# BIODIVERSITY AND WATER RESOURCE ASSESSMENT FOR THE PROPOSED DECOMMISSIONING OF THE TRANSNET DURBAN TO JOHANNESBURG PIPELINE (DJP)

## Gauteng, Free State and KwaZulu Natal

**Date**
December 2019

**Prepared for:**

**Prepared by:**

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|---|---|
| **Report Name** | **BIODIVERSITY AND WATER RESOURCE ASSESSMENT FOR THE PROPOSED DECOMMISSIONING OF THE TRANSNET DURBAN TO JOHANNESBURG PIPELINE (DJP)** |
| **Submitted to** | VGI CONSULTING |
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| | Martinus Erasmus (Cand Sci Nat) obtained his B-Tech degree in Nature Conservation in 2016 at the Tshwane University of Technology. Martinus has been conducting EIAs, basic assessments and assisting specialists in the field during his studies since 2015. |
| **Report Writer** | **Lindi Steyn**  |
| | Lindi Steyn has a PhD in Biodiversity and Conservation from the University of Johannesburg. She specialises in avifauna and has worked in this specialisation since 2013. |
| **Report Writer** | **Tyron Clark**  |
| | Tyron has 9 years of experience conducting wetland and biodiversity assessments in a number of African countries, affording him good experience in variety of development types. He attained his MSC in Zoological science from the University of the Witwatersrand. His research interests centre on biogeography and ecological niche modelling. Tyron has completed courses in wetland deliniation and management hosted by the University of the Free State. |
| **Report Writer** | **Christian Fry (Pr. Sci. Nat. 119082)**  |
| | Christian Fry is Pr Sci Nat registered (119082) in the field of Aquatic Science. Christian has 6 years of experience of consulting in the Aquatic Science, and has completed numerous training courses for buffers and riverine ecology, and is an accredited SASS5 practitioner. |
| **Report Reviewer** | **Andrew Husted**  |
| | Andrew Husted is Pr Sci Nat registered (400213/11) in the following fields of practice: Ecological Science, Environmental Science and Aquatic Science. Andrew is an Aquatic, Wetland and Biodiversity Specialist with more than 12 years' experience in the environmental consulting field. Andrew has completed numerous wetland training courses, and is an accredited wetland practitioner, recognised by the DWS, and also the Mondi Wetlands programme as a competent wetland consultant. |
| **Declaration** | The Biodiversity Company and its associates operate as independent consultants under the auspice of the South African Council for Natural Scientific Professions. We declare that we have no affiliation with or vested financial interests in the proponent, other than for work performed under the Environmental Impact Assessment Regulations, 2014 (as amended). We have no conflicting interests in the undertaking of this activity and have no interests in secondary developments resulting from the authorisation of this project. We have no vested interest in the project, other than to provide a professional service within the constraints of the project (timing, time and budget) based on the principles of science. |

## EXECUTIVE SUMMARY

The Biodiversity Company was appointed to conduct a terrestrial ecology and water resource baseline and impact (risk) assessment for the environmental authorisation processes for the proposed decommissioning of the Transnet Durban-Johannesburg Pipeline (DJP) and associated structures, specifically the demolition and dismantling and selected depots.

Wet season surveys were completed from the 28th of October 2019 till the 15th of November 2019. The surveys primarily focussed on the area along the pipeline servitude with a 64 m survey corridor, referred to as the project area herein. The project also considered the 500 m regulation area, which comprises fieldwork information and desktop data.

### Terrestrial Ecology

The project area (pipeline and depots) stretches across three provinces namely: Gauteng, Free State and KwaZulu-Natal. Various assessment sites were selected along the project area. The following datasets were used to select the assessment points: NFEPA, topographical data (rivers and inland waterbodies), D'MOSS, CoJ wetlands and RAMSAR. The points selected are focussed around water resources, to ensure the habitat is assessed from a terrestrial, aquatics and a wetland perspective. A total of 544 sites were selected on a desktop basis as they fell in a number of different classifications as per the scoping report (TBC: Biodiversity and Water Resource Desktop Assessment for the Proposed Decommissioning of the Transnet Durban to Johannesburg Pipeline (DJP). Scoping Report., 2019). These sites were further reduced and a total of 129 sites were visited based on the inherent sensitivity of these areas, of these 61 sites were found to have a moderately-high to high sensitivity. A total of 44 sites were rated as low-moderate or moderate, and 24 sites were given a low sensitivity. The sensitivity allocated to the areas were based on the overall habitat quality and state, the species of conservation concern (SCC) present as well as the function of landscape features (e.g. wetland) in the area that contribute to the general ecology of the area. These areas exhibit a healthy ecological functionality, integrity and may provide habitat for some additional threatened species. This diversity is indicative of the importance of these systems to collectively provide refugia, food and corridors for dispersal in and through the surrounding area.

The proposed project area is disturbed primarily due to clearing of vegetation within the servitude, presence of humans and associated impacts such as litter and livestock. Additional impacts include secondary and main roads, power and telephone lines as well as farming which resulted in many sites being scored low or not even being considered for the field assessment.

### Wetland Ecology

Based on a combination of desktop and in-field delineation, a total of 356 individual wetland hydrogeomorphic (HGM) units were identified and delineated within the 32 m survey area on either side of the pipeline route (62 m corridor). These included six wetland HGM types floodplains, channelled valley-bottoms, unchanneled valley-bottoms, flats, seeps and depressions. Together these wetlands occupied a total of 267.7 ha covering 6% of the 64 m survey corridor along the pipeline route. Encouragingly the majority of wetlands along the pipeline route were found to be in a Largely Natural to Moderately Modified state, reflecting

the large extent of undeveloped and often remote (and intact) rural land traversed by the pipeline. Class B systems were least abundant Gauteng Province where they were mainly encountered near Faerie Glen and south of Rietvlei (near Elandsfontein AH) nature reserves while the highest frequency of these systems were encountered in the Free State (particularly between Bethlehem and Swinburne) and KwaZulu-Natal (particularly in the midlands between Estcourt and Curries Post). most wetlands along the pipeline route have a High (class B) to Moderate (class C) EIS with a comparatively small proportion of wetlands occupying either extreme (class A or D). Most of the systems (174) along the pipeline route are considered to provide Highly important ecosystem services. These are predominantly large, relatively intact systems that provide both direct provisional and indirect regulating and supporting services in rural settings.

To facilitate the feasibility and practicality of pipeline decommissioning efforts given the high number of wetland crossings (356 HGM units) an approach was adopted to prioritise wetlands in order of highest to lowest risk to the anticipated impacts associated with pipeline closure and ultimate abandonment. The prioritization of wetland sites was primarily based on hydroperiod while ecological integrity was also considered. Two closure scenarios are anticipated; Scenario 1 remove the pipeline and Scenario 2 leave in place and mitigate in-situ. The risk assessment provided in this report caters for both potential scenarios (scenarios 1 and 2). It is, however, our understanding that the client intends to opt for Scenario 2 which involves applying non-invasive mitigation from beyond the delineated wetland boundary and associated buffer. All post-mitigation ratings for this scenario should be used to inform decisions with regards to the level of water use licencing required. Under this scenario, it is recommended that at sites earmarked as being of potential risk (Priority 1 and 2) that the mitigation as outlined in the risk assessment be applied while at all times remaining outside of the delineated wetland boundary and associated buffers as provided in the GIS shapefile provided to the client. Effective implementation of the suggested mitigation is anticipated to decrease the risk of all impacts associated with Scenario 2 to Low, and as such, a General Authorisation should be considered in terms of water use licensing.

**Riverine Ecology**

The watercourses in the project area drain into the Vaal and the Pongola and Mtamvuna Water Management Areas (WMAs). A total of 30 riverine assessments were conducted to characterise the watercourses encountered during the proposed pipeline decommissioning. Standard riverine and wetland assessments were completed to define their spatial sensitivity and Present Ecological Status. The watercourses ranged from seriously modified (class E/F) to largely natural (class B) according to biotic integrity of macroinvertebrate assemblages. A single protected fish species was collected during the study in the Vaal and Suikerbosrand systems, *Labeobarbus kimberleyensis*, which is listed as Near Threatened. The proposed activities do not pose a threat to the species populations should the pipeline be left in situ. Numerous drainage lines are encountered along the pipeline, these sites were delineated in the wetland assessment and appropriate buffers were applied. According to the proposed activities, recommended buffers and mitigations measures, the risks to the ephemeral and perennial watercourses were rated as low.

## Document Guide

The table below provides the NEMA (2014) Requirements for Ecological Assessments, and also the relevant sections in the reports where these requirements are addressed:

| GNR 982 April 2017 | Description | Section in the Report |
|---|---|---|
| **Specialist Report** | | |
| Appendix 6 (a) | A specialist report prepared in terms of these Regulations must contain—<br>details of—<br>i. the specialist who prepared the report; and<br>ii. the expertise of that specialist to compile a specialist report including a curriculum vitae; | Page i |
| Appendix 6 (b) | A declaration that the specialist is independent in a form as may be specified by the competent authority; | Page Vi - Viii |
| Appendix 6 (c) | An indication of the scope of, and the purpose for which, the report was prepared; | Section 3 |
| Appendix 6 (cA) | An indication of the quality and age of base data used for the specialist report; | Section 7 |
| Appendix 6 (cB) | A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change; | Section 9 & 10 |
| Appendix 6 (d) | The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment; | Section 8 |
| Appendix 6 (e) | A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used; | Scoping report (TBC, 2019) |
| Appendix 6 (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 alternatives; | Section 8 |
| Appendix 6 (g) | An identification of any areas to be avoided, including buffers; | Section 8 as well as spatial data |
| Appendix 6 (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 8 |
| Appendix 6 (i) | A description of any assumptions made and any uncertainties or gaps in knowledge; | Section 5 |
| Appendix 6 (j) | A description of the findings and potential implications of such findings on the impact of the proposed activity [including identified alternatives on the environment] or activities; | Section 9 |
| Appendix 6 (k) | Any mitigation measures for inclusion in the EMPr; | Section 9 |
| Appendix 6 (l) | Any conditions for inclusion in the environmental authorisation; | Section 9 & 13 |
| Appendix 6 (m) | Any monitoring requirements for inclusion in the EMPr or environmental authorisation; | Section 9 & 13 |
| Appendix 6 (n) | A reasoned opinion—<br>i. [as to] whether the proposed activity, activities or portions thereof should be authorised;<br>(iA) regarding the acceptability of the proposed activity or activities; and<br>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; | Page ii |
| Appendix 6 (o) | A description of any consultation process that was undertaken during the course of preparing the specialist report; | None |
| Appendix 6 (p) | A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and | None |
| Appendix 6 (q) | Any other information requested by the competent authority. | None |

## Declaration

I, Martinus Erasmus, 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; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

Martinus Erasmus

Terrestrial Ecologist

The Biodiversity Company

December 2019

## Declaration

I, Tyron Clark 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 work relevant to this application, including knowledge of the Act (NEMA), 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; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

Tyron Clark

Wetland Specialist

The Biodiversity Company

December 2019

## Declaration

I, Christian Fry 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 work relevant to this application, including knowledge of the Act (NEMA), 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; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

Christian Fry

Aquatic Specialist

The Biodiversity Company

December 2019

## Abbreviations

| Abbreviation | Meaning |
|---|---|
| **ASPT** | Average Score Per Recorded Taxon |
| **CBA** | Critical biodiversity Area |
| **CBD** | Convention on Biological Diversity |
| **CBG** | Central Bushveld Group |
| **CITES** | The Convention on International Trade in Endangered Species of Wild Fauna and Flora |
| **CoJ** | City of Johannesburg |
| **D'MOSS** | Durban Metropolitan Open Space System |
| **DEA** | Department of Environmental Affairs |
| **DHG** | Dry Highveld Grasslands Group |
| **DJP** | Transnet Durban-Johannesburg Pipeline |
| **DO** | Dissolved Oxygen |
| **DWS** | Department of water and Sanitation |
| **ECO** | Environmental control officer |
| **EIA** | Environmental Impact Assessment |
| **EIS** | Ecological Importance and Sensitivity |
| **EMP** | Environmental Management Plan |
| **EN** | Endangered |
| **ESA** | Environmental Support Area |
| **GDARD** | Gauteng Department of Agriculture and Rural Development |
| **HGM** | Hydrogeomorphic |
| **IEM** | Integrated environmental management |
| **IHIA** | Habitat integrity |
| **IOCBG** | Indian Ocean Coastal Belt Group |
| **IUCN** | International Union for Conservation of Nature |
| **KZN** | KwaZulu-Natal |
| **LC** | Least Concerned |
| **MHGG** | Mesic Highveld Grasslands Group |
| **NBF** | National Biodiversity Framework |
| **NEMA** | The National Environmental Management Act |
| **NFEPA (FEPA)** | National Freshwater Ecosystem Priority Areas |
| **NPAES** | National Protected Areas Expansion Strategy |
| **NSBA** | National Spatial Biodiversity Assessment |
| **NT** | Near threatened |
| **NWA** | National Water Act |
| **PES** | Present ecological state |
| **RAMSAR** | Ramsar Convention on Wetlands of International Importance |
| **SANBI** | South African National Biodiversity Institute |
| **SASS5** | South African Scoring System version 5 |
| **SCC** | species of conservation concern |
| **SEGG** | Sub-Escarpment Grassland |
| **SES** | Sub-Escarpment Savanna Group |
| **TBC** | The Biodiversity Company |

| | |
|---|---|
| **ToR** | Terms of Reference |
| **UNFCC** | The United Nations Framework Convention on Climate Change |
| **VGI** | VGI Consulting |
| **VU** | Vulnerable |
| **WCO** | Without Channelled Inflow |
| **WMA** | Water Management Area |

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## Tables

# Figures

# 1 Introduction

The Biodiversity Company (TBC) was appointed to conduct a terrestrial ecology and water resource baseline and impact (risk) assessment for the environmental authorisation processes for the proposed decommissioning of the Transnet Durban-Johannesburg Pipeline (DJP) and associated structures (Figure 1).

The pipeline was established in 1965 to supply refined petroleum products to Gauteng. In March 2018 the DJP stopped operating and due to welding defects, which increased the risk of failure as well as spillages and the pipeline seized to operate. The decommissioning of the pipeline will take place after the deactivation which involves the displacement of the product (removal of the product) and cleaning of the pipeline. At the decommissioning phase the pipeline is classified as empty and clean.

Along with the pipeline, selected depots will also be decommissioned (demolition and dismantling). The decommissioning includes the removal of all above ground infrastructure including, buildings, pumps, motors, valves, spill basins, bunded areas, electrical and communication infrastructure, power and water infrastructure as well as fencing and security. The depots that will be decommissioned are:

- Van Reenen;
- Bethlehem;
- Magdala;
- Elardus Park;
- Pretoria West; and
- Potchefstroom.

The pipeline will be left underground as this is deemed internationally as the most environmentally friendly option. The pipeline will be segmented and plugged to limit its ability to function as a conduit. Certain sections of the pipe will be filled with a wet sand mixture. At the areas where the pipe will be cut and filled a 4 m by 4 m hole will be excavated, while at the other end of the section of pipe a 2 m by 2 m hole will be opened. A contactors camp will also be set up next to the excavated hole. Both project areas will be fenced in. The pipe will be filled in areas where subsidence could be a problem, this includes river crossings, streams, wetlands, roads and rail crossings. The estimate of total area disturbed at each point is 10 m by 10 m.

This assessment is in accordance with the 2014 EIA Regulations (No. R. 982-985, Department of Environmental Affairs, 4 December 2014) emanating from Chapter 5 of the National Environmental Management Act (Act No. 107 of 1998). The findings and information herein are in terms of Appendix 6 of the 2014 NEMA EIA Regulations (amended in 2017).

The project was also completed in accordance with the requirements of the Water Use Authorisation in terms of Section 21(c) and (i) of the National Water Act (Act 36 of 1998) (NWA).

# 2 Project Area

The sections of the pipeline along with the decommissioned depots and their associated infrastructure are referred to as the project area herein. The project area portions stretch across three provinces, namely Gauteng, Free State and KwaZulu-Natal (KZN). A station might also be decommissioned in the North West in Potchefstroom. The Gauteng portion stretches from Pretoria Industrial to Moreletapark, Silverton to Moreletapark, Moreletapark to Boksburg, Alrode to Maraisburg, Maraisburg to the Free State border and then stretches to Sasolburg. In between Sasolburg and Kroonstad Magdala depot is found. The project area then starts again in Kroonstad where it continues to Bethlehem, from Bethlehem to Harrismith, Harrismith into KZN continuing to Ladysmith, Ladysmith to Estcourt, Estcourt to Howick, Howick to Ashburton (old line), Howick via Ashburton to Lynnfield Park (new line) and Lynnfieldpark ending in Durban (Figure 1).

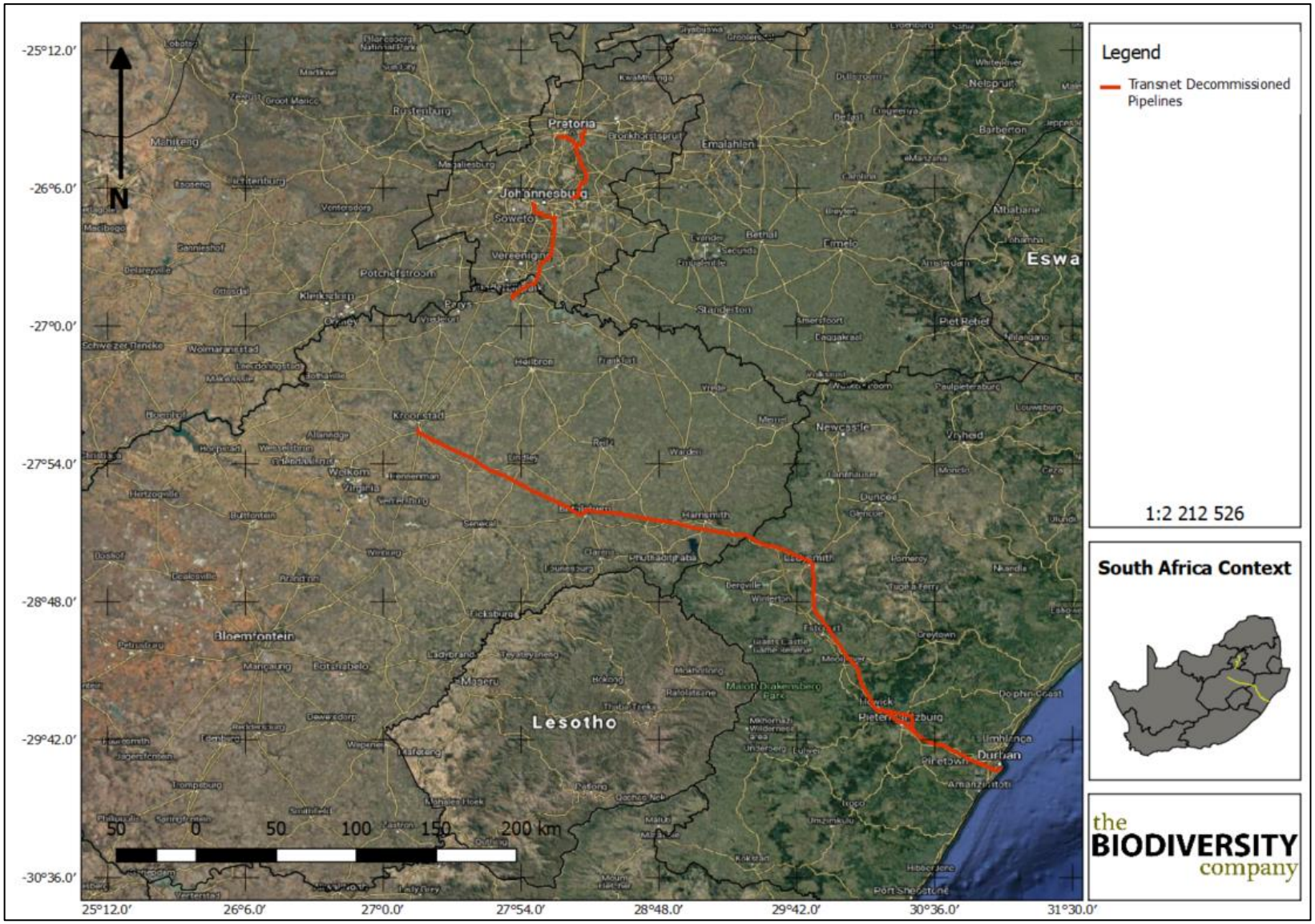



*Figure 1: The general location of the project area*

# 3 Terms of Reference

The specialist assessments undertaken for this project took into consideration what is typically deemed as best practice and also the draft minimum requirements for biodiversity considerations in land-use management and integrated environmental management (IEM) by the Department of Environmental Affairs (DEA). The specialist assessments completed herein include:

- Terrestrial biodiversity assessment;
- Aquatic ecology assessment; and
- Wetland assessment.

The Terms of Reference (ToR) included the following:

- Description of the baseline receiving environment specific to the field of expertise (general surrounding area as well as site specific environment);
- Identification and description of any sensitive receptors in terms of relevant specialist disciplines (biodiversity, aquatics and wetlands) that occur in the project area, and the manner in which these sensitive receptors may be affected by the activity;
- Identify 'significant' ecological and faunal features within the proposed development areas; and
- Risk study to identify any critical issues (potential fatal flaws) that may result in project delays or rejection of the application.

# 4 Methodologies

Refer to scoping report for a full method description for the Terrestrial, Aquatic and Wetland studies (TBC, 2019).

# 5 Limitation

The following limitations are relevant for this project:

- This report must be read in conjunction with the desktop scoping report that assessed the spatial datasets for the project area (TBC: Biodiversity and Water Resource Desktop Assessment for the Proposed Decommissioning of the Transnet Durban to Johannesburg Pipeline (DJP). Scoping Report., 2019);
- The joining - and termination location of the old line (Howick to Ashburton) and new line (Howick via Ashburton to Lynnfields) are not accurate as per the provided shapefiles, the variation falls inside of urban areas which does not influence the sites selected for this study;
- Some field sites could not be accessed due to various restrictions including locked gates and inaccessible roads, these sites were then assessed on a desktop basis or from an adjacent property;

- Only sites identified as sensitive as per the desktop scoping assessment were assessed in field, desktop assessments of the other areas are provided in this report as well as the scoping report (TBC Biodiversity and Water Resource Desktop Assessment for the Proposed Decommissioning of the Transnet Durban to Johannesburg Pipeline (DJP). Scoping Report., 2019, 2019);
- Spillage of fuel out of the system was not considered in the impact section as the pipe were drained and cleaned before the start of the decommissioning;
- Only representative water resources have been assessed for the riverine assessment portion of the project, with the location and extent of the remaining water resources indicated (only);
- Field assessments were completed to assess as much of the site as possible with focus on the proposed directly impacted and downstream areas;
- Only defined watercourses at the Sub Quaternary Reach level were considered in the aquatic ecology study;
- Numerous watercourses were observed to be dry during the survey;
- The use of two of the main wetland indicators namely hydromorphic soils and hydrophytic vegetation was, in places, limited due to soil disturbances;
- Due to the considerable scale of the project area, in field delineations were restricted to within a 32 m corridor on either side of the pipeline route. As such the delineations end abruptly outside this corridor. Wetlands within the 500 m regulated area were considered but not explicitly assessed;
- Due to the scale of the project the delineations represent a combination of in-field and desktop delineations; and
- The GPS used for water resource delineations is accurate to within five meters. Therefore, the wetland delineation plotted digitally may be offset by at least five meters to either side

# 6 Key Legislative Requirements

The legislation, policies and guidelines listed below are applicable to the ecological component of the current project in terms of biodiversity and ecological support systems. The list below may not be applicable to other parts of the project but are relevant to the ecological studies alone. The list below, although extensive, may not be complete and other legislation, policies and guidelines may apply in addition to those listed below.

Explanation of certain documents or organisations is provided (Table 1) where these have a high degree of relevance to the project and/or are referred to in this assessment.

*Table 1: A list of key legislative requirements relevant to biodiversity and conservation in Gauteng, Free State and KwaZulu Natal*

| | |
|---|---|
| INTERNATIONAL | Convention on Biological Diversity (CBD, 1993) |
| | The United Nations Framework Convention on Climate Change (UNFCC,1994) |
| | The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES 1973) |
| | The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention, 1979) |
| NATIONAL | Constitution of the Republic of South Africa (Act No. 108 of 2006) |
| | The National Environmental Management Act (NEMA) (Act No. 107 of 1998) |
| | The National Environmental Management Protected Areas Act (Act No. 57 of 2003) |
| | The National Environmental Management Biodiversity Act (Act No. 10 of 2004) |
| | The National Environmental Management: Waste Act, 2008 (Act 59 of 2008); |
| | The Environment Conservation Act (Act No. 73 of 1989) |
| | National Environmental Management Air Quality Act (No. 39 of 2004) |
| | National Protected Areas Expansion Strategy (NPAES) |
| | Natural Scientific Professions Act (Act No. 27 of 2003) |
| | National Biodiversity Framework (NBF, 2009) |
| | National Forest Act (Act No. 84 of 1998) |
| | National Water Act, 1998 (Act 36 of 1998) |
| | National Freshwater Ecosystem Priority Areas (NFEPA's) |
| | National Spatial Biodiversity Assessment (NSBA) |
| | World Heritage Convention Act (Act No. 49 of 1999) |
| | National Heritage Resources Act, 1999 (Act 25 of 1999) |
| | Municipal Systems Act (Act No. 32 of 2000) |
| | Alien and Invasive Species Regulations, 2014 |
| | South Africa's National Biodiversity Strategy and Action Plan (NBSAP) |
| | Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983) |
| | Sustainable Utilization of Agricultural Resources (Draft Legislation). |
| | White Paper on Biodiversity |
| PROVINCIAL | GDARD Requirements for Biodiversity Assessments (Version 3, 2014a) |
| | Gauteng Department of Agriculture and Rural Development (GDARD): Checklist for Biodiversity Assessments |
| | GDARD Mining and Environmental Impact Guide |
| | Free State Nature Conservation Ordinance 8 of 1969 |
| | KwaZulu-Natal Environmental, Biodiversity and Protected Areas Management Bill, 2014 |
| | KwaZulu-Natal Nature Conservation Management Act (No. 9 of 1997) |
| | KwaZulu-Natal Nature Conservation Management Amendment Act (No. 5 of 1999) |
| | KwaZulu-Natal Planning and Development Act (No. 6 of 2008) |
| | Local Government Municipal System's Act (No 32 of 2000) |
| | Guidelines for Biodiversity Impact Assessments in KZN (2013) |

# 7 Assessment Sites

Assessment sites were selected based on the desktop information available as well as sites suggested by VGI. The following datasets were used for the selection of the sites: NFEPA, inland water (river and inland waterbodies), D'MOSS, CoJ and RAMSAR. The sites were numbered 1-544, this can be seen in Figure 2 to Figure 13. The sites selected are focussed

around water resources, to ensure the habitat is assessed from a terrestrial, aquatics and a wetland perspective. Areas of interest surrounding for example the river lines were delineated by using Google Earth imagery and a 32 m buffer was added to ensure sufficient area is considered as per the amended EIA Regulations, which lists a 32 m regulation area from a watercourse for developments under Activity 14.

The following guidelines were used as per legislations to determine whether the various assessment sites will be influenced by the various datasets on a desktop base.

- A 200 m buffer was considered for Class 1 and Class 2 ridges;
- A 500 m buffer was considered for a NFEPA river or NFEPA wetland;
- A 1 km buffer was considered for protected areas;
- A 10 km buffer was considered for National parks;
- PES rating was given to the most relevant data, the same rating was given to drainage lines of the same system; and
- Default ecological categories were used as per DWS (2019).

The sites selected for the field assessments were identified based on their sensitivities (CBA classifications, proximities to protected areas, ridge classifications, NFEPA), their topographical layout, size of the systems (wetlands and rivers) ultimately to provide a representative sample of the various systems and habitats. Sites that were not assessed in fields' destails are provided based on a desktop level.

