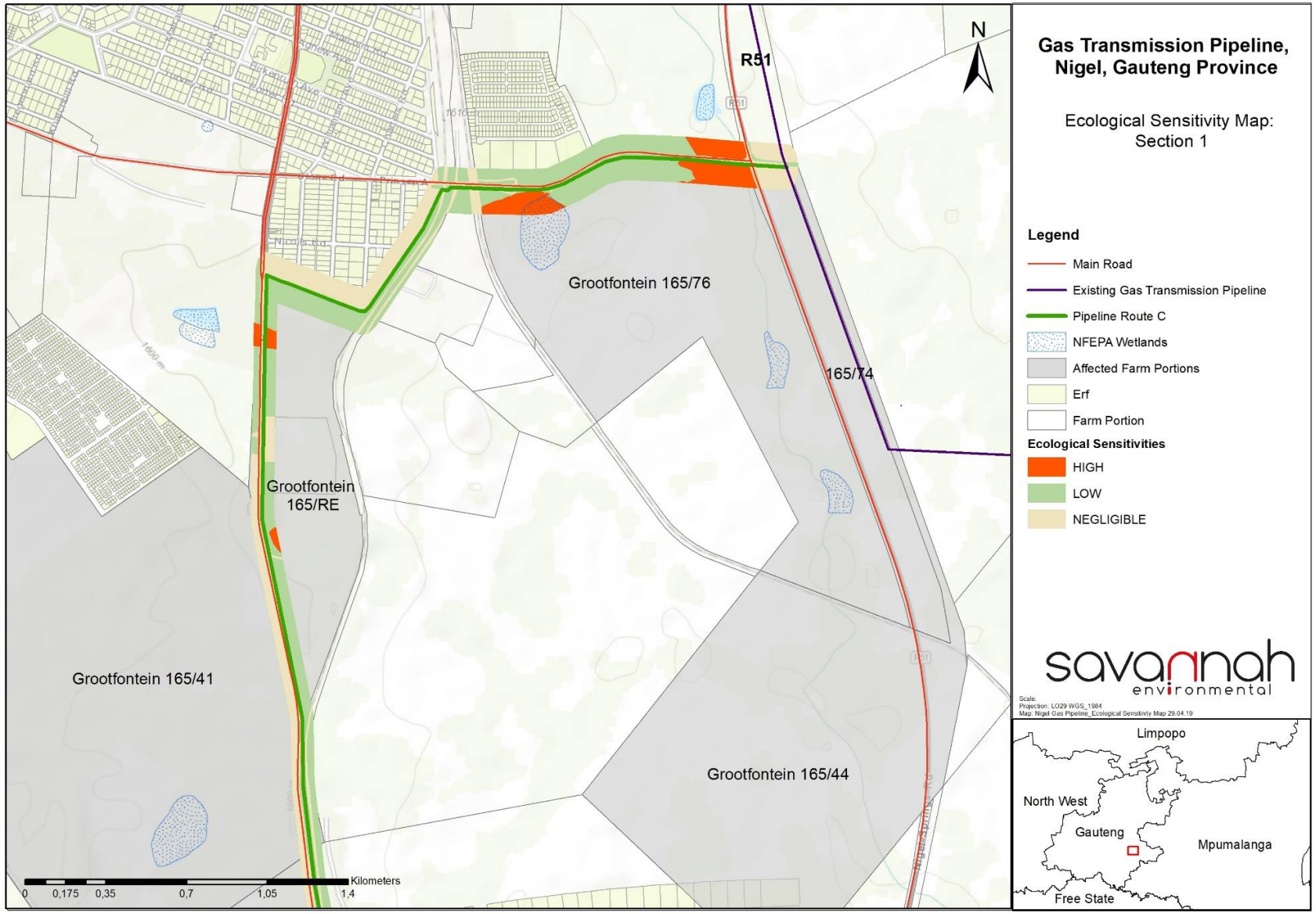

Figure 1. Ecological sensitivity map of the project area – Section 1/3.

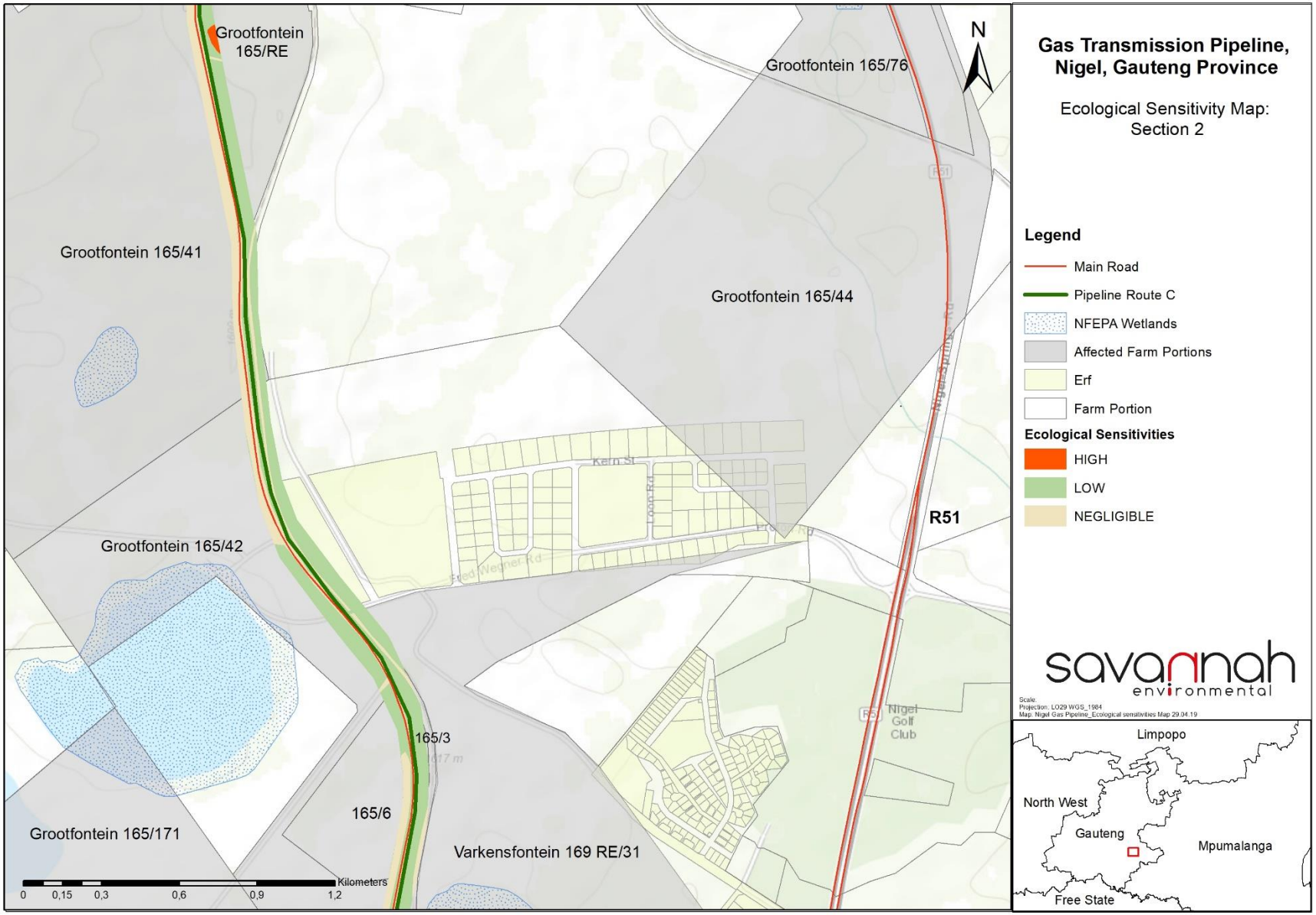

Figure 2. Ecological sensitivity map of the project area – Section 2/3.

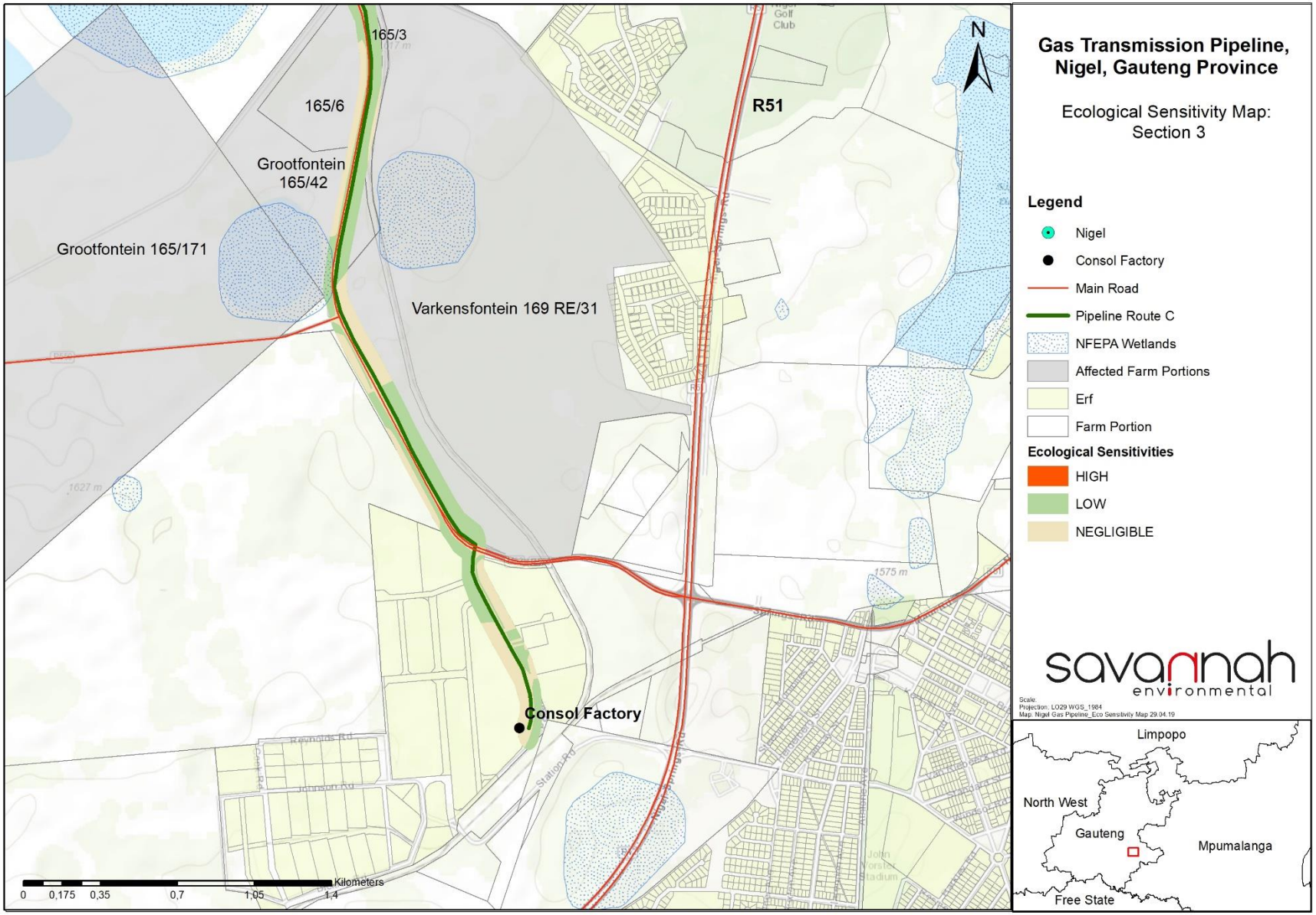

Figure 3. Ecological sensitivity map of the project area – Section 3/3.

The CBA classification for the development corridor also does not correspond to the real-world condition of the plant and animal species observed within the project area, and therefore contributes poorly to the ecological function of the broader study area. As such, **no functional CBA zones were deemed present** within the development corridor, as confirmed by the site assessment results, and therefore the proposed development will not significantly impact the overall quantity and quality of the remaining CBA areas in the broader study area. The project may therefore commence with little lasting negative impact on the current CBA classification of the development corridor and the broader study area.

There are zero no-go areas determined for the development corridor. DWS authorisation is however, required for works within 500m of wetland features, and within 100m of watercourse features, and all mitigation measure contained in this report must be strictly applied where the wetland vegetation unit is present.

The impact assessment identified no impacts for the design phase, six impacts for the construction phase relating predominantly to the clearance of vegetation and the destruction of habitat, as well as one impact for the operations phase, and one for the decommissioning phase. Two impacts were determined for the no-go alternative, and two cumulative impacts determined, all related to the issue of loss of biodiversity. Table 1 below shows the summary of impacts identified before and after mitigation.

Table 1: Summary of impacts identified in this assessment.

IMPACT	PRE-MITIGATION	POST-MITIGATION
DESIGN PHASE		
No impacts were determined for this phase		
CONSTRUCTION PHASE		
Loss of highly degraded Tsakane Clay Grassland	Medium (45)	Low (20)
Loss of Species of Conservation Concern	Low (22)	Low (10)
Loss of floral and faunal biodiversity leading to a disruption of ecosystem function and processes	Low (27)	Low (12)
Poor control of alien plant species during construction leading to increasing invasive species presence	Medium (33)	Low (18)
Increased erosion due to vegetation clearing for infrastructure	Low (27)	Low (10)
Loss of areas classified as CBA or ESA due to vegetation clearance.	Low (27)	Low (18)
OPERATION PHASE		
Poor control of alien plant species during construction leading to increasing invasive species presence	Low (18)	Low (12)
DECOMISSIONING PHASE		
Loss of floral and faunal biodiversity from poor rehabilitation efforts during closure, leading to a disruption of ecosystem function and processes	Medium (40)	Low (24)
CUMULATIVE IMPACTS		
Reduced ability to meet conservation obligations and targets.	Low (18)	Low (21)
Impacts on Critical Biodiversity Areas and Broad-Scale Ecological Processes.	Low (18)	Low (27)
NO-GO ALTERNATIVE*		
Poor control of alien plants on site will lead to increasing invasive species presence, as well as regulatory liability for their control	High (70)	

Poor control of fires on site, initiated by the ongoing burning of waste adjacent to the site, will alter the species composition and richness of the existing vegetation and continue to degrade the ecological function and processes on site.	Medium (48)

* Impacts are rated here based on isolation (i.e. project only), or in combination with other projects in the surrounding areas, as opposed to pre-mitigation and post-mitigation.

Based on the results of the site assessment, the sensitivity analysis and the impact assessment, **none of the anticipated impacts were deemed insurmountable** as all the pre-mitigation medium impacts were readily mitigated, and no high severity impacts were identified. Ecological areas have been mapped in terms of sensitivity for the project area and recommendations in chapter 8 in this report provide mitigation measures to reduce the severity of the impacts. **Overall, it was determined that the identified ecological impacts associated with the facility can be effectively mitigated.**

PROJECT DETAILS

Title	:	Ecological Impact Assessment Report for the proposed ENGP Gas Pipeline development, Nigel, Gauteng Province.
Authors	:	Savannah Environmental (Pty) Ltd Gideon Raath Karen Jodas
Peer Review	:	Sandula Conservation (Pty) Ltd Roy de Kock
Client	:	Iliza Gas (Pty) Ltd
Report Revision	:	Revision 3.0 (first release)
Date	:	May 2019

When used as a reference this report should be cited as: Savannah Environmental (2019). Ecological Impact Assessment Report for the proposed ENGP Gas Pipeline development, Nigel, Gauteng Province.

SPECIALIST CONTACT DETAILS AND DECLARATION OF INTEREST

Specialist Company Name:	Savannah Environmental Pty Ltd			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	2	Percentage Procurement recognition	-
Specialist name:	Gideon Raath			
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I, Gideon Raath, declare that –

- I act as the independent specialist in this application.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant.
- I declare that there are no circumstances that may compromise my objectivity in performing such work.
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity.
- I will comply with the Act, Regulations and all other applicable legislation.
- I have no, and will not engage in, conflicting interests in the undertaking of the activity.
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing – any decision to be taken with respect to the application by the competent authority; and – the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority.
- All the particulars furnished by me in this form are true and correct.
- I realise that a false declaration is an offence in terms of Regulation 48 and is punishable in terms of section 24F of the Act.

Gideon Raath	
Name	Signature
May 2019	Savannah Environmental Pty Ltd
Date	Name of Company

SHORT SUMMARY OF SPECIALIST EXPERTISE

Gideon holds an MSc (Geography and Environmental Management; SU), a BSc Honours (Ecology and Environmental Studies - Cum laude; Wits) and a BSc (Geography and Environmental Management; UJ). His MSc thesis focused on the hydrological impact on the spatial distribution of invasive Eucalyptus trees along the Breede River, while his honours thesis evaluated ethnobotanical relationships around the Rio Tinto copper mine in Phalaborwa. Most recently he has worked as an Environmental Consultant at EOH Coastal and Environmental Services (EOH CES), conducting environmental authorisations applications (NWA, NEMA, MPRDA), Public Participation Processes, GIS specialisation as well as Ecological and Wetland specialist studies. Previously, Gideon worked as the Monitoring & Evaluation Project Manager for the City of Cape Town's invasive species unit (Environmental Resources Management Department).

Gideon's GIS background includes the management of the City of Cape Town invasive species GIS database, involving the storage, management, recall and quality control off all sightings, clearance visits and known infestations. Further experience include mapping for various consulting projects, boundary verification through ground-truthing and the spatial mapping and delineation component of this MSc research. Gideon has further attended public participation workshops, and has been involved with IAP identification, translation, public meetings and engagement for a variety of projects, mainly within the Afrikaans speaking Northern Cape. Gideon is interested in invasion ecology, treatment of groundwater pollution through phytoremediation, botanical and wetland specialist studies, GIS application for ecology and environmental management, and the EIA processes in general. Lastly, Gideon has undertaken several ecological impact assessments for various developments.

A selection of recent specialist ecological studies undertaken, include the following:

Project Name & Location	**Client Name**	**Role**
City of Johannesburg nature reserve proclamation (Phase II), Johannesburg, Gauteng	City of Johannesburg SOC Ltd	Botanical specialist
SANRAL Bierspruit R510 road upgrade Water Use Licence, Basic Assessment, Thabazimbi, Limpopo Province	SANRAL SOC Ltd & Royal Haskoning DHV South Africa	Ecological specialist
Kibler Park Church Development Ecological Assessment, Johannesburg, Gauteng	Riverside Community Church	Ecological specialist
SANRAL Caledon N2 Section 3 road upgrade project Basic Assessment, Water Use Licence and Specialist reports, Caledon, Western Cape Province	JG Afrika Engineering	Ecological specialist
iGas integrated biodiversity screening, Saldanha, Western Cape	Central Energy Fund - iGas (subsidiary)	Faunal specialist (assistant)
Bloekombos (Kraaifontein) botanical baseline and impact assessment, Cape Town, Western Cape	Western Cape Provincial Government (PGWC)	Botanical specialist
Masetjaba 15ML water reservoir development, Nigel, Gauteng	Naidu Consulting Engineers (Pty) Ltd	Ecological specialist

A full curriculum vitae (CV) is attached as **Appendix C.**

EIA REGULATIONS: APPENDIX 6 – SPECIALIST REPORT REQUIREMENTS

As per Appendix 6 of the EIA regulations (2017), the following aspects must be addressed in a specialist report. These aspects are indicated in the table below along with the corresponding sections where these are addressed in this report.

Description	Section in report where this aspect has been addressed
(a) details of— (i) the specialist who prepared the report; and (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	Page vii above, as well as Appendix C
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page vii above
(c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 2.1
(cA) an indication of the quality and age of base data used for the specialist report;	Section 2.2
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Chapter 8
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 2.2
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 2.2 – 2.5
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternative;	Chapter 7
(g) an identification of any areas to be avoided, including buffers;	Chapter 7
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 7.4
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 2.5
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities	Chapter 6 (specifically) and Chapter 7
(k) any mitigation measures for inclusion in the EMPr;	Chapter 8, and Section 9.3
(l) any conditions for inclusion in the environmental authorisation;	Section 9.3
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 9.4
(n) a reasoned opinion— (i) whether the proposed activity, activities or portions thereof should be authorised;	Section 9.3 & Section 9.5

(iA) regarding the acceptability of the proposed activity or activities; and (ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	
(o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	No formal public participation was conducted for the Ecological Impact Assessment. Please refer to the associated Basic Assessment documentation (which this report will form part of as an Appendix) for a complete
(p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	
(q) any other information requested by the competent authority.	None requested

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ACRONYMS

ADU	Animal Demography Unit
BA	Basic Assessment
CBA	Critical Biodiversity Area
CITES	Convention on International Trade in Endangered Species
CoE	City of Ekurhuleni
C-Plan	Gauteng Conservation Plan Version 3
CR	Critically Endangered
DEA	Department of Environmental Affairs
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
EN	Endangered
ESA	Ecological Support Area
ESO	Environmental Site Officer
GDARD	Gauteng Department of Agriculture and Rural Development
GN. R	Government Notice Regulation
GPEMF	Gauteng Province Environmental Management Framework
GPS	Global Positioning System
Ha	Hectare
IBA	Important Birding Area
IUCN	International Union for Conservation of Nature
km	Kilometre
LC	Least Concern
LM	Local Municipality
ML	Megalitre
NEM:BA	National Environmental Management: Biodiversity Act
NEMA	National Environmental Management Act (No. 107 of 1998)
NT	Near Threatened
NWA	National Water Act, 1998 (Act No. 36 of 1998)
PPP	Public Participation Process
QDS	Quarter Degree Square
RE	Resident Engineer
SACNASP	South African Council for Natural and Scientific Professions
SANBI	South African National Biodiversity Institute
SARCA	Southern African Reptile Conservation Assessment
SCC	Species of Conservation Concern
VU	Vulnerable
WWF	Worldwide Fund for Nature

1. INTRODUCTION

Iliza Gas (Pty) Ltd. ('ENGP' hereafter) propose the development of a 10km gas pipeline within the Nigel area, to provide gas reticulation services to the Consol glass factory (Figure 1.1). This pipeline will connect to the Sasol distribution line passing through the broader Nigel area (from which the gas will be obtained), and terminate at the Consol factory (the intended end user). Should the project proceed, the pipeline will be connected to the nearby Sasol line, decompressed and piped through to the Nigel Consol Glass facility, for use in their ongoing smelting operations. Savannah Environmental have been appointed to conduct the Basic Assessment (BA) process for environmental authorisation, as well as the General Authorisation (GA) process for the licencing and registration of water uses under the National Water Act (NWA). As part of the suite of documents accompanying the BAR application, this Ecological Impact Assessment is required to determine the baseline ecological condition of the site, and to provide the severity and nature of ecological impacts anticipated from the proposed development, along with providing suitable mitigation measures for the ongoing management thereof during both construction and operational phases.

The pipeline will be situated entirely within the road reserve for the full length of the route, however the project area may still be considered to fall within areas containing the endangered Tsakane Clay Grassland vegetation, as per the Mucina and Rutherford 2018 Vegetation Map (VegMap) classification. Furthermore, based on the Gauteng Conservation Plan Version 3.3 (C-Plan; 2011), Critical Biodiversity Areas (CBA) or Ecological Support Areas (ESAs) may be impacted by the development of this pipeline, and as such requires an ecological assessment prior to implementation. In addition, the pipeline route occurs within close (< 500m) proximity to various wetland features, for which a separate wetland impact assessment is being carried out. The broader study area is generally intended for agricultural development land uses.

Please note, for the purposes of this report the following terminology is used:

- Study area: The broader Nigel and Tsakane area, inclusive of conservation features such as important birding areas or protected areas in the greater surrounds of the project area (i.e. the broad contextual region surrounding the project area).
- Project area: A 100m wide corridor around the pipeline route, which was assessed in this report in terms of species occurrence. This area is intended to serve as the region of interest, or boundary of assessment, for the purposes of this report, but extends far beyond the actual footprint of the pipeline infrastructure (development corridor below).
- Development corridor: The exact footprint required for the installation and operation of the pipeline (i.e. the immediate area that will be cleared, excavated and occupied by the pipeline after installation). This is the footprint that will be disturbed by the pipeline development, which will remain within the road reserve for the entire length of the pipeline (i.e. in real terms this refers to the proposed pipeline in the existing road reserve, and no further).

In terms of the Environmental Impact Assessment (EIA) Regulations (as amended), clearance of more than 300m^2 vegetation within a sensitive environment, such as a CBA or endangered vegetation type requires Environmental Authorisation. As the listed activities fall within Listing Notice 3 of the EIA Regulations of 2014, as amended, the application for Environmental Authorisation is required to be supported by a Basic Assessment (BA) process. This report subsequently informs the Basic Assessment report by considering the ecological (faunal and floral) impacts of the proposed development within the environmental authorisation process.

1.1. Project Description

Natural gas will be transmitted via the proposed new pipeline from the Consol Glass factory in Nigel, to the Farm Grootfontein 165 Portion 44 - where it connects with the distribution node of the larger Sasol pipeline network (passing through the study area). This connection node is located approximately 10m from the Nigel-Springs Road in Nigel. The proposed project falls within the Ekurhuleni District Municipality, in the Gauteng Province. The pipeline route remains within the road reserve for the entire length of the pipeline. The project will have a lifespan of 20 years after which the pipeline and associated infrastructure will be decommissioned. The proposed construction method for water crossings and road crossings is horizontal directional drilling (HDD), however due to the inhibitive cost of this method it will only be applied along certain sections of the route, and all other portions of the route will be trenched (Figure 1.5). Horizontal drilling does not require trenches and does not disrupt the land surface. In contrast, traditional trenching will be required for the portions in the road reserve where the route does not have any potential to impact on any surface water features. This trenching method represents the greatest portion of the pipeline length, and thus the dominant construction method. The construction period for the pipeline is approximately 6 - 8 months.

While two initial alternative routes were investigated (known as Route C and Route D respectively), initial feasibility work indicated that due to the current servitude owners and the various land use agreements necessary for implementation, only route C is proposed in the BAR application as the **preferred and only feasible alternative,** and is subsequently the only route assessed within this specialist report.

Route C is approximately 10 km length and 0.15m in width (pipeline width only). Due to safety concerns related to the transmission of compressed gas, it is proposed that the entire pipeline be buried below ground with no surface pipe sections. This is to avoid unauthorised access and potential tampering with the pipe.

The development will include the following temporary and permanent infrastructure:

- A 10km long, 0.15m diameter carbon-steel pipeline, buried to a depth of 2.5m in trenches approximately 0.5m wide;
- A High-Pressure Reduction and Metering Station (RMS) approximately 14 x 10 m in surface area and 4m tall, with a block valve to control flow, housed on the Consol property enclosed by wall and access controlled as per all other Consol factory infrastructure.
- Permanent infrastructure:
    - Cathodic Protection (CP) system, which protects the pipeline against corrosion by an impressed current CP system, requiring a ground bed, transformer/rectifier cabinet a power supply, along with buried sacrificial anodes at various locations along the pipeline;
    - Pipeline marking: Markers will be place at strategic locations along the length of the pipeline using industry standard marker posts;
- Temporary infrastructure:
    - Pig dumps: Areas along the route for storage of pipe and associated materials;
    - Temporary construction compounds or laydown areas; and
    - Entry and exit camps where the HDD method is employed, to house the entrance and exit pits, along with control infrastructure and drilling rig.

The following general trenching methodology will be employed:

- Fencing of the construction strip (nominally 5m in width or less, where necessitated by the road reserve);
- Removal of vegetation within the trench area (0.5m wide);
- The stripping of topsoil and storage to one side of trench area;
- The excavation of the trench and the removal of surplus material;
- The laying out (stringing) and welding of pipes;
- The 'ditching' of the pipe into the trench;
- The backfilling of the pipeline trench;
- The reinstatement of the top soil;
- The restoration of hedges or vegetation along the trench area length; and
- The restoration of the land including land drainage and ditches.

The crossing of roads is normally carried out by 'trench-less' techniques, which involves auger / thrust-boring underneath the road. The drilling depth at these crossings will be determined by existing services that will have to be avoided. Road sections being crossed will remain open during construction.

A specialist HDD methodology has been provided for instances where surface water features must be avoided. Please refer to the BAR appendices of this project for a comprehensive description of the HDD methodology.

1.2. Project Location

The proposed pipeline is approximately 10 km in length and 0.15m in width, and will cross the following erven and farm portions within the Nigel area (Table 1.1).

Table 1.1. Properties associated with the proposed pipeline Route C.

