907
ENVIRONMENTAL

Wetland Impact Assessment for the proposed upgrading of existing main outfall sewer (Evaton and Sebokeng noth to Sebokeng Water Water Treatment Works)

VEREENIGING, GAUTENG

CLIENT: EMFULENI LOCAL MUNICIPALITY

NOVEMBER 2020

EMFULENI
LOCAL MUNICIPALITY

This report titled Wetland Impact Assessment for the proposed upgrading of existing main outfall sewer (Evaton and Sebokeng noth to Sebokeng Water Water Treatment Works) was compiled by Ndumiso Dlamini. Ndumiso is registered with the South African Council for Natural Scientific Professions and has completed training in various ecological tools.

Foreword

This document has been prepared to provide a general introduction and overview of the planned upgrade of an outfall sewer pipeline and the use, reproduction and/or presentation thereof is subject to the following:

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Prepared By:	Ndumiso Dlamini Ecologist 9ZeroSeven Environmental (Pty) Ltd 21 Rorke Street I Dundee I 3000 Mobile: 071 343 1503 Email: mdumela@9zeroseven.com

Executive Summary

Introduction
9ZeroSeven Environmental (907 Environmental or 907) was appointed on behalf Emfuleni Local Municipality to undertake a Wetland Impact Assessment for the proposed Sewer Upgrade within the Boitumelo area of the Emfuleni Local Municipality within the Gauteng Province.
Project Area Description & Desktop Data
The project area is situated in a densely populated area that is dominated by informal and formal residential areas, informal business districts and road networks. The project is situated within the C22H Quaternary Catchment within the Vaal Water Management area and Highveld Ecoregion. The project area falls within the portion of the WMA that was previously known as the Middle Vaal WMA. Several NFEPA wetland areas were determined to be within 500m of the proposed project area. The identified NFEPA wetlands were classified as a channelled and unchannelled valley wetlands. The wetland was classified as a natural system with a wetland condition classified as Moderately Modified (C) and Largely Modified (Z1). The wetlands were determined to be a Rank 5 and Rank 6 NFEPA wetland with wetland associations.
Findings
Two (2) wetland areas were identified within the project area. The identified wetlands were classified as channelled valley bottom wetlands as classified according to the SANBI Guideline. The wetland areas were characterised by soils of the Rensburg and Kroonstad soil forms. The overall PES of the wetland areas was determined to be Largely Modified (PES Class D) for the seep wetland. The major impacts to the wetland health were the altered hydrology and flows, increased soil exportation in the wetland area leading to the onset of erosion. The wetlands provided elevated flood attenuation and streamflow regulation. The direct benefits offered by the wetland were not evident during the field survey. The Ecological Importance & Sensitivity for the wetlands was determined to have a Moderate (C) level of importance. The Hydrological Functionality of wetlands was determined to have a Moderate (C) level of importance. The Direct Human Benefits were calculated to have a Marginal (D) level of importance.
Risk Assessment
The upgrade of the outfall pipeline will entail the clearing of areas and digging of trenches, laying of pipeline and the upgrade of the manholes, with the level of risk determined to vary from low to moderate.

The moderate risks determined for the study are associated with the digging works, soil stockpile management and operation of equipment and machinery in proximity to wetland areas. Notable expected risks include the potential for increased sedimentation of the wetlands as the soils in the area may be susceptible to dispersion. The impairment of water quality during as a result of sedimentation is expected.

The operation of the pipeline does pose a risk to the identified water resources, with the level of risk determined to be low. The low risks are largely attributed to the proposed project being for the upgrade of existing infrastructure that will alleviate some of the existing impacts such as sewer overflows. The moderate risk ratings were re-allocated a low status due to implementation of additional mitigation methodologies. The moderate risk ratings were re-allocated a low status due to implementation of additional mitigation methodologies.

Recommendations

A minimum buffer zone of 15m, with mitigations, was determined for the wetlands within project area. This buffer is to be applied throughout all phases of the project as far as possible.

Specialist Opinion

The impacts as described, rated and mitigated in this report pose a risk to the wetland area. The ecological sensitivity of the area is determined to be moderatly sensitive. With firm adherence to the mitigation measures prescribed in this report, the risks have been rated as low and it is the opinion of the specialist the proposed Boitumelo Sewer Upgrade project may proceed, following authorisations with the following conditions:

- An infrastructure monitoring and service plan must be compiled and implemented during the operational phase.
- An Environmental Control Officer (ECO) must oversee the construction phase of the project, with wetland areas as a priority.
- Based on the wetland assessment there is no envisaged alternative route, especially since the project is for the upgrade of existing infrastructure.

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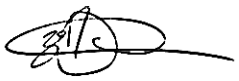
Declaration

I Ndumiso Ian Dlamini, as duly authorised representative of 9ZeroSeven Environmental, hereby confirm my independence and declare that I:

- 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.

Signature of the specialist:	
Designation:	Ecologist (Pr. Sci. Nat.)
Qualifications:	BSc Life and Environmental Sciences (UJ) BSc Hons Botany (UJ)
Experience (years):	Six (6)
Date:	July 2020

1 Introduction

9ZeroSeven Environmental (907 Environmental or 907) was appointed by Emfuleni Local Municipality (Pty) Ltd (NKT) to undertake a Wetland Impact Assessment for the proposed Sewer Upgrade within the Boitumelo area of the Emfuleni Local Municipality within the Gauteng Province.

This report presents the results of a wetland ecological assessment completed for the proposed project. This report should be interpreted after taking into consideration the findings and recommendations provided by the specialist herein. Further, this report should inform and guide the Environmental Assessment Practitioner (EAP) and regulatory authorities, enabling informed decision making, as to the ecological viability of the proposed project.

1.1 Aim and objectives

As part of this assessment, the following objectives were established:

- The identification of wetland areas through a desktop assessment;
- The identification and delineation of wetland areas within 500m of the proposed project;
- A risk/impact assessment for the proposed development; and
- The prescription of mitigation measures and recommendations for identified impacts / risks.

2 Key Legislative Requirements

The legislation, policies and guidelines listed below are applicable to the current project in terms of biodiversity and ecological support systems. 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 where these have a high degree of relevance to the project and/or are referred to in this assessment.

2.1 International Legislation and Policy

- Convention on Biological Diversity (Rio de Janeiro, 1992);
- The Ramsar Convention (on wetlands of international importance);
- The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). CITES is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival; and
- The IUCN (World Conservation Union). The IUCN's mission is to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable

2.2 National Legislation

- Constitution of the Republic of South Africa (Act 108 of 1996). The Bill of Rights, in the Constitution of South Africa states that everyone has a right to a nonthreatening environment and requires that reasonable measures be applied to protect the environment. This protection encompasses preventing pollution and promoting conservation and environmentally sustainable development;
- The National Environmental Management Act (NEMA) No. 107 of 1198): Ecological Assessment Regulations, 2014. Specifically, the requirements of the specialist report as per the requirements of Appendix 6;
- The National Environmental Management: Biodiversity Act (NEM:BA) No. 10 of 2004: specifically, the management and conservation of biological diversity within the RSA and of the components of such biological diversity;
- National Environmental Management: Biodiversity Act, 2004: Threatened and Protected Species Regulations;
- National Environmental Management: Protected Areas Act, 2003 (Act 57 of 2003);
- National Water Act, 1998 (Act 36 of 1998);
- Environmental Conservation Act, 1989 (ECA), (Act no. 73 of 1989);
- National Forests Act, 1998 (Act 84 of 1998), specifically with reference to Protected Tree species;
- National Heritage Resources Act, 1999 (Act 25 of 1999);
- Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983).

2.3 National Policy and Guidelines

- South Africa's National Biodiversity Strategy and Action Plan (NBSAP);
- National Spatial Ecological Assessment (NSBA); and
- National Freshwater Ecosystem Priority Areas (NFEPA's).

2.4 Provincial and Municipal Level

In addition to national legislation, South Africa's nine provinces have their own provincial biodiversity legislation, as nature conservation is a concurrent function of national and provincial government in terms of the Constitution (Act 108 of 1996).

- The Gauteng Biodiversity Conservation Plan (2017).

2.5 Structure of the Report

Aspect	Section
The person who prepared the report; and the expertise of that person to carry out the specialist study or specialised process.	Section 6
A declaration that the person is independent	Page viii
An indication of the scope of, and the purpose for which, the report was prepared	Section 1.1
A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 4
A description of any assumptions made and any uncertainties or gaps in knowledge	Section 5
(f) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 7 and Section 8
Recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority	Section 8 and Section 9
A description of any consultation process that was undertaken during the course of carrying out the study	N/A
A summary and copies of any comments that were received during any consultation process	N/A
Any other information requested by the competent authority.	N/A

3 Description of the Project Area

The project area is located in the Boitumelo Township area within the Emfuleni Local Municipality. The project area is situated in a densely populated area that is dominated by informal and formal residential areas, informal business districts and road networks as presented in Figure 2.

The project is situated within the C22H Quaternary Catchment within the Vaal Water Management area and Highveld Ecoregion. The project area falls within the portion of the WMA that was previously known as the Middle Vaal WMA. The WMA is located downstream of the confluence of the Vaal and the Rietspruit Rivers and upstream of Bloemhof Dam. It extends to the headwaters of the Schoonspruit River in the north and the Vet River in the south. The I WMA includes parts of Free State and North-West provinces. Major rivers in the Middle Vaal Water Management Area include the Schoonspruit, Rhenoster, Vals, Vet and Vaal rivers (StatsSA, 2010).

