WETLAND ASSESSMENT FOR THE PROPOSED DELMORE X8 BULK WATER AND SEWER PIPELINES

Delmore, Gauteng

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Report No. xxx

CLIENT

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Report Name	**Vegetation Assessment for the proposed Delmore X8 bulk water and sewer pipelines**
Reference	**Delmore pipelines**
Submitted to	Alta van Dyk Environmental
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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, 2017. 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 principals of science.

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1 Introduction

The Biodiversity Company was appointed to conduct a wetland assessment for the proposed Delmore X8 bulk water and sewer pipelines, Delmore, Gauteng Province. The proposed development (Figure 1-1) is between the R29 and the M35 Commissioner Street, adjacent to housing developments and mining activity.

A wet season survey was conducted in November 2020, across the whole development footprint hereafter referred to as the "project area". The survey focused on the project footprint and the areas directly adjacent to the project area. Furthermore, identification and description of any sensitive receptors were recorded across the project area, and the manner in which these sensitive receptors may be affected by the proposed development were also investigated

The approach has taken cognisance of the recently published Government Notice 320 in terms of NEMA dated 30 October 2020: "Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation". The National Web based Environmental Screening Tool has characterised the Bulk water pipeline project area was rated as "very high' sensitivity for aquatics. The sewage pipeline project area was not associated with any aquatic area and as such no sensitivity was provided by the screening report.

This report, after taking into consideration the findings and recommendations provided by the specialist herein, should inform and guide the Environmental Assessment Practitioner (EAP) and regulatory authorities, enabling informed decision making with regards to the proposed project.

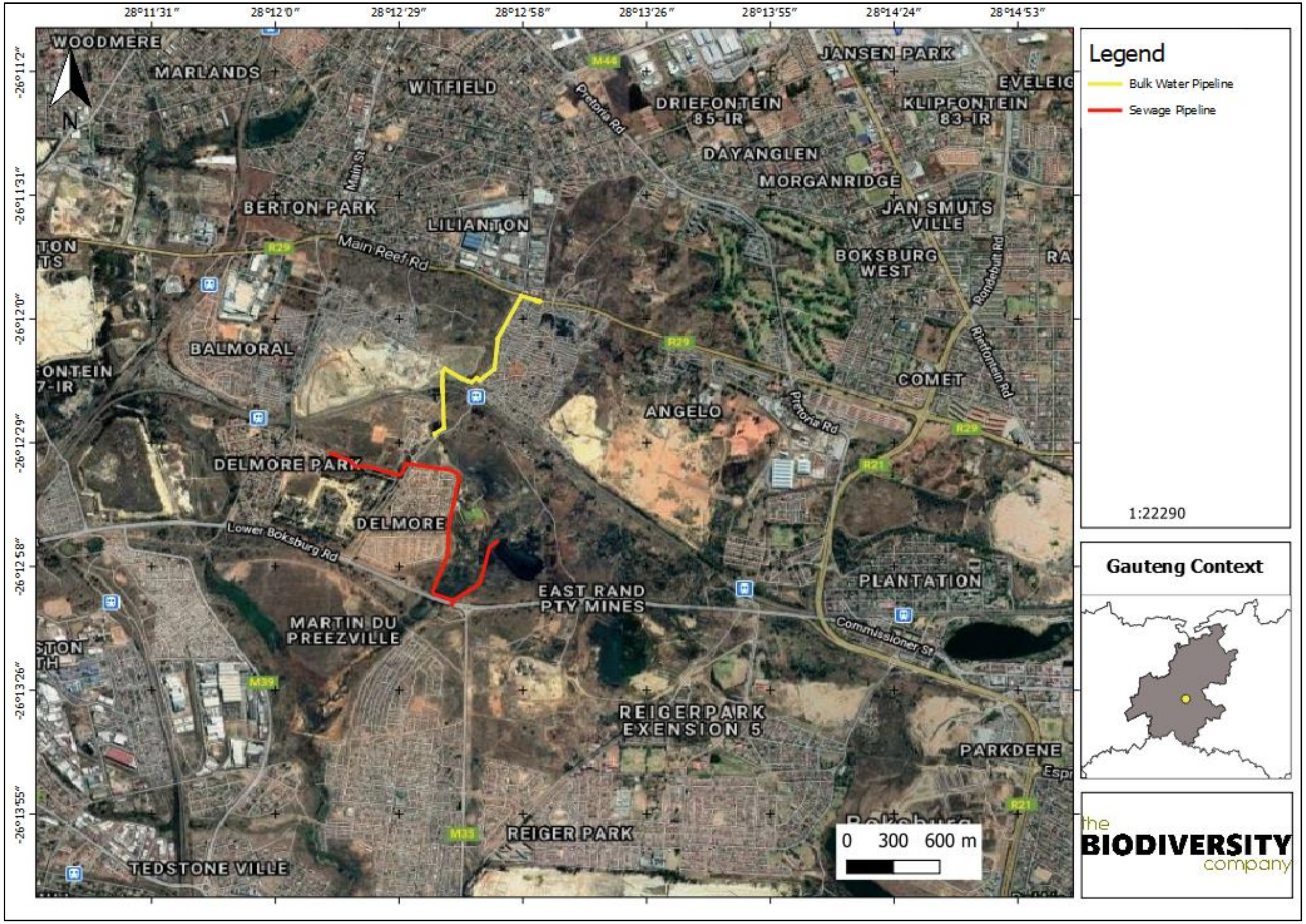


Figure 1-1 The location of the proposed project area

2 Terms of Reference

The following tasks were completed in fulfilment of the terms of reference for this study:

- Review of existing desktop information and literature;
- Determining the integrity and functionality of the water resources;
- An impact assessment for the proposed activities; and
- The prescription of mitigation measures, and recommendations for identified risks.

3 Legislative and Policy Framework

3.1 National Water Act (Act No. 36 of 1998)

The Department of Water & Sanitation (DWS) is the custodian of South Africa's water resources and therefore assumes public trusteeship of water resources, which includes watercourses, surface water, estuaries, or aquifers. The National Water Act (NWA) (Act No. 36 of 1998) allows for the protection of water resources, which includes:

- The maintenance of the quality of the water resource to the extent that the water resources may be used in an ecologically sustainable way;
- The prevention of the degradation of the water resource; and
- The rehabilitation of the water resource.

A watercourse means:

- A river or spring;
- A natural channel in which water flows regularly or intermittently;
- A wetland, lake or dam into which, or from which, water flows; and
- Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

The NWA recognises that the entire ecosystem, and not just the water itself, and any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the DWS.

For the purposes of this project, a wetland area is defined according to the NWA (Act No. 36 of 1998): "Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil".

Wetlands have one or more of the following attributes to meet the NWA wetland definition (DWAF, 2005):

- A high water table that results in the saturation at or near the surface, leading to anaerobic conditions developing in the top 50 cm of the soil;
- Wetland or hydromorphic soils that display characteristics resulting from prolonged saturation, i.e. mottling or grey soils; and

- The presence of, at least occasionally, hydrophilic plants, i.e. hydrophytes (water loving plants).

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

The National Environmental Management Act (NEMA) (Act 107 of 1998) and the associated Regulations as amended in April 2017, states that prior to any development taking place within a wetland or riparian area, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment Report (BAR) process or the EIA process depending on the scale of the impact.

4 Assumptions, Uncertainties and Gaps in Knowledge

The following aspects were considered as limitations:

- Only a single season survey was conducted for the respective studies, this would constitute a wet season survey;
- The Biodiversity Company completed a wetland assessment for the proposed Delmore X8 development in March 2018, which was then updated in February 2019. Findings from the assessment have been considered and included for this project where suitable;
- The use of soil and vegetation indicators for wetland delineation was limited in places where longstanding and intense crop cultivation and mining was present;
- This assessment has not assessed any temporal trends for the project;
- Due to the scale of the project, wetland delineation was limited to extent of the project area for detailed field-based delineation while wetlands beyond this (within the 500 m regulated area) were desktop delineated; 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.

5 Methodologies

A survey was conducted in early November 2020, would constitute a wet season assessment. Methodology descriptions employed for the study are provided below.

5.1 Wetland Assessment

The following information sources were considered for the desktop assessment;

- Aerial imagery (Google Earth Pro);
- Land Type Data (Land Type Survey Staff, 1972 - 2006);
- South African Inventory of Inland Aquatic Ecosystems (Van Deventer *et al*., 2019);
- The National Freshwater Ecosystem Priority Areas (Nel *et al*., 2011);
- Contour data (5m); and

- South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (Van Deventer *et al.*, 2018).

5.1.1 Wetland Identification and Mapping

The National Wetland Classification Systems (NWCS) developed by the South African National Biodiversity Institute (SANBI) was 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. In addition, the method also includes the assessment of structural features at the lower levels of classification (Ollis *et al.,* 2013).

The wetland areas are delineated in accordance with the DWAF (2005) guidelines, a cross section is presented in Figure 5-1. The outer edges of the wetland areas were identified by considering the following four specific indicators:

- The Terrain Unit Indicator helps to identify those parts of the landscape where wetlands are more likely to occur;
- The Soil Form Indicator identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation.
    - The soil forms (types of soil) found in the landscape were identified using the South African soil classification system namely; Soil Classification: A Taxonomic System for South Africa (Soil Classification Working Group, 1991);
- The Soil Wetness Indicator identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation; and
- The Vegetation Indicator identifies hydrophilic vegetation associated with frequently saturated soils.

Vegetation is used as the primary wetland indicator. However, in practise the soil wetness indicator tends to be the most important, and the other three indicators are used in a confirmatory role.