Varkensfontein 169 RE of portion 31	Grootfontein 165 RE
Grootfontein 165 portion 42	Grootfontein 165 portion RE/46
Grootfontein 165 portion 6	Grootfontein 165 Portion 76
Grootfontein 165 portion 3	Grootfontein 165 Portion 74
Grootfontein 165 Portion 44	Grootfontein 165 Portion 75
Grootfontein 165 portion 41/RE	Grootfontein 165 Portion 46
Pretoriusstad 104 portion 2	Pretoriusstad 101

The route runs in a north-south direction approximately 1.5 - 3km to the west of the R51 near Nigel, for a length of approximately 10km (Figure 1.1). At the southernmost point of the route the R550 is crossed, and at the northernmost point the road deviates sharply eastwards towards the R51, where the M63 reaches the Dunnotar suburb. The route further follows the alignment of the M63 ("Nigel-Dunnotar Road") for the majority of the route, after which it follows the M45 ("Dunnottar Road") where it deviates towards the east near the Dunnotar suburb. An indicative layout map of the pipeline is provided in Figure 1.2, Figure 1.3 and Figure 1.4.

1.3. Structure of this report

This Ecological Impact Assessment report has been structured as follows:

- **Chapter 1** provides an introduction to the project long with the location and project description.

- **Chapter 2** provides an overview of the methodology, objectives, approach and limitations and assumptions utilised in preparing this report.
- **Chapter 3** provides an overview of the legislative framework applicable to the proposed development from an ecological perspective.
- **Chapter 4** provides the description of the biophysical environment within which the project occurs.
- **Chapter 5** provides a description of the ecological environment within which the project occurs.
- **Chapter 6** provides the biodiversity and sensitivity assessment criteria and results.
- **Chapter 7** provides the impact identification and assessment related to the proposed development.
- **Chapter 8** provides the impact statement, conclusions and recommendations.

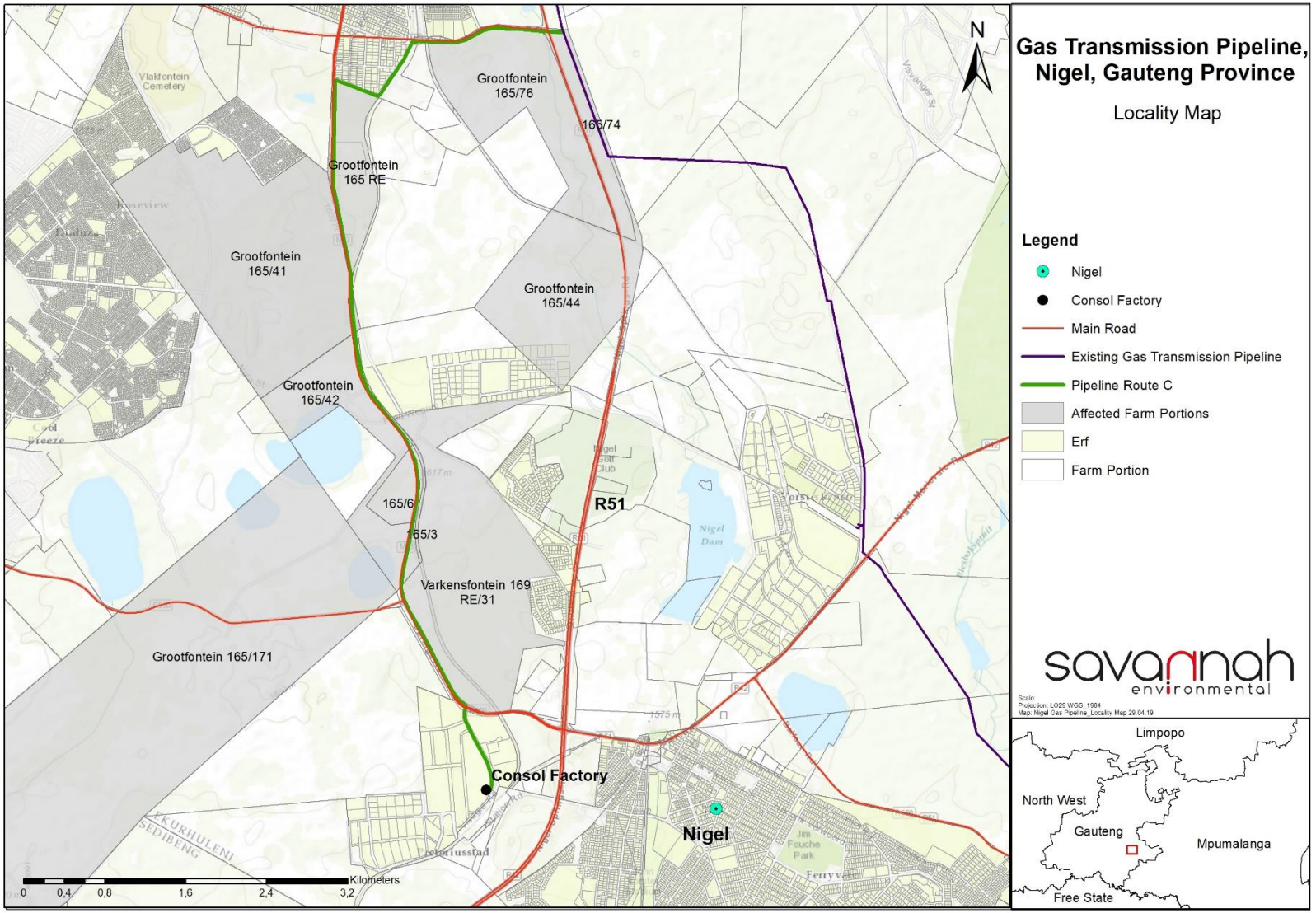

Figure 1.1. Locality map of the Nigel pipeline route.

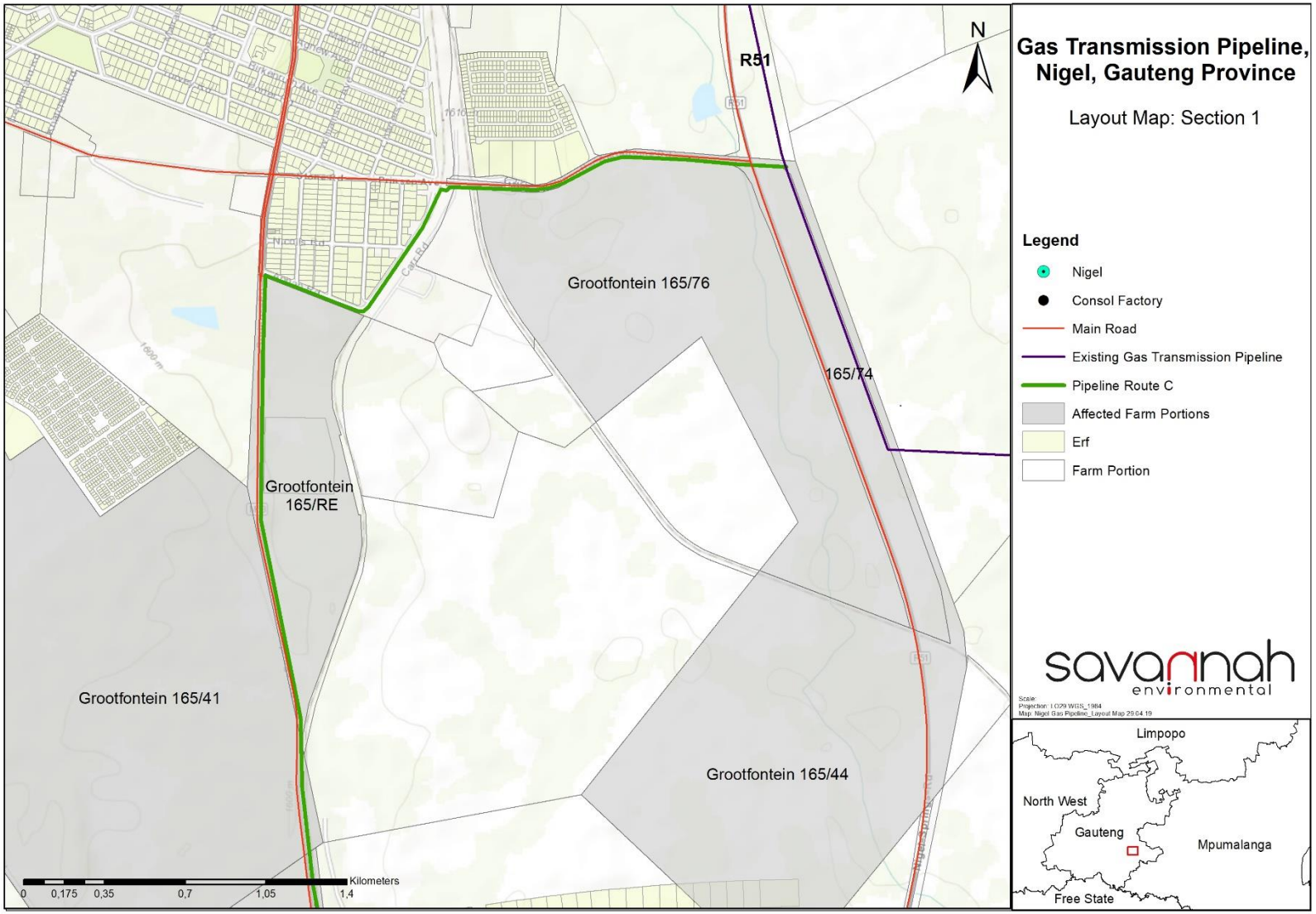

Figure 1.2. Layout map of the proposed development – Section 1/3

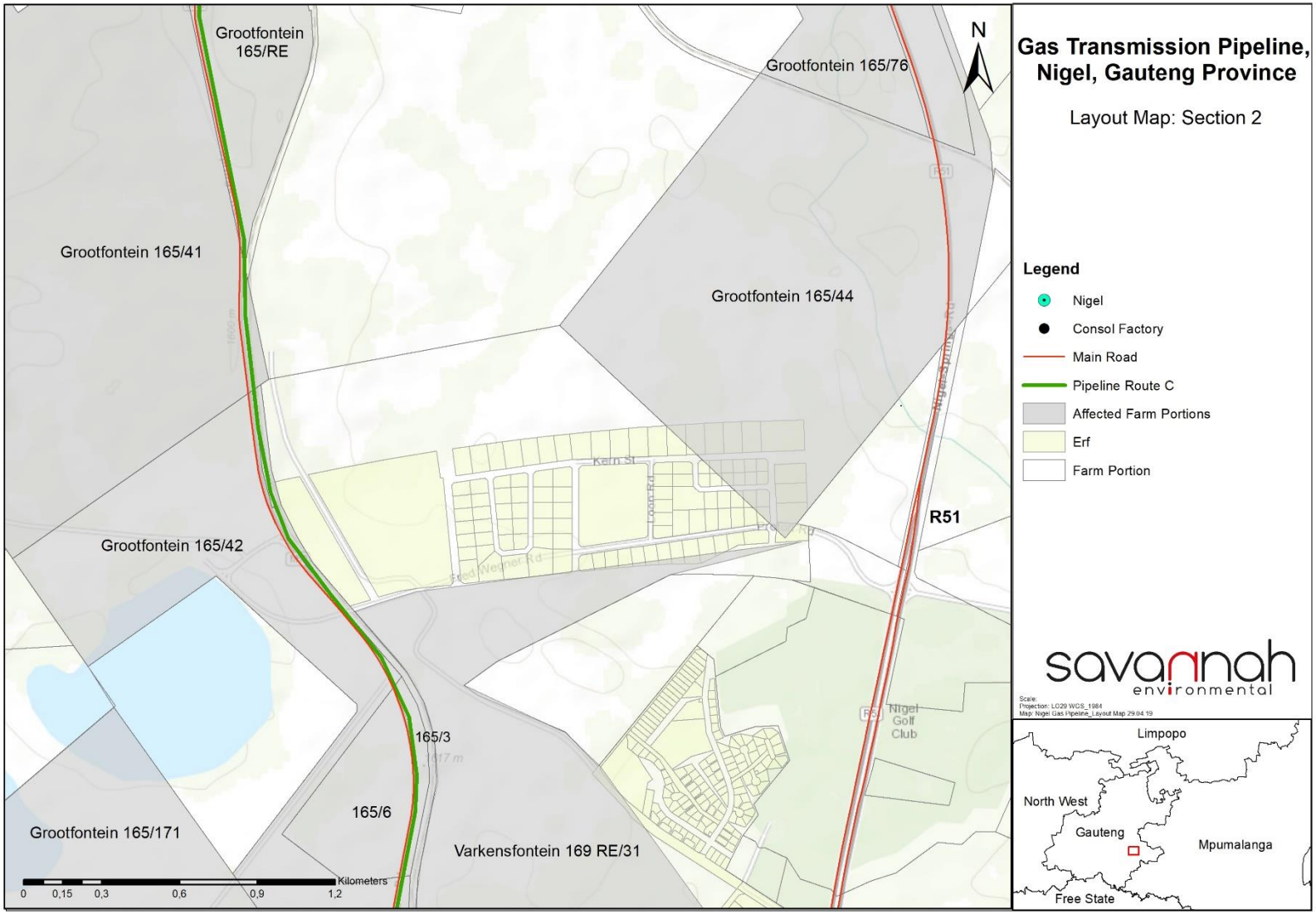

Figure 1.3. Layout map of the proposed development – Section 2/3

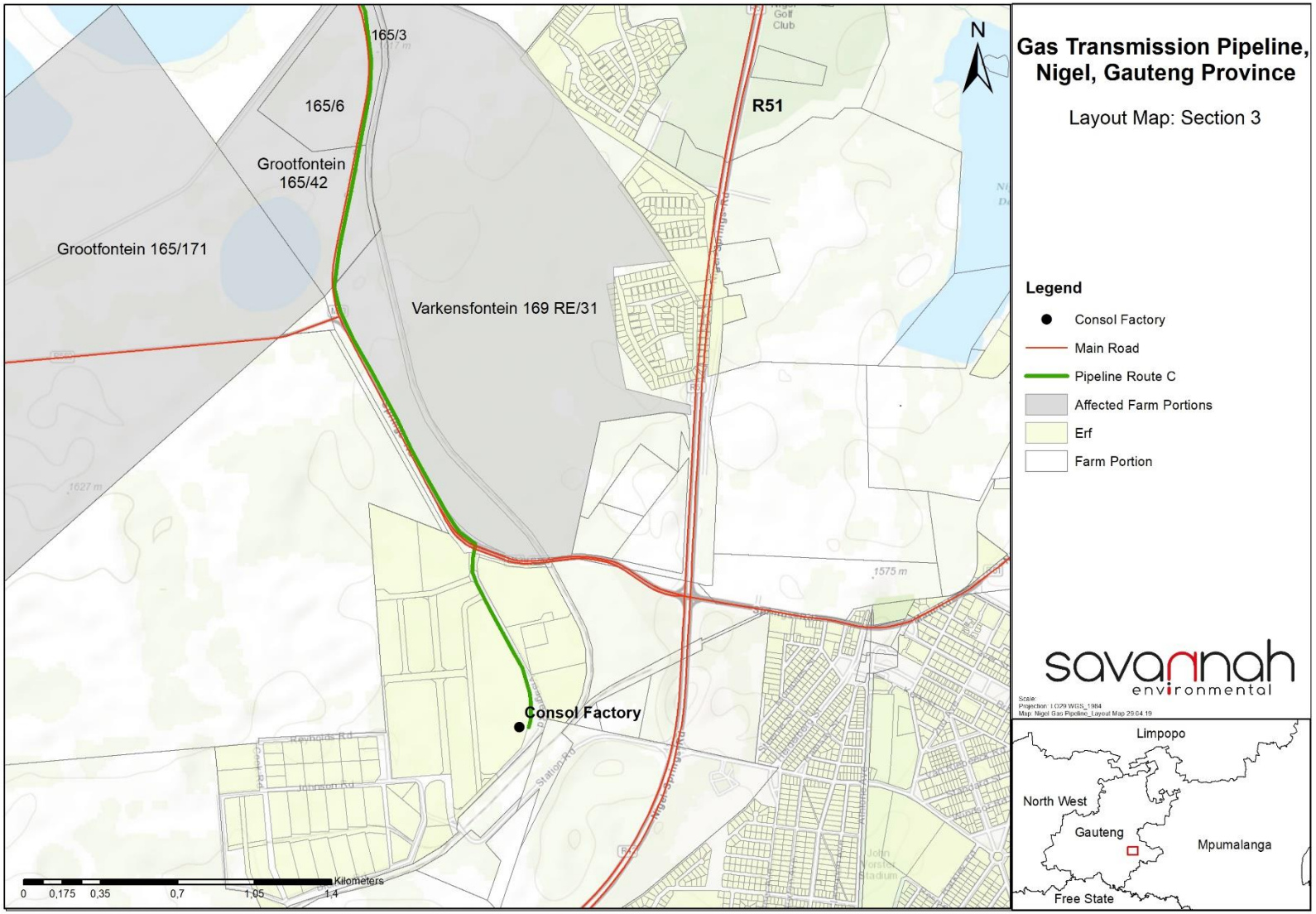

Figure 1.4. Layout map of the proposed development – Section 3/3

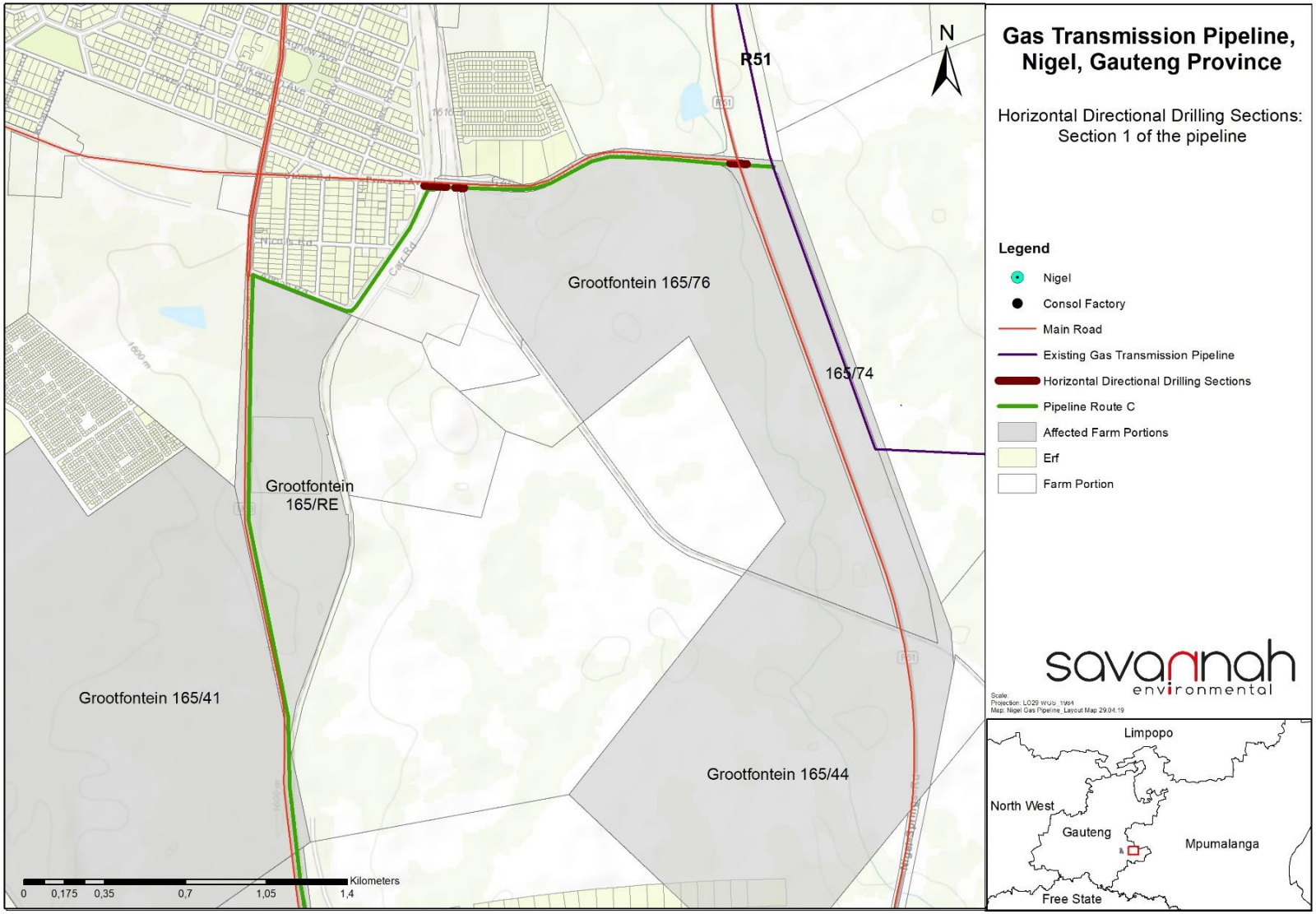

Figure 1.5. Locations of the proposed HDD underground drilling method along the route Section 1/3.

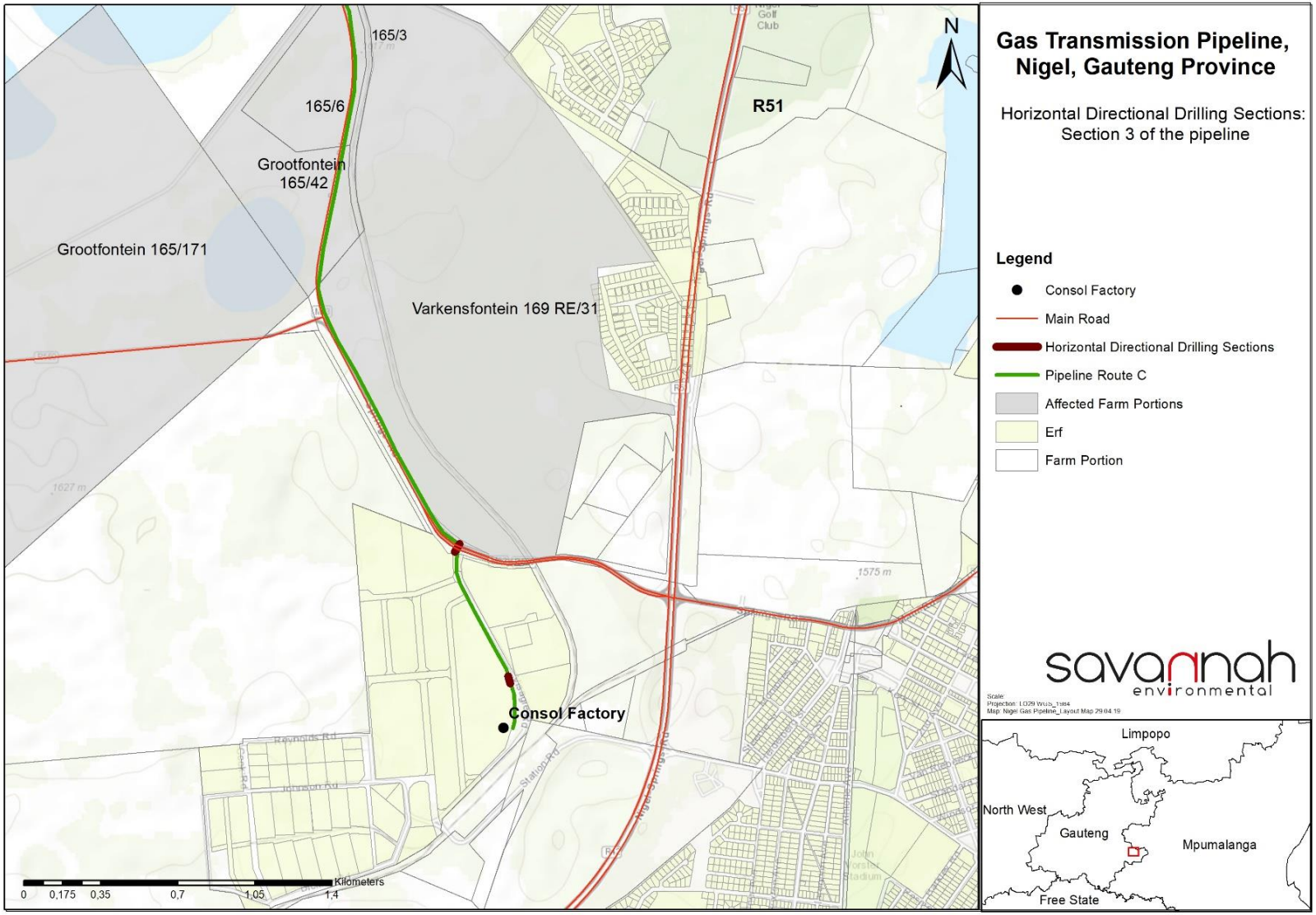

Figure 1.6. Locations of the proposed HDD underground drilling method along the route Section 3/3.

2. METHODOLOGY AND APPROACH OF THE STUDY

This Ecological Impact Assessment has been prepared at the request of the client for the purpose of determining the current ecological state and sensitivity of the project area, to identify potential impacts and severity on the ecological environment and to recommend mitigation measures to reduce potential impacts on the natural environment.

2.1. Objectives and Terms of Reference

The objectives and terms of reference for this report include:

- An indication of the methodology used in determining the significance of potential environmental impacts;
- A description of all environmental issues that were identified during the environmental impact assessment process;
- An assessment of the significance of direct, indirect and cumulative impacts in terms of the following criteria:
  - the *nature* of the impact, which shall include a description of what causes the effect, what will be affected and how it will be affected
  - the *extent* of the impact, indicating whether the impact will be local (limited to the immediate area or site of development), regional, national or international
  - the *duration* of the impact, indicating whether the lifetime of the impact will be of a short-term duration (0–5 years), medium-term (5–15 years), long-term (> 15 years, where the impact will cease after the operational life of the activity) or permanent
  - the *probability* of the impact, describing the likelihood of the impact actually occurring, indicated as improbable (low likelihood), probable (distinct possibility), highly probable (most likely), or definite (impact will occur regardless of any preventative measures)
  - the *severity/beneficial scale*, indicating whether the impact will be very severe/beneficial (a permanent change which cannot be mitigated/permanent and significant benefit, with no real alternative to achieving this benefit), severe/beneficial (long-term impact that could be mitigated/long-term benefit), moderately severe/beneficial (medium- to long-term impact that could be mitigated/ medium- to long-term benefit), slight or have no effect
  - the *significance*, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high
  - the *status*, which will be described as either positive, negative or neutral
  - the *degree* to which the impact can be reversed
  - the *degree* to which the impact may cause irreplaceable loss of resources
  - the *degree* to which the impact can be *mitigated*
- A description and comparative assessment of all alternatives identified during the environmental impact assessment process;
- Recommendations regarding practical mitigation measures for potentially significant impacts, *for inclusion in the Environmental Management Programme (EMPr)*;
- An indication of the extent to which the issue could be addressed by the adoption of mitigation measures;
- A description of any assumptions, uncertainties and gaps in knowledge;
- An environmental impact statement which contains:

- a summary of the key findings of the environmental impact assessment;
- an assessment of the positive and negative implications of the proposed activity.

2.2. Approach to the Study

The project area and development corridor were described using a two-phased approach. Firstly, a desktop assessment was conducted in terms of current vegetation classifications, faunal databases and biodiversity programmes and plans. This included the consideration of:

- The South African Vegetation Map (Mucina and Rutherford, 2018 revision);
- Gauteng Conservation Plan (C-Plan) (2011);
- Grassland Ecosystem Guidelines (2013);
- Ekurhuleni Bioregional Plan (2014);
- Gauteng Environmental Management Framework (2011);
- Faunal databases regarding the presence or absence of Species of Conservation Concern (SCC), including:
    - Animal species listed in the Endangered or Vulnerable categories in the revised South African Red Data Books (Amphibians, du Preez and Carruthers, 2009; Reptiles, Branch 1988; Birds, SA Birding, 2008);
    - Endangered Wildlife Trust mammal red list (2016);
    - Animal Demographic Unit (ADU) databases for frogs, birds, mammals and reptiles (2019);
    - International Union for Conservation of Nature (IUCN) red list of threatened species (2018); and
    - SANBI Threatened Species Programme (red list of threatened species) for South Africa (2017).

Further to the above, one field assessment was conducted on the 26th of March 2019, in order to assess the actual ecological state, current land-use, identify potential sensitive ecosystems and identify sensitive plant and animal species associated with the proposed project activities. The field assessment also served to identify potential impacts of the proposed project and how significantly it would impact on the surrounding project area. The site visit was conducted within the summer season, with many seasonally flowering plants still showing, and as such was considered an acceptable sampling time.

It is not the aim of this study to produce a complete list of all animal and plant species occurring in the region, but rather to examine a representative sample. It is however, important to note that areas of high sensitivity as well as SCC have been identified as far as possible, either from records from the site or a review of their habitat requirements, and whether or not these habitats occur within the site. Species that are afforded special protection, which are protected by CITES (Convention on International Trade in Endangered Species of Wild Flora and Fauna) are also regarded as SCC (see http://www.cites.org/).

2.3. Sampling protocol

2.3.1. Vegetation

The project area was inspected at sample locations along the length of the pipeline, to evaluate the vegetation of the project area and to provide more detailed information on the plant communities present. The site inspection took into account the amount of time available for the study and limitations such as the seasonality of the vegetation.