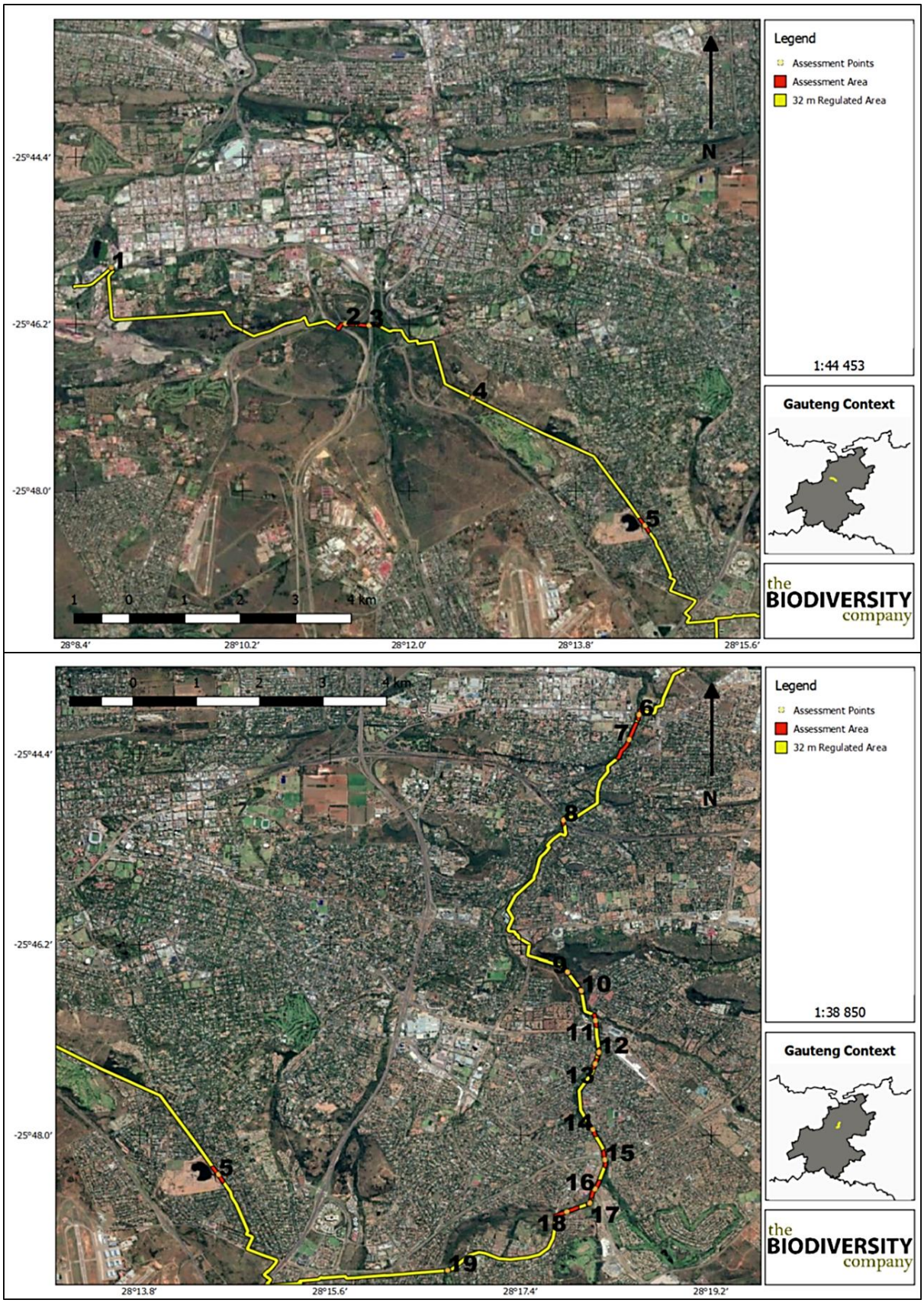



*Figure 2: Assessment sites identified*

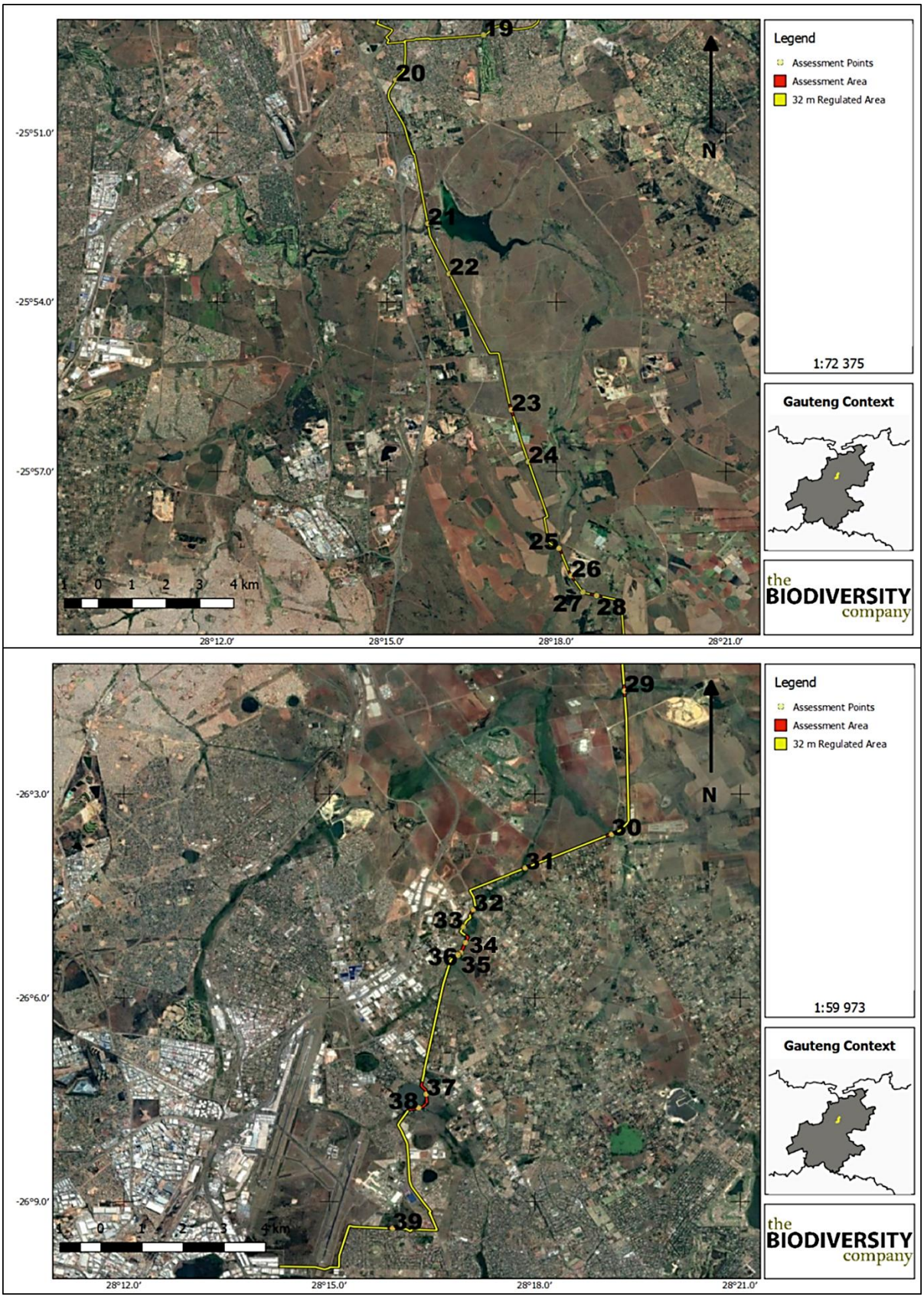



*Figure 3: Assessment sites identified*

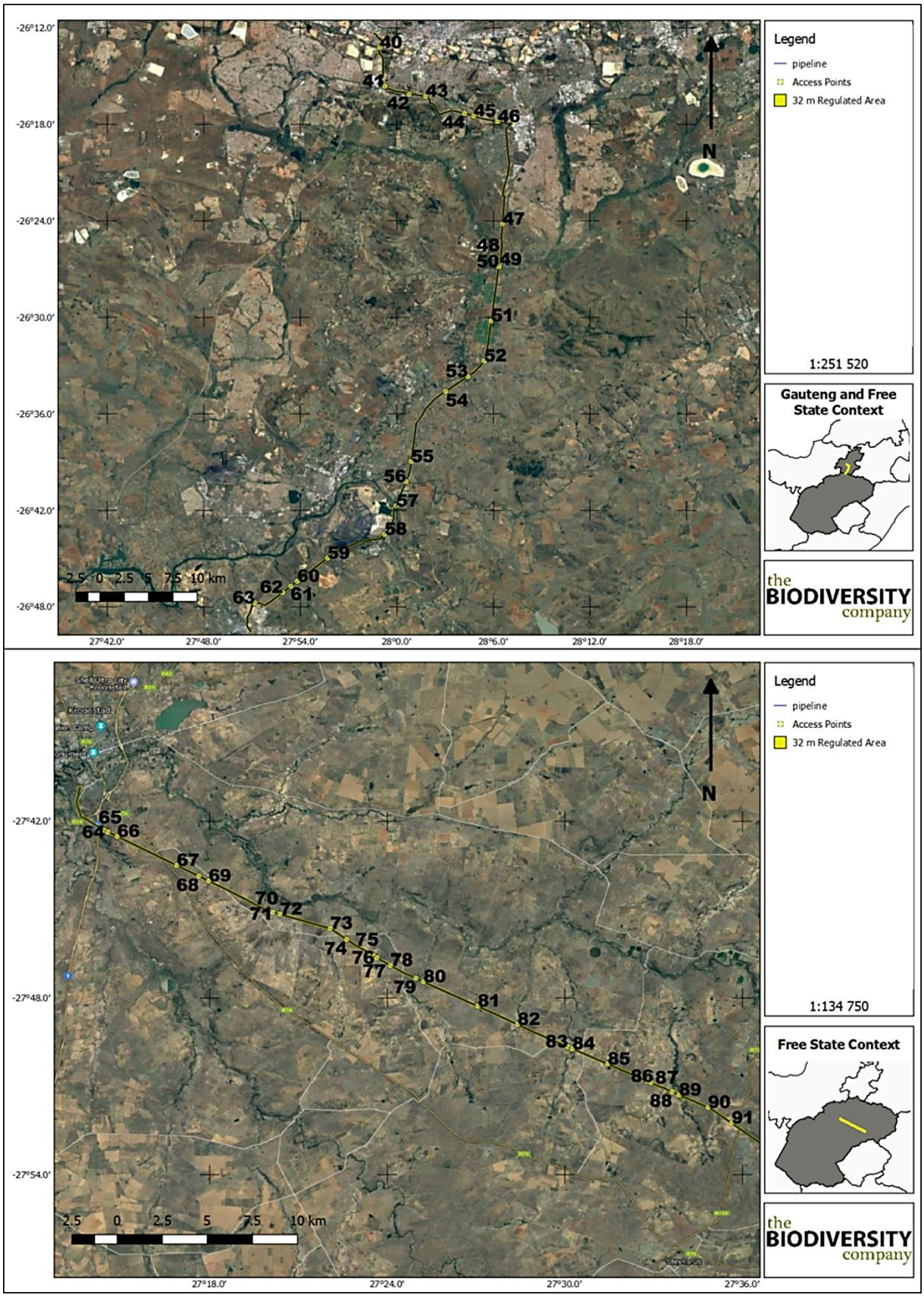



*Figure 4: Assessment sites identified*

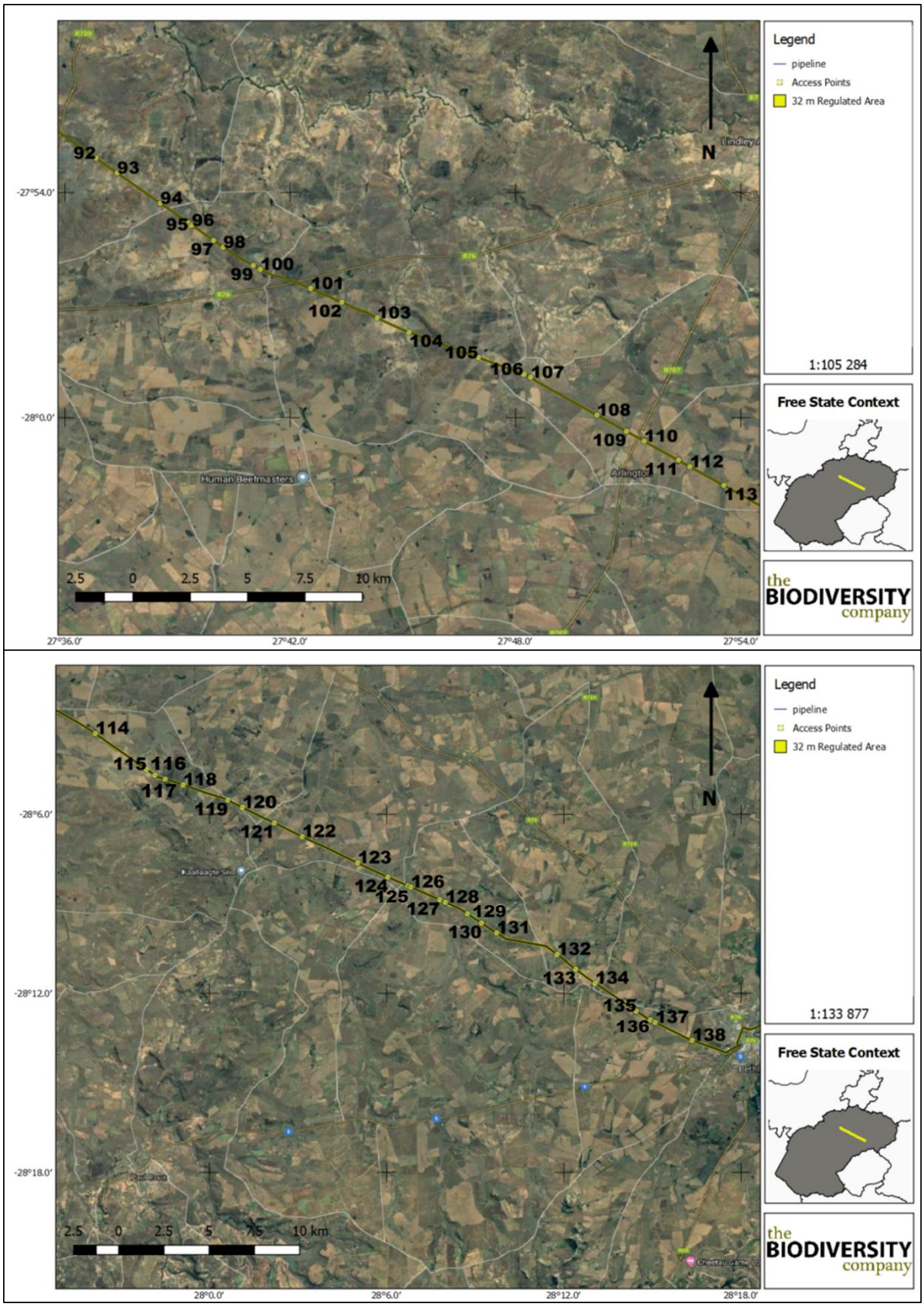



*Figure 5: Assessment sites identified*

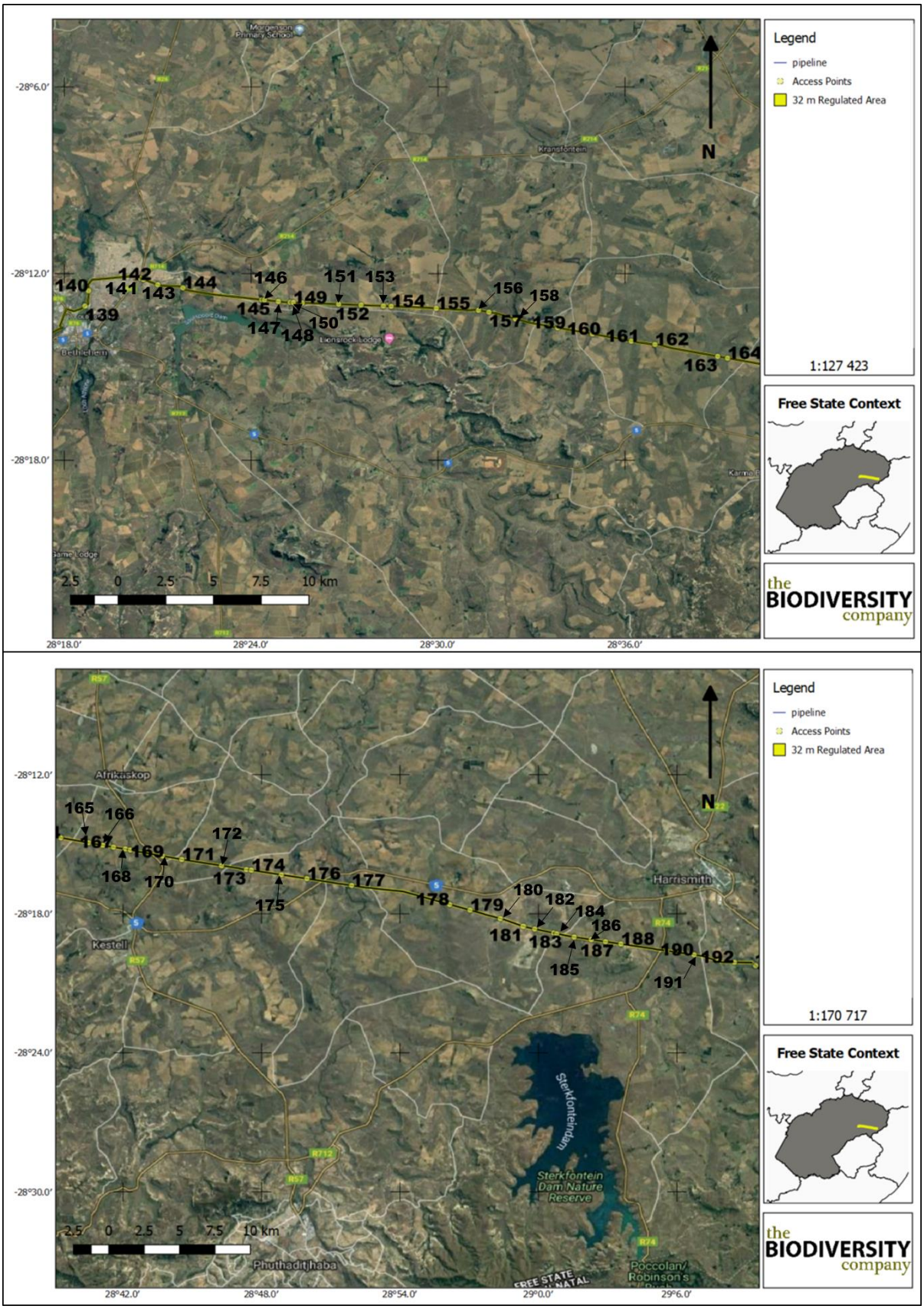



*Figure 6: Assessment sites identified*

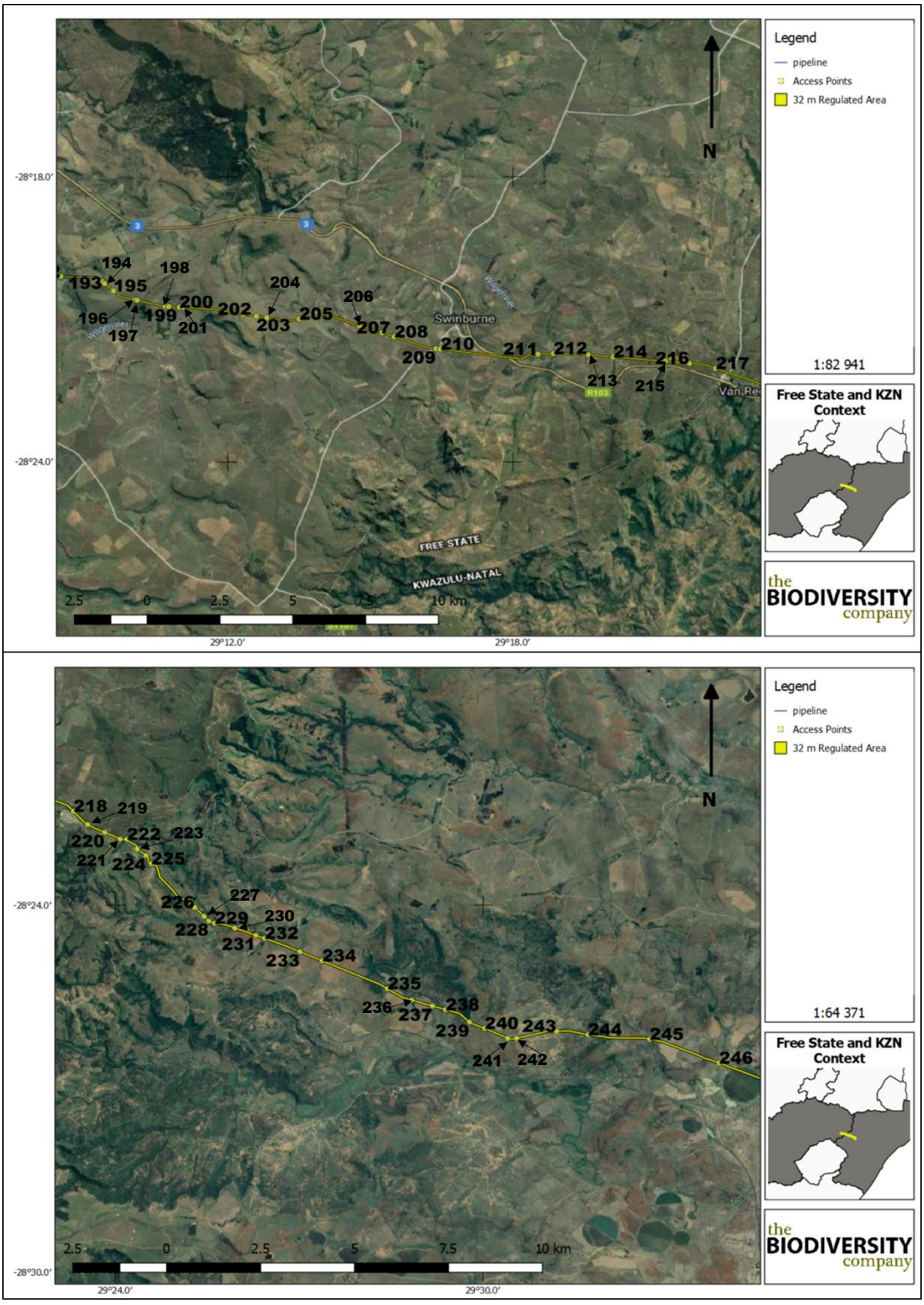



*Figure 7: Assessment sites identified*

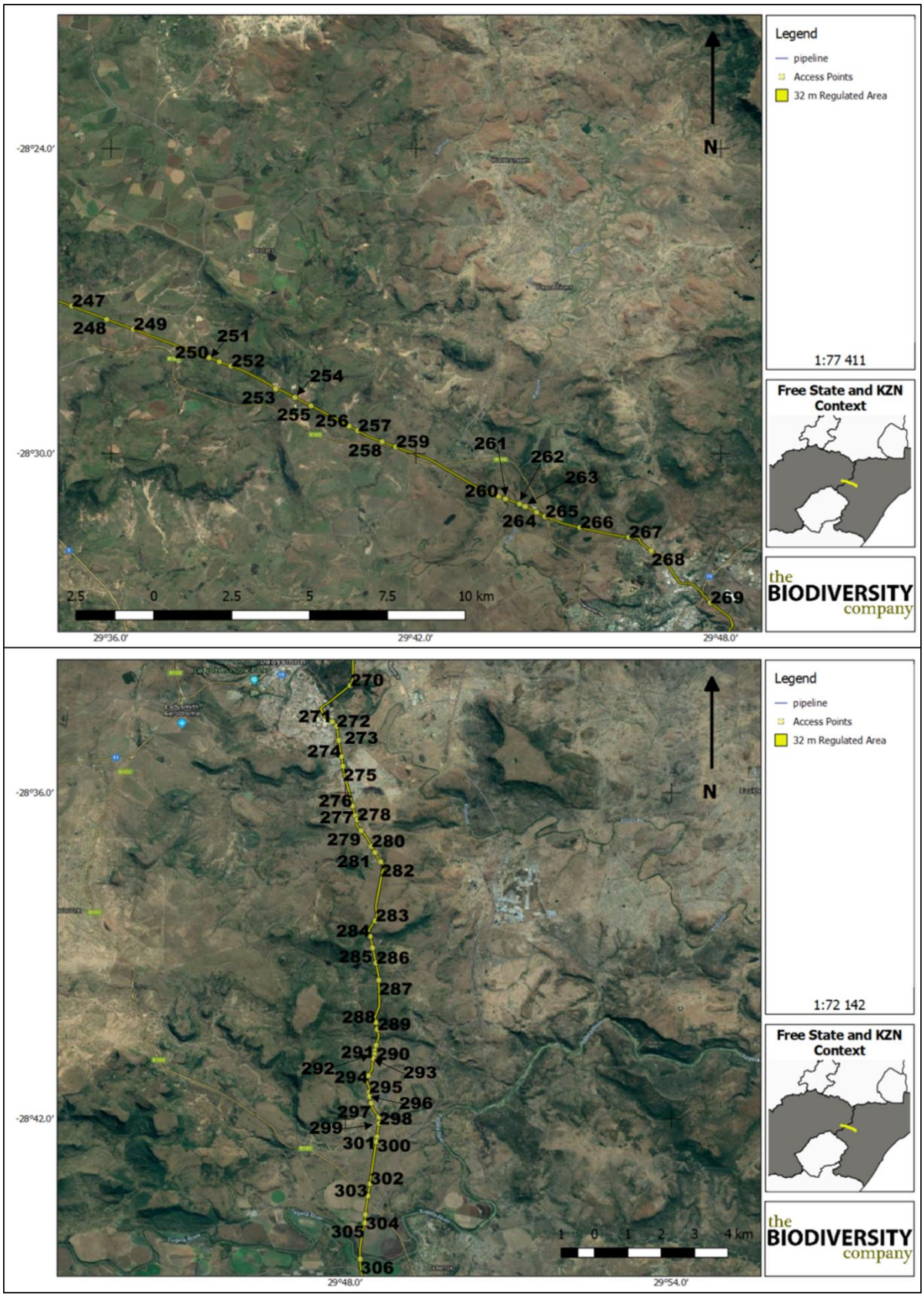



*Figure 8: Assessment sites identified*

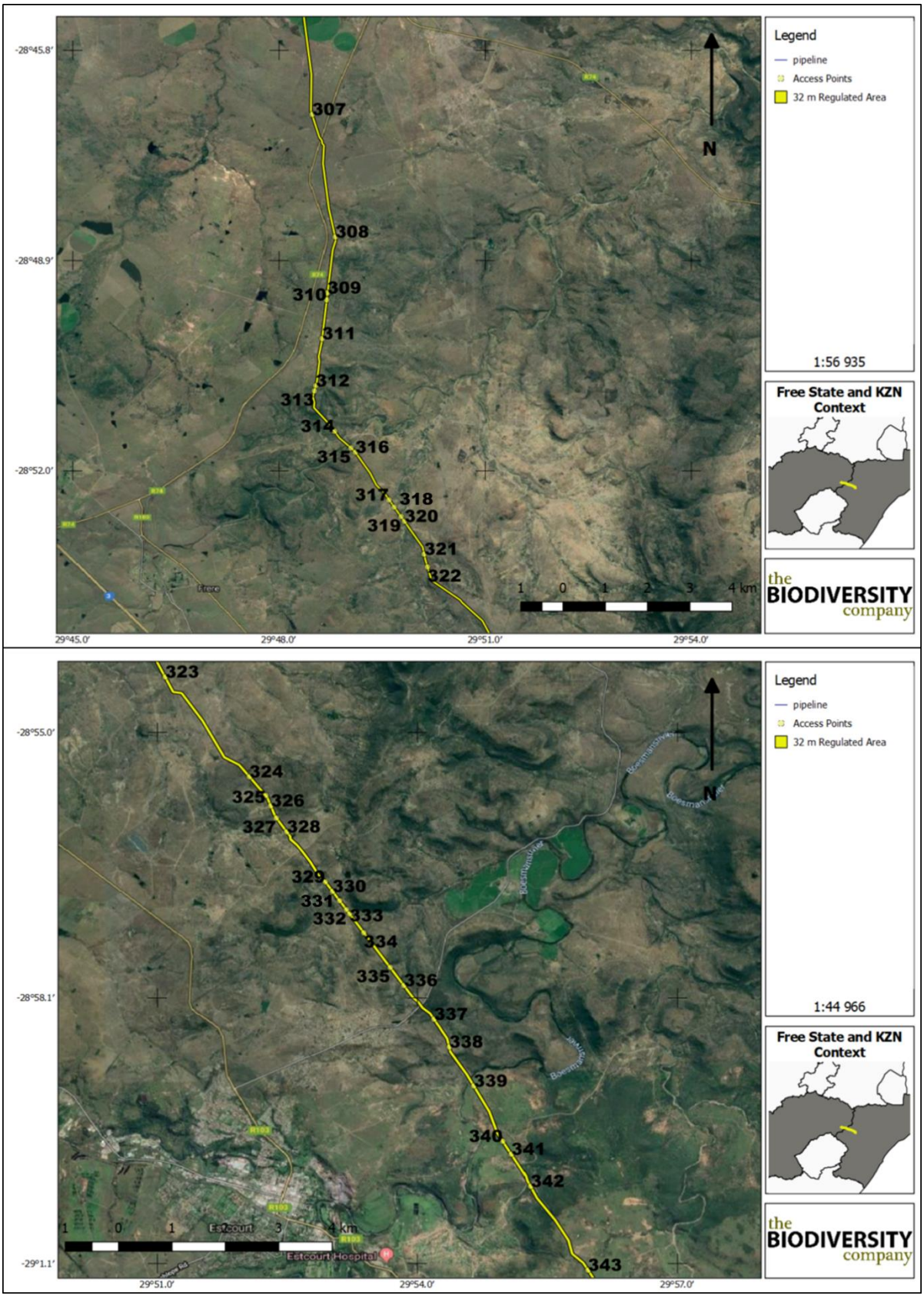



*Figure 9: Assessment sites identified*

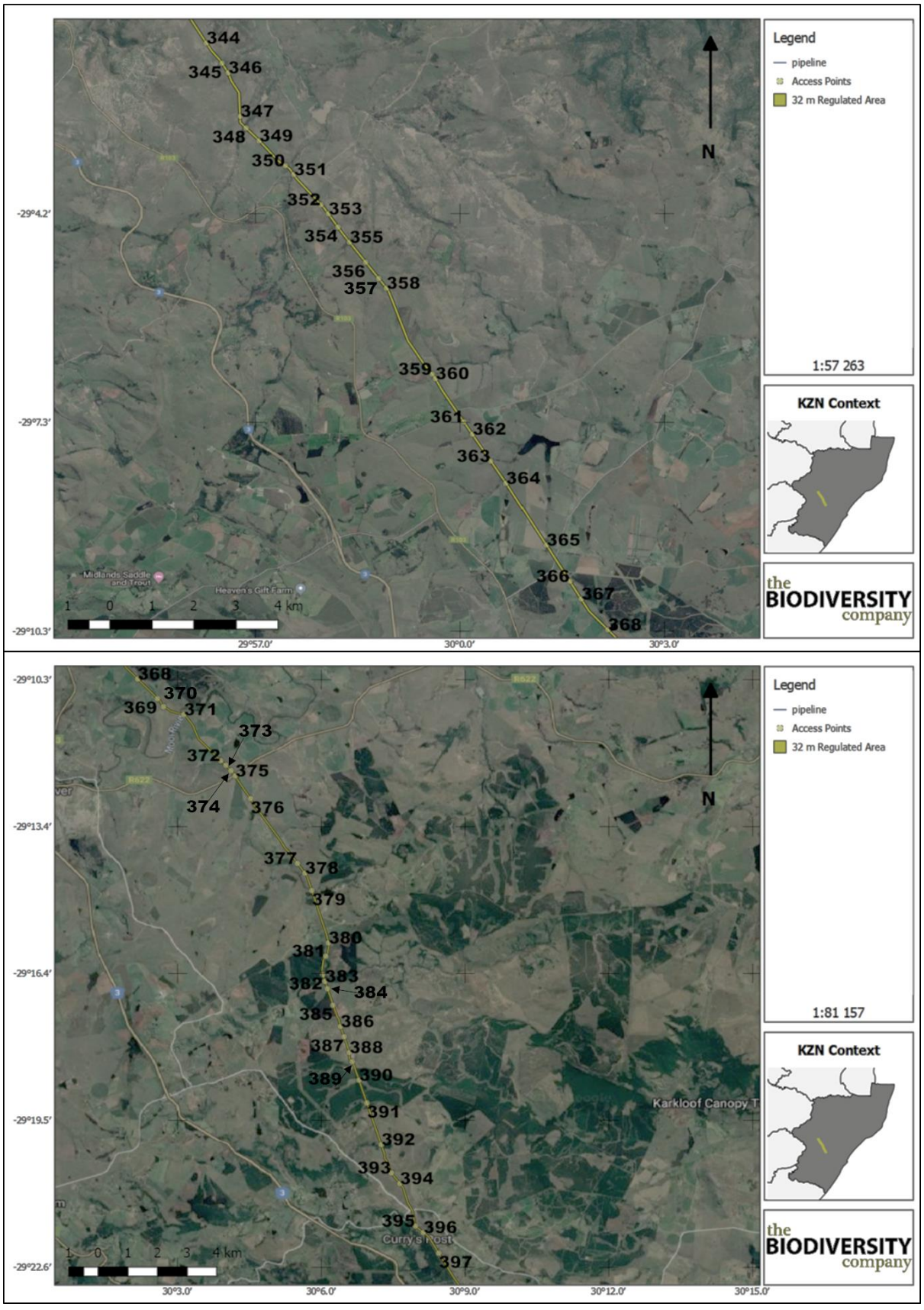



*Figure 10: Assessment sites identified*

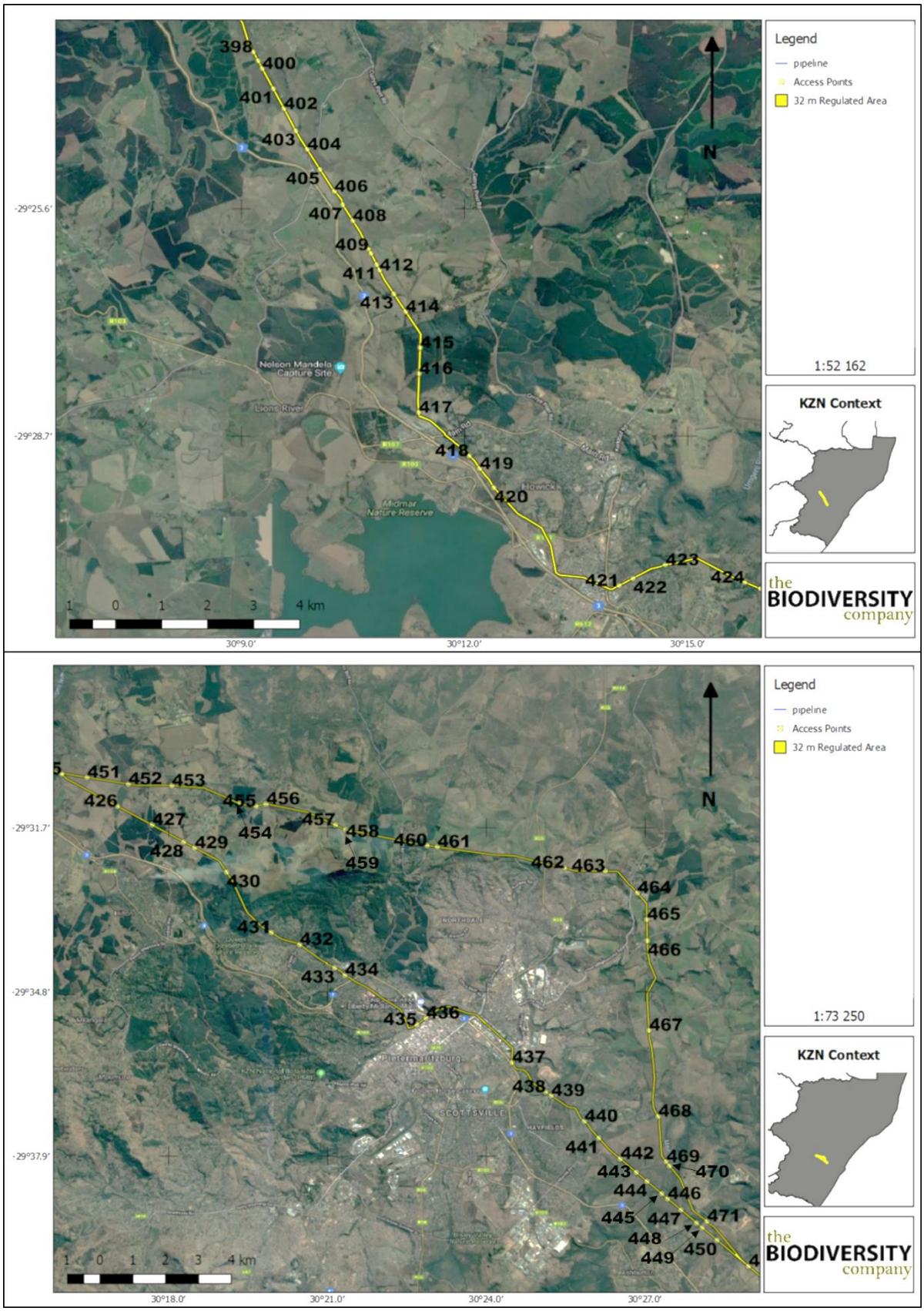



*Figure 11: Assessment sites identified*

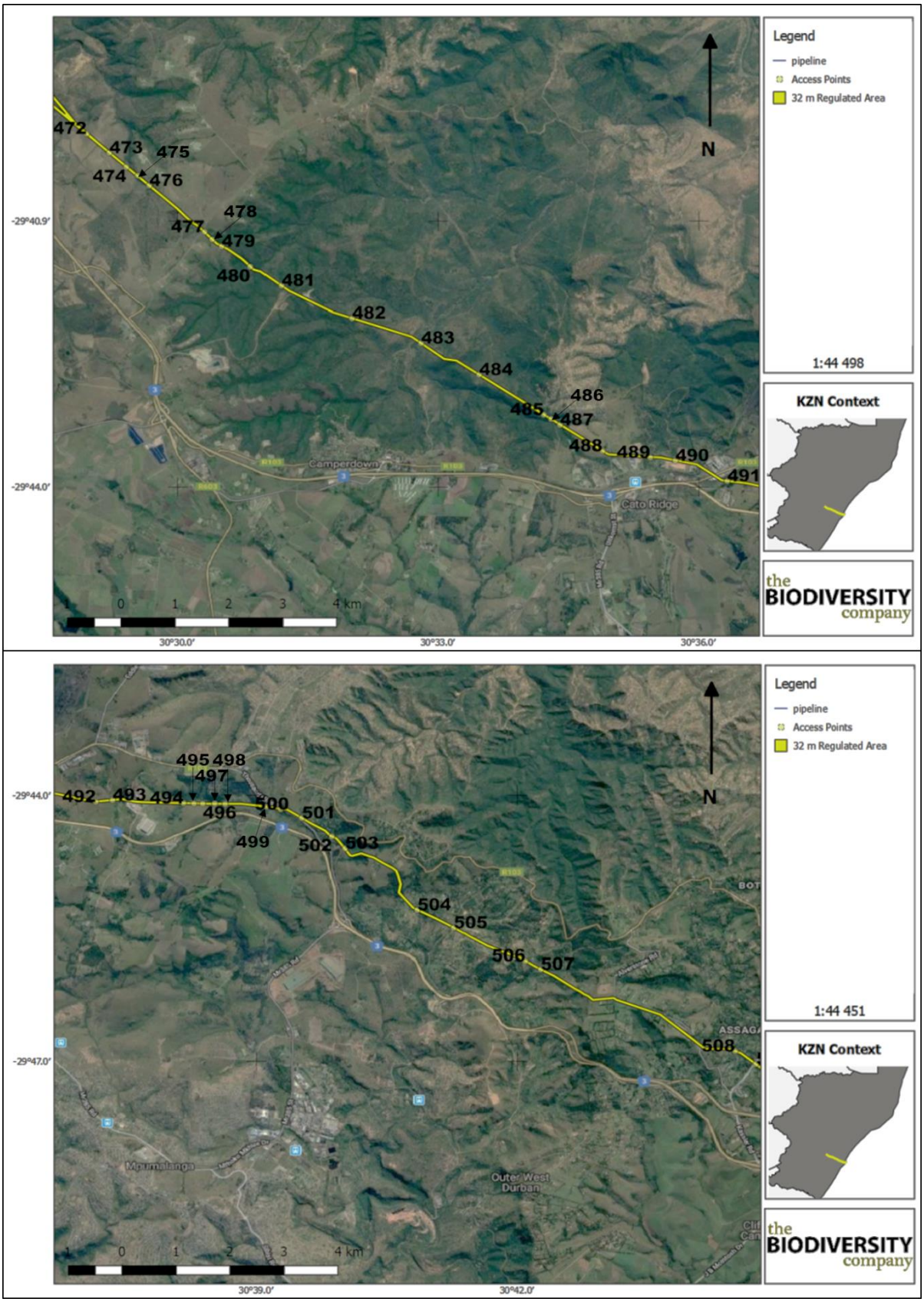



*Figure 12: Assessment sites identified*

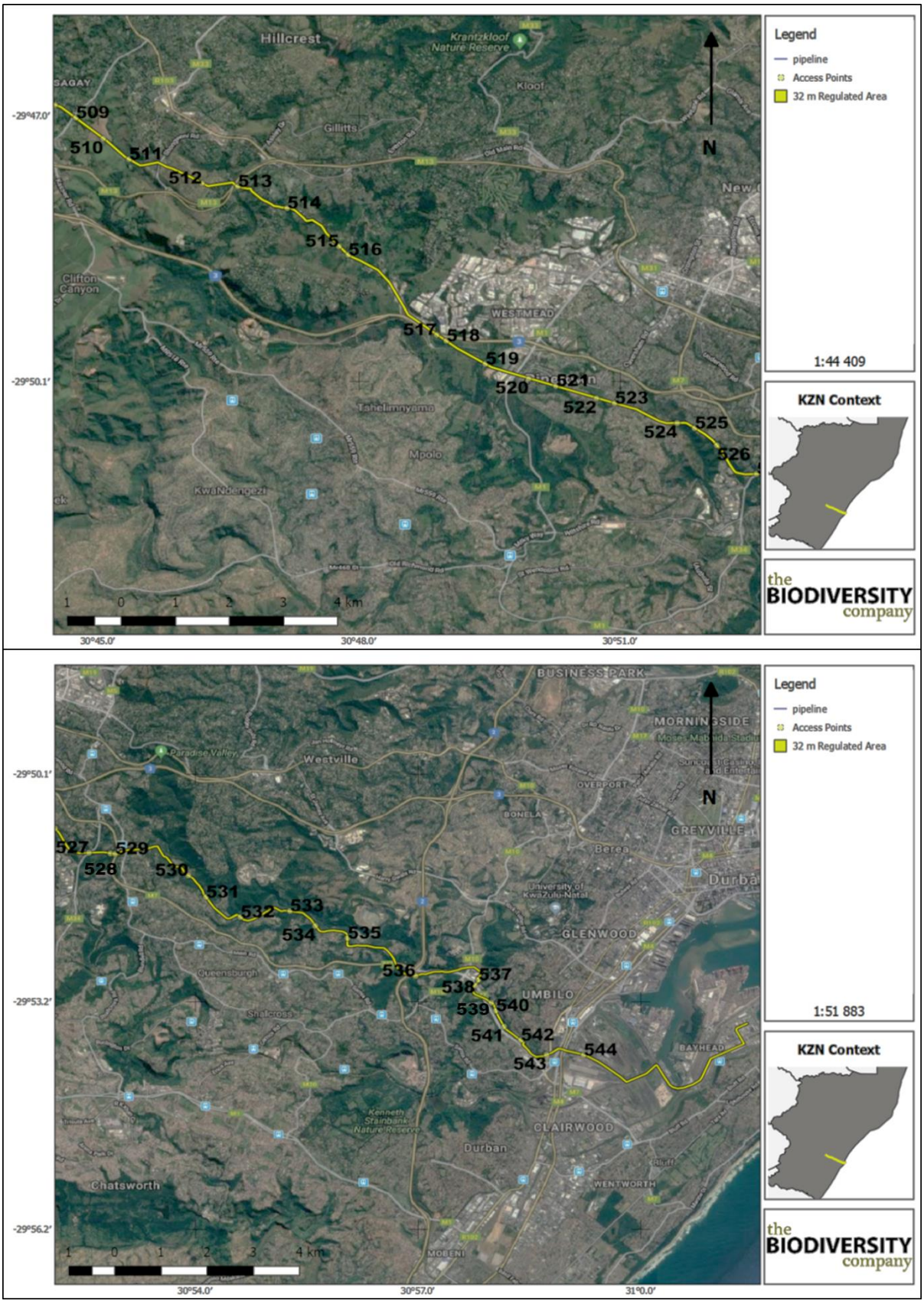



*Figure 13: Assessment sites identified*

# 8 Field Results

The following is a summary of the results from the field survey of the project area, the aim of this section is to highlight some of the sensitive areas and to ensure that the impact of the project is managed. Key features (such as location, habitat type, sensitivity, system type and hydrology) of all the sites assessed in the field are provided in Appendix A (Terrestrial) and Appendix B (Wetlands). Wet season surveys were completed from the 28th of October 2019 till the 15th of November 2019. The surveys primarily focussed on the area along the pipeline servitude with a 64 m corridor (comprising the 32 m buffer).

## 8.1 Terrestrial

A total of 129 sites were visited, of these 61 sites were found to have a moderately-high to high sensitivity. A total of 44 sites were rated as low-moderate or moderate, and 24 sites were given a low sensitivity. The sensitivity given to the areas were based on the overall habitat quality and state, the species of conservation concern (SCC) found in the area as well as the function of landscape features (e.g. wetland) in the area that contribute to the general ecology of the area. Table 2 to Table 24 is an overview of the terrestrial sites visited and summarises the reasons for the sensitivities as well as the general impacts found at that specific site. Co-ordinates of the sites where these species are found were not provided in an attempt to reduce the likelihood of poaching or harvesting of these SCCs and CITES species. Buffers given below were adapted in the spatial data to ensure desktop information is incorporated, for example the sites buffer would have been extended to ensure that the Critical Biodiversity Area is included as such this report needs to be read in conjunction with the spatial data. Areas with a high sensitivity is shown in Figure 15 to Figure 17. For the buffer determination other provinces' guidelines and legislation as well as literature were consulted to ensure sufficient protection for the various species as some of the SCCs do not have province specific guidelines.

The pipeline runs through a number of different environments from natural areas to farmlands and urban areas. In each different habitat a new set of species can be encountered. The pipeline crosses areas that are home to some of the big 5 (Rhino, Leopard, Lion, Elephant and Buffalo), as well as areas where species that are highly endemic occur. Some plants and animals depend on the existence of habitats of a certain size that is undisturbed and unfragmented. In addition to this, they can also depend on the existence of other plants and animals within their habitat for pollination, food/ nutrients or cover to name a few. A total of 24 different SCCs were recorded during the survey that spans three provinces and approximately 716 km. These SCCs include mammals (4%), reptiles (4%), avifauna (38%) and flora (54%) species of which in some cases numerous specimens were found of each (Figure 14). In order to ensure these species, their habitats and species on which they depend are sufficiently protected mitigations and guidelines are described in section 9.

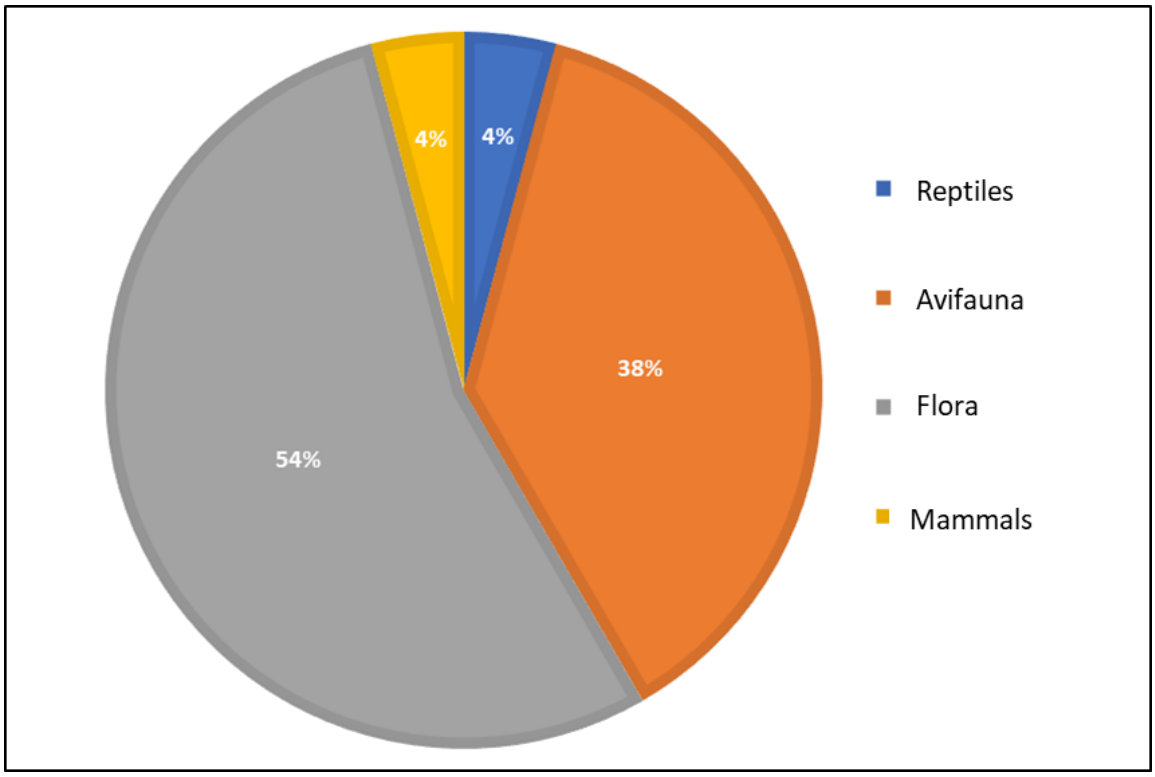



*Figure 14: Graphical representation of the composition of the terrestrial SCCs recorded in in the various sites surveyed.*

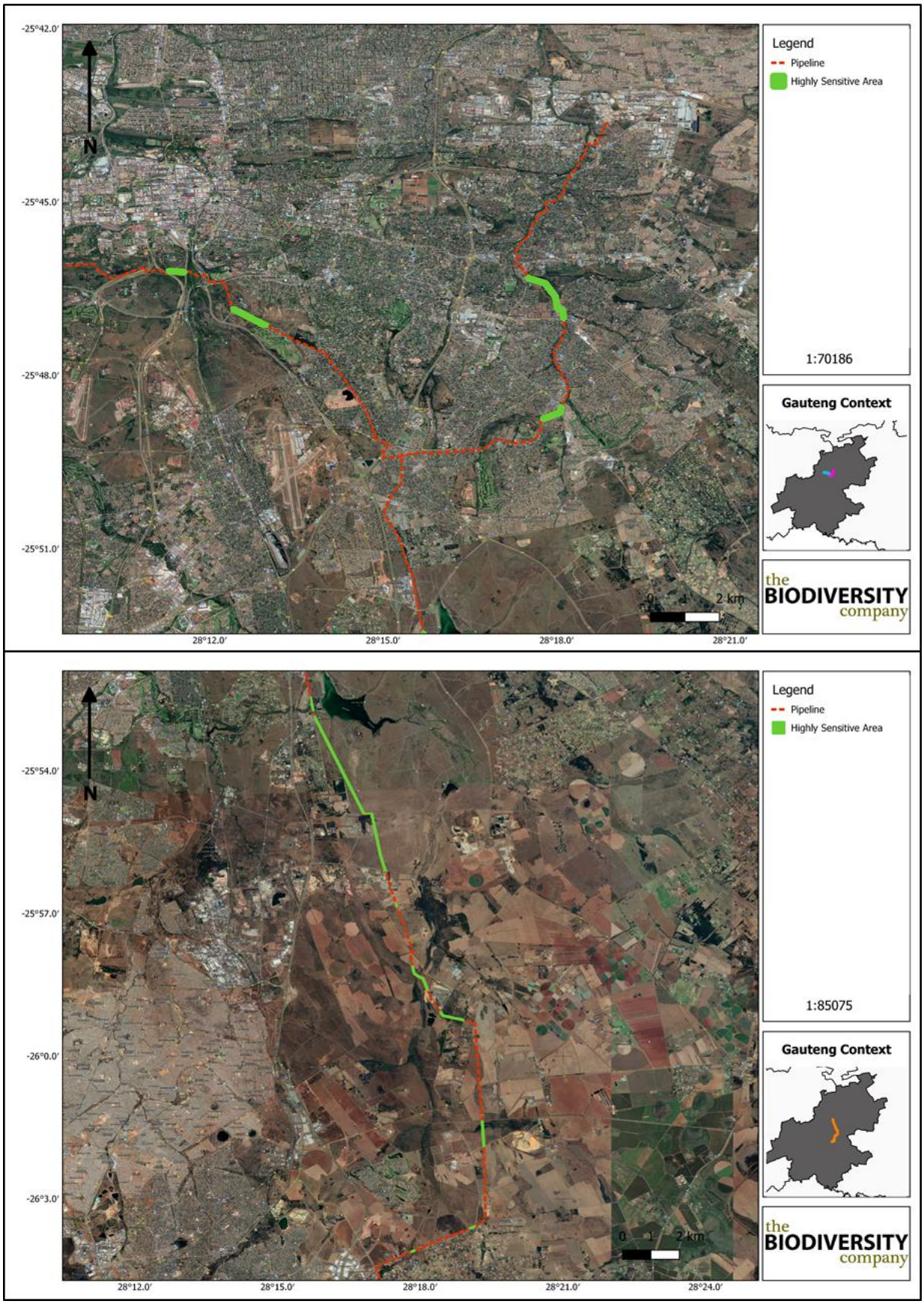



*Figure 15: Areas with high sensitivities found along the pipeline.*

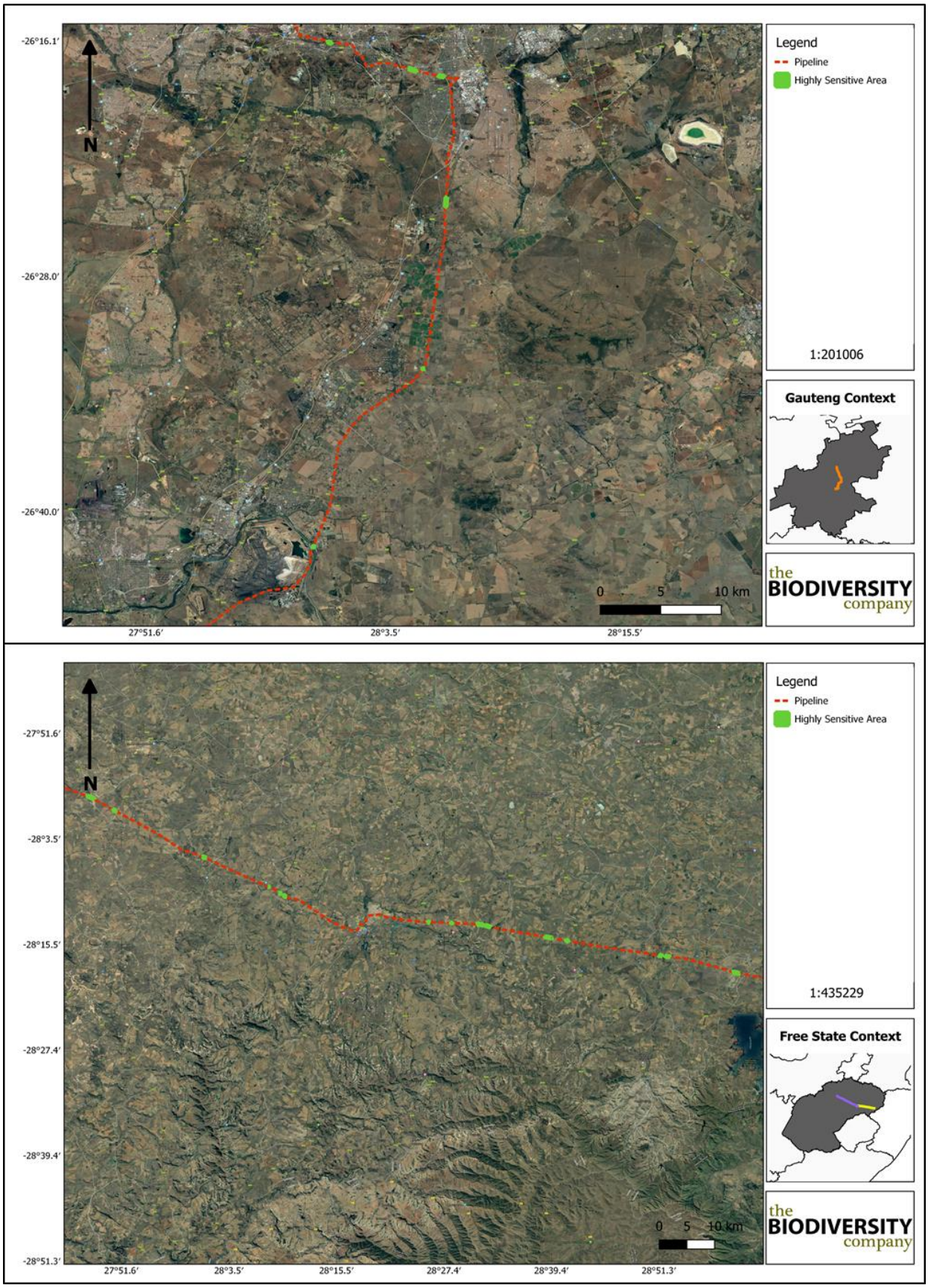



*Figure 16: Areas with high sensitivities found along the pipeline.*

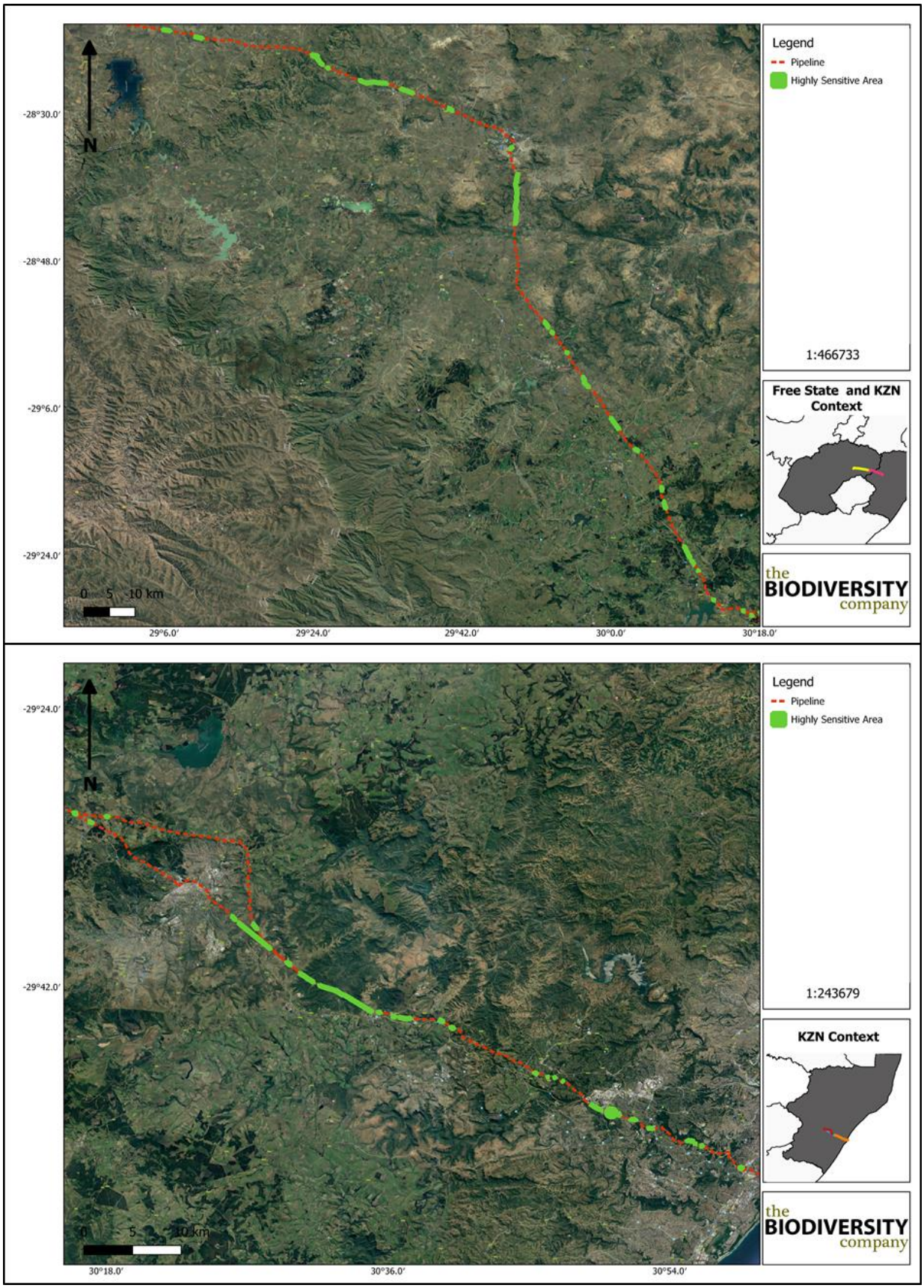



*Figure 17: Areas with high sensitivities found along the pipeline.*

*Table 2: Summary of terrestrial features of site106*

| **Site Number** | 106 | **Sample Date** | 2019/04/11 |
|---|---|---|---|
| **Site photo** | | **Feature** | |
|  | |  Giant girdled lizard (*Smaug giganteus*) burrow. | |
| **Habitat Type** | Natural grassland | | |
| **Habitat features** | Secondary Grassland that has only had impact from livestock, with a wetland present. | | |
| **Sensitivity** | **Low** | **Moderate** | **Moderate-High** | **High** X |
| **Current Impacts** | Erosion, Livestock and footpaths | | |
| **Discussion:** | This area was given a 200m buffer around the point based on guidelines specified in the Free State CBA guidelines 2016. Based on this the Giant Girdled Lizards' burrows can be found 17m apart. This species is categorised as VU based on the IUCN (2019) and are nationally and provincially protected. It is thus important that area must be carefully checked before any construction /development takes place in the area and adjacent areas. | | |

*Table 3: Summary of terrestrial features of site 107*

| **Site Number** | 107 | **Sample Date** | 10/29/2019 |
|---|---|---|---|
| **Site photo** | | **Feature** | |
|  | |  Giant girdled lizard (*Smaug giganteus*) | |

| | | | | |
|---|---|---|---|---|
| **Habitat Type** | Secondary Grassland | | | |
| **Habitat features** | Secondary Grassland that has only had impact from livestock, with a wetland present. | | | |
| **Sensitivity** | **Low** | **Moderate** | **Moderate-High** | **High** X |
| **Current Impacts** | Erosion, Livestock and footpaths | | | |
| **Discussion:** | This area was given a 200m buffer around the point based on guidelines specified in the Free State CBA guidelines 2016. Based on this the Giant Girdled Lizards' burrows can be found 17m apart. This species is categorised as VU based on the IUCN (2019) and are nationally and provincially protected. It is thus important that area must be carefully checked before any construction /development takes place in the area. | | | |

*Table 4: Summary of terrestrial features of site 182*

| **Point Number** | 182 | **Sample Date** | 2019/04/11 |
|---|---|---|---|
| **Site photo** | | **Feature** | |
|  | |  Southern Bald Ibis (*Geronticus calvus*) | |
| **Habitat Type** | Secondary Grassland with historical and current impacts due to the close proximity of the rural community with the associated livestock. | | |
| **Habitat features** | Small stream that still functions as a water resource for this SCC. | | |
| **Sensitivity** | **Low** | **Moderate** | **Moderate-High** | **High** X |
| **Current Impacts** | Livestock, Alien vegetation , Litter and Dumping , Roads , Urban development | | |
| **Discussion:** | This area was given a 500m buffer around the site based on guidelines specified in the Free State CBA guidelines 2016. The Southern Bald Ibis is listed as VU (IUCN, 2019). The area needs to be walked through to ensure this species is not present where construction and decommissioning begins. | | |

*Table 5: Summary of terrestrial features of site 182*

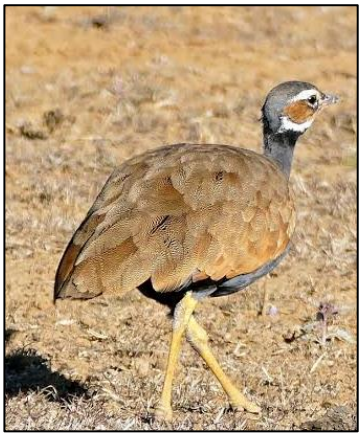
| Site Number | 193 | Sample Date | 2019/05/11 |
|---|---|---|---|
| **Site photo** | | **Feature** | |
|  | |  <br>Example of a Blue korhaan (*Eupodotis caerulescens*)<br>  <br>Blue korhaan (*Eupodotis caerulescens*) specimen recorded in field | |
| **Habitat Type** | Secondary Grassland with historical Impacts and has been recent disturbed. | | |
| **Habitat features** | Secondary Grassland with a drainage line that has been artificially altered. | | |
| **Sensitivity** | **Low** | **Moderate** | **Moderate-High** | **High** X |
| **Current Impacts** | Cattle and agriculture | | |
| **Discussion:** | This area was given a 500m buffer from the edge of the drainage line as per the Free State CBA guidelines 2016. The Blue korhaan is listed as NT (IUCN, 2019). The area needs to be walked through to ensure this species is not present where construction and decommissioning begins. | | |

*Table 6: Summary of terrestrial features of sites 196 and 197*

| **Site Number** | 196 and197 | **Sample Date** | 2019/05/11 |
|---|---|---|---|
| **Site photo** | | **Feature** | |
|  | |  Giant girdled lizard (*Smaug giganteus*) | |
| **Habitat Type** | Secondary Grassland with historical Impacts | | |
| **Habitat features** | Semi-Natural Grassland, even though degraded rated as important and sensitive. | | |
| **Sensitivity** | **Low** | **Moderate** | **Moderate-High** | **High** X |
| **Current Impacts** | Livestock | | |
| **Discussion:** | This area was given a 200m buffer around the sites based on guidelines specified in the Free State CBA guidelines 2016. Based on this the Giant Girdled Lizards' burrows can be found 17m apart. This species is categorised as VU based on the IUCN (2019) and are nationally and provincially protected. It is important that area must be carefully checked before any construction /decommissioning takes place in the area. | | |

*Table 7: Summary of terrestrial features of sites 196 and 197*

| **Site Number** | 220 | **Sample Date** | 2019/04/11 |
|---|---|---|---|
| **Site photo** | | **Feature** | |
|  | |  Southern Bald Ibis (*Geronticus calvus*) | |
| **Habitat Type** | Secondary Grassland with a seep and the Katspruit. | | |

| | | | | |
|---|---|---|---|---|
| **Habitat features** | Stream, wetland and a dam in close proximity | | | |
| **Sensitivity** | **Low** | **Moderate** | **Moderate-High** | **High** X |
| **Current Impacts** | Livestock , Roads and the community in close proximity. | | | |
| **Discussion:** | This area was given a 500m buffer around the site based on guidelines specified in the Free State CBA guidelines 2016. The Southern Bald Ibis is listed as VU (IUCN, 2019). The area needs to be walked through to ensure this species is not present where construction and decommissioning begins. | | | |

*Table 8: Summary of terrestrial features of sites 221 and 222*

| **Site Number** | 221 and 222 | **Sample Date** | 2019/06/11 |
|---|---|---|---|
| **Site photo** | | **Feature** | |
|  | |  Yellow wood (*Podocarpus latifolius*) | |
| **Habitat Type** | Secondary Grassland , Thicket | | |
| **Habitat features** | The presence of the intact forest thicket with protected tree species (Yellow wood) makes the adjacent area sensitive. | | |
| **Sensitivity** | **Low** | **Moderate** | **Moderate-High** | **High** X |
| **Current Impacts** | Erosion, Livestock, Vegetation Clearing , Roads | | |
| **Discussion:** | This area was given a 20m buffer from the edge of the thicket as per the KZN CBA guidelines 2013. The yellow wood tree is nationally protected (Protected Trees List of South Africa, 2016). The thicket area must be demarcated, if it needs to be relocated permits will need to be sourced. | | |

*Table 9: Summary of terrestrial features of site 270*

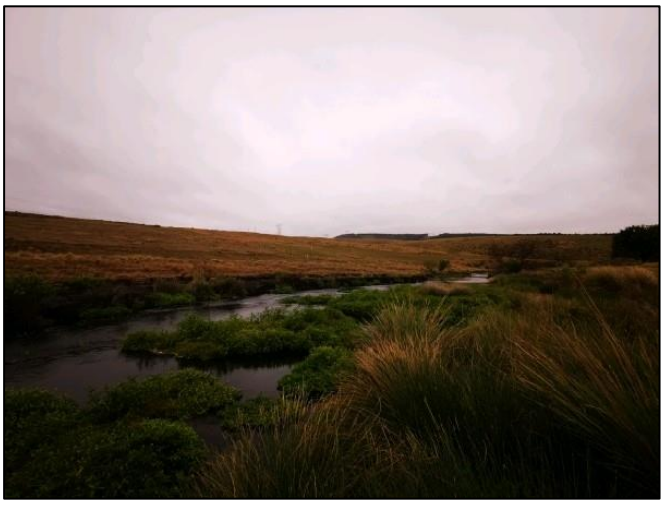
| **Site Number** | 270 | **Sample Date** | 2019/05/11 |
|---|---|---|---|
| **Site photo** | | **Feature** | |
|  | |  Greater Flamingo (*Phoenicopterus roseus*) | |
| **Habitat Type** | Wetland depression area around the Rensburg spruit | | |
| **Habitat features** | Exceptionally high richness and abundance of waterfowl in correlation with the wastewater treatment works. Potential to support significant congregations of migratory species. A green Island within the Ladysmith urban area. | | |
| **Sensitivity** | **Low** | **Moderate** | **Moderate-High** | **High** X |
| **Current Impacts** | Erosion, Livestock, Vegetation Clearing, Roads and the urban area. | | |
| **Discussion:** | This area was given a 500m buffer from the edge of the wetland area as per the GDARD Biodiversity guidelines 2012. The greater flamingo is listed as NT nationally (SANBI, 2016). | | |

*Table 10: Summary of terrestrial features of site 280*

| **Site Number** | 280 | **Sample Date** | 2019/05/11 |
|---|---|---|---|
| **Site photo** | | **Feature** | |
|  | |  Example of a White bellied korhaan (*Eupodotis senegalensis*) | |

| | |
|---|---|
| |  <br>Lanner Falcon (*Falco biarmicus*) recorded. |
| **Habitat Type** | Natural degraded grassland with a wetland seep. |
| **Habitat features** | Open degraded grassland. |
| **Sensitivity** | **Low** \| **Moderate** \| **Moderate-High X** \| **High** ~~X~~ |
| **Current Impacts** | Rural settlements and overgrazing |
| **Discussion:** | This area was given a 500m buffer from the edge of the wetland area as per the Free State CBA guidelines 2016. The White bellied korhaan is listed as VU nationally (SANBI, 2016) and the Lanner Falcon (*Falco biarmicus*) is VU on a national scale. |

*Table 11: Summary of terrestrial features of site 371*

| **Site Number** | 371 | **Sample Date** | 2019/07/11 |
|---|---|---|---|
| **Site photo** | | **Feature** | |
|  | |  <br>Grey Crowned Crane (*Balearica regulorum*) | |
| **Habitat Type** | Grasslands around the Mooi river | | |
| **Habitat features** | Mooi river with associated riparian habitat | | |

| Sensitivity | Low | Moderate | Moderate-High | High X |
|---|---|---|---|---|
| Current Impacts | Livestock, Roads and farm development | | | |
| Discussion: | This area was given a 200m buffer from the site as per the GDARD Biodiversity guidelines 2012. The Grey Crowned Crane is listed as EN nationally and internationally (IUCN, 2019; SANBI, 2016). The areas need to be walked through prior to any activities to ensure faunal species is not present in the site. | | | |

*Table 12: Summary of terrestrial features of site 420*

| Site Number | 420 | Sample Date | 2019/11/11 |
|---|---|---|---|
| Site photo | | Feature | |
|  | |  *Crinum bulbispermum* | |
| Habitat Type | Grasslands surrounding a wetland that leads into a riparian area. | | |
| Habitat features | Wetland and riparian area with surrounding grassland. Functions as a movement corridor. | | |
| Sensitivity | Low | Moderate | Moderate-High | High X |
| Current Impacts | Alien vegetation, Vegetation Clearing , Powerlines , Roads , Urban development | | |
| Discussion: | The project area is adjacent to a wetland, species such as *Crinum bulbispermum* is common in this habitat. As this species is declining and the habitat is sensitive a 200m buffer were given to this site. | | |

*Table 13: Summary of terrestrial features of site 425*

| Site Number | 425 | Sample Date | 2019/11/11 |
|---|---|---|---|
| **Site photo** | | **Feature** | |
|  | |  Example of a *Cape Clawless Otter (Aonyx capensis)* | |
| **Habitat Type** | Grasslands with associated wetland habitat | | |
| **Habitat features** | Rocky outcrop to the west, adjacent to the wetland | | |
| **Sensitivity** | **Low** | **Moderate** | **Moderate-High** | **High** X |
| **Current Impacts** | Livestock, Farming, Alien vegetation, Vegetation Clearing | | |
| **Discussion:** | Cape Clawless Otter scat were found, this species is classified as NT both Nationally (SANBI, 2016) and Internationally (IUCN, 2019). A 500m buffer were placed around the site as per the GDARD Biodiversity guidelines 2012. KZN does not have specified buffer guidelines for this species so we referred to GDARD for guidance. The wetland area needs to be regarded as a no-go area. | | |

*Table 14: Summary of terrestrial features of site 426*

| Site Number | 426 | Sample Date | 2019/11/11 |
|---|---|---|---|
| **Site photo** | | **Feature** | |
|  | |  Example of a Grey Crowned Crane (*Balearica regulorum*) | |
| **Habitat Type** | Grasslands surrounding a wetland | | |
| **Habitat features** | Wetland and dam, surrounded by grassland within a farming area. | | |
| **Sensitivity** | **Low** | **Moderate** | **Moderate-High** | **High** X |
| **Current Impacts** | Farming , Powerlines | | |
| **Discussion:** | This area was given a 200m buffer from the pin as per the GDARD Biodiversity guidelines 2012. The Grey Crowned Crane is listed as EN nationally and internationally (IUCN, 2019; SANBI, 2016). The areas need to be walked through prior to any activities to ensure faunal species is not present in the site. Site could not be accessed due to access restrictions; survey was done from adjacent property. | | |

*Table 15: Summary of terrestrial features of site 450*

| Site Number | 450 | Sample Date | 2019/12/11 |
|---|---|---|---|
| **Site photo** | | **Feature** | |
|  | |  *Hypoxis hemerocallidea* | |
| **Habitat Type** | Grassland , Thicket , Riparian | | |
| **Habitat features** | The riparian zone and adjacent thornveld is regarded as sensitive. *Ledebouria revoluta* and *Hypoxis hemerocallidea* occur on the servitude. | | |
| **Sensitivity** | **Low** | **Moderate** | **Moderate-High** | **High** X |
| **Current Impacts** | Alien vegetation, Vegetation Clearing , Roads | | |
| **Discussion:** | *Hypoxis hemerocallidea* is protected in KZN under schedule 8, this combined with the sensitive habitat a 200m buffer were given to this site. | | |

*Table 16: Summary of terrestrial features of site 476*

| Site Number | 476 | Sample Date | 2019/12/11 |
|---|---|---|---|
| **Site photo** | | **Feature** | |
|  | |  *Cape Vulture (Gyps coprotheres)* | |
| **Habitat Type** | Grassland, Thicket | | |
| **Habitat features** | Vegetation surrounding the route is natural with *Hypoxis hemerocallidea* and *H. angustifolia* present in grassland and servitude. Overall a relatively high biodiversity was present in the site and a Cape Vulture (*Gyps coprotheres*) as well as a Rock monitor (*Varanus albigularis*) were observed. | | |
| **Sensitivity** | **Low** | **Moderate** | **Moderate-High** | **High** X |
| **Current Impacts** | Alien vegetation, Vegetation Clearing | | |
| **Discussion:** | This site is highly sensitive based on the fauna and flora species present. *Hypoxis hemerocallidea* is protected in KZN under schedule 8. Cape vulture is EN both regionally (SANBI, 2016) and internationally (IUCN, 2019). It is unlikely that the vulture will be nesting in the project area, but as it was seen foraging this must still be considered. The rock monitor is protected in KZN under schedule 3 and a permit will be required for the relocation of this species. Overall a 500m buffer was placed around the sites. It is imperative that the area must be investigated first to ensure that a rock monitor has not moved into the area outside of the buffer area. | | |

*Table 17: Summary of terrestrial features of site 489*

| **Site Number** | 489 | **Sample Date** | 2019/13/11 |
|---|---|---|---|
| **Site photo** | | **Feature** | |
|  | |  *Hypoxis hemerocallidea* | |
| **Habitat Type** | Grassland, Thicket, Riparian | | |
| **Habitat features** | Vegetation in surrounding area largely natural. *Hypoxis hemerocallidea* present within servitude and surrounding grassland. | | |
| **Sensitivity** | **Low** | **Moderate** | **Moderate-High** | **High** X |
| **Current Impacts** | Livestock, Alien vegetation, Vegetation Clearing , Roads | | |
| **Discussion:** | *Hypoxis hemerocallidea* is protected in KZN under schedule 8, this combined with the sensitive habitat a 200m buffer were given to this site. | | |

*Table 18: Summary of terrestrial features of site 492*

| **Site Number** | 492 | **Sample Date** | 2019/13/11 |
|---|---|---|---|
| **Site photo** | | **Feature** | |
|  | |  *Boophone disticha* | |

| | | | | |
|---|---|---|---|---|
| **Habitat Type** | Secondary Grassland | | | |
| **Habitat features** | Habitat is semi-natural. However, *Hypoxis angustifolia, H. hemerocallidea and B. disticha* present within grassland and servitude. | | | |
| **Sensitivity** | **Low** | **Moderate** | **Moderate-High** | **High** X |
| **Current Impacts** | Erosion, Livestock , Alien vegetation , Vegetation Clearing , Litter and Dumping | | | |
| **Discussion:** | *H. hemerocallidea* and *B. disticha* are protected in KZN under schedule 8, as a result of these protected species a 200m buffer were given to this site. A permit will be required should these species need to be relocated. | | | |

*Table 19: Summary of terrestrial features of site 521*

| | | | |
|---|---|---|---|
| **Site Number** | 521 | **Sample Date** | 11/14/2019 |
| **Site photo** | | **Feature** | |
|  | |  Riparian area | |
| **Habitat Type** | Thicket, Riparian | | |
| **Habitat features** | Protected coastal forest inside the Marianwood Nature Reserve | | |
| **Sensitivity** | **Low** | **Moderate** | **Moderate-High** | **High** X |
| **Current Impacts** | Alien vegetation, Vegetation Clearing | | |
| **Discussion:** | The coastal forest was given a 500m buffer as this fall within a nature reserve and the overall habitat is in a natural state. This area also has a high likelihood of being habitat for SCCs. | | |

*Table 20: Summary of terrestrial features of site 522*

| **Site Number** | 522 | | **Sample Date** | 11/14/2019 |
|---|---|---|---|---|
| **Site photo** | | | **Feature** | |
|  | | |  *Zantedeschia aethiopica* | |
| **Habitat Type** | Grassland, Riparian | | | |
| **Habitat features** | Grassland and riparian vegetation are predominantly natural, albeit with degradation due to edge effects. Grassland and associated seeps, including servitude, possesses *Merwilla plumbea, Kniphofia spp, Hypoxis angustifolia, Zantedeschia aethiopica and Sclerocarya birrea.* Consequently, this habitat is regarded as sensitive. | | | |
| **Sensitivity** | **Low** | **Moderate** | **Moderate-High** | **High** X |
| **Current Impacts** | Alien vegetation, Vegetation Clearing | | | |
| **Discussion:** | *Merwilla plumbea, Kniphofia spp, Hypoxis angustifolia, Zantedeschia aethiopica* and *Sclerocarya* birrea is protected provincially under schedule 8 of KZN. While *Sclerocarya* birrea is also a Nationally protected tree (Protected Trees List of South Africa, 2016). A 200m buffer was placed around this project area due to the high density of protected species. | | | |

*Table 21: Summary of terrestrial features of site 450*

| **Site Number** | 524 | **Sample Date** | 11/14/2019 |
|---|---|---|---|
| **Site photo** | | **Feature** | |
|  | |  *Sclerocarya birrea* (Marula) | |
| **Habitat Type** | Grassland, Riparian | | |
| **Habitat features** | Surrounding vegetation largely natural. *Merwilla plumbea* and *Sclerocarya birrea* present within grassland. | | |
| **Sensitivity** | **Low** | **Moderate** | **Moderate-High** | **High** X |
| **Current Impacts** | Alien vegetation, Vegetation Clearing , Litter and Dumping | | |
| **Discussion:** | *Merwilla plumbea* and *Sclerocarya birrea are* protected provincially under schedule 8 of KZN. *Sclerocarya birrea* is also a Nationally protected tree (Protected Trees List of South Africa, 2016). A 300m buffer was placed around this project area due to the protected species and overall natural state of the project area. | | |

*Table 22: Summary of terrestrial features of site 533*

| **Site Number** | 533 | **Sample Date** | 11/15/2019 |
|---|---|---|---|
| **Site photo** | | **Feature** | |
|  | |  *Freesia laxa* | |
| **Habitat Type** | Thicket, Riparian | | |
| **Habitat features** | Although degraded along the servitude, the surrounding vegetation is predominantly comprised of indigenous flora. *Freesia laxa* and *Hypoxis hemerocallidea* occur within the servitude. | | |
| **Sensitivity** | **Low** | **Moderate** | **Moderate-High** | **High** X |
| **Current Impacts** | Alien vegetation, Vegetation Clearing , Litter and Dumping | | |
| **Discussion:** | *Hypoxis hemerocallidea and Freesia laxa* is protected provincially under schedule 8 of KZN. A 300m buffer was placed around this project area due to the protected species in the project area. | | |

*Table 23: Summary of terrestrial features of site 535*

| **Site Number** | 535 | **Sample Date** | 11/15/2019 |
|---|---|---|---|
| **Site photo** | | **Feature** | |
|  | |  *Scadoxus puniceus* | |
| **Habitat Type** | Thicket, Riparian | | |
| **Habitat features** | Although degraded along the servitude and urban edge, vegetation interior consists primarily of indigenous flora. *Scadoxus puniceus* and *Freesia laxa* occurs in the servitude. | | |
| **Sensitivity** | **Low** | **Moderate** | **Moderate-High** | **High** X |
| **Current Impacts** | Erosion, Alien vegetation , Vegetation Clearing , Powerlines , Litter and Dumping | | |
| **Discussion:** | *Scadoxus puniceus* and *Freesia laxa* is protected provincially under schedule 11 and Schedule 8 of KZN, respectively. A 300m buffer was placed around this project area due to the protected species in the project area. | | |

*Table 24: Summary of terrestrial features of site 545*

| Site Number | 542 | Sample Date | 11/15/2019 |
|---|---|---|---|
| **Site photo** | | **Feature** | |
|  | |  *Pink-backed pelican (Pelecanus rufescens)* | |
| **Habitat Type** | Thicket with an artificial dam | | |
| **Habitat features** | Pink-backed pelican (*Pelecanus rufescens*) were found in an artificial dam close to the project area. The habitat is mainly thicket vegetation. | | |
| **Sensitivity** | **Low** | **Moderate** | **Moderate-High** | **High** X |
| **Current Impacts** | Alien vegetation, Vegetation Clearing , Powerlines , Urban development | | |
| **Discussion:** | Pink-backed pelican (*Pelecanus rufescens*) is VU on a regional scale (SANBI, 2016) and although parts of the habitat is disturbed, this species is very sensitive to disturbance and a 500m buffer were given to the area surrounding the dam. | | |

Th depots that will be decommissioned include Pretoria West, Elardus Park, Magdala, Bethlehem and Van Reenen (Figure 18). These sites have been disturbed long term and have been cleared and maintained and as such the habitat is transformed and will need to be rehabilitated extensively. The following tables (Table 25 to Table 29) presents an overview of the depots, the current alien species found on the sites as well as recommendations of plant species that should be planted that are specific to the region they occur in.