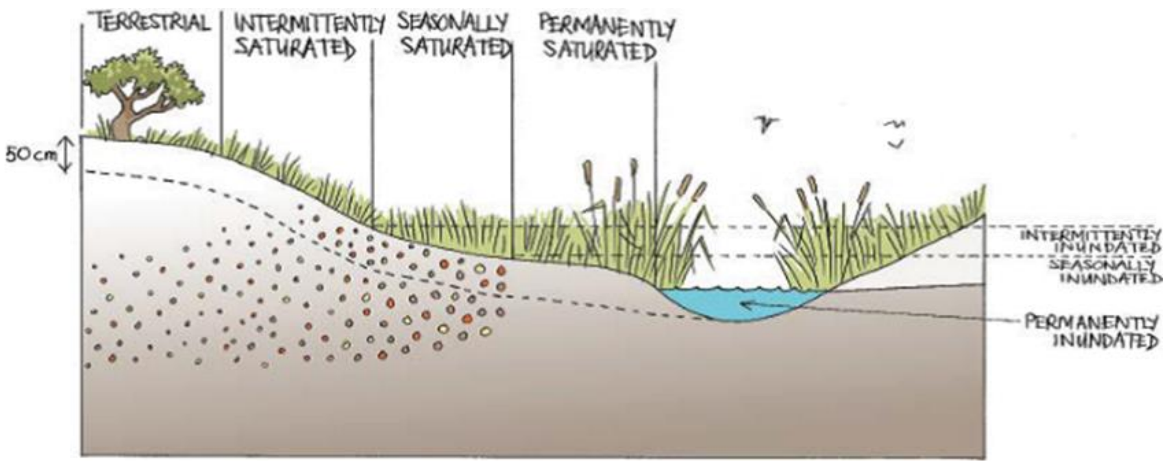


Figure 5-1 Cross section through a wetland, indicating how the soil wetness and vegetation indicators change (Ollis et al., 2013).

5.1.2 Present Ecological Status

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 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. The Present State categories are provided in Table 5-1.

Table 5-1 The Present Ecological Status categories (Macfarlane et al., 2009)

Impact Category	Description	Impact Score Range	PES
None	Unmodified, natural	**0 to 0.9**	**A**
Small	Largely Natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1.0 to 1.9	B
Moderate	Moderately Modified. A moderate change in ecosystem processes and loss of natural habitats has taken place, but the natural habitat remains predominantly intact.	2.0 to 3.9	C
Large	Largely Modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4.0 to 5.9	D
Serious	Seriously Modified. The change in ecosystem processes and loss of natural habitat and biota is great, but some remaining natural habitat features are still recognizable.	6.0 to 7.9	E
Critical	Critical Modification. The modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8.0 to 10	F

5.1.3 Ecological Importance and Sensitivity

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, where 0 indicates no importance and 4 indicates very high importance. The mean of the determinants is used to assign the EIS category as listed in Table 5-2 (Rountree & Kotze, 2013).

Table 5-2 Description of Ecological Importance and Sensitivity categories

EIS Category	Range of Mean	Recommended Ecological Management Class
Very High	3.1 to 4.0	**A**
High	2.1 to 3.0	**B**
Moderate	1.1 to 2.0	**C**
Low Marginal	< 1.0	**D**

5.1.4 Recommended Ecological Category

The Recommended Ecological Category (REC) is determined by the PES of the water resource and the importance and/or sensitivity of the water resource.

Water resources which have Present Ecological State categories in an E or F ecological category are deemed unsustainable by the DWA. In such cases the REC must automatically be increased to a D (Rountree *et.al.* 2013).

Where the PES is in the A, B, C or D ecological category, then the EIS components must be checked to determine if any of the aspects of importance and sensitivity (Ecological Importance; Hydrological Functions and Direct Human Benefits) are high or very high. If this is the case, the feasibility of increasing the PES (particularly if the PES is in a low C or D category) should be evaluated. This is recommended to enable important and/or sensitive wetland water resources to maintain their functionality and continue to provide the goods and services for the environment and society.

The REC is determined as follows with Table 5-3 showing the summarised selection criteria.

- If PES is in an E or F category, then the EIS is not important and the REC is set to at least a D (since E and F ecological categories are considered unsustainable);
- If PES is in an A, B, C or D category, ***AND*** the EIS is Moderate to Low ***OR*** the EIS criteria is High or even Very High, ***AND*** It is ***not feasible*** or practicable for the PES to be improved ***THEN*** the REC is set to the current PES; and
- If PES is in a B, C or D category, ***AND*** the EIS is High or Very High. ***AND*** It is ***feasible*** or practicable for the PES to be improved ***THEN*** the REC is set to at least one category higher than the current PES.

Table 5-3 Summary of selection criteria

PES	EIS	Condition	REC
E or F	N/A	N/A	At least a D
A, B, C, or D	Moderate to Low OR the EIS criteria is High or even Very High	It is not feasible or practicable for the PES to be improved	Set to current PES
B, C, or D	High or Very High	It is feasible or practicable for the PES to be improved	Set at least one category higher than the current PES

5.1.5 Determining Buffer Requirements

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

5.1.6 Risk Assessment

The risk assessment will be completed in accordance with the requirements of the DWS General Authorisation (GA) in terms of Section 39 of the NWA for water uses as defined in Section 21(c) or Section 21(i) (GN 509 of 2016)

6 Results and Discussion

6.1 Desktop Spatial Assessment

The following features describes the general area and habitat, this assessment is based on spatial data that are provided by various sources such as the provincial environmental authority and the SANBI. The desktop analysis and their relevance to this project are listed in Table 6-1.

Table 6-1 Desktop spatial features examined.

Desktop Information Considered	Relevant/Not relevant	Section
Conservation Plan	The project area overlaps with Critical Biodiversity Area (CBA): Important and a Ecological Support Area (ESA) areas	7.1
Wetland Ecosystem Threat Status	A Critically Endangered (CR) wetland was found within the 500m regulated area of the project area	7.1.2.1
Wetland Ecosystem Protection Level	The wetland protection level as per the National Biodiversity Assessment (NBA) shows that the wetland within the 500 m regulated area is classed as “Not Protected	7.1.2.2
Vegetation Type	The project area occurs in the Soweto Highveld Grassland	7.1.5
SWSA	Irrelevant: 48km from the closest Strategic Water Source Area (SWSA)	-
City of Johannesburg wetlands	Irrelevant: falls outside of the spatial data footprint	-
National Freshwater Ecological Priority Area (NFEPA)	The 500 m regulated area does overlap with unclassified wetland areas	7.1.8

6.1.1 The Biodiversity Conservation Plan

The Gauteng Conservation Plan (Version 3.3) (GDARD, 2014b) classified areas within the province based on its contribution to reach the conservation targets within the province. These areas are classified as Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) to ensure sustainability in the long term. The CBAs are classified as either ‘Irreplaceable’ (must be conserved), or ‘Important’.

Critical Biodiversity Areas (CBAs) are terrestrial and aquatic areas of the landscape that need to be maintained in a natural or near-natural state to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. Thus, if these areas are not maintained in a natural or near natural state then biodiversity targets cannot be met.

Figure 6-1 shows the project area superimposed on the Terrestrial CBA map. The project area of the bulk water pipeline follows the same path as an area classified as an ESA and the southern portion also overlaps with a CBA: Important area. The sewage pipeline also overlap with a CBA: important and ESA area.

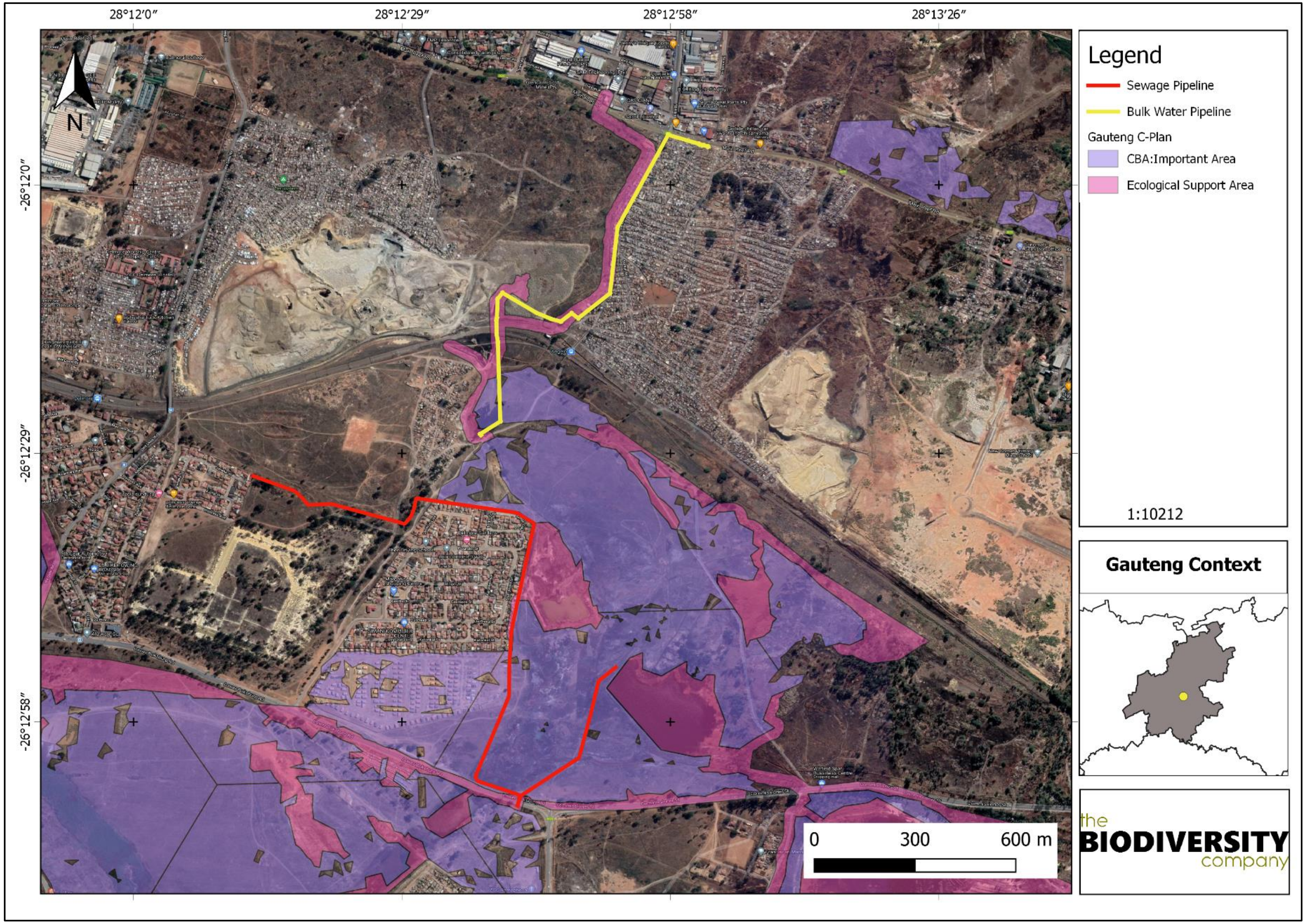


Figure 6-1 Project area superimposed on the Gauteng Conservation Plan terrestrial map

6.1.2 Project Area in Relation to the NBA

The two headline indicators assessed in the NBA are ecosystem threat status and ecosystem protection level (Skowno *et al*, 2019).