The land uses within the local area includes semi-urban rural settlements of varied size, livestock grazing and informal business districts. (Figure 1).

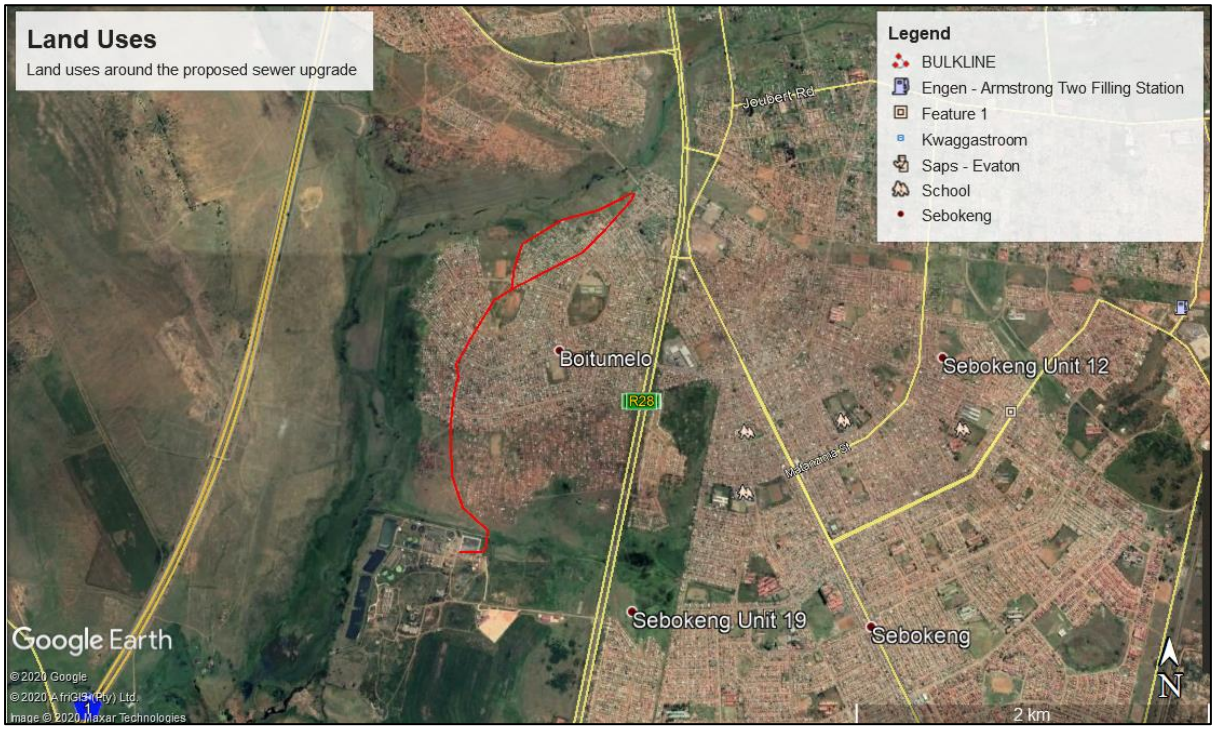


Figure 1: Local land uses within and around the project area

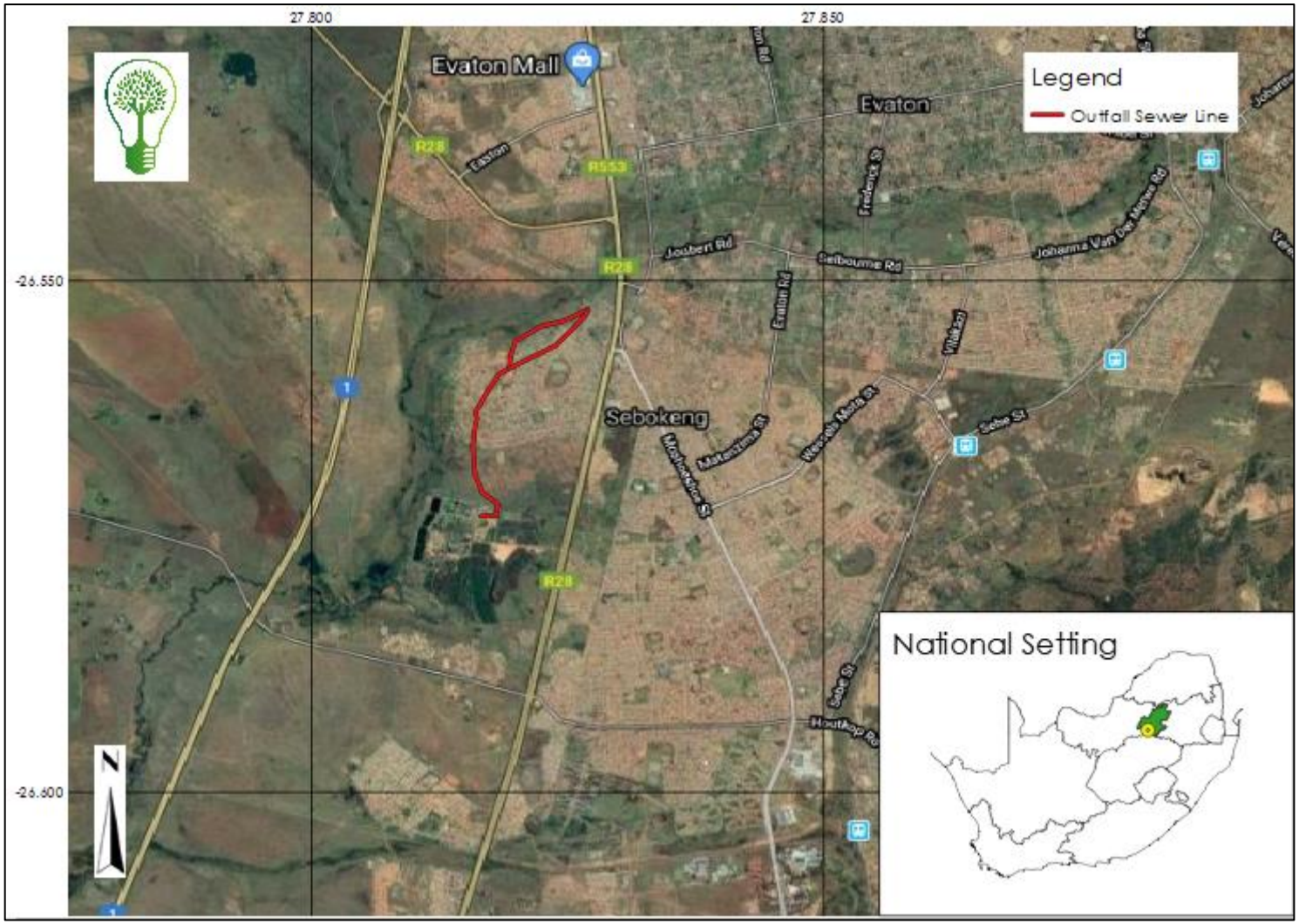


Figure 2: Location of the Project Area

3.1.1 Climate

The area is characterised as a summer rainfall area with a Mean Annual Precipitation (MAP) of 662mm. Much of the rainfall is predominantly in December and January with occasional storms in other wet season months. The winters can be cold with frost being frequent in the area (Mucina and Rutherford, 2006). The climate diagram for the area is presented in Figure 3.

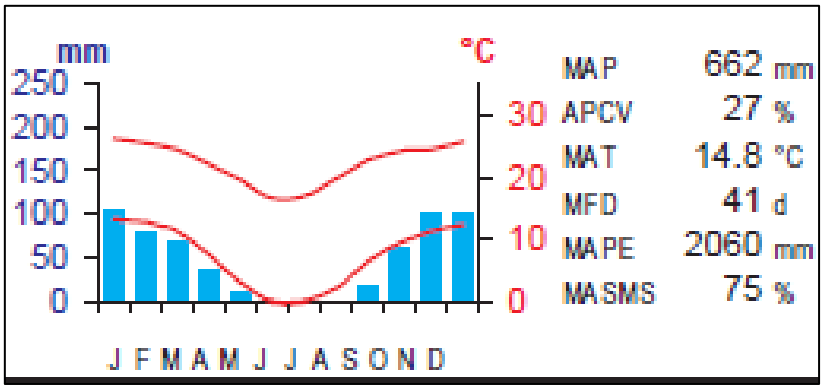


Figure 3: Climate diagram (Mucina and Rutherford, 2006)

3.1.2 Landtype Soils

The geology of the area is shale, sandstone or mudstone of the Madzaringwe Formation (Karoo Supergroup) or the Karoo Suite dolerites which occur prominently as intrusions.

According to the land type database (Land Type Survey Staff, 1972-2006) the project falls largely within the Ba 36 Landtype. The Ba 36 landtype was characterised by a plinthic catena with dystrophic and/or mesotrophic red soils being widespread in area.