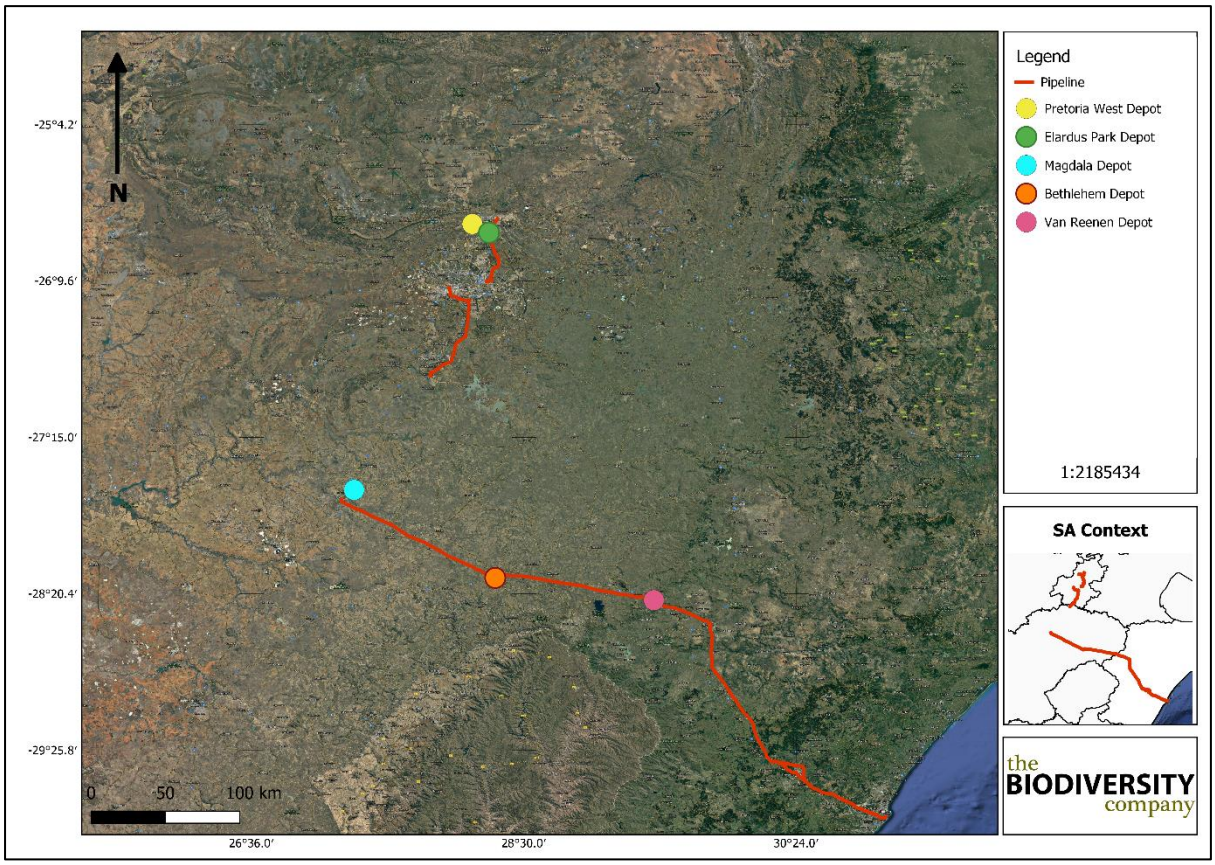



*Figure 18: The Depots to be decommissioned*

*Table 25: Summary of terrestrial features of the Pretoria West depot.*

| **Depot Name** | Pretoria West | | **Sample Date** | 10/28/2019 |
|---|---|---|---|---|
| **Site photo** | | | **Feature** | |
|  | | |  | |
| **Habitat Type** | Transformed, with a park across the road | | | |
| **Sensitivity** | Low | **Moderate** | **Moderate-High** | **High** |
| **Current Impacts** | Industrial area, footpaths, road and litter | | | |

| | |
|---|---|
| **Invasive plant species present** | *Arundo donax (Across the road)*<br>*Jacaranda mimosifolia (Across the road)*<br>*Pennisetum clandestinum (Kikuyu)* |
| **Plant species suggested to be used in rehabilitation** | *Elionurus muticus*<br>*Eragrostis lehmanniana*<br>*Pogonarthria squarrosa*<br>*Searsia lancea*<br>*Searsia pyroides*<br>*Themeda triandra*<br>*Vachellia karroo* |

*Table 26: Summary of terrestrial features of the Elardus Park depot.*

| **Depot Name** | Elardus Park | | **Sample Date** | 10/28/2019 |
|---|---|---|---|---|
| **Site photo** | | | **Feature** | |
|  | | |  <br>Footpath adjacent to fence | |
| **Habitat Type** | Transformed adjacent to an urban greenbelt | | | |
| **Sensitivity** | ~~Low~~ | **Moderate** | **Moderate-High** | **High** |
| **Current Impacts** | Erosion, footpaths, Urban area, roads | | | |
| **Invasive plant species present** | *Pennisetum clandestinum (Kikuyu)*<br>*Verbena bonariensis* | | | |
| **Plant species suggested to be used in rehabilitation** | *Cymbopogon caesius*<br>*Elephantorrhiza elephantina*<br>*Elionurus muticus* | | | |

| | |
|---|---|
| | *Eragrostis chloromelas*<br>*Eragrostis curvula*<br>*Themeda triandra* |

*Table 27: Summary of terrestrial features of the Magdala depot.*

| **Depot Name** | Magdala | **Sample Date** | 2019/01/11 |
|---|---|---|---|
| **Site photo** | | **Feature** | |
|  | |  <br>Cattle dung | |
| **Habitat Type** | Secondary Grassland surrounds the station, the habitat within the station is transformed. | | |
| **Sensitivity** | **Low** (X) | **Moderate** | **Moderate-High** | **High** |
| **Current Impacts** | Livestock, Vegetation Clearing, Powerlines and Roads | | |
| **Invasive plant species present** | *Pennisetum clandestinum* (Kikuyu) | | |
| **Plant species suggested to be used in rehabilitation** | *Themeda triandra*<br>*Elionurus muticus*<br>*Cymbopogon caesius* | | |

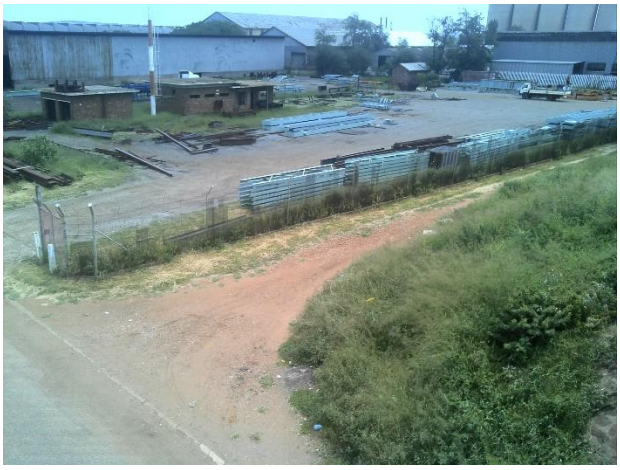
*Table 28: Summary of terrestrial features of the Bethlehem depot.*

| **Depot Name** | Bethlehem | **Sample Date** | 2019/04/11 |
|---|---|---|---|
| **Site photo** | | **Feature** | |
|  | |  Sewage spilling out. | |
| **Habitat Type** | Degraded and Transformed | | |
| **Sensitivity** | **Low** (X) | **Moderate** | **Moderate-High** | **High** |
| **Current Impacts** | Livestock, Alien vegetation, Powerlines, Litter and Dumping, Roads, Urban development, Sewage | | |
| **Invasive plant species present** | *Acacia mearnsii* (Black Wattle)<br>*Eucalyptus camaldulensis*<br>*Melia azedarach*<br>*Pennisetum clandestinum (Kikuyu)*<br>*Verbena bonariensis* | | |
| **Plant species suggested to be used in rehabilitation** | *Aristida congesta (Grass)*<br>*Aristida junciformis (Grass)*<br>*Cynodon dactylon (Grass)*<br>*Eragrostis chloromelas (Grass)*<br>*Themeda triandra (Grass)* | | |

*Table 29: Summary of terrestrial features of the Van Reenen depot.*

| **Depot Name** | Van Reenen | **Sample Date** | 2019/05/11 |
|---|---|---|---|
| **Site photo** | | **Feature** | |
|  | |  *Acacia mearnsii* (Black Wattle) | |
| **Habitat Type** | Degraded surrounding habitat whereas the area within the station is transformed. Topography is sensitive, erosion control mitigations will be crucial. | | |
| **Sensitivity** | **Low** | **Moderate** X | **Moderate-High** | **High** |
| **Current Impacts** | Livestock, Alien vegetation, Powerlines, Litter and Dumping and Roads | | |
| **Invasive plant species present** | *Acacia mearnsii* (Black Wattle) (Dominated) all individuals within and surrounding the station must be eradicated.<br>*Pennisetum clandestinum* (Kikuyu)<br>Palm species | | |
| **Plant species suggested to be used in rehabilitation** | *Aristida diffusa (Grass)*<br>*Buddleja salviifolia (Tree)*<br>*Diospyros whyteana (Tree)*<br>*Elionurus muticus (Grass)*<br>*Eragrostis chloromelas (Grass)*<br>*Eragrostis curvula (Grass)*<br>*Leucosidea sericea (Tree)*<br>*Pennisetum sphacelatum (Grass)* | | |
| **Rehabilitation** | The existing slope of the area is inclining, and if left un-rehabilitated, severe soil erosion will exist; Geojute netting and Geojute logs are suggested.<br>Seeds for plants:<br>Lifestyle Seeds (https://lifestyleseeds.co.za/)<br>Silverhill Seeds (http://www.silverhillseeds.co.za/default.asp) | | |

*Table 30: Summary of terrestrial features of the Potchefstroom depot*

| | | | |
|---|---|---|---|
| **Depot Name** | Potchefstroom | **Sample Date** | 02/18/2020 |
| **Site photo** | | **Feature** | |
|  | |  | |
| **Habitat Type** | Transformed, with storage of metal on site | | |
| **Sensitivity** | **Low** X | **Moderate** | **Moderate-High** | **High** |
| **Current Impacts** | Industrial area, dust, oil spills, road and metal storage | | |
| **Invasive plant species present** | *Ipomoea purpurea (On fence)*<br>*Pennisetum clandestinum (Kikuyu)*<br>*Solanum mauritianum*<br>*Bidens pilosa* | | |
| **Plant species suggested to be used in rehabilitation** | *Elionurus muticus*<br>*Eragrostis lehmanniana*<br>*Eragrostis curvula*<br>*Pogonarthria squarrosa*<br>*Searsia lancea*<br>*Searsia pyroides*<br>*Themeda triandra*<br>*Vachellia karroo* | | |
| **Rehabilitation** | All materials stored on the area must be removed, all soil affected by oil must be removed and replaced with topsoil. Alien management must be made a priority as surrounding area has large numbers of alien invasive species. | | |

## 8.2 Wetlands

### 8.2.1 Classification

Based on a combination of desktop and in-field delineation, a total of 356 individual wetland hydrogeomorphic (HGM) units were identified and delineated within the 32 m survey area on either side of the pipeline route (64 m corridor). Non-HGM units intersected by the pipeline corridor included 17 dams and two artificial systems.

Each wetland was classified following the national wetland classification system (level 1-4) as per (Ollis *et al.,* 2013) into one of six main types (Table 31). These included floodplains, channelled valley-bottoms, unchanneled valley-bottoms, flats, seeps and depressions. Together these wetlands occupied a total of 267.7 ha covering 6% of the 64 m survey corridor along the pipeline route. A representative example of each wetland HGM type is shown in Figure 20 to Figure 25 The numbers and areas of each delineated HGM unit are provided in Table 31.

*Table 31: Wetland classification as per SANBI guideline (Ollis et al. 2013)*

| Wetlands (n) | Area (ha) | Level 1 | Level 2 | | Level 3 | Level 4 | | |
|---|---|---|---|---|---|---|---|---|
| | | System | DWS Ecoregion/s | NFEPA Wet Veg Group/s | Landscape Unit | 4A (HGM) | 4B | 4C |
| 26 | 47.8 | Inland | Western Bankenveld, Highveld; Eastern Escarpment Mountains; North-eastern Highlands; South-eastern Uplands; North-eastern Coastal Belt | CBG1 & 2, DHG4,5, MHGG1,2, 3,4, SEGG2, 3, 4 & 5; SES; IOCBG2 | Plain | Floodplain | Floodplain flats and depressions | N/A |
| 177 | 107.6 | | | | Valley-bottom | Channeled valley-bottom | N/A | N/A |
| 76 | 44.2 | | | | Valley-bottom | Unchanneled valley-bottom | N/A | N/A |
| 10 | 17.3 | | | | Plain | Flat | | |
| 40 | 32.1 | | | | Slope | Seep | With and without channeled outflow | N/A |
| 26 | 18.7 | | | | Plain | Depression | Endorheic | WCO |

Key: CBG, Central Bushveld Group; DHG, Dry Highveld Grasslands Group; MHGG, Mesic Highveld Grasslands Group, SEGG, Sub-Escarpment Grassland; SES Sub-Escarpment Savanna Group; IOCBG, Indian Ocean Coastal Belt Group; WCO, Without Channelled Inflow.

### 8.2.2 Hydrogeomorphic Setting

Figure 19 presents a diagram of the HGM units, showing the dominant movement of water into, through and out of the system (Ollis et al., 2013). A description of the wetland HGM unit is provided below.

Channelled valley-bottom wetlands are typically found on valley floors with a clearly defined, finite stream channel and lacks floodplain features, referring specifically to meanders. Channelled valley-bottom wetlands are known to undergo loss of sediment in cases where the wetlands' slope is high and the deposition thereof in cases of low relief. Unchanneled valley-bottom wetlands are typically found on valley floors where the landscape does not allow high energy flows.

Depressions are inward draining basins with an enclosing topography which allows for water to accumulate within the system. Depressions, in some cases, are also fed by lateral sub-surface flows in cases where the dominant geology allows for these types of flows.

Hillslope seeps are characterised by colluvial movement of material. These systems are fed by very diffuse sub-surface flows which seep out at very slow rates, ultimately ensuring that no direct surface water connects this wetland with other water courses within the valleys.

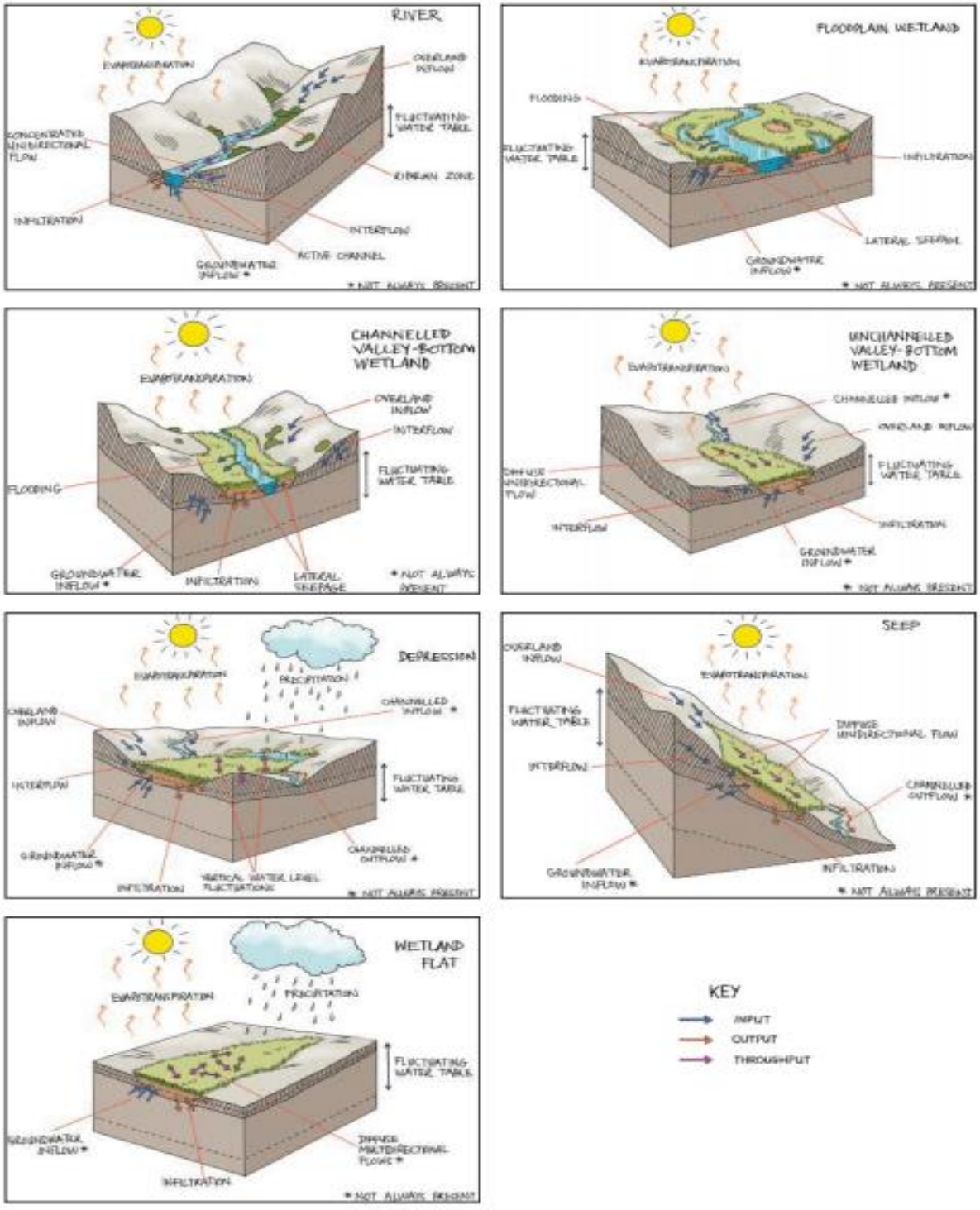



*Figure 19: Amalgamated diagram of the wetland units, highlighting the dominant water inputs, throughputs and outputs, SANBI guidelines (Ollis et al. 2013)*

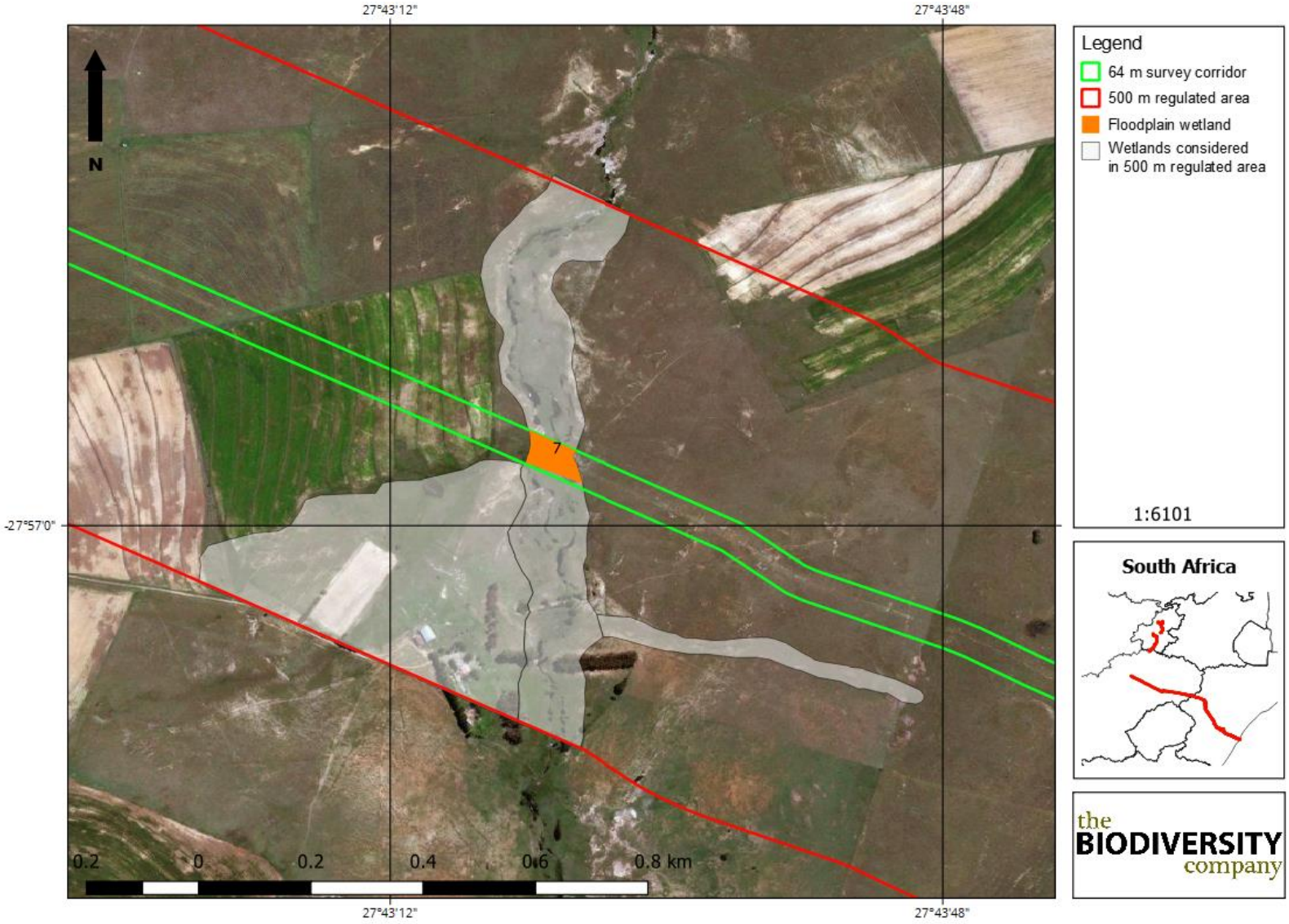



*Figure 20: Example of a typical priority 1A floodplain wetland identified along the pipeline route*

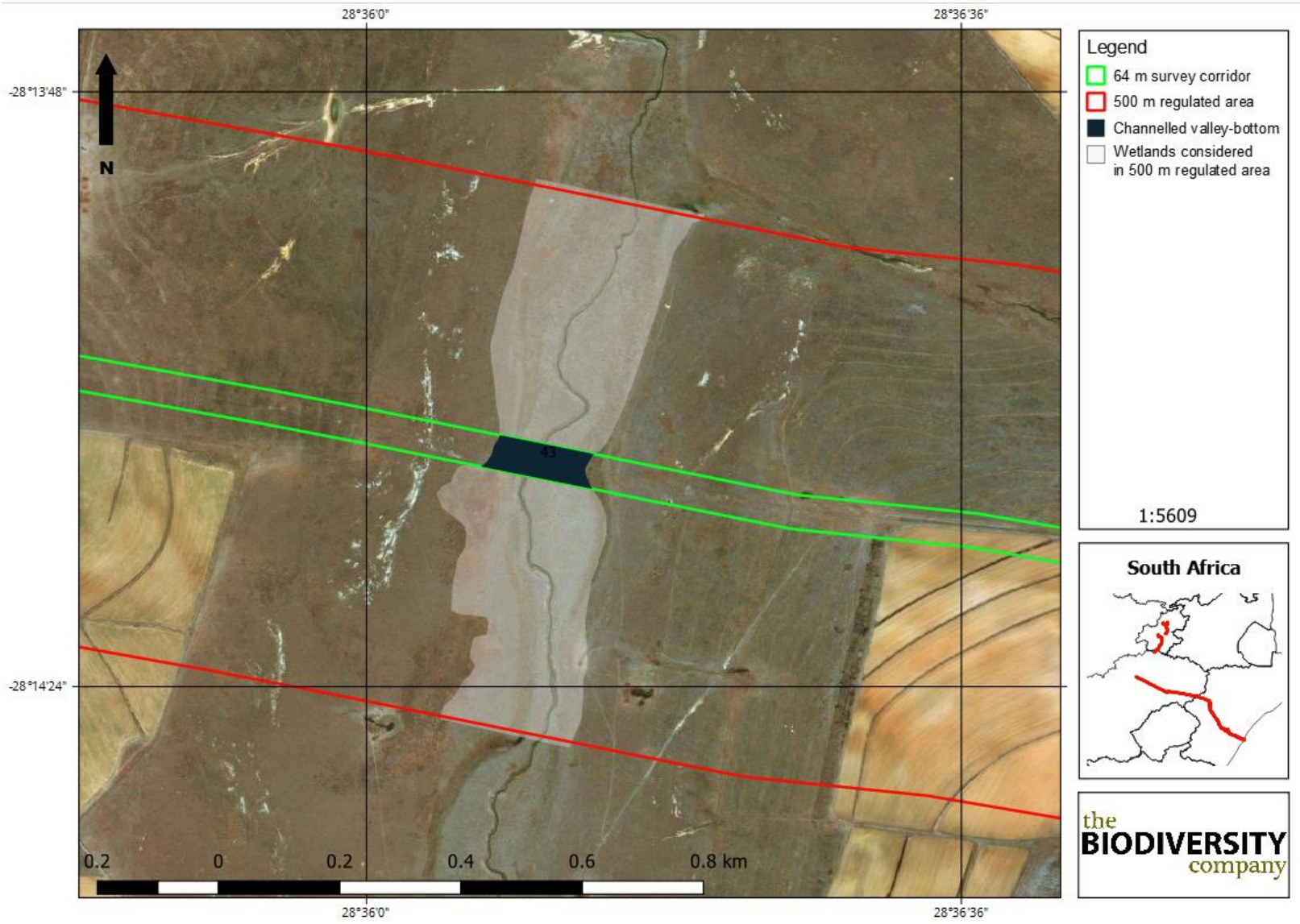



*Figure 21: Example of a typical priority 1B channelled valley-bottom wetland identified along the pipeline route*

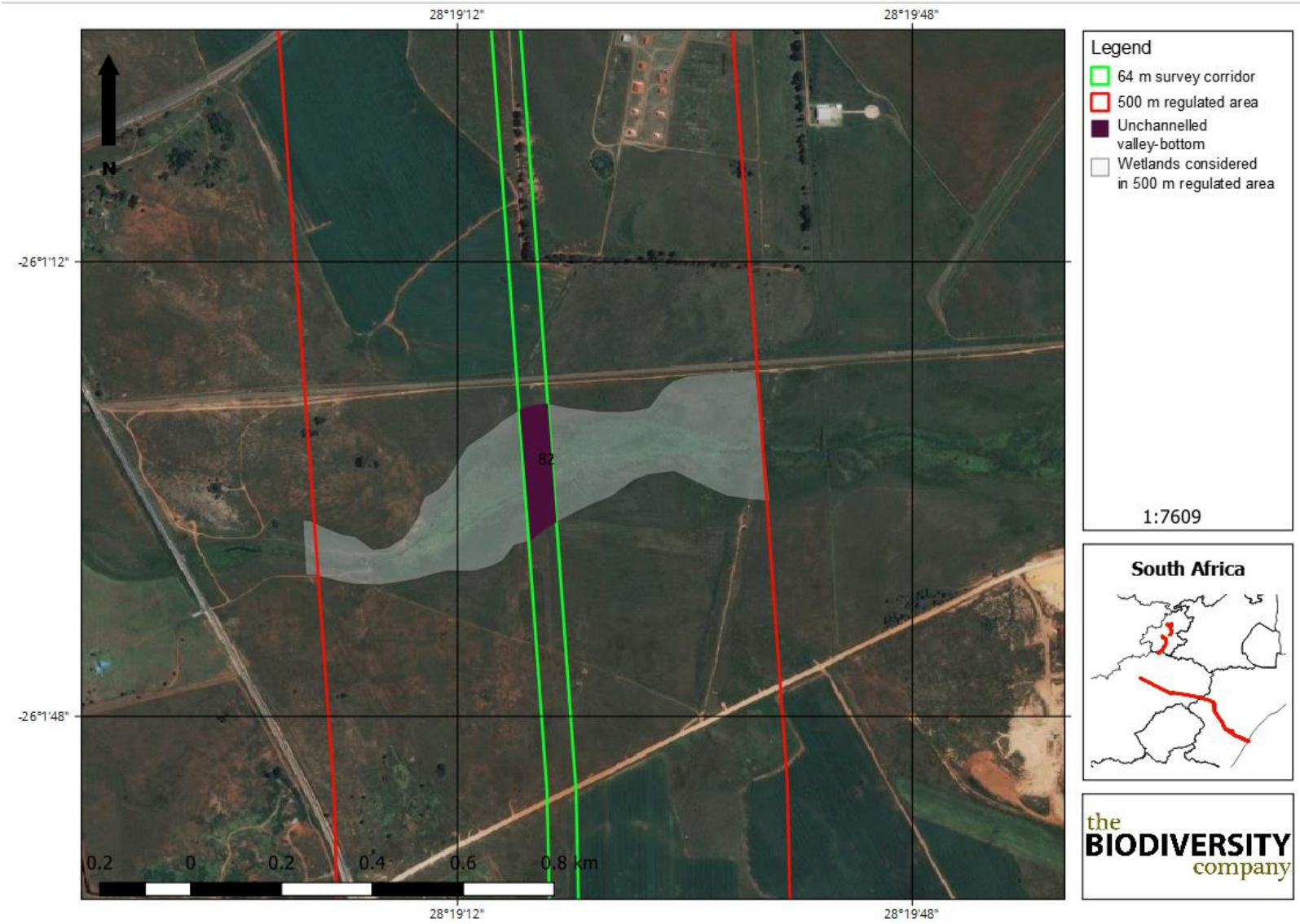



*Figure 22: Example of a typical priority 1C unchanneled valley-bottom wetland identified along the pipeline route*

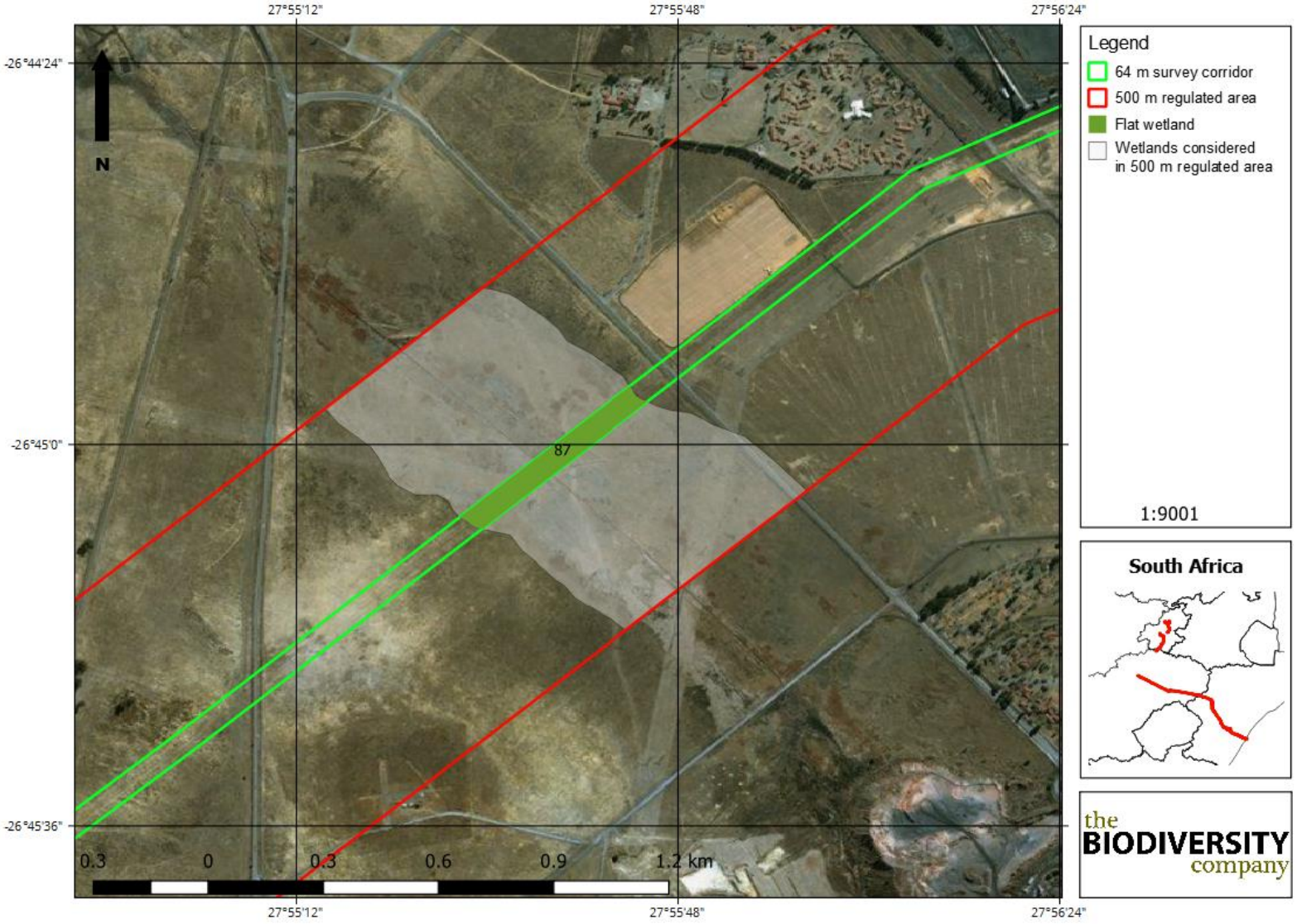



*Figure 23: Example of a typical priority 1D flat wetland identified along the pipeline route*

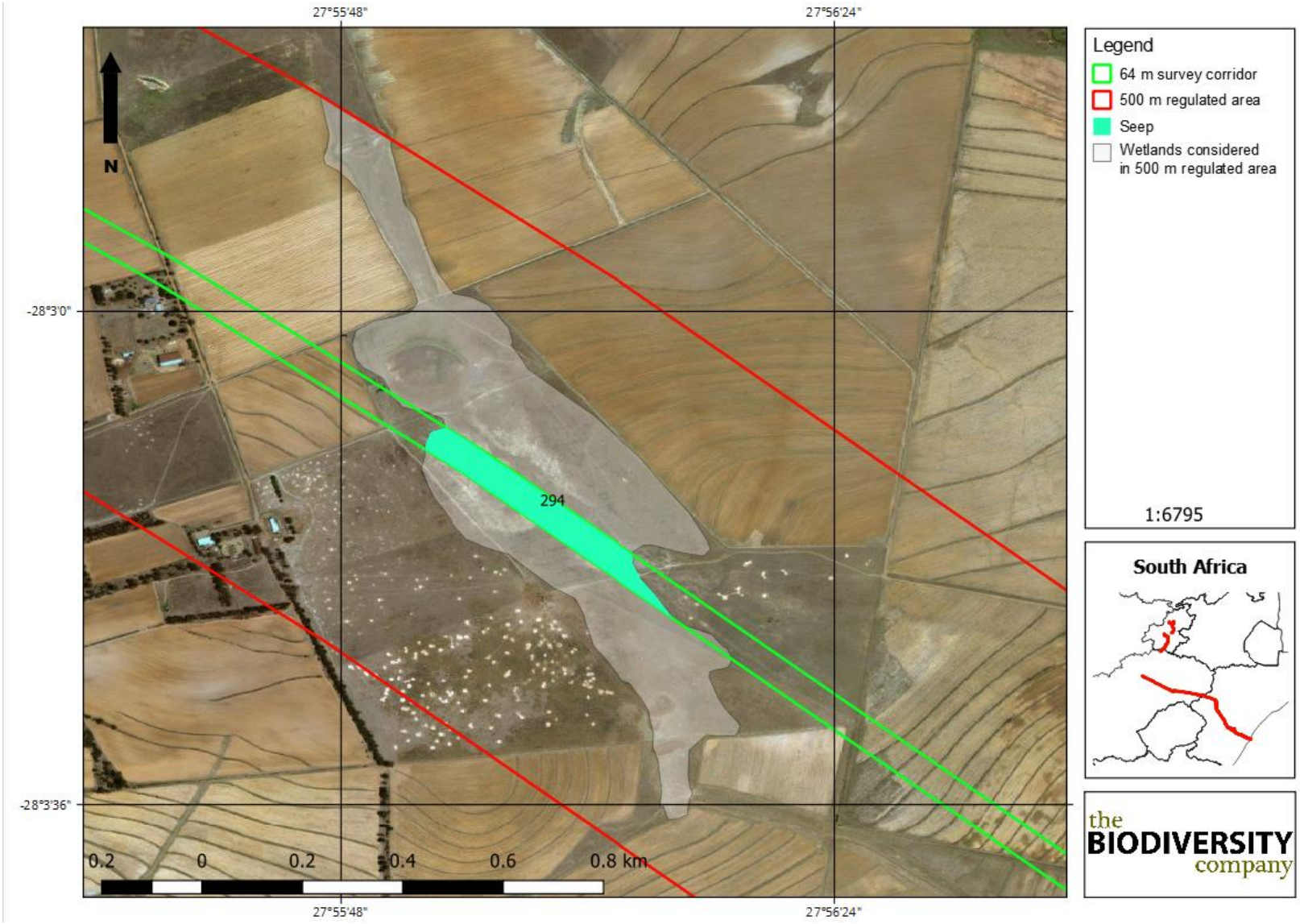



*Figure 24: Example of a typical priority 3E seep wetland identified along the pipeline route*

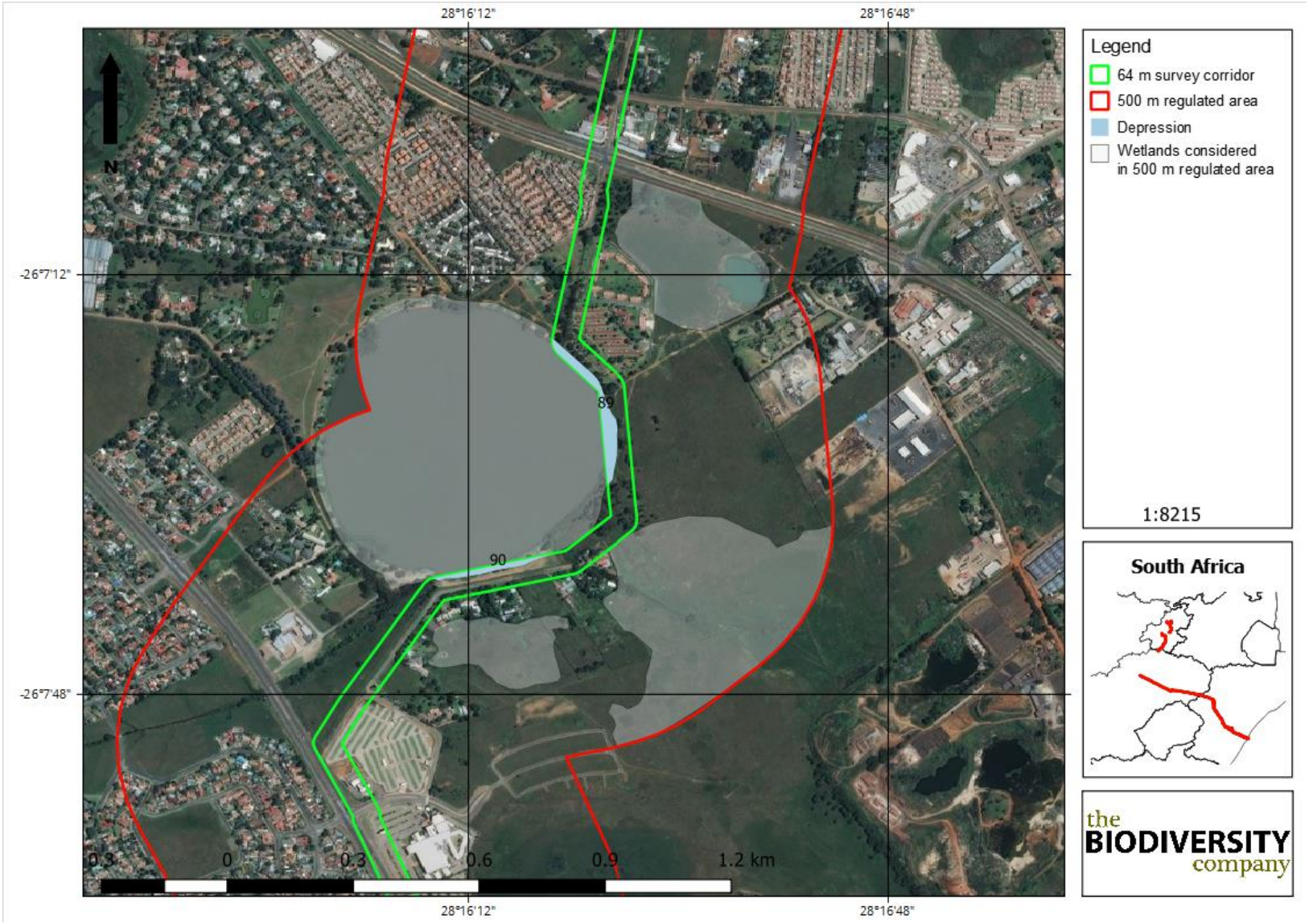


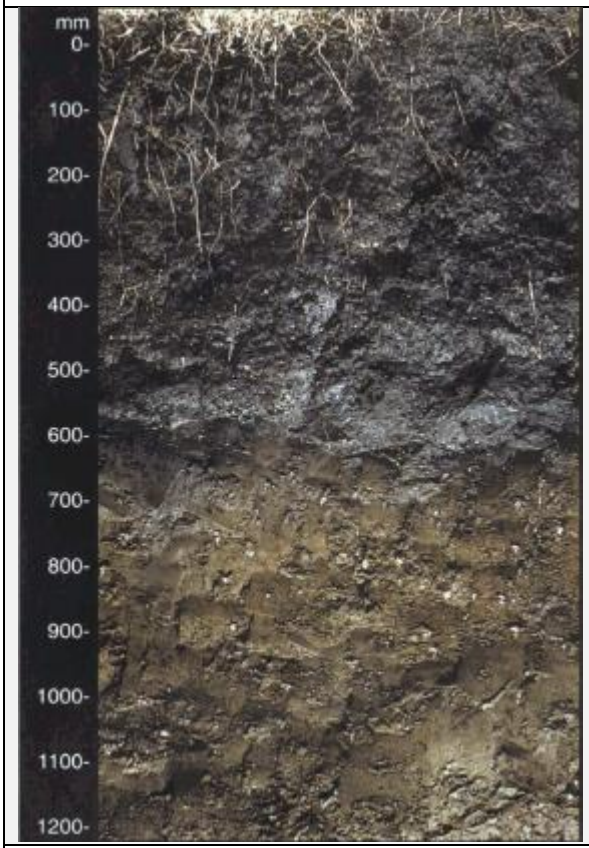

*Figure 25: Example of a typical priority 1F depression wetland identified along the pipeline route*

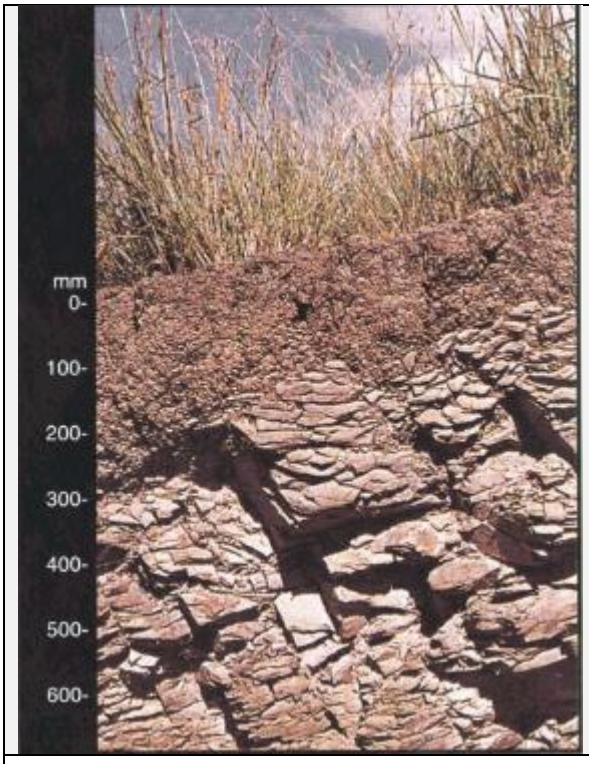
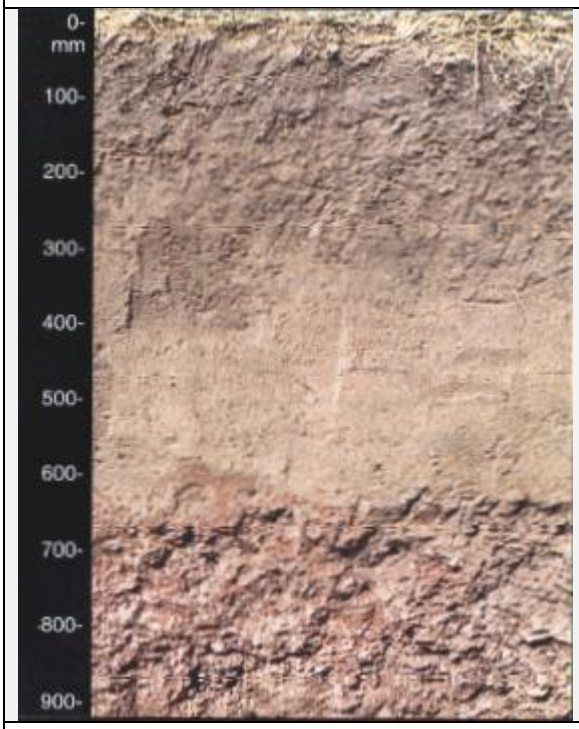
### 8.2.3 Soils

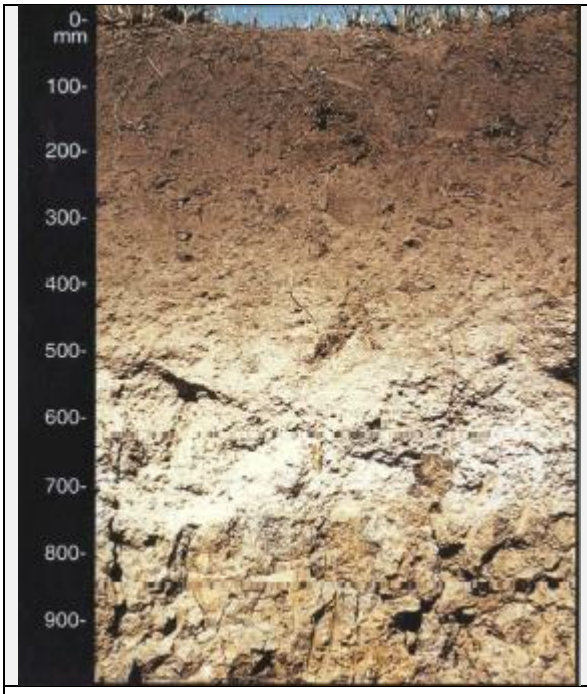
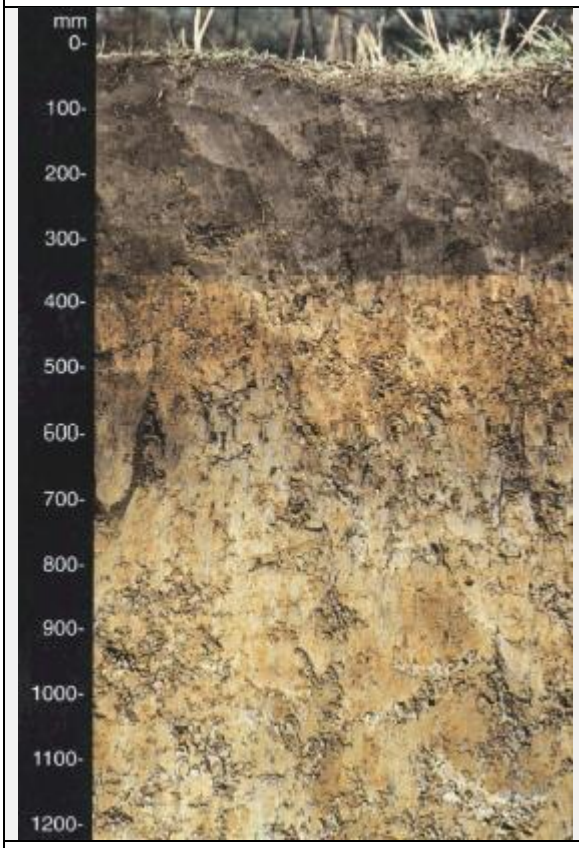
Although the pipeline route traverses a wide range lithologies and soil types nine soil forms dominated the majority of sites visited. These included Willowbrooke, Westleigh, Rensburg, Mispah, Longlands, Kroonstad, Katspruit, Dundee and Champagne. Examples of these dominant soil forms are shown in Table 32. A brief discussion on each is provided below provided pertinent information on the distribution, typical topographical position, saturation levels associated with each of the soil forms as encountered along the pipeline route with additional information on their structure and physical properties.

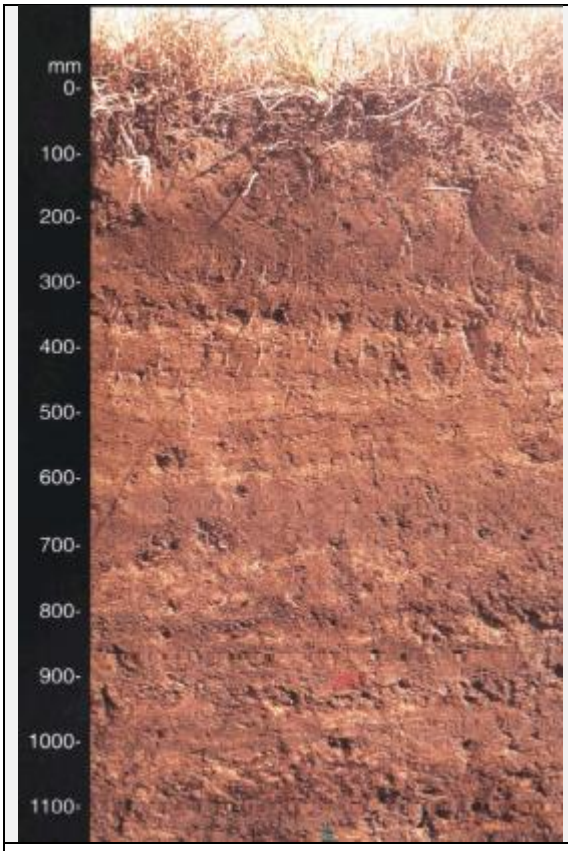
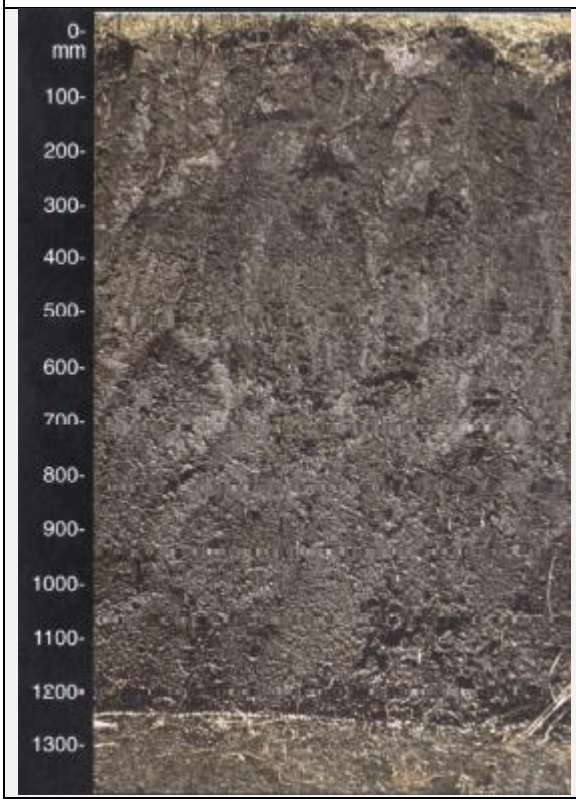
*Table 32: Examples and descriptions of the dominant soil forms encountered on site (SASA, 1991)*

| | |
|---|---|
| **Willowbrook** | |
|  | These soils were predominantly encountered between Bethlehem and Van Reenen. They typically occurred on mid-slope to channel topographies and were associated with permanent to seasonal conditions. They showed a melanic topsoil overlying a G horizon. The Melanic clays are very similar to that of the vertic clays in saturated conditions. Melanic clays have extremely good structure, which therefore allows for rapid infiltration and percolation without the possibility of precipitation accumulating within the first 50cm. Melanic clays will have a blocky structure which are approximately 5cm in diameter with extremely dark colours being present. |
| **Westleigh** | |

| | |
|---|---|
|  | The soils were mostly found in the transition into and out of the Midlands mainly at Estcourt and again at Pietermaritzburg and Pinetown. They occurred in mid-slope to channel settings. Saturation levels were permanent to seasonal. These consist of an orthic topsoil over a soft plinthic B subsoil. The dominance of soft plinthite in this soil profile reflects long periods of saturation, which increases oxidation/reduction processes, which results in the formation of plinthite. The soft plinthic B-horizon is located between the bedrock and topsoil, which suggests interflow between soil and bedrock |
| **Rensburg** | |
|  | These soils were widespread in the northern portions of the pipeline especially in areas underlain by doleritic rocks where utramafic vertic (turf soils) soils predominate. However, these soils were largely lacking from Colenso through the Midlands and southwards towards Durban. They typically occurred on midslope to channel settings and were associated with permanent to seasonal conditions. These soils are characterised by a Vertic topsoil underlain by a G horizon which may or may not be calcareous. The vertic A horizon of the Rensburg soil form has clearly visible slickensides in the transition to the lower layers and is characteristically cracked when dry. The vertic A horizon ranges from moist to dry depending on the frequency and duration of wetting when the soils are flooded. The underlying G horizon is often saturated unless the system has been drained and has typical grey matrix colours often with blue or green tint with or without mottling |
| **Mispah** | |

| | |
|---|---|
|  | These soils were widespread and associated with higher lying rocky terrain. They occurred on crest settings and were typically associated with seasonal to temporary perched aquifer systems. These soils are characterised by a shallow orthic topsoil over hard rock. |
| **Longlands** | |
|  | Like Westleigh, these soils occurred mostly at transition into and out of the Midlands, Estcourt, Pietermaritzburg and Pinetown. They were found mostly on mid-slope to channel settings and were associated with seasonal conditions. They have an orthic over E over a soft plinthic B profile. The upper horizons are relatively freely drained, with the Plinthic horizon being the limiting layer where water fluctuates to develop plinthic properties. The increased clay content in the plinthic horizon slows infiltration and forces water to move laterally downslope leaching the E-horizon. |
| **Kroonstad** | |

| | |
|---|---|
|  | This soil form was encountered mainly from steynrus to Bethlehem. The terrain sett was mid-slope to channel. Saturation was typically permanent to seasonal. The soil shows an orthic A horizon over an E over a G horizon. The G-horizon acts as a plug with virtually no permeability and as a result water moves laterally downslope leaching the E-horizon. |
| **Katspruit:** | |
|  | Widespread associated with a number of permanent zones throughout the length of the pipeline route but particularly abundant between Mooi River to Bellair KwaZulu-Natal. Midslope to channel terrain setting. Permanent. Orthic over G horizon. In the Katspruit soil form an orthic A horizon overlies a G horizon which is typical moist with grey matrix colours. Mottling may or may not occur down to a depth of 50 cm. Many of the Katspruit soils associated with the floodplains in the area are not characteristically saturated at depth. This is largely the result of incision of the stream channel, which serves to drain these areas and also reduces the likelihood of overbank topping during flooding rainfall and thus reduces the frequency of flooding. The soil profile thus dries out. |
| **Dundee** | |

| | |
|---|---|
|  | Widespread, associated with larger alluvial systems particularly floodplains, most abundant in the coastal plain systems near Durban. Channel terrain setting. Permanent zones. The Dundee soil form consists of an Orthic A-horizon on top of a stratified alluvium horizon. The soil family group identified for the Dundee soil form on-site has been classified as the Mtamvuna (1210) soil family due to the non-calcareous nature, the fact that signs of wetness is present and the lack of red colours. This diagnostic soil type is formed alluvial or colluvial processes. This soil type is stratified and closely resembles the parent material of this soil type. Stratified alluvium generally is fertile and is often therefore used for cultivation purposes. |
| **Champagne** | |
|  | This soil form was scattered, uncommon (encountered twice along Rietvleirivier Gauteng and Near Swinburne, Free State) and associated with larger more well vegetated and permanent systems. It occurred in channel settings and was associated with permanent conditions. The soil is identified by having an organic horizon underlain by unspecified material with signs of wetness. |

### 8.2.4 Wetland Health

Wetland health or present ecological state (PES) ratings for each of the 356 wetland HGM units identified within the 64 m pipeline corridor is provided in Appendix B. A summary of the frequency with which each of the 6 PES classes was encountered along the pipeline route together with the total area occupied by each is provided in Figure 26. This figure shows that most of the systems along the route are classified as class C (Moderately Modified) followed by class B (Largely Natural). Class D (Largely Modified) systems are less numerous but still common but were, on average, larger. Class E (seriously Modified) and F (Critically Modified) systems are considerably less common and accounted for a small proportion of the identified wetlands. The fact that the majority of wetlands along the pipeline route are in a Largely Natural to Moderately Modified state, reflects the large extent of undeveloped and often remote (and intact) rural land traversed by the pipeline. Class B systems were least abundant in the Gauteng Province where they were mainly encountered near Faerie Glen and south of Rietvlei (near Elandsfontein AH) nature reserves while the highest frequency of these systems were encountered in the Free State (particularly between Bethlehem and Swinburne) and KwaZulu-Natal (particularly in the midlands between Estcourt and Curries Post). More impacted systems (class E and F) were typically only encountered closer to major towns or in areas of intense overgrazing and / or alien plant infestation.

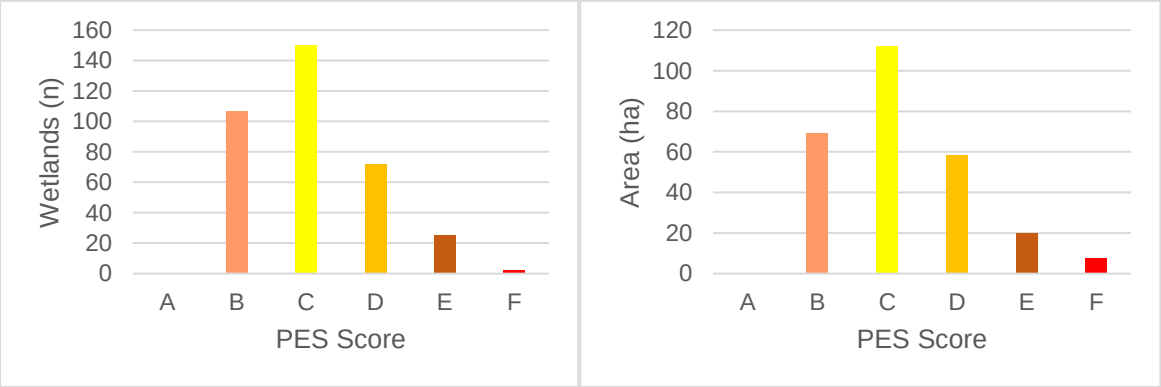



*Figure 26: Present Ecological State, (a) numbers and (b) area of wetlands classified under each of the PES classes within the 64 m pipeline corridor project area*

**Hydrological** impacts within urban landscapes typically centred on increased runoff as a result of increased hardened surfaces (decreased ground infiltration and permeability) associated with the built environment including areas of infilling, but also various flow impeding features in the form of roads, railway lines and dams. In rural settings hydrological impacts mainly involved decreased water inputs due to woody alien bush clumps together with a decreased water distribution and retention time within the soils due to tillage practices associated with crop cultivation but also included increased runoff from crust formation due to livestock overgrazing.

**Geomorphological** impacts within urban settings was dominated by the disruption of natural sediment regimes as a result of numerous impeding features (dams and bridge culverts) which in most cases served to create a depositional environment upstream and an erosive environment downstream of the impeding feature accompanied by noticeable bed scouring, bank incisement and increased channelization. In more rural settings the most frequently encountered geomorphological impact was gulley formation. Gulleys were most frequently encountered in areas where rainfall was more sporadic and intense particularly in areas prone

to increased runoff due to veld overutilization from frequent burning and / or livestock overgrazing.