6.1.2.1 Ecosystem Threat Status

Ecosystem threat status outlines the degree to which ecosystems are still intact or alternatively losing vital aspects of their structure, function and composition, on which their ability to provide ecosystem services ultimately depends (Skowno *et al.*, 2019).

Ecosystem types are categorised as Critically Endangered (CR), Endangered (EN), Vulnerable (VU) or Least Concerned (LC), based on the proportion of each ecosystem type that remains in good ecological condition (Skowno *et al.*, 2019).

A CR wetland was found within 500 m of the project area and overlaps with the project footprint of the sewage pipeline as per the South African Inventory of Inland Aquatic Ecosystems (SAIIAE) which was released as part of the National Biodiversity Assessment (NBA) 2018 (Figure 6-2).

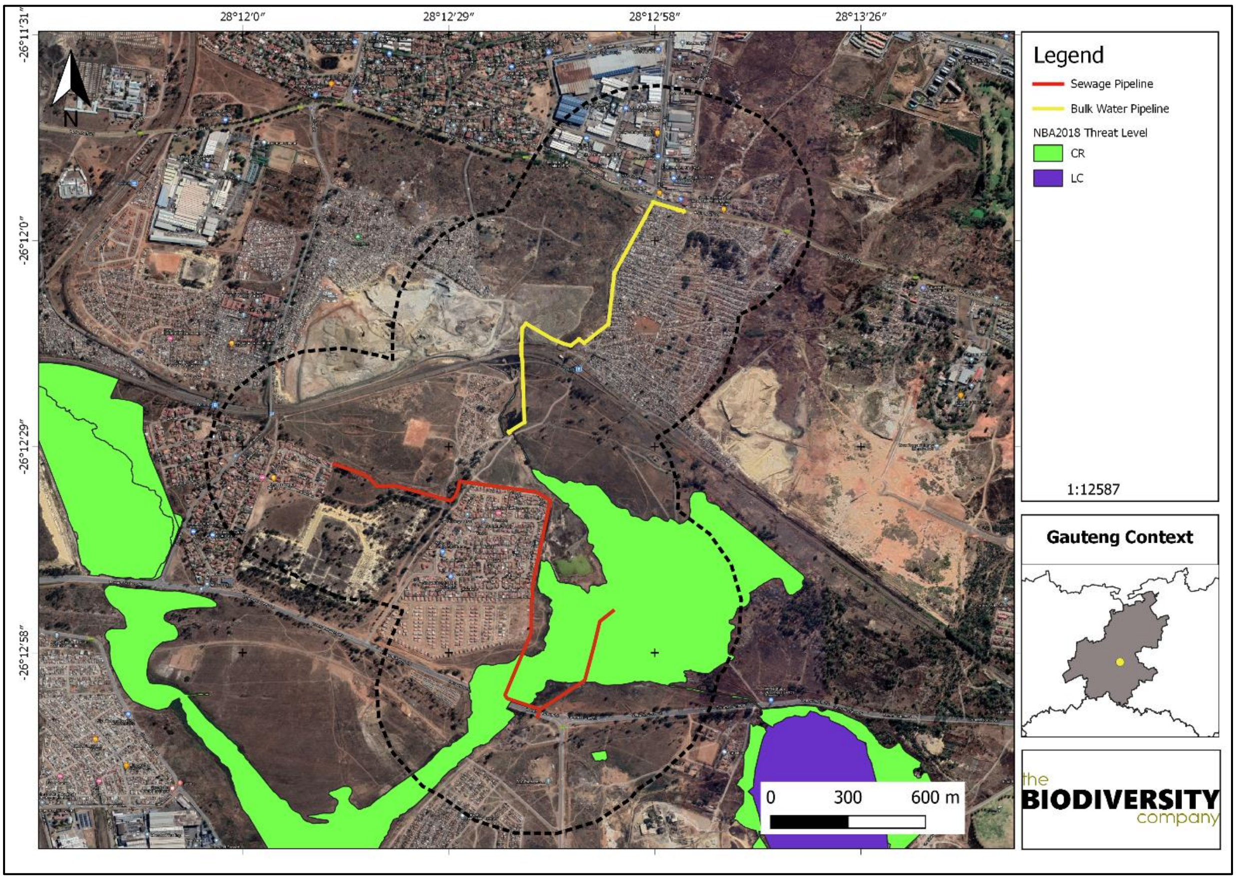


Figure 6-2 The threat status of the wetlands within the 500 m regulated area

6.1.2.2 Ecosystem Protection Level

Ecosystem protection level tells us whether ecosystems are adequately protected or under-protected. Ecosystem types are categorised as not protected, poorly protected, moderately protected or well protected, based on the proportion of each ecosystem type that occurs within a protected area recognised in the Protected Areas Act (Skowno *et al*, 2019).

The wetland protection level as per the NBA shows that the wetland within the 500 m regulated area is classed as “not protected”, which means no portion of this wetland is protected in any conservation or protected area (Figure 6-3).

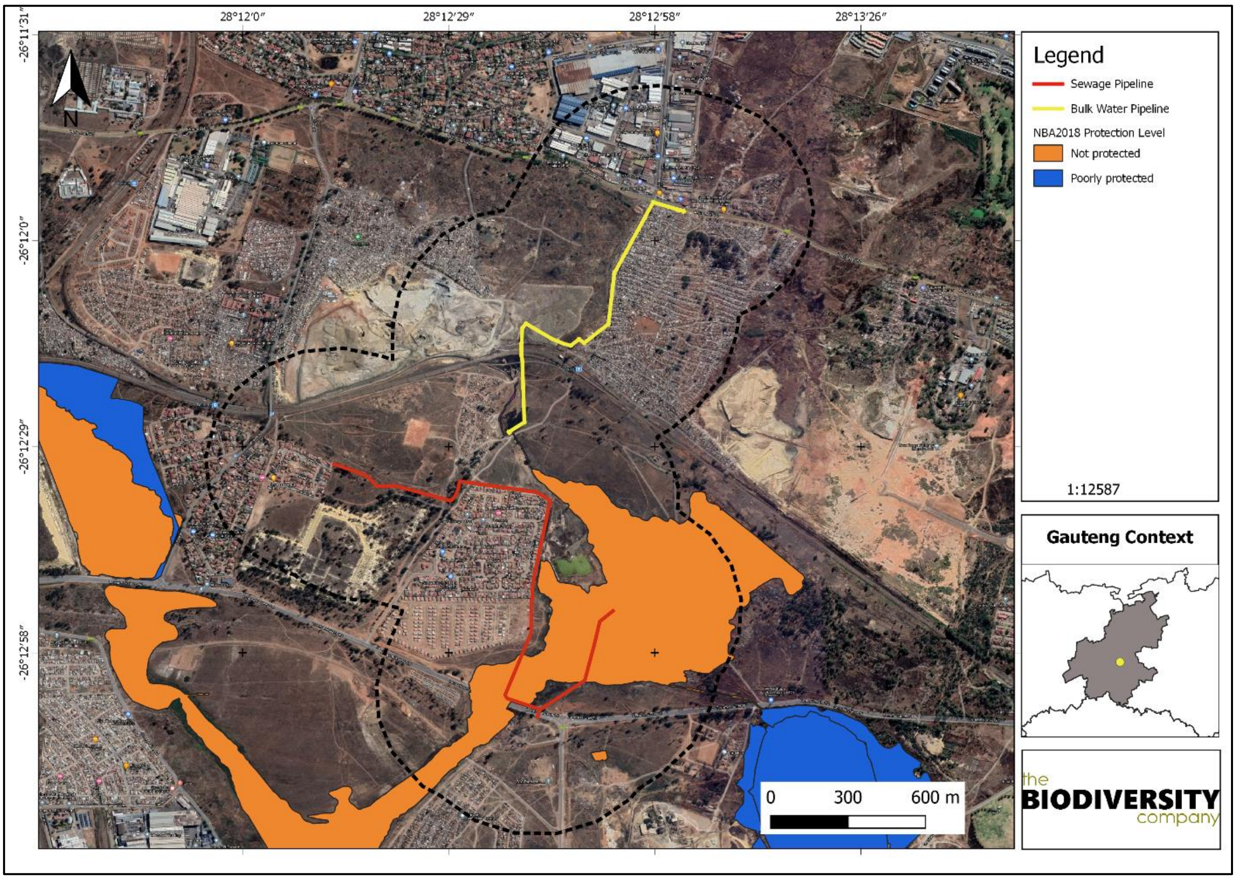


Figure 6-3 The protection level of the wetlands within the 500 m regulated area

6.1.3 Vegetation Type

The project area is situated within the Soweto Highveld Grassland according to SANBI (2018) (Figure 6-4).