3.1.3 Regional Vegetation

The project area is located within the Soweto Highveld Grassland vegetation unit (Mucina and Rutherford, 2006) within the Highveld bioregion. The vegetation unit occurs largely in the Gauteng and Mpumalanga provinces and marginally in the Free State and North-West provinces. The vegetation unit occurs in altitudes of 1420 m – 1760 m above sea level. The vegetation unit falls within a summer rainfall climate with MAP of 662 mm.

The vegetation unit is characterised by gentle to moderately undulating plains that support short to medium-high dense grasslands which are dominated by *Themeda triandra* in natural conditions.

The vegetation unit is considered as Endangered in terms of the conservation status. Several patches of the vegetation unit are statutorily conserved within Nature Reserves with the conservation target set at 24%. An approximate 50% of the vegetation unit has been transformed by cultivation, urban sprawl, infrastructure

and mining throughout the unit. Some of the plant species of significance within the vegetation unit are presented in Table 1.

Table 1: Plants of significance within the Dwaalboom Thornveld vegetation unit

Plant type	Plant species
Graminoids	*Themeda triandra, Aristida bipartite, Aristida congesta, Digitaria eriantha subsp. eriantha, Hyparrhenia hirta, Panicum maximum, Cymbopogon posposchilli, Eragrostis curvula, Eragrostis obtuse, Eragrostis racemosa*

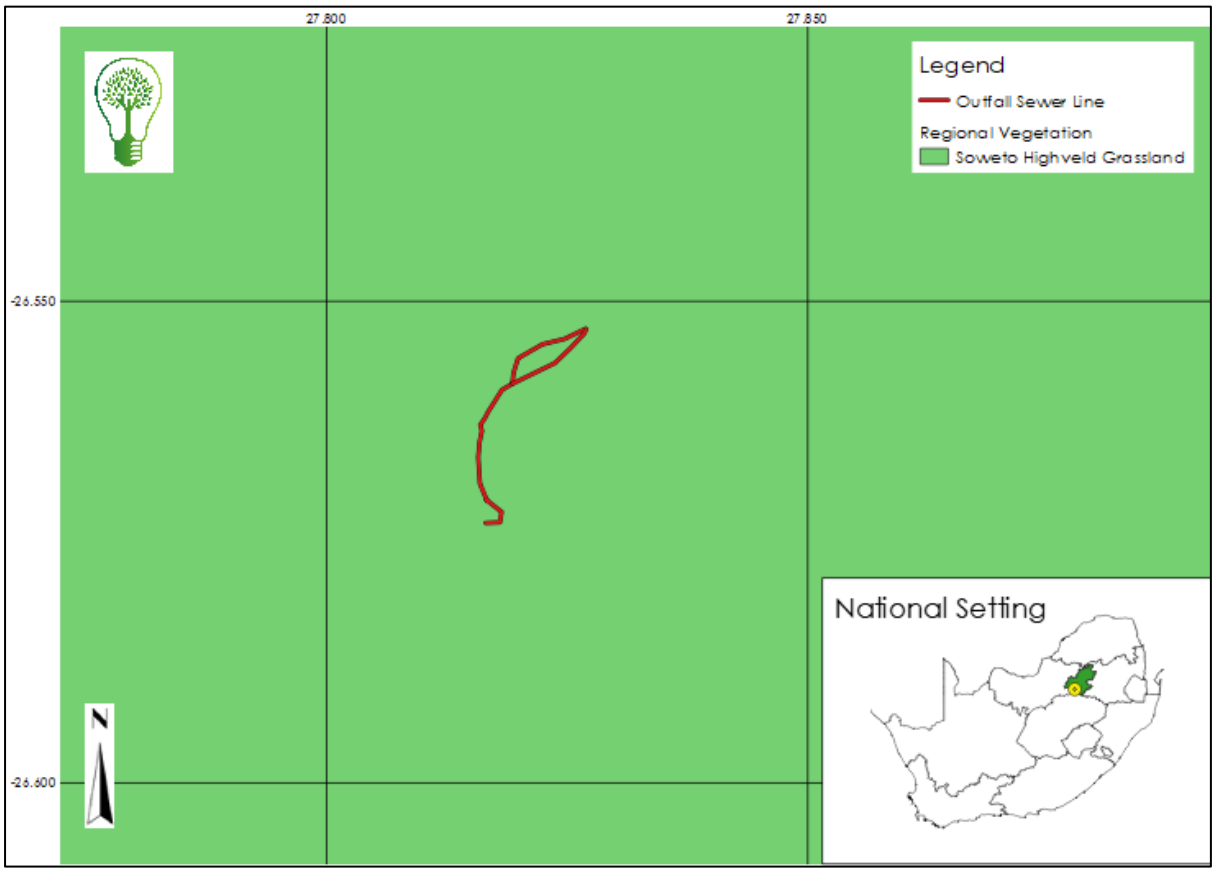


Figure 4: The regional vegetation associated with the project area

4 Methodology

4.1 Desktop Assessment

The following information sources were considered for the desktop assessment;

- Aerial imagery (Google Earth Pro);
- Department of Water and Sanitation (DWS, 2019);
- Land Type Data (Land Type Survey Staff 1972 - 2006);
- The National Freshwater Ecosystem Priority Areas (Nel et al., 2011);
- Provincial and municipal spatial datasets; and
- Contour data (5m).

4.2 Field Survey

A survey was conducted on the 13th of July 2020 by an ecologist where the wetland areas in the project area was delineated and assessed. The survey was conducted during the wet season. The project area was ground-truthed on foot. Photographs were recorded during the site visit.

4.2.1 Wetland Assessment

The National Wetland Classification Systems (NWCS) developed by the South African National Biodiversity Institute (SANBI) will be considered for this study. This system comprises a hierarchical classification process of defining a wetland based on the principles of the hydrogeomorphic (HGM) approach at higher levels, and also then includes structural features at the lower levels of classification (Ollis *et al.*, 2013) as presented in Figure 5. The methodology to assess wetlands is presented in Table 2.

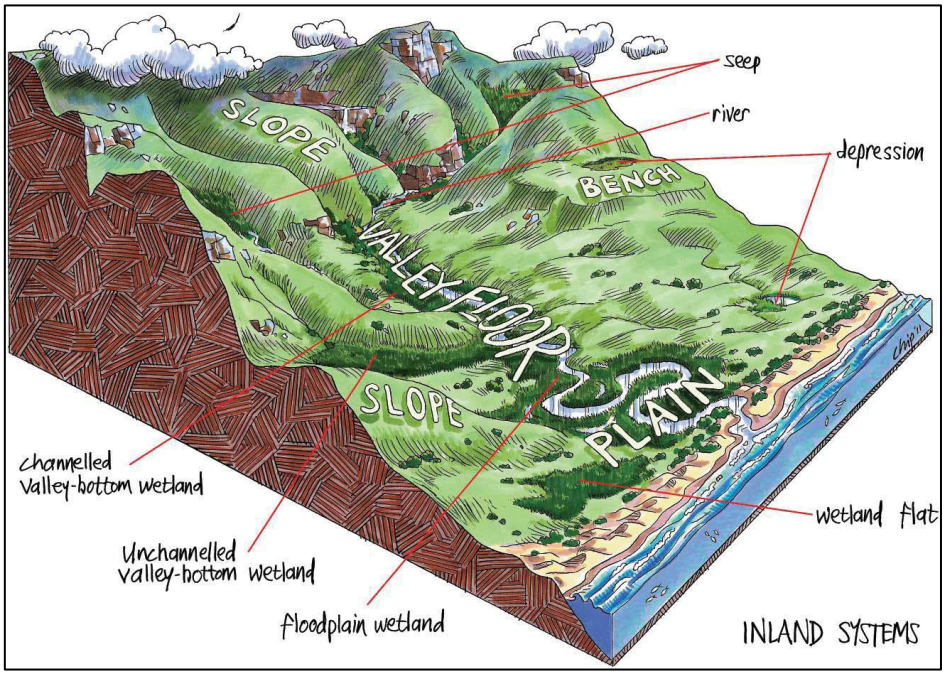
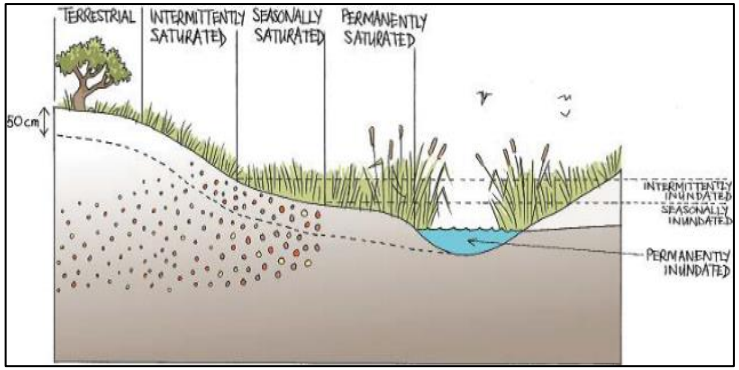


Figure 5: Wetland hydrogeomorphic (HGM) units (Ollis et al., 2013)

Table 2: Wetland assessment methodolgy

<table>
<tr><th>Assessment Aspect</th><th>Criteria</th><th>Determinant</th></tr>
<tr><td>Delineation</td><td>❖ The Terrain Unit Indicator
❖ The Soil Form Indicator
❖ The Soil Wetness Indicator
❖ The Vegetation Indicator