**Vegetation** impacts in urban landscapes where mainly associated with vegetation clearing, soil disturbances and encroachment by alien and invasive species. In rural settings wetland vegetation was most extensively impacted by crop cultivation. Aside from the complete loss of wetland vegetation within active croplands many of the wetlands showed an altered vegetation integrity due to past cultivation. Recently cultivated areas were dominated by weedy annuals such *Tagetes minuta* and *Verbena bonariensis* while older abandoned lands simply have not re-established the species diversity typically associated with them. Seeps and, to a lesser extent, depressions were the most impacted HGM types in this regard due to their shallow cross-sectional profile which often coincided with prime arable land. Alien and invasive plant infestation was another major impact in both urban and rural settings. The most commonly encountered alien bushclumps encroaching on wetlands systems long the pipeline route included *Eucalyptus camaldulensis*, *Acacia mernsii*, *Populus alba* and *Lantana camara* (lower KwaZulu-Natal). Some of the most intact wetland vegetation was encountered along the escarpment between Bethlehem and Van Reenen, in Tugela Private Nature Reserve (near Colenso) and in the KwaZulu-Natal midlands between Estcourt and Curries Post.

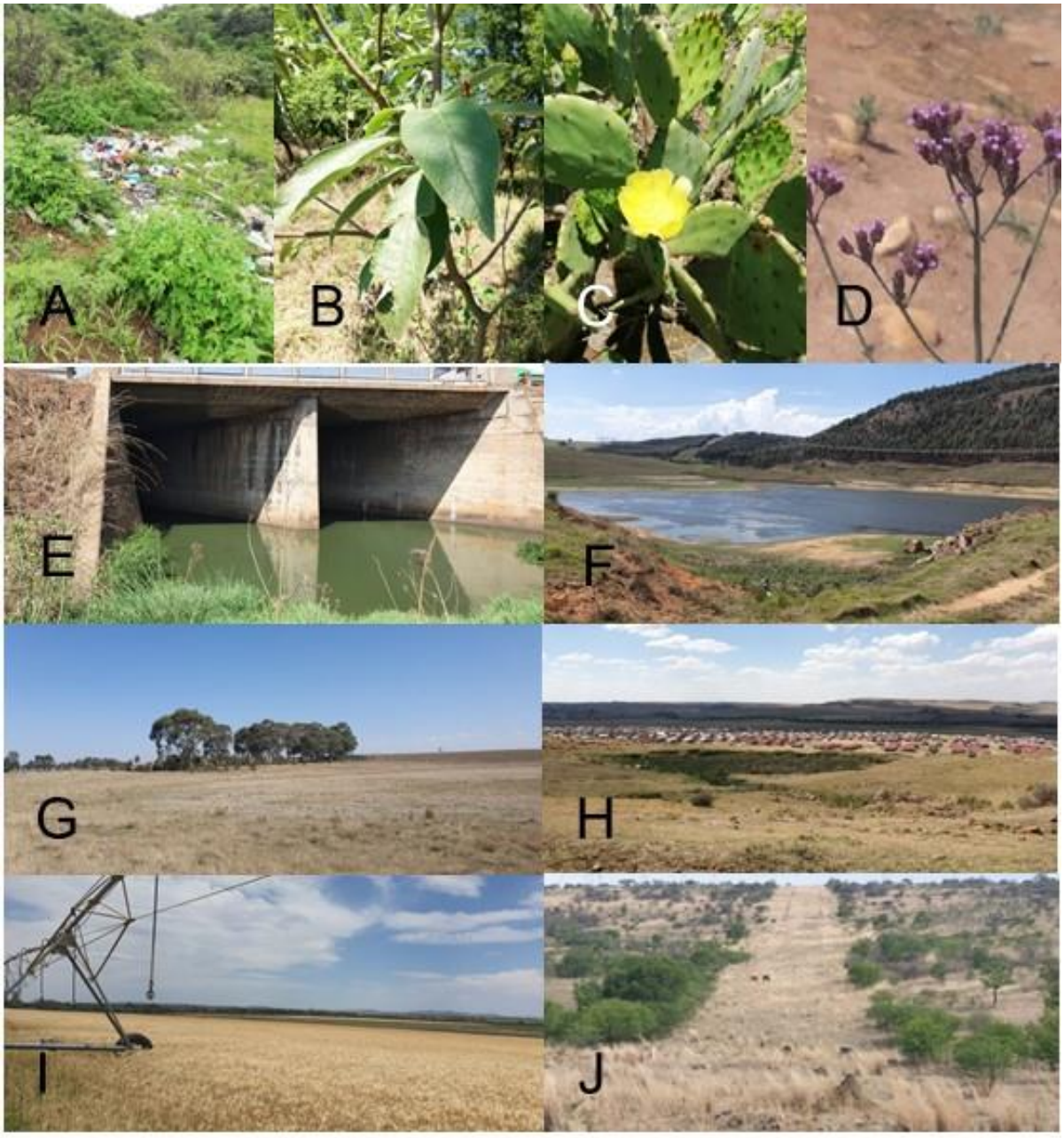



*Figure 27: Examples of typical impacts affecting the PES ratings of wetlands along the pipeline route; A) litter dumping, B) Solanum mauritianum, C) Opuntia ficus indica, D) Verbena bonariensis, E) bridge, F) dams, G) alien bush clumps, H) settlement, I) Nigeria, J) Clearing of riparian zone*

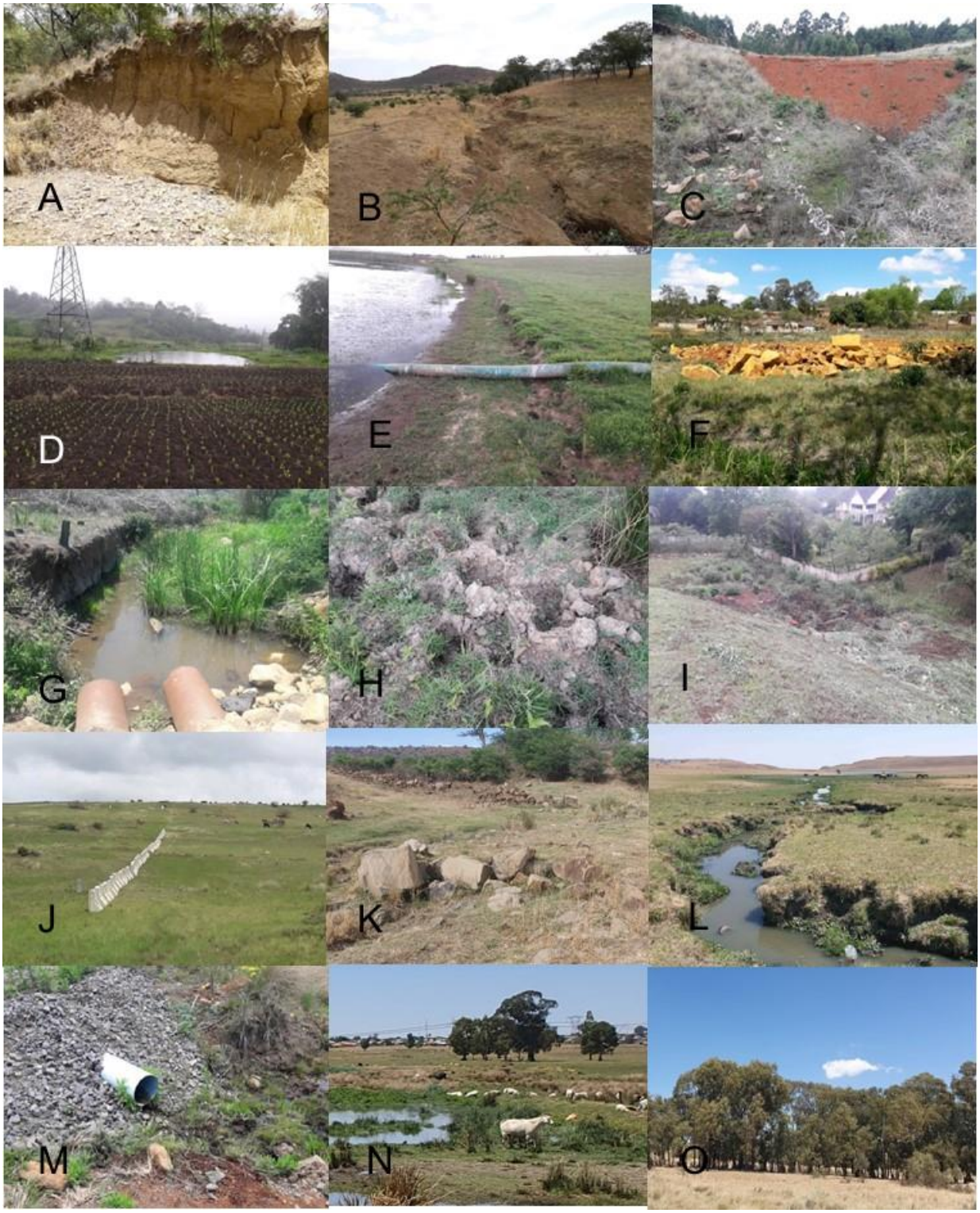



*Figure 28: Examples of typical impacts affecting the PES continued; A) bank erosion, B) gulley erosion, C) infilling, D) crop cultivation, E) abstraction, F) rock infilling, G) pipe culverts and subsequent erosion, H) soil poaching by livestock, I) wall across wetland and flow impediment, J) restrictive barriers, K) erosion, L) bank incisement and channelisation, M) infilling and flow concentration, N) livestock grazing, O) Eucalyptus camaldulensis*

### 8.2.5 Wetland Ecological Importance and Sensitivity

The Ecological Importance and Sensitivity ratings for each of the wetland HGM units is provided in Appendix B. Several factors were considered when establishing the EIS of a system. Regional to national scale considerations included NFEPA river or wetland status, provincial conservation plans (Critical Biodiversity Areas, Ecological Support Areas and Other Natural Areas), protected areas as well as Ramsar wetlands. Local considerations included habitat integrity and diversity, likelihood of supporting conservation important species and potential for hosting significant congregations of local or migratory species.

A summary of the frequency with which each of the four (4) EIS classes was encountered along the pipeline route together with the total area occupied by each is provided in Figure 29. From this figure it is evident that most wetlands along the pipeline route have a High (class B) to Moderate (class C) EIS with a comparatively small proportion of wetlands occupying either extreme (class A or D).

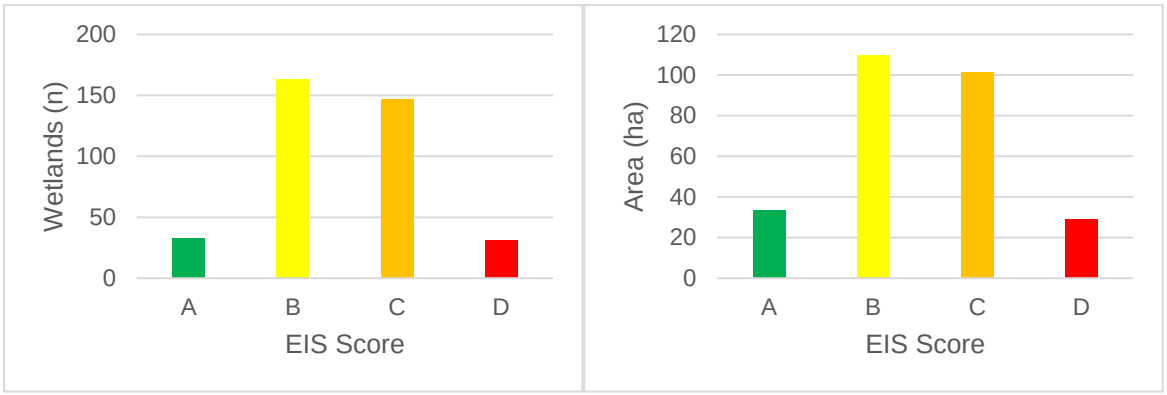



*Figure 29: Ecological Importance and Sensitivity, (a) numbers and (b) area of wetlands classified under each of the four EIS classes within the 64 m pipeline corridor project area*

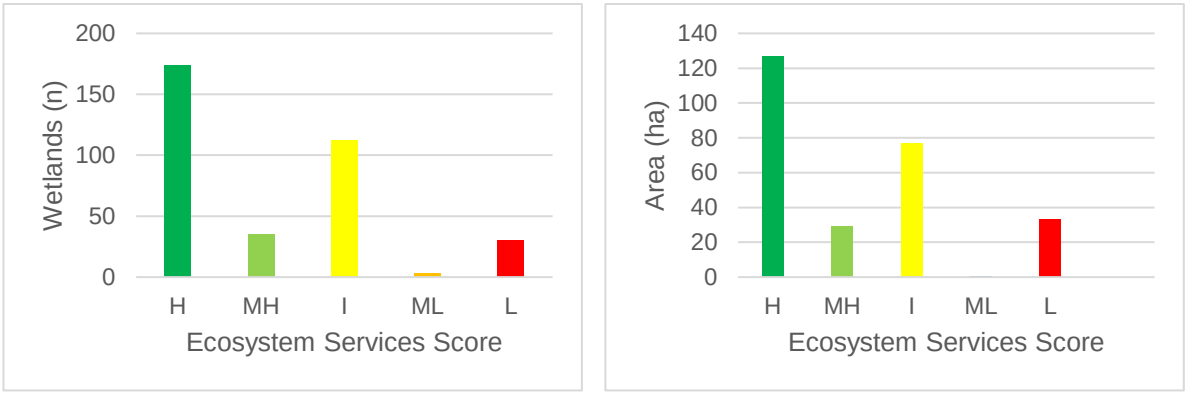
Wetlands of particular ecological importance and sensitivity (Very High) were as follows:

- **Gauteng**; Blaauwpan (Wetlands 89, 90), Sesmylspruit (Wetland 81), Reitvleirivier (Wetland 82), Wetland 16, Wetlands 158, 263 and 264, Blouwkransrivier (Wetland 3)
- **Free State**; Wetlands 6 and 7 (near Steynsrus), Jordaanrivier (370), Kroonspruit (14), Nuwejaarspruit (10), Wilgerivier (274)
- **KwaZulu-Natal**; Ngwenyana (Wetlands 148-150), Wetlands 228 and 1 near Tugela Private Nature reserve, Wetlands 2, 57, 220 and 386 between Frere and Mooi River, Kusane (Wetlands 61 and 62 and 236), Umgeni River (Wetland 182), Msunduzi (Wetland 19).

### 8.2.6 Wetland Ecosystem Services

The ecosystem services provided by the wetlands identified along the pipeline corridor were assessed and rated using the WET-EcoServices method (Kotze *et al*. 2008). A summary of the frequency with which each of the five ecosystem services classes was encountered along the pipeline route together with the total area occupied by each is provided in Figure 30. This figure shows that most of the systems (174) along the pipeline route are considered to provide Highly important ecosystem services. Of these the most significant are Wetlands 16, 14, 10, 15, 54, 77, 86, 95, 96, 158, 228, 266, 264, 263, 267, 274, 295 and 356. These are

predominantly large, relatively intact systems that provide both direct provisional and indirect regulating and supporting services in rural settings.




(a) (b)

*Figure 30: Ecosystem services, (a) numbers and (b) area of wetlands classified under each of the five ecosystem services classes within the 64 m pipeline corridor project area namely High (H), Moderate High (MH), Intermediate (I), Moderate Low (ML) and Low (L)*

Due to the high number of HGM units identified and delineated for the project, only a general description of the ecoservices typically associated with each HGM type is provided here. Table 33 provides a general guide as to the hydrological benefits likely to be provided by a the respective HGM types. It is however important to note that the descriptions of the above-mentioned functions are merely typical expectations. All wetland systems are unique and therefore, the ecosystem services ratings as provided in Appendix B may deviate from the trends as outlined below.

*Table 33: Preliminary rating of the hydrological benefits likely to be provided by a wetland based on its particular HGM type (Kotze et al., 2009)*

| WETLAND HYDRO-GEO-MORPHIC TYPE | REGULATORY BENEFITS POTENTIALLY PROVIDED BY WETLAND | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Flood attenuation | | Stream flow regulation | Enhancement of water quality | | | | |
| | Early wet season | Late wet season | | Erosion control | Sediment trapping | Phos-phates | Nitrates | Toxicants[2] |
| 1. Floodplain | ++ | + | 0 | ++ | ++ | ++ | + | + |
| 2. Valley-bottom - channelled | + | 0 | 0 | ++ | + | + | + | + |
| 3. Valley-bottom -unchannelled | + | + | +? | ++ | ++ | + | + | ++ |
| 4. Hillslope seepage connected to a stream channel | + | 0 | + | ++ | 0 | 0 | ++ | ++ |
| 5. Isolated hillslope seepage | + | 0 | 0 | ++ | 0 | 0 | ++ | + |
| 6. Pan/ Depression | + | + | 0 | 0 | 0 | 0 | + | + |

Rating: 0 Benefit unlikely to be provided to any significant extent
+ Benefit likely to be present at least to some degree
++ Benefit very likely to be present (and often supplied to a high level)

According to (Kotze *et al*. 2009), floodplains typically contribute mostly towards flood attenuation (more than other HGM types), erosion control and phosphate assimilation particularly during the onset of the rainy season. Their size, high channel sinuosity, abundance of depressions and meander cut-offs make them particularly effective in this regard.

Channelled valley-bottom wetlands tend to contribute less to sediment trapping and flood attenuation than other systems. Channelled valley-bottom wetlands are well known to improve the assimilation of toxicants, nitrates and sulphates, especially in cases where sub-surface flows contribute to the systems' water source (Kotze *et al*., 2009).

Unchanneled valley-bottoms are characterised by sediment deposition, a gentle gradient with streamflow generally being spread diffusely across the wetland, ultimately ensuring prolonged saturation levels and high levels of organic matter (Kotze *et al.* 2009). The assimilation of toxicants, nitrates and phosphates are usually high for unchanneled valley-bottom wetlands, especially in cases where the valley is fed by sub-surface interflow from slopes. The shallow depths of surface water within this system adds to the degradation of toxic contaminants by means of sunlight penetration.

According to (Kotze *et al.* 2009), the generally impermeable nature of depressions and their inward draining features are the main reasons why the streamflow regulation ability of these systems is mediocre. Additionally, depressions do not tend to contribute meaningfully to sediment trapping. The reason for this phenomenon is due to winds picking up sediments within pans during dry seasons which ultimately leads to the removal of these sediments and the deposition thereof elsewhere. The assimilation of nitrates, toxicants and phosphates are some of the higher rated ecosystem services for depressions due to the continuous precipitation and dissolving of minerals and other contaminants during dry and wet seasons respectively, (Kotze *et al.,* 2009).

Hillslope seeps are well documented by (Kotze *et al.,* 2009) to be associated with sub-surface ground water flows. These systems tend to contribute to flood attenuation given their diffuse nature. This attenuation only occurs while the soil within the wetland is not yet fully saturated. The accumulation of organic material and sediment contributes to prolonged levels of saturation due to this deposition slowing down the sub-surface movement of water. Water typically accumulates in the upper slope (above the seep). The accumulation of organic matter additionally is essential in the denitrification process involved with nitrate assimilation. Seeps generally also improve the quality of water by removing excess nutrients and inorganic pollutants originating from agriculture, industrial or mine activities. The diffuse nature of flows ensures that the assimilation of nitrates, toxicants and phosphates occurs readily while at the same time protecting against erosion.

### 8.2.7 Wetland Prioritisation

To facilitate the feasibility and practicality of pipeline closure efforts given the high number of wetland crossings (356 HGM units) an approach was adopted to prioritise wetlands in order of highest to lowest risk to the anticipated impacts associated with pipeline closure and ultimate abandonment. All 356 wetlands identified during a combination of in-field and desktop delineation where assigned a rating according to two variables namely level of saturation and ecological integrity. These systems were then further classified by HGM type (floodplain, channelled valley-bottom, unchanneled valley-bottom, flat, seep and depression) to yield a

total of 24 classes (1-4; a-f) (Table 34). It is advised that at least all HGM 1 and 2 systems be earmarked for closure activities.

*Table 34: Wetland prioritisation*

| Code | Hydroperiod | Integrity | Priority |
|---|---|---|---|
| 1 (a-f) | Permanent to seasonally saturated | Mostly intact | Very High |
| 2 (a-f) | Permanent to seasonally saturated | Mostly degraded | High |
| 3 (a-f) | Seasonally to temporarily saturated | Mostly intact | Moderate |
| 4 (a-f) | Seasonally to temporarily saturated | Mostly degraded | Low |

Key: a) floodplain, b) channelled valley-bottom, c) unchanneled valley-bottom, d) flat, e) seep and f) depression.

The prioritization of wetland sites was primarily based on hydroperiod while ecological integrity was also considered. Corrosion of pipeline steel in the soil is a complex process but is essentially driven by the interplay of water, carbon dioxide and oxygen, the rate of which being influenced by various factors including saturation, the atmospheric conditions and bacterial activity. In situations where the pipeline is above the water table oxygen, either dissolved in the water or diffusing into the soil from the surface, is predominantly responsible for the corrosion and the rate of corrosion in turn is mainly dependant on the hydraulic conductivity of the soil. Sandier soils with larger grain sizes (e.g. Dundee soils) are generally more water permeable and will result in faster corrosion than pipelines situated in more clay rich soils (e.g. Rensburgs) which are less water permeable.

Generally dry soils are of low concern with corrosion risk increasing with increasing saturation. Soils with low water contents (<20%) are subject to pitting corrosion whereas those with greater water contents (>20%) are vulnerable to general corrosion. Pipelines situated below the water table are in permanent contact with water with corrosion being influenced by the levels of dissolved oxygen and carbon dioxide (Scott, 2015). Wetland hydroperiod further influences corrosion by altering atmospheric conditions in the soil. As permanency of saturation increases oxygen levels decrease until the soil becomes anoxic. Corrosion rates in anoxic soils are generally higher than in aerobic conditions due to the presence of sulphide reducing bacteria which accelerate the corrosion process.

These factors influenced the prioritisation of wetlands based on saturation levels affording more permanently saturated systems a higher priority for mitigation than more temporarily (ephemerally) inundated systems.

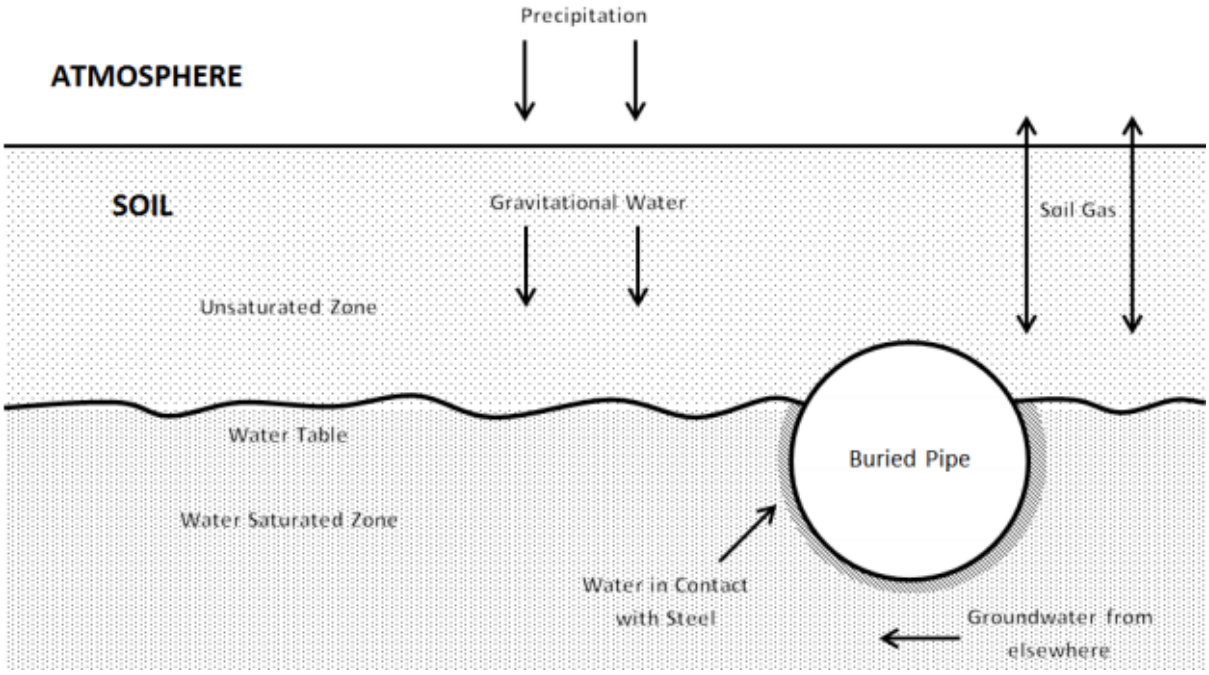



*Figure 31: Schematic of corrosion process of steel pipeline in soil (Scott, 2015)*

### 8.2.8 Wetland Buffers

Separate buffer calculations were made on the basis of biophysical attributes which included the HGM type, and the wetlands EIS following Graham and de Winnaar (2009). The buffers varied from 12 m for the most impacted low inundation systems to 30 m for the largest most intact floodplain and valley-bottom systems. The methodology implemented in order to determine the extent of the areas of risk is as follows:

- Amalgamated the wetland shapefiles with the wetlands delineated in field in order to obtain a single wetlands shapefile;
- Standardised the attributes table for the wetlands shapefiles using the national wetland classification system nomenclature (i.e. NFEPA wetland nomenclature); and
- Buffers were then assigned systematically to each feature following the proposed process outline presented in Figure 32.

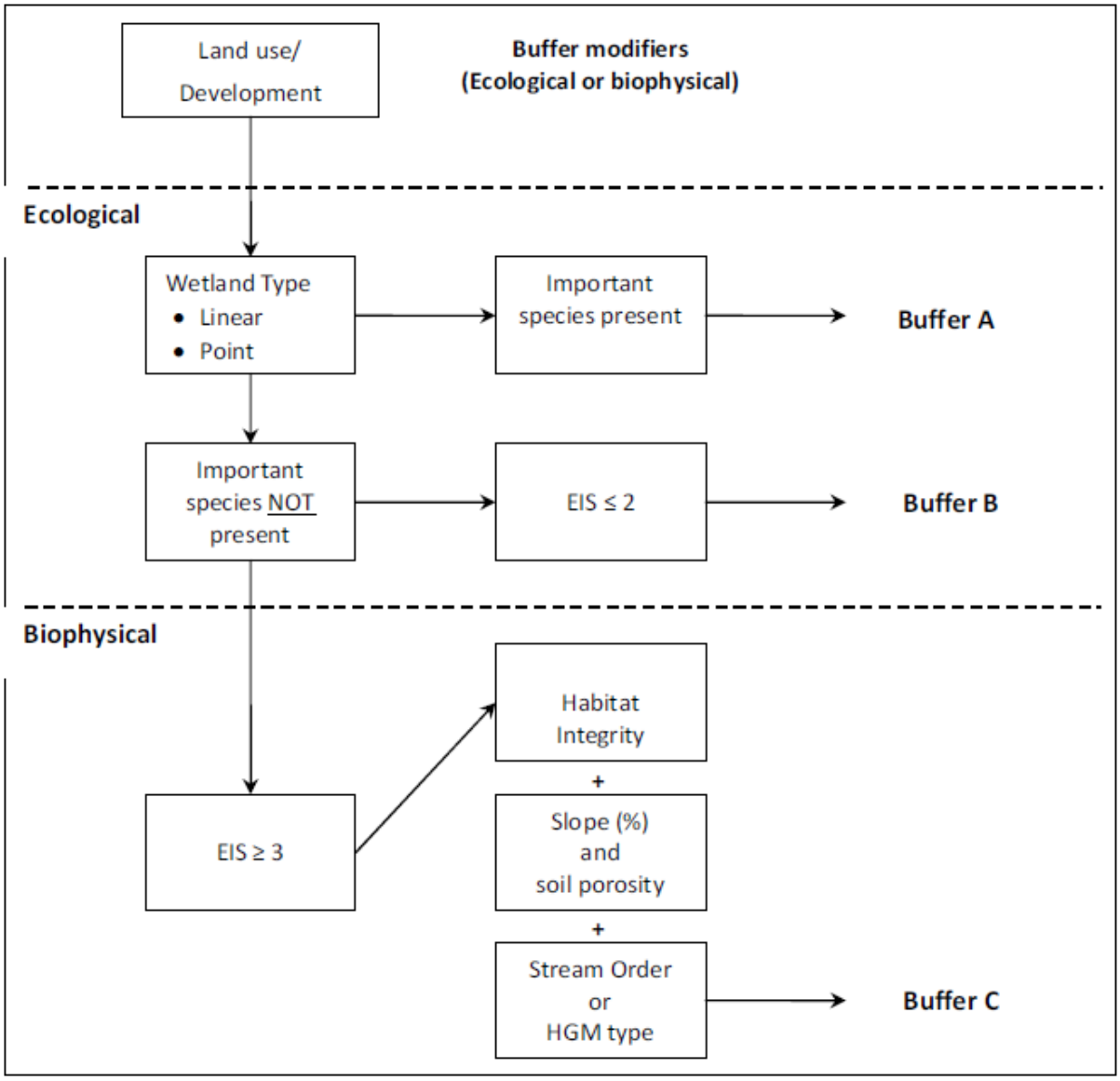



*Figure 32: Model for wetland buffer width determination according to land use in KwaZulu-Natal (Source: Graham and de Winnaar, 2009)*

### 8.2.9 Representative wetland sites

Table 35 to Table 57 are examples of a small representative subset of the wetlands visited during fieldwork illustrating some of the more pertinent information collected at each.

*Table 35: Summary of the wetland system sampled at site 15*

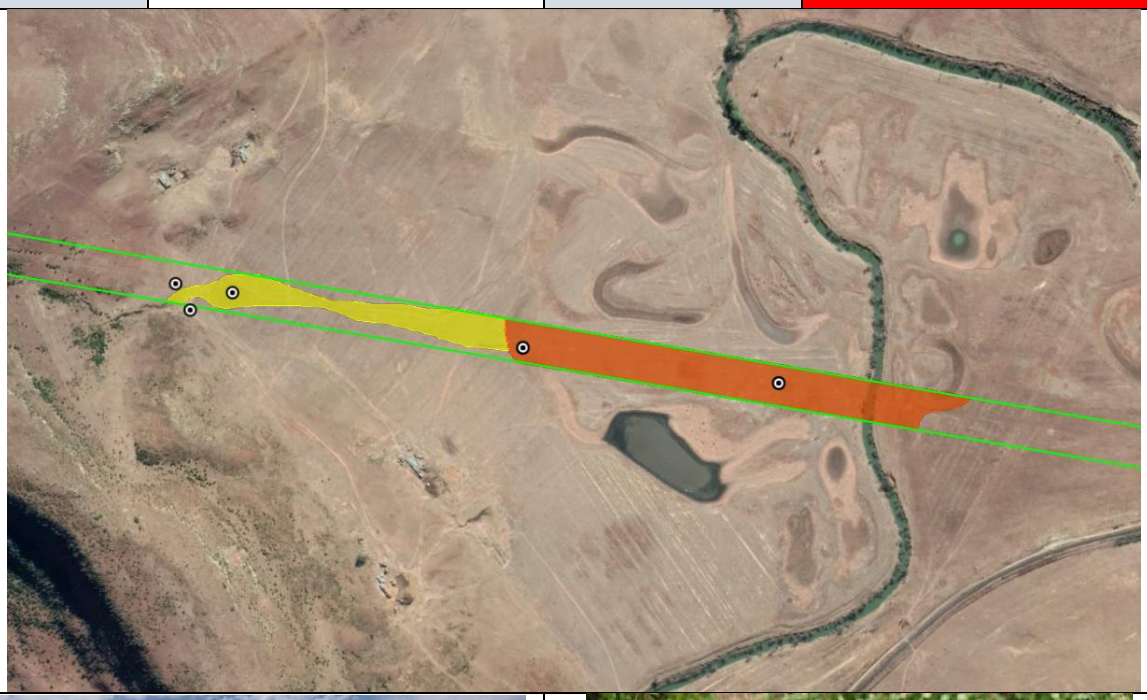
| | | | |
|---|---|---|---|
| **HGM Type** | Floodplain | **Site Code** | 15 |
| **Location** | -28.349571, 29.214173 | **Priority** | **Very High** |
|  | | | |
|  | |  | |
| Wetland | | Katspruit | |
| **Wetland FEPA** | No | **River FEPA** | FEPA Code 1 |
| **Description** | Very Intermittently inundated system, hydrophytic indicators few, bed covered by grass (*Themeda triandra* dominated). Deep alluvial deposits with feint signs of mottling. | | |
| **Impacts** | Powerlines, road crossings, alien and invasive plants present but minor and restricted to road verge. Mild grazing pressure from game. | | |
| **Assessment Rating** | **PES** | **EIS** | **Ecosystem Services** |
| | **B: Largely Modified** | **Moderate** | Very High |

*Table 36: Summary of the wetland system sampled at site 87*

| | | | |
|---|---|---|---|
| **HGM Type** | Flat | **Site Code** | 87 |
| **Location** | -26.750481, 27.926415 | **Priority** | **Very High** |
|  | | | |
|  | |  | |
| Wetland | | *Scirpoides* spp on edge of temporary zone | |
| **Wetland FEPA** | No | **River FEPA** | No |
| **Description** | Degraded area with several wetlands. Fragmented from surrounding areas. | | |
| **Impacts** | Livestock, Alien vegetation, Powerlines, Roads. Old degraded Grassland due to livestock mainly | | |
| **Assessment Rating** | **PES** | **EIS** | **Ecosystem Services** |
| | C: Moderately Modified | High | Moderately High |

*Table 37: Summary of the wetland system sampled at site 81*

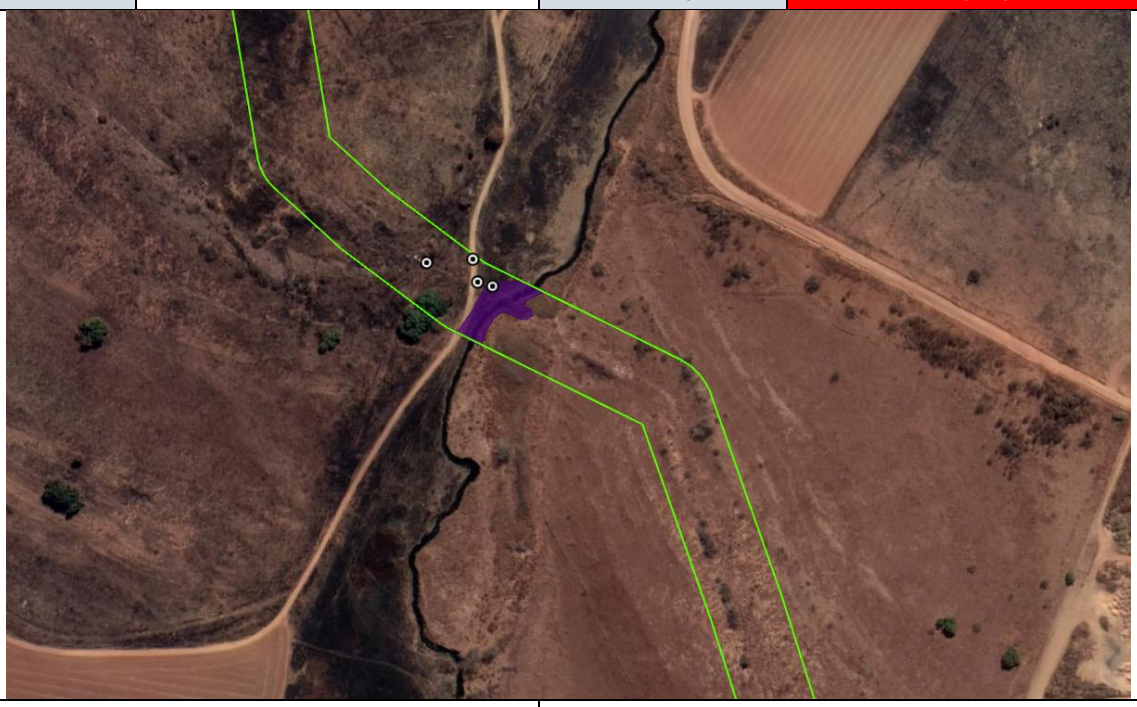
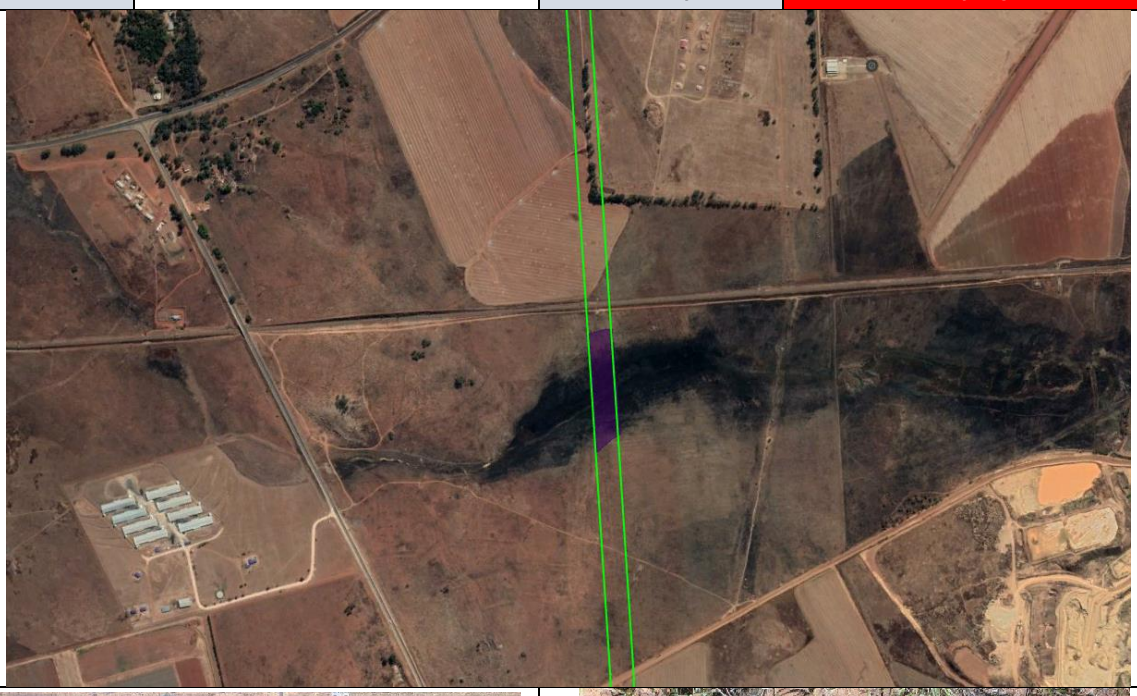
| | | | |
|---|---|---|---|
| **HGM Type** | Channelled valley-bottom | **Site Code** | 81 |
| **Location** | -25.971931, 28.299415 | **Priority** | **Very High** |
|  | | | |
| Wetland | | Other | |
| **Wetland FEPA** | No | **River FEPA** | FEPA Code 4 |
| **Description** | Use existing path and track to pump valve stay out of wetland | | |
| **Impacts** | Moderate bank incisement, clear water minimal alien vegetation, decreased surface roughness grazing. | | |
| **Assessment Rating** | **PES** | **EIS** | **Ecosystem Services** |
| | B: Largely Natural | Very High | Moderately High |

*Table 38: Summary of the wetland system sampled at site 82*

| | | | |
|---|---|---|---|
| **HGM Type** | Unchanneled valley-bottom | **Site Code** | 82 |
| **Location** | -26.024605, 28.321810 | **Priority** | **Very High** |
|  | | | |
|  | |  | |
| Wetland | | Dundee Soils | |

| | | | |
|---|---|---|---|
| **Wetland FEPA** | FEPA Code 1 | **River FEPA** | No |
| **Description** | Large system, wide system, shallow cross-sectional profile. Relatively intact vegetation. | | |
| **Impacts** | Livestock, Railway decreased roughness. Burning | | |
| **Assessment Rating** | **PES** | **EIS** | **Ecosystem Services** |
| | B: Largely natural | Very High | Moderately High |

*Table 39: Summary of the wetland system sampled at site 19*

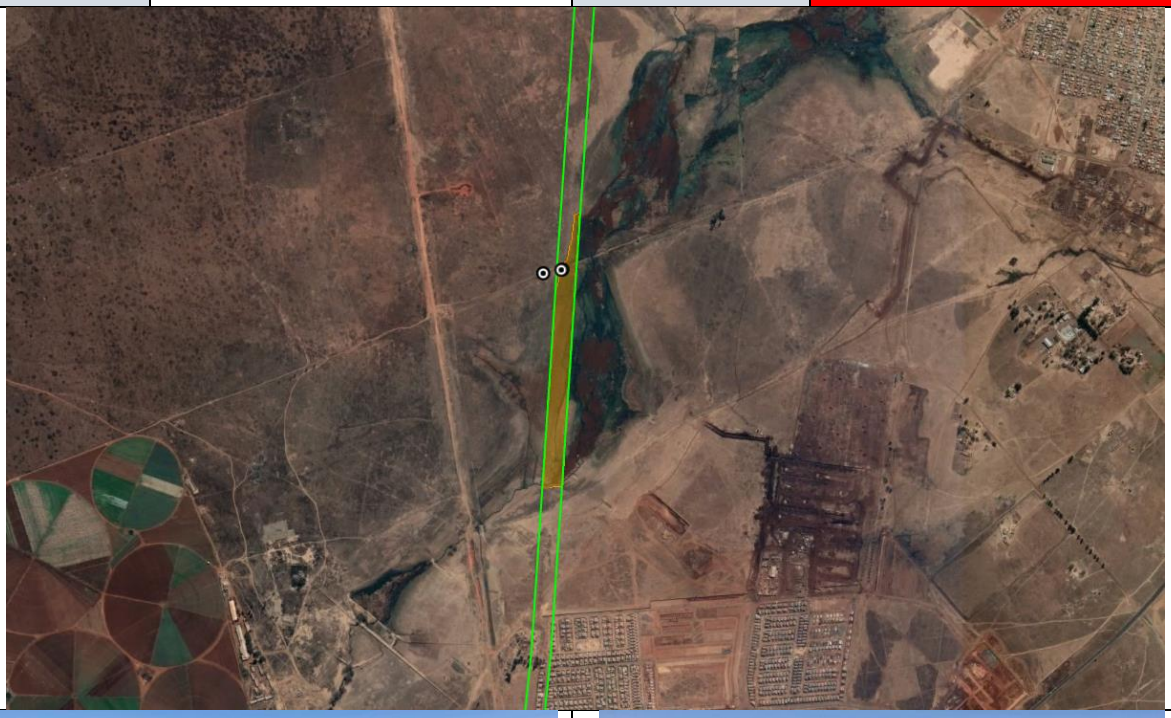
| | | | |
|---|---|---|---|
| **HGM Type** | Floodplain | **Site Code** | 19 |
| **Location** | -26.399984, 28.109348 | **Priority** | **Very High** |
|  | | | |
|  | |  | |
| Wetland | | Livestock | |
| **Wetland FEPA** | No | **River FEPA** | No |
| **Description** | Large wetland maintains much of its functionality although vegetation roughness has been significantly reduced by livestock grazing. | | |
| **Impacts** | Livestock, Alien vegetation, Litter and Dumping, Roads | | |
| **Assessment Rating** | **PES** | **EIS** | **Ecosystem Services** |
| | C: Moderately modified | Very High | High |

*Table 40: Summary of the wetland system sampled at site 14*

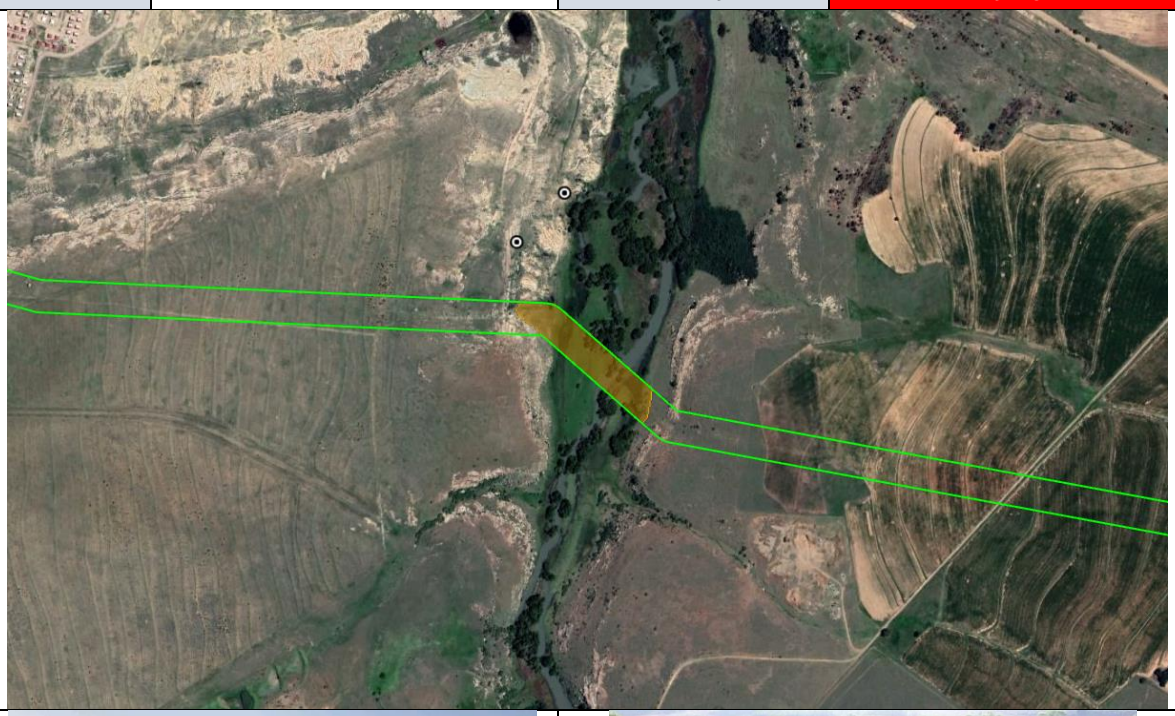
| | | | |
|---|---|---|---|
| **HGM Type** | Floodplain | **Site Code** | 14 |
| **Location** | -28.204761, 28.362827 | **Priority** | **Very High** |
|  | | | |
|  | |  | |
| Wetland | | *Serisium vulgare* | |
| **Wetland FEPA** | No | **River FEPA** | No |
| **Description** | Impacted area due to proximity of urban area. Avoid riparian and rocky outcrop area. | | |
| **Impacts** | Erosion, livestock, alien vegetation, litter and dumping, Roads, urban development | | |
| **Assessment Rating** | **PES** | **EIS** | **Ecosystem Services** |
| | C: Moderately Modified | Very High | High |

*Table 41: Summary of the wetland system sampled at site 54*

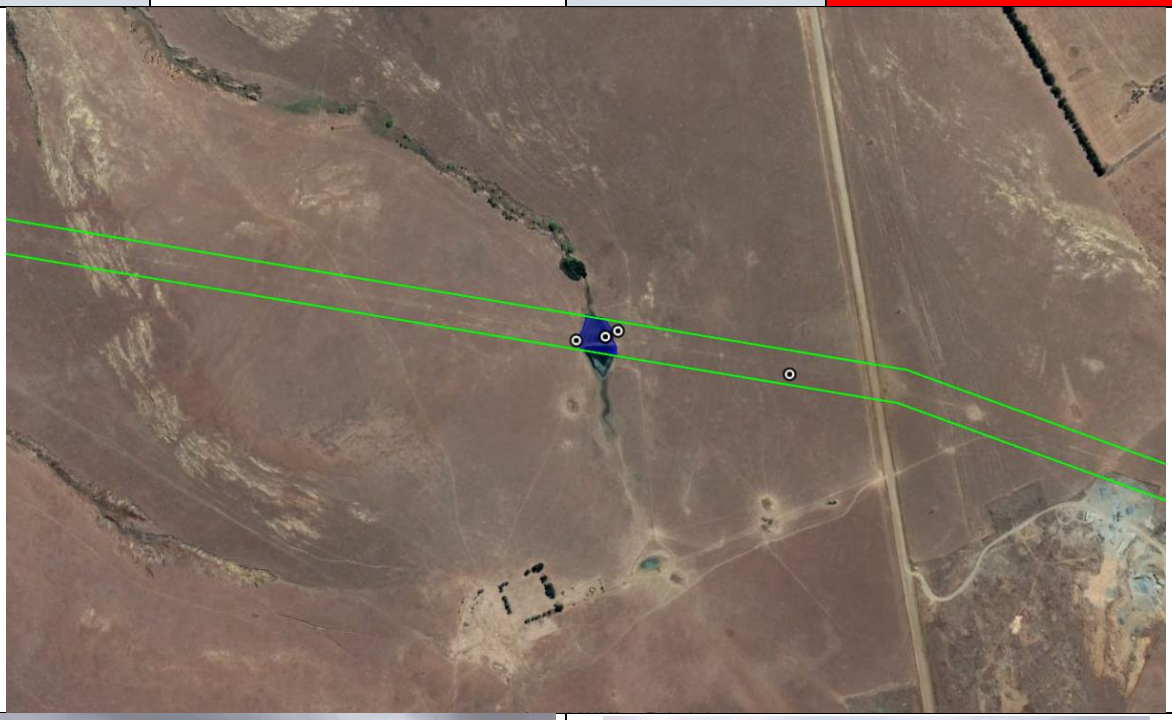
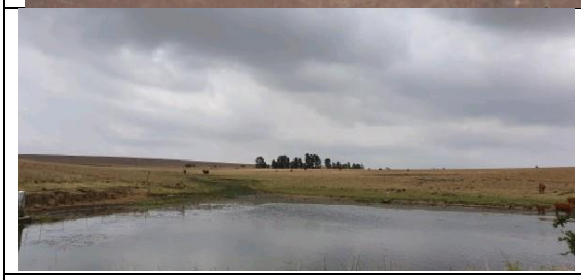
| | | | |
|---|---|---|---|
| **HGM Type** | Channelled valley-bottom | **Site Code** | 54 |
| **Location** | -28.329719, 29.112475 | **Priority** | **Very High** |
|  | | | |
|  | |  | |
| Wetland | | View looking downstream, *Eucalyptus camaldulensis* in background. | |
| **Wetland FEPA** | No | **River FEPA** | No |
| **Description** | Small yet permanently saturated system with vegetation in a largely natural state. | | |
| **Impacts** | Alien vegetation and dams (minor). | | |
| **Assessment Rating** | **PES** | **EIS** | **Ecosystem Services** |
| | C: Moderately modified | High | High |

*Table 42: Summary of the wetland system sampled at site 57*

| HGM Type | Channelled valley-bottom | Site Code | 57 |
|---|---|---|---|
| Location | -28.951001, 29.886447 | Priority | Very High |

Wetland

Downstream showing exposed bedrock

| Wetland FEPA | No | River FEPA | No |
|---|---|---|---|
| Description | Large intact channelled valley-bottom system in nature reserve. Extensive sheets of exposed bedrock. | | |
| Impacts | Slight erosion from overgrazing by game. | | |
| Assessment Rating | PES | EIS | Ecosystem Services |
| | C: Moderately modified | Very High | Moderately High |

*Table 43: Summary of the wetland system sampled at site 12*

| | | | |
|---|---|---|---|
| **HGM Type** | Floodplain | **Site Code** | 12 |
| **Location** | 28°44'32.69"S, 29°48'12.41"E | **Priority** | **Very High** |
|  | | | |
| **Wetland FEPA** | FEPA Code 1 | **River FEPA** | FEPA Code 4 |
| **Description** | Thukela River. Large floodplain with distinct channel. Moderate to high channel sinuosity. | | |
| **Impacts** | Alien vegetation has replaced natural riparian zone. Crop cultivation. | | |
| **Assessment Rating** | **PES** | **EIS** | **Ecosystem Services** |
| | D: Largely modified | High | High |

*Table 44: Summary of the wetland system sampled at site 17*

| | | | |
|---|---|---|---|
| **HGM Type** | Floodplain | **Site Code** | 17 |
| **Location** | -26.773718, 27.896160 | **Priority** | **Very High** |
|  | | | |
|  | |  | |
| Wetland | | Pipe culverts for dirt road crossings | |
| **Wetland FEPA** | No | **River FEPA** | No |
| **Description** | Taaibospruit. Particularly large, wide, low gradient floodplain. Vegetation cover low. Deep alluvial Dundee soils. Signs of past cultivation. | | |
| **Impacts** | Burning, weedy annuals, culvert, livestock, farming, alien vegetation, roads. | | |
| **Assessment Rating** | **PES** | **EIS** | **Ecosystem Services** |
| | C: Moderately modified | High | Intermediate |

*Table 45: Summary of the wetland system sampled at site 59*

| | | | |
|---|---|---|---|
| **HGM Type** | Channelled valley-bottom | **Site Code** | 59 |
| **Location** | 29°44'5.43"S, 30°38'31.38"E | **Priority** | **Very High** |
|  | | | |
|  | |  | |
| Wetland | | Encroachment by *Pinus* spp. | |
| **Wetland FEPA** | No | **River FEPA** | Np |
| **Description** | Livestock grazing limited to grassland. Alien and invasive plant species tended to occur in more intensive growth on south-facing slope. Sand could be sourced locally from surrounding grassland. No SCC or protected species observed. | | |
| **Impacts** | Erosion, Livestock, Alien vegetation | | |
| **Assessment Rating** | **PES** | **EIS** | **Ecosystem Services** |
| | C: Moderately modified | High | Intermediate |

*Table 46: Summary of the wetland system sampled at site 58*

| | | | |
|---|---|---|---|
| **HGM Type** | Channelled valley-bottom | **Site Code** | 58 |
| **Location** | 29°29'3.74"S, 30°12'11.36"E | **Priority** | **Very High** |
|  | | | |
|  | |  | |
| Wetland showing young *Phragmites australis* | | Soil ped showing coarse sandy Katspruit soils | |
| **Wetland FEPA** | FEPA Code 1 | **River FEPA** | No |
| **Description** | A large permanently saturated system with signs of channel erosion. | | |
| **Impacts** | Altered surface roughness, alien vegetation. | | |
| **Assessment Rating** | **PES** | **EIS** | **Ecosystem Services** |
| | D: Largely modified | Moderate | Intermediate |

*Table 47: Summary of the wetland system sampled at site 53*

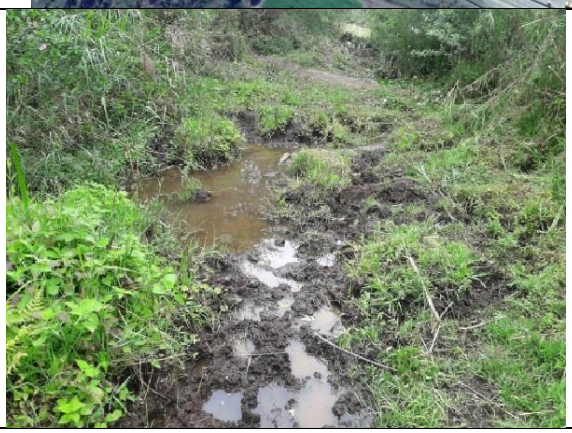
| | | | |
|---|---|---|---|
| **HGM Type** | Channelled valley-bottom | **Site Code** | 53 |
| **Location** | 29°44'6.57"S, 30°39'6.88"E | **Priority** | **Very High** |
|  | | | |
|  | |  | |
| Wetland showing signs of soil poaching by livestock | | G horizon in Katspruit soil form | |
| **Wetland FEPA** | No | **River FEPA** | No |
| **Description** | A relatively intact channelled valley-bottom system in incised terrain. | | |
| **Impacts** | Alien vegetation. | | |
| **Assessment Rating** | **PES** | **EIS** | **Ecosystem Services** |
| | B: Largely Natural | High | High |

*Table 48: Summary of the wetland system sampled at site 51*

| | | | |
|---|---|---|---|
| **HGM Type** | Channelled valley-bottom | **Site Code** | 51 |
| **Location** | -29.5223, 30.3276 | **Priority** | **Very High** |
|  | | | |
|  | |  | |
| Wetland showing pipe culverts | | Erosion downstream of culverts | |

| | | | |
|---|---|---|---|
| **Wetland FEPA** | No | **River FEPA** | No |
| **Description** | A small yet permanently saturated channelled valley-bottom wetland. The presence of two small pipe culverts serves to funnel and direct flows which has led to notable erosion of the bed and banks. | | |
| **Impacts** | Erosion, culverts, farming, alien vegetation, roads | | |
| **Assessment Rating** | **PES** | **EIS** | **Ecosystem Services** |
| | D: Largely modified | Moderate | Intermediate |

*Table 49: Summary of the wetland system sampled at site 50*

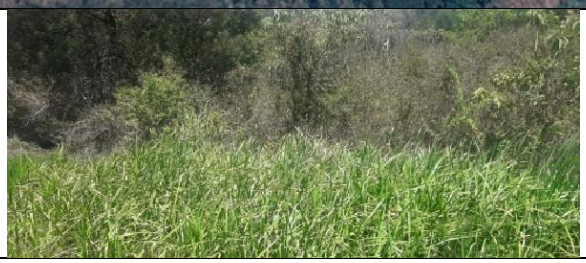
| | | | |
|---|---|---|---|
| **HGM Type** | Channelled valley-bottom | **Site Code** | 50 |
| **Location** | -29.5216, 30.3226 | **Priority** | **Very High** |
|  | | | |
|  | | | |
| Wetland | | | |
| **Wetland FEPA** | No | **River FEPA** | No |
| **Description** | Small, permanently inundated channelled valley-bottom wetland surrounded by farming. | | |
| **Impacts** | Erosion, alien vegetation, farming. | | |
| **Assessment Rating** | **PES** | **EIS** | **Ecosystem Services** |
| | D: Largely modified | Moderate | Intermediate |