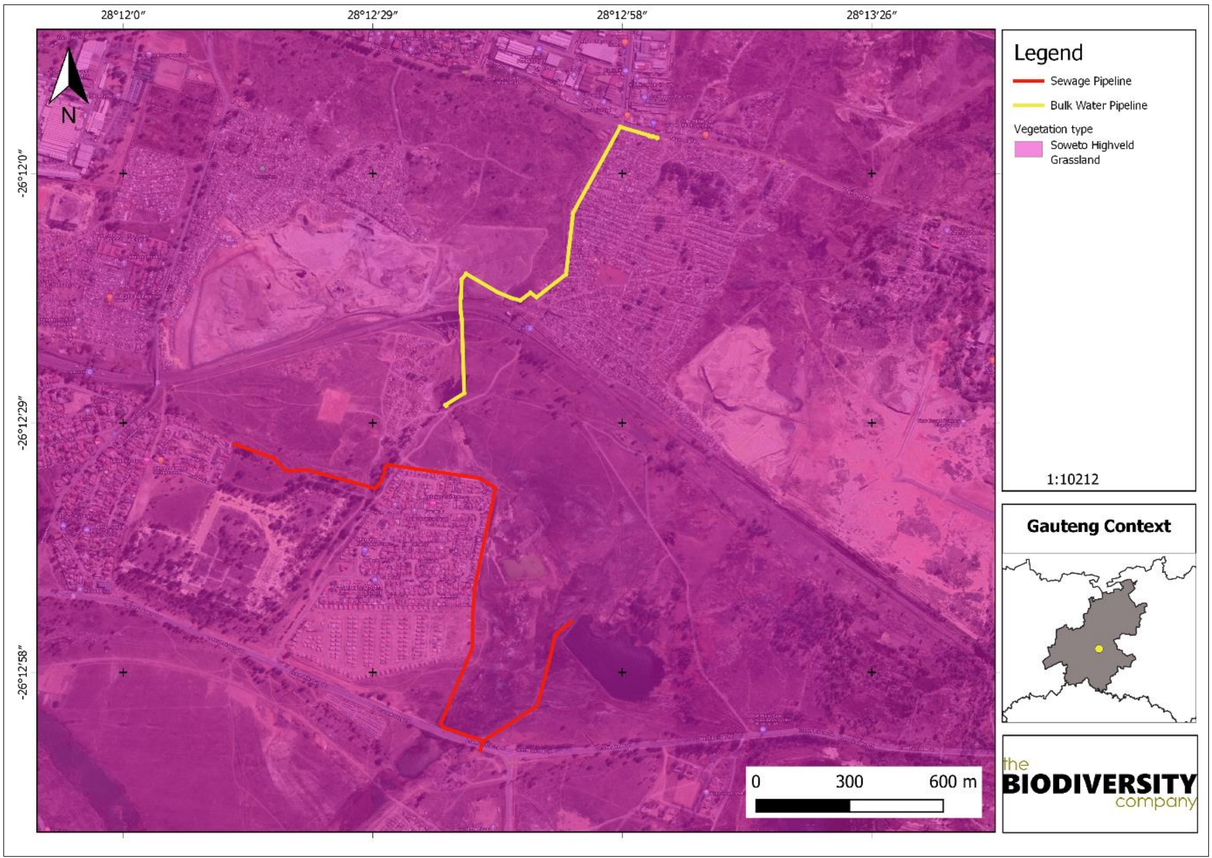


Figure 6-4 Project area showing the vegetation type based on the Vegetation Map of South Africa, Lesotho & Swaziland (BGIS, 2017).

6.1.3.1 Soweto Highveld Grassland

The Soweto Highveld Grassland vegetation type is found in Mpumalanga, Gauteng and to a little extent also in neighbouring Free State and North-West Provinces. This vegetation type typically comprises of an undulating landscape on the Highveld plateau supporting short to medium-high, dense, tufted grassland dominated almost entirely by *Themeda triandra* and accompanied by a variety of other grasses such as *Elionurus muticus, Eragrostis racemosa, Heteropogon contortus* and *Tristachya leucothrix*. Scattered small wetlands, narrow stream alluvia, pans and occasional ridges or rocky outcrops interrupt the continuous grassland cover (Mucina & Rutherford, 2006).

Important Taxa:

Important plant taxa are those species that have a high abundance, a frequent occurrence or are prominent in the landscape within a particular vegetation type (Mucina & Rutherford, 2006). The following species are important in the Soweto Highveld Grassland.

Graminoids: *Andropogon appendiculatus, Brachiaria serrata, Cymbopogon pospischilii, Cynodon dactylon, Elionurus muticus , Eragrostis capensis, E. chloromelas, E. curvula, E. plana, E. planiculmis, E. racemosa, Heteropogon contortus, Hyparrhenia hirta, Setaria nigrirostris, S. sphacelata, Themeda triandra, Tristachya leucothrix, Andropogon schirensis, Aristida adscensionis, A. bipartita, A. congesta, A. junciformis subsp. galpinii, Cymbopogon caesius, Digitaria diagonalis, Diheteropogon amplectens, Eragrostis micrantha, E. superba, Harpochloa falx, Microchloa caffra, Paspalum dilatatum* (Mucina & Rutherford, 2006).

Herbs: *Hermannia depressa, Acalypha angustata, Berkheya setifera, Dicoma anomala, Euryops gilfillanii, Geigeria aspera var. aspera, Graderia subintegra, Haplocarpha scaposa, Helichrysum miconiifolium, H. nudifolium var. nudifolium, H. rugulosum, Hibiscus pusillus, Justicia anagalloides, Lippia scaberrima, Rhynchosia effusa, Schistostephium crataegifolium, Selago densiflora, Senecio coronatus, Vernonia oligocephala, Wahlenbergia undulata* (Mucina & Rutherford, 2006).

Geophytic Herbs**:** *Haemanthus humilis subsp. hirsutus, H. montanus. Herbaceous Climber: Rhynchosia totta* (Mucina & Rutherford, 2006).

Low Shrubs: *Anthospermum hispidulum, A. rigidum subsp. pumilum, Berkheya annectens, Felicia muricata, Ziziphus zeyheriana* (Mucina & Rutherford, 2006).

Conservation Status of the Vegetation Type

According to Mucina and Rutherford (2006), the Soweto Highveld Grassland vegetation type is classified as Endangered. The national target for conservation protection for both these vegetation types is 24%, but only a few patches are statutorily conserved in Waldrift, Krugersdorp, Leeuwkuil, Suikerbosrand, Rolfe's Pan Nature Reserves or privately conserved in Johanna Jacobs, Tweefontein, Gert Jacobs, Nikolaas and Avalon Nature Reserves and the Heidelberg Natural Heritage Site.

By 2006 nearly half of the area of occupancy of this vegetation type had already been transformed by cultivation, urban sprawl, mining and building of road infrastructure. The amount of area transformed has most likely increased substantially. Some Soweto Grassland areas have been flooded by dams including Grootdraai, Leeukuil, Trichardtsfontein, Vaal and Willem Brummer.

6.1.4 Desktop soils

The geology consists mainly of Witwatersrand quartzite, slate, grit and conglomerate. Black Reef quartzite, shale, grit and conglomerate in western part. Ecca shale and sandstone with occasional dolerite sills in east. Sporadic occurrence of Basement Complex granite, dolomite and Ventersdorp lava mainly to the west. Pans occupy 0,4% of land type.

According to the land type database (Land Type Survey Staff, 1972-2006) the project area is located within the Ba36 land type. The Crest and midslope dominates the landscape positions with Shallow Mispah and Glenrosa soils in these positions. There is also Glencoe soils present in these two land positions. The Footslopes are dominated by Kroonstad and Fernwood soil forms, whilst the valley bottoms are dominated by Dundee soils.

The following information (Table 6-2) specific to the project area is summarised for the Gauteng Agricultural Potential Atlas (GAPA IV).

Table 6-2 Summary description for the GAPA IV dataset

PURPOSE	DESCRIPTION
The Agro-Ecological Zones combine Land Capability, Land Use, Land Cover and Biodiversity into a single zoning database.	Land use classification for the project area is No agriculture.
The protection of High Potential Agricultural Land is proposed by all municipality SDF's. Applications for new infrastructure developments, mining, change in land-use, etc., should take the location of high potential agricultural land into consideration.	The two class values are 0-24.99 ha and 50-74.99 ha.
The important agricultural sites-boundaries demarcated by GDARD as areas with a high agricultural potential, existing cultivated agricultural activities or both.	No sites are located in the project area
Land capability is a measure of suitability of land for many different forms of land-use activities.	Ranges from moderately-high to high

6.1.5 National Freshwater Ecological Priority Areas

Figure 6-5 shows the location of the project area in relation to wetland FEPAs. Based on this information, the 500 m regulated area does overlap with several wetland areas. However, none of these wetland areas are classified as FEPA wetlands (Nel *et al*. 2011).