2.3.2. Animals

The assessment of animals was based on a general observation of species noted during the field assessment, but with particular consideration of known potential animal Species of Conservation Concern (SCC).

2.4. Definitions

Where applicable, the following definitions were used based on the conservation status classification of the SANBI Red Data List (floral), or IUCN Red Data List (faunal):

- ***Critically Endangered (CR)*** - A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Section V of the Red Data List), and it is therefore considered to be facing an extremely high risk of extinction in the wild.
- ***Endangered (EN)*** - A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section V of the Red Data List), and it is therefore considered to be facing a very high risk of extinction in the wild.
- ***Vulnerable (VU)*** - A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable, and it is therefore considered to be facing a high risk of extinction in the wild.
- ***Near Threatened (NT)*** - A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
- ***Sensitive species*** - Species not falling in the categories above but listed in: Appendix 1 or 2 of the Convention of International Trade in Endangered Species (CITES).
- ***Endemic species*** - Species endemic to South Africa, and more specifically the province.
- ***Least concern (LC)*** – A taxon is of Least Concern when it does not qualify for any of the other categories. Widespread and abundant taxa are typically listed in this category.

2.5. Limitations and Assumptions

The following assumptions and limitations are applicable:

- The report is based on a project description taken from design specifications for the proposed infrastructure which is likely to undergo a number of further refinements before it can be regarded as definitive;
- Species of Conservation Concern (SCC) are difficult to find and difficult to identify, thus species described in this report do not comprise an exhaustive list; and
- Once-off sampling only was conducted. Consequently, some plant or animal species may therefore have gone undetected.

3. LEGISLATIVE FRAMEWORK

The applicable legislative framework plays an important role in contextualising the proposed development from an ecological perspective. In this regard, a key component of the legislative context is to assess the proposed development in terms of the suitability with regards to key legislation.

The following key pieces of legislation were reviewed as part of this review process:

National Legislative Context:

» Constitution of the Republic of South Africa (1996).
» National Environmental Management Act (No. 107 of 1998) (NEMA); and
» National Environmental Management: Biodiversity Act (No. 10 of 2004);

3.1. Constitution of the Republic of South Africa (1996)

The Constitution of the Republic of South Africa, 1996 is the supreme law of South Africa, and forms the foundations for a democratic society in which fundamental human rights are protected. The Bill of Rights contained in Chapter 2 of the Constitution enshrines the rights of all people in South Africa, and affirms the democratic values of human dignity, equality and freedom. Section 24 of the Constitution pertains specifically to the environment. It states that:

24. Everyone has the right –
(a) To an environment that is not harmful to their health or well-being; and
(b) To have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that:
(i) Prevent pollution and ecological degradation.
(ii) Promote conservation.
(iii) Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

The Constitution also however outlines the need to promote social and economic development. Section 24 of the Constitution therefore requires that development be conducted in such a manner that it does not infringe on an individual's environmental rights, health, or well-being and to have the environment protected. This is relevant with regards to wetland environments, which are protected under national legislation in South Africa (see section below).

3.2. National Environmental Management Act (No. 107 of 1998) (NEMA)

The National Environmental Management Act (No. 107 of 1998) (NEMA) is South Africa's key piece of environmental legislation, and sets the framework for environmental management in South Africa. It provides for co-operative environmental governance by establishing principles for decision-making on matters affecting the environment. NEMA is founded on the principle that everyone has the right to an environment that is not harmful to their health or well-being as contained within the Bill of Rights. In accordance with this, it states that:

» *The State must respect, protect, promote and fulfil the social, economic and environmental rights of everyone and strive to meet the basic needs of previously disadvantaged communities.*

- *Sustainable development requires the integration of social, economic and environmental factors in the planning, implementation and evaluation of decisions to ensure that development serves present and future generations.*
- *Everyone has the right to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.*

In addition, the National environmental management principles contained within NEMA state that:

- Development must be socially, environmentally and economically sustainable;
- Sustainable development requires the consideration of all relevant factors including the following:
    - That the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied;
    - That pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimised and remedied; and
    - That negative impacts on the environment and on people's environmental rights be anticipated and prevented, and where they cannot be altogether prevented, are minimised and remedied.
- The costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects must be paid for by those responsible for harming the environment; and
- Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.

Sensitive ecosystems are specifically mentioned with regards to requiring specific attention in management and planning procedures, and therefore need to be identified when planning developments, such that adequate management procedures can be put in please to ensure negative impacts are avoided, minimised or remedied appropriately.

3.3. National Environmental Management: Biodiversity Act (No. 10 of 2004)

The objectives of the National Environmental Management: Biodiversity Act include inter alia, to provide for:

- The management and conservation of biological diversity within the Republic and of the components of such biological diversity;
    - The use of indigenous biological resources in a suitable manner;
    - The fair and equitable sharing of benefits arising from bio-prospecting of genetic material derived from indigenous biological resources; an
    - To give effect to ratified international agreements relating to biodiversity which are binding on the Republic.
- To provide for co-operative governance in biodiversity management and conservation; and
- To provide for a South African National Biodiversity Institute to assist in achieving the objectives of the Act.

Threatened or protected ecosystems and species

Sections 50 - 62 further provide details relating to the protection of threatened or protected ecosystems and species. A person may not carry out a restricted activity involving a specimen of a listed threatened or

protected species without a permit (Section 56 - 1).

Alien and invasive species
Sections 63 - 77 provide details relating to the alien and invasive species with the purpose of preventing the introduction and spread, managing and controlling, and eradicating alien and invasive species.

The implications of this act for the proposed development include the need to develop an invasive species monitoring, control and eradication plan for land/activities under their control should invasive species be found on site, as part of their environmental plans in accordance with section 11 of NEMA.

4. DESCRIPTION OF THE BIOPHYSICAL ENVIRONMENT

4.1. Climate

Climate within the broader study area is generally subtropical, with mild and sunny winters and pleasantly warm, sunny summers. The study area is known for afternoon thunderstorms during the summer. Due to the high elevation of the broader area, the climate is tempered by altitude, with average temperature ranging from 16.7 °C in June and July, to 26 °C in January. Figure 4.1 below illustrates the average temperatures and precipitation found within the Nigel region, which is approximately 2km from the project area. Precipitation ranges between 127mm average in December to 3 - 5mm in July.

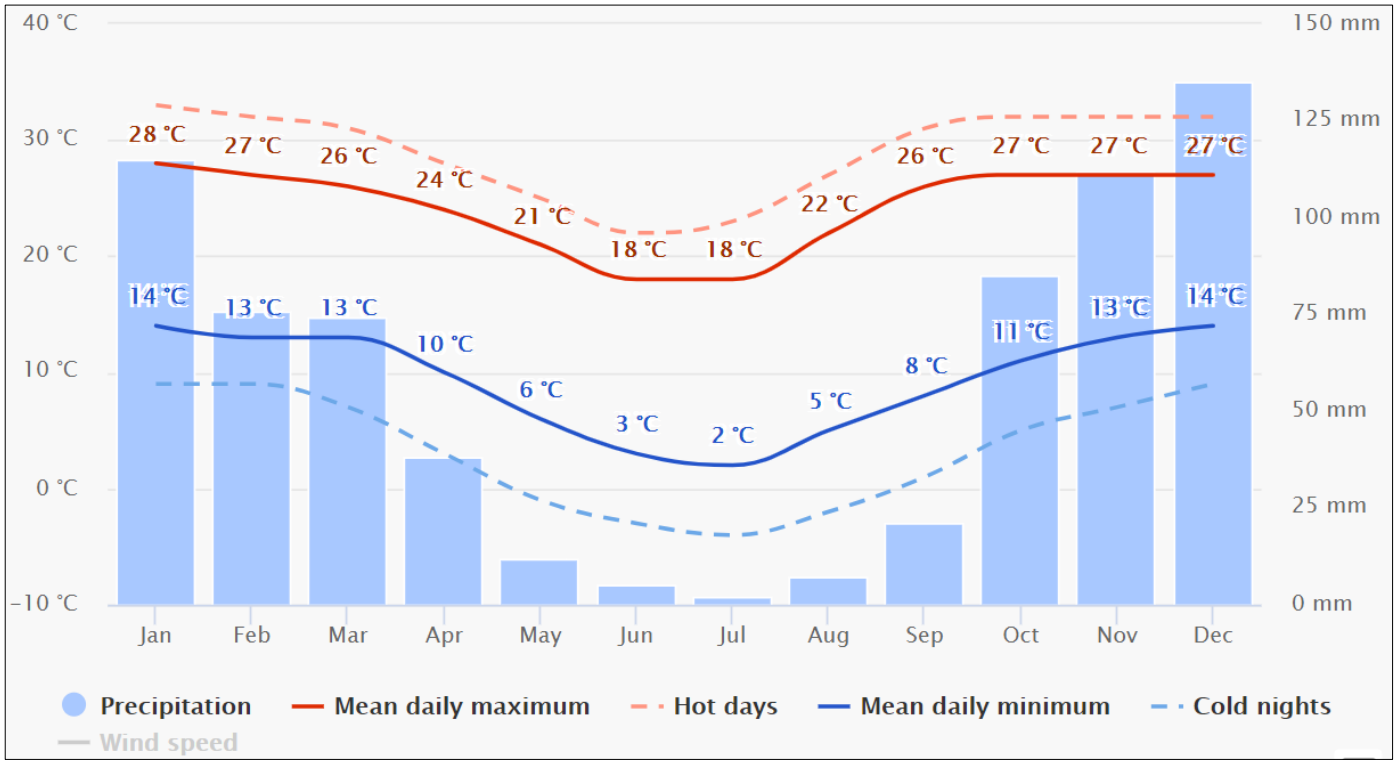

Figure 4.1. Average temperatures and precipitation found within the Nigel region.
(Source: www.meteoblue.com. Accessed 19 March 2019).

4.2. Geology

The overall geology of the study area contains mostly shales, coal and arenites derived from the Vryheid Formation, of the Ecca Group and Karoo Supergroup of rocks. This formation dates back to the Paleozoic era (541 to 251 million years ago).

4.3. Topography

The general topography of the study area is flat to moderately undulating, with no distinct topographical features, within a broader study area context of slightly undulating hills with intermittent small valleys in which drainage lines and wetlands are common. Plate 4.1 below illustrates the overall topography of the development corridor.

Plate 4.1. Topography of the development corridor, showing generally flat terrain features.

The elevation of the site is approximately 1 572 m above mean sea level, with an elevation gain/loss of 85m across 10km, representing a slope of 1.5% across the entire site (Figure 4.2).

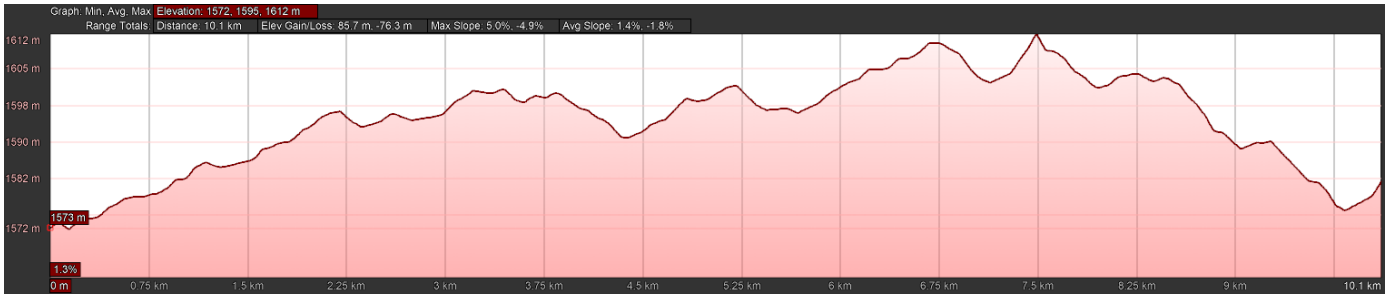

Figure 4.2. Elevation profile of the development corridor, showing the moderately undulating nature and overall flat topography.

4.4. Current land use

The pipeline will occur entirely within the road reserve of the various roads along the length of the project site. The development corridor is associated with a wide variety of land uses located adjacent the existing road reserve. These include power line servitudes for Eskom 400kV lines transmission lines, agriculture in the form of maize and soya beans plantations, including large numbers of cattle being grazed within the road reserves, urban homesteads where the development corridor is located near the town of Dunnottar (a small portion of the proposed pipeline), the Nigel cemetery, and some industrial complexes, including the notably AfriSam cement factory complex, a Coca-Cola bottling plant, a waste transfer station (municipal owned) and one restaurant and accommodation hostel. While not occurring immediately adjacent the development corridor, a railroad line is located close by the M63 within the 100m project area, along the Nigel-Dunnottar road. Plate 4.2 below shows a number of land uses found immediately adjacent the project site and associated road reserve.

	
General road verge with invasive *Eucalyptus* tree and adjacent maize plantation visible	Entrance to the existing graveyard showing maintained lawn along road verge and concrete fencing
	
Large number of cattle grazing within the road verge visible along the road	Crop cultivation along the road verge showing agricultural land use within the area

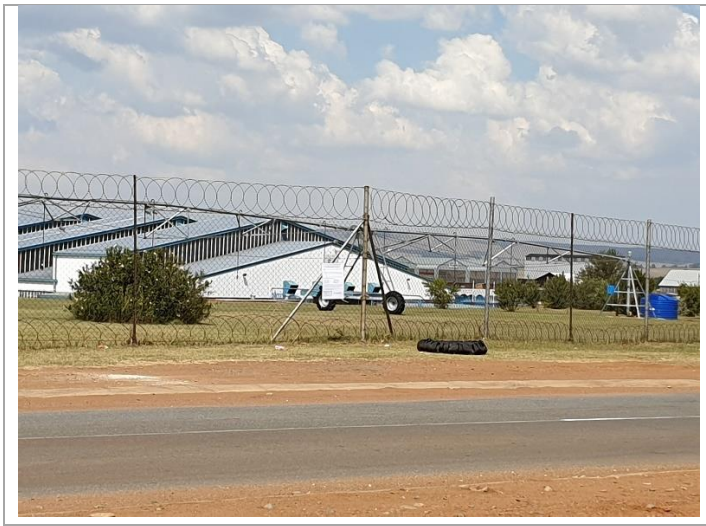	
Business and fencing along pipeline route which is a common land use within the area	The railway tracks adjacent to which the proposed pipeline will route near Dunnottar town

Plate 4.2. A wide variety of land uses in the area, dominated by agriculture, medium sized industrial, homesteads (near Dunnottar) as well as road and rail infrastructure.

5. DESCRIPTION OF THE ECOLOGICAL ENVIRONMENT

5.1. Regional context

The project area occurs entirely within the Grassland Biome (Mucina & Rutherford, 2012), which occurs from just north of Bisho in the Eastern Cape, to the Free-State border near Kimberley, to Pretoria in the north and Pietermaritzburg in the East. The bioregion within this biome – the Mesic Highveld Grassland Bioregion – furthermore occurs mainly in eastern, wetter areas of the Highveld, reaching towards the northern escarpment, straddling the border of the Grassland and Savanna Biome in the north. This Bioregion is comprised of 'sour' grasslands, with the various vegetation units generally distinguished by geology and substrate, elevation, topography and rainfall characteristics.

5.2. SANBI vegetation classification: Tsakane Clay Grassland (GM9)

Mucina and Rutherford (2012) developed the National Vegetation map (and updated in 2018) as part of a South African National Biodiversity Institute (SANBI) funded project, to provide floristically based vegetation units of South Africa, Lesotho and Swaziland at a greater level of detail than was available prior to their work. A national map was developed using large quantities of data from several contributors and has allowed for the best national vegetation map to date, the last being that of Acocks, developed over 50 years ago. The SANBI Vegetation map (2018) informs finer scale bioregional plans such as STEP and had two main aims:

- "to determine the variation in and units of southern African vegetation based on the analysis and synthesis of data from vegetation studies throughout the region, and
- to compile a vegetation map. The aim of the map was to accurately reflect the distribution and variation on the vegetation and indicate the relationship of the vegetation with the environment. For this reason, the collective expertise of vegetation scientists from universities and state departments were harnessed to make this project as comprehensive as possible."

The result of the abovementioned work described each vegetation type in detail, showing the most important taxa, endemic species and any species that carry bioregional importance, and represents that most comprehensive dataset for vegetation types in South Africa to date. The Tsakane Clay Grassland occupies the full extent of the project area and thus the smaller development corridor, according to the vegetation classification (Figure 5.1), and is described in greater detail below.

5.2.1. Distribution

Tsakane Clay Grassland occurs mainly in the Gauteng and Mpumalanga provinces, with patches extending in a narrow band between Springs and Soweto, southwards towards Nigel and as far as Vereeniging. The grassland also occurs north of the Vaal Dam, and between Balfour and Standerton, and preferentially occurs at altitude ranging from 1 480 – 1 680 m (Mucina and Rutherford, 2012).

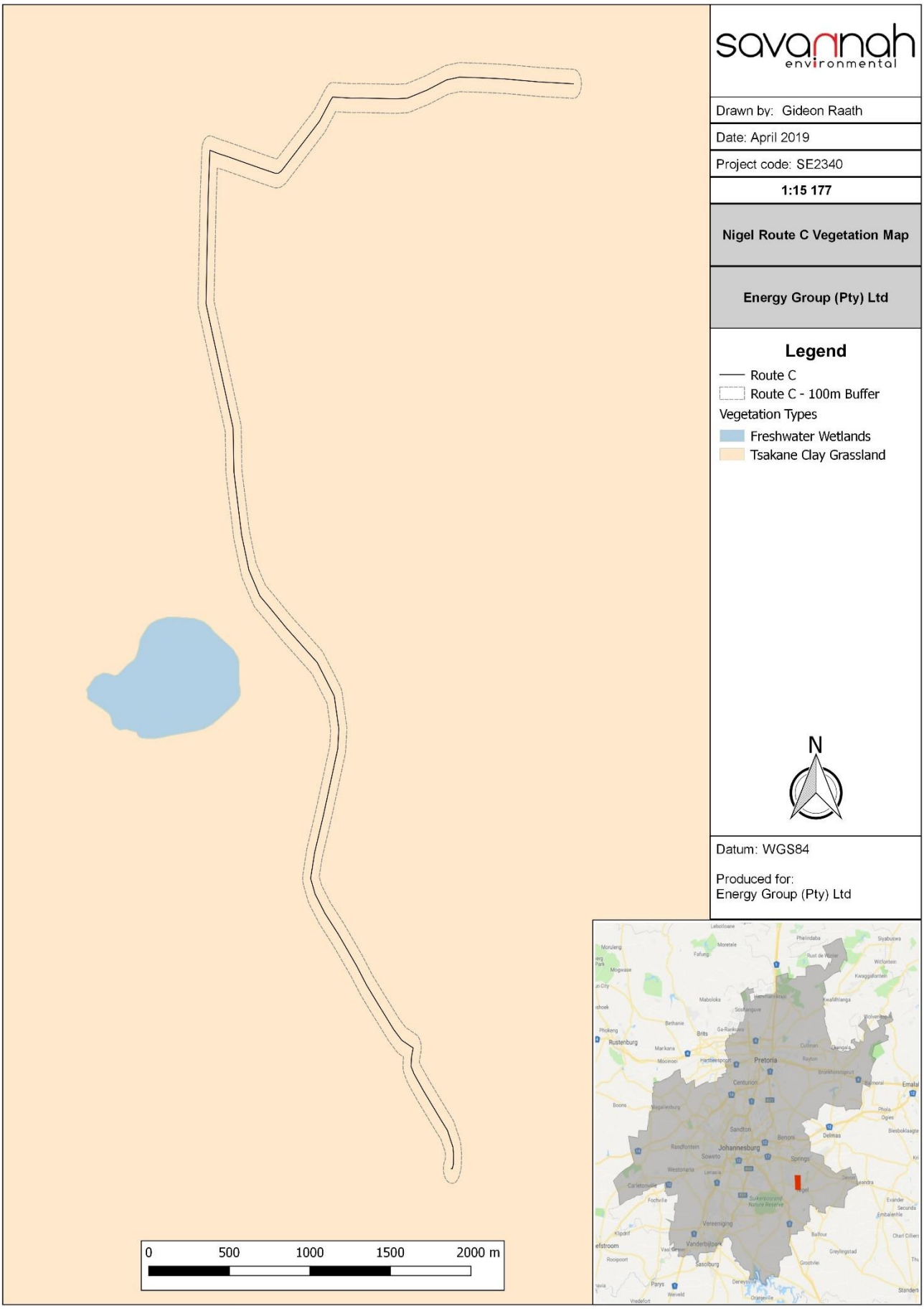

Figure 5.1. Mucina and Rutherford (2018) vegetation map of the study site.

5.2.2. Vegetation & Landscape Features

This vegetation type occurs predominantly on flat to slightly undulating plains and low hills, and is short and dense in structure. Tsakane Clay Grassland is dominated by a mixture of common highveld grasses such as *Themeda triandra*, *Heteropogon contortus*, *Elionurus muticus* and a variety of *Eragrostis* species (Mucina and Rutherford, 2012). The forbs most common are of the families *Asteraceae*, *Rubiaceae*, *Malvaceae*, *Lamiaceae* and *Fabaceae*. Disturbance in this vegetation type allows for an increase in abundance of *Hyparrhenia hirta* and *Eragrostis chloromelas* (Mucina and Rutherford, 2012).

5.2.3. Geology & Soils

This vegetation unit is contained generally on regions where the most dominant rock is basaltic lava of the Klipriviersberg Group (Ventersdorp Supergroup), together with the sedimentary rocks of the Madzaringwe Formation of the Karoo Supergroup. Soils are typical of the Ba and Bb land types (Mucina and Rutherford, 2012).

5.2.4. Climate

Climate within the regions where this vegetation type occurs is strongly seasonal, with summer rainfall and very dry winters. Mean annual precipitation ranges between 630–720 mm, with a mean annual temperature of 15°C indicating the transitional nature between a cool-temperate and warm-temperate climate (Mucina and Rutherford, 2012).

5.2.5. Important Taxa

According to Mucina and Rutherford (2012), the following important taxa are characteristic of this vegetation type (Table 5.1):

Table 5.1. Important Taxa (Mucina and Rutherford, 2012) of the Tsakane Clay Grassland.

Growth Form	Taxon name	Family
Graminoids	*Brachiaria serrata*	POACEAE
Graminoids	*Cynodon dactylon*	POACEAE
Graminoids	*Cynodon hirsutus*	POACEAE
Graminoids	*Digitaria ternata*	POACEAE
Graminoids	*Elionurus muticus*	POACEAE
Graminoids	*Eragrostis chloromelas*	POACEAE
Graminoids	*Eragrostis patentipilosa*	POACEAE
Graminoids	*Eragrostis plana*	POACEAE
Graminoids	*Eragrostis racemosa*	POACEAE
Graminoids	*Heteropogon contortus*	POACEAE
Graminoids	*Hyparrhenia hirta*	POACEAE
Graminoids	*Microchloa caffra*	POACEAE
Graminoids	*Setaria sphacelata*	POACEAE
Graminoids	*Themeda triandra*	POACEAE
Graminoids	*Trachypogon spicatus*	POACEAE
Graminoids	*Abildgaardia ovata*	CYPERACEAE

Growth Form	Taxon name	Family
Graminoids	*Andropogon schirensis*	POACEAE
Graminoids	*Cymbopogon caesius*	POACEAE
Graminoids	*Diheteropogon amplectens*	POACEAE
Graminoids	*Melinis nerviglumis*	POACEAE
Graminoids	*Panicum gilvum*	POACEAE
Graminoids	*Setaria nigrirostris*	POACEAE
Herbs	*Acanthospermum australe*	ASTERACEAE
Herbs	*Ajuga ophrydis*	LAMIACEAE
Herbs	*Eriosema salignum*	FABACEAE
Herbs	*Euryops transvaalensis subsp. transvaalensis*	ASTERACEAE
Herbs	*Gerbera viridifolia*	ASTERACEAE
Herbs	*Helichrysum nudifolium var. nudifolium*	ASTERACEAE
Herbs	*Helichrysum rugulosum*	ASTERACEAE
Herbs	*Hermannia depressa*	MALVACEAE
Herbs	*Lotononis macrosepala*	FABACEAE
Herbs	*Nidorella hottentotica*	ASTERACEAE
Herbs	*Pentanisia prunelloides subsp. latifolia*	RUBIACEAE
Herbs	*Peucedanum caffrum*	APIACEAE
Herbs	*Rotheca hirsuta*	LAMIACEAE
Herbs	*Selago paniculata*	SCROPHULARIACEAE
Herbs	*Senecio coronatus*	ASTERACEAE
Herbs	*Senecio inornatus*	ASTERACEAE
Herbs	*Sonchus nanus*	ASTERACEAE
Herbs	*Vernonia oligocephala*	ASTERACEAE
Geophytic Herbs	*Aspidoglossum ovalifolium*	APOCYNACEAE
Geophytic Herbs	*Hypoxis rigidula var. pilosissima*	HYPOXIDACEAE
Semiparasitic Herb	*Striga asiatica*	OROBANCHACEAE
Low Shrubs	*Anthospermum rigidum subsp. pumilum*	RUBIACEAE
Low Shrubs	*Chaetacanthus setiger*	ACANTHACEAE
Low Shrubs	*Tephrosia capensis var. acutifolia*	FABACEAE
Semiparasitic Shrub	*Thesium impeditum*	SANTALACEAE

5.2.6. Conservation status

According to Mucina and Rutherford (2012), the conservation status of Tsakane Clay Grassland is Endangered (EN), with only 1.5% of the 24% conservation target conserved in 2012, mainly in the Suikerbosrand, Olifantsvlei, Klipriviersberg and Marievale Nature Reserves, with some minor patches in private reserves. The main threats to this vegetation type are transformation by cultivation, which had transformed approximately 60% of the distribution already, along with mining, dam-building and road development and operation. Large portions of Alberton, Springs, Tsakane and part of Soweto (all south and east of Johannesburg) were built in the area of this vegetation unit. Increasing urbanisation, especially in the south of Johannesburg and near the East Rand (Brakpan district) will increase pressure on the remaining vegetation, amplifying the need for the Endangered conservation status. Erosion across this vegetation unit is generally very low or low.

5.3. Gauteng Conservation Plan (C-Plan)

The Gauteng C-Plan is based on the systematic conservation protocol developed by Margules and Pressey (2000) and is based on the principles of complementarity, efficiency, defensibility and flexibility, irreplaceability, retention, persistence and accountability. Ultimately, the tool resulted in systematic classification and mapping of the Gauteng region, taking a vast array of ecological and land use factors into account.

The main purposes of the C-Plan are:

- To serve as the primary decision support tool for the biodiversity component of the Environmental Impact Assessment (EIA) process;
- To inform protected area expansion and biodiversity stewardship programmes in the province;
- To serve as a basis for development of Bioregional Plans in municipalities within the province.

As such, the plan delineates Critical Biodiversity Areas (CBAs), and Ecological Support Areas (ESAs) for the entire province, to be used by private and public entities to guide land use decisions within Gauteng.

Critical Biodiversity Areas are areas required to meet biodiversity targets for ecosystems, species and ecological processes, while Ecological Support Areas are not essential for meeting biodiversity targets but play an important role in supporting the ecological functioning of Critical Biodiversity Areas and/or in delivering ecosystem services. Critical Biodiversity Areas and Ecological Support Areas may be terrestrial or aquatic.

The Gauteng C-Plan shows that the study area contains numerous CBA and ESA regions, which is also true of the 100m project area. In addition, the Gauteng C-Plan further shows that the development corridor occurs within approximately 2 186m (21%) of the Critical Biodiversity Area (CBA), whereas a further 6 578m (62%) occurs within an Ecological Support Area, with the remaining 17% unallocated according the C-Plan categorisation (Figure 5.2). The CBA areas found within the development corridor comprise "Irreplaceable Area" of approximately 600m towards the north-east of the route, with the remainder being defined as either "Important Areas" or "Ecological Support Areas", as shown in Figure 5.2 below.

5.3.1. Critical Biodiversity Areas (CBAs)

CBAs include natural or near-natural terrestrial and aquatic features that were selected based on biodiversity characteristics, spatial configuration and requirement for meeting both biodiversity pattern and ecological process targets. CBAs include irreplaceable sites where no other options exist for meeting targets for biodiversity features, as well as best-design sites which represent an efficient configuration of sites to meet targets in an ecologically sustainable way that is least conflicting with other land uses and activities. These areas need be maintained in the appropriate condition for their category (GDARD C-Plan Technical Report, 2014). Despite the classification of CBA of part of the development corridor, the historical and ongoing disturbance has severely degraded these areas, making it highly degraded and no longer functionally contributing to the critical biodiversity classification. As such, the entirety of the development corridor is not deemed as a functioning CBA anymore, despite the classification. The current on-site condition is expanded upon further below in Chapter 6.