Vegetation is used as the primary wetland indicator. However, in practise the soil wetness indicator tends to be the most important and reliable, and the other three indicators are used in a confirmatory role</td><td> 
</td></tr>
<tr><td>Present Ecological State (PES)/ Wetland Health</td><td>The overall approach is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a Present Ecological Status (PES) score. This takes the form of assessing the spatial extent of impact of individual activities/occurrences and then separately assessing the intensity of impact of each activity in the affected area. The extent and intensity are then combined to determine an overall magnitude of impact</td><td>
<table>
<tr><th>Impact Category</th><th>Description</th><th>Impact Score Range</th><th>Present State Category</th></tr>
<tr><td>None</td><td>Unmodified, natural</td><td>0 to 0.9</td><td>A</td></tr>
<tr><td>Small</td><td>Largely Natural</td><td>1.0 to 1.9</td><td>B</td></tr>
<tr><td>Moderate</td><td>Moderately Modified</td><td>2.0 to 3.9</td><td>C</td></tr>
<tr><td>Large</td><td>Largely Modified</td><td>4.0 to 5.9</td><td>D</td></tr>
<tr><td>Serious</td><td>Seriously Modified.</td><td>6.0 to 7.9</td><td>E</td></tr>
<tr><td>Critical</td><td>Critical Modification.</td><td>8.0 to 10</td><td>F</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Assessment Aspect</th><th>Criteria</th><th>Determinant</th></tr>
<tr><td>Wetland Functionality/ Ecosystem Services</td><td>The assessment of the ecosystem services supplied by the identified wetlands was conducted per the guidelines as described in WET-EcoServices (Kotze, et al, 2009). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the services are provided</td><td>
<table>
<tr><th>Score</th><th>Rating of functionality</th></tr>
<tr><td>< 0.5</td><td>Low</td></tr>
<tr><td>0.6 - 1.2</td><td>Moderately Low</td></tr>
<tr><td>1.3 - 2.0</td><td>Intermediate</td></tr>
<tr><td>2.1 - 3.0</td><td>Moderately High</td></tr>
<tr><td>> 3.0</td><td>High</td></tr>
</table>
</td></tr>
<tr><td>Wetland Ecological Importance and Sensitivity (EIS)</td><td>The method used for the EIS determination was adapted from the method as provided by DWS (1999) for floodplains. The method takes into consideration PES scores obtained for WET-Health as well as function and service provision to enable the assessor to determine the most representative EIS category for the wetland feature or group being assessed. A series of determinants for EIS are assessed on a scale of 0 to 4.</td><td>
<table>
<tr><th>EIS Category</th><th>Range of Mean</th><th>Recommended Ecological Management Class</th></tr>
<tr><td>Very High</td><td>3.1 to 4.0</td><td>A</td></tr>
<tr><td>High</td><td>2.1 to 3.0</td><td>B</td></tr>
<tr><td>Moderate</td><td>1.1 to 2.0</td><td>C</td></tr>
<tr><td>Low Marginal</td><td>< 1.0</td><td>D</td></tr>
</table>
</td></tr>
</table>

4.3 Buffer Determination

A buffer zone is defined as "A strip of land with a use, function or zoning specifically designed to protect one area of land against impacts from another." (Macfarlane, et al., 2014).

Buffer zones protect water resources in a variety of ways, such as;

- Maintenance of basic aquatic processes;
- The reduction of impacts on water resources from activities and adjoining land uses;
- The provision of habitat for aquatic and semi-aquatic species;
- The provision of habitat for terrestrial species; and
- The provision of societal benefits.

The "Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries" (Macfarlane, et al., 2014) was used to determine the appropriate buffer zone for the proposed activity. This guideline was designed to assist in the determination of the appropriate buffer zones for water resources. The assessment procedure can be seen in Figure 6.

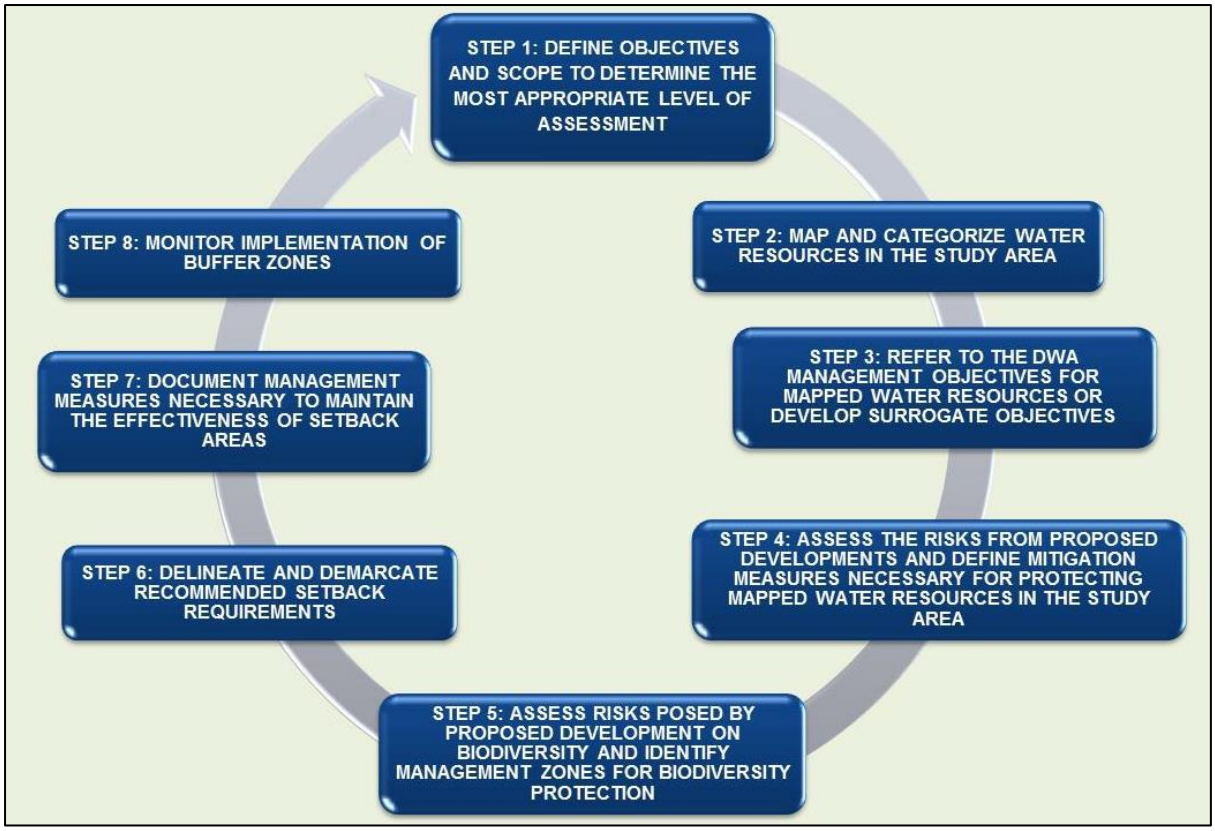


Figure 6: The assessment for the determination of the appropriate buffer zone follows this procedure

An Excel tool was developed as part of this project to help assessors identify a suite of alternative mitigation measures and management guidelines that can be used to reduce potential impacts on aquatic ecosystems. The tool is designed to act as a quick reference to a wide range of mitigation measures and guidelines which would otherwise need to be accessed through a plethora of different guidelines. The tool is structured according to nine primary threats which are also assessed as part of the buffer zone determination process. These include:

- Alteration to flow volumes;
- Alteration of patterns of flows (increased flood peaks);
- Increase in sediment inputs & turbidity;
- Increased nutrient inputs;
- Inputs of toxic contaminants (including organics & heavy metals);
- Alteration of acidity (pH);
- Increased inputs of salts (salinization);
- Change (elevation) of water temperature; and
- Pathogen inputs (i.e. disease-causing organisms).

4.4 Risk Assessment

The risk assessment was conducted in accordance with the DWS risk-based water use authorisation approach and delegation guidelines. The significance of the impact is calculated according to Table 3.

Table 3: Significance ratings matrix

Rating	Class	Management Description
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated. Wetlands may be excluded.
56 – 169	(M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and require specialist input. Wetlands are excluded.
170 – 300	(H) High Risk	Always involves wetlands. Watercourse(s)impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve.

5 Limitations and Assumptions

The following assumptions and limitations are applicable to this report:

- The wetland assessment is confined to the proposed project area, and does not include the neighbouring and adjacent areas beyond a 50m radius of the project site; these were however considered as part of the desktop assessment;
- With ecology being dynamic and complex, some aspects (some of which may be important) may have been overlooked. It is, however, expected that

most floral and faunal communities have been accurately assessed and considered;

- The data presented in this report is based on a single site visit, undertaken in July 2020 (dry season) by the author and an assistant. A more accurate assessment would require that assessments take place in all seasons of the year. It is therefore anticipated that some aspects of the ecology may not be identified as a result of seasonal changes in the vegetation.
- It is assumed that the proposed sewer line route will follow the existing pipeline route as this project is for a proposed upgrade; and
- No activities list has been provided and as such the risk assessment will be conducted based on the proposed works outlined in the technical documents.