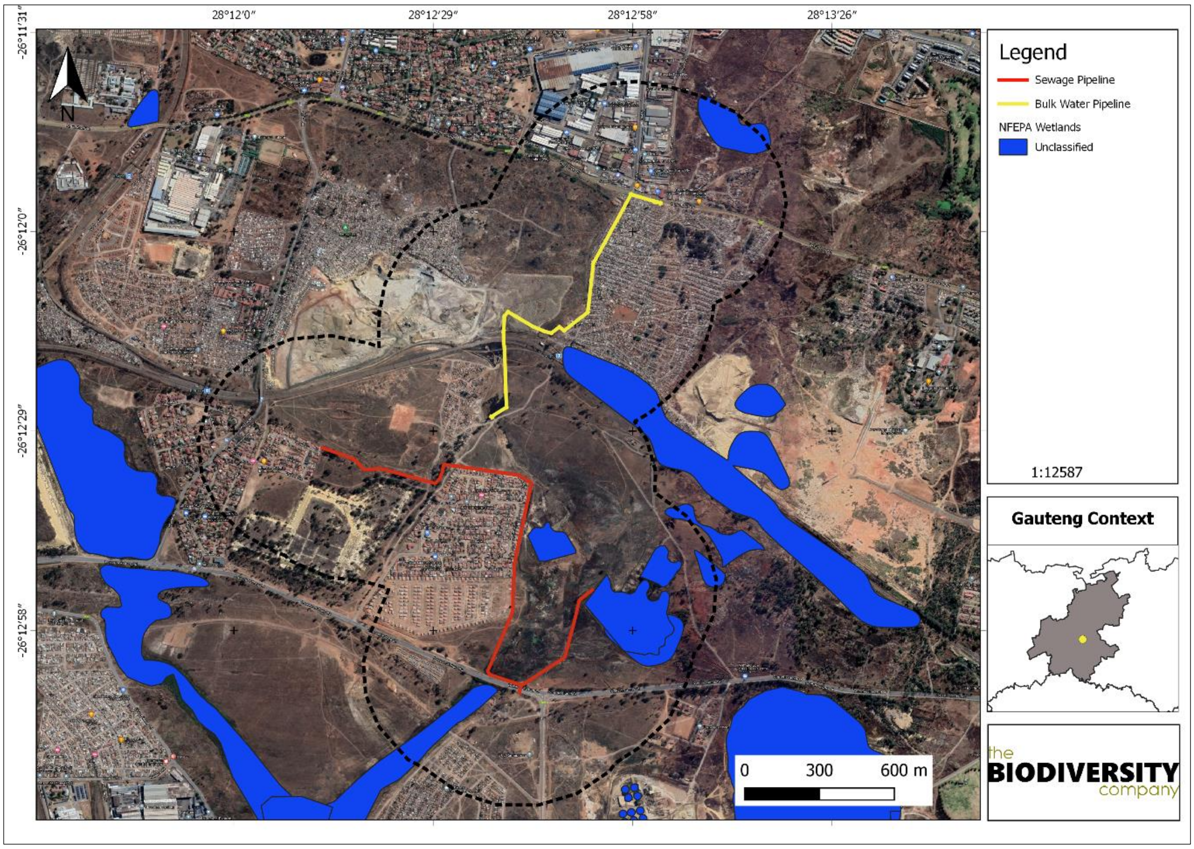


Figure 6-5 The Project area in relation to the National Freshwater Ecosystem Priority Areas

6.2 Wetland Assessment

6.2.1 Classification

Based on a combination of desktop and in-field delineations, a total of eight (8) individual wetland hydrogeomorphic (HGM) units were identified and delineated within the project area, comprising both natural and artificial systems. HGM 1 runs adjacent to the Angelo informal settlement area and is representative of a stormwater channel. Based on this, this system is regarded as an artificial resource and has been excluded from the ecological assessment. HGM units 3 and 4 are classified as excavated depressions and are artificial systems. Similarly, these units have been excluded from the ecological assessment. The upper reaches of HGM 5 is characterised by dams, but the remaining extent of the system is representative of a valley bottom system which has been cumulatively assessed for the project. Another dam is located within the seepage area associated with HGM 8, this system is also regarded as artificial, but the remaining extent of HGM 8 has been further assessed. The dams are regarded as artificial systems and have been delineated for the purposes of the study, but no further ecological or functional assessment was undertaken for this system. Photographs of some of the HGM types identified for the study are presented in Figure 6-6.

The location and extent of the delineated wetland systems are presented in Figure 6-7. 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 6-3). These included depressions, seepage wetlands and channelled valley bottom system.

Table 6-3 Wetland classification as per SANBI guideline (Ollis et al. 2013)

HGM	Level 1	Level 2		Level 3	Level 4		Description
	System	DWS Ecoregion/s	NFEPA Wet Veg Group/s	Landscape Unit	4A (HGM)	4B	
HGM 1	Inland	Highveld	Mesic Highveld Grasslands	Valley bottom	Channelled valley bottom	N/A	Stormwater channel
HGM 2				Valley bottom	Channelled valley bottom	N/A	Natural
HGM 3				Plain	Depression	Endorheic	Artificial Excavation
HGM 4				Plain	Depression	Endorheic	Artificial Excavation
HGM 5				Valley bottom	Channelled valley bottom	N/A	Natural
HGM 6				Slope	Seep	With channeled outflow	Natural
HGM 7				Slope	Seep	With channeled outflow	Natural
HGM 8				Slope	Seep	With channeled outflow	Natural

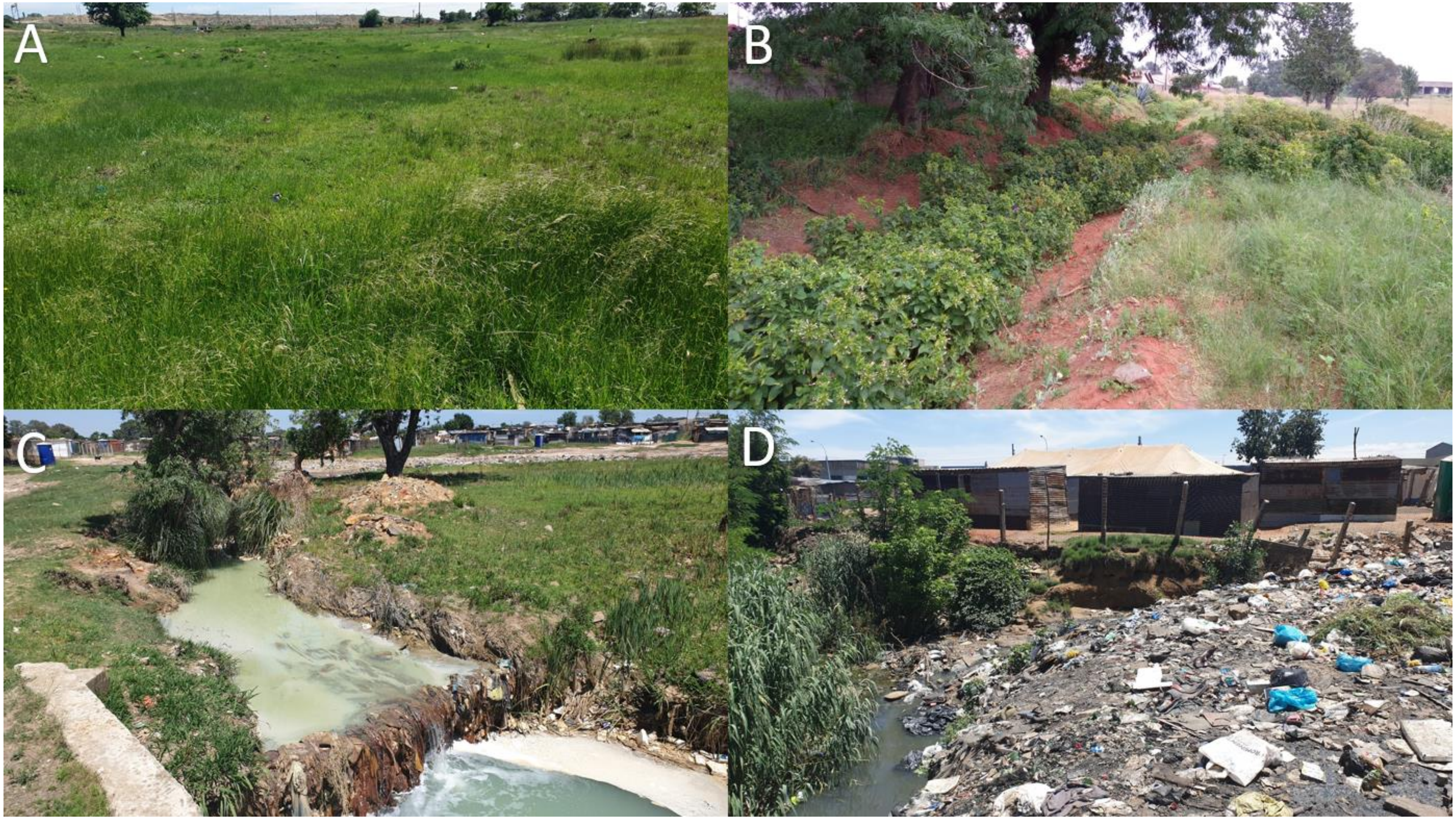


Figure 6-6 Photographs of wetlands identified for the assessment A) Seep, B) Drainage channel, C) Channelled valley bottom, D) Artificial stormwater channel