5.3.2. Ecological Support Areas (ESAs)

ESAs include natural, near-natural, degraded or heavily modified areas that are required to be maintained in an ecologically functional state to support Critical Biodiversity Areas and/or Protected Areas. ESAs maintain the ecological processes on which Critical Biodiversity Areas and Protected Areas depend. Some ESAs are irreversibly modified, but are still required as they still play an important role in supporting ecological processes (GDARD C-Plan Technical Report, 2014). The majority of the development corridor occurred on ESA-mapped areas, however, as the development corridor remains within the road reserve, and a very high degree of historical disturbance has occurred, all the ESA areas occupied by the development corridor was regarded as highly degraded and no longer functionally contributing to the Ecological Support Area classification. As such, these areas were not deemed as functioning ESA's anymore. The current on-site condition is expanded upon further below in Chapter 6.

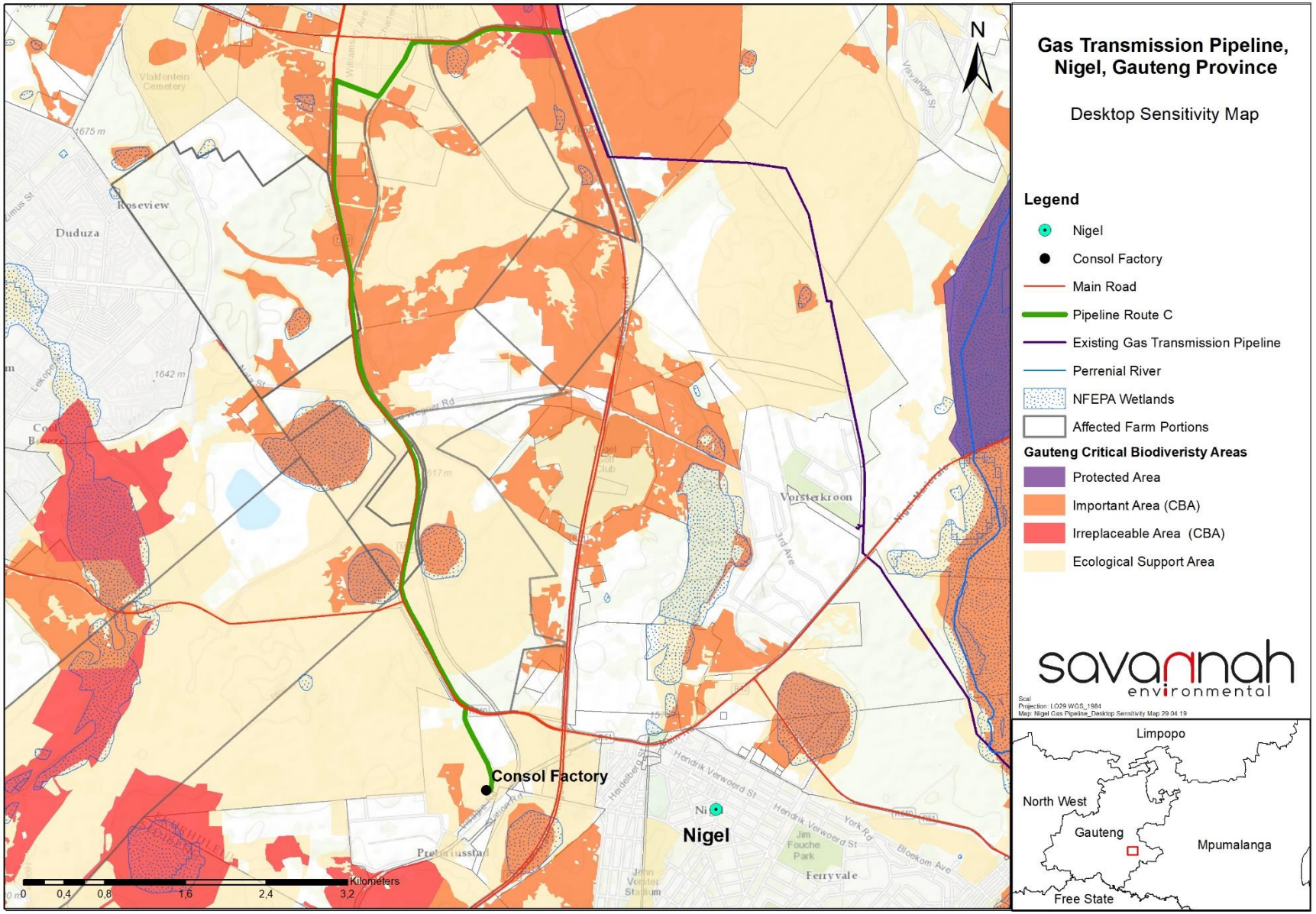

Figure 5.2. Gauteng C-Plan classification of the broader project area, with the development corridor shown in green.

5.4. Grassland Ecosystem Guidelines

The South African National Biodiversity Institute (SANBI) determined Grassland Ecosystem Guidelines, for land use planning used by both developers and authorities, to inform developments located near or within sensitive grassland regions. Based on the results, only the Blaauwpan and Kaalfontein grassland features are located in the wider project region, however both are located at a great distance from the proposed site (in excess of 15km). As such, these grasslands do not contribute to any environmental sensitivity of the proposed site.

5.5. Gauteng Provincial Environmental Management Framework (GPEMF)

The Gauteng Provincial Environmental Management Framework (GPEMF) delineated various environmental management zones throughout the province, which take into account biodiversity sensitivity, land use planning objectives and the current status of these sites as far as possible, and provide clear development instruction regarding the various zones. The GPEMF indicated that the development corridor falls within the "Normal Control Zone (Zone 4)" and the "High Control Zone (outside the urban development zone) (Zone 3)" which are conservation and agricultural focus zones under the GPEMF, respectively. In addition, the development corridor traverses the "Urban Development Zone" (Zone 1) and the "Industrial and large commercial focus zone" (Zone 5) (Figure 5.3), which are both development zones under the GEMPF. These zones are detailed further below.

5.5.1. Zone 1 – Urban development zone

The intention with this zone is to streamline urban development activities in it and to promote development infill, densification and concentration of urban development, in order to establish a more effective efficient city region that will minimise urban sprawl into rural areas. Approximately 2 915m of the development corridor currently occurs within this zone, located predominantly towards the northern portion of the corridor (near Dunnottar), representing 29% of the entire development corridor.

5.5.2. Zone 3 – High control zone (outside the urban development zone)

According to the GPEMF, this zone is sensitive to development activities and in several cases also have specific values that need to be protected. Conservation and related tourism and recreation activities should dominate development in this zone. Approximately 4 884m of the development corridor currently occurs within this zone, located predominantly towards the southern and north-western (horizontally running) portion of the development corridor, representing approximately 46% of the entirety of the development corridor. It is worth noting that while the development corridor occurs across the abovementioned Zone 3 areas, the development corridor is entirely contained within the road reserve which traverses this area.

5.5.3. Zone 4 – Normal Control Zone

This zone is dominated by agricultural uses outside the urban development zone. Agricultural and rural development that support agriculture should be promoted. Approximately 2 047m of the proposed route currently occurs within this zone, located predominantly towards the central portion of the route, representing approximately 19% of the route. It is worth noting that while the development corridor occurs across the abovementioned Zone 4 areas, the development corridor is entirely contained within the road reserve which traverses this area.

5.5.4. Zone 5 – Industrial and large commercial focus zone

The intention with Zone 5 is to streamline non-polluting industrial and large-scale commercial activities (warehouses etc.) in areas that are already used for such purposes and areas that are severely degraded but in proximity to required infrastructure. Approximately 603m of the development corridor currently occurs within this zone, located towards the extreme south of the route, representing 6% of the entirety of the development corridor.

Figure 5.3. GPEMF Zones 1 & 5 map, showing the zones meant for urban and industrial development along the proposed development corridor.

5.6. Animal species that may occur on site

The following list of potential animal SCC were derived from current literature found for the Quarter Degree Square (QDS) surrounding the study area, as well as the international IUCN Red Data list, the South African Red Data List, and CITES. The results are summarised (i.e. potential SCC only) in the tables below, while a full species list appears in Appendix A along with conservation status for each species.

5.6.1. Mammals

No potential SCC are expected to occur within the QDS (Table 5.2), with all mammal species (25 different species) expected to occur in the development corridor being listed as either Least Concern (LC) or Near-Threatened (NT), neither of which are deemed SCC due to their common occurrence and low sensitivity classification. Table 5.2 below indicates the potential Near-Threatened mammal species that may occur in the development corridor. None of these species were however observed during the field assessment.

Table 5.2. Mammalian species with conservation status other than Least Concern, which may occur within the project region (ADU, 2019).

Family	Scientific name	Common name	Red list category
Muridae	*Otomys auratus*	Southern African Vlei Rat	NT
Mustelidae	*Aonyx capensis*	African Clawless Otter	NT
Mustelidae	*Poecilogale albinucha*	African Striped Weasel	NT
Soricidae	*Crocidura mariquensis*	Swamp Musk Shrew	NT

5.6.2. Reptiles

A wide variety (27 different species) of reptiles are known to occur within the QDS (ADU, 2019), all of Least Concern (LC) conservation status (amongst the evaluated ones) (SARCA, 2014), and none are thus not considered to be SCC due to their common occurrence and low sensitivity classification. A full listing is provided in Appendix A, with only two species of Least Concern being noted in the project area - *Trachylepis punctatissima* (Speckled Rock Skink) and *Trachylepis varia sensu lato* (Common Variable Skink Complex) and thus may possibly occur in the development corridor.

5.6.3. Frogs

Of the ten frog-species that may occur project area (ADU, 2019), all were classified as either Least Concern (9) (IUCN, 2019), with only one being classified as Near-Threatened (Table 5.3), and none are thus regarded as SCC due to their common occurrence and low sensitivity classification. A full listing is provided in Appendix A. None of these species were however observed during the field assessment.

Table 5.3. Frog species that may occur in the project site, with conservation status other than Least Concern.

Family	Scientific name	Common name	Red list category
Pyxicephalidae	*Pyxicephalus adspersus*	Giant Bull Frog	NT

5.6.4. Orchids

Of the three orchid species that may occur within the study area (ADU, 2019), two were classified as Least Concern (9) (IUCN, 2019), and one being classified as Vulnerable (VU), namely *Eulophia coddii* (Table 5.4),

and only this one is regarded as a SCC due to the very rare occurrence and high sensitivity classification thereof. It is worth noting that there are only five known locations for *Eulophia coddii*, and only approximately 1000 individuals known within the wild (SANBI Red List, 2005). A full listing is provided in Appendix A. None of these species were however observed during the field assessment, including the *Eulophia coddii* mentioned above (i.e. *E. coddii* was absent from the project area, based on the field survey).

Table 5.4. Orchid species that may occur in the project site with conservation status other than Least Concern.

Family	Scientific name	Common name	Red list category
Orchidaceae	*Eulophia coddii*	*Eulophia coddii*	VU

5.6.5. Birds

The project area is located approximately 3km from the Blesbokspruit Important Bird Area (IBA), a sub-regional IBA of the Gauteng Province. Approximately 209 different bird species may thus occur in the broader study area surrounding the development corridor (SABAP2, 2007). Numerous wetlands and water features are located adjacent to and nearby the project area, and are described in the wetland specialist report, and as such water birds may be a common sight in the broader study region. A summary of the species that may be present on study region, with a conservation status other than Least Concern, is shown below in Table 5.5 (Eskom, 2015; IUCN, 2019). **Please note**: species that are regarded as Least Concern (LC) locally are not included in the table below.

Table 5.5. Bird species that may be present on site, with conservation status other than Least Concern (Eskom, 2015).

Taxon name	Common name	Red List (Eskom, 2015)	IUCN Red List (Global)
Circus ranivorus	African Marsh-Harrier	EN	LC
Falco biarmicus	Lanner Falcon	VU	LC
Glareola nordmanni	Black-winged Pratincole	NT	NT
Mycteria ibis	Yellow-billed Stork	EN	LC
Polemaetus bellicosus	Martial Eagle	EN	VU
Sagittarius serpentarius	Secretarybird	VU	VU

Based on the Red List, all bird species that may be present within the development corridor are classified regionally as either Least Concern, with one classified Near-Threatened (NT), two as Vulnerable (VU), and three as Endangered (EN). None of the species were observed during the field assessment. A full listing of observed species is provided in Appendix A.

6. SITE OBSERVATIONS AND DESCRIPTION

6.1. Vegetation units and description

The following land uses were noted within the assessment area (i.e. project area) during the field assessment, and may, in part, occur within the development corridor as well:

- Rail Reserve: Transnet railroad infrastructure and servitude (where the development corridor traverses the railroad);
- Industrial/Built Up: Zones where current commercial activity occur, or households (outside of the road reserve near Dunnottar);
- Road: Road surface or bridge infrastructure; and
- Agriculture (adjacent road reserve along certain parts of the project area);

Where these land uses were not evident along the development corridor, the following vegetation units were defined:

- Degraded mixed grassland;
- Wetland vegetation; and
- Mixed invasive woodland;

These three vegetation units are detailed further, and mapped below in Figure 6.1, Figure 6.2 and Figure 6.3 alongside other current land uses where no vegetation occurs.

6.1.1. Degraded mixed grassland unit

The degraded mixed grassland unit was found predominantly within the road reserves and in areas which have not been built up or completely transformed through agriculture (Plate 6.1) adjacent the road reserve and as such represents the largest vegetation unit within the development corridor. While this vegetation type does contain a moderate amount of Tsakane Clay Grassland species in particular, a big variety of other common grasses have been introduced into the area, and a very large composition of invasive alien plant (IAP) are present within this vegetation type. In addition, apart from the graminoid component, this vegetation type did not represent Tsakane Clay Grassland well due to the low occurrence of important species as per the Mucina and Rutherford (2012) classification of this vegetation type - i.e. apart from the grass species, a very low number of diagnostic Tsakane Clay Grassland species was found on site. The large number of invasive species and the high number of other common grass species are likely due to the strong historical and ongoing disturbance of this unit via anthropogenic interaction throughout the site, detailed further below.

This vegetation unit was comprised of a wide variety of mixed grasses mainly – dominated by *Themeda triandra*, introduced *Melinis repens* and *Aristida congesta*, as well as *Cymbopogon caesius*. Invasive alien species found interspersed within this vegetation unit was comprised of shrub and herb species - mainly invasive wattle species of *Acacia decurrens*, *Acacia* mearnsii and *Acacia baileyana*.

While this vegetation unit occupies the largest footprint (compared to other vegetation units) within the assessed project area, the development corridor will remain within the road reserve, and will thus impact only on the most-disturbed areas of this vegetation unit (i.e. where the quality of this vegetation unit is poorest, and most degraded).

Plate 6.1. Typical illustration of the degraded mixed grassland vegetation unit, showing the mainly grass species mix with invasive tree species.

6.1.2. Wetland vegetation unit

Where surface water features are evident, typical wetland vegetation can be found (Plate 6.2). This was found to occur entirely within the northernmost section of the proposed pipeline, where surface water features intersect with the road, and occurred only at three locations with a very small overall footprint when compared to the remainder of the project area and development corridor therein. This vegetation type is restricted to seasonally saturated soil zones where conditions favour wetland vegetation development, and is predominantly comprised of *Phragmites australis* and *Typha capensis*, with much smaller representation of *Schoenoplectus corymbosus* and *Paspalum urvillei*. This vegetation unit however is also largely disturbed as in all instances it occurs within extremely close proximity to the road surface and is freely traversed by people using footpaths, as well as usage of the water for informal business and laundry washing, and is highly invaded by invasive species along with other associated impacts. Regardless, this vegetation type may provide habitat for more resilient aquatic bird species and is consequently of greater ecological importance.

Plate 6.2. Illustration of the most intact wetland vegetation unit on site, immediately adjacent the road at the intersection of the Nigel-Springs Road and the M45, showing the dominant *Typha capensis* stands.

6.1.3. Mixed invasive woodland unit

Two larger stands of mixed invasive woodland species are found in the project area, and intersect with the development corridor at two locations (Plate 6.3). These are along Nigel Road and Dunnottar Road. This vegetation unit differs from the Degraded mixed grassland unit by its greater comparative proportion of woody species, all of which were found to be invasive. This vegetation unit comprised entirely of invasive Eucalyptus trees, and wattle trees, and are mostly related to cultivated Eucalyptus stands used for timber, fuelwood or windbreaks by local farmers. Dominant species within this vegetation unit was *Acacia decurrens*, *Acacia mearnsii* and *Acacia baileyana*, and *Eucalyptus camaldulensis*, *Eucalyptus cladocalyx* and *Eucalyptus grandis*, with a stronger occurrence of *Eucalyptus* species where this vegetation unit was found.

Plate 6.3. Mixed invasive woodland unit vegetation in the background (yellow rectangle) showing the dominant stands of Eucalyptus species adjacent the road.

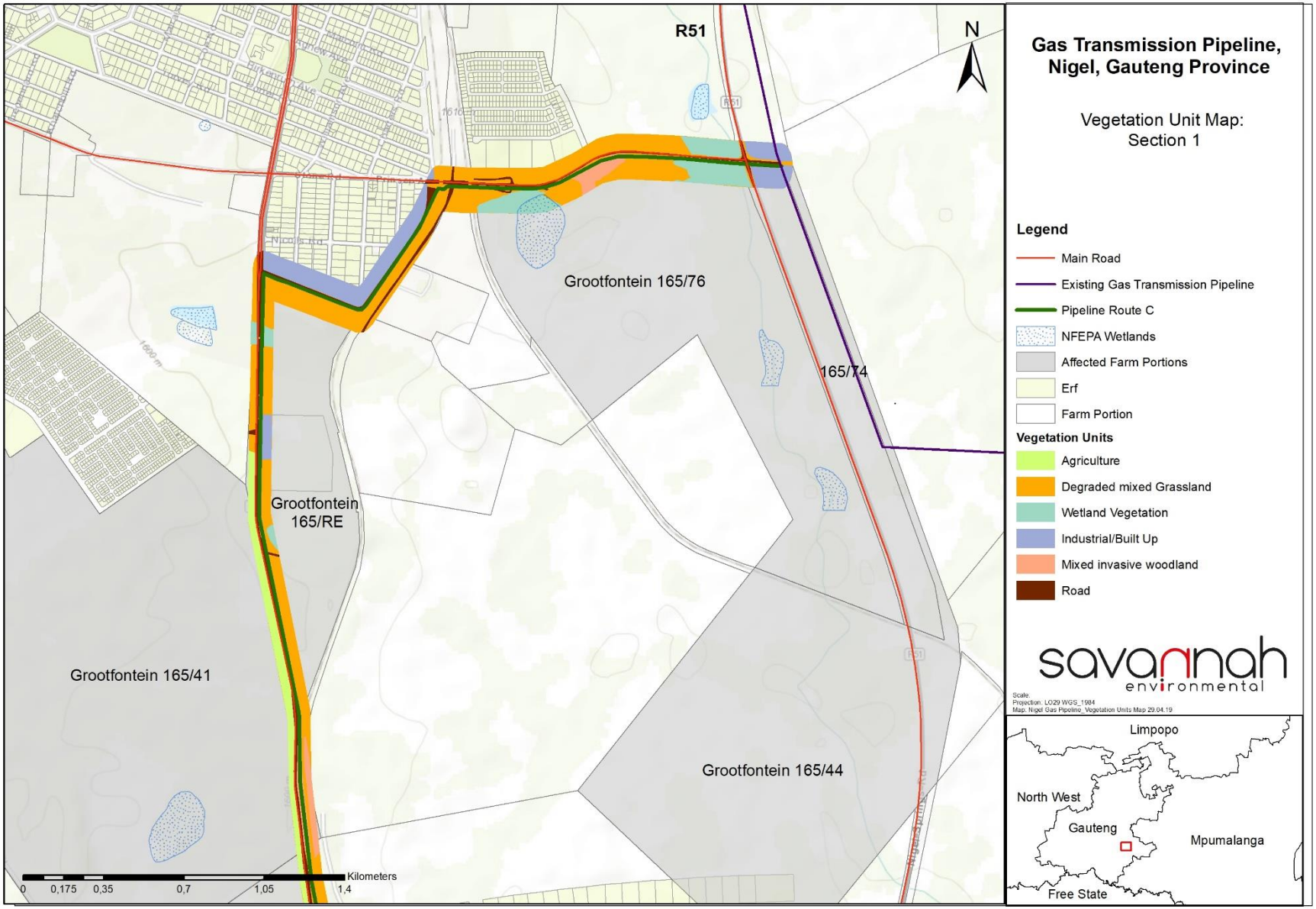

Figure 6.1. Vegetation units present in the project area – Section 1/3.

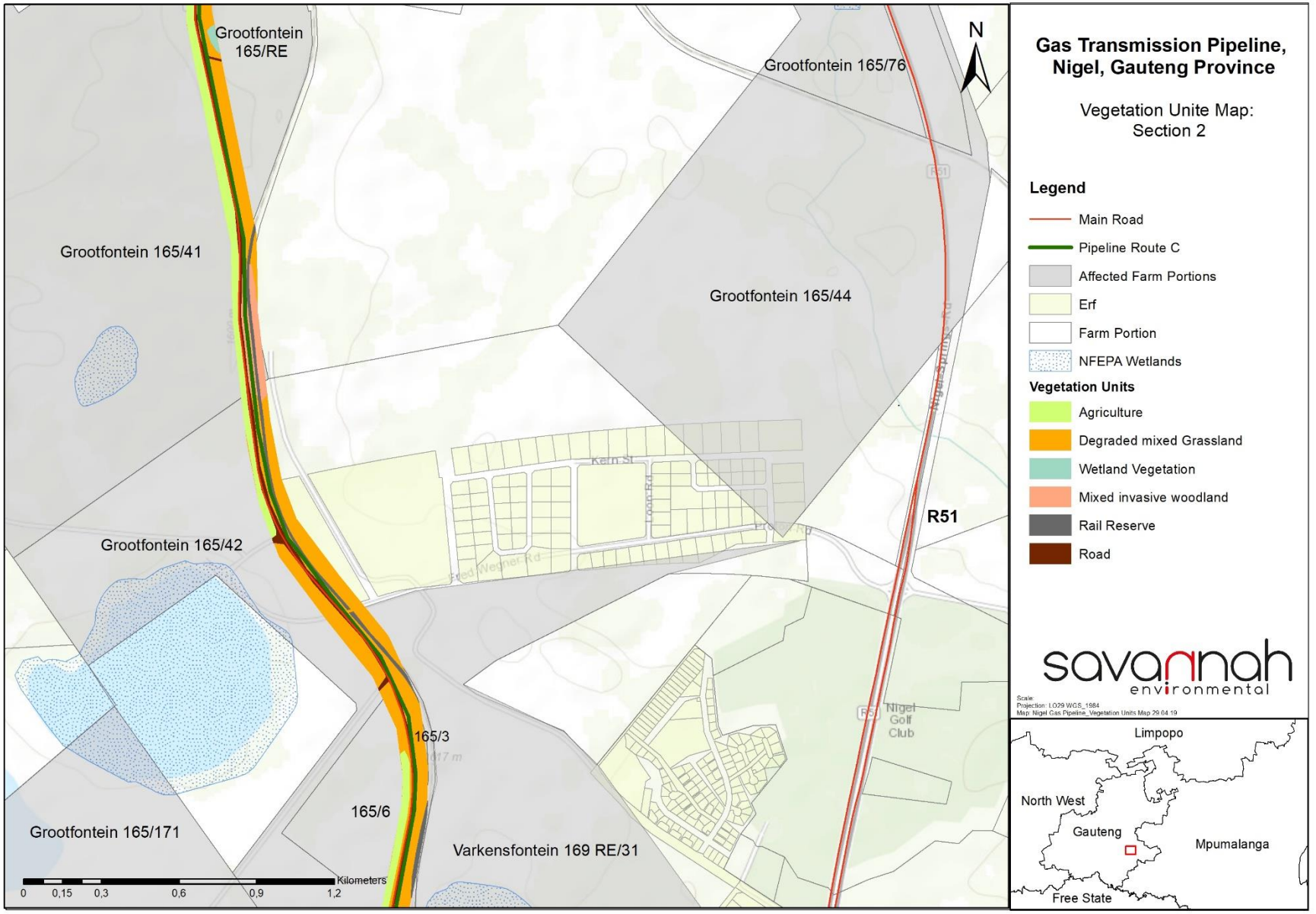

Figure 6.2. Vegetation units present in the project area – Section 2/3.

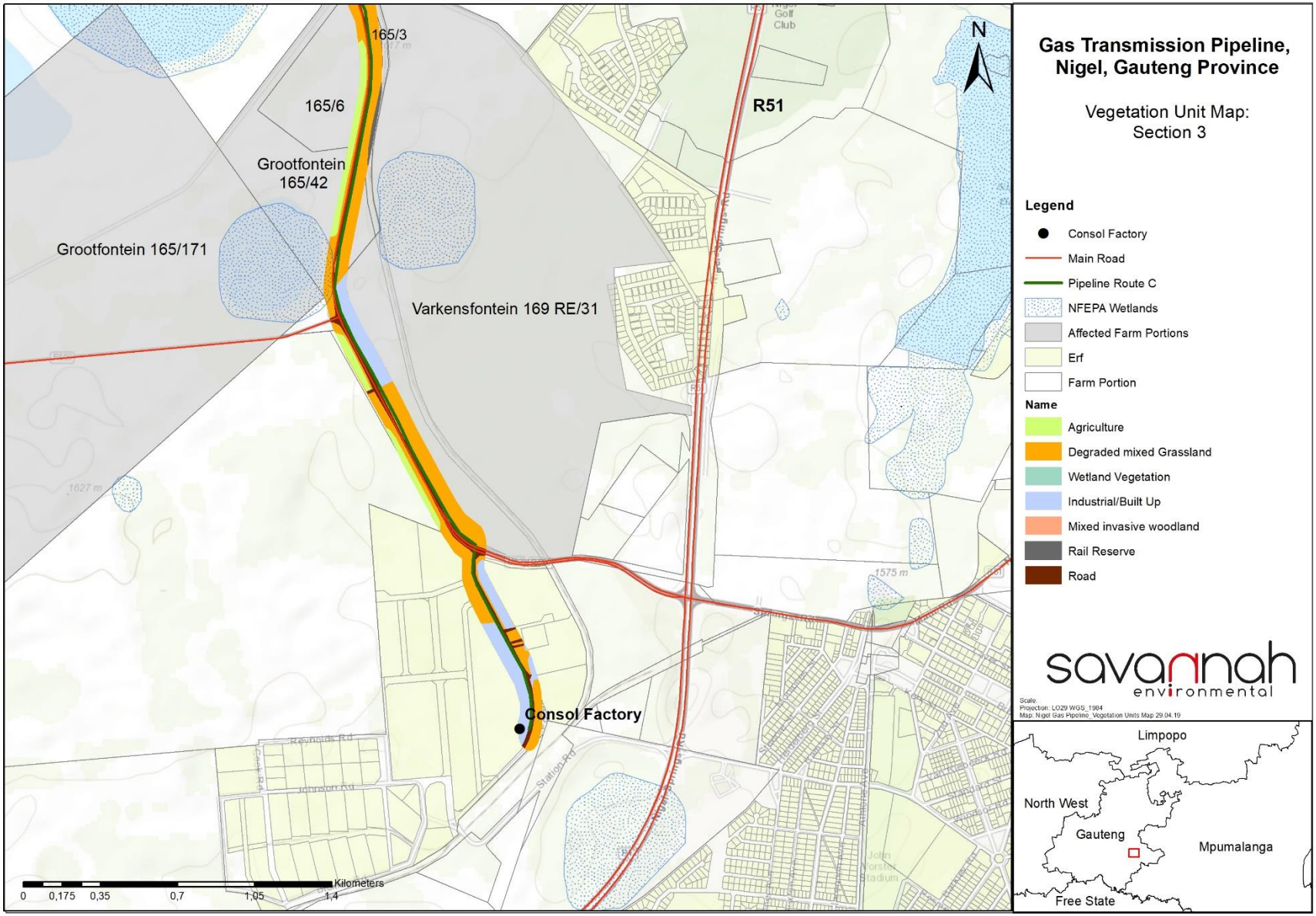

Figure 6.3. Vegetation units present in the project area – Section 3/3.