6 Expertise of the Specialists

Ndumiso Dlamini obtained his BSc Hons degree in Botany in 2011 at the University of Johannesburg and is a registered Pr. Sci. Nat with SACNASP (116579) in Botanical Science and Ecological Science. Ndumiso has been conducting biodiversity, ecological and water resources assessments as an Environmental Consultant for over 6 years. He has performed numerous ecological impact assessments for various projects which include mining, housing developments, roads and infrastructure and rehabilitation. A detailed CV can be made available on request.

7 Findings

7.1 Desktop Assessment

The National Freshwater Ecosystem Priority Areas (NFEPA) database forms part of a comprehensive approach to the sustainable and equitable development of South Africa's scarce water resources. This database provides guidance on how many rivers, wetlands and estuaries, and which ones, should remain in a natural or near-natural condition to support the water resource protection goals of NWA (Act 36 of 1998). This directly applies to the National Water Act, which feeds into Catchment Management Strategies, water resource classification, reserve determination, and the setting and monitoring of resource quality objectives (Nel *et al*., 2011). The NFEPAs are intended to be conservation support tools and envisioned to guide the effective implementation of measures to achieve the National Environment Management Biodiversity Act's biodiversity goals (NEM:BA) (Act 10 of 2004), informing both the listing of threatened freshwater ecosystems and the process of bioregional planning provided for by this Act (Nel *et al*., 2011).

Several NFEPA wetland areas were determined to be within 500m of the proposed project area as seen in Figure 7. The identified NFEPA wetlands were classified as a channelled and unchannelled valley wetlands. The wetland was classified as a natural system with a wetland condition classified as Moderately Modified (C) and Largely Modified (Z1). The wetlands were determined to be a Rank 5 and Rank 6

NFEPA wetland with wetland associations. The wetland classification of the wetlands can be seen in Table 4.

Table 4: The wetland classification of the FEPA wetlands

FEPA Wetland	Classification Levels				Wetland Veg Class	Nat / Art	Cond.	Rank
	L1 (System)	L2 (Ecoregion)	L3 Landscape Position	L4 HGM Class				
Channelled Valley Bottom	Inland System	Highveld	Valley bottom	Channelled	Mesic Highveld Grassland	Natural	C	5
Unchannelled Valley Bottom	Inland System	Highveld	Valley bottom	Unchannelled	Mesic Highveld Grassland	Natural	Z1	6

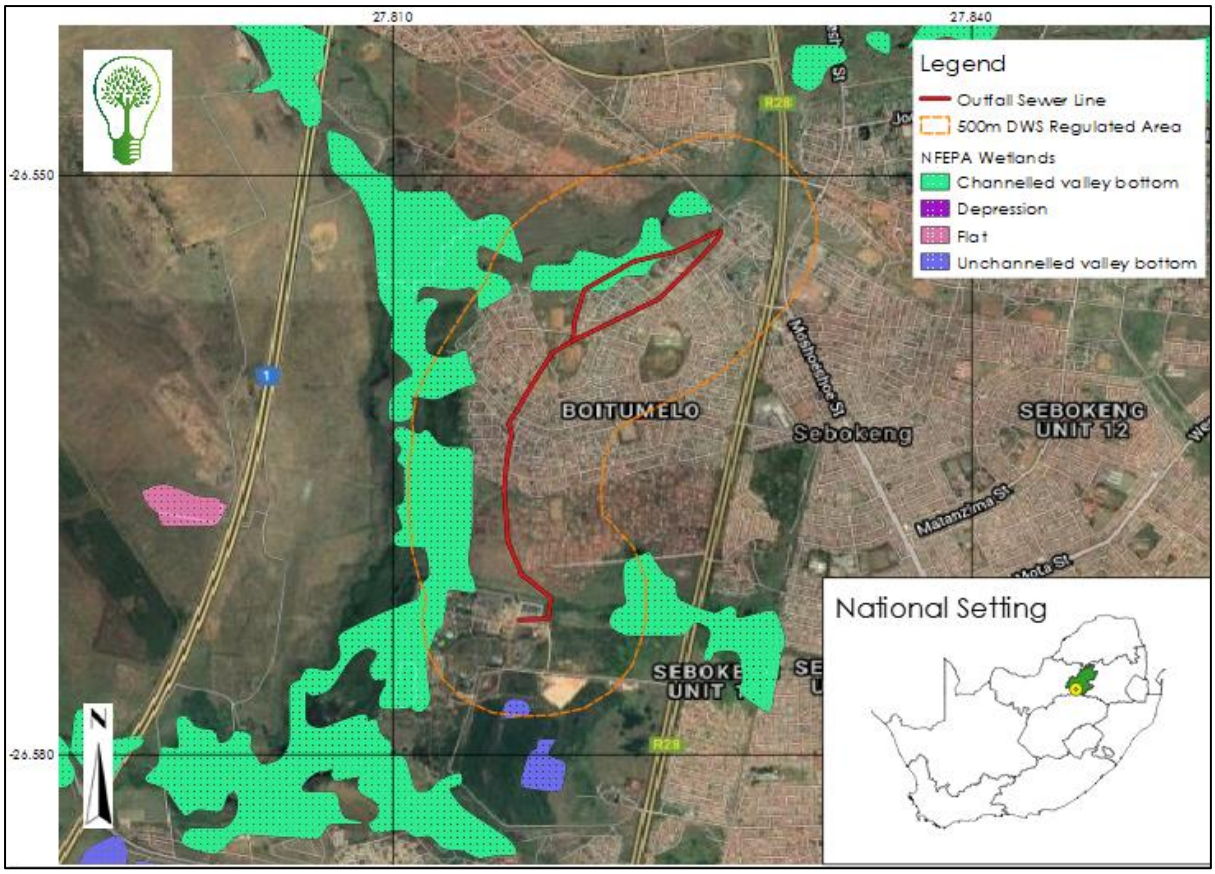


Figure 7: NFEPA wetlands in relation to the project area

7.2 Field Survey

The field investigation was conducted to identify wetland areas within the proposed project area and with 500m of the project area. Two (2) wetland areas were identified within the project area. The identified wetlands were classified as channelled valley bottom wetlands as classified according to the SANBI Guideline shown in Table 5. The identified wetland areas are presented in Figure 8.

Table 5: Wetland classification as per SANBI guideline (Ollis et al., 2013)

Wetland Name	Level 1	Level 2		Level 3	Level 4		
	System	DWS Ecoregion/s	NFEPA Wet Veg Group/s	Landscape Unit	4A (HGM)	4B	4C
HGM 1	Inland System	Highveld	Mesic Highveld Grassland	Valley Bottom	Channelled Valley Bottom	N/A	N/A
HGM 2	Inland System	Highveld	Mesic Highveld Grassland	Valley Bottom	Channelled Valley Bottom	N/A	N/A

Figure 8: The identified channelled valley bottom wetland

The wetland vegetation could not be identified due to the seasonal changes and condition of the wetland; however, remanants of what resembled *Typha capensis* were identified although could not be confirmed. The wetland areas wer haracterised by soils of the Rensburg and Kroonstad soil forms. The wetland delineation can be seen in Figure 9.