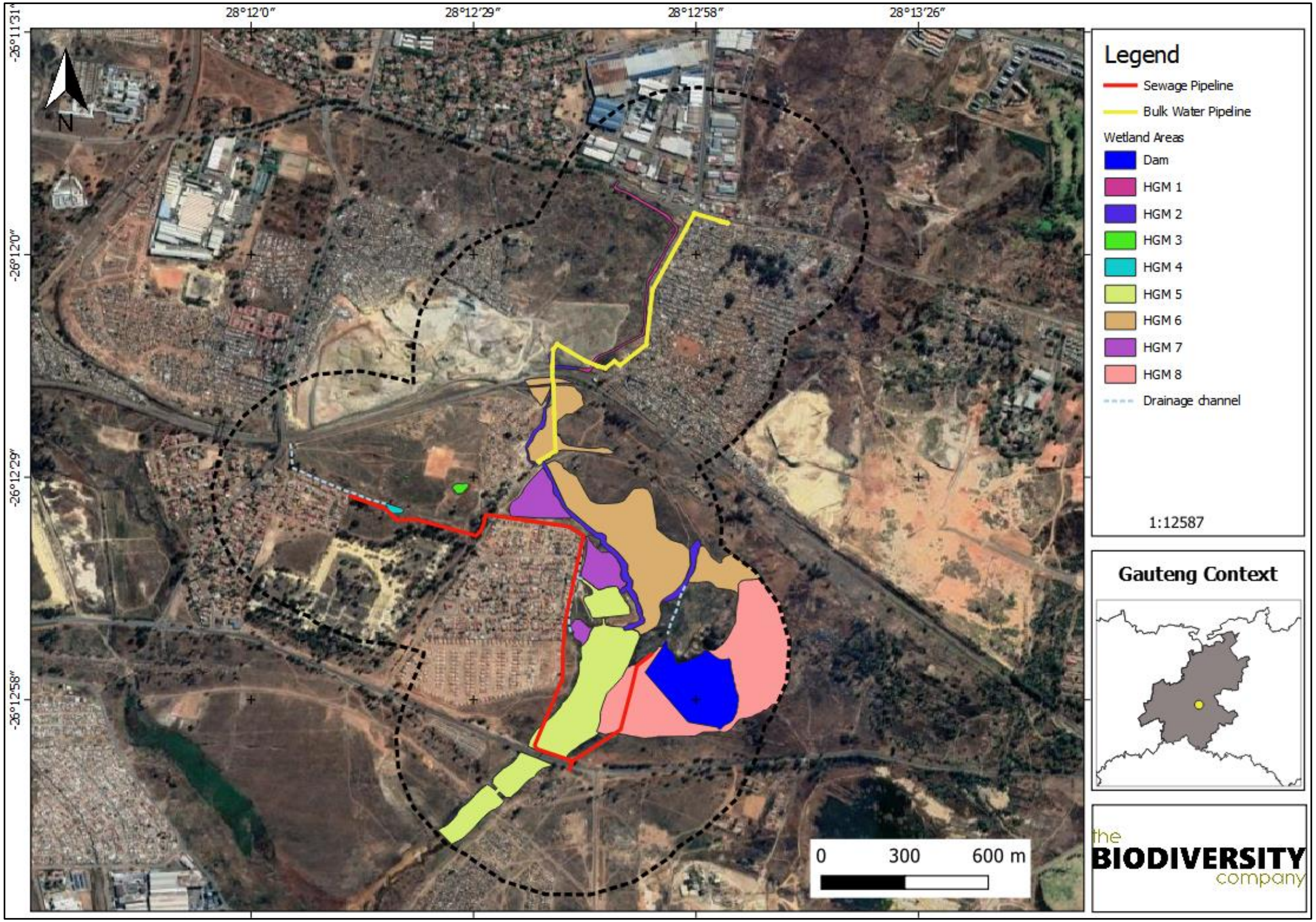


Figure 6-7 Wetland delineation

6.2.2 Hydrogeomorphic Setting

Figure 6-8 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 (UVB) wetlands are typically found on valley floors where the landscape does not allow high energy 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.

According to Ollis *et al*. (2013) depressions are often closed or near closed, which increases in depth from the perimeter to a central area of greatest depth and within which water typically accumulates.

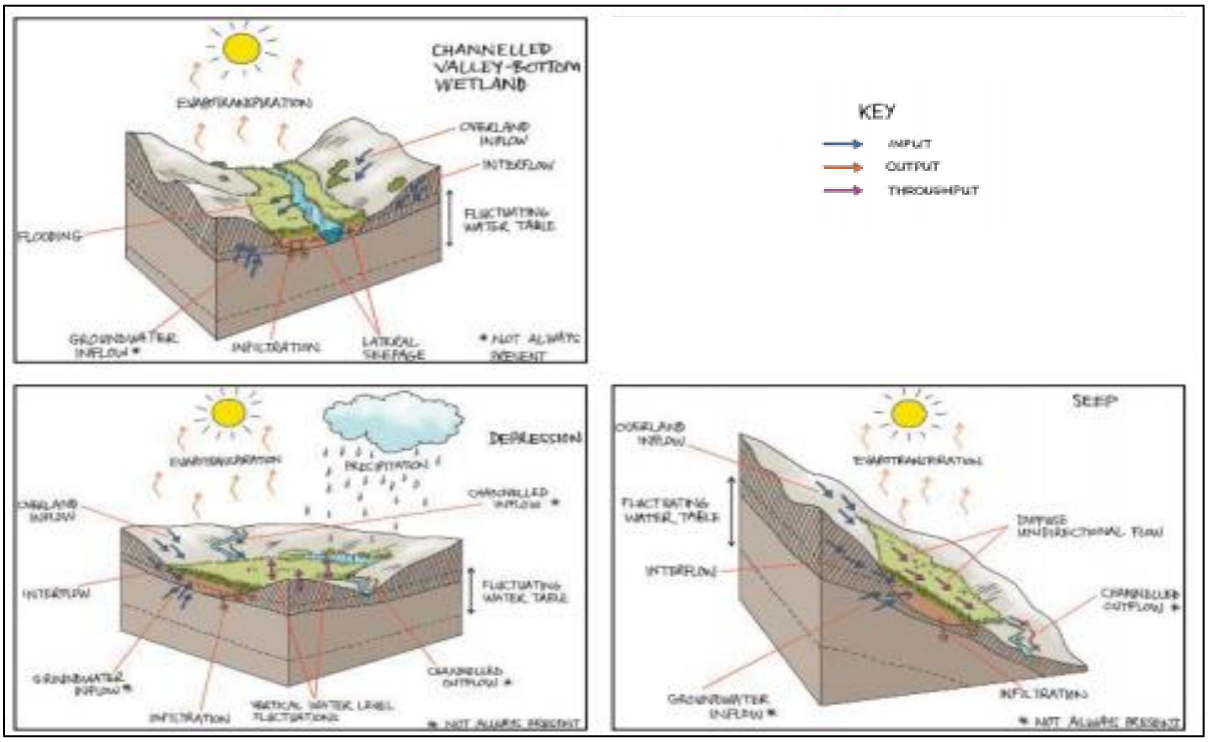


Figure 6-8 Amalgamated diagram of the wetland units, highlighting the dominant water inputs, throughputs and outputs, SANBI guidelines (Ollis et al. 2013)

6.2.3 Soils

The range of Soil Forms identified for the study included the Katspruit (permanent wetland zone), Longlands (seasonal zone), Westleigh (seasonal zone), Oakleaf (non-wetland) and Witbank (Man-made) forms. Soil sampling during the site visit revealed mainly dark orthic topsoils underlain by a G-horizon which were classified as a Katspruit soil form, although some areas contained a more gritty, sandy substrate which was classified as a Kroonstad soil form.

Descriptions of the Katspruit Soil Form is shown in Figure 6-9. Photographs of Soil Form and Soil Wetness encountered in the project area presented in Figure 6-10.

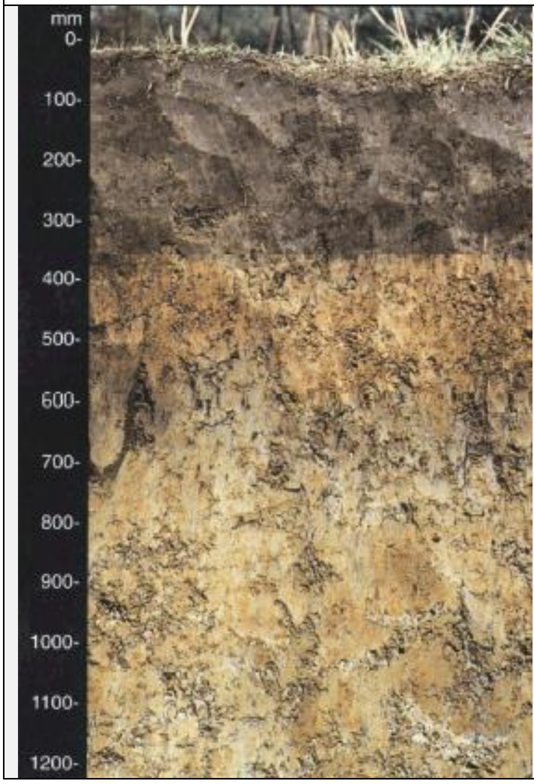
Katspruit:	
	Widespread associated with several permanent zones throughout lower lying areas. Midslope to channel terrain setting. Permanent. Orthic over G horizon. In the Katspruit soil form an orthic A horizon overlies a G horizon which is typical moist with grey matrix colours. Mottling may or may 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.

Figure 6-9 Cross section of soil profiles (SASA, 1999)

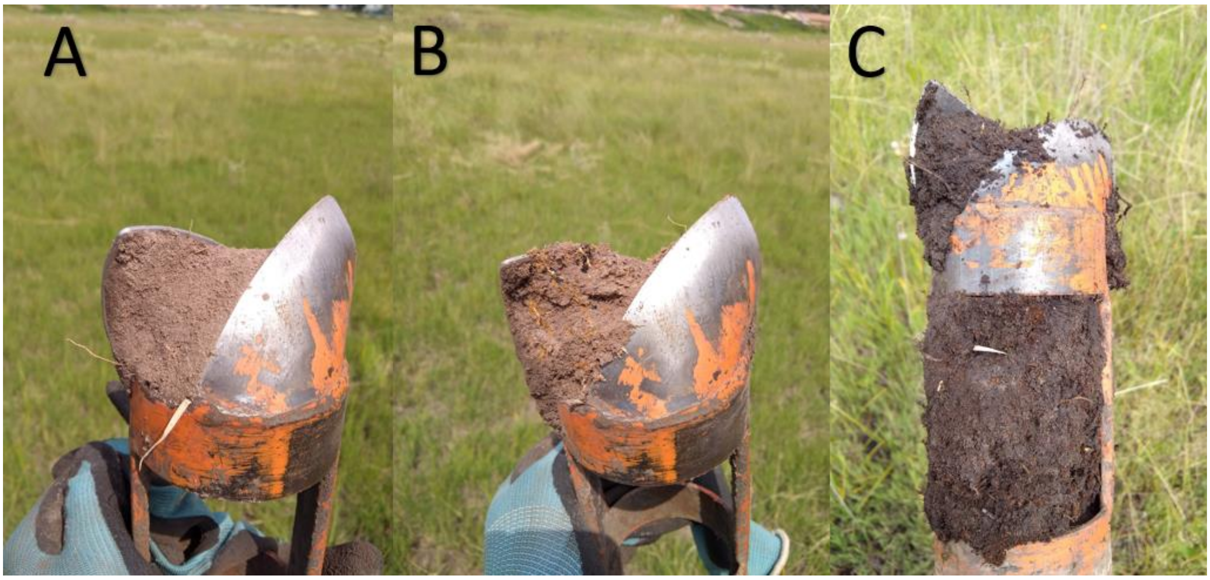


Figure 6-10 Photographs of Soil Forms and Soil Wetness considered for the study. A) E horizon, B) G horizon, C) Katspruit

6.2.4 Wetland Vegetation

Wetland vegetation which was recorded for the study includes *Typha capensis, Phragmites australis, Imperata cylindrica, Anthephora pubescens, Cyperus erogrostus, Setaria* *sphacelata, Juncus rigidus, Schoenoplectus brachyceras, Panicum repens, Persicaria sp, Andropogon eucomus, Cyperus longus, Cyperus congestus,* and *Cyperus fastigiates.* Figure 6-11 presents photographs of wetland vegetation recorded for the project area.