6.2. Current site disturbance

A wide variety of historical and ongoing disturbances are currently experienced by all three vegetation units within the project area, and consequently the development corridor also (Plate 6.4). These are detailed further below:

- » Mowing: ongoing mowing of the road reserve is being conducted by the local municipality, in order to increase visibility and ease of maintenance of the road and the road verge. This continued mowing alters the species composition and abundance and is a regular disturbance in these areas.
- » Invasive species: A wide variety of woody, shrub and herbaceous invasive species are present throughout the project area, possibly due to their historical introduction from earthworks associated with the road verge maintenance, the construction of bridge and railroad infrastructure, and the frequent foot traffic throughout the project area.
- » Burning: Evidence of fires were found within the project area, near bridge structures, and on aerial imagery where widescale burning had occurred. These fires may be started for heat or firebreaks, or accidentally via pedestrians traversing the project area, and inadvertently influences the species composition and abundance by promoting the greater occurrence and density of grass species.
- » Foot traffic: Pedestrian footpaths are almost ubiquitous throughout the project area as people use the road, road verge and open areas to commute. While small amounts of vegetation are lost this way, secondary impacts (dumping, fires, litter) are strongly related to an increase in pedestrian presence. These in turn alter species composition and abundance.
- » Washing in rivers: The field assessment confirmed ongoing use of the rivers to wash clothes, and materials (in the case of informal traders). These activities degrade the water quality of these surface water features and contribute to the decline in aquatic wetland vegetation quality, quantity and species diversity.
- » Old pipeline reserves: Historical pipelines were observed near the intersection of John Mackie drive and Visagie Weg, as well as within the northern wetland area near Dunnottar road and the Nigel-Springs Road. This historic infrastructure has had a small, but lasting influence on drainage and vegetation patterns within the areas, thus contributing to the historical degradation of the project area.
- » Cattle grazing: Large scale cattle grazing (in excess of 100 heads of cattle) was observed directly within the road reserve and the proposed development corridor. Such grazing alters the species composition found in the project area.
- » Derelict roads and vehicles stopping adjacent the road: Numerous old, derelict roads are evident throughout the project area where access was required once and no longer used. These roads are mostly dirt roads, with two derelict tar roads found. The construction of these roads, their road verge maintenance and the construction of their associated stormwater features would have impacted of the species composition along the development corridor where these intersect with each other.
- » Illegal dumping: Illegal dumping was evident throughout the project area and development corridor where anything from domestic waste to building rubble was deposited in the road reserve and open areas. These contribute to ongoing degradation of the vegetation in the project area.
- » Clearing: Denuded, bare areas used historically for construction laydown areas were evident in the project area, specifically near the M45 and R51 where a new commercial park was created since 2016 (as observed on aerial imagery and confirmed during the field assessment). These areas show a very high degree of invasive species due to the earthworks and associated disturbance from that construction, but also remain largely denuded as rehabilitation efforts were not conducted

adequately. Subsequently cleared areas are evident along some portions of the development corridor.

» Road verge grading: Evidence of grading was observed along the development corridor where road verges were graded following strong rainfall events and subsequent erosion. These areas are subsequently entirely denuded and mostly strongly occupied by invasive species.

Mowing along the development corridor (in this instance near the graveyard)

Maintenance hole for existing buried pipeline within the development corridor

Derelict roads and illegal dumping within the development corridor

Denuded areas used for historical laydown areas not rehabilitated properly, within the development corridor

Old pipelines running through the surface water feature at the northern portion of the development corridor

Building rubble illegal dumping near surface water features in the development corridor

Old infrastructure foundations near the northern portion of the development corridor

Evidence of historical fires within the development corridor

Washing laundry and dumping evident in the distance, near the wetland vegetation found along Nigel Road in the development corridor

Grading and vegetation clearing evident along the road verge in the development corridor

A small stand of invasive *Canna indica* as example of the consistent invasive species presence within the development corridor

Large herd of cattle observed grazing within the development corridor

Plate 6.4: Evidence of current and historic disturbance on site.

At present, the development corridor is entirely unfenced and is planned within the road reserve. The evidence of historical and ongoing disturbance above was observed within the development corridor for all vegetation units, along the entirely of the proposed pipeline route, and as such a very high degree of degradation (historical and present) is evident for the vegetation units of this study.

6.3. Vegetation species observed

A total of 45 native vegetation species were identified within the project area, consisting mainly of mixed grass species commonly occurring in the highveld region. In addition, a total of 43 invasive vegetation species were observed, primarily in regions where the greatest historical and ongoing disturbance was evident. All of the native species observed were classified as Least Concern (LC) according to the SANBI red data list (2019) and were not considered to be sensitive species on that basis. Taking into account the moderate diversity of species occurring on site, and the low conservation classification (LC) of those present as well as the widespread abundance of these species, the overall vegetation within the Degraded Mixed Grassland vegetation unit was deemed to have an overall low conservation status in as far as the vegetation component was concerned. Table 6.1 indicates the plant species observed during the field assessment.

Table 6.1. Native plant species identified within the proposed project area.

Growth Form	Taxon name	Family	SANBI red data list
Herbs	*Acanthospermum australe*	ASTERACEAE	LC
Graminoids	*Andropogon schirensis*	POACEAE	LC
Graminoids	*Aristida canescens*	POACEAE	LC
Graminoids	*Aristida congesta*	POACEAE	LC
Graminoids	*Arundo donax*	POACEAE	LC
Herbs	*Berkheya insignis*	ASTERACEAE	LC
Graminoids	*Brachiaria serrata*	POACEAE	LC
Herbs	*Conyza podocephala*	ASTERACEAE	LC
Herbs	*Cotula anthemoides*	ASTERACEAE	LC
Graminoids	*Cymbopogon caesius*	POACEAE	LC

Growth Form	Taxon name	Family	SANBI red data list
Graminoids	*Cynodon dactylon*	POACEAE	LC
Graminoids	*Cynodon hirsutus*	POACEAE	LC
Graminoids	*Digitaria eriantha*	POACEAE	LC
Graminoids	*Digitaria ternata*	POACEAE	LC
Graminoids	*Diheteropogon amplectens*	POACEAE	LC
Graminoids	*Echinocloa colona*	POACEAE	LC
Graminoids	*Elionurus muticus*	POACEAE	LC
Graminoids	*Eragrostis chloromelas*	POACEAE	LC
Graminoids	*Eragrostis plana*	POACEAE	LC
Graminoids	*Eragrostis racemosa*	POACEAE	LC
Herbs	*Felicia muricata*	ASTERACEAE	LC
Herbs	*Haplocarpha scaposa*	ASTERACEAE	LC
Herbs	*Helichrysum nudifolium var. nudifolium*	ASTERACEAE	LC
Herbs	*Helichrysum pilosellum*	ASTERACEAE	LC
Graminoids	*Heteropogon contortus*	POACEAE	LC
Graminoids	*Hyparrhenia hirta*	POACEAE	LC
Geophytic Herbs	*Hypoxis iridifolia*	HYPOXIDACEAE	LC
Graminoids	*Melinis nerviglumis*	POACEAE	LC
Graminoids	*Melinis repens*	POACEAE	LC
Marsh grass	*Paspalum urvillei*	POACEAE	.
Graminoids	*Phragmites australis*	POACEAE	LC
Herbs	*Plantago lanceolata*	PLANTAGINACEAE	LC
Herbs	*Polygala hottentotta*	POLYGACEAE	LC
Graminoids	*Schizachyrium sanguineum*	POACEAE	LC
Marsh Herb	*schoenoplectus corymbosus*	CYPERACEAE	LC
Marsh Herb	*Schoenoplectus corymbosus*	CYPERACEAE	LC
Medium tree	*Senegalia galpinii*	FABACEAE	LC
Graminoids	*Setaria incrassata*	POACEAE	LC
Graminoids	*Setaria sphacelata*	POACEAE	LC
Herbs	*Sonchus nanus*	ASTERACEAE	LC
Graminoids	*Sporobolus fimbriatus*	GRAMINEAE	LC
Graminoids	*Themeda triandra*	POACEAE	LC
Marsh Herb	*Typha capensis*	TYPHACEAE	LC
Medium tree	*Vachellia karroo*	FABACEAE	LC
Graminoids	*Zea mays*	POACEAE	LC

6.3.1. Plant Species of Conservation Concern

No plant Species of Conservation Concern were identified within the project area or development corridor.

6.3.2. Plant alien invasive species observed

Forty-three (43) invasive species were observed within the project area (Table 6.2) found predominantly where historical construction activities had occurred.

Table 6.2. Invasive plant species observed on site.

Common Name	Taxon name	NEMBA Category Listing (2016)	CARA Listing (1983)
Bailey's wattle	*Acacia baileyana*	3	3
Green wattle	*Acacia decurrens*	2	2
Black wattle	*Acacia mearnsii*	2	2
Century plant	*Agave americana*	Not listed in Gauteng	Not listed
Sisal	*Agave sisalana*	2	2
Khaki burr	*Alternanthera pungens*	Not listed	Not listed
Mexican poppy	*Argemone mexicana*	Not listed	1
Black jack	*Bidens pilosa*	Not listed	Not listed
Pom Pom weed	*Campuloclinium macrocephalum*	1b	1
Indian Shot	*Canna indica*	Not listed	1
Balloon vine	*Cardiospermum grandiflorum*	Not listed	1
Spear thistle	*Cirsium vulgare*	1b	1
Pampas grass	*Cortaderia selloana*	1b	1
Cosmos	*Cosmos bipinnatus*	Not listed	Not listed
Large thorn apple	*Datura ferox*	Not listed	1
Downy thorn apple	*Datura stramonium*	Not listed	1
River Red Gum	*Eucalyptus camaldulensis*	Category 1b in Fynbos, Grassland, Savanna, Albany Thicket, Forest and Indian Ocean Coastal Belt biomes, but- (ii) Not listed within cultivated land that is at least 50 metres away from untransformed land, but excluding within any area in (a) above. (iii) Not listed within 50 metres of the main house on a farm, but excluding in (a) above. (iv) Not listed in urban areas for trees with a diameter of more than 400 mm at 1000 mm height at the time of publishing of this Notice, but excluding in (a) above.	2
Sugar gum	*Eucalyptus cladocalyx*		2
Rose gum	*Eucalyptus grandis*		2
Blue morning glory	*Ipomoea indica*	1b	3 in Gauteng
Common morning glory	*Ipomoea purpurea*	1b	3
Syringa Tree	*Melia azedarach*	Not listed	3
Prickly pear	*Opuntia ficus indica*	1b	1
Common prickly pear	*Opuntia stricta*	1b	1

Common Name	Taxon name	NEMBA Category Listing (2016)	CARA Listing (1983)
Kikuyu	*Pennisetum clandestinum*	a. 1b in Protected Areas and wetlands in which it does not already occur. b. Not listed elsewhere.	Not listed
Cluster pine	*Pinus pinaster*	b. 1b elsewhere (i.e. where not in plantations or windrows)	2
Grey poplar	*Populus × canescens*	2	2
English Oak	*Quercus robur*	Not listed	Not listed
Silver-leaved nightshade	*Solanum elaeagnifolium*	1b	1
Apple of Sodom	*Solanum linnaeanum*	Not listed	Not listed
Common sowthistle	*Sonchus oleraceus*	Not listed	Not listed
Johnson grass	*Sorghum halepense*	Not listed	2
Khakibush	*Tagetes minuta*	Not listed	Not listed
Tipuana tree	*Tipuana tipu*	3	3
Purple Top	*Verbena bonariensis*	1b	Not listed
Brazilian verbain	*Verbena brasiliensis*	1b	Not listed
Veined verbena	*Verbena rigida*	1b	Not listed
Horseweed	*Conyza bonariensis*	Not listed	Not listed
Knoppiesvermeer bos	*Geigeria burkei*	Not listed	Not listed
Watercress	*Nasturtium officinale*	2	2
Snake-root	*Persicaria serrulata*	Not listed	Not listed
Broadleaf plantain	*Plantago major*	Not listed	Not listed
Slangbos	*Seriphium plumosum*	Not listed	Not listed

6.4. Animal species observed

Due to the highly degraded nature of the project area and development corridor in particular, the frequent disturbance and constant pedestrian foot traffic, very few animal species were observed on site, with only *Trachylepis punctatissima* (speckled rock skink), and *Trachylepis varia sensu lato* (common variable skink) identified within the project area, both of which are considered as Least Concern (LC) (SARCA, 2014). Avifaunal species were the exception however, being attracted by the nearby water features (in the broader study area) and due to their mobile nature. Apart from the above two reptiles, only birds were noted within the project area, as indicated by Table 6.3 below. A total of 30 avifaunal species were observed within the project area.

Table 6.3. Bird species observed within the project area.

Common Name	Taxon Name	Red List (ESKOM, 2015)	IUCN Red List
Common Myna	*Acridotheres tristis*	Not listed	LC
African Reed-warbler	*Acrocephalus baeticatus*	Not listed	Not found

Common Name	Taxon Name	Red List (ESKOM, 2015)	IUCN Red List
Marsh Warbler	*Acrocephalus palustris*	Not listed	LC
Orange-breasted Waxbill	*Amandava subflava*	Not listed	LC
African Pipit	*Anthus cinnamomeus*	Not listed	LC
Common Swift	*Apus apus*	Not listed	LC
Horus Swift	*Apus horus*	Not listed	LC
Black-headed Heron	*Ardea melanocephala*	Not listed	LC
Hadeda Ibis	*Bostrychia hagedash*	Not listed	LC
Familiar Chat	*Cercomela familiaris*	Not found	LC
Wing-snapping Cisticola	*Cisticola ayresii*	Not listed	LC
Rock Dove	*Columba livia*	Not listed	LC
Yellow Canary	*Crithagra flaviventris*	Not listed	LC
African Palm-swift	*Cypsiurus parvus*	Not listed	LC
Little Egret	*Egretta garzetta*	Not listed	LC
Black-shouldered Kite	*Elanus caeruleus*	Not listed	LC
Common Waxbill	*Estrilda astrild*	Not listed	LC
Southern Red Bishop	*Euplectes orix*	Not listed	LC
Long-tailed Widowbird	*Euplectes progne*	Not listed	LC
Rock Kestrel	*Falco rupicolus*	Not listed	Not found
Cape Glossy Starling	*Lamprotornis nitens*	Not listed	LC
Cape Wagtail	*Motacilla capensis*	Not listed	LC
Helmeted Guineafowl	*Numida meleagris*	Not listed	LC
Cape Sparrow	*Passer melanurus*	Not listed	LC
House Sparrow	*Passer domesticus*	Not listed	LC
Southern Masked-weaver	*Ploceus velatus*	Not listed	LC
Cape Weaver	*Ploceus capensis*	Not listed	LC
Red-eyed Dove	*Streptopelia semitorquata*	Not listed	LC
Blacksmith Lapwing	*Vanellus armatus*	Not listed	LC
Crowned Lapwing	*Vanellus coronatus*	Not listed	LC

None of the bird species observed within the project area were regarded as sensitive, with all considered Least Concern (LC) in terms of their conservation status. Along with the moderate number of observed species on site, the common status for all of the observed species, their overall abundance in other similar habitats, and the highly disturbed and frequented status of the project area, the project area and in particular the development corridor had an overall low faunal conservation potential.

6.4.1. Animal Species of Conservation Concern

No animal Species of Conservation Concern were identified within the project area.

6.4.2. Animal alien invasive species observed

No animal invasive species were identified within the project area.

7. SITE SENSITIVITY ANALYSIS

The preferred alternative (Route C) and the 'no-go' alternative was assessed in the sensitivity analysis and impact assessment for this study.

7.1. Categorisation

The various biodiversity tools, maps and guidelines available and discussed in the previous chapters, along with the results of the field assessment was combined to determine the various areas within the project area that are deemed sensitive, classified into four categories:

- **High sensitivity**:
  - Process areas, such as all surface water bodies and drainage areas, including dams, wetlands, drainage systems, rivers and streams;
  - Areas with a high species richness;
  - Areas that are not significantly impacted, transformed or degraded by current land use; and
  - Areas that contain the majority of species of conservation concern and which may contain high numbers of globally important species, or comprise part of a globally important vegetation type.

- **Moderate sensitivity**:
  - Intact natural vegetation with moderate levels of disturbance, and that still provide a valuable contribution to biodiversity and ecosystem functioning despite being somewhat degraded;
  - Degraded areas that still have a relatively high species richness; and
  - Degraded areas that still contain species of special concern.

- **Low sensitivity**:
  - Areas that are highly impacted by current or historical land use, including dumping, mowing, frequent fire, ground or surface water alteration, as well as earthworks or soil disturbance, and which thus provide little value to the ecosystem; and
  - Highly degraded areas that are unlikely to contain any species of special concern.

- **Negligible sensitivity**:
  - Areas that are entirely void of vegetation due to existing or historical clearance and/or disturbance; and
  - Areas that are occupied by existing or historical infrastructure such as roads, fences, stormwater drains, bridges and commercial buildings.

The combined faunal and floral sensitivity for the project area was then categorised into one of those four categories, taking the following aspects into account (

Table 7.1):

Table 7.1. Aspects informing the sensitivity analysis for the proposed project (bolded cells applicable to this project).

INDICATOR	**Biodiversity Indicators**				
ASPECT	**Conservation status**	**Species of Conservation Concern**	**Habitat**	**Biodiversity**	**CBA & ESA**
DESCRIPTION	Fauna, flora and habitat conservation status	Presence and quantity of Species of Conservation Concern	Viable population size and fragmentation effects	Species composition and richness contribution to biodiversity	Presence or absence of Critical Biodiversity and Ecological Support Areas
SENSITIVITY					
Low	Well conserved, independent of conservation value	**None, although occasional regional endemics may be present.**	**Extensive areas of preferred habitat present elsewhere in region less susceptible to fragmentation.**	**Low diversity or species richness.**	No CBA or ESA within project region
Medium	**Not well conserved, moderate conservation value.**	No endangered or vulnerable species, some indeterminate or rare endemics	Reasonably extensive areas of preferred habitat elsewhere and habitat susceptible to fragmentation	Moderate diversity, and moderately high species richness	ESA found within project region
High	Not conserved – has a high conservation value	One or more endangered and vulnerable species, or more than 2 endemics or rare species	Limited areas of this habitat, susceptible to fragmentation in currently occupied regions	High species diversity, complex plant and animal communities	**CBA zone classified in project region.**
INDICATOR	**Biophysical Indicator**				
ASPECT	**Topography**	**Vegetation**	**Erosion Potential**	**Rehabilitation**	**Disturbance**
DESCRIPTION	The distribution of parts or features	Extent and spatial distribution of habitat type in the broader study area	Soil stability and exposure	Degree to which the site may be rehabilitated	Degree of degradation from anthropogenic or other influences
SENSITIVITY					
Low	**Even**	Extensive	**Very stable, low soil exposure or soil erosion potential.**	**Site is easily rehabilitated.**	**Site is very disturbed or degraded.**
Medium	Undulating; fairly steep slopes	**Restricted to a particular region.**	Some possibility of erosion or change due to episodic events.	There is some degree of difficulty in rehabilitation of the site.	There is some degree of disturbance of the site.

High	Complex and uneven with steep slopes	Restricted to a specific locality or site (i.e. 'site specific'	Large possibility of erosion, change to the site or destruction due to climatic or other factors.	Site is difficult to rehabilitate due to the terrain, type of habitat or species required to reintroduce.	The site is hardly or very slightly impacted upon by human disturbance.
INDICATOR	**Hydrological Indicator**				
ASPECT	**Water Bodies***				
DESCRIPTION	Presence or absence of surface water features, including wetlands and rivers, estuaries				
SENSITIVITY					
Low	No water bodies are present on site.				
High	**Includes one or more of all water bodies (e.g. wetlands, perennial rivers, non-perennial rivers, drainage systems etc.) where such features are in a moderate or good condition and thus contribute significantly to ecological processes and function on site**				

*Water bodies are either Low or High sensitivity, based solely on the presence or absence of hydrological features on site.

It is important to note the general location of the pipeline. Considering the fact that the proposed pipeline will only utilise portions of the road reserve, and the current precedent for linear features such as sewer mains, electricity cables and fibre optic cable being installed into such areas, as well as the highly degraded nature of the road reserve commonly found, and the fact that this development will introduce invasive species control measures, it is argued that the utilisation of the road reserve for this project is highly favourable in terms of the broader land use of the area and for linear developments such as this

Based on all the above, three sensitivity classes were determined relevant for the project area, determined for each of the vegetation units identified and as such share the same boundaries as the associated vegetation units. The rationale for each class is detailed further below, and must be read in conjunction with the sensitivity map provided below (Figure 7.1, Figure 7.2 and Figure 7.3).

7.1.1. NEGLIGIBLE ecological sensitivity

Areas contained within this class were zones within the project area where residential homes occurred near Dunnottar for instance, where commercial activity occurred (the Consol factory for instance), and where there was existing infrastructure such as paved or dirt roads, bridges, derelict infrastructure, existing pipelines or similar infrastructure, or stormwater and culvert features associated with the road. This did not include the road reserve despite the highly degraded nature of the road reserve area, as their road reserve contained a mixture of grass species and contributed to the ecological functioning on site.

7.1.2. LOW ecological sensitivity

The entirety of the degraded mixed grassland vegetation unit was deemed of LOW ecological sensitivity. This was due to the following aspects:

i. The very low ecological function of the project area presently;
ii. The highly degraded nature of the project area (refer to section 6.2 above);
iii. The moderate species richness observed during the field assessment;

iv. The low conservation classification of plant and animal species that may occur within the project area;
v. The low conservation classification of plant and animal species that were actually observed within the project area;
vi. The low erosion potential and ease with which project area may be rehabilitated, and the highly disturbed and degraded nature of the project area currently.

In addition, the entirety of the mixed invasive woodland vegetation unit was deemed of LOW ecological sensitivity. This was due to the following aspects:

i. The very low ecological function of the project area presently;
ii. The highly degraded nature of the project area (refer to section 6.2 above);
iii. The low species richness observed during the field assessment;
iv. The low conservation classification of plant and animal species that may occur within the project area;
v. The low conservation classification of plant and animal species that were actually observed within the project area;
vi. The very small footprint of the development corridor and thus limited habitat types available for faunal groups within this area;
vii. The low erosion potential and ease with which the project area may be rehabilitated, and the highly disturbed and degraded nature of the project area currently; and
viii. The highly invaded nature of this vegetation unit, with predominantly invasive species found.

7.1.3. MODERATE ecological sensitivity

No features of moderate ecological sensitivity were determined within the project area, as all features were either classified as low or high ecological sensitivity (as described above and below).

7.1.4. HIGH ecological sensitivity

The wetland vegetation unit was deemed of HIGH ecological sensitivity throughout the project area, due to the presence of water features and subsequently these wetland areas are regarded as important process zones within the broader landscape, as they represent unique habitats in an otherwise highly degraded landscape (despite being highly degraded themselves), and do currently contribute to species diversity and abundance within the broad study area.

7.2. CBA and ESA verification

According to the Gauteng C-Plan, CBA and ESA areas occur within the development corridor, and occur on all three vegetation units identified. However, based on the fieldwork results and sensitivity assessment above, it was determined that where all three vegetation units occurred in regions classified as CBA by the Gauteng C-Plan, the CBA classification does not correspond to the real-world condition of the plant and animal species observed within the project area, and therefore contributes moderately-to-poorly to the ecological function of the broader area. This is most applicable to the mixed invasive woodland vegetation unit, and least applicable for the wetland vegetation unit, however, overall no functional CBA zone was determined present in any of the vegetation units - as confirmed by the site assessment results.

Furthermore, while the vegetation type deemed to be present in the project area has a high conservation value according to Mucina and Rutherford (2012), the highly degraded real-world condition of the vegetation units observed during the field assessment confirmed a modest overall conservation contribution. The degraded mixed grassland vegetation unit within the project area thus weakly resembled Tsakane Clay Grassland, but remains highly degraded, with poor ecological functioning and a low conservation contribution, and as such does not represent a good conservation opportunity and does not currently contribute to the overall health and conservation status of the Tsakane Clay Grassland vegetation type or ESA status.

Furthermore, the mixed invasive woodland vegetation unit did not resemble Tsakane Clay Grassland at all due to the high composition of invasive species within this vegetation unit and due to the low species diversity - and presence - of diagnostic Tsakane Clay Grassland species. This vegetation unit therefore also did not represent a good conservation opportunity and does not currently contribute to the overall health and conservation status of the Tsakane Clay Grassland vegetation type or the ESA status.

7.3. No-go and buffer areas

An ecological resource buffer zone is typically an area of vegetated, un-developed land surrounding a natural resource that is maintained to protect, support and screen flora and fauna associated with a resource from the disturbances associated with neighbouring land uses and / or a proposed development. Depending on the current condition and sensitivity of a given feature (for instance, identified vegetation units), buffer zones of varying distances may be required to adequate protect and minimise the edge impacts on such features.

Despite the presence of high sensitivity wetland vegetation on site, these areas are **not** regarded as no-go areas, **for which no buffer areas were deemed necessary**, due primarily to their existing highly degraded nature (refer to section 6.2 above) and the proposed horizontal directional drilling methods for these areas. Should these areas be required for construction and operation, they must however be subjected to stringent mitigation measures to ensure limited impact on their ecological function and current condition. Importantly, due to the National Water Act definition of water use, traversing or crossing these areas will require water use authorisation from the Department of Water and Sanitation (DWS), which must form part of any mitigation strategy where such areas are involved in a proposed development.

7.4. Sensitivity map

A sensitivity map was developed based on the allocations made in Sections 7.1 above, for the entire project area (Figure 7.1, Figure 7.2 and Figure 7.3). As indicated, no regions of moderate sensitivity were determined for within the project area and for the proposed project. In addition, no areas are deemed no-go zones provided stringent mitigation measures are applied, and DWS water use authorisation is granted. Furthermore, no buffer zones are required for implementation within the project area. This is primarily due to the poor ecological condition of much of the project area and the highly degraded nature of the surface water features found during the field assessment.

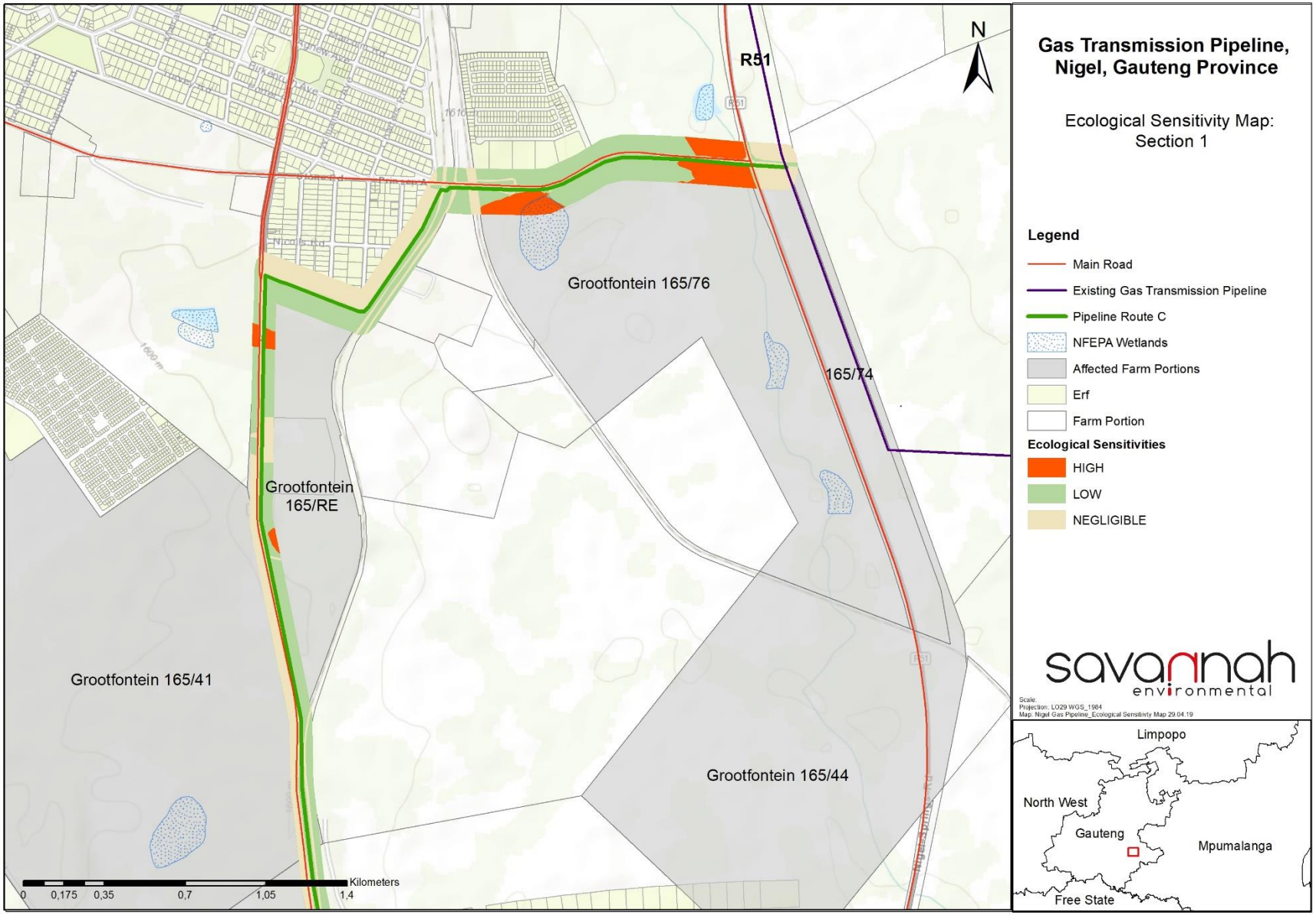

Figure 7.1. Ecological sensitivity map of the project area – Section 1/3.