*Table 50: Summary of the wetland system sampled at site W131CBI*

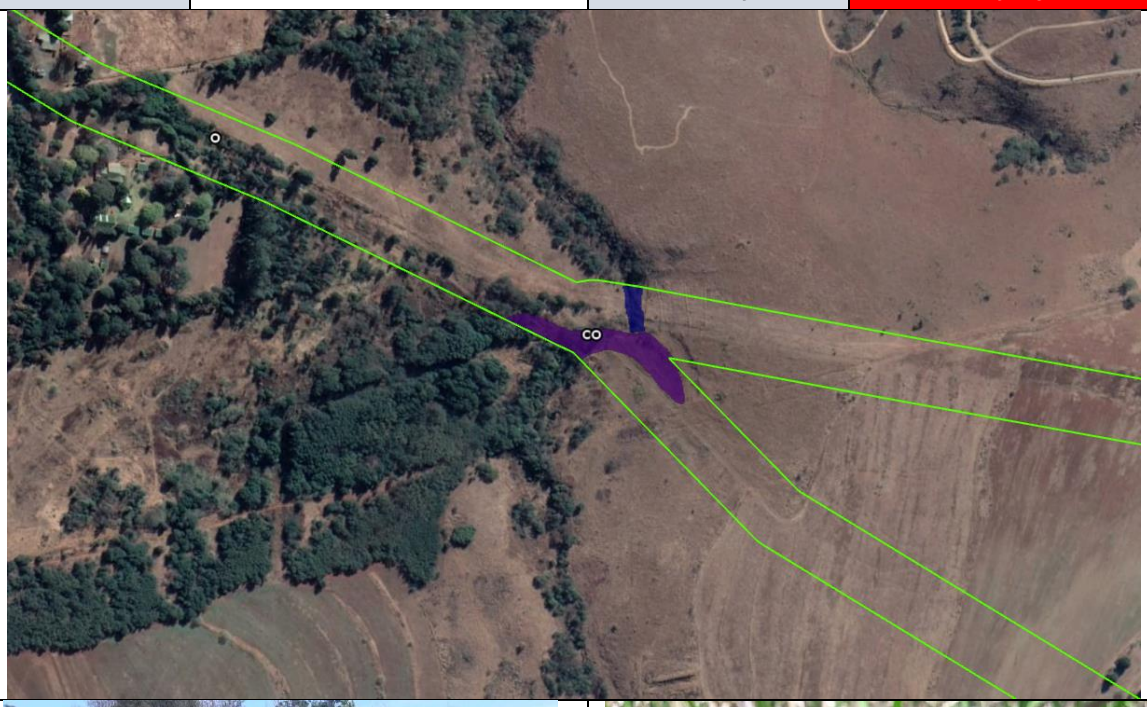
| HGM Type | Channelled valley-bottom | Site Code | W131CBI |
|---|---|---|---|
| Location | -29.5123, 30.2661 | Priority | Very High |
|  | | | |
|  | |  | |
| Wetland | | Root mottling. | |
| Wetland FEPA | Fepa Code 1 | River FEPA | No |
| Description | Small permanently inundated system with dense hydromorphic vegetation cover. | | |
| Impacts | Livestock, alien vegetation. | | |
| Assessment Rating | PES | EIS | Ecosystem Services |
| | C: Moderately modified | High | Intermediate |

*Table 51: Summary of the wetland system sampled at site 46*

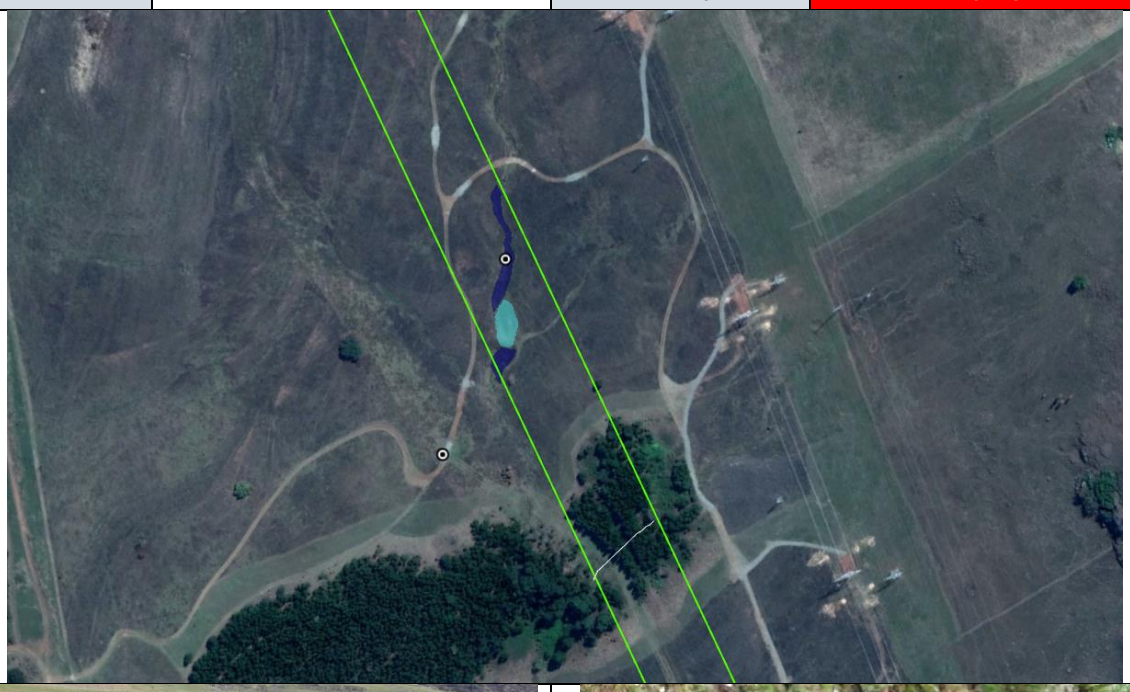
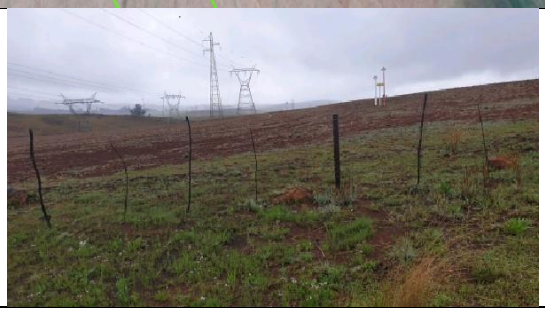
| | | | |
|---|---|---|---|
| **HGM Type** | Channelled valley-bottom | **Site Code** | 46 |
| **Location** | 29°23'33.12"S, 30° 9'10.15"E | **Priority** | **Very High** |
|  | | | |
|  | |  | |
| Wetland | | Katspruit soils | |
| **Wetland FEPA** | No | **River FEPA** | No |
| **Description** | Small permanently inundated system, remote largely intact. | | |
| **Impacts** | Erosion, livestock, alien vegetation | | |
| **Assessment Rating** | **PES** | **EIS** | **Ecosystem Services** |
| | D: Largely modified | Moderate | Moderately Low |

*Table 52: Summary of the wetland system sampled at site 83*

| HGM Type | Unchanneled valley-bottom | Site Code | 83 |
|---|---|---|---|
| Location | -29.4047, 30.1597 | Priority | Very High |



| Wetland | | Other | |
|---|---|---|---|
| **Wetland FEPA** | No | **River FEPA** | No |
| **Description** | Intact mountain grassland to the north. Agriculture to the south. Pump from agriculture | | |
| **Impacts** | Farming, powerlines, adjacent impacts | | |
| **Assessment Rating** | **PES** | **EIS** | **Ecosystem Services** |
| | C: Moderately modified | High | High |

*Table 53: Summary of the wetland system sampled at site 78*

| | | | |
|---|---|---|---|
| **HGM Type** | Unchanneled valley-bottom | **Site Code** | 78 |
| **Location** | -29.7663, 30.7045 | **Priority** | **Very High** |
|  | | | |
|  | |  | |
| Wetland | | *Acacia melanoxylon* encroaching om wetland | |

| | | | |
|---|---|---|---|
| **Wetland FEPA** | No | **River FEPA** | No |
| **Description** | Moderate to small, permanent system with dense hydrophytic vegetation. | | |
| **Impacts** | Dams, past cultivation. | | |
| **Assessment Rating** | **PES** | **EIS** | **Ecosystem Services** |
| | C: Moderately modified | High | High |

*Table 54: Summary of the wetland system sampled at site 76*

| HGM Type | Unchanneled valley-bottom | Site Code | 76 |
|---|---|---|---|
| Location | -29.5123, 30.2661 | Priority | Very High |

View downstream

| Wetland FEPA | No | River FEPA | No |
|---|---|---|---|
| Description | Small system that still retains an intact wetland vegetation although impacted further upstream by *Acacia mearnsii* bushclumps. | | |
| Impacts | Livestock, Alien vegetation | | |
| Assessment Rating | PES | EIS | Ecosystem Services |
| | C: Moderately modified | Moderate | High |

*Table 55: Summary of the wetland system sampled at site 86*

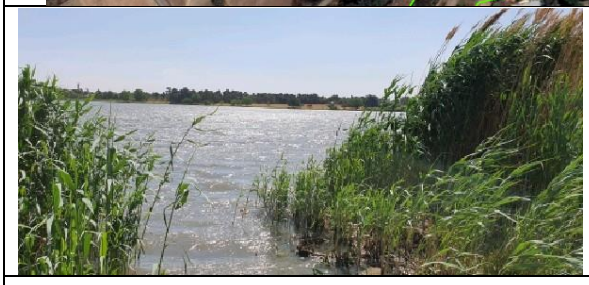
| HGM Type | Flat | Site Code | 86 |
|---|---|---|---|
| Location | -29.5723, 30.3522 | Priority | Very High |
|  | | | |
|  | |  | |
| Wetland | | Humus rich melanic A horizon of a Willowbrook soil form. | |
| Wetland FEPA | No | River FEPA | No |
| Description | A permanently saturated fat wetland adjacent to residential area. | | |
| Impacts | Alien vegetation, urban development. | | |
| Assessment Rating | PES | EIS | Ecosystem Services |
| | B: Largely natural | High | Very High |

*Table 56: Summary of the wetland system sampled at site 85*

| | | | |
|---|---|---|---|
| **HGM Type** | Flat | **Site Code** | 85 |
| **Location** | -29.4799, 30.1989 | **Priority** | **Very High** |
|  | | | |
|  | |  | |
| Wetland showing *Cyperus dives* | | Willowbrook soil form | |
| **Wetland FEPA** | No | **River FEPA** | No |
| **Description** | Large permanently inundated flat wetland | | |
| **Impacts** | Alien vegetation, Roads, Urban development | | |
| **Assessment Rating** | **PES** | **EIS** | **Ecosystem Services** |
| | C: Moderately modified | High | High |

*Table 57: Summary of the wetland system sampled at site 90*

| HGM Type | Depression | Site Code | 90 |
|---|---|---|---|
| Location | -26.123640, 28.273442 | Priority | Very High |



| Wetland | Other |
|---|---|

| Wetland FEPA | No | River FEPA | No |
|---|---|---|---|
| Description | Large permanent pan, high inundation levels during survey. Only a narrow belt of associated hydrophytic vegetation persist along margin | | |
| Impacts | Alien vegetation, litter and Dumping, roads, urban development | | |
| Assessment Rating | PES | EIS | Ecosystem Services |
| | B: Largely natural | Very High | Moderately High |

## 8.3 Riverine Ecology

A total of 30 riverine systems were assessed during the survey. A selection of systems was conducted to provide a representative sample of riverine systems encountered during the decommissioning of the pipeline. These sites are summarised in Table 58 to Table 86. The river systems assessed ranged from ephemeral mountain streams with Strahler order 1, to large lowland rivers such as the Vaal River. *In situ* water quality, macroinvertebrates, habitat, and fish were assessed at each site that presented adequate surface water to conduct each assessment. Dry systems were photographed, and habitat integrity assessed. Site access was limited at several sites and therefore sampling was conducted up or downstream at an accessible point to assess the state of the riverine system. The state of the systems fluctuated from largely natural to critically modified according to biological bands (Dallas, 2007). All riverine system delineations are provided in the wetland assessment, which included the riparian zones within the delineations. Buffers were appropriately added to each delineation. Despite the fluctuating states of the systems assessed, the buffers and risks to the systems remain constant due to legislative protections of the water resources. Methodologies and desktop assessments are provided in the scoping report (TBC, 2019).

*Table 58: Summary of the aquatic system sampled at site 56*

| Site Code | 56 | Priority | 1 | Sample Date | 01/11/2019 |
|---|---|---|---|---|---|
| **Upstream** | | | | **Downstream** | |
|  | | | |  | |
| **Coordinates** | | | | 26°40'12.50"S | 28° 0'33.24"E |
| **Desktop data for the Sub-Quaternary Reach: C21G-1692** | | | | **River Name** | **Suikerbosrand River** |
| **Strahler Order** | 3 | **Modifications** Dryland agriculture, Vereeniging, Rand Water – treatment works, Suikerbosrand treatment plant, Alien invasive species | | | |
| **Present Ecological State** | Class D | | | | |
| **Ecological Importance** | High | | | | |
| **Ecological Sensitivity** | High | | | | |
| **Water Quality** | | | | | |
| **pH** | **Conductivity (µS/cm)** | **DO (mg/l)** | **Temperature (°C)** | | |
| 7.86 | 1249 | 4.81 | 20.1 | | |
| **Habitat** | | | | | |
| **Geoclass** | Class F – Lowland river | **WMA** | **Vaal** | **Ecoregion** | Highveld |
| **Habitat integrity (IHIA)** | **Riparian** | **Instream** | | | |
| | Class D | Class D | | | |
| **Biotope Rating X/45** | **22.5** | **Comment** | | | |
| | | Site dominated by stones in current, with limited marginal and aquatic vegetation. | | | |
| **Macroinvertebrate Assessment** | | | | | |
| **SASS5 Score** | **No. of Taxa** | **ASPT** | **Ecological category (Dallas 2007)** | | |
| 95 | 21 | 4.5 | Class B | | |
| **Fish Community Assessment** | | | | | |
| **Species collected (IUCN Status)** | | **Species of Conservational Concern** | 1 | | |
| *Labeo capensis (LC)*<br>*Labeobarbus aeneus (LC)*<br>*Labeobarbus kimberleyensis (NT)* | | | | | |
| **Discussion** | | | | | |
| The state of the Suikerbosrand River was found to be in a moderately modified state. This was attributed to habitat and water quality modifications. A largely intact biotic macroinvertebrate community was observed during the study. A single fish species of conservational concern was collected during the survey and identified according to *(Skelton, 2001)*, *Labeobarbus kimberleyensis (NT)*. Access point to the pipeline should be located outside the recommended buffer for the riparian zone. | | | | | |

*Table 59: Summary of the aquatic system sampled at site 57*

| Site Code | 57 | Priority | 1 | Sample Date | 01/11/2019 |
|---|---|---|---|---|---|
| **Upstream** | | | | **Downstream** | |
|  | | | |  | |
| **Coordinates** | | | | 26°41'43.42"S | 27°59'56.57"E |
| **Desktop data for the Sub-Quaternary Reach: C22F-1737** | | | | **River Name** | **Vaal River** |
| **Strahler Order** | 4 | **Modifications**<br>• Agriculture<br>• Power station,<br>• Mining<br>• Methabo weir | | | |
| **Present Ecological State** | Class C | | | | |
| **Ecological Importance** | High | | | | |
| **Ecological Sensitivity** | High | | | | |
| **Water Quality** | | | | | |
| **pH** | **Conductivity (µS/cm)** | **DO (mg/l)** | **Temperature (°C)** | | |
| Not assessed | | | | | |
| **Habitat** | | | | | |
| **Geoclass** | Class F – Lowland river | **WMA** | **Vaal** | **Ecoregion** | Highveld |
| **Habitat integrity (IHIA)** | **Riparian** | **Instream** | | | |
| | Class C | Class D | | | |
| **Biotope Rating X/45** | - | **Comment** | | | |
| | | Slow deep moving waters, marginal vegetation | | | |
| **Macroinvertebrate Assessment** | | | | | |
| **SASS5 Score** | **No. of Taxa** | **ASPT** | **Ecological category (Dallas 2007)** | | |
| Not assessed | | | | | |
| **Fish Community Assessment** | | | | | |
| **Species collected (IUCN Status)** | | **Species of Conservational Concern** | 1 | | |
| *Labeo capensis (LC)*<br>*Labeobarbus aeneus (LC)*<br>*Labeobarbus kimberleyensis (NT)* | | | | | |
| **Discussion** | | | | | |
| The access point to the pipeline falls within the Rand Water treatment works. Should the access point be within the Rand Water property, and negligible risk is assessed for the Vaal system. The desktop state of the Vaal is classed as moderately modified. | | | | | |

*Table 60: Summary of the aquatic system sampled at site 61*

| Site Code | 61 | Priority | 1 | Sample Date | 01/11/2019 |
|---|---|---|---|---|---|
| **Upstream** | | | | **Downstream** | |
|  | | | |  | |
| **Coordinates** | | | | 26°46'43.70"S | 27°53'22.49"E |
| **Desktop data for the Sub-Quaternary Reach: C22K-1795** | | | | **River Name** | **Taaibospruit** |
| **Strahler Order** | 3 | **Modifications**<br>• Impacts from discharge from industries,<br>• Agriculture from run-of-river,<br>• back water from Barrage in lower reach | | | |
| **Present Ecological State** | Class D | | | | |
| **Ecological Importance** | High | | | | |
| **Ecological Sensitivity** | High | | | | |
| **Water Quality** | | | | | |
| **pH** | **Conductivity (µS/cm)** | **DO (mg/l)** | **Temperature (°C)** | | |
| Not assessed | | | | | |
| **Habitat** | | | | | |
| **Geoclass** | Class F – Lowland river | **WMA** | **Vaal** | **Ecoregion** | Highveld |
| **Habitat integrity (IHIA)** | **Riparian** | **Instream** | | | |
| | Class C | Class D | | | |
| **Biotope Rating X/45** | - | **Comment** | | | |
| | | Slow deep moving waters, marginal vegetation | | | |
| **Macroinvertebrate Assessment** | | | | | |
| **SASS5 Score** | **No. of Taxa** | **ASPT** | **Ecological category (Dallas 2007)** | | |
| Not assessed | | | | | |
| **Fish Community Assessment** | | | | | |
| **Species collected (IUCN Status)** | | **Species of Conservational Concern** | 1 | | |
| *Labeo capensis (LC)*<br>*Labeobarbus aeneus (LC)*<br>*Labeobarbus kimberleyensis (NT)* | | | | | |
| **Discussion** | | | | | |
| A large floodplain occurs either side of the river channel, and therefore the wetland delineation and buffer should be followed. | | | | | |

*Table 61: Summary of the aquatic system sampled at site 61*

| Site Code | 69 | Priority | 3 | Sample Date | 01/11/2019 |
|---|---|---|---|---|---|
| Upstream | | | | Downstream | |
|  | | | |  | |
| Coordinates | | | | 27°44'2.35"S | 27°17'58.10"E |
| Desktop data for the Sub-Quaternary Reach: C60D-2472 | | | | River Name | Unnamed Tributary of the Vals River |
| Strahler Order | 1 | Modifications | | | |
| Present Ecological State | Class D | • Erosion<br>• Livestock<br>• Instream impoundment | | | |
| Ecological Importance | Moderate | | | | |
| Ecological Sensitivity | Moderate | | | | |
| Water Quality | | | | | |
| pH | Conductivity (µS/cm) | DO (mg/l) | Temperature (°C) | | |
| DRY | | | | | |
| Habitat | | | | | |
| Geoclass | Class D – Lowland river | WMA | Vaal | Ecoregion | Highveld |
| Habitat integrity (IHIA) | Riparian | Instream | | | |
| | Class D | Class D | | | |
| Biotope Rating X/45 | N/A | Comment | | | |
| | | Dry dam | | | |
| Macroinvertebrate Assessment | | | | | |
| SASS5 Score | No. of Taxa | ASPT | Ecological category (Dallas 2007) | | |
| Dry | | | | | |
| Fish Community Assessment | | | | | |
| Species collected (IUCN Status) | | Species of Conservational Concern | 0 | | |
| Dry | | | | | |
| Discussion | | | | | |
| Site was dry, proposed activities pose a low risk to aquatic system. Follow wetland delineation and buffer. Due to the ephemeral nature a lower priority assigned. | | | | | |

*Table 62: Summary of the aquatic system sampled at site 84*

| Site Code | 84 | Priority | 1 | Sample Date | 04/11/2019 |
|---|---|---|---|---|---|
| **Upstream** | | | | **Downstream** | |
|  | | | |  | |
| **Coordinates** | | | | 27°49'43.36"S | 27°30'14.98"E |
| **Desktop data for the Sub-Quaternary Reach: C60D-2507** | | | | **River Name** | **Unnamed Tributary of the Vals River** |
| **Strahler Order** | 1 | **Modifications**<br>• Erosion<br>• Livestock<br>• Abstraction<br>• Alien vegetation | | | |
| **Present Ecological State** | Class C | | | | |
| **Ecological Importance** | Moderate | | | | |
| **Ecological Sensitivity** | Moderate | | | | |
| **Water Quality** | | | | | |
| **pH** | **Conductivity (µS/cm)** | **DO (mg/l)** | **Temperature (°C)** | | |
| 8.16 | 1052 | 3.84 | 23.3 | | |
| **Habitat** | | | | | |
| **Geoclass** | Class E – Lowland river | **WMA** | **Vaal** | **Ecoregion** | Highveld |
| **Habitat integrity (IHIA)** | **Riparian** | **Instream** | | | |
| | Class C | Class B | | | |
| **Biotope Rating X/45** | 10 | **Comment**<br>Site dominated by stones in current, with limited marginal and aquatic vegetation. | | | |
| **Macroinvertebrate Assessment** | | | | | |
| **SASS5 Score** | **No. of Taxa** | **ASPT** | **Ecological category (Dallas 2007)** | | |
| 107 | 24 | 4.5 | Class B | | |
| **Fish Community Assessment** | | | | | |
| **Species collected (IUCN Status)** | | **Species of Conservational Concern** | 0 | | |
| *Enteromius anoplus* (LC) | | | | | |
| **Discussion** | | | | | |
| Limited flow within the reach. Largely intact macroinvertebrate community, a single species of fish collected, listed as Least Concern. Modified instream and riparian habitat, however, largely intact macroinvertebrates community. Follow wetland delineation and prescribed buffer. | | | | | |

*Table 63: Summary of the aquatic system sampled at site 126*

| Site Code | 125/126 | Priority | 1 | Sample Date | 04/11/2019 |
|---|---|---|---|---|---|
| **Upstream** | | | | **Downstream** | |
|  | | | |  | |
| **Coordinates** | | | | 28° 8'27.37"S | 28° 6'48.67"E |
| **Desktop data for the Sub-Quaternary Reach: C60A-2607** | | | | **River Name** | **Vals River** |
| **Strahler order** | 2 | **Modifications** | | | |
| **Present Ecological State** | Class C | • Roads<br>• instream dam<br>• dams in tributaries<br>• agriculture<br>• Eutrophication | | | |
| **Ecological Importance** | High | | | | |
| **Ecological Sensitivity** | High | | | | |
| **Water Quality** | | | | | |
| **pH** | **Conductivity (µS/cm)** | **DO (mg/l)** | **Temperature (°C)** | | |
| 7.79 | 905 | 4.67 | 23.1 | | |
| **Habitat** | | | | | |
| **Geoclass** | Class E – Lowland river | **WMA** | Vaal | **Ecoregion** | Highveld |
| **Habitat integrity (IHIA)** | **Riparian** | **Instream** | | | |
| | Class D | Class D | | | |
| **Biotope Rating X/45** | **12.5** | **Comment** | | | |
| | | Site dominated by mud, marginal vegetation, undercut banks, and limited stones out of current | | | |
| **Macroinvertebrate Assessment** | | | | | |
| **SASS5 Score** | **No. of Taxa** | **ASPT** | **Ecological category (Dallas 2007)** | | |
| 78 | 18 | 4.3 | Class C | | |
| **Fish Community Assessment** | | | | | |
| **Species collected (IUCN Status)** | | **Species of Conservational Concern** | 0 | | |
| No fish collected at site | | | | | |
| **Discussion** | | | | | |
| Limited flow at site due to upstream impoundment. Moderately modified biotic community. Largely modified habitat integrity due to flow, sedimentation and water quality modifications. Meandering system with large floodplain, follow wetland delineation and prescribed buffer. | | | | | |

*Table 64: Summary of the aquatic system sampled at site 144*

| Site Code | 144 | Priority | 1 | Sample Date | 05/11/2019 |
|---|---|---|---|---|---|
| **Upstream** | | | | **Downstream** | |
|  | | | |  | |
| **Coordinates** | | | | 28°12'27.97"S | 28°21'48.61"E |
| **Desktop data for the Sub-Quaternary Reach: C83C-2847** | | | | **River Name** | **Liebenbergsvlei River** |
| **Strahler Order** | 3 | **Modifications**<br>• Erosion<br>• Livestock<br>• Sewage<br>• Alien vegetation<br>• Increased flows | | | |
| **Present Ecological State** | Class E | | | | |
| **Ecological Importance** | Low | | | | |
| **Ecological Sensitivity** | High | | | | |
| **Water Quality** | | | | | |
| **pH** | **Conductivity (µS/cm)** | **DO (mg/l)** | **Temperature (°C)** | | |
| * | 110 | 4.75 | 18.4 | | |
| **Habitat** | | | | | |
| **Geoclass** | Class E – Lowland river | **WMA** | Upper Vaal | **Ecoregion** | Eastern Escarpment Mountains |
| **Habitat integrity (IHIA)** | **Riparian** | **Instream** | | | |
| | Class C | Class D | | | |
| **Biotope Rating X/45** | **8** | **Comment** | | | |
| | | Site dominated by sand and marginal vegetation. | | | |
| **Macroinvertebrate Assessment** | | | | | |
| **SASS5 Score** | **No. of Taxa** | **ASPT** | **Ecological category (Dallas 2007)** | | |
| 54 | 14 | 3.9 | Class D | | |
| **Fish Community Assessment** | | | | | |
| **Species collected (IUCN Status)** | | **Species of Conservational Concern** | 0 | | |
| No Fish collected | | | | | |
| **Discussion** | | | | | |
| Extensive channel modification and erosion has limited instream habitat diversity. Modified habitat integrity and biotic community. Follow wetland delineation and prescribed buffer. | | | | | |

*Table 65: Summary of the aquatic system sampled at site 158*

| Site Code | 158 | Priority | 3 | Sample Date | 05/11/2019 |
|---|---|---|---|---|---|
| **Upstream** | | | | **Downstream** | |
|  | | | |  | |
| **Coordinates** | | | | 28°13'27.93"S | 28°32'29.91" |
| **Desktop data for the Sub-Quaternary Reach: C83D-2806** | | | | **River Name** | **Kalkoenspruit River** |
| **Strahler Order** | 1 | **Modifications** | | | |
| **Present Ecological State** | Class C | • Small area cultivation,<br>• Excessive nutrients,<br>• abandoned lands,<br>• road crossings | | | |
| **Ecological Importance** | Moderate | | | | |
| **Ecological Sensitivity** | High | | | | |
| **Water Quality** | | | | | |
| **pH** | **Conductivity (µS/cm)** | **DO (mg/l)** | **Temperature (°C)** | | |
| * | 341 | 3.82 | 20.2 | | |
| **Habitat** | | | | | |
| **Geoclass** | Class D – Lowland river | **WMA** | Upper Vaal | **Ecoregion** | Eastern Escarpment Mountains |
| **Habitat integrity (IHIA)** | **Riparian** | | **Instream** | | |
| | Class B | | Class B | | |
| **Biotope Rating X/45** | **11.5** | **Comment** | | | |
| | | Site dominated by stones out of current current, with marginal and aquatic vegetation. | | | |
| **Macroinvertebrate Assessment** | | | | | |
| **SASS5 Score** | **No. of Taxa** | **ASPT** | **Ecological category (Dallas 2007)** | | |
| 123 | 24 | 5.1 | Class C | | |
| **Fish Community Assessment** | | | | | |
| **Species collected (IUCN Status)** | | **Species of Conservational Concern** | 0 | | |
| *Enteromius anoplus* (LC) | | | | | |
| **Discussion** | | | | | |
| No flow observed during the survey within the reach. Habitat limited to a standing pool with stones and mud substrate. No access to site, sampled upstream at road crossing. Channelled valley-bottom wetland, follow wetland delineation and prescribed buffer. Kalkoenspruit runs parallel and classed unchanneled valley-bottom wetland (Sites 156 and 157). | | | | | |

*Table 66: Summary of the aquatic system sampled at site 177*

| Site Code | 177 | Priority | 1 | Sample Date | 05/11/2019 |
|---|---|---|---|---|---|
| Upstream | | | | Downstream | |
|  | | | |  | |
| Coordinates | | | | 28°16'47.18"S | 28°51'54.78"E |
| Desktop data for the Sub-Quaternary Reach: C81H-2894 | | | | River Name | Elands River |
| Strahler order | 3 | Modifications | | | |
| Present Ecological State | Class B | • Erosion<br>• Livestock<br>• Alien vegetation<br>• Agriculture | | | |
| Ecological Importance | High | | | | |
| Ecological Sensitivity | High | | | | |
| Water Quality | | | | | |
| pH | Conductivity (µS/cm) | DO (mg/l) | Temperature (°C) | | |
| * | 509 | 4.8 | 22.0 | | |
| Habitat | | | | | |
| Geoclass | Class E – Lowland river | WMA | Upper Vaal | Ecoregion | Eastern Escarpment Mountains |
| Habitat integrity (IHIA) | Riparian | Instream | | | |
| | Class C | Class C | | | |
| Biotope Rating X/45 | 7 | Comment | | | |
| | | Site dominated by marginal and aquatic vegetation, no observable flow, mud substrate | | | |
| Macroinvertebrate Assessment | | | | | |
| SASS5 Score | No. of Taxa | ASPT | Ecological category (Dallas 2007) | | |
| 46 | 12 | 3.8 | Class D | | |
| Fish Community Assessment | | | | | |
| Species collected (IUCN Status) | | Species of Conservational Concern | 0 | | |
| No fish collected | | | | | |
| Discussion | | | | | |
| Barely perceptible flow at site. Eroded banks and eutrophic conditions as indicated by excess algae. Combination of channelled valley-bottom and a large floodplain adjacent to the Elands River. Follow wetland delineation and prescribed buffer. | | | | | |

*Table 67: Summary of the aquatic system sampled at site 189*

| Site Code | 189 | Priority | 1 | Sample Date | 05/11/2019 |
|---|---|---|---|---|---|
| **Upstream** | | | | **Downstream** | |
|  | | | |  | |
| **Coordinates** | | | | 28°19'36.56"S | 29° 5'32.96"E |
| **Desktop data for the Sub-Quaternary Reach: C81E-2930** | | | | **River Name** | **Nuwejaarspuit River** |
| **Strahler Order** | 2 | **Modifications** | | | |
| **Present Ecological State** | Class C | • Channelization<br>• Inundation<br>• Livestock<br>• Alien vegetation | | | |
| **Ecological Importance** | Moderate | | | | |
| **Ecological Sensitivity** | High | | | | |
| **Water Quality** | | | | | |
| **pH** | **Conductivity (µS/cm)** | **DO (mg/l)** | **Temperature (°C)** | | |
| * | 111 | 4.26 | 25.4 | | |
| **Habitat** | | | | | |
| **Geoclass** | Class E – Lowland river | **WMA** | Vaal | **Ecoregion** | Highveld |
| **Habitat integrity (IHIA)** | **Riparian** | **Instream** | | | |
| | Class C | Class D | | | |
| **Biotope Rating X/45** | **7** | **Comment** | | | |
| | | Site characterised as slow deep moving waters with marginal vegetation, substrate was limited to mud and detritus | | | |
| **Macroinvertebrate Assessment** | | | | | |
| **SASS5 Score** | **No. of Taxa** | **ASPT** | **Ecological category (Dallas 2007)** | | |
| 118 | 23 | 5.1 | Class B | | |
| **Fish Community Assessment** | | | | | |
| **Species collected (IUCN Status)** | | **Species of Conservational Concern** | 0 | | |
| *Cyprinus carpio* | | | | | |
| **Discussion** | | | | | |
| Channelized system, and pushback from downstream impoundment has flooded instream habitat. A large floodplain occurs either side of the channel. A largely intact (class B) macroinvertebrate community was collected, however, taxa with a preference to cobbles and flow were absent from the site. A single exotic fish species was collected. Due to the large floodplain, a low risk to the riverine system is expected. | | | | | |

*Table 68: Summary of the aquatic system sampled at site 192*

| Site Code | 192 | Priority | 1 | Sample Date | 05/11/2019 |
|---|---|---|---|---|---|
| **Upstream** | | | | **Downstream** | |
|  | | | |  | |
| **Coordinates** | | | | 28°20'6.34"S | 29° 8'29.15"E |
| **Desktop data for the Sub-Quaternary Reach: C81B-2864** | | | | **River Name** | **Wilge River** |
| **Strahler Order** | 2 | **Modifications**<br>• Erosion<br>• Livestock<br>• Alien vegetation<br>• Sedimentation | | | |
| **Present Ecological State** | Class D | | | | |
| **Ecological Importance** | High | | | | |
| **Ecological Sensitivity** | High | | | | |
| **Water Quality** | | | | | |
| **pH** | **Conductivity (µS/cm)** | **DO (mg/l)** | **Temperature (°C)** | | |
| * | 190.7 | 5.44 | 27.4 | | |
| **Habitat** | | | | | |
| **Geoclass** | Class F – Lowland river | **WMA** | Vaal | **Ecoregion** | Highveld |
| **Habitat integrity (IHIA)** | **Riparian** | **Instream** | | | |
| | Class D | Class D | | | |
| **Biotope Rating X/45** | **5** | **Comment**<br>No flow, dominated by bedrock and mud substrate. Limited habitat diversity. | | | |
| **Macroinvertebrate Assessment** | | | | | |
| **SASS5 Score** | **No. of Taxa** | **ASPT** | **Ecological category (Dallas 2007)** | | |
| 34 | 10 | 3.4 | Class E/F | | |
| **Fish Community Assessment** | | | | | |
| **Species collected (IUCN Status)** | | | **Species of Conservational Concern** | 0 | |
| *Cyprinus carpio (Exotic)*<br>*Labeo capensis (LC)*<br>*Labeobarbus aeneus (LC)*<br>*Clarias gariepinus (LC)* | | | | | |
| **Discussion** | | | | | |
| Modified riparian and instream habitat was observed during the survey. No flow and limited instream habitat diversity limited the macroinvertebrate community, resulting in a seriously modified ecological category. Four fish species were collected, however, no species of conservational concern. | | | | | |

*Table 69: Summary of the aquatic system sampled at site 204*

| Site Code | 204 | Priority | 1 | Sample Date | 05/11/2019 |
|---|---|---|---|---|---|
| **Upstream** | | | | **Downstream** | |
|  | | | |  | |
| **Co-ordinate** | | | | 28°20'57.70"S | 29°12'57.25"E |
| **Desktop data for the Sub-Quaternary Reach: C81B-2864** | | | | **River Name** | **Wilge River** |
| **Strahler Order** | 2 | **Modifications**<br>• Erosion<br>• Excessive algae<br>• Livestock<br>• Alien vegetation<br>• No flow | | | |
| **Present Ecological State** | Class D | | | | |
| **Ecological Importance** | High | | | | |
| **Ecological Sensitivity** | High | | | | |
| **Water Quality** | | | | | |
| **pH** | **Conductivity (µS/cm)** | **DO (mg/l)** | **Temperature (°C)** | | |
| * | 127 | 4.97 | 27.2 | | |
| **Habitat** | | | | | |
| **Geoclass** | Class F – Lowland river | **WMA** | Vaal | **Ecoregion** | Highveld |
| **Habitat integrity (IHIA)** | **Riparian** | **Instream** | | | |
| | Class C | Class B | | | |
| **Biotope Rating X/45** | **18** | **Comment**<br>Site dominated by stones out of current and mud, with limited marginal and aquatic vegetation. Undercut banks with root systems provide diverse habitat | | | |
| **Macroinvertebrate Assessment** | | | | | |
| **SASS5 Score** | **No. of Taxa** | **ASPT** | **Ecological category (Dallas 2007)** | | |
| 183 | 32 | 5.7 | Class A | | |
| **Fish Community Assessment** | | | | | |
| **Species collected (IUCN Status)** | | **Species of Conservational Concern** | 0 | | |
| No Fish | | | | | |
| **Discussion** | | | | | |
| Diverse biotopes were available within the reach, despite absence of flow. A natural macroinvertebrate community was collected at the site, with 32 taxa collected. Flow modifications within the river resulted in the absence of flow in the reach. Livestock and agricultural activities have resulted in a modified riparian and instream habitat integrity. A large floodplain with oxbow lakes occurs within the reach. Follow wetland delineation and prescribed buffer. | | | | | |

*Table 70: Summary of the aquatic system sampled at site 230*

| Site Code | 230 | Priority | 2 | Sample Date | 06/11/2019 |
|---|---|---|---|---|---|
| **Upstream** | | | | **Downstream** | |
|  | | | |  | |
| **Coordinates** | | | | 28°24'22.81"S | 29°25'56.97"E |
| **Desktop data for the Sub-Quaternary Reach: V12D-2987** | | | | **River Name** | **Unnamed Tributary of the Sandspruit** |
| **Strahler Order** | 2 | **Modifications**<br>• Erosion<br>• Livestock and agriculture<br>• Instream impoundments<br>• Sedimentations | | | |
| **Present Ecological State** | Class C | | | | |
| **Ecological Importance** | High | | | | |
| **Ecological Sensitivity** | High | | | | |
| **Water Quality** | | | | | |
| **pH** | **Conductivity (µS/cm)** | **DO (mg/l)** | **Temperature (°C)** | | |
| 6.27 | 151 | 3.86 | 24.2 | | |
| **Habitat** | | | | | |
| **Geoclass** | Class D – Lowland river | **WMA** | Pongola-Mtamvuna | **Ecoregion** | North Eastern Uplands |
| **Habitat integrity (IHIA)** | **Riparian** | **Instream** | | | |
| | Class C | Class B | | | |
| **Biotope Rating X/45** | **18** | **Comment**<br>Diverse stones in and out of current, diverse marginal and aquatic vegetation. | | | |
| **Macroinvertebrate Assessment** | | | | | |
| **SASS5 Score** | **No. of Taxa** | **ASPT** | **Ecological category (Dallas 2007)** | | |
| 232 | 40 | 5.8 | Class A | | |
| **Fish Community Assessment** | | | | | |
| **Species collected (IUCN Status)** | | **Species of Conservational Concern** | 0 | | |
| *Enteromius anoplus* (LC) | | | | | |
| **Discussion** | | | | | |
| Moderate to largely natural habitat integrity. Good water quality and instream habitat diversity resulted in a natural macroinvertebrate community. A single fish species was collected. The narrow channel and size of the system resulted in a priority rating of 2. | | | | | |

*Table 71: Summary of the aquatic system sampled at site 261*

| Site Code | 261 | Priority | 1 | Sample Date | 06/11/2019 |
|---|---|---|---|---|---|
| Upstream | | | | Downstream | |
|  | | | |  | |
| Co-ordinate | | | | 28°30'54.20"S | 29°43'46.24" |
| Desktop data for the Sub-Quaternary Reach: V12F-3125 | | | | River Name | Klip River |
| Strahler Order | 3 | Modifications | | | |
| Present Ecological State | Class C | • Flow modifications<br>• Livestock<br>• Alien vegetation<br>• Windsor dam | | | |
| Ecological Importance | High | | | | |
| Ecological Sensitivity | High | | | | |
| Water Quality | | | | | |
| pH | Conductivity (µS/cm) | | | DO (mg/l) | Temperature (°C) |
| 8.08 | 331 | | | 5.06 | 29.8 |
| Habitat | | | | | |
| Geoclass | Class E – Lowland river | WMA | Pongola-Mtamvuna | Ecoregion | South Eastern Uplands |
| Habitat integrity (IHIA) | Riparian | | | Instream | |
| | Class C | | | Class B | |
| Biotope Rating X/45 | 10.5 | Comment | | | |
| | | Site dominated by gravel substrate, limited marginal vegetation | | | |
| Macroinvertebrate Assessment | | | | | |
| SASS5 Score | No. of Taxa | | | ASPT | Ecological category (Dallas 2007) |
| 179 | 31 | | | 5.8 | Class A |
| Fish Community Assessment | | | | | |
| Species collected (IUCN Status) | | | | Species of Conservational Concern | 0 |
| *Labeobarbus natalensis* (LC)<br>*Enteromius anoplus* (LC)<br>*Clarias gariepinus* (LC)<br>*Pseudocrenilabrus philander* (LC) | | | | | |
| Discussion | | | | | |
| Flow, riparian and instream modifications have resulted in a lower desktop PES of class C, however, according to biological bands, a natural macroinvertebrate community was collected. No fish species of conservational concern were collected in the reach. | | | | | |

*Table 72: Summary of the aquatic system sampled at site 270*

| Site Code | 270 | Priority | 1 | Sample Date | 06/11/2019 |
|---|---|---|---|---|---|
| **Upstream** | | | | **Downstream** | |
|  | | | |  | |
| **Co-ordinate** | | | | 28°30'54.20"S | 29°43'46.24" |
| **Desktop data for the Sub-Quaternary Reach: V12F-3125** | | | | **River Name** | **Klip River** |
| **Strahler Order** | 3 | **Modifications**<br>• Flow modifications<br>• Livestock<br>• Alien vegetation<br>• Sewage<br>• Urban runoff | | | |
| **Present Ecological State** | Class C | | | | |
| **Ecological Importance** | High | | | | |
| **Ecological Sensitivity** | High | | | | |
| **Water Quality** | | | | | |
| **pH** | **Conductivity (µS/cm)** | **DO (mg/l)** | **Temperature (°C)** | | |
| Not assessed | | | | | |
| **Habitat** | | | | | |
| **Geoclass** | Class E – Lowland river | **WMA** | Pongola-Mtamvuna | **Ecoregion** | South Eastern Uplands |
| **Habitat integrity (IHIA)** | **Riparian** | **Instream** | | | |
| | Class D | Class D | | | |
| **Biotope Rating X/45** | - | **Comment** | | | |
| | | Site dominated by sand substrate | | | |
| **Macroinvertebrate Assessment** | | | | | |
| **SASS5 Score** | **No. of Taxa** | **ASPT** | **Ecological category (Dallas 2007)** | | |
| Not assessed | | | | | |
| **Fish Community Assessment** | | | | | |
| **Species expected (IUCN Status)** | | **Species of Conservational Concern** | 0 | | |
| *Labeobarbus natalensis* (LC)<br>*Enteromius anoplus* (LC)<br>*Clarias gariepinus* (LC)<br>*Pseudocrenilabrus philander* (LC) | | | | | |
| **Discussion** | | | | | |
| No access to crossing point. Visual observation of reach. Riparian vegetation dominated by alien invasive species. Large mount of solid waste within the channel and deteriorated water quality due to urban runoff of a sewage. Follow wetland delineation and prescribed buffer. | | | | | |

*Table 73: Summary of the aquatic system sampled at site 298*

| Site Code | 298 | Priority | 1 | Sample Date | 07/11/2019 |
|---|---|---|---|---|---|
| Upstream | | | | Downstream | |
|  | | | |  | |
| Co-ordinate | | | | 28°41'58.56"S | 29°48'37.06"E |
| Desktop data for the Sub-Quaternary Reach: V14B-3296 | | | | River Name | Unnamed Tributary of the Thukela |
| Strahler Order | 3 | Modifications | | | |
| Present Ecological State | Class B | • Erosion<br>• Alien invasive vegetation | | | |
| Ecological Importance | High | | | | |
| Ecological Sensitivity | High | | | | |
| Water Quality | | | | | |
| pH | Conductivity (µS/cm) | DO (mg/l) | Temperature (°C) | | |
| Dry | | | | | |
| Habitat | | | | | |
| Geoclass | Class E – Lowland river | WMA | Pongola-Mtamvuna | Ecoregion | South Eastern Uplands |
| Habitat integrity (IHIA) | Riparian | Instream | | | |
| | Class B | Class B | | | |
| Biotope Rating X/45 | - | Comment | | | |
| | | Habitat dominated by bedrock and sand | | | |
| Macroinvertebrate Assessment | | | | | |
| SASS5 Score | No. of Taxa | ASPT | Ecological category (Dallas 2007) | | |
| Dry | | | | | |
| Fish Community Assessment | | | | | |
| Species collected (IUCN Status) | | Species of Conservational Concern | 0 | | |
| Dry | | | | | |
| Discussion | | | | | |
| System was dry during the survey. Within a nature reserve. Priority 1, follow wetland delineation and prescribed buffer. | | | | | |

*Table 74: Summary of the aquatic system sampled at site 306*

| Site Code | 306 | Priority | 1 | Sample Date | 07/11/2019 |
|---|---|---|---|---|---|
| Upstream | | | | Downstream | |
|  | | | |  | |
| Co-ordinate | | | | 28°44'33.59"S | 29°48'16.47"E |
| Desktop data for the Sub-Quaternary Reach: V14B-3296 | | | | River Name | Thukela |
| Strahler Order | 4 | Modifications | | | |
| Present Ecological State | Class C | • Road crossings<br>• agriculture from canal<br>• gauging weir<br>• small sand mining operations | | | |
| Ecological Importance | High | | | | |
| Ecological Sensitivity | High | | | | |
| Water Quality | | | | | |
| pH | Conductivity (µS/cm) | DO (mg/l) | Temperature (°C) | | |
| 7.11 | 81.2 | 5.5 | 25.2 | | |
| Habitat | | | | | |
| Geoclass | Class F – Lowland river | WMA | Pongola-Mtamvuna | Ecoregion | North Eastern Uplands |
| Habitat integrity (IHIA) | Riparian | Instream | | | |
| | Class C | Class B | | | |
| Biotope Rating X/45 | 25 | Comment | | | |
| | | Diverse biotopes within the system. | | | |
| Macroinvertebrate Assessment | | | | | |
| SASS5 Score | No. of Taxa | ASPT | Ecological category (Dallas 2007) | | |
| 200 | 34 | 5.9 | B | | |
| Fish Community Assessment | | | | | |
| Species collected (IUCN Status) | | Species of Conservational Concern | 0 | | |
| No fish collected | | | | | |
| Discussion | | | | | |
| Large lowland river with diverse instream habitat. Largely natural macroinvertebrate community. Riparian vegetation dominated by alien invasive species. Extensive agricultural activities within the reach. Follow riparian delineation and buffer. | | | | | |

*Table 75: Summary of the aquatic system sampled at site 315*

| Site Code | 315 | Priority | 1 | Sample Date | 07/11/2019 |
|---|---|---|---|---|---|
| **Upstream** | | | | **Downstream** | |
|  | | | |  | |
| **Co-ordinate** | | | | 28°51'38.08"S | 29°49'2.96"E |
| **Desktop data for the Sub-Quaternary Reach: V14D-3374** | | | | **River Name** | **Bloukrans** |
| **Strahler Order** | 2 | **Modifications**<br>• Road crossings,<br>• sediments from upper reaches,<br>• dams in tributaries. | | | |
| **Present Ecological State** | Class B | | | | |
| **Ecological Importance** | High | | | | |
| **Ecological Sensitivity** | High | | | | |
| **Water Quality** | | | | | |
| **pH** | **Conductivity (µS/cm)** | **DO (mg/l)** | **Temperature (°C)** | | |
| 8.43 | 674 | 4.8 | 32.4 | | |
| **Habitat** | | | | | |
| **Geoclass** | Class D – Upper Foothills | **WMA** | Pongola-Mtamvuna | **Ecoregion** | North Eastern Uplands |
| **Habitat integrity (IHIA)** | **Riparian** | | **Instream** | | |
| | Class B | | Class B | | |
| **Biotope Rating X/45** | **9** | **Comment** | | | |
| | | Site dominated by bedrock and mud substrate | | | |
| **Macroinvertebrate Assessment** | | | | | |
| **SASS5 Score** | **No. of Taxa** | **ASPT** | **Ecological category (Dallas 2007)** | | |
| 68 | 16 | 4.13 | **E/F** | | |
| **Fish Community Assessment** | | | | | |
| **Species collected (IUCN Status)** | | **Species of Conservational Concern** | 1 | | |
| *Clarias gariepinus*<br>*Labeo rubromaculatus* (VU) | | | | | |
| **Discussion** | | | | | |
| Characterised as a channelled valley-bottom with adjacent floodplain. A largely natural instream and riparian habitat occurs within the reach, however the biotic community was rated as seriously modified, likely due to flow modifications within the reach. A single fish species of conservational concern was collected, *Labeo rubromaculatus,* which is listed as Vulnerable. The proposed activities pose a risk a low to the fish community within the Bloukransriver. | | | | | |

*Table 76: Summary of the aquatic system sampled at site 332*

| Site Code | 332 | Priority | 1 | Sample Date | 07/11/2019 |
|---|---|---|---|---|---|
| **Upstream** | | | | **Downstream** | |
|  | | | |  | |
| **Co-ordinate** | | | | 28°59'1.05"S | 29°54'36.38"E |
| **Desktop data for the Sub-Quaternary Reach: V70F-3623** | | | | **River Name** | **Unnamed Tributary of the Boesmans** |
| **Strahler Order** | 2 | **Modifications**<br>• Bank erosion<br>• Livestock<br>• Instream sedimentation | | | |
| **Present Ecological State** | Class C | | | | |
| **Ecological Importance** | High | | | | |
| **Ecological Sensitivity** | High | | | | |
| **Water Quality** | | | | | |
| **pH** | **Conductivity (µS/cm)** | **DO (mg/l)** | **Temperature (°C)** | | |
| 7.92 | 745 | 6.17 | 28.1 | | |
| **Habitat** | | | | | |
| **Geoclass** | Class E – Lower foothills | **WMA** | Pongola-Mtamvuna | **Ecoregion** | South Eastern Uplands |
| **Habitat integrity (IHIA)** | **Riparian** | **Instream** | | | |
| | Class B | Class B | | | |
| **Biotope Rating X/45** | **23** | **Comment** | | | |
| | | Site characterised by a single standing pool, substrate gravel and sand | | | |
| **Macroinvertebrate Assessment** | | | | | |
| **SASS5 Score** | **No. of Taxa** | **ASPT** | **Ecological category (Dallas 2007)** | | |
| 76 | 15 | 5.1 | E/F | | |
| **Fish Community Assessment** | | | | | |
| **Species collected (IUCN Status)** | | **Species of Conservational Concern** | 0 | | |
| - | | | | | |
| **Discussion** | | | | | |
| Ephemeral system. Standing pools present during the survey. Largely natural habitat integrity within the reach. However, seriously modified macroinvertebrate community, predominantly tolerant taxa collected within refuge areas. | | | | | |

*Table 77: Summary of the aquatic system sampled at site 339*

| Site Code | 339 | Priority | 1 | Sample Date | 08/11/2019 |
|---|---|---|---|---|---|
| **Upstream** | | | | **Downstream** | |
|  | | | |  | |
| **Co-ordinate** | | | | **28°41'58.56"S** | **29°48'37.06"E** |
| **Desktop data for the Sub-Quaternary Reach: V14B-3296** | | | | **River Name** | Boesmans River |
| **Strahler Order** | 4 | **Modifications**<br>• Estcourt WWTWs, Alien invasive plants,<br>• road crossing,<br>• small sand mining operation,<br>• irrigation in lower reaches | | | |
| **Present Ecological State** | Class C | | | | |
| **Ecological Importance** | High | | | | |
| **Ecological Sensitivity** | High | | | | |
| **Water Quality** | | | | | |
| **pH** | **Conductivity (µS/cm)** | **DO (mg/l)** | **Temperature (°C)** | | |
| - | 127.2 | 3.74 | 19.5 | | |
| **Habitat** | | | | | |
| **Geoclass** | Class E – Lower foothills | **WMA** | Pongola-Mtamvuna | **Ecoregion** | North Eastern Uplands |
| **Habitat integrity (IHIA)** | **Riparian** | | **Instream** | | |
| | Class C | | Class C | | |
| **Biotope Rating X/45** | 14 | **Comment** | | | |
| | | Site dominated by bedrock and marginal vegetation in current | | | |
| **Macroinvertebrate Assessment** | | | | | |
| **SASS5 Score** | **No. of Taxa** | **ASPT** | **Ecological category (Dallas 2007)** | | |
| 44 | 12 | 3.7 | **E/F** | | |
| **Fish Community Assessment** | | | | | |
| **Species collected (IUCN Status)** | | **Species of Conservational Concern** | 0 | | |
| No fish collected | | | | | |
| **Discussion** | | | | | |
| Extensive sewage present at the site resulting in modified water quality and critically modified biotic community. Modified instream and habitat integrity within the reach. | | | | | |

*Table 78: Summary of the aquatic system sampled at site 371*

| Site Code | 371 | Priority | 1 | Sample Date | 08/11/2019 |
|---|---|---|---|---|---|
| **Upstream** | | | | **Downstream** | |
|  | | | |  | |
| **Co-ordinate** | | | | 29°11'1.91"S | 30° 3'4.14"E |
| **Desktop data for the Sub-Quaternary Reach: V20E-3884** | | | | **River Name** | **Mooi River** |
| **Strahler Order** | 4 | **Modifications**<br>• Start in Mearns weir,<br>• irrigation,<br>• roads,<br>• textile factory<br>• WWTWs,<br>• gauging weir,<br>• urban (Mooiriver & surrounding),<br>• dairy farming | | | |
| **Present Ecological State** | Class C | | | | |
| **Ecological Importance** | High | | | | |
| **Ecological Sensitivity** | Very High | | | | |
| **Water Quality** | | | | | |
| **pH** | **Conductivity (µS/cm)** | **DO (mg/l)** | **Temperature (°C)** | | |
| - | 136.6 | 6.35 | 17.5 | | |
| **Habitat** | | | | | |
| **Geoclass** | Class E – Lower foothills | **WMA** | Pongola-Mtamvuna | **Ecoregion** | North Eastern Uplands |
| **Habitat integrity (IHIA)** | **Riparian** | **Instream** | | | |
| | Class C | Class B | | | |
| **Biotope Rating X/45** | 22 | **Comment**<br>Diverse instream habitat. Diverse stones in current, aquatic and marginal vegetation | | | |
| **Macroinvertebrate Assessment** | | | | | |
| **SASS5 Score** | **No. of Taxa** | **ASPT** | **Ecological category (Dallas 2007)** | | |
| 192 | 38 | 5.1 | **B** | | |
| **Fish Community Assessment** | | | | | |
| **Species collected (IUCN Status)** | | **Species of Conservational Concern** | 0 | | |
| *Micropterus salmoides*<br>*Lepomis macrochirus* | | | | | |
| **Discussion** | | | | | |
| Diverse instream habitat was present at the site. Modifications to the reach included water quality and alien invasive vegetation within marginal and riparian zones. A largely intact macroinvertebrate community was collected, and two exotic fish species. | | | | | |

*Table 79: Summary of the aquatic system sampled at site 420*

| Site Code | 420 | Priority | 1 | Sample Date | 10/11/2019 |
|---|---|---|---|---|---|
| **Upstream** | | | | **Downstream** | |
|  | | | |  | |
| **Co-ordinate** | | | | **29°29'24.81"S** | **30°12'26.00"E** |
| **Desktop data for the Sub-Quaternary Reach: U20E-4340** | | | | **River Name** | **Umgeni** |
| **Strahler Order** | 3 | **Modifications** | | | |
| **Present Ecological State** | Class C | • Upper part in Midmar Dam, Howick, industrial, Howick falls, Howick WWTW, AIP in riparian zone, informal areas, dryland agric. Sakabula Stream and Riet not digitised. | | | |
| **Ecological Importance** | High | | | | |
| **Ecological Sensitivity** | High Very | | | | |
| **Water Quality** | | | | | |
| **pH** | **Conductivity (µS/cm)** | **DO (mg/l)** | **Temperature (°C)** | | |
| | **74.6** | **5.11** | **16.9** | | |
| **Habitat** | | | | | |
| **Geoclass** | Class E – Lower foothills | **WMA** | Pongola-Mtamvuna | **Ecoregion** | South Eastern Uplands |
| **Habitat integrity (IHIA)** | **Riparian** | | **Instream** | | |
| | Class C | | Class D | | |
| **Biotope Rating X/45** | **6.5** | **Comment** | | | |
| | | Sampling limited to marginal vegetation and mud substrate. | | | |
| **Macroinvertebrate Assessment** | | | | | |
| **SASS5 Score** | **No. of Taxa** | **ASPT** | **Ecological category (Dallas 2007)** | | |
| **65** | **14** | **4.6** | **E/F** | | |
| **Fish Community Assessment** | | | | | |
| **Species collected (IUCN Status)** | | **Species of Conservational Concern** | 0 | | |
| *Gambusia affinis* (Exotic) | | | | | |
| **Discussion** | | | | | |
| Channelized reach of the Umgeni River. Sampling limited to marginal zones. Seriously modified macroinvertebrate community collected. Habitat integrity rated as moderately to largely modified. Extensive wetlands adjacent to the channel, follow wetland delineation and prescribed buffer. | | | | | |