Figure 6-11 Photographs of wetland vegetation recorded for the project

6.2.5 Wetland Health

The integrity for the assessed wetland areas is presented in Table 6-4 and Figure 6-13. Photographs of aspects that have contributed to the modifications of the systems are presented in Figure 6-12. The overall wetland health (or PES) for HGM 2, 5 and 6 was Largely Modified (Class D), and HGM 7 and 8 were rated as Seriously Modified (Class E).

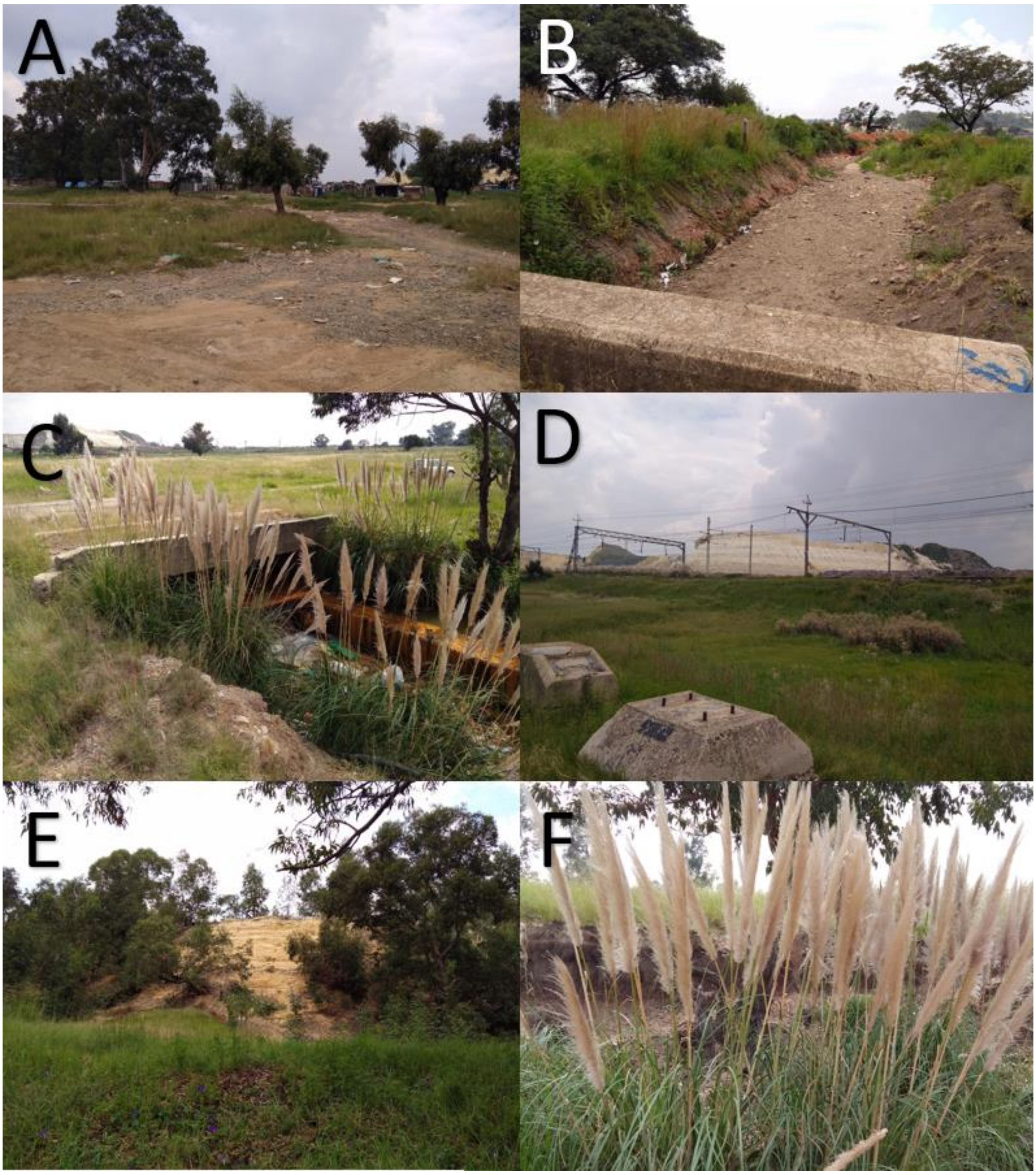


Figure 6-12 Photographs of aspects impacting on the wetlands. A) Cleared areas and human settlement, B) Stormwater measures, C) Crossings and litter, D) Infrastructure development, E) Mining, F) Alien vegetation, Cortaderia selloana

The channelled valley bottom wetlands (HGM 2) are fed by precipitation and runoff in the upper portions of the catchment. These sources are extremely contaminated as they flow through/from a tailings dump, solid waste dump, and other urban areas. The depression wetlands (HGM 2, and 3) are also fed by precipitation and overland flow. HGM 2 can be considered as artificial in the sense that this is an old platformed area and the area developed a depression in which water accumulates. The seepage areas (HGM 6 and 7) are fed from subsurface flows in concave landscapes. Unit HGM 8 is fed from subsurface flow but is also supported by overland flow stemming from the adjacent mining areas. A number of drainage channels have been constructed to drain areas and divert flows in the area.

The major impact on the hydrological component of these HGM units was that of impervious and bare areas. Surface run-off has been re-directed and concentrated in certain areas within the project area. Crossing structures have also impeded flows across the catchment area. The proliferation of alien vegetation in some HGM units also affects the water balance within the catchment, largely caused by consumption. Large areas of bare and eroded areas increase surface runoff and sediment loads into stream channels. A number of dams have also resulted in the inundation of systems, with evidence of erosion below the walls. The local land uses have also encroached into the catchment, resulting in the narrowing of some wetland areas as a result of this. The geomorphology of the wetlands has also been impacted on due to the historical and current land uses. The construction of crossings, channels to direct flow, extensive erosion, and increased hydrological inputs have all altered this component.

The vegetation of the wetland systems within the project area and the offset area has been impacted on by subsistence grazing practices. Disturbances to the project area has resulted in the establishment of alien vegetation within these areas, which included *Verbena bonariensis, Bidins bipannata,* and *Eucalyptus spp.*

Table 6-4 Summary of the scores for the wetland Present Ecological State

Wetland	Hydrology		Geomorphology		Vegetation	
	Rating	Score	Rating	Score	Rating	Score
HGM 2	E: Seriously Modified	6.5	D: Largely Modified	5.1	D: Largely Modified	5.4
Overall PES	5.8		Overall PES Class		D: Largely Modified	
Wetland	Hydrology		Geomorphology		Vegetation	
	Rating	Score	Rating	Score	Rating	Score
HGM 5	D: Largely Modified	4.0	C: Moderately Modified	3.8	D: Largely Modified	4.5
Overall PES	4.1		Overall PES Class		D: Largely Modified	
Wetland	Hydrology		Geomorphology		Vegetation	
	Rating	Score	Rating	Score	Rating	Score
HGM 6	D: Largely Modified	4.5	C: Moderately Modified	3.6	D: Largely Modified	4.5
Overall PES	4.2		Overall PES Class		D: Largely Modified	
Wetland	Hydrology		Geomorphology		Vegetation	
	Rating	Score	Rating	Score	Rating	Score
HGM 7	E: Seriously Modified	6.5	D: Largely Modified	5.7	E: Seriously Modified	6.8
Overall PES Score	6.4		Overall PES Class		E: Seriously Modified	
Wetland	Hydrology		Geomorphology		Vegetation	
	Rating	Score	Rating	Score	Rating	Score
HGM 8	E: Seriously Modified	6.5	D: Largely Modified	6.0	D: Largely Modified	6.8
Overall PES	6.4		Overall PES Class		E: Seriously Modified	

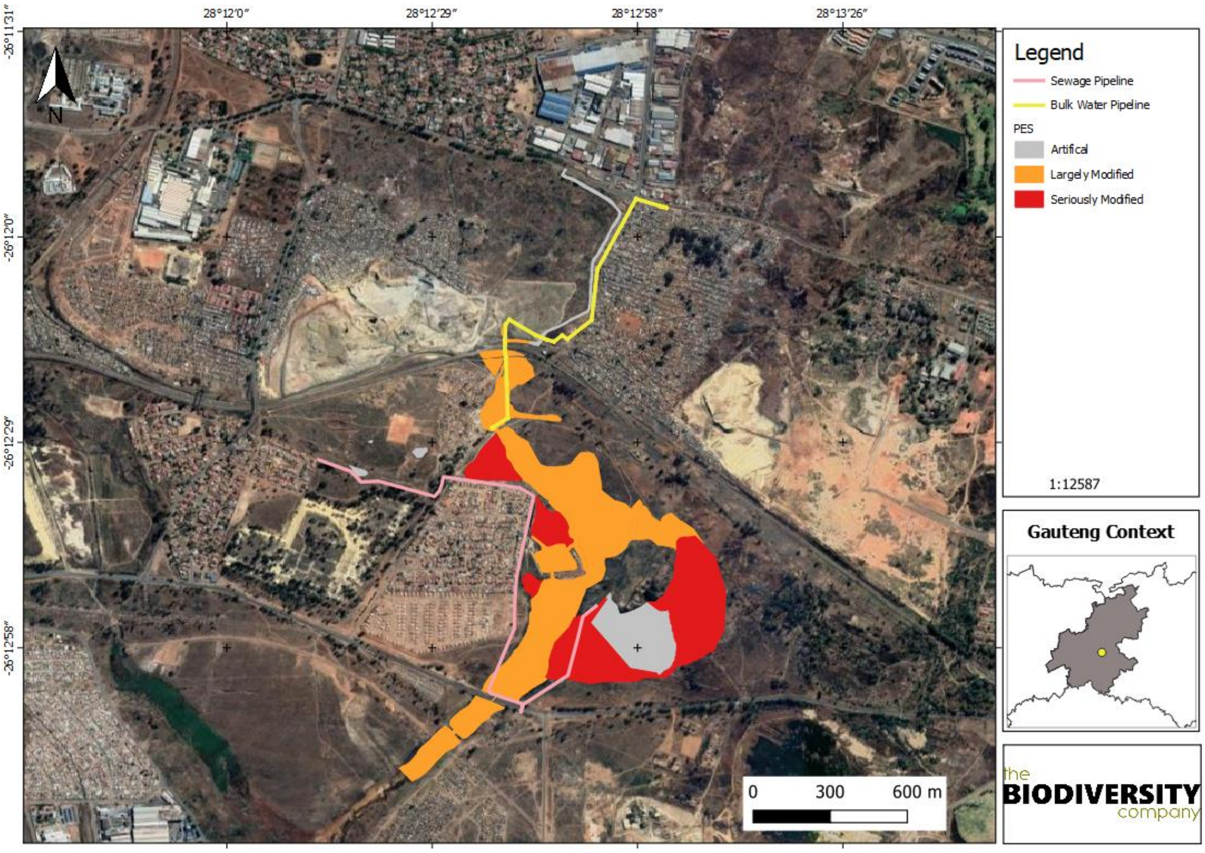


Figure 6-13 The PES of the delineated systems

6.2.6 Ecosystem Services

A general description of the ecoservices typically associated with each HGM type is provided here. Table 6-8 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 functions are merely typical expectations.