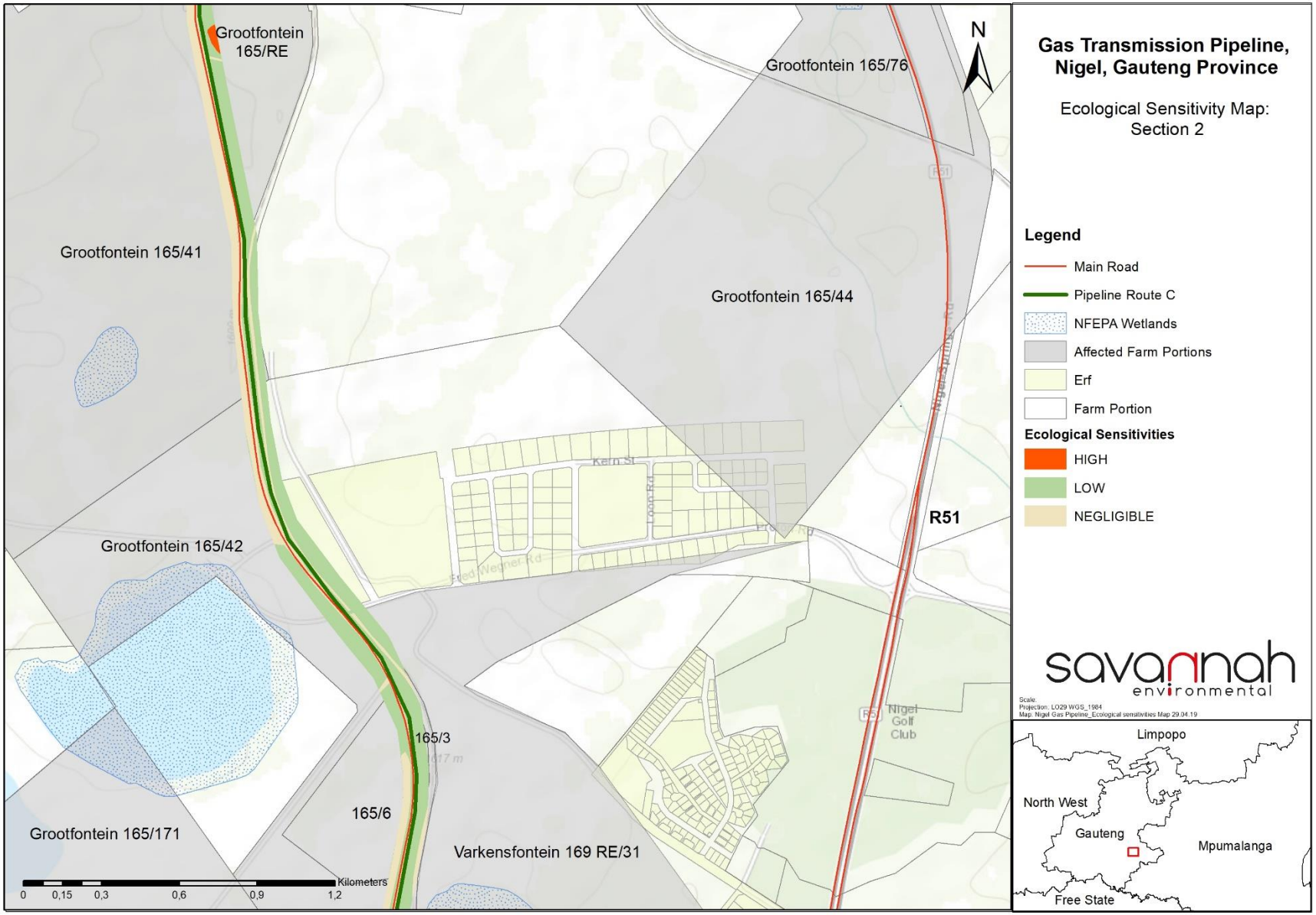

Figure 7.2. Ecological sensitivity map of the project area – Section 2/3.

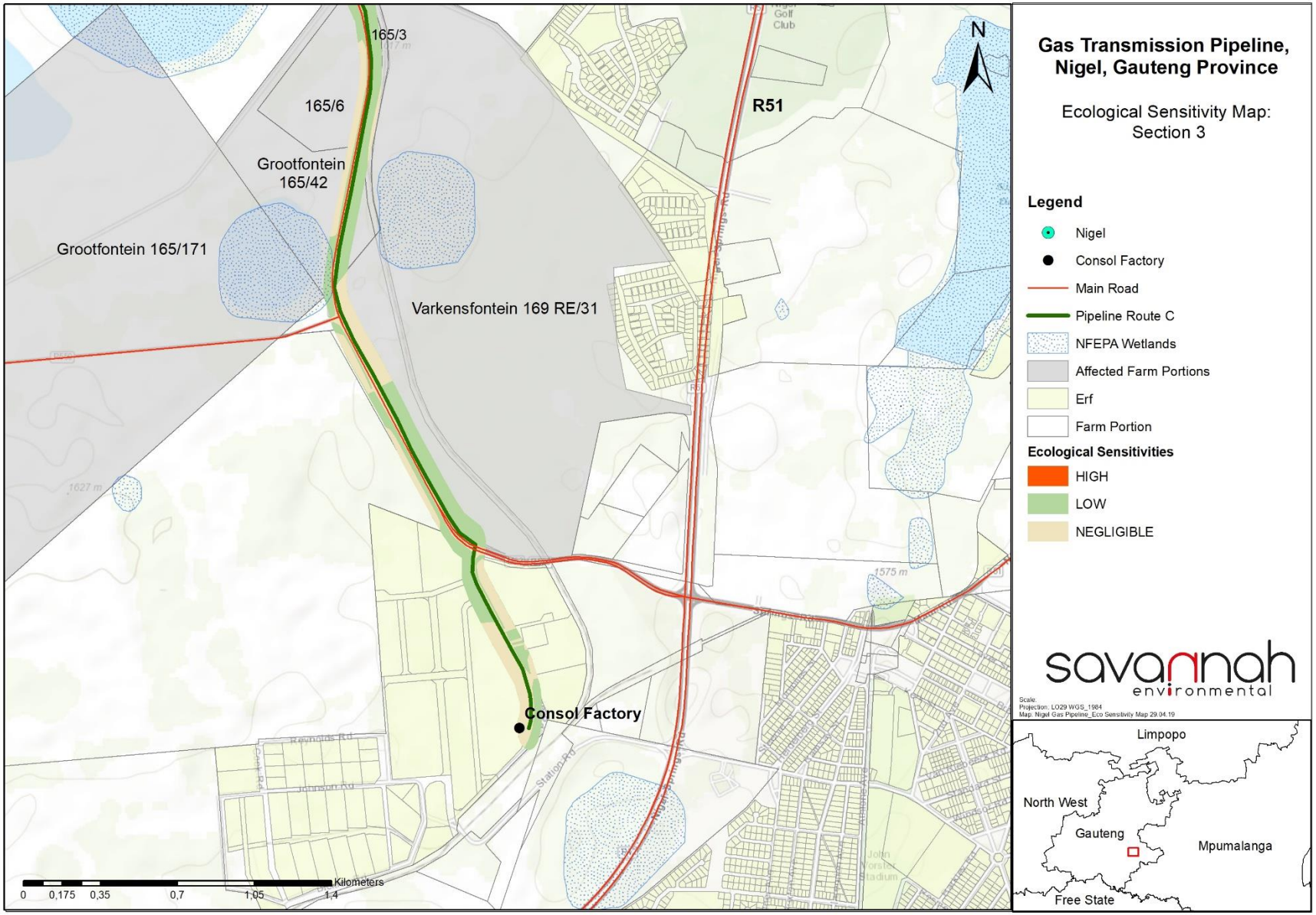

Figure 7.3. Ecological sensitivity map of the project area – Section 3/3.

8. IMPACT ASSESSMENT

This study provides the necessary information to assess the impacts of the project on the fauna and flora at various spatial and temporal scales.

The individual impacts have been grouped together as a series of key environmental issues (Table 8.1). All of the issues relate to the loss of the existing vegetation cover and faunal habitat as a result of project activities within the development corridor. The main issues identified with the existing impacts are discussed below for each phase of the project.

Table 8.1. Issues identified from the sensitivity analysis.

ISSUES IDENTIFIED	DESCRIPTION OF IMPACTS
Loss of vegetation communities	The clearing of natural vegetation will lead to the permanent loss of highly degraded Tsakane Clay Grassland within the mixed grassland vegetation unit in the development corridor.
Loss of biodiversity and Ecosystem Function and Process	The clearing of natural vegetation for the proposed development may lead to the destruction of habitats and the loss of unidentified plant SCC, disrupting ecosystem function and processes, especially around surface water features
Control of alien plant species	The lack of an effective alien vegetation management plan may lead to further alien plant invasion following construction earthworks.
Erosion	During construction activities, the site will be vulnerable to erosion.
Loss of Critical Biodiversity Area or ESA areas	Although minor in extent, the region classified as CBA and ESA will be partially cleared during construction, resulting in a loss of CBA and ESA classified area in the development corridor.
Rehabilitation of disturbed areas	Poor rehabilitation of disturbed areas after construction may lead to the permanent degradation of ecosystems, increased erosion as well as allow invading alien vegetation species to expand.
Cumulative impacts: loss of biodiversity and conservation potential	Cumulative impacts may result from similar development types in the broader study area. These impacts are addressed below in conjunction with their associated impacts.

8.1. Planning and Design Phase

Activities associated with the design and pre-construction phase pertains mostly to a feasibility assessment which is done at a desktop level. As such, no planning and design phase ecological impacts are expected.

8.2. Construction Phase

This section contains the assessment of all impacts associated with the construction phase, as they relate to the proposed development.

8.2.1. Issue 1: Loss of vegetation communities

Impact 1.1: Loss of highly degraded Tsakane Clay Grassland

Nature:
The clearing of natural vegetation within the development corridor will lead to the loss of Tsakane Clay Grassland, albeit in its current highly degraded state, which is considered an endangered vegetation type by SANBI. This vegetation type occurs along the entire length op proposed pipeline route and impact is inevitable.

	Without mitigation	**With mitigation**
Extent	Local (2)	Immediate area (1)
Duration	Very short term (1)	Very short term (1)
Magnitude	Moderate (6)	Minor (2)
Probability	Definite (5)	Definite (5)
Significance	**Medium (45)**	**Low (20)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes

Mitigation:

- Since this vegetation type is listed as endangered, impacts must be kept to a minimum through the development and implementation of an EMPr, and the employment of an Environmental Control Officer (ECO) for the duration of construction.
- Laydown areas and turning areas must be located in areas that have already been impacted or show evidence of degradation. The EO must identify such areas.
- Vegetation clearing for the establishment of infrastructure must be kept to a minimum, by only clearing what is absolutely needed in order to further construction.
- Vegetation impacted during the construction phase must be restored.
- Topsoil must be stockpiled separately to subsoil. This is done to conserve the existing seedbank and aid in the restoration of natural grasslands during rehabilitation.

Residual Risks:
The loss of highly degraded Tsakane Clay Grassland is inevitable for the construction of the proposed infrastructure; however, the highly disturbed and low conservation value within the development corridor contributes to a low residual risk remaining following the implementation of mitigation measures.

Impact 1.2: Loss of Species of Conservation Concern

Nature:
While highly unlikely, SCC that were not found during the field assessment may still be present on site. As such, the clearing of natural vegetation within the project footprint may lead to the loss of Species of Conservation Concern (SCC).

	Without mitigation	**With mitigation**
Extent	Local (2)	Immediate area (1)
Duration	Medium term (3)	Medium term (3)
Magnitude	Moderate (6)	Moderate (6)
Probability	Improbable (2)	Very improbable (1)
Significance	**Low (22)**	**Low (10)**
Status (positive or negative)	Negative	Negative

Reversibility	Low	Low
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes
Mitigation: » Should any SCC be identified during excavation, these must be relocated or removed from the construction footprint by a qualified specialist prior to commencement of further activities. » In the event that SCC are identified during construction works, the relevant permits must be obtained from the relevant departments in order to remove such species prior to commencement of further activities.		
Residual Risks: The loss of SCC during the construction of the proposed infrastructure is highly unlikely, and as such the residual risk following the implementation of mitigation measures was deemed low.		

8.2.2. Issue 2: Loss of biodiversity and ecosystem function

Impact 2.1: Loss of floral and faunal biodiversity leading to a disruption of ecosystem function and processes

Nature: The disturbance of natural vegetation and faunal habitats within the development corridor and near surface water features will lead to a loss of biodiversity and ecosystem function and processes.		
	Without mitigation	**With mitigation**
Extent	Local (2)	Immediate area (1)
Duration	Medium term (3)	Medium term (3)
Magnitude	Low (4)	Minor (2)
Probability	Probable (3)	Improbable (2)
Significance	**Low (27)**	**Low (12)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes
Mitigation: » Prohibit all employees from harvesting wild plants or hunting any animals on site; » Prohibit open fires; » Rehabilitate laydown areas immediately after they are no longer required; » Develop an invasive management plan and implement during construction to ensure alien species do not invade disturbed or cleared areas and that ongoing invasions are controlled and limited as far as possible; » An ECO must be employed during construction; » Laydown areas and turning areas must be located in areas that have already been impacted or show evidence of degradation. The EO must identify such areas. » Vegetation clearing for the establishment of infrastructure must be kept to a minimum, by only clearing what is absolutely needed in order to further construction.		

» Vegetation impacted must be restored and the area rehabilitated. It is likely that this will occur naturally but given the presence of alien species active rehabilitation and the removal of alien species will be required to ensure that only indigenous species remain. » Topsoil must be stockpiled separately to subsoil. » Where required by DWS for water features, implement the horizontal directional drilling methodology to reduce the impact on surface water features and wetland vegetation as far as possible; » Where unavoidable, and as far as possible, conduct trenching work through the wetland vegetation unit during the dry season.
Residual Risks: The disturbance of faunal and floral biodiversity during the construction of the proposed infrastructure is unlikely, and the small extent of the site, the low conservation status of each of the identified species on site contribute to a low residual risk following the implementation of mitigation measures.

8.2.3. Issue 3: Control of alien plant species

Impact 3.1: Poor control of alien plant species during construction leading to increasing invasive species presence.

Nature: The lack of an effective alien vegetation management plan may lead to alien plant invasion following construction earthworks.		
	Without mitigation	**With mitigation**
Extent	Local (2)	Immediate area (1)
Duration	Medium term (3)	Medium term (3)
Magnitude	Moderate (6)	Minor (2)
Probability	Probable (3)	Probable (3)
Significance	**Medium (33)**	**Low (18)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes
Mitigation: » An Alien Plant Monitoring and Management Plan must be developed and implemented during the construction phase to reduce the establishment and spread of undesirable alien plant species. » Alien plants must be removed from the site through appropriate methods for the specific species of concern such as hand pulling, application of chemicals, cutting etc., on a regular basis during construction.		
Cumulative impacts: Due to the already highly invaded nature of the development corridor and broader project area, the cumulative impact of increasing invasive species abundance in the region is deemed low. Regardless, effective alien invasive species management through the implementation of the alien management plan is required to reduce introduction and establishment of novel invasive species, and to control the extent of current invasive species.		
Residual Risks:		

Due to the already highly invaded nature of the development corridor and broader project region, the residual risk following implementation of mitigation measures is deemed low.

8.2.4. Issue 4: Erosion

Impact 4.1: Increased erosion due to vegetation clearing for infrastructure.

Nature:
During construction activities, the site will be vulnerable to erosion.

	Without mitigation	**With mitigation**
Extent	Local (2)	Immediate area (1)
Duration	Medium (3)	Short (2)
Magnitude	Low (4)	Minor (2)
Probability	Probable (3)	Improbable (2)
Significance	**Low (27)**	**Low (10)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes

Mitigation:

- Any erosion observed as a result of the construction works should be rectified immediately and monitored thereafter to ensure interventions are successful.
- All bare areas, affected by the development, should be re-vegetated with locally occurring species, to bind the soil and limit erosion potential.
- Reinstate as much of the eroded area to its pre-disturbed, "natural" levels.
- During the construction phase, gravel access road and other disturbed areas (laydown areas) should be regularly monitored for erosion occurrences and must receive follow-up monitoring by the EO to assess the success of the erosion management.
- Topsoil should be removed and stored separately from subsoil and should be reapplied where appropriate as soon as possible in order to encourage and facilitate rapid regeneration of the natural vegetation on cleared areas.
- Where feasible, phased development and vegetation clearing should be practiced so that cleared areas are not left denuded and vulnerable to erosion for extended periods of time.

Residual Risks:
With appropriate avoidance and mitigation, residual impacts will be very low and may be limited little potential to spread beyond the point of origin.

8.2.5. Issue 5: Loss of Critical Biodiversity Area (CBA) or Ecological Support Areas (ESA)

Impact 5.1: Loss of areas classified as CBA or ESA due to vegetation clearance.

Nature:
Although small in extent, some areas classified as CBA and ESA will be partially cleared during construction, resulting in a loss of CBA and ESA area. These areas are however not regarding as functioning CBA due to the highly degraded state of the development corridor in particular.

	Without mitigation	With mitigation
Extent	Local (2)	Immediate area (1)
Duration	Medium (3)	Short (2)
Magnitude	Low (4)	Minor (2)
Probability	Probable (3)	Probable (3)
Significance	**Low (27)**	**Low (18)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Moderate
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes

Mitigation:

- Prohibit all employees from harvesting wild plants or hunting any animals on site or in the surrounding areas;
- Prohibit open fires;
- Rehabilitate laydown areas immediately after they are no longer required;
- Develop an invasive management plan and implement during construction to ensure alien species do not invade disturbed or cleared areas;
- An ECO must be employed during construction;
- Laydown areas and turning areas must be located in areas that have already been impacted or show evidence of degradation. The EO must identify such areas.
- Vegetation clearing for the establishment of infrastructure must be kept to a minimum, by only clearing what is absolutely needed in order to further construction.
- Vegetation impacted must be restored and the area rehabilitated. It is likely that this will occur naturally but given the presence of alien species active rehabilitation and the removal of alien species will be required to ensure that only indigenous species remain.
- Topsoil must be stockpiled separately to subsoil.

Residual Risks:

Due to the already highly invaded nature of the development corridor and broader project region, the residual risk following implementation of mitigation measures is deemed low.

8.3. Operations Phase

This section contains the assessment of all impacts associated with the operational phase, as they relate to the proposed development.

8.3.1. Issue 6: Control of alien plant species

Impact 6.1: Poor control of alien plant species leading to increasing invasive species presence.

Nature:

Following the earthworks during construction, dormant seeds and newly introduced seed may germinate leading to a spate of invasive alien species into the operations phase. The lack of an effective alien vegetation management plan, and implementation thereof during operations, may lead to increasing alien plant communities within the development corridor.

	Without mitigation	With mitigation

Extent	Local (2)	Immediate area (1)
Duration	Medium (3)	Medium (3)
Magnitude	Low (4)	Minor (2)
Probability	Improbable (2)	Improbable (2)
Significance	**Low (18)**	**Low (12)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes
Mitigation: » As the project is contained with the road reserve, an Alien Plant Monitoring and Management Plan must be developed and implemented by the responsible roads agency to form part of their ongoing road maintenance programme. Ongoing control efforts must thus be implemented by the roads agency through the relevant maintenance plan for the road verges.		
Residual Risks: Due to the already highly invaded nature of the development corridor and broader project region, the residual risk following implementation of mitigation measures is deemed low.		

8.4. Decommissioning Phase

The decommissioning of the project could have a positive impact on the natural vegetation and faunal habitats on site, if the disturbed areas are appropriately rehabilitated (should that be possible at the time). This section contains the assessment of all impacts associated with the decommissioning phase, as they relate to the proposed development.

8.4.1. Issue 7: Disturbance, poor rehabilitation and associated impacts

Impact 7.1: Loss of floral and faunal biodiversity from poor rehabilitation efforts during closure, leading to a disruption of ecosystem function and processes, as well as increased erosion due to vegetation clearing for removal of infrastructure.

Nature: During the decommissioning phase, project infrastructure will be removed. The removal process may result in the clearance of vegetation. In addition, there will be large areas of bare ground where the project infrastructure was located along the pipeline route. Without vegetation cover, these areas are sensitive to erosion, invasion by alien plant species and will reduce the biodiversity potential within the development corridor.		
	Without mitigation	**With mitigation**
Extent	Local (2)	Immediate area (1)
Duration	Short (2)	Very short (1)
Magnitude	Moderate (6)	Low (4)
Probability	Highly probable (4)	Highly probable (4)
Significance	**Medium (40)**	**Low (24)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High

Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes

Mitigation:

- » Design and implement a rehabilitation plan for the decommissioning phase;
- » Design and implement an erosion management plan for the decommissioning phase;
- » Any erosion observed should be rectified immediately and monitored thereafter to ensure interventions are successful.
- » All bare areas, affected by the development, should be re-vegetated with locally occurring species, to bind the soil and limit erosion potential.
- » Reinstate as much of the eroded area to its pre-disturbed, "natural" levels
- » Topsoil should be removed and stored separately and should be reapplied where appropriate as soon as possible in order to encourage and facilitate rapid regeneration of the natural vegetation on cleared areas.
- » Where feasible, phased development and vegetation clearing should be practiced so that cleared areas are not left denuded and vulnerable to erosion for extended periods of time.

Residual Risks:

Considering the small extent of the development corridor, and the low conservation status of each of the identified species on site and their widespread distribution, a low to negligible residual risk following the implementation of mitigation measures was deemed appropriate for the decommissioning phase.

8.5. Cumulative Impacts

8.5.1. Issue 8: Loss of biodiversity and conservation potential

Impact 8.1: Reduced ability to meet conservation obligations and targets.

Nature:

The loss of sensitive vegetation types on a cumulative basis in the broader context impacts the ability to meet stated conservation targets for Tsakane Clay Grassland in particular.

	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Immediate area (1)	Local (2)
Duration	Medium (3)	Medium (3)
Magnitude	Minor (2)	Low (2)
Probability	Probable (3)	Probable (3)
Significance	**Low (18)**	**Low (21)**
Status (positive or negative)	Negative	Negative
Reversibility	High	Moderate
Irreplaceable loss of resources?	No	Unlikely
Confidence in findings	High	Low
Can impacts be mitigated?	Yes	Yes

Mitigation:

- » The development footprints of similar or related facilities in the area must be kept to a minimum and natural vegetation should be encouraged to return to disturbed areas.

» Reduce the footprint of facilities within proven sensitive habitat types as much as possible. » An Alien Plant Monitoring and Management Plan must be developed and implemented by similar or related facilities to reduce the establishment and spread of undesirable alien plant species.
Residual Risks: Some loss of vegetation is inevitable, and cannot be avoided, however the vegetation in the development corridor has a low sensitivity and conservation value, and contributes very little ecological function to the broader study area, especially in the road reserve where the proposed pipeline will be placed. Cumulative loss of conservation potential is thus regarded as low taking into account other possible developments within the broader study region.

Impact 8.2: Impacts on Critical Biodiversity Areas and Broad-Scale Ecological Processes.

Nature: Although small in extent, some areas classified as CBA and ESA will be partially cleared during construction, resulting in a loss of CBA and ESA area. These areas are however not regarding as functioning CBA due to the highly degraded state of the development corridor in particular.		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Immediate area (1)	Local (2)
Duration	Medium (3)	Medium (3)
Magnitude	Minor (2)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**Low (18)**	**Low (27)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Moderate
Irreplaceable loss of resources?	No	Likely
Confidence in findings	High	Low
Can impacts be mitigated?	Yes	Yes
Mitigation: » The development footprints of similar or related facilities in the area must be kept to a minimum and natural vegetation should be encouraged to return to disturbed areas. » Reduce the footprint of facilities within proven sensitive habitat types as much as possible. » Conserve the aquatic features within the broader landscape by allocating sufficient buffers to these and reducing development within those buffers as far as possible.		
Residual Risks: Some loss of CBA and ESA areas is inevitable, and cannot be avoided, however the vegetation in the development corridor has a low sensitivity and conservation value, and contributes very little ecological function to the broader study area. Cumulative loss of CBA and ESA regions is thus regarded as low taking into account other likely developments within the broader study region.		

8.6. 'No-go' option

A viable alternative, the 'no-go' option, which essentially refers to the indefinite continuation of the current land use and operational management of the area, must also be assessed. This section therefore assesses the impact of carrying on with the current activities on site, in terms of their ecological impact.

8.6.1. Issue 9: Control of alien plant species

Impact 9.1: Poor control of alien plants within the development corridor *will lead to increasing invasive species presence, as well as regulatory liability for their control*

Nature: The lack of an effective alien vegetation management plan (and implementation thereof) will lead to increasing alien plant communities on site.	
	Without mitigation
Extent	Regional (3)
Duration	Medium (3)
Magnitude	High (8)
Probability	Definite (5)
Significance	**High (70)**
Status (positive or negative)	Negative
Reversibility	Low
Irreplaceable loss of resources?	No
Can impacts be mitigated?	Yes – provided an alien monitoring and management plan is developed and implemented by the governing authorities.
Mitigation: » An Alien Monitoring and Management Plan must be developed and implemented along the road verge and near areas where recent earthworks have occurred, to limit the further establishment and spread of undesirable alien plant species. » Ongoing monitoring should be conducted by city management and staff to ensure problem-areas are identified where alien species are proliferating, and to inform the control efforts throughout the operational phase. » Alien plants must be removed from the site through appropriate methods such as hand pulling, application of chemicals, cutting etc., on a regular basis during operation.	
Residual Risks: Not applicable	

8.6.2. Issue 10: Loss of biodiversity and species richness from frequent fires

Impact 10.1: Poor control of fires on site, initiated by the ongoing burning of waste adjacent to the development corridor*, will alter the species composition and richness of the existing vegetation and continue to degrade the ecological function and processes in the* development corridor.

Nature: The lack of an effective fire control mechanism on site will promote the frequent burning of vegetation in the project area, which in turn will lead to a loss in species richness and biodiversity represented by the vegetation units in the development corridor.	
	Without mitigation

Extent	Regional (3)
Duration	Medium (3)
Magnitude	Moderate (6)
Probability	Highly probable (4)
Significance	**Medium (48)**
Status (positive or negative)	Negative
Reversibility	High
Irreplaceable loss of resources?	No
Can impacts be mitigated?	Yes

Mitigation:

» Municipal fire control and monitoring methods must be rigorously implemented to reduce incidents of unplanned, runaway fires, especially during the winter months.

Cumulative impacts:

Due to the high occurrence of fires within the broader Gauteng region in the winter months, and the high likelihood of fires initiating within the proposed pipeline footprint, poor fire control measures will continue to cumulatively reduce the regional ecological function by altering species composition and abundance where frequent burning occurs. This will serve to slowly reduce overall biodiversity functioning and health for the regions affected.

Residual Risks:

Not applicable.

9. IMPACT STATEMENT, CONCLUSION AND RECOMMENDATIONS

9.1. Comparison of impacts

The following table (Table 9.1) summarises the change in impacts from pre- to post- mitigation for the proposed development (in terms of ecological impacts).

Table 9.1. Impact severity summary pre- and post-mitigation for all phases.

SEVERITY	PRE-MITIGATION (or in isolation – for cumulative impacts)					
	Construction	Operations	Decommissioning	Cumulative*	TOTAL	No-go alternative**
LOW	4	1	0	2	7	0
MEDIUM	2	0	1	0	3	1
HIGH	0	0	0	0	0	1
SEVERITY	POST-MITIGATION (or broader context – for cumulative impacts)					
	Construction	Operations	Decommissioning	Cumulative***	TOTAL	
LOW	6	1	1	2	10	
MEDIUM	0	0	0	0	0	
HIGH	0	0	0	0	0	

*Cumulative impacts here rated in isolation.
**No-go Alternative impacts are represented here for comparison only.
***Cumulative impacts here rated in combination with other projects in the broader region, in this section.

Based on the results of the field assessment, the sensitivity analysis and the impact assessment, none of the anticipated impacts were deemed insurmountable, as all the pre-mitigation medium impacts were readily mitigated, and no high severity impacts were identified. Ecological areas have been mapped in terms of sensitivity for the project area and recommendations in chapter 8 in this report provide mitigation measures to reduce the severity of the impacts. Overall, it was determined that the identified ecological impacts associated with the facility can be affectively mitigated.