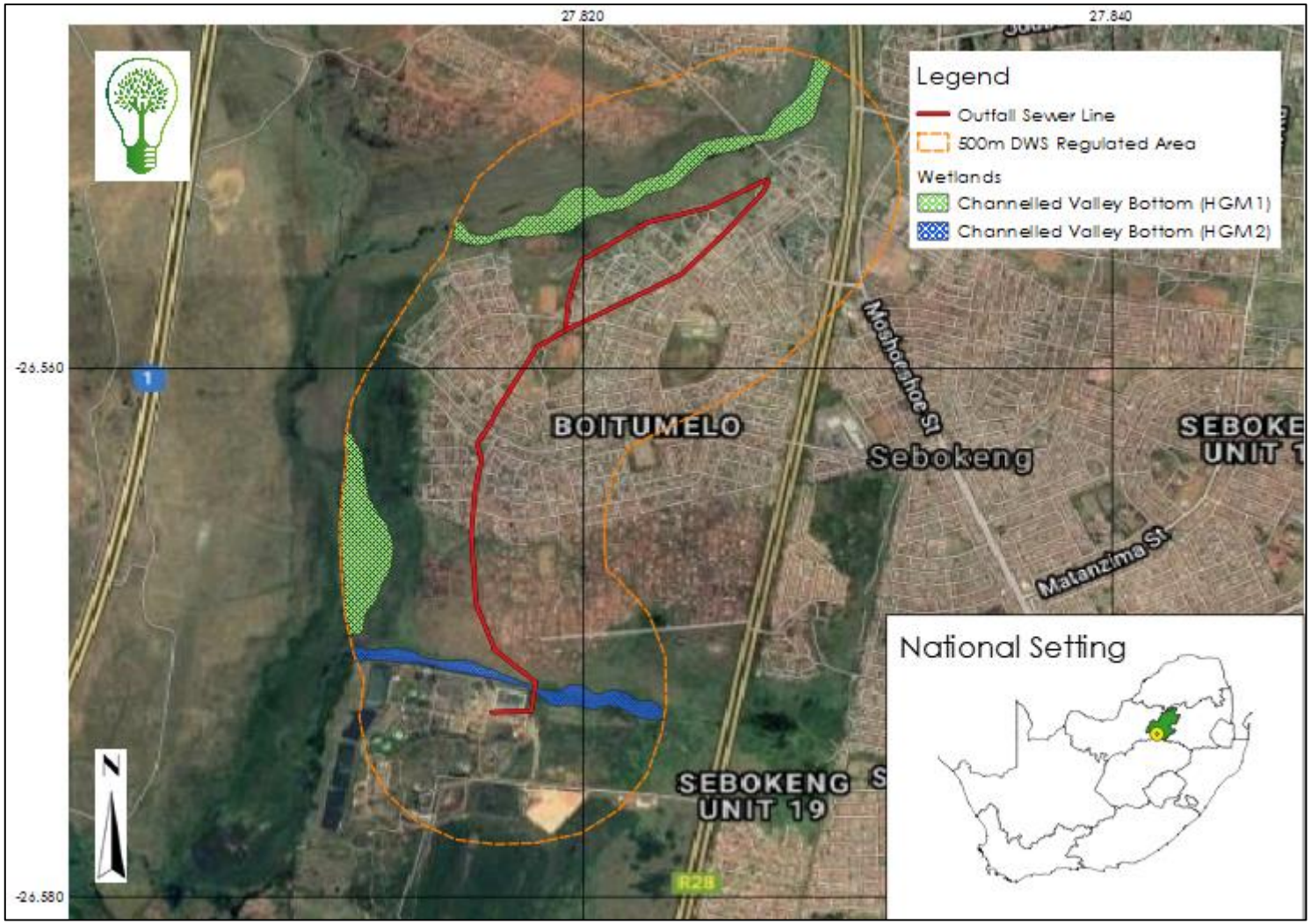


Figure 9: Wetland delineation for proposed Boitumelo Sewer Upgrade

7.3 Present Ecological State (PES)

The PES assessment measures the amount of alteration a wetland has undergone, as a result of impacts, and how much it has diverted from the reference state. The wetlands observed in the study area were classified as floodplain, dam and seepage wetlands.

The PES assessment determined and evaluated impacts to the wetland and the level of modification these impacts have brought about to the wetland. The following impacts were observed:

- Incised wetland areas – indicative of altered hydrology and flows;
- Incised wetland channel – indicative of increased soil exportation with little or no sediment trapping;
- Pollution (soild waste) – indicative of anthropogenic disturbance to the wetland area;
- Sewerage spillage into the wetland areas;
- Loss of natural wetland vegetation.

The overall PES of the wetland areas was determined to be Largely Modified (PES Class D) for the wetland areas. The scores for the respective modules can be seen in Table 6.

Table 6: Summary of the wetland PES Score and PES Class

Wetland	Hydrology		Geomorphology		Vegetation	
	Rating	Score	Rating	Score	Rating	Score
HGM 1	C: Moderately Modified	3.5	C: Moderately Modified	3.8	D: Largely Modified	5.0
Overall PES Score	4.0		**Overall PES Class**		D: Largely Modified	
HGM 2	D: Largely Modified	4.0	D: Largely Modified	4.0	D: Largely Modified	4.2
Overall PES Score	4.3		**Overall PES Class**		D: Largely Modified	

7.4 Ecosystem Services Assessment

The ability of the wetlands to provide Ecosystem Services is linked to the PES of the wetland. The wetlands were determined to be Largely Modified which in turn affected the level of services that the wetlands could provide. However, in the local setting the wetlands provided elevated flood attenuation and streamflow regulation. The direct benefits offered by the wetland were not evident during the field survey. Furthermore, direct benefits provided by the wetland were further

decreased by the local setting of the wetland, in a densely populated area with sewage discharging into the wetlands (Figure 10). The summarised results for the Ecosystem Services Assessment are shown in Table 7.

Figure 10: Sewage discharge within the wetland – damaged and deteriorated pipeline

Table 7: The EcoSystem Services scores for the wetland

Wetland Unit					HGM 1	HGM 2
Ecosystem Services Supplied by Wetlands	Indirect Benefits	Flood attenuation			2.2	1.8
		Streamflow regulation			2.2	2.0
		Regulating and supporting benefits	Water Quality enhancement benefits	Sediment trapping	2.0	1.6
				Phosphate assimilation	2.0	1.5
				Nitrate assimilation	2.0	1.5
				Toxicant assimilation	1.9	1.5
				Erosion control	1,5	1.8
			Carbon storage		1,5	1.8
	Direct Benefits	Biodiversity maintenance			1,3	1.3
		Provisioning benefits	Provisioning of water for human use		1.1	0.5
			Provisioning of harvestable resources		0,4	0.5
			Provisioning of cultivated foods		1.0	0.5
		Cultural benefits	Cultural heritage		0,0	0.0
			Tourism and recreation		1.1	1.0
			Education and research		0,8	0.8
Overall					20.9	18.1
Average					1,4	1.2

7.5 Ecological Importance and Sensitivity

The EIS assessment was applied to the wetland described in the previous section in order to assess the levels of sensitivity and ecological importance of the wetland. The results of the assessment are shown in Table 8.

The Ecological Importance & Sensitivity for the wetlands was determined to have a Moderate (C) level of importance. The EIS was determined to be moderate as there were no signs of ecologically important taxa within the wetland area and none had been recorded within the area.

The Hydrological Functionality of wetlands was determined to have a Moderate (C) level of importance. The Direct Human Benefits were calculated to have a Marginal (D) level of importance.

Table 8: The EIS results for the delineated wetland

Category	Importance	
	HGM 1	HGM 2
Ecological Importance & Sensitivity	1.9	1.5
Hydrological/Functional Importance	1.9	1.8
Direct Human Benefits	1.0	1.0

7.6 Buffer Zone Determination

The wetland buffer zone tool was used to calculate the appropriate buffer required for the upgrade of the Outfall Sewer. The model shows that the largest risks (Moderate) posed by the project during the construction phase is that of "increased sediment inputs and turbidity" and "inputs of metal contaminants". During the operational phase, the High risks identified for the project included "Increase in sediment inputs and turbidity", "altered patterns of flows", "inputs of toxic organic contaminants" and the "input of metal contaminants" (Table 11). These risks are calculated with no prescribed mitigation and the calculated buffer requirement is presented in Table 9.

Table 9: Pre-mitigation buffer requirement

Required Buffer before mitigation measures have been applied	
Construction Phase	**31m**
Operational Phase	**16m**

According to the buffer guideline (Macfarlane, et al. 2014) a high-risk activity would require a buffer that is 95% effective to reduce the risk of the impact to a low level threat.

The risks were then reduced to Low with the prescribed mitigation measures and therefore the recommended buffer was calculated to be 15m (Table 10) for the construction and operational phases.

Table 10: Post-mitigation buffer requirement

Required Buffer after mitigation measures have been applied	
Construction Phase	**15 m**
Operational Phase	**15 m**

A conservative buffer zone was suggested of 15 m for the construction and operation phases respectively, this buffer is calculated assuming mitigation measures are applied.

The buffer zone will not be applicable for areas of the project that traverse wetland areas, however, for all secondary activities such as lay down yards, storage areas and camp sites, the buffer zone must be implemented.

Table 11: The risk results from the wetland buffer model for the proposed project

Threat Posed by the proposed land use / activity		Specialist Threat Rating	Threat Rating after Mitigation	Recommended Mitigation
Construction Phase	1. Alteration to flow volumes	Very Low	Very Low	
	2. Alteration of patterns of flows (increased flood peaks)	Low	Low	
	3. Increase in sediment inputs & turbidity	Very High	Medium	There is an existing road over the wetland areas and the proposed project will not introduce a new impact. Dry season construction, silt traps, managed stockpiles, storm water management will reduce the risk of sedimentation during the construction.
	4. Increased nutrient inputs	Low	Low	
	5. Inputs of toxic organic contaminants	Medium	Very Low	
	6. Inputs of toxic heavy metal contaminants	Medium	Low	Off-site equipment vehicle fuelling and maintenance, storage in bunded area, no on-site fabrication, oil spill kits, equipment & vehicle inspections.
	7. Alteration of acidity (pH)	Low	Low	
	8. Increased inputs of salts (salinization)	N/A	N/A	
	9. Change (elevation) of water temperature	Very Low	Very Low	
	10. Pathogen inputs (i.e. disease-causing organisms)	Very Low	Very Low	
Operational Phase	1. Alteration to flow volumes	Medium	Low	The proposed pipeline will be underground and will not impact on the surface hydrology during the duration of its operation. An infrastructure monitoring plan will be devised to regularly check for leaks and remedy these. Furthermore, the project is for existing infrastructure upgrade and will minimse the current impacts.
	2. Alteration of patterns of flows (increased flood peaks)	High	Low	
	3. Increase in sediment inputs & turbidity	High	Low	
	4. Increased nutrient inputs	High	Low	
	5. Inputs of toxic organic contaminants	High	Medium	
	6. Inputs of toxic heavy metal contaminants	High	Low	
	7. Alteration of acidity (pH)	High	Low	
	8. Increased inputs of salts (salinization)	High	Low	
	9. Change (elevation) of water temperature	Medium	Low	
	10. Pathogen inputs (i.e. disease-causing organisms)	High	Medium	

It is recommended that the operational phase buffer zone of 15m be applied throughout all phases of the project (Figure 11).