*Table 80: Summary of the aquatic system sampled at site 437*

| Site Code | 437 | Priority | 1 | Sample Date | 10/11/2019 |
|---|---|---|---|---|---|
| Upstream | | | | Downstream | |
|  | | | |  | |
| Co-ordinate | | | | 29°36'6.06"S | 30°24'28.75"E |
| Desktop data for the Sub-Quaternary Reach: U20J-4364 | | | | River Name | uMnsunduze |
| Strahler Order | 4 | Modifications | | | |
| Present Ecological State | Class E | • Campsdrift, weir without fish ladder, industries, stormwater runoff, urban, road crossings, Dorpspruit, settlements, WWTW (Darvill) return flows, Bainspruit (pollution), oil industry, chicken farms | | | |
| Ecological Importance | Moderate | | | | |
| Ecological Sensitivity | Very High | | | | |
| Water Quality | | | | | |
| pH | Conductivity (µS/cm) | DO (mg/l) | Temperature (°C) | | |
| - | 242 | 5.34 | 22.9 | | |
| Habitat | | | | | |
| Geoclass | Class E – Lower foothills | WMA | Pongola-Mtamvuna | Ecoregion | South Eastern Uplands |
| Habitat integrity (IHIA) | Riparian | Instream | | | |
| | Class C | Class B | | | |
| Biotope Rating X/45 | 23 | Comment | | | |
| | | Site dominated by stones in current, with limited marginal and aquatic vegetation. | | | |
| Macroinvertebrate Assessment | | | | | |
| SASS5 Score | No. of Taxa | ASPT | Ecological category (Dallas 2007) | | |
| 37 | 9 | 4.1 | E/F | | |
| Fish Community Assessment | | | | | |
| Species collected (IUCN Status) | | Species of Conservational Concern | 0 | | |
| No fish collected | | | | | |
| Discussion | | | | | |
| modifications to the reach include urban runoff, solid waste disposal and alien vegetation encroachment into the riparian zone. Diverse instream habitat was present at the site, indicating water quality deterioration has impacted on the biotic integrity of the reach, resulting in a class E/F ecological category. | | | | | |

*Table 81: Summary of the aquatic system sampled at site 468*

| Site Code | 468 | Priority | 1 | Sample Date | 09/11/2019 |
|---|---|---|---|---|---|
| Upstream | | | | Downstream | |
|  | | | |  | |
| Co-ordinate | | | | 29°37'7.24"S | 30°27'14.66"E |
| Desktop data for the Sub-Quaternary Reach: V14B-3296 | | | | River Name | uMnsunduze |
| Strahler Order | 4 | Modifications | | | |
| Present Ecological State | Class E | • Campsdrift, weir without fish ladder, industries, stormwater runoff, urban, road crossings, Dorpspruit, settlements, WWTW (Darvill) return flows, Bainspruit (pollution), oil industry, chicken farms | | | |
| Ecological Importance | Moderate | | | | |
| Ecological Sensitivity | Very High | | | | |
| Water Quality | | | | | |
| pH | Conductivity (µS/cm) | | DO (mg/l) | | Temperature (°C) |
| - | 388 | | 4.38 | | 23.5 |
| Habitat | | | | | |
| Geoclass | Class E – Lowland river | WMA | Pongola-Mtamvuna | Ecoregion | South Eastern Uplands |
| Habitat integrity (IHIA) | Riparian | | Instream | | |
| | Class C | | Class B | | |
| Biotope Rating X/45 | 23 | Comment | | | |
| | | Site dominated by stones in current, with limited marginal and aquatic vegetation. | | | |
| Macroinvertebrate Assessment | | | | | |
| SASS5 Score | No. of Taxa | | ASPT | | Ecological category (Dallas 2007) |
| 26 | 8 | | 3.3 | | Class E/F |
| Fish Community Assessment | | | | | |
| Species collected (IUCN Status) | | | Species of Conservational Concern | | 0 |
| No fish collected | | | | | |
| Discussion | | | | | |
| Site 468 was sampled upstream at the road crossing. Water quality deterioration within the reach has resulted in a critically modified macroinvertebrate community. Several instream impoundments have resulted in flow and habitat modifications. Pipeline access should follow the riparian delineation and applicable buffer. | | | | | |

*Table 82: Summary of the aquatic system sampled at site 471*

| Site Code | 471 | Priority | 1 | Sample Date | 09/11/2019 |
|---|---|---|---|---|---|
| **Upstream** | | | | **Downstream** | |
|  | | | |  | |
| **Co-ordinate** | | | | **28°41'58.56"S** | **29°48'37.06"E** |
| **Desktop data for the Sub-Quaternary Reach: U20J-4488** | | | | **River Name** | Unnamed Tributary of the uMnsunduze |
| **Strahler Order** | 3 | **Modifications**<br>• Erosion<br>• Livestock<br>• Sewage<br>• Alien vegetation | | | |
| **Present Ecological State** | Class C | | | | |
| **Ecological Importance** | High | | | | |
| **Ecological Sensitivity** | High | | | | |
| **Water Quality** | | | | | |
| **pH** | **Conductivity (µS/cm)** | **DO (mg/l)** | **Temperature (°C)** | | |
| **-** | **857** | **2.75** | **21.2** | | |
| **Habitat** | | | | | |
| **Geoclass** | Class E – Lowland river | **WMA** | Pongola-Mtamvuna | **Ecoregion** | South Eastern Uplands |
| **Habitat integrity (IHIA)** | **Riparian** | **Instream** | | | |
| | Class C | Class C | | | |
| **Biotope Rating X/45** | 9 | **Comment** | | | |
| | | Site dominated by stones in current, with limited marginal and aquatic vegetation. | | | |
| **Macroinvertebrate Assessment** | | | | | |
| **SASS5 Score** | **No. of Taxa** | **ASPT** | **Ecological category (Dallas 2007)** | | |
| 87 | 22 | 4.0 | **E/F** | | |
| **Fish Community Assessment** | | | | | |
| **Species collected (IUCN Status)** | | **Species of Conservational Concern** | 0 | | |
| No fish collected | | | | | |
| **Discussion** | | | | | |
| Ephemeral system, characterised by a standing pool during the survey. Reach dominated by sandy substrate and aquatic vegetation. Seriously modified macroinvertebrate community collected. | | | | | |

*Table 83: Summary of the aquatic system sampled at site 480*

| | | | |
|---|---|---|---|
| **Site Code** | 480 | **Sample Date** | 09/11/2019 |
| **Upstream** | | **Downstream** | |
|  | |  | |
| **Co-ordinate** | | 29°41'27.03"S | 30°30'50.26"E |
| **Desktop data for the Sub-Quaternary Reach: U20J-4488** | | **River Name** | **Unnamed Tributary of the Mshwati** |
| **Strahler Order** | 3 | **Modifications**<br>• Erosion<br>• Alien vegetation | |
| **Present Ecological State** | Class B | | |
| **Ecological Importance** | High | | |
| **Ecological Sensitivity** | Very High | | |
| **Water Quality** | | | |
| **pH** | **Conductivity (µS/cm)** | **DO (mg/l)** | **Temperature (°C)** |
| DRY | | | |
| **Habitat** | | | |
| **Geoclass** | Class E – Lowland river | **WMA** | Pongola-Mtamvuna |
| **Ecoregion** | South Eastern Uplands | | |
| **Habitat integrity (IHIA)** | **Riparian** | **Instream** | |
| | Class B | Class B | |
| **Biotope Rating X/45** | **N/A** | **Comment** | |
| | | Dry ephemeral system | |
| **Macroinvertebrate Assessment** | | | |
| **SASS5 Score** | **No. of Taxa** | **ASPT** | **Ecological category (Dallas 2007)** |
| DRY | | | |
| **Fish Community Assessment** | | | |
| **Species collected (IUCN Status)** | | **Species of Conservational Concern** | 0 |
| DRY | | | |
| **Discussion** | | | |
| Ephemeral system. No water present during the survey. Instream and riparian habitat integrity rated as largely natural. | | | |

*Table 84: Summary of the aquatic system sampled at site 483*

| | | | |
|---|---|---|---|
| **Site Code** | 483 | **Sample Date** | 09/11/2019 |
| **Upstream** | | **Downstream** | |
|  | |  | |
| **Co-ordinate** | | 29°41'27.03"S | 30°30'50.26"E |
| **Desktop data for the Sub-Quaternary Reach: U20J-4488** | | **River Name** | **Unnamed Tributary of the Mshwati** |
| **Strahler Order** | 3 | **Modifications**<br>• Erosion<br>• Alien vegetation | |
| **Present Ecological State** | Class B | | |
| **Ecological Importance** | High | | |
| **Ecological Sensitivity** | Very High | | |
| **Water Quality** | | | |
| **pH** | **Conductivity (µS/cm)** | **DO (mg/l)** | **Temperature (°C)** |
| DRY | | | |
| **Habitat** | | | |
| **Geoclass** | Class E – Lowland river | **WMA** | Pongola-Mtamvuna |
| **Ecoregion** | South Eastern Uplands | | |
| **Habitat integrity (IHIA)** | **Riparian** | **Instream** | |
| | Class B | Class B | |
| **Biotope Rating X/45** | **N/A** | **Comment** | |
| | | Dry ephemeral system | |
| **Macroinvertebrate Assessment** | | | |
| **SASS5 Score** | **No. of Taxa** | **ASPT** | **Ecological category (Dallas 2007)** |
| DRY | | | |
| **Fish Community Assessment** | | | |
| **Species collected (IUCN Status)** | | **Species of Conservational Concern** | 0 |
| DRY | | | |
| **Discussion** | | | |
| Ephemeral system. No water present during the survey. Instream and riparian habitat integrity rated as largely natural. | | | |

*Table 85: Summary of the aquatic system sampled at site 530*

| Site Code | 530 | Sample Date | 09/11/2019 |
|---|---|---|---|
| **Upstream** | | **Downstream** | |
|  | |  | |
| **Co-ordinate** | | 29°51'28.53"S | 30°53'55.50"E |
| **Desktop data for the Sub-Quaternary Reach: U60F-4632** | | **River Name** | **Umbilo** |
| **Strahler Order** | 2 | **Modifications**<br>• Residential (Pinetown), industrial area, Paradise Valley Nature Reserve, Alien invasive plants in riparian zone, quarry, into estuary. Mkhumbane River not digitised. | |
| **Present Ecological State** | Class D | | |
| **Ecological Importance** | High | | |
| **Ecological Sensitivity** | Very High | | |

| **Water Quality** | | | |
|---|---|---|---|
| **pH** | **Conductivity (µS/cm)** | **DO (mg/l)** | **Temperature (°C)** |
| | **328** | **5.02** | **23.1** |

| **Habitat** | | | | | |
|---|---|---|---|---|---|
| **Geoclass** | Class E – Lowland river | **WMA** | Pongola-Mtamvuna | **Ecoregion** | North Eastern Coastal Belt |
| **Habitat integrity (IHIA)** | **Riparian** | | **Instream** | | |
| | Class B | | Class B | | |
| **Biotope Rating X/45** | **16** | **Comment** | | | |
| | | Site dominated by stones in current, with diverse marginal vegetation. | | | |

| **Macroinvertebrate Assessment** | | | |
|---|---|---|---|
| **SASS5 Score** | **No. of Taxa** | **ASPT** | **Ecological category (Dallas 2007)** |
| **14** | **5** | **2.8** | **E/F** |

| **Fish Community Assessment** | | |
|---|---|---|
| **Species collected (IUCN Status)** | **Species of Conservational Concern** | 0 |
| *Poecilia reticulata (Exotic)* | | |

| **Discussion** |
|---|
| Perennial system. Instream and riparian habitat integrity rated as largely natural, however, extensive water quality deterioration due to sewage discharge resulted in a critically modified biotic integrity of the system. |

*Table 86: Summary of the aquatic system sampled at site 537*

| Site Code | 537 | Sample Date | 06/11/2019 |
|---|---|---|---|
| **Upstream** | | **Downstream** | |
|  | |  | |
| **Co-ordinate** | | **28°41'58.56"S** | **29°48'37.06"E** |
| **Desktop data for the Sub-Quaternary Reach: U60F-4632** | | **River Name** | **Umbilo** |
| **Strahler Order** | 3 | **Modifications**<br>• Residential (Pinetown), industrial area, Paradise Valley Nature Reserve, AIP in riparian zone, quarry, into estuary. Mkhumbane River not digitised. | |
| **Present Ecological State** | Class D | | |
| **Ecological Importance** | High | | |
| **Ecological Sensitivity** | Very High | | |

| **Water Quality** | | | |
|---|---|---|---|
| **pH** | **Conductivity (µS/cm)** | **DO (mg/l)** | **Temperature (°C)** |
| | **455** | **4.97** | **21.3** |

| **Habitat** | | | | | |
|---|---|---|---|---|---|
| **Geoclass** | Class E – Lowland river | **WMA** | Pongola-Mtamvuna | **Ecoregion** | North Eastern Coastal Belt |
| **Habitat integrity (IHIA)** | **Riparian** | | **Instream** | | |
| | Class C | | Class C | | |
| **Biotope Rating X/45** | **12** | | **Comment** | | |
| | | | Substrate dominated by sand. Diverse marginal vegetation | | |

| **Macroinvertebrate Assessment** | | | |
|---|---|---|---|
| **SASS5 Score** | **No. of Taxa** | **ASPT** | **Ecological category (Dallas 2007)** |
| **46** | **11** | **4.2** | **E/F** |

| **Fish Community Assessment** | | |
|---|---|---|
| **Species collected (IUCN Status)** | **Species of Conservational Concern** | 0 |
| *Poecilia reticulata (Exotic)* | | |

| **Discussion** |
|---|
| Instream habitat dominated by sand substrate, with diverse marginal vegetation. Low biotope diversity and water quality modifications have contributed to the seriously modified state of the macroinvertebrate community. A single fish species was collected at the site. |

# 9 Impact and Risk Assessment

Potential impacts were evaluated against the data captured during the fieldwork to identify relevance to the project area. It should be noted that the impacts described are not exhaustive, and more impacts may be identified at a later stage as more project specific information becomes available.

Mitigation measures were only applied to impacts deemed relevant based on the impact analysis. The standard impact assessment methodology may be used in the capture of generic anticipated impacts and potential mitigation measures for Basic Assessment Reports and Environmental Impact Assessment (EIA) Reports. The methodology described herein complies with the requirements of the EIA Regulations (2014), promulgated in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998). The methodology of impact assessment described herein must be used in relation to the Impact Assessment Rating Matrix Tool.

## 9.1 Impact Assessment Methodology

Each issue identified during the EIA process consists of components that on their own or in combination with each other give rise to potential impacts, either positive or negative from the project onto the environment or from the environment onto the project. The significance of the potential impacts for the project area will be considered before and after identified mitigation is implemented. The methodology provided by Hydroscience is described below, TBC included the sensitivity of the habitat to ensure the receiving environment is considered.

**Methodology**

The significance of the adverse environmental impacts identified were assessed in terms of their:

- Duration;
- Extent;
- Probability; and
- Severity.

The above was used to determine the significance of an impact without any mitigation, as well as with mitigation.

**Nature of an impact:** An impact's nature can be positive (+) or negative (-).

**Consequence:** Considers duration, extent and severity

Consequence = duration + extent + severity

*Table 87: Environmental risk and impact assessment criteria*

| | | |
|---|---|---|
| **DURATION (D)** | | |
| Immediate | Less than 1 month | 1 |
| Short-term | 2 - 24 months | 2 |
| Life of project | Decommissioning phase | 3 |
| Post-closure | Time of rehabilitation and for re-establishment of natural systems | 4 |
| Residual | A permanent impact (100 years or more) | 5 |
| **EXTENT (E)** | | |
| Site specific | Site of the proposed work | 1 |
| Local | Site and immediate surroundings (property) | 2 |
| Regional | Municipal area | 3 |
| Provincial | Provincial area | 4 |
| National | Republic of South Africa | 5 |
| **PROBABILITY (P)** | | |
| Rare | <5% probability of occurrence – may occur in exceptional circumstances | 1 |
| Unlikely | 15% - 6% probability of occurrence – could potentially occur at some time | 2 |
| Possible | 45% - 16% chance of occurrence – might occur at some time | 3 |
| Likely | 65% - 46% probability of occurrence – will probably occur in most circumstances | 4 |
| Almost Certain | 90% - 66% probability of occurrence – is expected to occur | 5 |
| Definite | 100%- will occur | 6 |
| **SEVERITY (S)** | | |
| Catastrophic (critical) | Total change in area of direct impact, relocation not an option, death, toxic release off-site with detrimental effects, irreversible loss, huge financial loss | 6 |
| Significant (High) | > 70% change in area of direct impact due to loss of significant aspect, extensive injuries, long term loss in capabilities, off-site release to high extent, major financial implications | 5 |
| Serious | 50 – 70% long-term loss, extensive rehabilitation / restoration / treatment required, high financial impact, still restricted in extent | 4 |
| Moderate (medium) | 20 – 49% change, medium term loss in capabilities, rehabilitation / restoration / treatment required, on-site release with outside assistance, medium financial impact | 3 |
| Minor | 10 – 19% change, short term impact that can be absorbed, on-site release, immediate containment, low financial implications | 2 |
| Insignificant (low) | < 10 % change in the area of impact, no financial implications, localised impact, a small percentage of population | 1 |

[Duration (D) + Extent (E) + Severity (S)] x Probability (P) = Impact Significance (IS)

| IMPACT SIGNIFICANCE (IS) | | |
|---|---|---|
| **Impact Significance** | **IS score range** | **Description** |
| **Low (L)** | <15 | The impact is minor or insubstantial; it is of little importance to any stakeholder and can easily be rectified. |
| **Moderate Low (ML)** | 16 - 45 | The impact is limited in extent, even if the intensity is major; the probability will only be likely, the impact will not have a significant impact considered in relation to the bigger picture; no major material effect on decisions and will require only small-scale management intervention bearing moderate costs. |
| **Moderate High (MH)** | 46 - 70 | The impact is significant to one or more stakeholders, and its intensity will be medium or high; therefore, the impact may materially affect the decision, and management intervention will be required. |
| **High (H)** | 71 < | The impact could render options controversial or the entire project unacceptable if it cannot be reduced to acceptable levels; and/or the cost of management intervention will be a significant factor in project decision-making. |

## 9.2 Current Impacts

The impacts identified during the survey that are having a negative impact in the project area were identified, and are listed below and can be seen in Figure 33 to Figure 35

- Agriculture, forestry and subsequent large-scale alteration of land use;
- Presence of alien and invasive plant species which have altered natural vegetation communities;
- Dumping of building litter and general waste;
- Existing infrastructure including roads and railways and also urbanisation which have had a myriad of associated impacts to local ecology;
- The existing pipeline servitude that it maintained and regularly monitored:
- National and Secondary road with the associated noise disturbance, road mortalities and human disturbances; and
- Telephone lines and power lines within the vicinity of the project area.

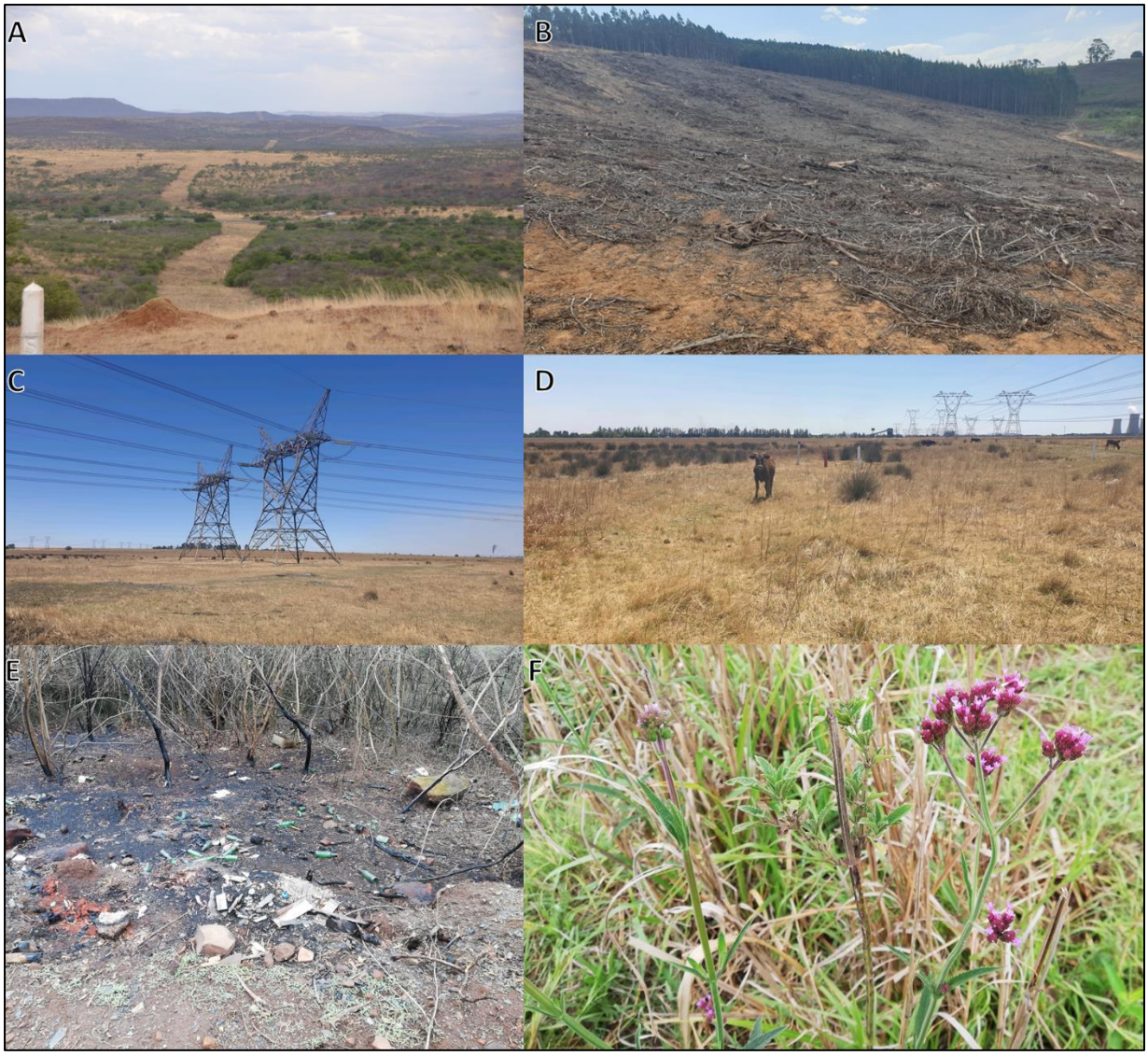



*Figure 33: Collage of some of the current impacts within the project area. A) Vegetation clearing as a result of the pipeline, B) Forestry, C) Powerlines, D) Cattle, E) Burning and F) Alien invasive plant species.*

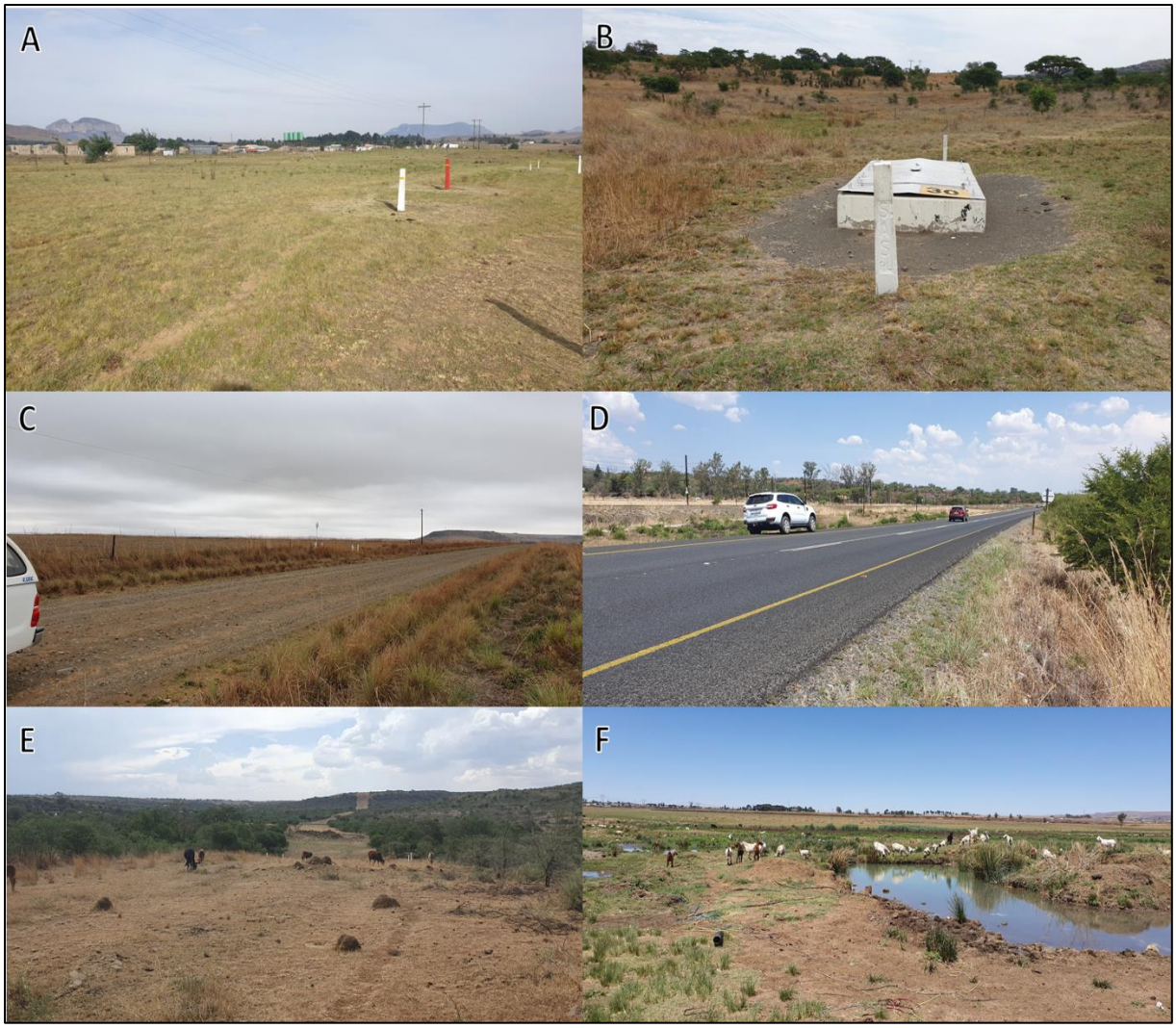



*Figure 34: Some of the impacts observed in and close to the pipe line; A) Urban and sub urban developments, B) Current block valve chamber of the pipeline, C) Secondary roads, D) National roads, E & F) Livestock*

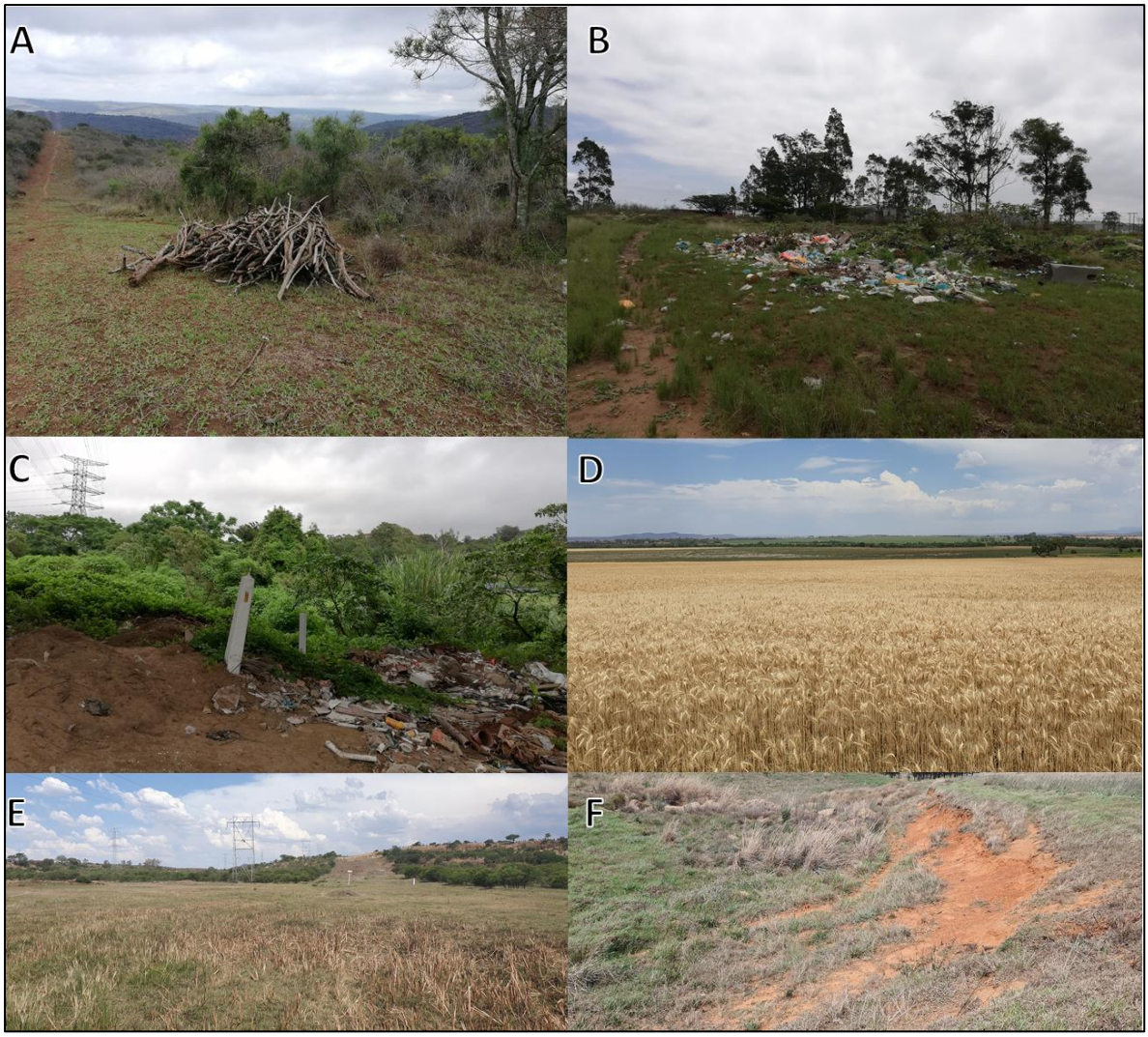



*Figure 35: Some of the impacts observed in and close to the pipeline; A) Wood harvesting, B) Litter, C) Building rubble, D) Agriculture, E) Exposed soil and F) Erosion.*

## 9.3 Impacts Assessment

### 9.3.1 Terrestrial Ecology Impacts

The proposed development is for the decommissioning of the underground pipeline and the associated structures, as well as selected depots. The proposed construction may result mainly in loss and alteration of habitats and displacement of fauna and flora:

The decommissioning of the pipeline will take place after the deactivation which involves the displacement of the product (removal of the product) and cleaning of the pipeline, thus resulting in no spillages. At the decommissioning phase the pipeline is classified as empty and clean. The pipeline will be left underground as this is deemed internationally as the most environmentally friendly option. The pipeline will be segmented and plugged to limit its ability to function as a conduit. Certain sections of the pipe will be filled with a wet sand mixture. At the areas where the pipe will be cut and filled a 4 m by 4 m hole will be excavated, while at the other end of the section of pipe a 2 m by 2 m hole will be opened. A contactors camp will also be set up next to the excavated hole. Both project areas will be fenced in. The pipe will be filled in areas where subsidence could be a problem, this includes river crossings, streams,

wetlands, roads and rail crossings. The estimate of total area disturbed at each point is 10 m by 10 m.

Along with the pipeline, selected depots will also be decommissioned (demolition and dismantling). The decommissioning includes the removal of all above ground infrastructure including, buildings, pumps, motors, valves, spill basins, bunded areas, electrical and communication infrastructure, power and water infrastructure as well as fencing and security. The following processes are expected to have impacts on terrestrial biodiversity:

- Gaining access to areas where the decommissioning will take place along the servitude, especially areas that do not have service roads to the pipeline;
- The removal and destruction of vegetation due to the excavation of the hole and the construction of the associated contactors camp, the same is expected for the depots;
- The removal of natural vegetation to accommodate surface infrastructure and operations will reduce the habitat available for fauna species and may reduce animal populations. Land clearing destroys local wildlife habitat and can lead to the loss of local breeding grounds, nesting sites and wildlife movement corridors such as rivers, streams and drainage lines, or other locally important features; and
- The human presence and associated impacts will result in the displacement of naturally occurring fauna. Besides direct impacts on faunal habitat, activities during the decommission process may also have additional impacts on local species due to increases in such as noise, waste, light, litter, vibrations, dust and encroachment by people.

Several areas throughout the project area provides habitat and shelter to several endemic and protected floral, mammal, reptile, amphibian and bird species. Although it is assumed that the majority of fauna species will move to different areas as a result of disturbance, many protected and endemic fauna species have very specific habitat requirements, and the destruction of their habitats will result in displacement to less optimal habitats.

The site establishment phase refers to the phase of the project where access to the areas being decommissioned are gained, the holes are excavated, and the contractor camps constructed. It also includes the process where the pipeline is being filled with the sand mixture.

The decommission phase refers to impacts at the end of the project lifecycle when removal of all surface infrastructure including those of the depots and the closing of excavations commences. Impacts regarding this phase may be detrimental as well as beneficial to the vegetation communities/ ecosystems depending on the extent and effort of the rehabilitation measures. Without the removal of all surface infrastructure as well as stockpiles and machinery or rehabilitation measures, removes the potential of vegetation communities/ ecosystems re-establishing within the footprint area, thus creating a dead spot within the area. Due to then transformed state to the area, the potential of impacting the vegetation community/ecosystem directly is unlikely. Thus, the impact of not demolishing the surface structure versus demolishing the infrastructure is rated.

The rehabilitation phase refers to the phase after the decommissioning phase when the impacted area is rehabilitated in conjunction with the decommission in order to attempt and return the area to the state it was in before construction, if not a better state. Rehabilitation efforts and removal of all unnatural structures, slopes and materials will result in conditions for

potential re-establishment of vegetation communities/ ecosystems and the associated fauna resulting in reinstating the land capability.

### 9.3.1.1 Anticipated Impact Framework

| Main Impact | Project activities that can cause loss of habitat (especially with regard to the proposed infrastructure areas): | Secondary impacts anticipated |
|---|---|---|
| **1. Loss / degradation of ecosystems** | Physical removal of vegetation<br>Access roads and servitudes<br>Soil dust precipitation<br>Water leakages<br>Dumping of waste products<br>Random events such as fire (cooking fires or cigarettes) | Displacement/loss of flora & fauna (including possible SCC)<br>Increased potential for soil erosion<br>Habitat fragmentation<br>Increased potential for establishment of alien & invasive vegetation |
| **2. Spread and/or establishment of alien and/or invasive species** | Vegetation removal<br>Vehicles potentially spreading seed<br>Unsanitary conditions surrounding infrastructure promoting the establishment of alien and/or invasive rodents<br>Creation of infrastructure suitable for breeding activities of alien and/or invasive birds<br>Unsanitary conditions surrounding infrastructure promoting the establishment of alien and/or invasive rodents | Habitat loss for native flora & fauna (including SCC)<br>Spreading of potentially dangerous diseases due to invasive and pest species<br>Alteration of fauna assemblages due to habitat modification |
| **3. Direct mortality of fauna** | Clearing of vegetation<br>Roadkill due to vehicle collision<br>Pollution of water resources due to dust effects, chemical spills.<br>Intentional killing of fauna for food (hunting) or otherwise (killing of snakes) | Displacement/loss of fauna (including possible SCC)<br>Loss of ecosystem services<br>Increase in rodent populations and associated disease risk |
| **4. Reduced dispersal/migration of fauna** | Loss of landscape used as corridor<br>Compacted roads<br>Removal of vegetation | Loss of ecosystem services<br>Reduced plant seed dispersal |
| **5. Environmental pollution due to water/ mine drainage runoff** | Chemical (organic/inorganic) spills<br>Erosion | Secondary impacts associated with pollution in water courses and the surrounding environment<br>Faunal mortality (direct and indirectly)<br>Groundwater pollution<br>Loss of ecosystem services |
| **6.Disruption/alteration of ecological life cycles (breeding, migration, feeding) due to noise** | Operation of machinery vehicles, generators etc | Loss of ecosystem services |
| **7. Disruption/alteration of ecological life cycles (breeding, migration, feeding) due to dust** | Vehicles | Loss of ecosystem services |
| **8. Staff and others interacting directly with potentially dangerous fauna or poaching of animals** | All unregulated/supervised activities outdoors | Loss of ecosystem services<br>Introduction of diseases and feral species such as cats. |

The potential impacts associated with the various project stages are discussed below, due to the fact that sensitive and critical habitats as well as SCC were present at some areas, the impact assessment comprises of an impact assessment regarding the more sensitive terrestrial facets and a separate assessment for the less sensitive areas identified:

### 9.3.1.2 Site Establishment Phase

The following potential impacts were considered on terrestrial biodiversity and habitats for biodiversity species that were sensitive and/or protected:

- Destruction, further loss and fragmentation of the vegetation community classified as CBA or protected areas;

- Destruction of protected plant species;
- Displacement of faunal community (including threatened and protected species) due to habitat loss, direct mortalities and disturbance (noise, dust and vibration);
- Loss of SCC faunal species (road mortalities and/or poaching); and
- Infringement by humans into the remaining natural grassland areas, with associated impacts such as poaching, litter as well as introduction of pests, diseases and feral species.

The following potential impacts were considered on terrestrial biodiversity and habitats for faunal species that were not as sensitive and protected:

- Destruction, further loss and fragmentation of the vegetation community;
- Displacement of faunal community due to habitat loss, direct mortalities and disturbance (noise, dust and vibration);
- Loss of faunal species (road mortalities and/or poaching); and
- Infringement by humans into the remaining natural grassland areas, with associated impacts such as poaching, litter as well as introduction of pests, diseases and feral species.

#### 9.3.1.3 Decommissioning Phase

The following potential impacts were considered on terrestrial biodiversity and habitats for faunal species that were sensitive and/or protected:

- Continued displacement, fragmentation and further loss of the vegetation community classified as CBA or protected areas;
- Continued displacement and fragmentation of the faunal community (including threatened and protected species) due to ongoing anthropogenic disturbances (noise, traffic and dust);
- Loss of SCC faunal species (road mortalities and/or poaching); and
- Infringement by humans into the remaining natural grassland areas, with associated impacts such as poaching, litter as well as introduction of pests, diseases and feral species.

The following potential impacts were considered on terrestrial biodiversity and habitats for faunal species that were not as sensitive and protected:

- Continued displacement, fragmentation and further loss of the of the vegetation community;
- Continued displacement and fragmentation of the faunal community due to ongoing anthropogenic disturbances (noise, traffic and dust);
- Loss of faunal species (road mortalities and/or poaching); and
- Infringement by humans into the remaining natural grassland areas, with associated impacts such as poaching, litter as well as introduction of pests, diseases and feral species.

### 9.3.1.4 Rehabilitation phase

The following potential impacts were considered on terrestrial biodiversity and habitats for faunal species in general regarding rehabilitation: The rehabilitation process may initially still displace the faunal species due to the large earth moving machines as well as the human presence. However, the post closure phase may result in fauna systematically returning in the best-case scenario if the rehabilitation efforts are well executed.

- Continued encroachment and displacement of the vegetation community due to alien invasive plant species, particularly in non-rehabilitated areas;
- Displacement, direct mortalities and sensory disturbance of faunal community as well as infringement by humans into the natural areas;
- Introduction of Indigenous plant species and the improvement of the area to be more natural; and
- Improvement of available habitat and the reduced displacement, loss and disturbance to faunal community and their associated ecological life cycles.

### 9.3.1.5 Assessment of Significance

**Site Establishment Phase**

Table 88 shows the significance of potential impacts associated with the decommissioning of the pipeline on sensitive vegetation and faunal communities before the implementation of mitigation measures. Prior to implementation of mitigation measures, the consequences of impacts were rated as moderately detrimental or highly detrimental due the fact that areas rated as CBA or containing SCC and/or protected species which would be impacted upon, implementation of avoidance measures such as avoiding these areas, reduced the significance of these potential impacts to low.

Table 89 shows the significance of potential impacts associated with the decommissioning of the pipeline on other vegetation and faunal communities before the implementation of mitigation measures. Prior to implementation of mitigation measures, the consequences of impacts were rated as moderately detrimental due to the areas that have been previously impacted or have a low sensitivity, implementation of avoidance measures such as access control, reduced the significance of these potential impacts to absent.

**Decommissioning Phase**

Table 90 shows the significance of potential impacts associated with the decommissioning of the pipeline and the depots on vegetation and faunal communities. Prior to implementation of mitigation measures, the consequences of impacts were rated as moderately detrimental due the fact that the areas have been impacted or have a low sensitivity, implementation of avoidance measures such as waste management, access control and environmental awareness reduced the significance of these potential impacts to absent. Table 91 shows the same as the impact of not demolishing the surface structure versus demolishing the infrastructure. The positive aspect of this is shown under rehabilitation.

**Rehabilitation Phase**

Table 92 shows the significance of potential impacts associated with the decommissioning of the pipeline and the depots on vegetation and faunal communities during the rehabilitation

phase. Rehabilitation efforts will result in a negative impact initially, as per the decommission phase due to the activities associated with the removal of all surface infrastructure. The positive impact arises from conditions for potential re-establishment of vegetation communities/ ecosystems and the associated fauna resulting in reinstating the land capability which results from following the mitigations of rehabilitation. The positive impact is low pre mitigation but becomes moderately positive post mitigation.

*Table 88: Assessment of significance of potential **site establishment phase** impacts on sensitive or protected vegetation and SCC faunal communities associated with the proposed decommissioning of the pipeline pre- and post-mitigation:*

| Impact | Prior to mitigation | | | | | | Post mitigation | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Duration of Impact | Extent | Severity of Impact | Sensitivity of Receiving Environment | Probability of Impact | Significance | Duration of Impact | Extent | Severity of Impact | Sensitivity of Receiving Environment | Probability of Impact | Significance |
| Destruction, further loss and fragmentation of the vegetation community classified as CBA or protected areas. | 4 | 3 | 4 | 4 | 5 | | 2 | 2 | 2 | 2 | 3 | |
| | Post-closure | Regional | Serious | Ecology highly sensitive /important | Almost Certain | **Moderately High** | Short-term | Local | Minor | Ecology with limited sensitivity/importance | Possible | **Low** |
| Destruction of protected plant species | 5 | 3 | 4 | 5 | 4 | | 2 | 2 | 2 | 2 | 3 | |
| | Residual | Regional | Serious | Ecology critically sensitive /important | Likely | **High** | Short-term | Local | Minor | Ecology with limited sensitivity/importance | Possible | **Low** |
| Displacement of faunal community(including threatened and protected species) due to habitat loss, direct mortalities and disturbance (noise, dust and vibration). | 3 | 3 | 4 | 5 | 4 | | 2 | 2 | 2 | 2 | 3 | |
| | Life of project | Regional | Serious | Ecology critically sensitive /important | Likely | **Moderately High** | Short-term | Local | Minor | Ecology with limited sensitivity/importance | Possible | **Low** |
| | 4 | 3 | 4 | 4 | 4 | | 2 | 2 | 2 | 3 | 2 | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Loss of SCC faunal species (road mortalities and/or poaching) | Post-closure | Regional | Serious | Ecology highly sensitive /important | Likely | **Moderately High** | Short-term | Local | Minor | Ecology moderately sensitive/ /important | Unlikely | **Low** |
| Infringement by humans into the remaining natural grassland areas, with associated impacts such as poaching, litter as well as introduction of pests, diseases and feral species. | 4 | 3 | 4 | 4 | 4 | | 2 | 2 | 2 | 3 | 2 | |
| | Post-closure | Regional | Serious | Ecology highly sensitive /important | Likely | **Moderately High** | Short-term | Local | Minor | Ecology moderately sensitive/ /important | Unlikely | **Low** |

*Table 89: Assessment of significance of potential **site establishment phase** impacts on vegetation and faunal communities associated with the proposed decommissioning of the pipeline pre- and post-mitigation:*

| Impact | Prior to mitigation | | | | | | Post mitigation | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Duration of Impact | Spatial Scope | Severity of Impact | Sensitivity of Receiving Environment | Probability of Impact | Significance | Duration of Impact | Spatial Scope | Severity of Impact | Sensitivity of Receiving Environment | Probability of Impact | Significance |
| Destruction, further loss and fragmentation of the vegetation community. | 3 | 3 | 3 | 3 | 4 | | 2 | 2 | 2 | 2 | 2 | |
| | Life of project | Regional | Moderate (medium) | Ecology moderately sensitive/ /important | Likely | **Moderate** | Short-term | Local | Minor | Ecology with limited sensitivity/importance | Unlikely | **Absent** |
| | 3 | 3 | 3 | 3 | 4 | | 2 | 2 | 2 | 2 | 2 | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Displacement of faunal community due to habitat loss, direct mortalities and disturbance (noise, dust and vibration). | Life of project | Regional | Moderate (medium) | Ecology moderately sensitive/ /important | Likely | **Moderate** | Short-term | Local | Minor | Ecology with limited sensitivity/importance | Unlikely | **Absent** |
| Loss of faunal species (road mortalities and/or poaching) | 5 | 3 | 3 | 3 | 3 | | 2 | 2 | 2 | 3 | 2 | |
| | Residual | Regional | Moderate (medium) | Ecology moderately sensitive/ /important | Possible | **Moderate** | Short-term | Local | Minor | Ecology moderately sensitive/ /important | Unlikely | **Low** |
| Infringement by humans into the remaining natural grassland areas, with associated impacts such as poaching, litter as well as introduction of pests, diseases and feral species. | 3 | 3 | 3 | 3 | 3 | | 2 | 2 | 2 | 3 | 3 | |
| | Life of project | Regional | Moderate (medium) | Ecology moderately sensitive/ /important | Possible | **Moderate** | Short-term | Local | Minor | Ecology moderately sensitive/ /important | Possible | **Low** |

*Table 90: Assessment of significance of potential **decommissioning phase** impacts on sensitive or protected vegetation and SCC faunal communities associated with the proposed decommissioning of the pipeline pre- and post-mitigation:*

| Impact | Prior to mitigation | | | | | | Post mitigation | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Duration of Impact | Spatial Scope | Severity of Impact | Sensitivity of Receiving Environment | Probability of Impact | Significance | Duration of Impact | Spatial Scope | Severity of Impact | Sensitivity of Receiving Environment | Probability of Impact | Significance |
| Continued displacement, fragmentation and further loss and fragmentation of the vegetation community classified as CBA or protected areas. | 3 | 3 | 4 | 4 | 4 | | 2 | 2 | 2 | 2 | 3 | |
| | Life of project | Regional | Serious | Ecology highly sensitive /important | Likely | **Moderately High** | Short-term | Local | Minor | Ecology with limited sensitivity/importance | Possible | **Low** |
| Continued displacement and fragmentation of the faunal community (including threatened and protected species) due to ongoing anthropogenic disturbances (noise, traffic and dust) | 3 | 3 | 4 | 4 | 4 | | 2 | 2 | 2 | 2 | 3 | |
| | Life of project | Regional | Serious | Ecology highly sensitive /important | Likely | **Moderately High** | Short-term | Local | Minor | Ecology with limited sensitivity/importance | Possible | **Low** |
| Loss of SCC faunal species (road mortalities and/or poaching) | 5 | 3 | 4 | 4 | 4 | | 2 | 2 | 2 | 3 | 2 | |
| | Residual | Regional | Serious | Ecology highly sensitive /important | Likely | **Moderately High** | Short-term | Local | Minor | Ecology moderately sensitive/ /important | Unlikely | **Low** |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Infringement by humans into the remaining natural grassland areas, with associated impacts such as poaching, litter as well as introduction of pests, diseases and feral species. | 3 | 3 | 4 | 4 | 4 | | 2 | 2 | 2 | 3 | 2 | |
| | Life of project | Regional | Serious | Ecology highly sensitive /important | Likely | **Moderately High** | Short-term | Local | Minor | Ecology moderately sensitive/ /important | Unlikely | **Low** |

*Table 91: Assessment of significance of potential **decommissioning phase** impacts on vegetation and faunal communities associated with the proposed decommissioning of the pipeline and the depots pre- and post-mitigation:*

| Impact | Prior to mitigation | | | | | | Post mitigation | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Duration of Impact | Spatial Scope | Severity of Impact | Sensitivity of Receiving Environment | Probability of Impact | Significance | Duration of Impact | Spatial Scope | Severity of Impact | Sensitivity of Receiving Environment | Probability of Impact | Significance |
| Destruction, further loss and fragmentation of the vegetation community. | 3 | 3 | 4 | 3 | 4 | | 2 | 2 | 2 | 2 | 3 | |
| | Life of project | Regional | Serious | Ecology moderately sensitive/ /important | Likely | **Moderate** | Short-term | Local | Minor | Ecology with limited sensitivity/importance | Possible | **Low** |
| Continued displacement and fragmentation of the faunal community due to ongoing anthropogenic | 3 | 3 | 3 | 3 | 3 | | 2 | 2 | 3 | 2 | 3 | |
| | Life of project | Regional | Moderate (medium) | Ecology moderately sensitive/ /important | Possible | **Moderate** | Short-term | Local | Moderate (medium) | Ecology with limited sensitivity/importance | Possible | **Low** |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| disturbances (noise, traffic and dust) | | | | | | | | | | | | |
| Loss of faunal species (road mortalities and/or poaching) | 5 | 3 | 3 | 3 | 3 | | 2 | 2 | 2 | 3 | 2 | |
| | Residual | Regional | Moderate (medium) | Ecology moderately sensitive/ /important | Possible | **Moderate** | Short-term | Local | Minor | Ecology moderately sensitive/ /important | Unlikely | **Low** |
| Infringement by humans into the remaining natural grassland areas, with associated impacts such as poaching, litter as well as introduction of pests, diseases and feral species. | 3 | 3 | 3 | 3 | 3 | | 2 | 2 | 2 | 3 | 3 | |
| | Life of project | Regional | Moderate (medium) | Ecology moderately sensitive/ /important | Possible | **Moderate** | Short-term | Local | Minor | Ecology moderately sensitive/ /important | Possible | **Low** |

*Table 92: Assessment of significance of potential **rehabilitation phase** impacts on vegetation and faunal communities associated with the proposed decommissioning of the pipeline and depots process pre- and post-mitigation:*

| Impact | Prior to mitigation | | | | | | Post mitigation | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Duration of Impact | Spatial Scope | Severity of Impact | Sensitivity of Receiving Environment | Probability of Impact | Significance | Duration of Impact | Spatial Scope | Severity of Impact | Sensitivity of Receiving Environment | Probability of Impact | Significance |
| Continued encroachment and displacement of the vegetation community due to alien invasive plant species, particularly in non-rehabilitated areas | 3 | 3 | 4 | 3 | 4 | | 2 | 2 | 2 | 2 | 3 | |
| | Life of project | Regional | Serious | Ecology moderately sensitive/ /important | Likely | **Moderate** | Short-term | Local | Minor | Ecology with limited sensitivity/importance | Possible | **Low** |
| Displacement, direct mortalities and sensory disturbance of faunal community as well as infringement by humans into the natural areas. | 3 | 3 | 3 | 3 | 3 | | 2 | 2 | 3 | 2 | 3 | |
| | Life of project | Regional | Moderate (medium) | Ecology moderately sensitive/ /important | Possible | **Moderate** | Short-term | Local | Moderate (medium) | Ecology with limited sensitivity/importance | Possible | **Low** |
| Introduction of Indigenous plant species and the improvement of the area to be more natural | 2 | 2 | 2 | 2 | 3 | | 4 | 3 | 3 | 3 | 4 | |
| | Short-term | Local | Minor | Ecology with limited sensitivity/importance | Possible | **Low** | Post-closure | Regional | Moderate (medium) | Ecology moderately sensitive/ /important | Likely | **Moderate** |
| | 2 | 2 | 2 | 2 | 3 | | 4 | 3 | 3 | 3 | 4 | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Improvement of available habitat and the reduced displacement, loss and disturbance to faunal community and their associated ecological life cycles. | Short-term | Local | Minor | Ecology with limited sensitivity/importance | Possible | **Low** | Post-closure | Regional | Moderate (medium) | Ecology moderately sensitive/ /important | Likely | **Moderate** |

### 9.3.2 Wetland and Riverine Risk Assessment

A risk assessment was conducted in line with Section 21 (c) and (i) of NWA to investigate the level of risk posed by the project, namely the proactive mitigatory measures associated with pipeline closure. Table 93 lists the potential risks posed by the development to wetlands within the 500 m regulated area surrounding for each of the four proposed footprint alternatives. As per DWS requirement the significance ratings presented in the risk matrix are post-mitigation ratings (i.e. the residual impact assuming all specified mitigation is successfully implemented).

A total of 30 riverine systems were assessed during the survey to characterise the various systems, from drainage lines to larger rivers. The risk assessment addresses ephemeral and perennial crossings and applies to all the relevant crossing points for the proposed decommissioning, including those not assessed. The wetland assessment included all 544 crossing points and recommended buffers have been applied to each crossing. As the buffers place the proposed activities at a distance from the watercourses, the risks for the proposed activities were rated as low for both ephemeral and perennial systems (Table 96 and Table 98).

Typically pipeline closure involves one of two main forms of mitigatory closure (1) remove the pipeline or (2) leave in place and mitigate in-situ. The risk assessment provided below caters for potential scenarios (scenarios 1 and 2). Given the scale of the project together with the high number of wetlands crossed, the large size of the pipeline and high ecological importance and sensitivity of many of the wetlands physical removal of the pipeline is likely to result in more damage to the integrity of this systems as opposed to leaving them in place and applying non-invasive mitigation. In acknowledgement of this, it is our understanding that the client intends to opt for Scenario 2 and all post-mitigation ratings for this scenario should be used to inform decisions with regards to the level of water use licencing required. Scenario 1 was retained in the risk assessment in the event that areas of past contamination are identified, or segments of the pipes discovered that still retain product post-cleansing. In these areas best practice advocates for the complete removal of the affected segment of pipeline followed by site cleansing and rehabilitation (Amec Foster Wheeler, 2017).

Unlike the new pipeline the old pipeline being decommissioned will not be subject to any cathodic protection and will gradually corrode with time losing its structural integrity leading to perforation and eventual collapse. From a wetland perspective the most potentially adverse impact associated with this would be the creation of a new preferential flow path along the void or more conductive structure that remains. This is known as the conduit effect. At this stage it is important to note that an extensive review of the available literature (79 sources) conducted by Amec Foster Wheeler (2017) revealed no evidence or reliable accounts of historical instances of water conduit formation in pipelines and that the understanding of the required conditions for water conduit formation in real-life applications is yet to be adequately established. In spite of these findings the study concluded that based on the paucity of available research it would be prudent to assume that conduit formation remains a potential concern during pipeline abandonment.