9.2. Current status

At present, the project area and development corridor in particular, are deemed highly disturbed due to ongoing disturbance through fires, invasive species, grazing, illegal dumping, pedestrian movements, road verge maintenance, historical infrastructure and recent construction. The development corridor remains unfenced and open to the public which promotes ongoing impacts identical to those just mentioned. No sensitive Species of Conservation Concern were observed within the development corridor, with the remainder of the species observed regarded as Least Concern (LC) in terms of their conservation status. Overall the ecological contribution of development corridor was deemed to be low, with no sensitive species observed and few ecological process areas and habitats due to the small size and highly disturbed character of the development corridor.

The CBA classification for the development corridor also does not correspond to the real-world condition of the plant and animal species observed during the field assessment, and therefore contributes poorly to the ecological function of the broader area. As such, no functional CBA zones were deemed present within the development corridor, as confirmed by the site assessment results, and thus the proposed development will not significantly impact the overall quantity and quality of the remaining CBA areas in the broader study

area. The project may thus commence with little lasting negative impact on the current CBA classification of the immediate development corridor and broader project area.

Furthermore, while the vegetation type present on site has a high conservation value according to Mucina and Rutherford (2012), the highly degraded real-world condition of the vegetation units observed within the development corridor confirmed a minimal overall conservation contribution, with the exception of wetland vegetation areas. Only the degraded mixed grassland vegetation unit within the development corridor resembles Tsakane Clay Grassland, but is highly degraded, with poor ecological functioning and a low conservation contribution, and as such does not represent a good conservation opportunity and does not currently contribute to the overall health and conservation status of the Tsakane Clay Grassland vegetation type. Should the development proceed, the loss of the highly degraded Tsakane Clay Grassland vegetation unit in the project area will not significantly reduce the conservation potential and current distribution of the vegetation type as a whole, due primarily to the severely degraded nature of this vegetation unit within the project area, and in particular the development corridor.

In addition, the mixed invasives woodland vegetation unit was not deemed to contribute significantly to the ecological functioning of the study area, due largely to the low species diversity, invasive nature of the vegetation within this unit, and the limited extent thereof.

Conversely, due to the important nature of the processes associated with wetland vegetation (water feature within the landscape), the wetland vegetation unit was deemed a highly sensitive area, for which stringent mitigation measures must apply in order to allow for development therein. Considering the minimally invasive construction methodology proposed for large portions of this vegetation unit, and the mitigation measures supplied in this report, this vegetation unit was **not** deemed a no-go area and construction may proceed on condition of first obtaining appropriate licencing from DWS, and strict implementation of the mitigation measures contained in this report.

There are a vast number and variety of alien invasive plant species present onsite, particularly near the bridge structures, immediate road reserve and areas where previous construction activities have degraded the environment. The particular alien invasive plant species found on site, as well as their category according to the NEMBA Alien and Invasive Species Regulations (published 1 August 2014) are presented in Chapter 6 of this report. Due to the high number and large extent of alien invasive plants found within the project area, it is requested that an alien and invasive management plan is drafted and implemented during the construction and operations phases, and that active management of alien and invasive species is conducted as a matter of priority.

Cumulative impacts were also determined for the project, with low severity identified for both cumulative impacts relating to the issue of a loss of biodiversity. Mitigation measures have been provided for the management of these impacts in the context of the broader study area. In addition, the development was not regarded as setting a further development precedent in the broader Nigel area.

Overall, some loss of biodiversity is inevitable, and cannot be avoided, however the vegetation on site generally has a low sensitivity and conservation value, and contributes very little ecological function (and CBA/ESA area) to the broader study area. Cumulative loss of conservation potential is therefore regarded as low taking into account other likely developments within the broader study area. The cumulative impacts are deemed acceptable considering the existing poor condition of the site, and the broader character of the study area (i.e. already developed and highly degraded).

9.3. Conditions for approval and mitigation measures to be included into the EMPr

All mitigation measures as supplied for the construction, operational and decommissioning phases in Chapter 8 of this report must be implemented as a condition of the environmental authorisation. These measures are summarised below for convenience.

9.3.1. Construction phase

- Alien plants must be removed from the site through appropriate methods for the specific species of concern such as hand pulling, application of chemicals, cutting etc., on a regular basis during construction.
- All bare areas, affected by the development, should be re-vegetated with locally occurring species, to bind the soil and limit erosion potential.
- An Alien Plant Monitoring and Management Plan must be developed and implemented during the construction phase to reduce the establishment and spread of undesirable alien plant species.
- Since this vegetation type is listed as endangered, impacts must be kept to a minimum through the development and implementation of an EMPr, and the employment of an Environmental Control Officer (ECO) for the duration of construction.
- Any erosion observed as a result of the construction works should be rectified immediately and monitored thereafter to ensure interventions are successful.
- Develop an invasive management plan and implement during construction to ensure alien species do not invade disturbed or cleared areas and that ongoing invasions are controlled and limited as far as possible;
- In the event that SCC are identified during construction works, the relevant permits must be obtained from the relevant departments in order to remove such species prior to commencement of further activities.
- Laydown areas and turning areas must be located in areas that have already been impacted or show evidence of degradation. The EO must identify such areas.
- Prohibit all employees from harvesting wild plants or hunting any animals on site or in the surrounding areas;
- Prohibit open fires;
- Rehabilitate laydown areas immediately after they are no longer required;
- Reinstate as much of the eroded area to its pre-disturbed, "natural" levels.
- Should any SCC be identified during excavation, these must be relocated or removed from the construction footprint by a qualified specialist prior to commencement of further activities.
- During the construction phase, gravel access road and other disturbed areas (laydown areas) should be regularly monitored for erosion occurrences and must receive follow-up monitoring by the EO to assess the success of the erosion management.
- Topsoil must be stockpiled separately to subsoil. This is done to conserve the existing seedbank and aid in the restoration of natural grasslands during rehabilitation.
- Topsoil should be removed and stored separately from subsoil and should be reapplied where appropriate as soon as possible in order to encourage and facilitate rapid regeneration of the natural vegetation on cleared areas.
- Vegetation clearing for the establishment of infrastructure must be kept to a minimum, by only clearing what is absolutely needed in order to further construction.
- Vegetation impacted during the construction phase must be restored.
- Vegetation impacted must be restored and the area rehabilitated. It is likely that this will occur naturally but given the presence of alien species active rehabilitation and the removal of alien species will be

required to ensure that only indigenous species remain.
- » Where feasible, phased development and vegetation clearing should be practiced so that cleared areas are not left denuded and vulnerable to erosion for extended periods of time.
- » Where required by DWS for water features, implement the horizontal directional drilling methodology to reduce the impact on surface water features and wetland vegetation as far as possible;
- » Where unavoidable, and as far as possible, conduct trenching work through the wetland vegetation unit during the dry season.

9.3.2. Operations phase

- » As the project is contained with the road reserve, an Alien Plant Monitoring and Management Plan must be developed and implemented by the responsible roads agency to form part of their ongoing road maintenance programme. Ongoing control efforts must thus be implemented by the roads agency through the relevant maintenance plan for the road verges.

9.3.3. Decommissioning phase

- » All bare areas, affected by the development, should be re-vegetated with locally occurring species, to bind the soil and limit erosion potential.
- » Any erosion observed should be rectified immediately and monitored thereafter to ensure interventions are successful.
- » Design and implement a rehabilitation plan for the decommissioning phase;
- » Reinstate as much of the eroded area to its pre-disturbed, "natural" levels
- » Topsoil should be removed and stored separately and should be reapplied where appropriate as soon as possible in order to encourage and facilitate rapid regeneration of the natural vegetation on cleared areas.
- » Where feasible, phased development and vegetation clearing should be practiced so that cleared areas are not left denuded and vulnerable to erosion for extended periods of time.

9.4. Monitoring requirements

Two primary aspects emanating from the impact assessment require monitoring:

- » Invasive alien plant species; and
- » Decommissioning and rehabilitation.

Invasive alien plant species:
The earthworks associated with construction activities allows for the proliferation of invasive species through the spread of seed via transported material into novel environments. In addition, the presence of known invasive species on site further necessitate the monitoring and control of invasive alien plant species, so as to ensure no further spread and establishment of the current populations is allowed. The following monitoring protocol must be employed specifically to (Table 9.2):

i. Identify plant species on site that require control action; and
ii. Identify the location of invasive plant communities on site;

Table 9.2. Monitoring protocol for invasive alien plant species during construction and operations.

PHASE	FREQUENCY	PERSON RESPONSIBLE
CONSTRUCTION		
Monitoring of ongoing construction activities or site condition to ensure no new species have established on site, and to identify effective control measures for such invasive plant communities	Every three months	Site manager (operational manager)
Monitoring of ongoing construction activity and earthworks to identify species and locations of new occurrences of invasive alien plants	Once monthly	Environmental Site Officer/Resident Engineer
Monitoring of soil stockpiles and laydown areas for Alien Invasive Species growth	Once monthly	Environmental Site Officer/Resident Engineer
OPERATION		
Monitoring of ongoing operational and maintenance activities or site condition to ensure no new species have established on site, and to identify effective control measures for such invasive plant communities	As indicated in the invasive species management plan of the roads agency	Roads Agency

Decommissioning and rehabilitation:
Rehabilitation measures conducted during rehabilitation of the site must ensure that the low sensitivity areas are appropriately restored to a near-natural state prior to site closure. As such, a rehabilitation plan for the decommissioning phase must be designed and implemented prior to the commencement of decommissioning. The implementation of this plan must be monitored by a suitable representative (Environmental Site Officer, Resident Engineer or Contractors Representative) and in accordance with the frequency and method as determined by the rehabilitation plan.

9.5. Environmental statement and specialist opinion

The ecological impacts of all aspects for the proposed project were assessed and considered to be ecologically acceptable (i.e. **no fatal flaws** were determined), provided that the mitigation measures provided in this report are implemented, and that relevant licencing is obtained from the Department of Water and Sanitation (DWS) for works conducted within or near the watercourses. Implementation of recommended mitigation measures is an important element of the mitigation strategy and will reduce all identified impacts to low negative.

No alternatives, apart from the no-go option, were considered for this project. However, the no-go option allows for two ongoing impacts of High and medium severity respectively. Should this project proceed, these impacts may be reduced through implementation of the measures contained in this report, and by virtue of having a responsible agency for implementation of erosion and invasive species control in particular. As such, this development proposal represents an opportunity to reduce invasive species presence and improve erosion and fire management of the site (provided mitigation measures are strictly and effectively implemented) and may thus serve to preserve the current poor ecological functioning of the site in the longer term. Cumulative impacts from this development proposals were all deemed low or negligible in the context of ecological functioning and contribution of the project site.

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11. APPENDIX A: COMPREHENSIVE SPECIES LISTS FOR FAUNAL AND FLORAL SPECIES THAT MAY OCCUR ON SITE

Table 11.1. Full species list of reptiles that may occur on the project site.

Family	Scientific name	Common name	Red list category (SARCA, 2014)
Agamidae	*Agama aculeata distanti*	Distant's Ground Agama	LC
Agamidae	*Agama atra*	Southern Rock Agama	LC
Colubridae	*Crotaphopeltis hotamboeia*	Red-lipped Snake	LC
Colubridae	*Dasypeltis scabra*	Rhombic Egg-eater	LC
Cordylidae	*Cordylus vittifer*	Common Girdled Lizard	LC
Cordylidae	*Pseudocordylus melanotus melanotus*	Common Crag Lizard	LC
Elapidae	*Hemachatus haemachatus*	Rinkhals	LC
Gekkonidae	*Pachydactylus affinis*	Transvaal Gecko	LC
Gekkonidae	*Pachydactylus capensis*	Cape Gecko	LC
Gerrhosauridae	*Gerrhosaurus flavigularis*	Yellow-throated Plated Lizard	LC
Lacertidae	*Nucras lalandii*	Delalande's Sandveld Lizard	LC
Lamprophiidae	*Aparallactus capensis*	Black-headed Centipede-eater	LC
Lamprophiidae	*Boaedon capensis*	Brown House Snake	LC
Lamprophiidae	*Lamprophis aurora*	Aurora House Snake	LC
Lamprophiidae	*Lycodonomorphus rufulus*	Brown Water Snake	LC
Lamprophiidae	*Lycophidion capense capense*	Cape Wolf Snake	LC
Lamprophiidae	*Prosymna sundevallii*	Sundevall's Shovel-snout	LC
Lamprophiidae	*Psammophis crucifer*	Cross-marked Grass Snake	LC
Lamprophiidae	*Psammophylax rhombeatus*	Spotted Grass Snake	LC
Lamprophiidae	*Pseudaspis cana*	Mole Snake	LC
Leptotyphlopidae	*Leptotyphlops scutifrons conjunctus*	Eastern Thread Snake	Unlisted
Scincidae	*Panaspis wahlbergi*	Wahlberg's Snake-eyed Skink	LC
Scincidae	*Trachylepis punctatissima*	Speckled Rock Skink	LC
Scincidae	*Trachylepis varia sensu lato*	Common Variable Skink Complex	LC
Testudinidae	*Stigmochelys pardalis*	Leopard Tortoise	LC
Viperidae	*Bitis arietans arietans*	Puff Adder	LC
Viperidae	*Causus rhombeatus*	Rhombic Night Adder	LC

Table 11.2. Full species list of frogs that may occur on the project site.

Family	Scientific name	Common name	Red list category
Bufonidae	Schismaderma carens	Red Toad	Least Concern
Bufonidae	Sclerophrys capensis	Raucous Toad	Least Concern
Bufonidae	Sclerophrys gutturalis	Guttural Toad	Least Concern
Hyperoliidae	Kassina senegalensis	Bubbling Kassina	Least Concern
Pipidae	Xenopus laevis	Common Platanna	Least Concern
Pyxicephalidae	Amietia delalandii	Delalande's River Frog	Least Concern

Family	Scientific name	Common name	Red list category
Pyxicephalidae	Amietia fuscigula	Cape River Frog	Least Concern
Pyxicephalidae	Cacosternum boettgeri	Common Caco	Least Concern
Pyxicephalidae	Pyxicephalus adspersus	Giant Bull Frog	Near Threatened
Pyxicephalidae	Tomopterna cryptotis	Tremelo Sand Frog	Least Concern

Table 11.3. Full species list of mammals that may occur on the project site.

Family	Scientific name	Common name	Red list category
Bathyergidae	Cryptomys hottentotus	Southern African Mole-rat	Least Concern (2016)
Bovidae	Alcelaphus buselaphus	Hartebeest	Least Concern
Bovidae	Antidorcas marsupialis	Springbok	Least Concern (2016)
Bovidae	Connochaetes gnou	Black Wildebeest	Least Concern (2016)
Bovidae	Damaliscus pygargus phillipsi	Blesbok	Least Concern (2016)
Bovidae	Raphicerus campestris	Steenbok	Least Concern (2016)
Bovidae	Redunca arundinum	Southern Reedbuck	Least Concern (2016)
Bovidae	Sylvicapra grimmia	Bush Duiker	Least Concern (2016)
Bovidae	Taurotragus oryx	Common Eland	Least Concern (2016)
Canidae	Canis mesomelas	Black-backed Jackal	Least Concern (2016)
Emballonuridae	Taphozous (Taphozous) mauritianus	Mauritian Tomb Bat	Least Concern
Equidae	Equus quagga	Plains Zebra	Least Concern (2016)
Hystricidae	Hystrix africaeaustralis	Cape Porcupine	Least Concern
Leporidae	Lepus saxatilis	Scrub Hare	Least Concern
Muridae	Aethomys namaquensis	Namaqua Rock Mouse	Least Concern
Muridae	Gerbilliscus leucogaster	Bushveld Gerbil	Least Concern (2016)
Muridae	Mastomys sp.	Multimammate Mice	
Muridae	Mus (Nannomys) minutoides	Southern African Pygmy Mouse	Least Concern
Muridae	Otomys auratus	Southern African Vlei Rat	Near Threatened (2016)
Muridae	Rhabdomys pumilio	Xeric Four-striped Grass Rat	Least Concern (2016)
Mustelidae	Aonyx capensis	African Clawless Otter	Near Threatened (2016)
Mustelidae	Poecilogale albinucha	African Striped Weasel	Near Threatened (2016)
Soricidae	Crocidura mariquensis	Swamp Musk Shrew	Near Threatened (2016)
Soricidae	Myosorex varius	Forest Shrew	Least Concern (2016)
Vespertilionidae	Myotis welwitschii	Welwitsch's Myotis	Least Concern (2016)

Table 11.4. Full species list of scorpions that may occur on the project site.

Family	Scientific name	Common name	Red list category
BUTHIDAE	*Pseudolychas ochraceus*	Plain Pygmy-thicktail	unlisted

Table 11.5. Full species list of spiders that may occur on the project site.

Family	Scientific name	Common name	Red list category
Araneidae	*Neoscona sp.*	Neoscona hairy field spiders	Unlisted
Oxyopidae	*Oxyopes sp.*	Grass lynx spiders	Unlisted
Philodromidae	*FAMILY Philodromidae*	Running spiders	Unlisted
Pholcidae	*FAMILY Pholcidae*	Daddy longlegs spiders	Unlisted
Pisauridae	*Rothus sp.*	Crowned pisaurids	Unlisted
Scytodidae	*Scytodes sp.*	spitting spiders	Unlisted
Sparassidae	*FAMILY Sparassidae*	Huntsman spiders	Unlisted
Sparassidae	*Palystes sp.*	Rain spiders	Unlisted
Theraphosidae	*Harpactira hamiltoni*	-	Unlisted
Theridiidae	*Theridion sp.*	Comb-footed or cobweb spiders	Unlisted
Theridiidae	*Theridion purcelli*	Common false house button spiders	Unlisted
Thomisidae	*Thomisus sp.*	Flower crab spiders	Unlisted
Trochanteriidae	*Platyoides sp.*	Scorpion spiders	Unlisted
Uloboridae	*FAMILY Uloboridae*	Hackled orb-web spiders	Unlisted
Uloboridae	*Uloborus sp.*	Hackled orb-web spiders	Unlisted

Table 11.6. Full species list of birds that may occur on the project site.

Common group	Common species	Genus	Species	ESKOM RED LIST	IUCN RED LIST
Shikra	Shikra	*Accipiter*	*badius*	-	LC
Myna	Common	*Acridotheres*	*tristis*	-	LC
Reed-warbler	African	*Acrocephalus*	*baeticatus*	-	Unlisted
Reed-warbler	Great	*Acrocephalus*	*arundinaceus*	-	LC
Swamp-warbler	Lesser	*Acrocephalus*	*gracilirostris*	-	LC
Warbler	Marsh	*Acrocephalus*	*palustris*	-	LC
Warbler	Sedge	*Acrocephalus*	*schoenobaenus*	-	LC
Sandpiper	Common	*Actitis*	*hypoleucos*	-	LC
Jacana	African	*Actophilornis*	*africanus*	-	LC
Korhaan	Northern Black	*Afrotis*	*afraoides*	-	LC
Kingfisher	Malachite	*Alcedo*	*cristata*	-	Unlisted
Goose	Egyptian	*Alopochen*	*aegyptiacus*	Unlisted	LC
Finch	Red-headed	*Amadina*	*erythrocephala*	-	LC
Waxbill	Orange-breasted	*Amandava*	*subflava*	-	LC
Crake	Black	*Amaurornis*	*flavirostris*	Unlisted	LC
Weaver	Thick-billed	*Amblyospiza*	*albifrons*	-	LC
Duck	African Black	*Anas*	*sparsa*	-	LC
Duck	Yellow-billed	*Anas*	*undulata*	-	LC
Shoveler	Cape	*Anas*	*smithii*	-	LC

Common group	Common species	Genus	Species	ESKOM RED LIST	IUCN RED LIST
Teal	Cape	*Anas*	*capensis*	-	LC
Teal	Hottentot	*Anas*	*hottentota*	-	LC
Teal	Red-billed	*Anas*	*erythrorhyncha*	-	LC
Darter	African	*Anhinga*	*rufa*	-	LC
Pipit	African	*Anthus*	*cinnamomeus*	-	LC
Apalis	Bar-throated	*Apalis*	*thoracica*	-	LC
Swift	Common	*Apus*	*apus*	-	LC
Swift	Horus	*Apus*	*horus*	-	LC
Swift	Little	*Apus*	*affinis*	-	LC
Swift	White-rumped	*Apus*	*caffer*	-	LC
Swift	African Black	*Apus*	*barbatus*	-	LC
Heron	Black-headed	*Ardea*	*melanocephala*	-	LC
Heron	Goliath	*Ardea*	*goliath*	-	LC
Heron	Grey	*Ardea*	*cinerea*	-	LC
Heron	Purple	*Ardea*	*purpurea*	-	LC
Heron	Squacco	*Ardeola*	*ralloides*	-	LC
Owl	Marsh	*Asio*	*capensis*	-	LC
Ibis	Hadeda	*Bostrychia*	*hagedash*	-	LC
Rush-warbler	Little	*Bradypterus*	*baboecala*	-	LC
Eagle-owl	Spotted	*Bubo*	*africanus*	-	LC
Egret	Cattle	*Bubulcus*	*ibis*	-	LC
Thick-knee	Spotted	*Burhinus*	*capensis*	-	LC
Buzzard	Steppe	*Buteo*	*vulpinus*	Unlisted	Unlisted
Lark	Red-capped	*Calandrella*	*cinerea*	-	LC
Sandpiper	Curlew	*Calidris*	*ferruginea*	LC	NT
Stint	Little	*Calidris*	*minuta*	-	LC
Coucal	Burchell's	*Centropus*	*burchellii*	-	Unlisted
Chat	Familiar	*Cercomela*	*familiaris*	Unlisted	LC
Kingfisher	Pied	*Ceryle*	*rudis*	-	LC
Sunbird	Amethyst	*Chalcomitra*	*amethystina*	-	LC
Plover	Common Ringed	*Charadrius*	*hiaticula*	-	LC
Plover	Kittlitz's	*Charadrius*	*pecuarius*	-	LC
Plover	Three-banded	*Charadrius*	*tricollaris*	-	LC
Lark	Spike-heeled	*Chersomanes*	*albofasciata*	-	LC
Tern	Whiskered	*Chlidonias*	*hybrida*	-	LC
Tern	White-winged	*Chlidonias*	*leucopterus*	-	LC
Cuckoo	Diderick	*Chrysococcyx*	*caprius*	-	LC
Stork	White	*Ciconia*	*ciconia*	-	LC
Sunbird	White-bellied	*Cinnyris*	*talatala*	-	LC
Marsh-harrier	African	*Circus*	*ranivorus*	EN	LC
Cisticola	Cloud	*Cisticola*	*textrix*	-	LC

Common group	Common species	Genus	Species	ESKOM RED LIST	IUCN RED LIST
Cisticola	Levaillant's	*Cisticola*	*tinniens*	-	LC
Cisticola	Wing-snapping	*Cisticola*	*ayresii*	-	LC
Cisticola	Zitting	*Cisticola*	*juncidis*	-	LC
Cisticola	Desert	*Cisticola*	*aridulus*	-	LC
Cisticola	Lazy	*Cisticola*	*aberrans*	-	LC
Cisticola	Wailing	*Cisticola*	*lais*	-	LC
Neddicky	Neddicky	*Cisticola*	*fulvicapilla*	-	LC
Mousebird	Speckled	*Colius*	*striatus*	-	LC
Dove	Rock	*Columba*	*livia*	-	LC
Olive-pigeon	African	*Columba*	*arquatrix*	-	LC
Pigeon	Speckled	*Columba*	*guinea*	-	LC
Crow	Pied	*Corvus*	*albus*	-	LC
Go-away-bird	Grey	*Corythaixoides*	*concolor*	-	LC
Robin-chat	Cape	*Cossypha*	*caffra*	-	LC
Starling	Wattled	*Creatophora*	*cinerea*	-	LC
Canary	Black-throated	*Crithagra*	*atrogularis*	-	LC
Canary	Yellow	*Crithagra*	*flaviventris*	-	LC
Canary	Yellow-fronted	*Crithagra*	*mozambicus*	Unlisted	Unlisted
Seedeater	Streaky-headed	*Crithagra*	*gularis*	-	LC
Palm-swift	African	*Cypsiurus*	*parvus*	-	LC
House-martin	Common	*Delichon*	*urbicum*	-	LC
Duck	Fulvous	*Dendrocygna*	*bicolor*	-	LC
Duck	White-faced	*Dendrocygna*	*viduata*	-	LC
Woodpecker	Cardinal	*Dendropicos*	*fuscescens*	-	LC
Egret	Great	*Egretta*	*alba*	-	LC
Egret	Little	*Egretta*	*garzetta*	-	LC
Egret	Yellow-billed	*Egretta*	*intermedia*	-	Unlisted
Heron	Black	*Egretta*	*ardesiaca*	-	LC
Kite	Black-shouldered	*Elanus*	*caeruleus*	-	LC
Bunting	Cinnamon-breasted	*Emberiza*	*tahapisi*	-	LC
Waxbill	Common	*Estrilda*	*astrild*	-	LC
Bishop	Southern Red	*Euplectes*	*orix*	-	LC
Bishop	Yellow-crowned	*Euplectes*	*afer*	-	LC
Bishop	Yellow	*Euplectes*	*capensis*	-	LC
Widowbird	Fan-tailed	*Euplectes*	*axillaris*	-	LC
Widowbird	Long-tailed	*Euplectes*	*progne*	-	LC
Widowbird	White-winged	*Euplectes*	*albonotatus*	-	LC
Widowbird	Red-collared	*Euplectes*	*ardens*	-	LC
Korhaan	Blue	*Eupodotis*	*caerulescens*	LC	NT
Falcon	Amur	*Falco*	*amurensis*	-	LC

Common group	Common species	Genus	Species	ESKOM RED LIST	IUCN RED LIST
Falcon	Lanner	*Falco*	*biarmicus*	VU	LC
Kestrel	Greater	*Falco*	*rupicoloides*	-	LC
Kestrel	Rock	*Falco*	*rupicolus*	-	Unlisted
Coot	Red-knobbed	*Fulica*	*cristata*	-	LC
Snipe	African	*Gallinago*	*nigripennis*	-	LC
Moorhen	Common	*Gallinula*	*chloropus*	-	LC
Pratincole	Black-winged	*Glareola*	*nordmanni*	NT	NT
Fish-eagle	African	*Haliaeetus*	*vocifer*	-	CR
Stilt	Black-winged	*Himantopus*	*himantopus*	-	LC
Cliff-swallow	South African	*Hirundo*	*spilodera*	Unlisted	LC
Martin	Rock	*Hirundo*	*fuligula*	Unlisted	Unlisted
Swallow	Barn	*Hirundo*	*rustica*	-	LC
Swallow	Greater Striped	*Hirundo*	*cucullata*	Unlisted	LC
Swallow	White-throated	*Hirundo*	*albigularis*	-	LC
Swallow	Lesser Striped	*Hirundo*	*abyssinica*	-	LC
Honeyguide	Greater	*Indicator*	*indicator*	-	LC
Honeyguide	Lesser	*Indicator*	*minor*	-	LC
Bittern	Little	*Ixobrychus*	*minutus*	-	LC
Wryneck	Red-throated	*Jynx*	*ruficollis*	-	LC
Starling	Cape Glossy	*Lamprotornis*	*nitens*	-	LC
Fiscal	Common (Southern)	*Lanius*	*collaris*	-	LC
Shrike	Red-backed	*Lanius*	*collurio*	-	LC
Gull	Grey-headed	*Larus*	*cirrocephalus*	Unlisted	LC
Barbet	Black-collared	*Lybius*	*torquatus*	-	LC
Longclaw	Cape	*Macronyx*	*capensis*	-	LC
Kingfisher	Giant	*Megaceryle*	*maximus*	Unlisted	Unlisted
Bee-eater	European	*Merops*	*apiaster*	-	LC
Lark	Rufous-naped	*Mirafra*	*africana*	-	LC
Lark	Eastern Clapper	*Mirafra*	*fasciolata*	-	LC
Rock-thrush	Sentinel	*Monticola*	*explorator*	LC	NT
Wagtail	Cape	*Motacilla*	*capensis*	-	LC
Wagtail	Yellow	*Motacilla*	*flava*	-	LC
Flycatcher	Spotted	*Muscicapa*	*striata*	-	LC
Stork	Yellow-billed	*Mycteria*	*ibis*	EN	LC
Chat	Anteating	*Myrmecocichla*	*formicivora*	-	LC
Sunbird	Malachite	*Nectarinia*	*famosa*	-	LC
Pochard	Southern	*Netta*	*erythrophthalma*	-	LC
Guineafowl	Helmeted	*Numida*	*meleagris*	-	LC
Night-Heron	Black-crowned	*Nycticorax*	*nycticorax*	-	LC
Dove	Namaqua	*Oena*	*capensis*	-	LC