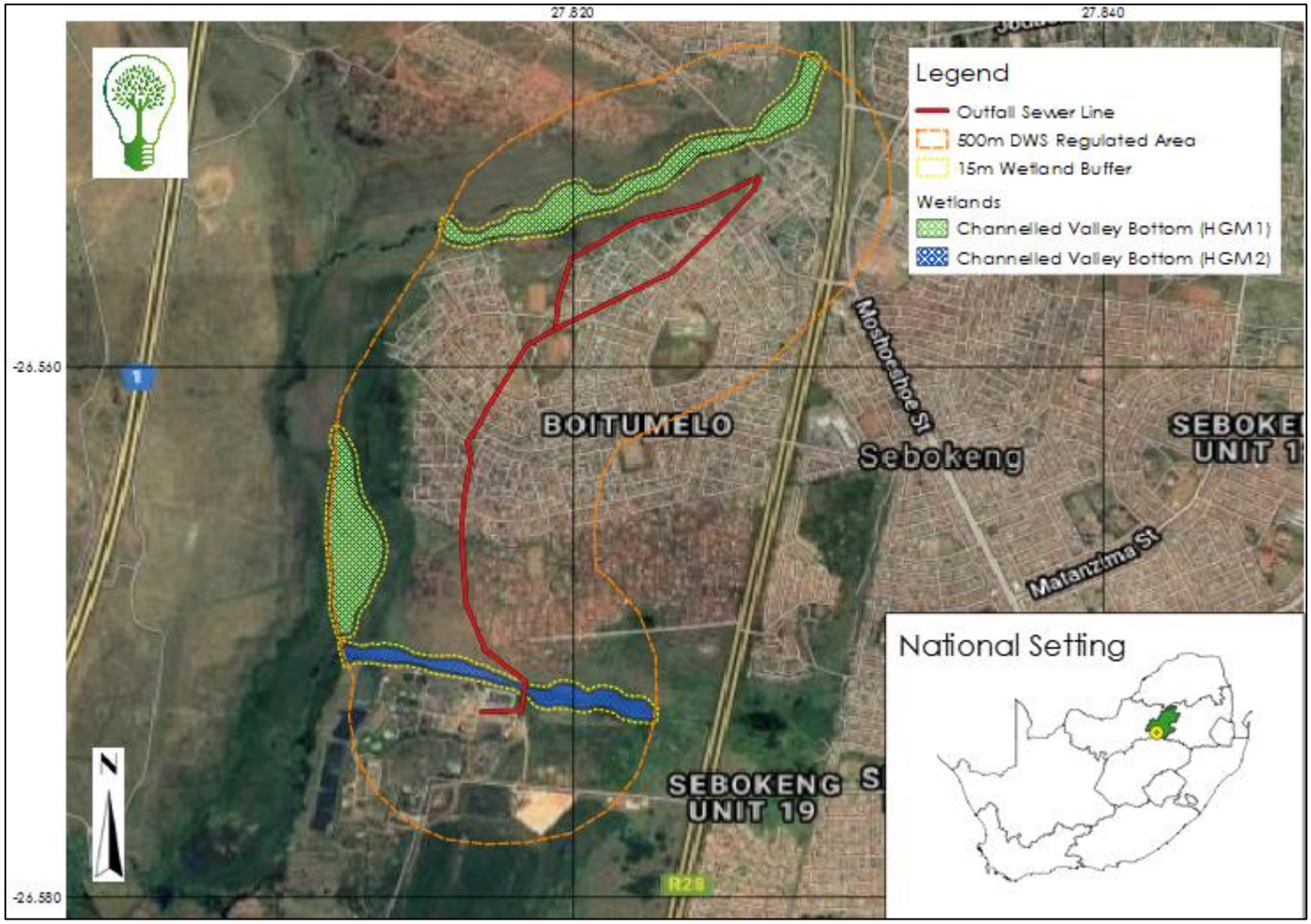


Figure 11: 15m Wetland Buffer Zone for the delineated wetland areas

8 Risk Assessment

The project is for the upgrade of the proposed sewer pipeline, that will directly and indirectly impact watercourses in proximity to the project area. The majority of the proposed pipeline is aligned with existing road and infrastructure servitudes with existing areas of impact. As this project is for the upgrade of a buried pipeline, impacts associated with the area are potentially moderate to low. Modifications to wetlands are likely to occur during construction. The project will entail the clearing of moderate amounts of vegetation and levelling of areas for the construction activities. This has the potential to increase erosion and sedimentation of downstream habitats due to surface runoff during the wet season. Furthermore, due to the proximity of the construction to the water resources, direct impacts to the wetland zones are likely. Some of the more notable impacts identified during the site visit and that will be considered for the risk assessment include the following:

- Portions of the pipeline within wetland areas
- Portions of the pipeline in proximity wetland areas,
- Potential for inadequate measures to dissipate flows and prevent erosion resulting in the sedimentation of the receiving systems.

8.1 Identification of Risk

Risks posed by the proposed project can be seen in Table 12. The findings of the risk assessment will determine the level and enable the opportunity to address some of the identified impacts. Findings from the DWS aspect and impact register / risk assessment are provided in Table 13 and Table 14.

Table 12: Risks identified for the proposed project

NDUMISO DLAMINI	PR. SCI. NAT.	116579
ACTIVITY	**Aspect**	**Impacts to watercourse**
CONSTRUCTION AND INSTALLATION OF PIPELINE AND CROSSINGS	Site clearing and preparation	❖ Increase in sediment inputs & turbidity
	Excavation of pipeline trenches	❖ Alteration to flow volumes ❖ Alteration of patterns of flows (increased flood peaks) ❖ Increase in sediment inputs & turbidity
	Soil stockpiles and management	❖ Alteration to flow volumes ❖ Alteration of patterns of flows (increased flood peaks) ❖ Increase in sediment inputs & turbidity
	Operation of machinery and vehicles within watercourse area	❖ Alteration to flow volumes

		❖ Alteration of patterns of flows (increased flood peaks) ❖ Increase in sediment inputs & turbidity
	Operation of machinery and vehicles in adjacent areas	❖ Alteration to flow volumes ❖ Alteration of patterns of flows (increased flood peaks) ❖ Increase in sediment inputs & turbidity
	Waste and ablutions facilities	❖ Inputs of toxic organic contaminants
	Pipeline trench back-filling and surface levelling	❖ Alteration to flow volumes ❖ Alteration of patterns of flows (increased flood peaks) ❖ Increase in sediment inputs & turbidity
	Final landscaping and shaping	❖ Alteration to flow volumes ❖ Alteration of patterns of flows (increased flood peaks) ❖ Increase in sediment inputs & turbidity
	Post-construction rehabilitation	❖ Increase in sediment inputs & turbidity
OPERATION OF PIPELINE AND CROSSINGS	Possible leaks (underground and above surface)	❖ Alteration to flow volumes ❖ Alteration of patterns of flows (increased flood peaks) ❖ Inputs of toxic organic contaminants
	Increased water runoff (manhole overflows)	❖ Alteration to flow volumes ❖ Alteration of patterns of flows (increased flood peaks) ❖ Increase in sediment inputs & turbidity ❖ Inputs of toxic organic contaminants
	Routine monitoring and maintenance work (vehicular movement)	❖ Alteration of patterns of flows (increased flood peaks) ❖ Increase in sediment inputs & turbidity
	Establishment of alien plants and erosion from disturbed areas	❖ Alteration of patterns of flows (increased flood peaks) ❖ Increase in sediment inputs & turbidity

Table 13: DWS Risk Impact Matrix for the proposed project

Aspect	Flow Regime	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Consequence
Construction Phase								
Site clearing and preparation	2	2	2	1	**1,75**	2	2	**5,75**
Excavation of pipeline trenches	2	1	2	2	**1,75**	2	2	**5,75**
Soil stockpiles and management	1	2	1	2	**1,5**	2	2	**5,5**
Operation of machinery and vehicles within watercourse area	2	2	2	2	**2**	2	2	**6**
Operation of machinery and vehicles in adjacent areas	1	2	1	1	**1,25**	2	2	**5,25**
Waste and ablutions facilities	1	3	1	3	**2**	1	2	**5**
Pipeline trench back-filling and surface levelling	2	2	1	1	**1,5**	2	2	**5,5**
Final landscaping and shaping	1	1	2	1	**1,25**	2	2	**5,25**
Post-construction rehabilitation	1	1	2	1	**1,25**	2	2	**5,25**
Operational Phase								
Possible leaks (underground and above surface)	2	1	2	1	**1,5**	2	4	**7,5**
Increased water runoff (manhole overflows)	2	1	2	1	**1,5**	2	4	**7,5**
Routine monitoring and maintenance work (vehicular movement)	1	1	1	1	**1**	1	4	**6**
Establishment of alien plants and erosion from disturbed areas	1	1	2	1	**1,25**	1	4	**6,25**

Table 14: DWS Risk Impact Matrix for the proposed project continued

Aspect	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Sig.	Without Mitigation	With Mitigation
Construction Phase								
Site clearing and preparation	1	2	1	3	7	**40,25**	**Low**	**Low**
Excavation of pipeline trenches	1	3	5	2	11	**63,25**	**Moderate***	**Low**
Soil stockpiles and management	1	3	1	2	7	**38,5**	**Low**	**Low**
Operation of machinery and vehicles within watercourse area	1	3	**5**	3	12	**69**	**Moderate***	**Low**
Operation of machinery and vehicles in adjacent areas	1	2	1	1	5	**31,25**	**Low**	**Low**
Waste and ablutions facilities	1	2	1	2	6	**34,5**	**Low**	**Low**
Pipeline trench back-filling and surface levelling	1	3	5	2	11	**63,25**	**Moderate***	**Low**
Final landscaping and shaping	1	1	1	3	6	**33**	**Low**	**Low**
Post-construction rehabilitation	1	1	1	3	6	**36**	**Low**	**Low**
Operational Phase								
Possible leaks (underground and above surface)	2	3	1	1	7	**52,5**	**Low**	**Low**
Increased water runoff (manhole overflows)	2	2	1	1	6	**45**	**Low**	**Low**
Routine monitoring and maintenance work (vehicular movement)	2	1	1	1	5	**30**	**Low**	**Low**
Establishment of alien plants and erosion from disturbed areas	2	2	1	2	7	**43,75**	**Low**	**Low**

(*) denotes - In accordance with General Notice 509 "Risk is determined after considering all listed control / mitigation measures. Borderline Low / Moderate risk scores can be manually adapted downwards up to a maximum of 25 points (from a score of 80) subject to listing of additional mitigation measures detailed below.