*Table 93: Wetland Risk Assessment (Andrew Husted (Pr Sci Nat 400213/11) for Scenario 1 and Scenario 2*

| Activity | Aspect | Impact | Priority | Severity | | | | | Spatial scale | Duration | Consequence | Frequency of activity | Frequency of impact | Legal Issues | Detection | Likelihood | Significance | Without Mitigation | With Mitigation | Control Measures |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Flow Regime | Water Quality | Habitat | Biota | Total | | | | | | | | | | | | |
| **Scenario 1 Removal of Pipeline Infrastructure** | | | | | | | | | | | | | | | | | | | | |
| Excavation and removal of pipeline infrastructure | Clearing of vegetation and striping of topsoil | Degradation of wetland vegetation and the introduction and spread of alien and invasive vegetation. | **1** | 1 | 1 | 5 | 5 | 5 | 3 | 5 | 13 | 3 | 3 | 5 | 4 | 15 | 195 | **H** | **M** | **It is understood that the client will avoid excavating and removing pipeline infrastructure wherever possible, as (in most cases) this will result in more damage than simply leaving it in place and applying in-situ mitigation. In situations where this is not possible, and a pipeline needs to be removed (e.g. for to spill clean-up purposes or in otherwise severely contaminated areas) a mandatory severity rating of 5 applies for activities within the watercourse. In this case apply the following mitigation under Scenario 1:**<br>• Restrict the disturbance footprint to within 10 m on either side of the proposed pipeline route (20 m corridor).<br>• Request the wetland spatial data from TBC, load it onto a GPS and use it to mark out the positions where the pipeline will enter and exits the buffer on the boundary of a wetland. Try to reduce the 20 m disturbance corridor and the unnecessary clearing of vegetation on either side of the trench as far as possible when traversing wetlands.<br>• Clearly demarcate footprint corridor, |
| | | | **2** | 1 | 4 | 4 | 4 | 5 | 2 | 4 | 11 | 3 | 3 | 5 | 3 | 14 | 154 | **M** | **M** | |
| | | | **3** | 1 | 4 | 4 | 4 | 5 | 2 | 4 | 11 | 3 | 3 | 5 | 2 | 13 | 143 | **M** | **M** | |
| | | | **4** | 1 | 4 | 3 | 3 | 5 | 2 | 4 | 11 | 3 | 3 | 5 | 1 | 12 | 132 | **M** | **M** | |

| Activity | Aspect | Impact | Priority | Severity | | | | | Spatial scale | Duration | Consequence | Frequency of activity | Frequency of impact | Legal Issues | Detection | Likelihood | Significance | Without Mitigation | With Mitigation | Control Measures |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Flow Regime | Water Quality | Habitat | Biota | Total | | | | | | | | | | | | and limit all activities to within this area.<br>• Minimize unnecessary clearing of vegetation.<br>• Landscape and re-vegetate all denuded areas as soon as possible.<br>• Demarcate with high visibility plastic fencing<br>• Signpost the area beyond the site establishment footprint as an environmentally sensitive area and keep all excavation, soil stockpiling, general access and construction activities out of this area.<br>• Promptly remove / control all alien and invasive plant species that may emerge during site establishment (i.e. weedy annuals and other alien forbs) must be removed.<br>• Appropriately stockpile topsoil excavated from the footprint corridor. |
| | | Increased bare surfaces, runoff and potential for erosion. | **1** | 1 | 5 | 4 | 4 | 3.5 | 3 | 5 | 12 | 3 | 1 | 1 | 1 | 6 | 69 | **M** | **L** | • Keep trench excavation neat and tidy ad limit disturbance to a 20 m corridor.<br>• Only stockpile on one side of the trench.<br>•Attempt to conduct the majority of the pipeline extraction activities during the dry seasons when storms are least likely to wash concrete and sand into wetlands. |
| | | | **2** | 1 | 4 | 3 | 4 | 3 | 3 | 4 | 10 | 3 | 1 | 1 | 1 | 6 | 60 | **M** | **L** | |
| | | | **3** | 1 | 3 | 2 | 4 | 2.5 | 3 | 4 | 9.5 | 3 | 1 | 1 | 1 | 6 | 57 | **M** | **L** | |
| | | | **4** | 1 | 1 | 1 | 4 | 1.8 | 3 | 4 | 8.8 | 3 | 1 | 1 | 1 | 6 | 53 | **L** | **L** | |
| | Trench excavation | Increased sediment loads to downstream reaches. | **1** | 1 | 5 | 4 | 4 | 3.5 | 3 | 5 | 12 | 3 | 1 | 1 | 1 | 6 | 69 | **M** | **L** | • Ensure soil stockpiles and concrete / building sand are sufficiently safeguarded against rain wash.<br>•Mixing of concrete must under no |

| Activity | Aspect | Impact | Priority | Severity | | | | | Spatial scale | Duration | Consequence | Frequency of activity | Frequency of impact | Legal Issues | Detection | Likelihood | Significance | Without Mitigation | With Mitigation | Control Measures |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Flow Regime | Water Quality | Habitat | Biota | Total | | | | | | | | | | | | |
| | | | **2** | 1 | 4 | 3 | 4 | 3 | 3 | 4 | 10 | 3 | 1 | 1 | 1 | 6 | 60 | **M** | **L** | circumstances take place in any wetland. Scrape the area where mixing and storage of sand and concrete occurred to clean once finished (preferably store on the south-eastern side of the project area).<br>• Do not situate any of the site establishment material laydown areas within any wetland.<br>• No machinery should be a parked in wetlands or their associated buffers.<br>• If storing materials on site, take into account the prevailing winds, distance to rivers, stream, wetlands, environmental protected areas and topography.<br>• Maintain a tidy site.<br>• Educate construction workers on upholding a clean site policy.<br>• No wetland vegetation is to be cleared without prior permission from the responsible TPL Environment Officer. |
| | | | **3** | 1 | 3 | 2 | 4 | 2.5 | 3 | 4 | 9.5 | 3 | 1 | 1 | 1 | 6 | 57 | **M** | **L** | |
| | | | **4** | 1 | 1 | 1 | 4 | 1.8 | 3 | 4 | 8.8 | 3 | 1 | 1 | 1 | 6 | 53 | **L** | **L** | |
| | | Contamination of wetlands with pipeline petroleum or hydrocarbons from machinery, equipment & vehicles. | **1** | 1 | 5 | 4 | 4 | 3.5 | 3 | 5 | 12 | 3 | 1 | 5 | 1 | 10 | 115 | **M** | **L** | • Make sure all excess consumables and building materials / rubble is removed from site and deposited at an appropriate waste facility.<br>• Appropriately contain any generator diesel storage tanks, machinery spills (e.g. accidental spills of hydrocarbons oils, diesel etc.) or construction materials on site (e.g. concrete) in such a way as to prevent them leaking and entering the north-western seep. |
| | | | **2** | 1 | 4 | 3 | 4 | 3 | 3 | 4 | 10 | 3 | 1 | 5 | 1 | 10 | 100 | **M** | **L** | |
| | | | **3** | 1 | 3 | 2 | 4 | 2.5 | 3 | 4 | 9.5 | 3 | 1 | 5 | 1 | 10 | 95 | **M** | **L** | |
| | | | **4** | 1 | 1 | 1 | 4 | 1.8 | 3 | 4 | 8.8 | 3 | 1 | 5 | 1 | 10 | 88 | **M** | **L** | |

| Activity | Aspect | Impact | Priority | Severity | | | | | Spatial scale | Duration | Consequence | Frequency of activity | Frequency of impact | Legal Issues | Detection | Likelihood | Significance | Without Mitigation | With Mitigation | Control Measures |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Flow Regime | Water Quality | Habitat | Biota | Total | | | | | | | | | | | | • Mixing of concrete must under no circumstances take place within the permanent or seasonal zones of the wetland. |
| | | Conduit formation along open trench. | 1 | 5 | 3 | 1 | 4 | 3.3 | 3 | 5 | 11 | 3 | 1 | 5 | 1 | 10 | 113 | L | M | • Install trench breakers along pipeline trench. This should comprise a material with a low permeability such as a bentonite clay mix. Install at regular intervals to completely block trench, increase frequency in areas of steeper slope.<br>• Work one wetland at a time (although multiple teams working on multiple wetlands at one time are of course possible, and indeed likely most pragmatic). |
| | | | 2 | 4 | 2 | 1 | 4 | 2.8 | 3 | 5 | 11 | 3 | 1 | 5 | 1 | 10 | 108 | L | M | |
| | | | 3 | 3 | 1 | 1 | 4 | 2.3 | 2 | 5 | 9.3 | 3 | 1 | 5 | 1 | 10 | 93 | L | L | |
| | | | 4 | 2 | 1 | 1 | 4 | 2 | 2 | 5 | 9 | 3 | 1 | 5 | 1 | 10 | 90 | L | L | |
| | Backfilling of trench | Disruption of wetland soil profile and alteration of hydrological regime. | 1 | 5 | 3 | 1 | 4 | 3.3 | 3 | 5 | 11 | 3 | 1 | 5 | 1 | 10 | 113 | L | M | • Work on one wetland at a time and backfill with original soil horizon order.<br>• Compact to appropriate geotechnical specifications of the wetland.<br>• Implement stormwater management plan.<br>• Re-vegetate denuded areas as soon as possible.<br>• Regularly clear drains.<br>• Minimise the extent of concreted / paved areas. |
| | | | 2 | 4 | 2 | 1 | 4 | 2.8 | 3 | 5 | 11 | 3 | 1 | 5 | 1 | 10 | 108 | L | M | |
| | | | 3 | 3 | 1 | 1 | 4 | 2.3 | 2 | 5 | 9.3 | 3 | 1 | 5 | 1 | 10 | 93 | L | L | |
| | | | 4 | 2 | 1 | 1 | 4 | 2 | 2 | 5 | 9 | 3 | 1 | 5 | 1 | 10 | 90 | L | L | |
| **Scenario 2 Treatment of Pipeline Infrastructure In-situ** | | | | | | | | | | | | | | | | | | | | |
| Leaving of pipeline infrastructure | Contamination | Contamination of wetlands with petroleum product. | 1 | 1 | 5 | 2 | 2 | 2.5 | 2 | 2 | 6.5 | 1 | 1 | 5 | 2 | 9 | 59 | M | L | • It is understood that the pipeline has been drained of product and cleaned and as such this is not considered to be a significant risk.<br>• If areas where significant amounts of |
| | | | 2 | 1 | 5 | 2 | 2 | 2.5 | 2 | 2 | 6.5 | 1 | 1 | 5 | 2 | 9 | 59 | M | L | |
| | | | 3 | 1 | 4 | 2 | 2 | 2.3 | 2 | 2 | 6.3 | 1 | 1 | 5 | 2 | 9 | 56 | M | L | |

| Activity | Aspect | Impact | Priority | Severity | | | | | Spatial scale | Duration | Consequence | Frequency of activity | Frequency of impact | Legal Issues | Detection | Likelihood | Significance | Without Mitigation | With Mitigation | Control Measures |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Flow Regime | Water Quality | Habitat | Biota | Total | | | | | | | | | | | | |
| | | | 4 | 1 | 3 | 2 | 2 | 2 | 2 | 2 | 6 | 1 | 1 | 5 | 2 | 9 | 54 | L | L | fuel product remain then implement pipeline cleaning exercise at that location prior to any closure-related activities or abonnement. Do so in accordance with national legislation as well as local and international best practice standards. |
| | Conduit effect | Transportation of contaminants (petroleum or other) from previous affected sites to downslope wetlands. | 1 | 5 | 5 | 4 | 4 | 4.5 | 4 | 5 | 14 | 3 | 3 | 5 | 3 | 14 | 189 | H | L | • Identify sites of previous spill events or where intense contamination with hazardous substances is otherwise known to occur.<br>• Application of suggested mitigation in this table should mitigate against this eventuality. |
| | | | 2 | 5 | 5 | 4 | 4 | 4.5 | 4 | 5 | 14 | 3 | 3 | 5 | 3 | 14 | 189 | H | L | |
| | | | 3 | 3 | 3 | 2 | 2 | 2.5 | 1 | 4 | 7.5 | 3 | 3 | 5 | 3 | 14 | 105 | M | L | |
| | | | 4 | 2 | 2 | 2 | 2 | 2 | 1 | 4 | 7 | 3 | 3 | 5 | 3 | 14 | 98 | M | L | |
| | | Transportation of water away from wetlands (flow loss via the conduit effect). | 1 | 5 | 3 | 4 | 4 | 4 | 4 | 5 | 13 | 3 | 3 | 5 | 3 | 14 | 182 | H | L | • Pipeline compartmentalisation required for high priority watercourses (see priorities 1 and 2).<br>• Fill pipeline with inert filler material such as bentonite or better still a mix of soils with similar texture, hydraulic conductivity, and density as is present in the wetland, geotechnical specialists could advise in this regard.<br>• Plug pipeline segment on either end and cap.<br>• Effect all activities from beyond the prescribed wetland buffer. Where block vales are present utilise them, however, if within the wetland buffer excavate and cap at a new location outside if the wetland buffer. |
| | | | 2 | 5 | 3 | 4 | 4 | 4 | 4 | 5 | 13 | 3 | 3 | 5 | 3 | 14 | 182 | H | L | |
| | | | 3 | 3 | 1 | 2 | 2 | 2 | 1 | 4 | 7 | 3 | 3 | 5 | 3 | 14 | 98 | M | L | |
| | | | 4 | 2 | 1 | 2 | 2 | 1.8 | 1 | 4 | 6.8 | 3 | 3 | 5 | 3 | 14 | 95 | M | L | |
| | | Increased floodpeaks into downslope wetlands from water entering the | 1 | 5 | 2 | 3 | 3 | 3.3 | 4 | 5 | 12 | 2 | 2 | 5 | 3 | 12 | 147 | M | L | The main objective here is to deny water ingress into the abandoned pipeline particularly in areas of |

| Activity | Aspect | Impact | Priority | Severity | | | | | Spatial scale | Duration | Consequence | Frequency of activity | Frequency of impact | Legal Issues | Detection | Likelihood | Significance | Without Mitigation | With Mitigation | Control Measures |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Flow Regime | Water Quality | Habitat | Biota | Total | | | | | | | | | | | | |
| | | corroded pipeline in areas of steep slope. | **2** | 5 | 2 | 3 | 3 | 3.3 | 4 | 5 | 12 | 2 | 2 | 5 | 3 | 12 | 147 | **M** | **L** | significant slope where ingress water could be diverted along the preferential flow path created by the pipeline an accelerated to potentially destructive and erosive velocities. Steps to mitigate against this include:<br>• Identifying areas where the pipeline traverses significantly long and steep slopes using. This may be achieved through GIS-based terrain modelling (i.e. slope, aspect, elevation) using fine scale digital elevation model data such as that provided by NASA and the USGS.<br>• This data can be used to prioritise sites where floodpeaks and consequent erosion of downstream watercourses are deemed to be highest.<br>• At these areas manage or divert stormflow channels away from the pipeline in areas of high slope e.g., control berms, water bars, ground contouring, matting, vegetation planting, terracing).<br>• Install breakers and plugs by cutting and capping along the abandoned pipeline in these areas to compartmentalise potential flows. |
| | | | **3** | 3 | 1 | 2 | 2 | 2 | 1 | 4 | 7 | 2 | 2 | 5 | 3 | 12 | 84 | **M** | **L** | |
| | | | **4** | 2 | 1 | 2 | 2 | 1.8 | 1 | 4 | 6.8 | 3 | 3 | 5 | 3 | 14 | 95 | **M** | **L** | |
| | Pipeline exposure | Impeding effects associated with pipeline exposure following | **1** | 3 | 1 | 2 | 1 | 1.8 | 2 | 2 | 5.8 | 1 | 1 | 1 | 2 | 5 | 29 | **L** | **L** | • Determine pipeline depths below the channel bed, consider pipeline removal only in areas situated in shallow sandy or alluvial soils in systems prone to |
| | | | **2** | 2 | 1 | 2 | 1 | 1.5 | 2 | 2 | 5.5 | 1 | 1 | 1 | 2 | 5 | 28 | **L** | **L** | |
| | | | **3** | 1 | 1 | 2 | 1 | 1.3 | 2 | 2 | 5.3 | 1 | 1 | 1 | 2 | 5 | 26 | **L** | **L** | |

| Activity | Aspect | Impact | Priority | Severity | | | | | Spatial scale | Duration | Consequence | Frequency of activity | Frequency of impact | Legal Issues | Detection | Likelihood | Significance | Without Mitigation | With Mitigation | Control Measures |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Flow Regime | Water Quality | Habitat | Biota | Total | | | | | | | | | | | | |
| | | eventual erosion of channel bed. | 4 | 1 | 1 | 2 | 1 | 1.3 | 2 | 2 | 5.3 | 1 | 1 | 1 | 2 | 5 | 26 | L | L | erosion.<br>• Low probability of occurring. |
| Activities associated with in-situ treatment | Approach to sites | Disturbance of wetland vegetation and soils through trampling of vegetation and poaching of soils by vehicles and people accompanied by the introduction and spread of alien and invasive vegetation. | 1 | 1 | 1 | 5 | 5 | 5 | 3 | 5 | 13 | 3 | 3 | 5 | 4 | 15 | 195 | H | L | • Adhere to the prescribed wetland buffers (varies among HGM units) by restricting all in-situ treatment activities to areas beyond these buffers. Where possible make use of block valves outside of the buffer zones to gain access to the pipeline (minimising the disturbance footprint), where none exist or are too far from the wetland then excavate just beyond the prescribed wetland buffer (as agreed upon by DWS).<br>• Avoid driving into and / or parking in wetlands and their buffers.<br>• Utilise existing tracks to gain access wherever possible and use the same access route to and from the wetland.<br>• Promptly remove / control all alien and invasive plant species that may emerge during site establishment (i.e. weedy annuals and other alien forbs) must be removed.<br>• Clearly demarcate site establishment footprint, and limit all activities to within this area.<br>• Minimise the clearing of vegetation.<br>• Landscape and re-vegetate all denuded areas as soon as possible. |
| | | | 2 | 1 | 4 | 4 | 4 | 5 | 2 | 4 | 11 | 3 | 3 | 5 | 3 | 14 | 154 | M | L | |
| | | | 3 | 1 | 4 | 4 | 4 | 5 | 2 | 4 | 11 | 3 | 3 | 5 | 2 | 13 | 143 | M | L | |
| | | | 4 | 1 | 4 | 3 | 3 | 5 | 2 | 4 | 11 | 3 | 3 | 5 | 1 | 12 | 132 | M | L | |
| | Filler materials, plugging and | Loss of wetland vegetation beneath fill materials storage / | 1 | 1 | 1 | 4 | 2 | 2 | 2 | 3 | 7 | 1 | 1 | 5 | 2 | 9 | 63 | L | L | • Attempt not to store and mix the filler slurry and other plugging materials on site but instead opt for contained, pre- |

| Activity | Aspect | Impact | Priority | Severity | | | | | Spatial scale | Duration | Consequence | Frequency of activity | Frequency of impact | Legal Issues | Detection | Likelihood | Significance | Without Mitigation | With Mitigation | Control Measures |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Flow Regime | Water Quality | Habitat | Biota | Total | | | | | | | | | | | | |
| | pumping process | mixing areas and increased potential for sediment input. | 2 | 1 | 1 | 4 | 2 | 2 | 2 | 3 | 7 | 1 | 1 | 5 | 2 | 9 | 63 | L | L | mixed mobile alternatives.<br>• Consider the use of cement trucks to neatly transport and contain the inert filler material and other plugging materials (separate trucks).<br>• If substances must be stored and mixed do so outside of the wetlands and their prescribed buffers and scrape area clean once finished. Also do one site at a time to avoid filler and plugging material stockpiles being washed into nearby wetlands. |
| | | | 3 | 1 | 1 | 4 | 2 | 2 | 2 | 3 | 7 | 1 | 1 | 5 | 2 | 9 | 63 | L | L | |
| | | | 4 | 1 | 3 | 4 | 2 | 2.5 | 2 | 3 | 7.5 | 1 | 1 | 5 | 2 | 9 | 68 | L | L | |
| | Contamination associated with closure activities | Contamination of wetlands from machinery spills or inappropriate sanitation practices | 1 | 1 | 5 | 2 | 2 | 2.5 | 2 | 2 | 6.5 | 1 | 1 | 5 | 2 | 9 | 59 | M | L | • Restrict all closure activities to outside of the wetlands and their associated buffers.<br>• Chemical ablutions toilets should be provided and be maintained in good working order.<br>• All non-decomissioning related activities should be prohibited within wetlands including bathing, swimming and general sanitation<br>• All concrete mixing must take place on a designated and impermeable surface<br>• In the event of a contaminant spills (e.g. engine or hydraulic oils) implement spill management plan and contact relevant clean up specialist. Materials that absorb fuel & oil, such as saw dust should be place over the spill. Remove and dispose of at an approved waste disposal site.<br>• Immediately repair all leaks of |
| | | | 2 | 1 | 5 | 2 | 2 | 2.5 | 2 | 2 | 6.5 | 1 | 1 | 5 | 2 | 9 | 59 | M | L | |
| | | | 3 | 1 | 4 | 2 | 2 | 2.3 | 2 | 2 | 6.3 | 1 | 1 | 5 | 2 | 9 | 56 | M | L | |
| | | | 4 | 1 | 3 | 2 | 2 | 2 | 2 | 2 | 6 | 1 | 1 | 5 | 2 | 9 | 54 | L | L | |

| Activity | Aspect | Impact | Priority | Severity | | | | | Spatial scale | Duration | Consequence | Frequency of activity | Frequency of impact | Legal Issues | Detection | Likelihood | Significance | Without Mitigation | With Mitigation | Control Measures |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Flow Regime | Water Quality | Habitat | Biota | Total | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | hydrocarbons or chemicals or oil.<br>• Do not discharge any substances including clean water into a watercourse. |
| | Post-closure aspects | Potential for the creation of either flow impeding features or in contrast the re-creation of conduits from using an inappropriate filler medium. | **1** | 1 | 3 | 2 | 2 | 2 | 2 | 5 | 9 | 1 | 1 | 5 | 2 | 9 | 81 | **M** | **L** | • Avoid the use of concrete as a filler material as it may end up acting as an impeding feature over the long-term. Instead opt for an inert filler material such as bentonite or better still a mix of soils with similar texture, porosity, and density as is present in the wetland, geotechnical specialists could advise in this regard.<br>• A detailed geotechnical description of the soils at each site earmarked for pipe filling would drastically assist in determining the correct physical properties of the filler material to be used.<br>• More closely matching the physical properties of the soil within the individual wetland in question would also help t reduce the potential for conduit creation following eventual pipeline disintegration. |
| | | | **2** | 1 | 3 | 2 | 2 | 2 | 2 | 5 | 9 | 1 | 1 | 5 | 2 | 9 | 81 | **M** | **L** | |
| | | | **3** | 1 | 3 | 2 | 2 | 2 | 2 | 5 | 9 | 1 | 1 | 5 | 2 | 9 | 81 | **M** | **L** | |
| | | | **4** | 1 | 3 | 2 | 2 | 2 | 2 | 5 | 9 | 1 | 1 | 5 | 2 | 9 | 81 | **M** | **L** | |

### 9.3.2.1 Unplanned Events

The planned activities will have known impacts as discussed above; however, unplanned events may occur on any project and may have potential impacts which will need mitigation and management. Table 94 is a summary of the findings from a riverine and wetland ecology perspective. Please note not all potential unplanned events may be captured herein and this must therefore be managed throughout all phases.

*Table 94: Unplanned Events, Low Risks and their Management Measures*

| Unplanned Event | Potential Impact | Mitigation |
|---|---|---|
| Hydrocarbon spill into wetland/riverine habitat | Contamination of sediments and water resources associated with the spillage. | A spill response kit must be available at all times. The incident must be reported on and if necessary, a wetland specialist must investigate the extent of the impact and provide rehabilitation recommendations. |
| Uncontrolled erosion | Sedimentation of downstream river reach. | Erosion control measures must be put in place. |
| Flooding during decommissioning | Significant habitat degradation of downstream areas. | A flood emergency response plan should be drafted. |

*Table 95: DWS Risk Assessment for perennial watercourses*

| Aspect | Flow Regime | Water Quality | Habitat | Biota | Severity | Spatial scale | Duration | Consequence |
|---|---|---|---|---|---|---|---|---|
| **Site establishment Phase** | | | | | | | | |
| Clearing of vegetation and striping of topsoil | **1** | **2** | **2** | **2** | 1,75 | **2** | **1** | 4,75 |
| Trench excavation | 1 | 2 | 2 | 2 | 1,75 | 1 | 1 | 3,75 |
| Backfilling of trench | 1 | 2 | 1 | 1 | 1,25 | 1 | 1 | 3,25 |
| Operational of heavy machinery | **1** | **3** | **1** | **2** | 1,75 | **2** | **1** | 4,75 |
| Erosion and sedimentation control | 1 | 2 | 3 | 2 | 2 | 2 | 1 | 5 |
| Staff ablutions | 1 | 2 | 1 | 1 | 1,25 | 1 | 1 | 3,25 |
| Erosion | 1 | 1 | 2 | 2 | 1,5 | 2 | 5 | 8,5 |
| Flow modification | 2 | 1 | 2 | 2 | 1,75 | 2 | 5 | 8,75 |

*Table 96: DWS Risk Assessment perennial watercourses*

| | Frequency of activity | Frequency of impact | Legal Issues | Detection | Likelihood | Sig. | Without Mitigation | With Mitigation |
|---|---|---|---|---|---|---|---|---|
| **Site Establishment Phase** | | | | | | | | |
| Clearing of vegetation and striping of topsoil | 1 | 2 | 1 | 2 | 6 | 28,5 | Low | Low |
| Trench excavation | 1 | 2 | 1 | 2 | 6 | 22,5 | Low | Low |
| Backfilling of trench | 1 | 2 | 1 | 1 | 5 | 16,25 | Low | Low |
| Operational of heavy machinery | 1 | 2 | 1 | 2 | 6 | 28,5 | Low | Low |
| Erosion and sedimentation control | 1 | 2 | 1 | 2 | 6 | 30 | Low | Low |
| Staff ablutions | 1 | 2 | 1 | 1 | 5 | 16,25 | Low | Low |
| Erosion | 1 | 1 | 1 | 2 | 5 | 42,5 | Low | Low |
| Flow modification | 1 | 1 | 1 | 2 | 5 | 43,75 | Low | Low |
| ( * ) denotes-In accordance with General Notice 509 “Risk is determined after considering all listed control / mitigation measures. Borderline moderate risk scores can be manually adapted downwards up to a maximum of 25 points (from a score of 80). This risk assessment was completed by Russell Tate (Pr. Sci. Nat: 400089/15 ) | | | | | | | | |

*Table 97: DWS Risk Assessment for ephemeral watercourses*

| Aspect | Flow Regime | Water Quality | Habitat | Biota | Severity | Spatial scale | Duration | Consequence |
|---|---|---|---|---|---|---|---|---|
| **Site Establishment Phase** | | | | | | | | |
| Clearing of vegetation and striping of topsoil | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 5 |
| Trench excavation | 1 | 2 | 2 | 2 | 1,75 | 1 | 1 | 3,75 |
| Backfilling of trench | 1 | 2 | 2 | 1 | 1,5 | 2 | 1 | 4,5 |
| Operational of heavy machinery | 1 | 3 | 2 | 2 | 2 | 2 | 1 | 5 |
| Erosion and sedimentation control | 2 | 2 | 3 | 2 | 2,25 | 2 | 1 | 5,25 |
| Staff ablutions | 1 | 2 | 1 | 1 | 1,25 | 1 | 1 | 3,25 |
| Erosion | 2 | 1 | 2 | 2 | 1,75 | 2 | 5 | 8,75 |
| Flow modification | 2 | 1 | 2 | 2 | 1,75 | 2 | 5 | 8,75 |

*Table 98: DWS Risk Assessment for ephemeral watercourses*

| | Frequency of activity | Frequency of impact | Legal Issues | Detection | Likelihood | Sig. | Without Mitigation | With Mitigation |
|---|---|---|---|---|---|---|---|---|
| **Site Establishment Phase** | | | | | | | | |
| Clearing of vegetation and striping of topsoil | 1 | 2 | 1 | 2 | 6 | 30 | Low | Low |
| Trench excavation | 1 | 2 | 1 | 2 | 6 | 22,5 | Low | Low |
| Backfilling of trench | 1 | 2 | 1 | 2 | 6 | 27 | Low | Low |
| Operational of heavy machinery | 1 | 2 | 1 | 2 | 6 | 30 | Low | Low |
| Erosion and sedimentation control | 1 | 2 | 1 | 2 | 6 | 31,5 | Low | Low |
| Staff ablutions | 1 | 2 | 1 | 2 | 6 | 19,5 | Low | Low |
| Erosion | 1 | 1 | 1 | 2 | 5 | 43,75 | Low | Low |
| Flow modification | 1 | 1 | 1 | 2 | 5 | 43,75 | Low | Low |
| ( * ) denotes-In accordance with General Notice 509 “Risk is determined after considering all listed control / mitigation measures. Borderline moderate risk scores can be manually adapted downwards up to a maximum of 25 points (from a score of 80). This risk assessment was completed by Russell Tate (Pr. Sci. Nat: 400089/15 ) | | | | | | | | |

## 9.4 Mitigation Measures

The mitigation actions provided below are important to consider with other specialist assessment. These mitigation measures should be implemented in the Environmental Management Plan (EMP) should the project go-ahead. The mitigation hierarchy proposed by Macfarlane et al., (2016) was considered for this study.

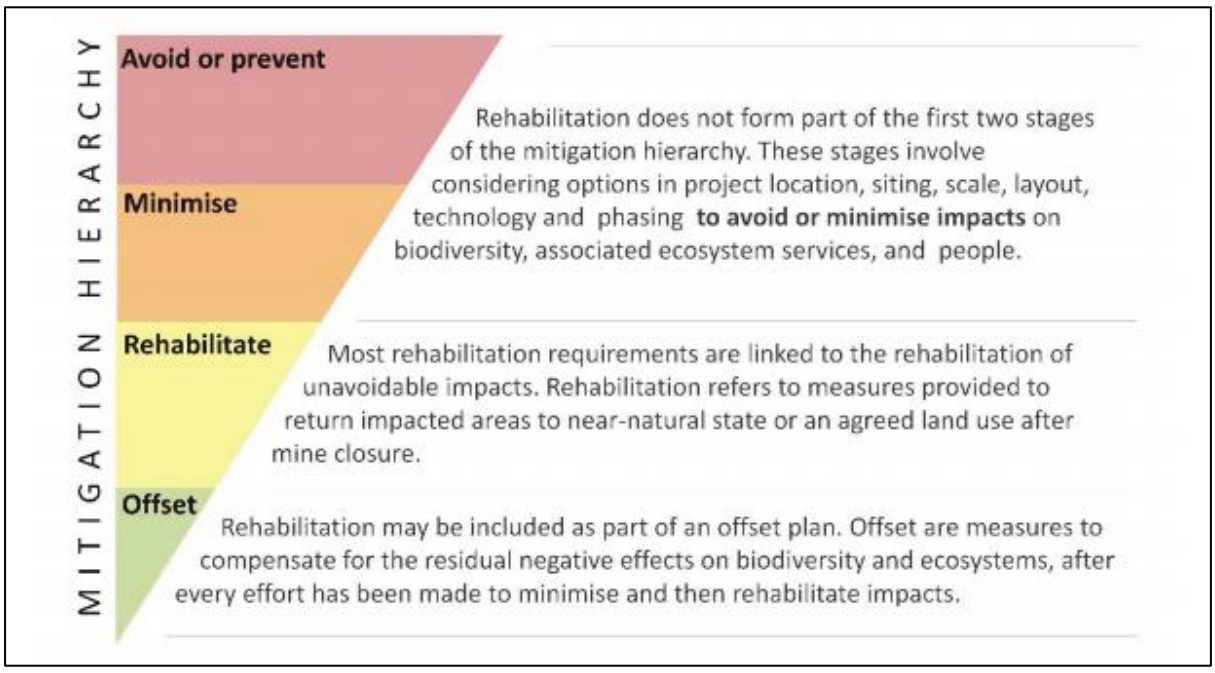



*Figure 36: The Mitigation Hierarchy (Macfarlane et al., 2016)*

The focus of mitigation measures is to reduce the significance of potential impacts associated with the decommissioning and thereby to:

- Prevent the further loss and fragmentation of sensitive vegetation communities, protected plants and the CBA areas in the vicinity of area decommissioned (including wetland areas);
- As far as possible, reduce the negative fragmentation effects of the linear development and enable safe movement of faunal species; and
- Prevent the direct and indirect loss and disturbance of faunal species and community (including potentially occurring species of conservation concern)

### 9.4.1 Mitigation Measures for Impacts on Flora and Faunal Communities

The mitigation measures below substantiate and emphasizes the provided comprehensive list of management protocols as per the Environmental Management Plan for DJP Petroleum project (Transnet, 2019);

- The decommission process and the associated access, movement and infrastructure should be limited to the already impacted pipeline servitude so that far as possible, the proposed areas to be decommissioned are placed in areas that have already been disturbed, thus no further loss of vegetation occurs. It is recommended that the footprint areas and access roads should be specifically demarcated so that during the life of the project, only the demarcated areas be impacted upon;

- The areas rated as highly sensitive and the associated buffers in the project as defined in this report are considered “no go” areas (section 8.1 and Appendix A) should be treated as such and should be adhered to;
- Managing the movement of large earth moving machinery, staff, livestock and local people is essential in order to prevent unnecessary loss of biodiversity. All essential operational staff, machinery must be limited to decommissioning area (no need to go outside area during the life of the project). Demarcating the footprint area and/or “no go” areas will prevent unregulated access and activities;
- Access to the surrounding areas should be prevented. Human encroachment into this area will most likely severely alter the more natural state of these areas especially areas rated as critical habitat and areas that contain SCC;
- Prefabricated structures should be prioritised for the contractor’s camp due to the temporary nature of the activities, in order to reduce on site fabrication. Where possible structures can be placed on plinths to avoid clearing areas and the impact footprint.
- The movement of construction vehicles and construction workers within these areas should be strictly prohibited to the servitude and low sensitivity areas;
- Existing access routes and walking paths must be made use of, and new routes limited;
- All laydown, storage areas, ablutions, skips etc should be restricted to the low sensitivity areas within the existing pipeline servitude of project area;
- Dust-reducing mitigation measures must be put in place and must be strictly adhered to. This includes wetting of exposed soft soil surfaces;
- Appropriately contain and prevent any chemical spills (e.g. accidental spills of hydrocarbons oils, diesel etc.)
- A qualified environmental control officer (ECO) must be on site when decommissioning begins to identify species that will be directly disturbed and to relocate fauna/flora that is found;
- Areas that are denuded during decommissioning need to be re-vegetated with indigenous vegetation to prevent erosion during flood events. This will also reduce the likelihood of encroachment by alien invasive plant species.
- During vegetation clearance, methods should be employed to minimize potential harm to fauna species. Clearing has to take place in a phased and slow manner, commencing from the interior of the site progressing outwards towards the boundary to maximize potential for mobile species to move to adjacent areas;
- Prior and during vegetation clearance any larger fauna species noted should be given the opportunity to move away from the construction machinery;
- Fauna species such as frogs and reptiles that have not moved away should be carefully and safely removed to a suitable location beyond the extent of the development footprint by a suitably qualified ECO trained in the handling and relocation of animals;

- Waste management must be a priority. Temporary storage of domestic waste shall be in covered waste skips. Refuse bins will be emptied and secured, to prevent unauthorized removal or access by wildlife. It is recommended that all waste be removed from site on a weekly basis to prevent rodents and pests entering the site.
- No trapping, killing or poisoning of any wildlife is to be allowed;
- Staff should be educated about the sensitivity of faunal species and measures should be put in place to deal with any species that are encountered during the decommissioning process as well as the fire risk associated with smoking and cooking; discarding of lit cigarette butts and/or glowing embers from cooking fires being blown into surrounding vegetation may cause runaway fires to remove habitat for terrestrial plant species that would otherwise have been available;
- Noise must be kept to a minimum to reduce the impact of the activities on the fauna residing on the site and neighbouring areas;
- Decommissioning activities and vehicles could cause spillages of lubricants, fuels and construction material which could then be transported to the wetland areas, impacting on the water quality and potentially the functioning of the systems. All vehicles and equipment must be maintained, and all re-fuelling and servicing of equipment is to take place off-site with only emergency maintenance done on-site in demarcated areas with drip trays;
- The intentional killing of any animals including snakes, insects, lizards, birds or other animals should be strictly prohibited;
- Speed limiting of large earth moving machinery and vehicles, speeds must be limited to 30 km/h;
- Staff should be made environmentally aware during the inductions and potentially as part of the environmental awareness plan;
- Signs prohibiting access as well as poaching of animals must be put up;
- The Contractor should inform all site staff to the use of supplied ablution facilities and under no circumstances shall indiscriminate excretion and urinating be allowed other than in supplied facilities. A minimum of one toilet must be provided per 10 persons;
- Under no circumstances may domestic waste be burned on site;
- Implementation of an alien vegetation management plan with the associated monitoring;
- Implementation of rehabilitation plan.
    - Areas were infrastructure was demolished must be landscaped back to original contours and rehabilitated to the designated land capability;
    - The replacement of the topsoil must be done within the rehabilitated areas. The topsoil will be ripped and reseeded. Any contamination of the topsoil must be avoided by ensuring machinery is well maintained and leak free. If contamination has occurred the area must be ameliorated immediately;

- The infringement by local people and the associated impacts such as livestock will hinder the rehabilitation process, thus accessibility to the rehabilitated areas must be prohibited as far as possible;
- The rehabilitated areas must be revegetated as soon as possible to reduce the risk of increased runoff from bare areas. Vehicles will be driving around on site and must stay within the designated routes. This will prevent compaction of soils outside of the disturbed area. If areas have been compacted the soil must be ripped to remedy the effects of compaction. More detailed management measure can be seen in the soils, land use and land capability study report; and
- During the rehabilitation effort, movement of large machinery as well as staff will resemble roles and movement as per the site establishment phase, thus management measures are similar, such as demarcating the footprint area and/or “no go” areas will prevent unregulated access and activities

**Specific Mitigation Measures for Reptiles**

- Regarding reptiles, a qualified Zoologist must conduct a pre-site establishment survey for potential burrows of Sungazers within the expected distribution that may be disturbed or destroyed.

# 10 Cumulative Impact

The impacts of projects are often assessed by comparing the post-project situation to a pre-existing baseline. Where projects can be considered in isolation this provides a good method of assessing a project’s impact. However, in areas where baselines have already been affected, or where future development will continue to add to the impacts in an area or region, it is appropriate to consider the cumulative effects of development. This is similar to the concept of shifting baselines, which describes how the environmental baseline at a point in time may represent a significant change from the original state of the system. This section describes the potential impacts of the project that are cumulative for terrestrial fauna and flora.

The area within the servitude area has previously and presently been impacted directly due to the maintenance of the pipeline which involves clearing of vegetation, the servitude has been impacted indirectly by rural communities, agriculture and the associated impacts. Due to the nature of and age of the pipeline, the impact is linear and is restricted to the servitude. The cumulative impact of the project was rated as moderate should the project go ahead, due to the negligible and short nature of the impact in comparison to existing impacts, but also taking into account the number and expanses of areas to be impacted.

*Table 99: Cumulative Impact of the project area*

| Nature of the impact: Habitat Quality Deterioration in the along the Transnet pipeline | | |
|---|---|---|
| | **Cumulative impact should the project not go ahead** | **Cumulative impacts should the project go ahead** |
| **Extent** | Regional | Regional |
| **Duration** | Long term | Life of project |

| | | |
|---|---|---|
| **Magnitude** | Medium | Medium |
| **Probability** | Definite | Definite |
| **Calculated Significance Rating** | **Minor / Moderate** | **Moderate** |
| **Impact Status:** | Negative | Negative/Positive |
| **Reversibility:** | Reversible | Reversible |
| **Irreplaceable loss of resources:** | No | Potentially |
| **Can impacts be enhanced:** | Yes | Yes |

# 11 Conclusion

## 11.1 Terrestrial Ecosystems

The project area (pipeline and depots) stretches across three provinces namely: Gauteng, Free State and KwaZulu-Natal. Various assessment sites were selected along the project area. The following datasets were used to select the assessment points: NFEPA, topographical data (rivers and inland waterbodies), D'MOSS, CoJ wetlands and RAMSAR. The points selected are focussed around water resources, to ensure the habitat is assessed from a terrestrial, aquatics and a wetland perspective. A total of 544 sites were selected on a desktop basis as they fell in a number of different classifications as per the scoping report (TBC: Biodiversity and Water Resource Desktop Assessment for the Proposed Decommissioning of the Transnet Durban to Johannesburg Pipeline (DJP). Scoping Report, 2019). These sites were further reduced and a total of 129 sites were visited based on the inherent sensitivity of these areas, of these 61 sites were found to have a moderately-high to high sensitivity. A total of 44 sites were rated as low-moderate or moderate, and 24 sites were given a low sensitivity. The sensitivity allocated to the areas were based on the overall habitat quality and state, the species of conservation concern (SCC) present as well as the function of landscape features (e.g. wetland) in the area that contribute to the general ecology of the area. These areas exhibit a healthy ecological functionality, integrity and may provide habitat for some additional threatened species. This diversity is indicative of the importance of these systems to collectively provide refugia, food and corridors for dispersal in and through the surrounding area.

The proposed project area is disturbed primarily due to clearing of vegetation within the servitude, presence of humans and associated impacts such as litter and livestock. Additional impacts include secondary and main roads, power and telephone lines as well as farming which resulted in many sites being scored low or not even being considered for the field assessment.

## 11.2 Riverine Ecology

The watercourses in the project area drain into the Vaal and the Pongola and Mtamvuna Water Management Areas (WMAs). A total of 30 riverine assessments were conducted to characterise the watercourses encountered during the proposed pipeline decommissioning. Standard riverine and wetland assessments were completed to define their spatial sensitivity and Present Ecological Status. The watercourses ranged from seriously modified (class E/F)

to largely natural (class B) according to biotic integrity of macroinvertebrate assemblages. A single protected fish species was collected during the study in the Vaal and Suikerbosrand systems, *Labeobarbus kimberleyensis*, which is listed as Near Threatened. The proposed activities do not pose a threat to the species populations should the pipeline be left *in situ*. Numerous drainage lines are encountered along the pipeline, these sites were delineated in the wetland assessment and appropriate buffers were applied. According to the proposed activities, recommended buffers and mitigations measures, the risks to the ephemeral and perennial watercourses were rated as low.

### 11.3 Wetlands

The combination of in-field and desktop delineation revealed a large number of wetland crossings (over 350). These systems varied considerably in hydrogeomorphic type, health, ecological importance and consequently in the ecosystem services they provide. To facilitate a practical and pragmatic approach to mitigating the potential effects of pipeline closure on these systems a decision was made to assign the various wetland systems a priority for mitigation action (1, Very High; 2, High; 3, Moderate and 4, Low). This rating was based primarily on hydroperiod (soil saturation levels) and ecological integrity. Generally, wetlands that were found to be more permanently saturated and ecologically intact were prioritised over wetlands that were more temporarily (ephemerally) inundated and adversely impacted. It is suggested that at least that priority 1 and 2 systems be considered for intensive mitigation. A total of 88 Priority 1 and 65 Priority 2 wetland crossings were identified along the pipeline route. Essentially two potential wetland risk scenarios are envisaged. Scenario 1 involves the removal of pipeline infrastructure from a given wetland. Scenario 2 involves the leaving of pipeline infrastructure in place followed by in-situ mitigation. Pipeline removal is considered the least favourable scenario due to the heightened hydrological risks associated with direct excavation and activities within the wetland. Scenario 1 is only included in the risk assessment in the unlikely event that an area of past contamination is identified, in which case the affected pipe and associated wetland soil needs to be removed and rehabilitated. In recognition of the potential impacts associated with pipeline removal the client intends to avoid Scenario 1 instead opting for non-invasive in-situ mitigation. Under this scenario, it is recommended that at sites earmarked as being of potential risk (Priority 1 and 2) that the mitigation as outlined in the risk assessment be applied while at all times remaining outside of the delineated wetland boundary and associated buffers as provided in the GIS shapefile provided to the client. Effective implementation of the suggested mitigation is anticipated to decrease the risk of all impacts associated with Scenario 2 to Low, and as such, a General Authorisation should be considered in terms of water use licensing. It is important to note that available research is yet to yield conclusive evidence for the conduit effect as a result of fuel pipeline abandonment and as such this project represents a pre-emptive approach following the precautionary principle.

## 12 Impact Statement

### 12.1 Terrestrial Ecosystems

Considering the above-mentioned conclusions, it is the opinion of the terrestrial specialists that, should the avoidance and mitigation actions proposed in this report be implemented, no significant fatal flaws could be determined as a result of the proposed project. The project can proceed, but only if the recommended mitigation measures are implemented.

### 12.1 Wetland and Riverine

Considering the above-mentioned conclusions, it is the opinion of the wetland and riverine specialists that, should the avoidance and mitigation actions proposed in this report be implemented, no significant fatal flaws could be determined as a result of the proposed project. It is thus the opinion of the specialists that the project can proceed, but only if the recommended mitigation measures are implemented.

## 13 Recommendations

A number of the points where the pipe will need to be exposed as part of the decommissioning phase, and also a few block valves that form part of the decommissioning phase, overlaps with the presented delineations and buffer areas. Taking into considering certain restraints associated with the decommissioning activities, selected buffer widths were re-examined and where feasible, these buffer widths reduced. In order to enable these reductions, further mitigation measures and recommendations have been prescribed for the specific points. Full reasoning for the buffers changed as well as ones that could not be changed can be seen in Table 100. It is apparent from these reductions that a rehabilitation plan is required for selected points, with the implementation of this plan important.

*Table 100: Recommendations for changes to buffers*

| TBC Number | Recommendation |
|---|---|
| | **Points to be opened** |
| **543** | Buffer originally 22m - plug point were 3m inside buffer therefore the buffer was reduced to 15m. Buffer reduced based on proximity of the road. |
| **542** | Buffer originally 22m- plug point 6m inside buffer- reduced to 15m: must demarcate and this needs to be strictly enforced due to coastal vegetation |
| **542** | Buffer originally 22m- plug point 4m inside buffer- Buffer reduced to 15m: must demarcate and this needs to be strictly enforced due to coastal vegetation. Buffer reduced based on proximity of the road. |
| **190** | Ridge buffer cannot be reduced. This falls inside the Free State, no legislation regrading ridges, but these areas are seen as highly sensitive. Work can only commence if the team are accompanied by an ECO and a rehabilitation plan is done for the footprint area. |
| **45** | Buffer to be reduced to 15m: rehabilitation needs to be prioritised |
| **25** | CBA important: All mitigations needs to be applied. Provincial authorities needs to be consulted to determine if work will be allowed in the CBA. |
| **18** | Inside wetland : buffer cannot be reduced. Recommend implementation of a rehabilitation plan. |
| **14** | Buffer 26m currently can be reduced to 15m: rehabilitation will be required. |
| **14** | Inside wetland : buffer cannot be reduced . Recommend implementation of a rehabilitation plan. |
| **13** | Inside wetland : buffer cannot be reduced . Recommend implementation of a rehabilitation plan. |
| **13** | Inside wetland : buffer cannot be reduced . Recommend implementation of a rehabilitation plan. |
| **12** | Buffer currently 26m; point 16m from delineation: Recommend implementation of a rehabilitation plan. |
| **12** | Buffer currently 26m; point 15m from delineation, however the vegetation cover is in a natural state currently. Recommend implementation of a rehabilitation plan. |
| **11** | Buffer currently 26m : point 4m from wetland. Recommend implementation of a rehabilitation plan. |
| **11** | CBA: Irreplaceable. All mitigations needs to be applied. Provincial authorities needs to be consulted to determine if work will be allowed in the CBA. |
| **11** | Buffer currently 26m: point 15m from wetland. Buffer reduced to 15m based on proximity of the road. |
| **11** | CBA: Irreplaceable. All mitigations needs to be applied. Provincial authorities needs to be consulted to determine if work will be allowed in the CBA. |
| **11** | 26m buffer, 15m from wetland. No change to buffer can be done. To accommodate for the 10m by 10m area, the buffer change will not be relevant. Recommend implementation of a rehabilitation plan. |
| **11** | 26m buffer, 4m from wetland. No change to buffer can be done. To accommodate for the 10m by 10m area, the buffer change will not be relevant. Recommend implementation of a rehabilitation plan. |

| | |
|---|---|
| **7** | 22m buffer, buffer reduced to 15m based on proximity of developed areas. |
| **7** | 22m buffer, point inside wetland. Recommend the point be moved or implement a rehabilitation plan. |
| **7** | 22m buffer, point 1m from wetland. Recommend the point be moved or implement a rehabilitation plan. |
| **7** | 22m buffer, point 4m from wetland. Recommend the point be moved or implement a rehabilitation plan. |
| **443** | CBA: Irreplaceable, ESA. All mitigations needs to be applied. Provincial authorities needs to be consulted to determine if work will be allowed in the CBA. |
| **443** | CBA: Irreplaceable, ESA. All mitigations needs to be applied. Provincial authorities needs to be consulted to determine if work will be allowed in the CBA. |
| **435** | 22m buffer, point inside wetland. Recommend the point be moved or implement a rehabilitation plan. |
| **435** | 22m buffer, point inside wetland. Recommend the point be moved or implement a rehabilitation plan. |
| | **Block valves** |
| **405** | CBA Irreplaceable. All mitigations needs to be applied. Provincial authorities needs to be consulted to determine if work will be allowed in the CBA. |
| **256** | CBA Optimal. All mitigations needs to be applied. Provincial authorities needs to be consulted to determine if work will be allowed in the CBA. |
| **150** | CBA 1. All mitigations needs to be applied. Provincial authorities needs to be consulted to determine if work will be allowed in the CBA. |
| **106** | Sungazers found in the area. Buffers cannot be reduced: Qualified herpetologist will need to accompany the team on foot into the area to ensure no sungazer burrows are present close to the area footprint |
| **23** | The block valve falls within the Rietvlei nature reserve and as such the buffer is based on legislation: Staff will need to be accompanied by reserve officials that must ensure no species are harmed during the process of decommissioning. |
| **304** | Block valve inside a wetland, however the decommissioning is regarded as part of the rehabilitation of the wetland. Recommendations: no vehicles, surface disturbances must be limited to valve footprint, rehabilitation of surface disturbances. Rehabilitation plan required |
| **256** | Buffer was 26m however to allow for the decommissioning the buffer was reduced to 18m. |
| **74** | Block valve inside a wetland, however the decommissioning is regarded as part of the rehabilitation of the wetland. Recommendations: no vehicles, surface disturbances must be limited to valve footprint, rehabilitation of surface disturbances. Rehabilitation plan required |
| **61** | Block valve inside a wetland, however the decommissioning is regarded as part of the rehabilitation of the wetland. Recommendations: no vehicles, surface disturbances must be limited to valve footprint, rehabilitation of surface disturbances. Rehabilitation plan required |
| **61** | Block valve inside a wetland, however the decommissioning is regarded as part of the rehabilitation of the wetland. Recommendations: no vehicles, surface disturbances must be limited to valve footprint, rehabilitation of surface disturbances. Rehabilitation plan required |
| **32** | Buffer is set at 17m and the block valve is located 7m inside of the buffer: unable to change the buffer. Recommendations: no vehicles, surface disturbances must be limited to valve footprint, rehabilitation of surface disturbances. Rehabilitation plan required |
| **19** | Buffer is set at 18m and the block valve is located 6m inside of the buffer: unable to change the buffer. Recommendations: no vehicles, surface disturbances must be limited to valve footprint, rehabilitation of surface disturbances. Rehabilitation plan required |
| **543** | Buffer is set at 22m and the block valve is located 6m inside of the buffer: unable to change the buffer on the basis that the vegetation surrounding the system is in a natural state. Recommendations: no vehicles, surface disturbances must be limited to valve footprint, rehabilitation of surface disturbances. Rehabilitation plan required |
| **304** | Inside the wetland/riparian buffer. Recommendations: no vehicles, surface disturbances must be limited to valve footprint, rehabilitation of surface disturbances |
| **61** | Inside the wetland/riparian buffer. Recommendations: no vehicles, surface disturbances must be limited to valve footprint, rehabilitation of surface disturbances |
| **61** | Inside the wetland/riparian buffer. Recommendations: no vehicles, surface disturbances must be limited to valve footprint, rehabilitation of surface disturbances |

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## Appendix A: Raw Terrestrial Appdata

| Site Code / Name | Date | Habitat Type | Impacts | Sensitivity | General discussion |
|---|---|---|---|---|---|
| **Point 25** | 10/28/2019 | Degraded, Secondary Grassland | Burning, Roads, Existing infrastructure | High | Ridge should be avoided on both sides. Stick to current infrastructure area using existing access |
| **Elardus Park** | 10/28/2019 | Transformed | Transformed adjacent to an urban greenbelt | Low | |
| **Pretoria West** | 10/28/2019 | Transformed | Industrial area, footpaths, road and litter | Low | |
| **Point 27** | 10/28/2019 | Degraded, Secondary Grassland | Burning, Livestock | Low | |
| **Point 29** | 10/28/2019 | Degraded, Grassland | Burning, Livestock , Roads | High | Stick to the existing infrastructure area. |
| **Point 32** | 10/28/2019 | Degraded, Secondary Grassland , Historical Impacts , Recent Disturbance | Burning, Alien vegetation, Litter and Dumping , Roads , Urban development Infringement | Low | Urban area impacts |
| **Point 35** | 10/28/2019 | Degraded, Secondary Grassland Secondary Grassland | Sewage, Aliens vegetation, Burning, Vegetation Clearing , Litter and Dumping , Urban development, Infringement | Low | |
| **Point 38** | 10/28/2019 | Degraded Secondary Grassland , Infrastructure , Historical Impacts , Recent Disturbance | Roads, Vegetation Clearing , Powerlines , Litter and Dumping , Roads , Urban development | Low | |
| **Point 37** | 10/28/2019 | Degraded Riparian | Alien vegetation , Litter and Dumping , Roads , Urban development | Moderate | Moderate due to the pan |
| **Point 61** | 10/29/2019 | Degraded Secondary Grassland , Riparian , Infrastructure , Historical Impacts | Farming , Alien vegetation , Vegetation Clearing , Roads | High | Riparian area |
| **Point 59** | 10/29/2019 | Degraded Secondary Grassland , Historical Impacts | Livestock , Alien vegetation , Powerlines , Roads, Old degraded Grassland due to livestock mainly | Low , Moderate | Degraded area with several wetlands. Fragmented from surrounding areas. |
| **Point 49** | 10/29/2019 | Natural , Degraded Riparian | Human waste dump, Roads, Rubble, Alien vegetation , Litter and Dumping , Roads | Moderate | Large wetland area with patches of impacts and a human waste dump nearby. |

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|---|---|---|---|---|---|
| **Point 48** | 10/29/2019 | Natural , Degraded Riparian | Sewage, Livestock , Farming , Alien vegetation , Roads | Moderate | |
| **Point 47** | 10/29/2019 | Degraded Secondary Grassland , Recent Disturbance | Livestock Trampling, Infringement Livestock , Alien vegetation , Litter and Dumping , Roads, Large wetland mainly impacted by livestock | High | |
| **Point 46** | 10/29/2019 | Natural , Degraded Secondary Grassland , Historical Impacts | Urban area, Dumping Litter and Dumping , Roads , Urban development | High | Nice Grassland with a rocky outcrop |
| **Magdala station** | 2019/01/11 | Degraded , Transformed Secondary Grassland , Infrastructure | Cattle, Existing infrastructure, Livestock , Vegetation Clearing , Powerlines , Roads | Low | |
| **Point 69** | 2019/04/11 | Degraded, Secondary Grassland | Livestock , Farming , Vegetation Clearing , Roads, Maintenance impacts | Low | Ridge to the south of the pipeline. |
| **Point 68** | 2019/04/11 | Degraded, Grassland , Secondary Grassland | No real impact. Grazing mainly Livestock | Low , Moderate | Avoid wetland and limit impact to pipeline area |
| **Point 70** | 2019/04/11 | Degraded, Secondary Grassland | Mainly cattle and associated impacts Erosion , Livestock | Moderate | Avoid wetland |
| **Point 73** | 2019/04/11 | Degraded, Secondary Grassland | Cattle Erosion , Livestock , Roads | Low , Moderate | Ridge in close proximity. Avoid ridge and wetland |
| **Point 74** | 2019/04/11 | Degraded, Secondary Grassland | Cattle Farming, Vegetation clearing on pipeline, Livestock | Low | Cattle Farming with vegetation being cleared on pipeline. |
| **Point 84** | 2019/04/11 | Natural , Degraded Secondary Grassland , Riparian | Cattle and associated impacts Erosion , Livestock Mainly grazing by cattle, trampling of the riparian area | Low , Moderate | Stay out of the river area |
| **Point 91** | 2019/04/11 | Degraded, Secondary Grassland | Erosion , Livestock | Low | Small ridge between 90 and 91 |
| **Point 91** | 2019/04/11 | Degraded, Secondary Grassland | Erosion , Livestock | Low | Small ridge between 90 and 92 |
| **Point 94** | 2019/04/11 | Degraded, Secondary Grassland , Riparian | Cattle, Erosion , Livestock | Low , Moderate | Riparian area sensitive. Ridge to the NW |

| | | | | | |
|---|---|---|---|---|---|
| **Point 101** | 2019/04/11 | Degraded, Secondary Grassland | Overgrazing Livestock , Roads | Low | General farming impacted area |
| **Point 106** | 2019/04/12 | Degraded, Secondary Grassland | Erosion , Livestock | High | Sungazers presents |
| **Point 107** | 2019/04/11 | Degraded, Secondary Grassland | Erosion , Livestock | High | Sungazers presents |
| **Point 110** | 2019/04/11 | Degraded, Secondary Grassland , Riparian | Agriculture, Water treatment | Moderate | Wetland surrounded by agriculture |
| **Point 120** | 2019/04/11 | Degraded, Secondary Grassland | Livestock , Farming , Roads | Low-Moderate | Artificial dam |
| **Point 121** | 2019/04/11 | Degraded, Secondary Grassland , Riparian | Agriculture Farming , Vegetation Clearing , Roads | Low-Moderate | Wetland /River with agriculture on both sides |
| **Point 132** | 2019/04/11 | Natural , Degraded Secondary Grassland , Riparian | Livestock , Farming | Moderate , High | Nice farm dam with intact to semi natural Grassland. |
| **Bethlehem Station** | 2019/04/11 | Degraded , Transformed Infrastructure , Historical Impacts , Recent Disturbance | Sewage, livestock , Alien vegetation , Powerlines , Litter and Dumping , Roads , Urban development | Low | Mitigations and rehab will be essential |
| **Point 144** | 2019/04/11 | Degraded, Secondary Grassland , Riparian | Cattle, Roads and human presence, Erosion , Livestock , Alien vegetation , Litter and Dumping , Roads , Urban development | Low , Moderate | Avoid riparian and ridge area. |
| **Point 145** | 2019/05/11 | Natural , Degraded Secondary Grassland , Riparian , Historical Impacts | Farming, Livestock , Farming , Alien vegetation , Roads Indirect impacts to the artificial dam and wetland area | Low , Moderate | Wetland area fragmented by farming and dammed. Pump from agricultural area. |
| **Point 152** | 2019/05/11 | Degraded, Secondary Grassland | Livestock , Farming , Roads Cattle grazing within fenced off wetland | Low , Moderate | Wetland and adjacent Grassland degraded by cattle grazing and indirect fragmentation due to agriculture. Pump from outside the fence |
| **Point 153** | 2019/05/11 | Degraded, Secondary Grassland , Historical Impacts | Livestock , Farming , Roads, Cattle grazing directly on the fenced off area which is surrounded by agriculture | High | Pump from outside fenced off area. |
| **Point 154** | 2019/05/11 | Degraded, Secondary Grassland , Historical Impacts | Erosion , Livestock , Farming , Roads | Low , Moderate | Functional as a Corridor and water resource. Pump from agricultural area. |