Common group	Common species	Genus	Species	ESKOM RED LIST	IUCN RED LIST
Wheatear	Capped	*Oenanthe*	*pileata*	-	LC
Wheatear	Mountain	*Oenanthe*	*monticola*	-	LC
Starling	Red-winged	*Onychognathus*	*morio*	-	LC
Quailfinch	African	*Ortygospiza*	*atricollis*	-	LC
Sparrow	Cape	*Passer*	*melanurus*	-	LC
Sparrow	House	*Passer*	*domesticus*	-	LC
Sparrow	Southern Grey-headed	*Passer*	*diffusus*	-	LC
Petronia	Yellow-throated	*Petronia*	*superciliaris*	Unlisted	LC
Cormorant	Reed	*Phalacrocorax*	*africanus*	Unlisted	LC
Cormorant	White-breasted	*Phalacrocorax*	*carbo*	Unlisted	LC
Ruff	Ruff	*Philomachus*	*pugnax*	Unlisted	LC
Flamingo	Greater	*Phoenicopterus*	*ruber*	Unlisted	LC
Flamingo	Lesser	*Phoenicopterus*	*minor*	Unlisted	NT
Wood-hoopoe	Green	*Phoeniculus*	*purpureus*	-	LC
Warbler	Willow	*Phylloscopus*	*trochilus*	-	LC
Spoonbill	African	*Platalea*	*alba*	-	LC
Goose	Spur-winged	*Plectropterus*	*gambensis*	-	LC
Ibis	Glossy	*Plegadis*	*falcinellus*	-	LC
Sparrow-weaver	White-browed	*Plocepasser*	*mahali*	-	LC
Masked-weaver	Southern	*Ploceus*	*velatus*	-	LC
Weaver	Cape	*Ploceus*	*capensis*	-	LC
Weaver	Village	*Ploceus*	*cucullatus*	-	LC
Grebe	Great Crested	*Podiceps*	*cristatus*	-	LC
Eagle	Martial	*Polemaetus*	*bellicosus*	EN	VU
Swamphen	African Purple	*Porphyrio*	*madagascariensis*	-	Unlisted
Prinia	Black-chested	*Prinia*	*flavicans*	-	LC
Prinia	Tawny-flanked	*Prinia*	*subflava*	-	LC
Spurfowl	Natal	*Pternistis*	*natalensis*	-	LC
Spurfowl	Swainson's	*Pternistis*	*swainsonii*	-	LC
Bulbul	Dark-capped	*Pycnonotus*	*tricolor*	-	Unlisted
Quelea	Red-billed	*Quelea*	*quelea*	-	LC
Rail	African	*Rallus*	*caerulescens*	-	LC
Avocet	Pied	*Recurvirostra*	*avosetta*	-	LC
Martin	Banded	*Riparia*	*cincta*	-	LC
Martin	Brown-throated	*Riparia*	*paludicola*	-	LC
Martin	Sand	*Riparia*	*riparia*	-	LC
Secretarybird	Secretarybird	*Sagittarius*	*serpentarius*	VU	VU
Flufftail	Red-chested	*Sarothrura*	*rufa*	-	LC

Common group	Common species	Genus	Species	ESKOM RED LIST	IUCN RED LIST
Stonechat	African	*Saxicola*	*torquatus*	-	LC
Francolin	Orange River	*Scleroptila*	*levaillantoides*	Unlisted	Unlisted
Hamerkop	Hamerkop	*Scopus*	*umbretta*	-	LC
Flycatcher	Fiscal	*Sigelus*	*silens*	Unlisted	LC
Grassbird	Cape	*Sphenoeacus*	*afer*	-	LC
Starling	Pied	*Spreo*	*bicolor*	Unlisted	LC
Flycatcher	Fairy	*Stenostira*	*scita*	-	LC
Dove	Laughing	*Streptopelia*	*senegalensis*	Unlisted	LC
Dove	Red-eyed	*Streptopelia*	*semitorquata*	-	LC
Turtle-dove	Cape	*Streptopelia*	*capicola*	-	LC
Ostrich	Common	*Struthio*	*camelus*	-	LC
Grebe	Little	*Tachybaptus*	*ruficollis*	-	LC
Shelduck	South African	*Tadorna*	*cana*	-	LC
Bokmakierie	Bokmakierie	*Telophorus*	*zeylonus*	-	LC
Duck	White-backed	*Thalassornis*	*leuconotus*	-	LC
Ibis	African Sacred	*Threskiornis*	*aethiopicus*	-	LC
Barbet	Crested	*Trachyphonus*	*vaillantii*	-	LC
Greenshank	Common	*Tringa*	*nebularia*	-	LC
Sandpiper	Marsh	*Tringa*	*stagnatilis*	-	LC
Sandpiper	Wood	*Tringa*	*glareola*	-	LC
Babbler	Arrow-marked	*Turdoides*	*jardineii*	-	LC
Thrush	Karoo	*Turdus*	*smithi*	-	LC
Owl	Barn	*Tyto*	*alba*	-	LC
Hoopoe	African	*Upupa*	*africana*	-	LC
Mousebird	Red-faced	*Urocolius*	*indicus*	-	LC
Lapwing	African Wattled	*Vanellus*	*senegallus*	-	LC
Lapwing	Blacksmith	*Vanellus*	*armatus*	-	LC
Lapwing	Crowned	*Vanellus*	*coronatus*	-	LC
Whydah	Pin-tailed	*Vidua*	*macroura*	-	LC
White-eye	Cape	*Zosterops*	*virens*	-	LC

Table 11.7. Full species list of orchids that may occur on the project site.

Family	Scientific name	Common name	Red list category
Orchidaceae	*Eulophia coddii*	-	VU
Orchidaceae	*Eulophia hians var. hians*	-	LC
Orchidaceae	*Eulophia ovalis*	-	LC

12. APPENDIX B: IMPACT ASSESSMENT METHODOLOGY

Impact Assessment methodology:

Direct, indirect and cumulative impacts of the issues identified through the EIA process, as well as all other issues identified due to the amendment must be assessed in terms of the following criteria:

- The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.
- The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):
- The **duration**, wherein it will be indicated whether:
  - the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
  - the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
  - medium-term (5–15 years) – assigned a score of 3;
  - long term (> 15 years) - assigned a score of 4; or
  - permanent - assigned a score of 5;
- The **consequences (magnitude)**, quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
- The **probability** *of occurrence*, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1–5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
- the **significance**, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and
- the **status**, which will be described as either positive, negative or neutral.
- the degree to which the impact can be reversed.
- the degree to which the impact may cause irreplaceable loss of resources.
- the *degree* to which the impact can be *mitigated.*

The **significance** is calculated by combining the criteria in the following formula:
S = (E+D+M)P
S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability

The **significance weightings** for each potential impact are as follows:

- < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),

» 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
» > 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

Assessment of impacts must be summarised in the following table format. The rating values as per the above criteria must also be included. The table must be completed and associated ratings for **each** impact identified during the assessment should also be included.

Example of Impact table summarising the significance of impacts (with and without mitigation):

Nature: **[Outline and describe fully the impact anticipated as per the assessment undertaken]**		
	Without mitigation	**With mitigation**
Extent	High (3)	Low (1)
Duration	Medium-term (3)	Medium-term (3)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**Medium (36)**	**Low (24)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	Yes
Mitigation: "Mitigation", means to anticipate and prevent negative impacts and risks, then to minimise them, rehabilitate or repair impacts to the extent feasible. Provide a description of how these mitigation measures will be undertaken keeping the above definition in mind.		
Cumulative impacts: "Cumulative Impact", in relation to an activity, means the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity, that in itself may not be significant, but may become significant when added to existing and reasonably foreseeable impacts eventuating from similar or diverse activities[1].		
Residual Risks: "Residual Risk", means the risk that will remain after all the recommended measures have been undertaken to mitigate the impact associated with the activity (Green Leaves III, 2014).		

[1] Unless otherwise stated, all definitions are from the 2014 EIA Regulations (as amended on 07 April 2017), GNR 326.

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13. APPENDIX C: SPECIALIST CV

CURRICULUM VITAE OF GIDEON RAATH

Profession : Environmental and Permitting Consultant

Specialisation: Environmental Impact Assessments, Water Use Licencing, Waste Licencing, Environmental Compliance Officer, Ecological Specialist, Wetland Specialist, GIS, MPRDA permitting

Work Experience: 4.5 years' experience in environmental management, National Water Act, Mineral and Petroleum Resources Development Act, ECO and compliance auditing, wetland and ecological specialist reporting

VOCATIONAL EXPERIENCE

Gideon holds an MSc (Geography and Environmental Management; SU), a BSc Honours (Ecology and Environmental Studies - Cum laude; Wits) and a BSc (Geography and Environmental Management; UJ). His MSc thesis focused on the hydrological impact on the spatial distribution of invasive Eucalyptus trees along the Breede River, while his honours thesis evaluated ethnobotanical relationships around the Rio Tinto copper mine in Phalaborwa. Most recently he has worked as an Environmental Consultant at EOH Coastal and Environmental Services (EOH CES), conducting environmental authorisations applications (NWA, NEMA, MPRDA), Public Participation Processes, GIS specialisation as well as Ecological and Wetland specialist studies. Previously, Gideon worked as the Monitoring & Evaluation Project Manager for the City of Cape Town's invasive species unit (Environmental Resources Management Department).
Gideon's GIS background includes the management of the City of Cape Town invasive species GIS database, involving the storage, management, recall and quality control off all sightings, clearance visits and known infestations. Further experience include mapping for various consulting projects, boundary verification through ground-truthing and the spatial mapping and delineation component of this MSc research. Gideon has further attended public participation workshops, and has been involved with IAP identification, translation, public meetings and engagement for a variety of projects, mainly within the Afrikaans speaking Northern Cape. Gideon is interested in invasion ecology, treatment of groundwater pollution through phytoremediation, botanical and wetland specialist studies, GIS application for ecology and environmental management, and the EIA processes in general.

SKILLS BASE AND CORE COMPETENCIES

- Environmental Management
- GIS data manipulation, storage, management and mapping
- EIA Impact Assessments and Basic Assessment
- Environmental Management Programmes
- Environmental Compliance Monitoring
- Mining Rights, Mining Permits, Prospecting Rights (and renewal) applications (MPRDA & NEMA)
- Public and Stakeholder Engagement (NEMA)
- Ecological/Botanical Specialist Studies

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- Wetland Delineation, Functional and Impact Assessment studies
- Water Use Licence Applications (NWA)
- General Authorisations (NWA)

EDUCATION AND PROFESSIONAL STATUS

Degrees:

- M.Sc. Geography and Environmental Science (2014), Stellenbosch University (2014)
- B.Sc. (Hons) Ecology, Environment and Conservation (Cum Laude), University of the Witwatersrand (2011)
- B.Sc. Life and Environmental Sciences, University of Johannesburg (2010)

Short Courses:

- GroundTruth SASS5 competency course, GroundTruth Aquatic Consulting (2017)
- DWS 21C&I GA training workshop, Department of Water and Sanitation (2016)
- IAIAsa Public Participation Process Workshop, IAIA South Africa (2016)
- EIA Theory and application, EOH Coastal and Environmental Services (2015)
- Water Safety Training, City of Cape Town Environmental Resources Department (2014)
- Herbicide safety and application for weed control, City of Cape Town Environmental Resources Department (2014)
- Snake awareness training, City of Cape Town Environmental Resources Department (2014)
- Habitable Planet Workshop, Applied Centre for Climate & Earth Systems Science, Cape Town (2011)

Professional Society Affiliations:

- Golden Key International Honour Society – University of the Witwatersrand Chapter
- South African Council for Scientific Natural Professionals (SACNASP): Certified Natural Scientist – Pr.Sci.Nat. (Membership No.: 117178)
- IAIAsa (Membership No.: 3619)

Other Relevant Skills:

- GPS use, spatial data capturing and ground truthing

EMPLOYMENT

Date	Company	Roles and Responsibilities
October 2018 - Current:	Savannah Environmental (Pty) Ltd	Environmental and Permitting Consultant Tasks include: Undertaking environmental impact assessments, basic assessments, environmental management programmes (EMPrs), environmental amendments, water use license applications, general authorisations, wetland assessments, botanical/ecological assessments, mining rights and permit applications, prospecting rights applications, environmental compliance officer audits and reporting, Ensuring environmental compliance on permitting processes, client liaison and relationship management.

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Date	Company	Roles and Responsibilities
February 2015 – September 2018	EOH Coastal and Environmental Services (Pty) Ltd	Senior Environmental Consultant Tasks included: Undertaking environmental impact assessments, basic assessments, environmental management programmes (EMPrs), environmental amendments, water use license applications, general authorisations, wetland assessments, botanical/ecological assessments, mining rights and permit applications, prospecting rights applications, environmental compliance officer audits and reporting, Ensuring environmental compliance on permitting processes, client liaison and relationship management, public participation processes for environmental authorisations.
March 2014 – February 2015	Invasive Species Unit (ISU), Environmental Resources Management Department (ERMD), City of Cape Town	Professional Officer Tasks included: Managed the Monitoring & Evaluation project portfolio, entailing the establishment of an invasive species monitoring & evaluation system for the ISU, as well as GIS database management, quality assurance and reporting thereof. Position required managing a small staff compliment (dealing directly with GIS database management), managing time and budgets for the monitoring division, conducting monitoring trials and research, writing species management plans as well as handling the GIS database, quality control, verification and integrity for the ISU.
January 2012 – March 2014	University of Stellenbosch	Departmental Assistant Tasks included: Technical editing of academic reports. Formatting of PhD and MSc reports on a weekly basis, with short turnaround time and good quality feedback.
January 2011 – January 2012	University of the Witwatersrand	Departmental Assistant Tasks included: Responsible for practical tutorials and marking of 1st year medical students. Included zoology and botany.
January 2006 – November 2010 (part time)	Codeon Networking CC	Co-founder and web developer Tasks included: Small business owner, responsible for all facets of the business. Self-taught HTML, CSS,

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Date	Company	Roles and Responsibilities
		PHP and MySQL. Won and produced two medium enterprise websites serving the gaming community. Websites required user profiles & permissions, CMS system and automated payment options as functionality. Development and maintenance of a user database and account management system.

PROJECT EXPERIENCE

Project experience includes project management, EIA, BA and EMPr documentation development, integrated water use license applications, general authorisations, specialist botanical and ecological impact assessments, specialist wetland delineation and impact assessments, GIS applications and mapping, compliance auditing and monitoring, vegetation rehabilitation and monitoring plans, integrated waste management plans and waste licencing, mining right & permits, as well as prospecting rights applications.
Industry experience includes the waste sector (IWMP's and waste licencing), road and rail infrastructure (BAR, S&EIR, WUL/GA, Waste Licence), ports and harbours (management plans), private sector clients across varying industries (various permits), mining sector (BAR, S&EIR, mining permits and rights, prospecting rights), conservation sector (biodiversity plans), renewable energy industry (BAR, S&EIR) as well as the gas and oil industry (biodiversity reports).

RENEWABLE POWER GENERATION PROJECTS: SOLAR ENERGY FACILITIES

Environmental Compliance, Auditing and ECO

Project Name & Location	Client Name	Role
Enel Paleisheuwel Solar compliance auditing, Paleisheuwel, Northern Cape	Enel Green Power RSA (EGP RSA)	Environmental consultant

RENEWABLE POWER GENERATION PROJECTS: WIND ENERGY FACILITIES

Environmental Impact Assessments and Environmental Management Programmes

Project Name & Location	Client Name	Role
G7 Brandvalley S&EIR, Matjiesfontein, Northern Cape	G7 Renewable Energy (Pty) Ltd	Environmental consultant
G7 Rietkloof S&EIR, Matjiesfontein, Northern Cape	G7 Renewable Energy (Pty) Ltd	Environmental consultant

Basic Assessments

Project Name & Location	Client Name	Role
G7 Renewable Energy 132kV BAR & EMPr, Matjiesfontein, Northern Cape	G7 Renewable Energy (Pty) Ltd	Project Manager, Environmental consultant, Public Participation

Compliance Advice and ESAP reporting

Project Name & Location	Client Name	Role
Biotherm Energy Golden Valley Wind Energy Facility ESAP, Bedford, Eastern Cape	Biotherm Energy Pty Ltd	Environmental consultant

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Amendments

Project Name & Location	Client Name	Role
Mosselbay Energy EA Amendment, Mosselbay, Western Cape	Mosselbay Energy IPP (Pty) Ltd	Environmental consultant

GAS PROJECTS

Screening Studies

Project Name & Location	Client Name	Role
iGas integrated biodiversity screening, Saldanha, Western Cape	Central Energy Fund - iGas (subsidiary)	Environmental consultant, Faunal specialist (assistant)

MINING SECTOR PROJECTS

Environmental Impact Assessments and Environmental Management Programmes

Project Name & Location	Client Name	Role
Triton Minerals Limited Ancuabe and Nicanda Hills EPDA, Ancuabe, Cabo Del Gado Province, Mozambique	Triton Minerals Ltd	Environmental consultant
Ancuabe graphite mine Environmental and Social Impact Assessment (ESIA), Cabo Del Gado Province, Mozambique	Grafex Limitada Mozambique	Environmental consultant

Basic Assessments

Project Name & Location	Client Name	Role
SANRAL material sourcing BAR (DMR), Hendrina, Mpumalanga Province	SANRAL SOC Ltd & Leo consulting engineers	Project Manager, Environmental consultant, Public Participation
SANRAL Bierspruit R510 Borrow Pit authorisation, Thabazimbi, Limpopo Province	SANRAL SOC Ltd & Royal HaskoningDHV South Africa	Project Manager, Environmental consultant, Ecological specialist, Public Participation
Almenar tin prospecting BAR, Carnarvon, Northern Cape	Almenar Property Investments (Pty) Ltd	Environmental consultant

Rehabilitation Studies

Project Name & Location	Client Name	Role
Ancuabe baseline vegetation monitoring assessment and programme, Ancuabe, Cabo Del Gado Province, Mozambique	Grafex Limitada Mozambique	Botanical specialist
Prospecting pit rehabilitation programme, Ancuabe, Cabo Del Gado Province, Mozambique	Grafex Limitada Mozambique	Botanical specialist, Environmental consultant
Mayfield Quarry rehabilitation plan, Grahamstown, Eastern Cape	Mayfield Quarry	Environmental consultant

Environmental Compliance, Auditing and ECO

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Project Name & Location	Client Name	Role
Construction monitoring and DMR environmental authorisation, Hendrina, Mpumalanga Province	SANRAL SOC Ltd & Leo consulting engineers	Project Manager, ECO,
SANRAL Caledon N2 Section 3 road upgrade ECO Audits and Reporting, Caledon, Western Cape Province	JG Afrika Engineering	Project Manager, ECO

Environmental Permitting, S53, Water Use Licence (WUL), Waste Management Licence (WML) & Other Applications

Project Name & Location	Client Name	Role
VMC Mining permit renewal application, Rust De Winter, Gauteng	Vergenoeg Mining Company (Pty) Ltd	Environmental consultant
Zirco Resources Kamiesberg heavy mineral sand mine water use licence, Kamiesberg, Northern Cape	Zirco Roode Heuwel (Pty) Ltd	Environmental consultant

INFRASTRUCTURE DEVELOPMENT PROJECTS (BRIDGES, PIPELINES, ROADS, WATER RESOURCES, STORAGE, ETC)

Environmental Impact Assessments and Environmental Management Programmes

Project Name & Location	Client Name	Role
S&EIR authorisation for the SANRAL Zandkraal-Windburg N1 road upgrade, Windburg, Free State Province	SANRAL SOC Ltd & SMEC Consulting Engineers	Project Manager, Environmental consultant, Public Participation
Thabazimbi Local Municipality Integrated Waste Management Plan, Thabazimbi, Limpopo Province	Thabazimbi Local Municipality & Anglo American Plc	Environmental consultant, Public Participation

Basic Assessments

Project Name & Location	Client Name	Role
SANRAL Masekwaspoort N1 Road Upgrade BA, Louis Trichardt, Limpopo Province	SANRAL SOC Ltd & Knight Piésold Consulting	Project Manager, Environmental consultant, Public Participation
SANRAL Polokwane N1 Ring Road Upgrade Basic Assessment, Polokwane, Limpopo Province	SANRAL SOC Ltd & KBK Engineers	Environmental consultant
Boshoek Loop Rail Upgrade BAR, Rustenburg, North-West Province	Transnet SOC Ltd	Project Manager, Environmental consultant, Wetland specialist, Public Participation
Heysterkrand Loop Rail Upgrade BAR, Rustenburg, North-West Province	Transnet SOC Ltd	Project Manager, Environmental consultant, Public Participation
SANRAL Bierspruit R510 road upgrade Basic Assessment, Thabazimbi, Limpopo Province	SANRAL SOC Ltd & Royal HaskoningDHV South Africa	Project Manager, Environmental consultant, Ecological specialist, Public Participation
Barberton IAPS Waste Water Treatment Works development BAR, Barberton, Mpumalanga Province	Umjindi Local Municipality and Rhodes University	Project Manager, Environmental consultant, Public Participation

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SANRAL Caledon N2 Section 3 road upgrade project Basic Assessment, Caledon, Western Cape Province	JG Afrika Engineering	Project Manager, Environmental consultant, Ecological specialist, ECO

Environmental Compliance, Auditing and ECO

Project Name & Location	Client Name	Role
Construction Monitoring and DMR environmental authorisation, Hendrina, Mpumalanga Province	SANRAL SOC Ltd & Leo consulting engineers	Project Manager, Environmental consultant, ECO

Environmental Permitting, S53, Water Use Licence (WUL), Waste Management Licence (WML) & Other Applications

Project Name & Location	Client Name	Role
Water use licence for the SANRAL Zandkraal-Windburg N1 road upgrade and quarrying, Windburg, Free State Province	SANRAL SOC Ltd & SMEC Consulting Engineers	Project Manager, Environmental consultant, Public Participation
SANRAL Masekwaspoort N1 road upgrade water use licence application, Louis Trichardt, Limpopo Province	SANRAL SOC Ltd & Knight Piésold Consulting	Project Manager, Environmental consultant, Public Participation
Boshoek Loop Rail Upgrade water use licence application, Rustenburg, North-West Province	Transnet SOC Ltd	Project Manager, Environmental consultant, Wetland specialist, Public Participation
SANRAL Bierspruit R510 road water use licence, Thabazimbi, Limpopo Province	SANRAL SOC Ltd & Royal HaskoningDHV South Africa	Project Manager, Environmental consultant, Ecological specialist, Public Participation
Barberton IAPS Waste Water Treatment Works water use licence and SASS 5 assessment, Barberton, Mpumalanga Province	Umjindi Local Municipality and Rhodes University	Project Manager, Environmental consultant, Aquatic specialist, Public Participation
SANRAL Caledon N2 Section 3 road upgrade water use licence and specialist reports, Caledon, Western Cape Province	JG Afrika Engineering	Project Manager, Environmental consultant, Ecological specialist, Public Participation

HOUSING AND URBAN PROJECTS

ENVIRONMENTAL IMPACT ASSESSMENTS AND ENVIRONMENTAL MANAGEMENT PROGRAMMES

Project Name & Location	Client Name	Role
Scoping and EIR authorisation, Water Use Licence, for the Ganspan tourism facility development, Jan Kempdorp, Northern Cape	Frances Baard Local Municipality	Project Manager, Environmental consultant, Public Participation

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Basic Assessments

Project Name & Location	Client Name	Role
Basic Assessment for the office complex development within the Pretoria National Botanical Gardens, Pretoria, Gauteng	South African National Biodiversity Institute (SANBI)	Project Manager, Environmental consultant, Public Participation, ECO
Corner Berg and Drooge Street township development BAR, Zeerust, North-West Province	Ramotshere Moiloa Local Municipality	Project Manager, Environmental consultant, Public Participation
Corner Kort and Bree Street township development BAR, Zeerust, North-West Province	Ramotshere Moiloa Local Municipality	Project Manager, Environmental consultant, Public Participation
Hope Village township development BAR, Johannesburg, Gauteng	Door of Hope Charity Organisation	Project Manager, Environmental consultant, Public Participation
ACSA Jones Road Filling Station Basic Assessment, Johannesburg, Gauteng	Airports Company South Africa SOC Ltd	Project Manager, Environmental consultant, Public Participation

Screening Studies

Project Name & Location	Client Name	Role
Kibler Park Church Development ecological assessment, Johannesburg, Gauteng	Riverside Community Church	Project Manager, Ecological specialist
DEA Quoin Point dune specialist assessments, Gansbaai, Western Cape	Department of Environmental Affairs (national)	Project Manager, Environmental consultant

Environmental Compliance, Auditing and ECO

Project Name & Location	Client Name	Role
Transnet Depot and Siding compliance auditing programme, Johannesburg, Gauteng & Rustenburg, North-West Province	Transnet SOC Ltd	ECO
Environmental compliance monitoring for the office complex development within the Pretoria National Botanical Gardens, Pretoria, Gauteng	South African National Biodiversity Institute (SANBI)	Project Manager, Environmental consultant, Public Participation, ECO

Environmental Permitting, S53, Water Use Licence (WUL), Waste Management Licence (WML) & Other Applications

Project Name & Location	Client Name	Role
Atmospheric Emissions Licence, Section 24G for the ER Galvanizing plant and operations, Johannesburg, Gauteng	ER Galvanizers Pty Ltd	Project Manager, Environmental consultant, Public Participation
City of Johannesburg nature reserve proclamation (Phase II), Johannesburg, Gauteng	City of Johannesburg SOC Ltd	Project Manager, Environmental consultant, Public Participation, Botanical specialist

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Hope Village township development water use licence, Johannesburg, Gauteng	Door of Hope Charity Organisation	Project Manager, Environmental consultant, Public Participation
Diamond Park Township Development Section 24G, Kimberley, Northern Cape	Sol Plaatje Local Municipality	Project Manager, Environmental consultant, Public Participation
Boschendal Wine Estate hydro-electric power station Water Use Licence and S24G application, Stellenbosch, Western Cape	Boschendal Wine Estate	Environmental consultant
City of Johannesburg nature reserve proclamation boundary verification (Phase I), Johannesburg, Gauteng	City of Johannesburg SOC Ltd	Environmental consultant
PRDW Cape Town harbour breakwater rehabilitation EMPr, Cape Town, Western Cape	PRDW Engineering	Project Manager, Environmental consultant
PRDW Bushman's Estuary dune encroachment project management, Kenton-on-sea, Eastern Cape	PRDW Engineering	Environmental consultant
Corner Berg and Drooge Street township development water use licence application, Zeerust, North-West Province	Ramotshere Moiloa Local Municipality	Project Manager, Environmental consultant
Corner Kort and Bree Street township development water use licence, Zeerust, North-West Province	Ramotshere Moiloa Local Municipality	Project Manager, Environmental consultant
Bloekombos (Kraaifontein) hospital water use licence application, Cape Town, Western Cape	Western Cape Provincial Government (PGWC)	Project Manager, Environmental consultant, Botanical specialist, Wetland specialist

SPECIALIST STUDIES

Project Name & Location	Client Name	Role
Boshoek Loop Rail Upgrade BAR and Water Use Licence, Rustenburg, North-West Province	Transnet SOC Ltd	Wetland specialist
City of Johannesburg nature reserve proclamation (Phase II), Johannesburg, Gauteng	City of Johannesburg SOC Ltd	Botanical specialist
SANRAL Bierspruit R510 road upgrade Water Use Licence, Basic Assessment, Thabazimbi, Limpopo Province	SANRAL SOC Ltd & Royal HaskoningDHV South Africa	Ecological specialist
Kibler Park Church Development Ecological Assessment, Johannesburg, Gauteng	Riverside Community Church	Ecological specialist
Barberton IAPS Waste Water Treatment Works development BAR, water use licence and SASS 5 assessment, Barberton, Mpumalanga Province	Umjindi Local Municipality and Rhodes University	Aquatic specialist
Wijnberg Trust Dam 2 expansion Aquatic Impact Assessment, Greyton, Western Cape	Wijnberg Trust	Aquatic specialist
SANRAL Caledon N2 Section 3 road upgrade project Basic Assessment, Water Use Licence and Specialist reports, Caledon, Western Cape Province	JG Afrika Engineering	Ecological specialist

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City of Johannesburg nature reserve proclamation boundary verification (Phase I), Johannesburg, Gauteng	City of Johannesburg SOC Ltd	GIS specialist
iGas integrated biodiversity screening, Saldanha, Western Cape	Central Energy Fund - iGas (subsidiary)	Faunal specialist (assistant)
Bloekombos (Kraaifontein) botanical baseline and impact assessment, Cape Town, Western Cape	Western Cape Provincial Government (PGWC)	Wetland specialist Botanical specialist