The upgrade of the outfall sewer pipeline will entail the clearing of areas and digging of trenches, laying of pipeline and the upgrade of the manholes, with the level of risk determined to vary from low to moderate.

The moderate risks determined for the study are associated with the digging works, soil stockpile management and operation of equipment and machinery in proximity to wetland areas. Notable expected risks include the potential for increased sedimentation of the wetlands as the soils in the area may be susceptible to dispersion. The impairment of water quality during as a result of sedimentation is expected.

The operation of the pipeline does pose a risk to the identified water resources, with the level of risk determined to be low. The low risks are largely attributed to the proposed project being for the upgrade of existing infrastructure that will alleviate some of the existing impacts such as sewer overflows. Furthermore, the majority of the pipeline will be buried and far enough away from wetland areas which reduces the risk of surface and sediment impacts. The moderate risk ratings were re-allocated a low status due to implementation of additional mitigation methodologies.

8.2 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 15 is a summary of the findings from a wetland ecological perspective.

Please note not all potential unplanned events may be captured herein and this must therefore be managed throughout all phases.

Table 15: Unplanned Events, Low Risks and their Management Measures

Unplanned Event	Potential Impact	Mitigation
Hydrocarbon spill on natural areas	Contamination of sediments and wetland areas associated with the spillage.	A spill response kit must be available at all times. All incidents must be reported on and if necessary, a wetland specialist must investigate the extent of the impact and provide remedial actions.
Uncontrolled erosion	Degradation of grassland habitat and wetland areas	Erosion control measures

8.3 Cumulative Impacts

It is necessary to consider the impacts that the development will have from a broad area perspective, by considering land-use and transformation of natural habitat in

areas surrounding the site. Cumulative impacts are assessed by considering past, present and anticipated changes to biodiversity.

Even with extensive mitigation, significant latent impacts on the receiving terrestrial ecological environment are deemed likely. The following points highlight the key latent impacts that have been identified:

- Destruction of wetland habitat structures;
- Permanent loss of and altered wetland species diversity;
- Alien floral invasion; and
- Disturbed areas are highly unlikely to be rehabilitated to pre-development conditions of ecological functioning and a loss of ecoservices.

8.4 Mitigation Measures

The mitigation measures are prescribed to address the risks that may arise from the proposed activities and can be seen in Table 16.:

Table 16: Mitigation Measures and Actions

Impact/Risk Aspect	Mitigation Measure	Responsible Person
Site Establishment	❖ The footprint area of the working area should be kept a minimum. The footprint area must be clearly demarcated to avoid unnecessary disturbances to adjacent areas; ❖ All contractors and employees should undergo induction which is to include a component of environmental awareness. The induction is to include aspects such as the need to avoid littering, the reporting and cleaning of spills and leaks and general good "housekeeping"; ❖ Adequate sanitary facilities and ablutions on the servitude must be provided for all personnel throughout the project area. Use of these facilities must be enforced (these facilities must be kept clean so that they are a desired alternative to the surrounding vegetation); ❖ Have action plans on site, and training for contactors and employees in the event of spills, leaks and other impacts to the aquatic systems;	Environmental Control Officer & Site Foreman
Excavation and pipeline construction	❖ The recommended buffer zones must be strictly adhered to during the construction phase of the project, with exception of the activities and structures required to traverse a watercourse. Any supporting aspects and activities not required to be within the buffer area must adhere to the buffer zone; ❖ All construction activities and access must make use of the existing road and any access to be established must be beyond the wetland area; ❖ A suitable storm water management plan must be compiled for the construction phase. This plan must attempt to displace and divert storm water and discharge the water into adjacent areas without eroding the receiving areas. It is preferable that run-off velocities be reduced with energy dissipaters and flows discharged into the local watercourses; ❖ Laydown yards, camps and storage areas must be beyond the aquatic areas. Where possible, the construction of the crossings must take place from the existing road and not from within the watercourse and associated buffer; ❖ The contractors used for the project should have spill kits available to ensure that any fuel or oil spills are clean-up and discarded correctly;	Environmental Control Officer & Site Foreman

Impact/Risk Aspect	Mitigation Measure	Responsible Person
	❖ It is preferable that construction takes place during the dry season to reduce the erosion potential of the exposed surfaces; ❖ Prevent uncontrolled access of vehicles through the water resources system that can cause a significant adverse impact on the hydrology and alluvial soil structure of these areas; ❖ All machinery and equipment should be inspected regularly for faults and possible leaks, these should be serviced off-site; ❖ Temporary storm water channels should be filled with aggregate and/or logs (branches included) to dissipate flows. ❖ The pipeline must be aligned as close to the road as possible; ❖ Pipeline trenches and sandy bedding material may produce preferential flow paths for water across the project area perpendicular to the general direction of flow instead of angle. This risk can be reduced by installing clay plugs at intervals down the length of the trench to force water out of the trench and down the natural topographical gradient; ❖ Pipelines crossing drainage areas, should preferably span the drainage lines above ground. This prevents disruptions to sub surface flow dynamics and allows the pipeline to be monitored for leaks. Pipelines buried underground should be buried at a sufficient depth below ground level such that the pipelines do not interfere with surface water movement or create obstructions, where flows can cause erosion; ❖ Contamination of aquatic systems with unset cement or cement powder should be negated as it is detrimental to aquatic biota. Pre-cast structures should be made use of (where possible) to avoid the mixing of these materials on site, reducing the likelihood of cement in the river system; ❖ During the excavation of trenches, flows should be diverted around active work areas where required. Water diversion must be temporary and re-directed flow must not be diverted towards any stream banks that could cause erosion; ❖ Cut off valves should be placed at regular intervals to shut down the pipeline in case of leaks, bursts and repairs	
Operational Phase, Maintenance and Monitoring	❖ The pipeline should be regularly inspected (quarterly) for any signs of failure, damage or leaks. Adequate maintenance measures need to be implemented upon finding pipeline issues and failures; ❖ Aquatic biomonitoring programme must be instated from onset of mining; ❖ Wetland monitoring must be instated to continually monitor the effects mining has on wetland areas; and ❖ Post-Rehabilitation monitoring must be performed after the final rehabilitation is completed.	Environmental Control Officer & Site Foreman

9 Recommendation/Opinion of the Specialist

An impact statement is required as per the NEMA regulations with regards to the proposed development.

The impacts as described, rated and mitigated in this report pose a risk to the wetland area. The ecological sensitivity of the area is determined to be moderatly sensitive. With firm adherence to the mitigation measures prescribed in this report, the risks have been rated as low and it is the opinion of the specialist the proposed Boitumelo Sewer Upgrade project may proceed, following authorisations with the following conditions:

- An infrastructure monitoring and service plan must be compiled and implemented during the operational phase.
- An Environmental Control Officer (ECO) must oversee the construction phase of the project, with wetland areas as a priority.
- Based on the wetland assessment there is no envisaged alternative route, especially since the project is for the upgrade of existing infrastructure.

10 Conclusion

The upgrade of the outfall pipeline will entail the clearing of areas and digging of trenches, laying of pipeline and the upgrade of the manholes, with the level of risk determined to vary from low to moderate.

The moderate risks determined for the study are associated with the digging works, soil stockpile management and operation of equipment and machinery in proximity to wetland areas. Notable expected risks include the potential for increased sedimentation of the wetlands as the soils in the area may be susceptible to dispersion. The impairment of water quality during as a result of sedimentation is expected.

The operation of the pipeline does pose a risk to the identified water resources, with the level of risk determined to be low. The low risks are largely attributed to the proposed project being for the upgrade of existing infrastructure that will alleviate some of the existing impacts such as sewer overflows. The moderate risk ratings were re-allocated a low status due to implementation of additional mitigation methodologies. The moderate risk ratings were re-allocated a low status due to implementation of additional mitigation methodologies.

It is the opinion of the specialists that the project be favourably considered and allow for the proposed upgrade of the Outfall Sewer to proceed, should all prescribed mitigation measures and recommendations be implemented. Furthermore, the proposed upgrade will decrease the sewage discharge into the weland areas.

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