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|---|---|---|---|---|---|
| | | | Fragmented by land use. | | |
| **Point 169** | 2019/05/11 | Degraded, Secondary Grassland | Farming, Alien vegetation , Roads Cattle Grazing directly with agriculture around. | Low | Wetland area, pump from agriculture. |
| **Point 177** | 2019/05/11 | Degraded, Secondary Grassland, Riparian | Fences, Livestock, Farming , Roads, Vegetation clearing | Moderate-High | Pump from agricultural area. Ridge to the east and riparian area in good condition. |
| **Point 182** | 2019/05/11 | Degraded, Secondary Grassland , Historical Impacts , Recent Disturbance | Pipeline construction, Livestock, Alien vegetation , Litter and Dumping , Roads , Urban development Very impacted area due to proximity to the informal area. Goats and cattle have overgrazed it. | High | Small stream still functions as a water resource. Bald ibis observed foraging. |
| **Point 189** | 2019/05/11 | Natural , Degraded Secondary Grassland , Riparian , Historical Impacts | Livestock , Alien vegetation | Moderate | Nice river with associated floodplain. Pump from Road on either side |
| **Point 193** | 2019/05/11 | Degraded, Secondary Grassland , Historical Impacts | Erosion , Livestock , Alien vegetation, Eroded drainage area, dammed up seems artificial. | High | Degraded area. Pump from agriculture, Blue Korhaan and Blue Crane present |
| **Point 196,197** | 2019/05/11 | Degraded, Secondary Grassland , Historical Impacts | Livestock , Roads | High | Nice Grassland, even though degraded. Important and sensitive. Sungazers present. |
| **Point 201** | 2019/05/11 | Degraded, Secondary Grassland , Historical Impacts , Recent Disturbance | Livestock , Alien vegetation , Roads | Moderate | Nice Rocky grassland adjacent to the areas. If wet at all, pump from existing infrastructure areas |
| **Point 202** | 2019/05/11 | Degraded, Secondary Grassland , Historical Impacts , Recent Disturbance | Livestock , Litter and Dumping , Roads, Human presence with associated disturbance, livestock includes horses, goats and cattle | Low , Moderate | Ridge area to the west is most sensitive next to wetland areas |
| **Point 208** | 2019/05/11 | Degraded, Secondary Grassland , Riparian | Road, Erosion , Livestock | Low | |
| **Point 209,210** | 2019/05/11 | Secondary Grassland , Riparian , Historical Impacts , Recent Disturbance | Road, Erosion , Livestock | Low , Moderate | Pump from the road. |

| | | | | | |
|---|---|---|---|---|---|
| **Point 211** | 2019/05/11 | Degraded, Secondary Grassland , Historical Impacts , Recent Disturbance | Unregulated burning, Livestock , Farming , Roads | Low , Moderate | The farm dam is large and supports avifauna and is a Corridor. Pump from degraded areas |
| **Point 219** | 2019/06/11 | Degraded, Secondary Grassland | Urban area impacts, littering, Livestock , Vegetation Clearing , Litter and Dumping , Roads | Low | Area not too sensitive wetland and ridge to the north that should be avoided by staff |
| **Point 220** | 2019/06/12 | Secondary Grassland | Livestock , Roads and the community in close proximity. | High | Bald Ibis, wetland and spruit |
| **Point 221,222** | 2019/06/11 | Degraded, Secondary Grassland , Thicket | Erosion , Livestock , Vegetation Clearing , Roads | High | The presence of the intact forest thicket with protected tree species (Yellowwood) makes the adjacent area sensitive. |
| **Van Reenen station** | 2019/06/11 | Degraded , Transformed Secondary Grassland , Historical Impacts , Recent Disturbance | Livestock , Alien vegetation , Powerlines , Litter and Dumping , Roads | Moderate | Topography sensitive, erosion control mitigations. Alien Veg clearance. Avoid ridge to the north. |
| **Point 232** | 2019/06/11 | Degraded, Secondary Grassland , Riparian | Livestock , Farming , Roads | Low , Moderate | Nice stream. Pump from agriculture |
| **Point 230** | 2019/06/11 | Natural , Degraded Secondary Grassland , Riparian , Historical Impacts , Recent Disturbance | Alien vegetation, Livestock , Farming , Roads | Moderate | Nice little stream surrounded by mountain Grassland which is still functional |
| **Point 250** | 2019/06/11 | Natural Grassland | Livestock , Vegetation Clearing, pipeline maintenance | Moderate | |
| **Point 256** | 2019/06/11 | Natural Grassland , Secondary Grassland | Cattle Livestock , Roads | High | Nice bushveld. Pump from existing infrastructure. |
| **Point 258** | 2019/06/11 | Natural , Degraded Grassland , Riparian | Livestock | Moderate | Nice stream/drain area. Dry at the moment. Pump from the east/roadside. Nice habitat to the west of the crossing. |
| **Point 265** | 2019/06/11 | Natural , Degraded Grassland , Historical Impacts | Livestock , Roads, vegetation clearing from maintaining the pipe | Moderate | Pump from the Road and the property NW |
| **Point 270** | 2019/06/12 | Wetland depression area around the Rensburg spruit | Erosion, Livestock , Vegetation Clearing , Roads and the urban area. | High | Exceptionally high richness and abundance of waterfowl in correlation with the wastewater treatment works. Potential to support significant congregations of migratory species. A |

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| | | | | | green Island within the Ladysmith urban area. |
| **Point 282** | 2019/06/11 | Natural , Degraded Grassland , Secondary Grassland | Roads, Vegetation clearance, Informal Settlements, Livestock | Moderate | Nice Rocky ridge bushveld. Intact except for overgrazing. Pump from downhill. |
| **Point 280** | 2019/06/11 | Degraded , Transformed Secondary Grassland , Historical Impacts , Recent Disturbance | Severely overgrazed. Informal settlement area, Erosion , Livestock , Alien vegetation , Vegetation Clearing , Litter and Dumping , Roads , Urban development | High | Pump from outside wetlands and stream(dry) at 281 |
| **Point 287** | 2019/06/11 | Natural Grassland | Roads | High | Tugela Private Game Reserve. |
| **Point 323** | 2019/07/11 | Natural , Degraded Grassland , Secondary Grassland | Livestock , Roads | Moderate | Nice bushveld with drainage to the west. Pump from cleared area. |
| **Point 324** | 2019/07/11 | Natural , Degraded Grassland , Historical Impacts , Recent Disturbance | Roads, vegetation clearance | High | Game reserve. 324 seems dry, ridge. |
| **Point 330** | 2019/07/11 | Natural , Degraded Grassland | No real impact except the disturbed condition of the habitat surrounding the pipeline | Moderate | Game farm area. Pump from outside wet area. Limit impact to pipeline area. |
| **Point 339** | 2019/07/11 | Natural , Degraded Secondary Grassland | Pipeline maintenance, Livestock , Roads | High | Pump from anywhere outside river area within pipeline concession. |
| **Point 342** | 2019/07/11 | Natural , Degraded Secondary Grassland , Historical Impacts | Pipeline maintenance, Livestock , Vegetation Clearing | Low , Moderate | Nice mountain to the south. Pump from road |
| **Point 343** | 2019/07/11 | Natural , Degraded Secondary Grassland | Dammed up drainage area, Livestock | Low , Moderate | Ridge to the north. Pump from either side outside wetland area avoiding the ridge. |
| **Point 350,351** | 2019/07/11 | Natural , Degraded Secondary Grassland , Historical Impacts | Pipeline maintenance, Livestock , Vegetation Clearing , Powerlines , Roads | Low , Moderate | Drainage area with a ridge to the north. Best to pump from the south as it is more degraded. |
| **Point 361** | 2019/07/11 | Natural Grassland , Secondary Grassland | Area has been burnt recently, Livestock | High | Intact Grassland . Antelope observed (Southern Reed buck) |
| **Point 371** | 2019/07/12 | Grasslands around the Mooi river | Livestock, Roads and farm development | High | Mooi river with associated riparian habitat |

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| **Point 381** | 2019/07/11 | Degraded , Transformed Secondary Grassland , Riparian , Historical Impacts , Recent Disturbance | Eucalyptus plantations, Vegetation Clearing | High | Grassland to the north. Pump from plantation area to the south. |
| **Point 398** | 2019/08/11 | Natural, Secondary Grassland | Livestock , Roads | High | Grassland. Pump from road |
| **Point 404** | 2019/07/11 | Natural , Degraded Grassland , Secondary Grassland , Riparian , Historical Impacts , Recent Disturbance | Pipeline maintenance, Cattle Livestock , Vegetation Clearing | Moderate | Stream with natural Grassland. Ridge to the north. Pump from existing infrastructure |
| **Point 408** | 2019/07/11 | Natural , Degraded Grassland , Secondary Grassland , Historical Impacts , Recent Disturbance | Burning, Roads, Powerlines | High | Rocky Ridge |
| **Point 407** | 2019/07/11 | Natural Secondary Grassland | Livestock | Low , Moderate | Ridge to the north. Avoid ridge and riparian area. Pump from grazed area to the south |
| **Point 402** | 2019/07/11 | Natural , Degraded Secondary Grassland , Historical Impacts , Recent Disturbance | Farming , Powerlines Adjacent impacts | Moderate | Mountain Grassland to the north. Agriculture to the south. Pump from agriculture |
| **Point 420** | 2019/11/11 | Degraded Grassland , Riparian | Alien vegetation , Vegetation Clearing , Powerlines , Roads , Urban development | High | Wetland sensitive. Cacosternum heard. Crinum bulbispermum within wetland and along servitude |
| **Point 423** | 2019/08/11 | Degraded Thicket , Riparian | Burning, solid waste, Alien vegetation , Vegetation Clearing , Litter and Dumping , Urban development | Moderate | Pipeline runs within the thicket. Sand should be pumped from field to the East |
| **Point 425** | 2019/11/11 | Degraded Grassland , Riparian | Vegetation clearing, fences, Livestock , Farming , Alien vegetation | High | Cacosternum heard calling. Spotted necked Otter scat found. Rocky outcrop adjacent to wetland. Sand should be pumped from the plateau of the agricultural field to the East or plateau of the Wattle stand to the South. Ledebouria revoluta located within servitude |
| **Point 426** | 2019/11/11 | Degraded , Transformed, Secondary Grassland , Riparian | Farming , Powerlines | High | Wetlands sensitive. Crowned cranes observed |

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| **Point 437** | 2019/11/11 | Transformed, Riparian | Solid waste, Erosion, pylons, Alien vegetation , Vegetation Clearing , Powerlines , Litter and Dumping , Roads , Urban development | Moderate | The South bank is owned by Ascot Bush Lodge. |
| **Point 450** | 2019/11/12 | Grassland , Thicket , Riparian | Alien vegetation , Vegetation Clearing , Roads | High | The riparian zone and adjacent thornveld is regarded as sensitive. *Ledebouria revoluta* and *Hypoxis hemerocallidea* occur on the servitude. |
| **Point 443** | 2019/12/11 | Natural Thicket , Riparian | Alien vegetation , Vegetation Clearing | High | Natural vegetation along route. |
| **Point 445** | 2019/12/11 | Natural Thicket | Vegetation clearing, possible Alien vegetation, Site could not be accessed but other impacts are possible | High | Vegetation is natural. |
| **Point 447** | 2019/12/11 | Natural Thicket | Alien vegetation , Vegetation Clearing Other impacts possible but site could not be accessed. | High | |
| **Point 459** | 2019/11/11 | Degraded, Secondary Grassland , Recent Disturbance | Livestock, agriculture, forestry, Roads | Low | |
| **Point 460** | 2019/11/11 | Transformed, Historical Impacts , Recent Disturbance | agriculture, forestry, Alien vegetation , Vegetation Clearing , Roads | Low | Area is transformed. No sensitive habitats or species observed. Sand supply can be used from local source. |
| **Point 468** | 2019/11/11 | Natural Grassland , Riparian | Vegetation clearing, erosion, Alien vegetation | High | Sand to be potentially pumped from field on the northern side of the road. |
| **Point 470** | 2019/12/11 | Natural Grassland , Riparian | Vegetation clearing, erosion, Alien vegetation | High | Sand to be potentially pumped from field on the northern side of the road. |
| **Point 471** | 2019/12/11 | Degraded, Secondary Grassland , Riparian | Vegetation clearing, Erosion , Alien vegetation , Roads | High | Riparian zone and immediate surrounds are regarded as sensitive. This is because it is used as a corridor, although it is degraded. |
| **Point 476** | 2019/12/11 | Natural Grassland , Thicket | Alien vegetation , Vegetation Clearing | High | Vegetation surrounding the route is natural. Relatively high biodiversity. Cape Vulture observed. Hypoxis hemerocallidea and H. angustifolia present in grassland |

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| | | | | | and servitude. Property belongs to rainbow farms. |
| **Point 480** | 2019/12/11 | Natural Thicket | Vegetation clearing, Erosion , Alien vegetation , Vegetation Clearing , Snares/Hunting , Litter and Dumping | High | Biodiversity relatively high. Numerous bird species recorded. |
| **Point 482** | 2019/12/11 | Natural Thicket | Vegetation clearing, Livestock , Alien vegetation , Snares/Hunting , Litter and Dumping | High | CBA. Points 482 - 486 same habitat. |
| **Point 482** | 11/13/2019 | Natural Thicket | Vegetation clearing, Livestock , Alien vegetation , Snares/Hunting , Litter and Dumping | High | CBA. Points 482 - 486 same habitat. |
| **Point 483** | 11/13/2019 | Natural Thicket | Vegetation clearing, Livestock , Alien vegetation , Snares/Hunting , Litter and Dumping, Erosion | High | Although there are impacts surrounding vegetation is natural. Eulophia parviflora observed within the vegetation. |
| **Point 484** | 11/13/2019 | Natural Thicket | Vegetation clearing, Alien vegetation , Snares/Hunting , Litter and Dumping | High | Surrounding vegetation is largely natural. CBA. Eulophia parviflora observed within the vegetation. |
| **Point 486** | 11/13/2019 | Degraded Thicket , Riparian | Vegetation clearing, Livestock , Alien vegetation , Snares/Hunting , Litter and Dumping | High | Although degraded the surrounding area is predominantly natural. Drainage line is an important corridor. |
| **Point 489** | 11/13/2019 | Natural Grassland , Thicket , Riparian | Livestock , Alien vegetation , Vegetation Clearing , Roads | High | Vegetation in surrounding area largely natural. Hypoxis hemerocallidea present within servitude and surrounding grassland. |
| **Point 492** | 11/13/2019 | Degraded, Secondary Grassland | Erosion , Livestock , Alien vegetation , Vegetation Clearing , Litter and Dumping | High | Habitat is semi-natural. However, *Hypoxis angustifolia, H. hemerocallidea* and *B. disticha* present within grassland and servitude. Rocky outcrops are to be avoided. |
| **Point 494** | 11/13/2019 | Degraded, Riparian | Erosion , Livestock , Alien vegetation , | Moderate | Riparian vegetation regarded as moderate sensitivity |

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| | | | Vegetation Clearing | | due to intensive growth of IAPs. No SCC or protected species observed. |
| **Point 497** | 11/13/2019 | Degraded, Secondary Grassland , Thicket | Erosion , Livestock , Alien vegetation | Low | |
| **Point 500** | 11/13/2019 | Degraded, Thicket | Alien vegetation , Roads | Low | largely degraded. |
| **Point 502** | 11/13/2019 | Degraded, Historical Impacts , Recent Disturbance | Alien vegetation , Vegetation Clearing , Powerlines , Roads | Low | Site is degraded although IAP clearing is presently occurring. No SCC or protected species observed. |
| **Point 503** | 11/13/2019 | Natural , Degraded Riparian | Alien vegetation , Vegetation Clearing , Roads | High | Although also regarded as degraded, this is predominantly along the edge and indigenous vegetation is ubiquitous within the riparian forest interior. Clearing of IAPs is currently occurring. There is a rocky ridge along the route towards the South and the surrounding grassland is regarded as sensitive. *Merwilla plumbea* and *Hypoxis hemerocallidea* present. |
| **Point 507** | 11/13/2019 | Transformed, Secondary Grassland , Thicket , Riparian | Alien vegetation | Moderate , High | Private property. Regarded as moderate - high sensitivity as although transformed, this route possesses predominantly indigenous vegetation and includes wetlands. |
| **Point 504** | 11/14/2019 | Transformed, Thicket , Historical Impacts , Recent Disturbance | Alien vegetation , Urban development | Low | Urban private property surrounding pipeline. Appears to be composed of exotic species. |
| **Point 518** | 11/14/2019 | Natural , Degraded Secondary Grassland , Riparian | Alien vegetation , Vegetation Clearing , Litter and Dumping , Roads , Urban development Impacts tend to be limited closer to urban development and IAPs along the riparian zone. | High | Although degraded along the route this tends to concentrate along roads and urban developments. As the route proceeds East, the grassland quality improves. Riparian zone used as a corridor by avifauna. Therefore, the vegetation along this route regarded as moderate-high sensitivity. |
| **Point 519** | 11/14/2019 | Natural , Degraded Secondary | Erosion , Alien vegetation , Litter | High | Forest patches dominated by |

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| | | Grassland , Thicket , Riparian | and Dumping , Roads Litter and dumping limited to road. Erosion and IAPs concentrated along riverbanks. | | indigenous vegetation. Grassland along NE route in semi-natural condition. Eulophia species present. Possible source of sand is transformed area to the South. |
| **Point 521** | 11/14/2019 | Natural Thicket , Riparian | Alien vegetation , Vegetation Clearing | High | Protected coastal forest. Named Marian wood Nature Reserve. 500 m buffer. |
| **Point 522** | 11/14/2019 | Natural , Degraded Grassland , Riparian | Vegetation Clearing , Litter and Dumping , Roads , Urban development Impacts tend to be limited along periphery and servitude. | High | Grassland and riparian vegetation are predominantly natural, albeit with degradation due to edge effects. Grassland and associated seeps, including servitude, possesses *Merwilla plumbea, Kniphofia* spp, *Hypoxis angustifolia, Zantedeschia aethiopica* and *Sclerocarya birrea.* Consequently, regarded as sensitive habitat |
| **Point 524** | 11/14/2019 | Natural Grassland , Riparian | Alien vegetation , Vegetation Clearing , Litter and Dumping concentrated near houses and IAPs within riparian zone. | High | Surrounding vegetation largely natural. *Merwilla plumbea* and *Sclerocarya birrea* present within grassland |
| **Point 527** | 11/14/2019 | Natural , Degraded Thicket | Alien vegetation , Vegetation Clearing , Roads | High | |
| **Point 530** | 11/14/2019 | Degraded Thicket , Riparian | Alien vegetation , Vegetation Clearing | Moderate , High | Considering the riparian zone, regarded as moderate-high sensitivity. |
| **Point 531** | 11/14/2019 | Degraded Thicket , Riparian | Alien vegetation , Vegetation Clearing | Moderate , High | Considering the riparian habitat, regarded as moderate-high sensitivity. |
| **Point 532** | 11/14/2019 | Degraded Thicket , Riparian | Erosion , Alien vegetation , Vegetation Clearing , Litter and Dumping , Roads | Low , Moderate | Route is highly degraded. Thicket is regarded as possessing low sensitivity and riparian as possessing moderate sensitivity. |
| **Point 533** | 11/15/2019 | Natural , Degraded Thicket , Riparian | Alien vegetation , Vegetation Clearing , Litter and Dumping | High | Although degraded along the servitude, the surrounding vegetation is predominantly |

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| | | | | | comprised of indigenous flora. *Freesia laxa* and *Hypoxis hemerocallidea* occur within the servitude. |
| **Point 534** | 11/15/2019 | Degraded, Thicket | Alien vegetation , Vegetation Clearing | High | Vegetation appears to be degraded. |
| **Point 535** | 11/15/2019 | Natural , Degraded Thicket , Riparian | Erosion , Alien vegetation , Vegetation Clearing , Powerlines , Litter and Dumping | High | Although degraded along the servitude and urban edge, vegetation interior consists primarily of indigenous flora. *Scadoxus puniceus* and *Freesia laxa* occurs in the servitude. Possible source of sand is quarry to the East. |
| **Point 539** | 11/15/2019 | Degraded, Riparian | Alien vegetation , Vegetation Clearing , Litter and Dumping | Low , Moderate | Site is largely degraded due to the presence of the Umbilo Canal and proximal urban development. Rated as possessing a low-moderate sensitivity as there are interspersed indigenous trees such as *Syzygium cordatum* and *Ekebergia capensis.* |
| **Point 540** | 11/15/2019 | Degraded, Riparian | Alien vegetation , Vegetation Clearing , Roads , Urban development | Low , Moderate | Site is largely degraded due to the presence of the Umbilo Canal and proximal urban development. Rated as possessing a low-moderate sensitivity as the route is interspersed with indigenous trees such as *Syzygium cordatum* and *Ekebergia capensis.* |
| **Point 542** | 11/15/2020 | Thicket, artificial dam | Alien vegetation , Vegetation Clearing , Powerlines , Urban development | High | Pink-backed pelican |
| **Point 543** | 11/15/2019 | Degraded, Riparian | Alien vegetation , Vegetation Clearing , Powerlines , Urban development | Low | |
| **Point 538** | 11/15/2019 | Degraded , Transformed Riparian | Alien vegetation , Vegetation Clearing , Litter and Dumping , Roads , Urban development | Low | Highly transformed site. No SCC or protected species observed. |

Appendix B: Wetland spatial data

| Code | Name | HGM | Priority | EIS | PES | Ecosystem services | Buffer | Area_ha |
|---|---|---|---|---|---|---|---|---|
| **1** | D123BAVH | Floodplain | 1A | A | B | H | 30 | 0.483 |
| **2** | D129BAH | Floodplain | 1A | A | E | H | 30 | 0.617 |
| **3** | D138BAH | Floodplain | 1A | A | B | H | 30 | 0.273 |
| **4** | D156DCH | Floodplain | 1A | C | D | H | 22 | 1.447 |
| **5** | D36BBH | Floodplain | 1A | B | B | H | 26 | 0.241 |
| **6** | D41BAH | Floodplain | 1A | A | B | H | 30 | 0.434 |
| **7** | D42BAH | Floodplain | 1A | A | B | H | 30 | 0.554 |
| **8** | D53BBH | Floodplain | 1A | B | B | H | 26 | 1.965 |
| **9** | D81BBVH | Floodplain | 1A | B | B | H | 26 | 1.037 |
| **10** | D91BAVH | Floodplain | 1A | A | B | H | 30 | 2.886 |
| **11** | D93BBH | Floodplain | 1A | B | B | H | 26 | 0.43 |
| **12** | W126DBH | Floodplain | 1A | B | D | H | 26 | 1.034 |
| **13** | W128CAH | Floodplain | 1A | A | C | H | 30 | 1.168 |
| **14** | W144 | Floodplain | 1A | A | C | H | 30 | 1.97 |
| **15** | W204 | Floodplain | 1A | C | B | H | 22 | 4.444 |
| **16** | W47 | Floodplain | 1A | A | C | H | 30 | 4.981 |
| **17** | W60 | Floodplain | 1A | B | C | I | 26 | 10.847 |
| **18** | D135BBH | Channelled valley-bottom | 1B | B | B | H | 26 | 1.71 |
| **19** | D163BAH | Channelled valley-bottom | 1B | A | B | H | 30 | 0.814 |
| **20** | D165BAVH | Channelled valley-bottom | 1B | A | B | H | 30 | 0.295 |
| **21** | D172CBI | Channelled valley-bottom | 1B | B | C | I | 26 | 0.162 |
| **22** | D173BBH | Channelled valley-bottom | 1B | B | B | H | 26 | 0.124 |
| **23** | D174BBH | Channelled valley-bottom | 1B | B | B | H | 26 | 0.138 |
| **24** | D175BBH | Channelled valley-bottom | 1B | B | B | H | 26 | 0.252 |
| **25** | D177BBH | Channelled valley-bottom | 1B | B | B | H | 26 | 0.403 |
| **26** | D178CBH | Channelled valley-bottom | 1B | B | C | H | 26 | 0.503 |
| **27** | D180CCI | Channelled valley-bottom | 1B | C | C | I | 22 | 0.126 |
| **28** | D184CCI | Channelled valley-bottom | 1B | C | C | I | 22 | 0.079 |

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| **29** | D185CBH | Channelled valley-bottom | 1B | B | C | H | 26 | 0.188 |
| **30** | D186BCI | Channelled valley-bottom | 1B | C | B | I | 22 | 0.181 |
| **31** | D187CCI | Channelled valley-bottom | 1B | C | C | I | 22 | 0.167 |
| **32** | D188CCI | Channelled valley-bottom | 1B | C | C | I | 22 | 0.344 |
| **33** | D189CCI | Channelled valley-bottom | 1B | C | C | I | 22 | 0.293 |
| **34** | D190BBH | Channelled valley-bottom | 1B | B | B | H | 26 | 0.081 |
| **35** | D31BBH | Channelled valley-bottom | 1B | C | B | H | 22 | 0.75 |
| **36** | D362CBH | Channelled valley-bottom | 1B | B | C | H | 26 | 0.619 |
| **37** | D383CBH | Channelled valley-bottom | 1B | B | C | H | 26 | 0.254 |
| **38** | D44BBH | Channelled valley-bottom | 1B | B | B | H | 26 | 1.031 |
| **39** | D524 | Channelled valley-bottom | 1B | C | C | H | 22 | 0.401 |
| **40** | D5BBH | Channelled valley-bottom | 1B | B | B | H | 26 | 0.885 |
| **41** | D5BBH | Channelled valley-bottom | 1B | B | B | H | 26 | 0.179 |
| **42** | D5BBH | Channelled valley-bottom | 1B | B | B | H | 26 | 0.455 |
| **43** | D72BBH | Channelled valley-bottom | 1B | B | B | H | 26 | 1.047 |
| **44** | D74BBH | Channelled valley-bottom | 1B | B | B | H | 26 | 0.229 |
| **45** | D76BBH | Channelled valley-bottom | 1B | B | B | H | 26 | 0.482 |
| **46** | W120DCML | Channelled valley-bottom | 1B | C | D | ML | 22 | 0.023 |
| **47** | W120DCML | Channelled valley-bottom | 1B | C | D | ML | 22 | 0.072 |
| **48** | W122CCI | Channelled valley-bottom | 4B | C | C | I | 22 | 0.057 |
| **49** | W131CBI | Channelled valley-bottom | 1B | B | C | I | 26 | 0.075 |
| **50** | W133DCI | Channelled valley-bottom | 1B | C | D | I | 22 | 0.309 |

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| **51** | W134DCI | Channelled valley-bottom | 1B | C | D | I | 22 | 0.157 |
| **52** | W146ECL | Channelled valley-bottom | 4B | C | E | L | 22 | 0.093 |
| **53** | W171BBH | Channelled valley-bottom | 1B | B | B | H | 26 | 0.242 |
| **54** | W190 | Channelled valley-bottom | 1B | B | C | H | 26 | 0.367 |
| **55** | W196CCI | Channelled valley-bottom | 1B | C | C | I | 22 | 0.94 |
| **56** | W198CCI | Channelled valley-bottom | 1B | C | C | I | 22 | 0.423 |
| **57** | W332 | Channelled valley-bottom | 1B | A | C | MH | 30 | 0.139 |
| **58** | W419DCI | Channelled valley-bottom | 1B | C | D | I | 22 | 0.671 |
| **59** | W497CBI | Channelled valley-bottom | 1B | B | C | I | 26 | 0.581 |
| **81** | W25 | Channelled valley-bottom | 1B | A | B | MH | 25 | 0.18 |
| **60** | D133BBH | Unchanneled valley-bottom | 1C | B | B | H | 22 | 0.362 |
| **61** | D147BAVH | Unchanneled valley-bottom | 1C | A | B | H | 25 | 0.916 |
| **62** | D148BAVH | Unchanneled valley-bottom | 1C | A | B | H | 25 | 0.768 |
| **63** | D152DBH | Unchanneled valley-bottom | 1C | B | D | H | 22 | 0.446 |
| **64** | D15BBH | Unchanneled valley-bottom | 1C | B | C | H | 22 | 0.207 |
| **65** | D168CBH | Unchanneled valley-bottom | 1C | C | C | H | 18 | 0.423 |
| **66** | D179CBH | Unchanneled valley-bottom | 1C | B | C | H | 22 | 0.244 |
| **67** | D181CCI | Unchanneled valley-bottom | 1C | C | C | I | 18 | 0.19 |
| **69** | D182CBI | Unchanneled valley-bottom | 1C | B | C | I | 22 | 0.135 |
| **70** | D183CCI | Unchanneled valley-bottom | 1C | C | C | I | 18 | 0.146 |
| **71** | D208DCI | Unchanneled valley-bottom | 1C | C | D | I | 18 | 1 |
| **73** | D209EDL | Unchanneled valley-bottom | 1C | D | E | L | 14 | 1.364 |

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| **74** | D214CBH | Unchanneled valley-bottom | 1C | B | C | H | 22 | 0.433 |
| **75** | D410CCH | Unchanneled valley-bottom | 1C | C | C | H | 18 | 3.656 |
| **76** | W131CBH | Unchanneled valley-bottom | 1C | C | C | H | 18 | 0.433 |
| **77** | W151BAVH | Unchanneled valley-bottom | 1C | C | B | H | 18 | 0.372 |
| **78** | W176CBH | Unchanneled valley-bottom | 1C | B | C | H | 22 | 0.123 |
| **79** | W178CBH | Unchanneled valley-bottom | 4C | B | C | H | 22 | 0.128 |
| **80** | W179BBH | Unchanneled valley-bottom | 1C | B | B | H | 22 | 0.612 |
| **82** | W29 | Unchanneled valley-bottom | 1C | A | B | MH | 25 | 1.879 |
| **83** | W402CBH | Unchanneled valley-bottom | 4C | B | C | H | 22 | 0.085 |
| **84** | W501BBH | Unchanneled valley-bottom | 1C | B | B | H | 22 | 0.192 |
| **85** | W127CBH | Flat | 1D | B | C | H | 22 | 4.428 |
| **86** | W147BBVH | Flat | 1D | B | B | H | 22 | 1.385 |
| **87** | W59 | Flat | 1D | B | C | MH | 22 | 3.681 |
| **88** | D211CDI | Depression | 1F | D | C | I | 12 | 0.399 |
| **89** | W37 | Seep | 1F | A | B | MH | 25 | 0.921 |
| **90** | W37 | Depression | 1F | A | B | MH | 20 | 0.313 |
| **91** | D120CCI | Floodplain | 2A | C | C | L | 22 | 0.472 |
| **92** | D14CCM | Floodplain | 2A | C | C | MH | 22 | 0.327 |
| **93** | D21CBH | Floodplain | 2A | B | C | H | 26 | 0.296 |
| **94** | D23DBH | Floodplain | 2A | B | D | H | 26 | 1.28 |
| **95** | W270 | Floodplain | 2A | C | D | H | 22 | 3.145 |
| **96** | W49 | Floodplain | 2A | C | D | H | 22 | 5.01 |
| **97** | D100CBH | Channelled valley-bottom | 2B | C | C | H | 22 | 0.395 |
| **98** | D101CBH | Channelled valley-bottom | 2B | C | C | H | 22 | 0.285 |
| **99** | D103CBH | Channelled valley-bottom | 2B | C | C | H | 22 | 0.186 |
| **100** | D104CBH | Channelled valley-bottom | 2B | C | C | H | 22 | 0.222 |
| **101** | D117DCI | Channelled valley-bottom | 2B | B | D | I | 26 | 0.335 |
| **102** | D119EDL | Channelled valley-bottom | 2B | B | E | L | 26 | 0.188 |

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| **103** | D11FDL | Channelled valley-bottom | 2B | D | F | L | 17 | 1.727 |
| **104** | D120DCI | Channelled valley-bottom | 2B | C | D | I | 22 | 0.41 |
| **105** | D153CCI | Channelled valley-bottom | 2B | C | C | I | 22 | 0.11 |
| **106** | D154CCI | Channelled valley-bottom | 2B | C | C | I | 22 | 0.306 |
| **107** | D155DBH | Channelled valley-bottom | 2B | B | D | H | 26 | 0.448 |
| **108** | D169DCI | Channelled valley-bottom | 2B | C | D | I | 22 | 0.139 |
| **109** | D170DCI | Channelled valley-bottom | 2B | C | D | I | 22 | 1.087 |
| **110** | D171DCI | Channelled valley-bottom | 2B | C | D | I | 22 | 0.1 |
| **111** | D182ECI | Channelled valley-bottom | 2B | C | E | I | 22 | 0.016 |
| **112** | D191CCI | Channelled valley-bottom | 2B | C | C | I | 22 | 0.778 |
| **113** | D192CCI | Channelled valley-bottom | 2B | C | C | I | 22 | 2.012 |
| **114** | D193ECL | Channelled valley-bottom | 2B | C | E | L | 22 | 2.752 |
| **115** | D201DCI | Channelled valley-bottom | 2B | C | D | I | 22 | 1.099 |
| **116** | D20CBH | Channelled valley-bottom | 2B | D | C | H | 17 | 0.508 |
| **117** | D348BCH | Channelled valley-bottom | 2B | C | B | H | 22 | 0.274 |
| **118** | D381CCI | Channelled valley-bottom | 2B | C | C | I | 22 | 0.346 |
| **119** | D3DCM | Channelled valley-bottom | 2B | C | D | M | 22 | 1.937 |
| **120** | D48DCI | Channelled valley-bottom | 2B | C | D | I | 22 | 0.708 |
| **121** | D4DBI | Channelled valley-bottom | 2B | B | D | I | 26 | 7.532 |
| **122** | D6DCI | Channelled valley-bottom | 2B | C | D | H | 22 | 0.244 |
| **123** | D70BBH | Channelled valley-bottom | 2B | B | B | I | 26 | 0.159 |
| **124** | D77CBH | Channelled valley-bottom | 2B | B | C | H | 26 | 0.285 |

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| **125** | D78CBH | Channelled valley-bottom | 2B | B | C | H | 26 | 0.549 |
| **126** | D7DCI | Channelled valley-bottom | 2B | C | D | I | 22 | 2.952 |
| **127** | D84DCL | Channelled valley-bottom | 2B | B | D | L | 26 | 0.403 |
| **128** | D86CBH | Channelled valley-bottom | 2B | B | C | H | 26 | 0.4 |
| **129** | D8EBH | Channelled valley-bottom | 2B | B | E | H | 26 | 1.159 |
| **130** | D96DCI | Channelled valley-bottom | 2B | C | D | I | 22 | 0.233 |
| **131** | D96DCI | Channelled valley-bottom | 2B | C | D | I | 22 | 0.35 |
| **132** | D97DCH | Channelled valley-bottom | 2B | C | D | H | 22 | 1.276 |
| **133** | W128CCI | Channelled valley-bottom | 2B | C | C | I | 22 | 0.918 |
| **144** | W144ECI | Channelled valley-bottom | 2B | C | E | I | 22 | 0.184 |
| **145** | W162ECI | Channelled valley-bottom | 2B | C | E | I | 22 | 0.078 |
| **146** | W183CCI | Channelled valley-bottom | 2B | C | C | I | 22 | 0.083 |
| **147** | W184CCI | Channelled valley-bottom | 2B | C | C | I | 22 | 0.174 |
| **148** | W232 | Channelled valley-bottom | 2B | A | C | MH | 30 | 0.246 |
| **149** | W232 | Channelled valley-bottom | 2B | A | C | MH | 30 | 2.643 |
| **150** | W232 | Channelled valley-bottom | 2B | A | C | MH | 30 | 2.278 |
| **151** | W32 | Channelled valley-bottom | 2B | D | C | I | | 0.26 |
| **152** | W32 | Channelled valley-bottom | 2B | D | C | I | 17 | 2.099 |
| **153** | W32 | Channelled valley-bottom | 2B | D | C | I | 17 | 4.321 |
| **154** | W32 | Channelled valley-bottom | 2B | C | C | I | 22 | 0.617 |
| **155** | W67b | Channelled valley-bottom | 2B | C | C | I | 22 | 0.873 |
| **156** | D1DCI | Unchanneled valley-bottom | 2C | C | D | I | 18 | 0.228 |

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|---|---|---|---|---|---|---|---|---|
| **157** | D2DBMH | Unchanneled valley-bottom | 2C | B | B | H | 22 | 2.107 |
| **158** | W167 | Unchanneled valley-bottom | 2C | A | C | H | 25 | 0.816 |
| **159** | W365DBH | Unchanneled valley-bottom | 2C | B | D | H | 22 | 0.5 |
| **160** | W368CBI | Unchanneled valley-bottom | 2C | C | C | I | 18 | 0.385 |
| **161** | D61DCL | Seep | 2E | C | D | L | 18 | 0.857 |
| **162** | D62CCI | Seep | 2E | C | C | I | 18 | 0.314 |
| **163** | W74.1 | Seep | 2E | D | C | MH | 14 | 0.295 |
| **164** | D10DBH | Depression | 2F | B | D | H | 17 | 0.517 |
| **165** | D22CBH | Depression | 2F | B | C | H | 17 | 0.412 |
| **166** | D207CCI | Floodplain | 3A | C | C | I | 22 | 1.135 |
| **167** | D47DCI | Floodplain | 3A | C | D | I | 22 | 0.613 |
| **168** | W106.1 | Floodplain | 3A | B | C | MH | 26 | 0.658 |
| **169** | D108CBH | Channelled valley-bottom | 3B | B | C | H | 26 | 0.184 |
| **170** | D110CBH | Channelled valley-bottom | 3B | B | C | H | 26 | 1.121 |
| **171** | D126ECL | Channelled valley-bottom | 3B | C | C | L | 22 | 0.885 |
| **172** | D131BCMH | Channelled valley-bottom | 3B | C | B | H | 22 | 0.133 |
| **173** | D131BCMH | Channelled valley-bottom | 3B | B | B | H | 26 | 0.121 |
| **174** | D136BBH | Channelled valley-bottom | 3B | B | B | H | 26 | 0.284 |
| **175** | D137BBH | Channelled valley-bottom | 3B | B | B | H | 26 | 0.359 |
| **176** | D137BBH | Channelled valley-bottom | 3B | B | B | H | 26 | 0.158 |
| **177** | D141CBH | Channelled valley-bottom | 3B | B | C | H | 26 | 2.55 |
| **178** | D142BBH | Channelled valley-bottom | 3B | B | B | H | 26 | 0.351 |
| **179** | D143BBH | Channelled valley-bottom | 3B | B | B | H | 26 | 0.372 |
| **180** | D145BBH | Channelled valley-bottom | 3B | B | B | H | 26 | 0.634 |
| **181** | D146DCI | Channelled valley-bottom | 3B | C | D | I | 22 | 0.433 |
| **182** | D157BAH | Channelled valley-bottom | 3B | A | B | H | 30 | 0.203 |

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|---|---|---|---|---|---|---|---|---|
| **183** | D158BCH | Channelled valley-bottom | 3B | B | B | H | 26 | 0.13 |
| **184** | D159CBI | Channelled valley-bottom | 3B | B | C | I | 26 | 0.269 |
| **185** | D161BBH | Channelled valley-bottom | 3B | B | D | H | 26 | 0.396 |
| **186** | D164 | Channelled valley-bottom | 3B | C | D | I | 22 | 0.082 |
| **187** | D216BBI | Channelled valley-bottom | 3B | B | B | I | 26 | 0.227 |
| **188** | D217CBH | Channelled valley-bottom | 3B | B | C | H | 26 | 0.463 |
| **189** | D218BBH | Channelled valley-bottom | 3B | B | B | H | 26 | 0.5 |
| **190** | D24BBH | Channelled valley-bottom | 3B | B | B | H | 26 | 0.863 |
| **191** | D27BBH | Channelled valley-bottom | 3B | B | B | H | 26 | 0.216 |
| **192** | D29CBH | Channelled valley-bottom | 3B | C | C | MH | 22 | 0.723 |
| **193** | D30CBH | Channelled valley-bottom | 3B | B | C | H | 26 | 0.385 |
| **194** | D32CCI | Channelled valley-bottom | 3B | C | C | H | 22 | 0.125 |
| **195** | D339CBH | Channelled valley-bottom | 3B | B | C | I | 26 | 0.539 |
| **196** | D348CBH | Channelled valley-bottom | 3B | C | C | H | 22 | 0.214 |
| **197** | D355BBH | Channelled valley-bottom | 3B | B | B | H | 26 | 0.459 |
| **198** | D35DCI | Channelled valley-bottom | 3B | C | D | I | 22 | 1.651 |
| **199** | D35DCI | Channelled valley-bottom | 3B | C | D | U | 22 | 0.225 |
| **200** | D37CBH | Channelled valley-bottom | 3B | B | C | I | 26 | 0.355 |
| **201** | D38CBH | Channelled valley-bottom | 3B | B | C | H | 26 | 0.194 |
| **202** | D39BBH | Channelled valley-bottom | 3B | B | B | H | 26 | 0.079 |
| **203** | D448BBH | Channelled valley-bottom | 3B | B | B | H | 26 | 0.494 |
| **204** | D45CBH | Channelled valley-bottom | 3B | B | C | H | 26 | 0.149 |

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| **205** | D478DCI | Channelled valley-bottom | 3B | C | D | I | 22 | 0.187 |
| **206** | D486CBH | Channelled valley-bottom | 3B | B | C | H | 26 | 0.326 |
| **207** | D489CBH | Channelled valley-bottom | 3B | B | C | H | 26 | 0.355 |
| **208** | D498CBH | Channelled valley-bottom | 3B | B | C | H | 26 | 0.238 |
| **209** | D50BBH | Channelled valley-bottom | 3B | B | B | H | 26 | 0.13 |
| **210** | D514CCI | Channelled valley-bottom | 3B | C | C | I | 22 | 1.006 |
| **211** | D51BBH | Channelled valley-bottom | 3B | B | B | H | 26 | 0.158 |
| **212** | D64BBH | Channelled valley-bottom | 3B | C | B | H | 22 | 0.399 |
| **213** | D64BBH | Channelled valley-bottom | 3B | B | B | H | 26 | 0.654 |
| **214** | D68BBH | Channelled valley-bottom | 3B | B | B | H | 26 | 0.181 |
| **215** | D69CBH | Channelled valley-bottom | 3B | B | C | H | 26 | 0.384 |
| **216** | D82BBH | Channelled valley-bottom | 3B | B | D | H | 26 | 0.883 |
| **217** | D98CBH | Channelled valley-bottom | 3B | B | C | H | 26 | 0.88 |
| **218** | D99CBH | Channelled valley-bottom | 3B | B | C | H | 26 | 0.347 |
| **219** | W1 | Channelled valley-bottom | 3B | B | C | MH | 26 | 1.733 |
| **220** | W126 | Channelled valley-bottom | 3B | A | C | MH | 30 | 1.042 |
| **221** | W128 | Channelled valley-bottom | 3B | B | C | I | 26 | 0.39 |
| **222** | W174DCI | Channelled valley-bottom | 3B | C | D | I | 22 | 0.103 |
| **223** | W187CCI | Channelled valley-bottom | 3B | C | C | I | 22 | 0.187 |
| **224** | W199CCH | Channelled valley-bottom | 3B | C | C | H | 22 | 0.099 |
| **225** | W204 | Channelled valley-bottom | 3B | B | B | I | 26 | 0.267 |
| **226** | W265 | Channelled valley-bottom | 3B | B | C | I | 26 | 0.292 |

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| **227** | W276 | Channelled valley-bottom | 3B | C | C | MH | 22 | 0.334 |
| **228** | W287 | Channelled valley-bottom | 3B | A | B | H | 30 | 2.366 |
| **229** | W330 | Channelled valley-bottom | 3B | B | C | MH | 26 | 0.093 |
| **230** | W35 | Channelled valley-bottom | 3B | C | C | I | 22 | 0.849 |
| **231** | D111BBH | Unchanneled valley-bottom | 3C | B | B | H | 22 | 1.249 |
| **232** | D121DDI | Unchanneled valley-bottom | 3C | D | D | I | 14 | 2.021 |
| **233** | D139CBH | Unchanneled valley-bottom | 3C | C | C | H | 18 | 0.383 |
| **234** | D140CBH | Unchanneled valley-bottom | 3C | B | C | H | 22 | 0.486 |
| **235** | D150BBH | Unchanneled valley-bottom | 3C | B | B | H | 22 | 0.364 |
| **236** | D151BAH | Unchanneled valley-bottom | 3C | A | B | H | 25 | 0.494 |
| **237** | D162DBH | Unchanneled valley-bottom | 3C | B | D | H | 22 | 0.351 |
| **238** | D17CCI | Unchanneled valley-bottom | 3C | C | C | I | 18 | 0.242 |
| **239** | D206BBH | Unchanneled valley-bottom | 3C | B | B | H | 22 | 0.245 |
| **240** | D210CBH | Unchanneled valley-bottom | 3C | B | C | H | 22 | 0.782 |
| **241** | D25BBH | Unchanneled valley-bottom | 3C | B | B | H | 22 | 0.172 |
| **242** | D34BBI | Unchanneled valley-bottom | 3C | B | B | I | 22 | 0.177 |
| **243** | D34BBI | Unchanneled valley-bottom | 3C | B | B | I | 22 | 0.806 |
| **244** | D36BBH | Unchanneled valley-bottom | 3C | B | B | H | 22 | 0.168 |
| **245** | D385CCI | Unchanneled valley-bottom | 3C | C | C | I | 18 | 0.061 |
| **246** | D40BBH | Unchanneled valley-bottom | 3C | B | B | H | 22 | 0.727 |
| **247** | D414DCI | Unchanneled valley-bottom | 3C | C | D | I | 18 | 0.108 |
| **248** | D43BBH | Unchanneled valley-bottom | 3C | B | B | H | 22 | 0.4 |

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| **249** | D445BBVH | Channelled valley-bottom | 3C | B | B | H | 26 | 0.67 |
| **250** | D46BBH | Unchanneled valley-bottom | 3C | B | B | H | 22 | 0.61 |
| **251** | D58BBH | Unchanneled valley-bottom | 3C | B | B | H | 22 | 0.531 |
| **252** | D66BBH | Unchanneled valley-bottom | 3C | B | B | H | 22 | 0.68 |
| **253** | D67BBH | Unchanneled valley-bottom | 3C | B | B | H | 22 | 1.428 |
| **254** | D73BBH | Unchanneled valley-bottom | 3C | B | B | H | 22 | 0.945 |
| **255** | D75BBH | Unchanneled valley-bottom | 3C | B | B | H | 22 | 0.485 |
| **257** | D80CBH | Unchanneled valley-bottom | 3C | B | C | H | 22 | 0.563 |
| **258** | D89CBH | Unchanneled valley-bottom | 3C | B | C | H | 22 | 0.908 |
| **259** | W1 | Unchanneled valley-bottom | 3C | B | B | MH | 22 | 0.72 |
| **260** | W116CCI | Unchanneled valley-bottom | 3C | C | C | I | 18 | 0.183 |
| **261** | W117CCI | Unchanneled valley-bottom | 3C | C | C | I | 18 | 0.294 |
| **262** | W152BBH | Unchanneled valley-bottom | 3C | B | B | H | 22 | 0.321 |
| **263** | W169 | Unchanneled valley-bottom | 3C | A | C | H | 25 | 0.392 |
| **264** | W169 | Unchanneled valley-bottom | 3C | A | C | H | 25 | 0.575 |
| **265** | W27 | Unchanneled valley-bottom | 3C | B | B | MH | 22 | 0.245 |
| **266** | W284 | Unchanneled valley-bottom | 3C | C | B | H | 18 | 0.246 |
| **267** | W68 | Unchanneled valley-bottom | 3C | B | C | H | 22 | 0.608 |
| **268** | W69 | Unchanneled valley-bottom | 3C | C | C | MH | 18 | 0.376 |
| **269** | W78 | Unchanneled valley-bottom | 3C | B | B | MH | 22 | 0.103 |
| **270** | D114CBH | Flat | 3D | B | C | H | 22 | 0.352 |
| **271** | W115CCI | Flat | 3D | C | C | I | 18 | 0.881 |
| **272** | W117 | Flat | 3D | D | C | MH | 14 | 1.319 |
| **273** | W117 | Flat | 3D | C | C | MH | 18 | 2.569 |

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|---|---|---|---|---|---|---|---|---|
| **274** | W202 | Flat | 3D | A | B | H | 25 | 1.936 |
| **275** | D121BAH | Seep | 3E | A | B | H | 25 | 0.09 |
| **276** | D124CBH | Seep | 3E | B | C | H | 22 | 0.386 |
| **277** | D125CBH | Seep | 3E | B | C | H | 22 | 0.394 |
| **278** | D132BCMH | Seep | 3E | B | B | H | 22 | 0.278 |
| **279** | D19CCI | Seep | 3E | C | C | I | 18 | 1.13 |
| **280** | D202CCI | Seep | 3E | B | C | I | 22 | 0.202 |
| **281** | D33BBMH | Seep | 3E | B | B | H | 22 | 0.694 |
| **282** | D361CCI | Seep | 3E | C | C | I | 18 | 0.412 |
| **283** | D366DCI | Seep | 3E | C | D | I | 18 | 0.086 |
| **284** | D377BNH | Seep | 3E | C | B | H | 18 | 0.22 |
| **285** | D506CBH | Seep | 3E | B | C | H | 22 | 0.128 |
| **286** | D60DCI | Seep | 3E | C | D | I | 18 | 1.006 |
| **287** | D79CBI | Seep | 3E | B | C | I | 22 | 1.027 |
| **288** | D94CBI | Seep | 3E | C | C | I | 18 | 0.682 |
| **289** | D9BBH | Seep | 3E | B | B | H | 22 | 1.464 |
| **290** | W133 | Seep | 3E | D | C | MH | 14 | 0.852 |
| **291** | W170 | Seep | 3E | D | D | MH | 14 | 0.724 |
| **292** | W187BCI | Seep | 3E | C | B | I | 18 | 0.728 |
| **293** | W199CCH | Seep | 3E | C | C | H | 18 | 0.476 |
| **294** | W203BCH | Seep | 3E | C | B | H | 18 | 3.42 |
| **295** | W220 | Seep | 3E | C | C | H | 18 | 1.598 |
| **296** | W46 | Seep | 3E | B | C | MH | 22 | 1.027 |
| **297** | W67 | Seep | 3E | B | C | I | 22 | 0.944 |
| **298** | D115CBI | Depression | 3F | B | C | H | 17 | 0.066 |
| **299** | D116BBH | Depression | 3F | B | B | H | 17 | 0.696 |
| **300** | D118BBH | Depression | 3F | C | B | H | 14 | 0.384 |
| **301** | D160DCI | Depression | 3F | C | B | I | 14 | 0.177 |
| **302** | D212BBH | Depression | 3F | B | B | H | 17 | 3.099 |
| **303** | D49BBH | Depression | 3F | B | B | H | 17 | 0.042 |
| **304** | D56BBH | Depression | 3F | B | B | H | 17 | 1.042 |
| **305** | D88CBH | Depression | 3F | B | C | H | 17 | 1.629 |
| **306** | D92BBH | Depression | 3F | B | B | H | 17 | 0.132 |
| **307** | W110 | Depression | 3F | B | C | MH | 17 | 0.811 |
| **308** | W111 | Depression | 3F | B | C | MH | 17 | 0.113 |
| **309** | W127BBI | Depression | 3F | B | B | I | 17 | 0.122 |
| **310** | W217 | Depression | 3F | C | D | I | 14 | 0.092 |
| **311** | D107ECI | Channelled valley-bottom | 4B | C | E | I | 22 | 0.901 |
| **312** | D109DCI | Channelled valley-bottom | 4B | C | D | I | 22 | 0.757 |
| **313** | D113DCI | Channelled valley-bottom | 4B | B | D | I | 26 | 0.128 |

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| **314** | D113DCI | Channelled valley-bottom | 4B | C | D | M | 22 | 0.4 |
| **315** | D122ECL | Channelled valley-bottom | 4B | D | E | L | 17 | 0.64 |
| **316** | D130CBH | Channelled valley-bottom | 4B | B | C | H | 26 | 0.203 |
| **317** | D13DCI | Channelled valley-bottom | 4B | C | D | I | 22 | 0.538 |
| **318** | D144DCI | Channelled valley-bottom | 4B | C | D | I | 22 | 0.169 |
| **319** | D18DCI | Channelled valley-bottom | 4B | C | D | I | 22 | 0.481 |
| **320** | D200CBI | Channelled valley-bottom | 4B | B | C | I | 26 | 0.486 |
| **321** | D215DCL | Channelled valley-bottom | 4B | C | D | L | 22 | 0.513 |
| **322** | D456DDI | Channelled valley-bottom | 4B | D | D | I | 17 | 0.325 |
| **323** | D474BBH | Channelled valley-bottom | 4B | B | B | H | 26 | 0.15 |
| **324** | D65DBI | Channelled valley-bottom | 4B | B | D | I | 26 | 0.6 |
| **325** | D90DCL | Channelled valley-bottom | 4B | C | D | L | 22 | 0.155 |
| **326** | W149ECL | Channelled valley-bottom | 4B | C | E | L | 22 | 0.132 |
| **327** | W173DCI | Channelled valley-bottom | 4B | C | D | I | 22 | 0.058 |
| **328** | W185DCI | Channelled valley-bottom | 4B | C | D | I | 22 | 0.041 |
| **329** | W195DCI | Channelled valley-bottom | 4B | C | D | I | 22 | 0.129 |
| **330** | W198 | Channelled valley-bottom | 4B | B | B | MH | 26 | 0.47 |
| **331** | W201FCL | Channelled valley-bottom | 4B | C | F | L | 22 | 5.996 |
| **332** | W282 | Channelled valley-bottom | 4B | B | B | MH | 26 | 0.217 |
| **333** | W58 | Channelled valley-bottom | 4B | D | C | MH | 17 | 0.015 |
| **334** | D112DCM | Unchanneled valley-bottom | 4C | B | D | H | 22 | 1.424 |
| **335** | D12ECL | Unchanneled valley-bottom | 4C | C | E | L | 18 | 2.106 |

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|---|---|---|---|---|---|---|---|---|
| **336** | D14DDL | Unchanneled valley-bottom | 4C | D | D | M | 14 | 0.122 |
| **337** | D16CCI | Unchanneled valley-bottom | 4C | C | C | I | 18 | 0.61 |
| **338** | D26CCI | Unchanneled valley-bottom | 4C | C | C | I | 18 | 0.108 |
| **339** | D26CCI | Unchanneled valley-bottom | 4C | C | C | I | 18 | 0.16 |
| **340** | D71DCL | Unchanneled valley-bottom | 4C | C | D | L | 18 | 0.813 |
| **341** | D87CBH | Unchanneled valley-bottom | 4C | B | C | H | 22 | 0.22 |
| **342** | D87CBH | Unchanneled valley-bottom | 4C | B | C | H | 22 | 0.49 |
| **343** | D8EDML | Unchanneled valley-bottom | 4C | D | E | ML | 14 | 0.162 |
| **344** | W181ECI | Unchanneled valley-bottom | 4C | C | E | I | 18 | 0.205 |
| **345** | D143ECL | Flat | 4D | C | E | L | 18 | 0.35 |
| **346** | W182ECI | Flat | 4D | C | E | I | 18 | 0.097 |
| **347** | W200ECI | Flat | 4D | C | E | I | 18 | 0.403 |
| **348** | D399DDL | Seep | 4E | B | D | L | 22 | 0.88 |
| **349** | D55DCL | Seep | 4E | C | D | L | 18 | 1.464 |
| **350** | D59ECL | Seep | 4E | C | E | L | 18 | 2.101 |
| **351** | D63CCL | Seep | 4E | C | C | L | 18 | 1.224 |
| **352** | D83DCL | Seep | 4E | C | D | L | 18 | 0.806 |
| **353** | D85DCL | Seep | 4E | C | D | L | 18 | 0.982 |
| **354** | D95DCI | Seep | 4E | C | D | I | 18 | 0.397 |
| **355** | W194ECL | Seep | 4E | C | E | L | 18 | 0.244 |
| **356** | W195 | Seep | 4E | B | C | H | 22 | 0.302 |
| **357** | W205DCI | Seep | 4E | C | D | I | 18 | 1.417 |
| **358** | W264DCL | Seep | 4E | C | D | L | 18 | 0.143 |
| **359** | W280 | Seep | 4E | B | C | MH | 22 | 0.103 |
| **360** | W304 | Seep | 4E | D | C | I | 14 | 1.636 |
| **361** | D105EDL | Depression | 4F | D | E | L | 12 | 2.442 |
| **362** | D106EDL | Depression | 4F | D | E | L | 12 | 2.433 |
| **363** | D52EDL | Depression | 4F | D | E | L | 12 | 0.492 |
| **364** | D54ECL | Depression | 4F | C | E | L | 14 | 0.613 |
| **365** | D57DCI | Depression | 4F | C | D | I | 14 | 0.849 |
| **366** | W134EDL | Depression | 4F | D | E | L | 12 | 0.093 |
| **367** | W171 | Depression | 4F | C | C | MH | 14 | 0.313 |
| **368** | W171 | Depression | 4F | D | C | MH | 12 | 0.51 |
| **369** | W171 | Depression | 4F | C | C | MH | 14 | 0.896 |
| **370** | W139 | Artificial | Artificial | A | | | 20 | 0.767 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **371** | W139 | Artificial | Artificial | D | | | 12 | 1.526 |
| **372** | D102 | Dam | Dam | D | | | 12 | 0.093 |
| **373** | D123 | Dam | Dam | D | | | 12 | 0.153 |
| **374** | D149 | Dam | Dam | D | | H | 12 | 1.443 |
| **375** | D28 | Dam | Dam | D | | H | 12 | 0.029 |
| **376** | W69 | Dam | Dam | C | | | 14 | 0.069 |
| **377** | W69 | Dam | Dam | C | | | 14 | 0.236 |
| **378** | D166 | Dam | DAM | D | | | 12 | 1.146 |
| **379** | D167 | Dam | DAM | D | | | 12 | 0.035 |
| **380** | D176 | Dam | DAM | D | | | 12 | 0.036 |
| **381** | D181 | Dam | DAM | C | | | 14 | 0.074 |
| **382** | D413 | Dam | DAM | C | | | 14 | 0.264 |
| **383** | W120 | Dam | DAM | B | | | 17 | 0.054 |
| **384** | W176 | Dam | DAM | B | | | 17 | 0.032 |
| **385** | W181 | Dam | DAM | C | | | 14 | 0.012 |
| **386** | W365 | Dam | DAM | A | | | 20 | 0.089 |
| **387** | W365 | Dam | DAM | C | | | 14 | 0.093 |
| **388** | W368 | Dam | DAM | A | | | 20 | 0.105 |