Table 6-5 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)

Channelled valley bottoms tend to contribute less towards flood attenuation and sediment trapping but would supply these benefits to a certain extent. Some nitrate and toxicant removal potential would be expected, particularly from the water being delivered from the adjacent hillslopes (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.

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. Regardless of the nature of depressions in regard to trapping all sediments entering the system, sediment trapping is another service that is not deemed as one of the essential services provided by depressions, even though some systems might contribute to a lesser extent. 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 sulphates are some of the higher rated Eco Services for depressions. This latter statement can be explained the precipitation as well as continues precipitation and dissolving of minerals and other contaminants during dry and wet seasons respectively, (Kotze *et al*., 2009).

The Ecosystem services provided by the HGM types present at the site were assessed and rated using the WET-EcoServices method (Kotze et al. 2009). The summarised results for the HGM types are shown in Table 6-6. The wetlands all had an overall intermediate level of service. Table 6-7 presents a summary of the indirect and direct benefits associated with the study area. The indirect benefits associated with HGM 2, 3, and 4 had an intermediate level of service, whilst HGM 6 and 7 were rated as moderately high. The level of service for the direct benefits was determined to be moderately low for all HGM units. The maintenance of biodiversity for all HGM units were rated as moderately low or lower with the exception of HGM 6 which had an intermediate rating.

Individual service that were rated as moderately high or better were mainly associated with water quality enhancements as well as the regulation of streamflow and flood attenuation. HGM 6 however was rated moderately high for the provision of cultivated foods, with some crops being grown on the edges of this system.

Table 6-6 The EcoServices being provided by the wetland areas

			Wetland Unit	HGM 2	HGM 5	HGM 6	HGM 7	HGM 8
Ecosystem Services Supplied by Wetlands	Indirect Benefits	Regulating and supporting benefits	Flood attenuation	2.1	2.1	2.1	2.2	2.1
			Streamflow regulation	2.2	1.3	2.2	2.0	1.3
		Water Quality enhancement benefits	Sediment trapping	2.3	1.7	2.4	2.4	1.7
			Phosphate assimilation	2.2	2.4	2.9	2.6	2.4
			Nitrate assimilation	2.1	2.1	2.8	2.5	2.1
			Toxicant assimilation	2.4	2.6	2.9	2.6	2.6
			Erosion control	1.6	1.9	2.8	1.8	1.9
			Carbon storage	1.3	1.0	1.7	0.7	1.0
	Direct Benefits		**Biodiversity maintenance**	0.8	0.1	1.9	0.8	0.4
		Provisioning benefits	Provisioning of water for human use	0.7	0.7	0.7	0.5	0.7
			Provisioning of harvestable resources	1.6	1.6	2.0	1.6	1.6
			Provisioning of cultivated foods	1.6	1.6	2.6	1.6	1.6
		Cultural benefits	Cultural heritage	1.0	1.0	1.0	1.0	1.0
			Tourism and recreation	0.1	0.0	0.1	0.0	0.1
			Education and research	0.8	0.8	0.8	0.8	0.8
			Overall	22.7	20.8	28.7	23.0	21.3
			Average	1.5	1.4	1.9	1.5	1.4

Table 6-7 A summary of the indirect and direct benefits provided by the wetlands

Wetland Area	HGM 2	HGM 5	HGM 6	HGM 7	HGM 8
Indirect Benefits	2.0	1.9	2.5	2.1	1.9
Direct Benefits	1.0	0.9	1.2	0.9	0.9

Biodiversity Maintenance	0.8	0.1	1.9	0.8	0.4

6.2.7 Ecological Importance and Sensitivity

Several factors were considered when establishing the EIS of the various wetlands. Regional to national scale considerations included NFEPA river or wetland status, 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. None of the systems traversed by the corridor routes are class 1 wetland nor are the Ramsar sites and none fall within any statutory protected areas. According to the SAIIAE dataset the wetlands that are traversed by the corridor are classified as Critically Endangered, but Not Protected.

The EIS of the wetland systems was determined to be Moderate (Class C) for all HGM units. The CBA area did have an effect on some of the ratings however from a regional and current health perspective these wetlands remained as Class C's.

The hydrological / functional importance for HGM 2, 5 and 8 was rated as Moderate (Class C), with HGM 6, and 7 being rated as High (Class B). These wetlands are important from a water quality perspective and reduce the impacts of already impacted water.

The direct human benefits were rated as Low (Class D) for all HGM units, with the exception of HGM 6 which was rated as Moderate (Class C). The area has been impacted on significantly and provides little to no benefit to the people in the area.

Table 6-8 The Ecological Importance and Sensitivity results for the wetland areas

	HGM 2	HGM 5	HGM 6	HGM 7	HGM 8
Ecological Importance & Sensitivity	1.8 (C)	1.4 (C)	1.6 (C)	1.6 (C)	1.6 (C)
Hydrological/Functional Importance	2.0 (C)	1.9 (C)	2.5 (B)	2.1 (B)	1.9 (C)
Direct Human Benefits	0.5 (D)	0.9 (D)	1.2 (C)	0.9 (D)	0.5 (D)

6.2.8 Recommended Ecological Category

The REC is set based on the combination of the PES and EIS values and is determined to set targets for the ecological state of the identified wetlands during and after the project has occurred. Table 6-9 shows the PES, EIS as well as the determined REC for the project area. The wetlands identified have a REC of class C.

Table 6-9 Wetland recommended ecological categories based on the PES and EIS results

HGM	Wetland Type	Overall PES	Overall EIS	REC
2	Channelled valley bottom	D	C	D
5	Unchannelled valley bottom	D	C	D
6	Seep	D	C	D
7	Seep	E	C	D
8	Seep	E	C	D

7 Buffer Assessment

The wetland buffer zone tool was used to calculate the appropriate buffer required for the pipelines. The model shows that the largest threat (High) posed during the construction phase is that of "increased sediment inputs and turbidity". The highest risk posed during the operational phase of the project are High risks, these include "increased nutrients", and "input of pathogens" (Table 7-3). These risks are calculated with no prescribed mitigation and the calculated buffer requirement is presented in Table 7-1.

Table 7-1 Pre-mitigation buffer requirement

Required Buffer before mitigation measures have been applied	
Construction Phase	**31 m**
Operational Phase	**58 m**

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 with the prescribed mitigation measures and therefor the recommended buffer was calculated to be 24 m (Table 7-2) for the construction and operational phases.

Table 7-2 Post-mitigation buffer requirement

Required Buffer after mitigation measures have been applied	
Construction Phase	**16 m**
Operational Phase	**24 m**

A conservative buffer zone was suggested of 24 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 laydown yards, storage areas and camp sites, the buffer zone must be implemented

Table 7-3 The risk results from the wetland buffer model for the proposed development

	Threat Posed by the proposed land use / activity	Specialist Threat Rating	Description of any additional mitigation measures	Refined Threat Class
Construction Phase	1. Alteration to flow volumes	Very Low		Very Low
	2. Alteration of patterns of flows (increased flood peaks)	Very Low		Very Low
	3. Increase in sediment inputs & turbidity	High	Avoid the delineated wetland and buffer boundaries where crossing is not required during all phases of construction (laydown yards, ablution, access roads et.,). Soil stockpiles must be placed upslope of the trench, away from the wetlands. Prioritise and schedule crossing work for the dry season period.	Medium
	4. Increased nutrient inputs	N/A		N/A
	5. Inputs of toxic organic contaminants	Medium	Provide ablution facilities for staff, and collect, separate and dispose of all on-site waste.	Low
	6. Inputs of toxic heavy metal contaminants	Low		Low
	7. Alteration of acidity (pH)	Very 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	Low	The pipeline should either span the wetlands, with a limited number of piers within the wetland and buffer. Alternatively, the pipeline could be sunken below the base of the wetland area.	Low
	2. Alteration of patterns of flows (increased flood peaks)	Low		Very Low
	3. Increase in sediment inputs & turbidity	Very Low		Very Low
	4. Increased nutrient inputs	High	It is assumed that no failure will take place. The increased capacity would address existing issues and prevent future spillages in the area. The increased capacity would prevent future surges of sewerage resulting in manhole spillages.	Low
	5. Inputs of toxic organic contaminants	Medium		Low
	6. Inputs of toxic heavy metal contaminants	Medium		Low
	7. Alteration of acidity (pH)	Very Low		Very Low
	8. Increased inputs of salts (salinization)	Very Low		Very Low
	9. Change (elevation) of water temperature	Very Low		Very Low
	10. Pathogen inputs (i.e. disease-causing organisms)	High	The pipeline will be prevent future leakages of sewerage.	Low

8 Sensitivity Assessment

A sensitivity map was produced to visually represent the sensitivity of each HGM unit to the proposed development based on the findings of the wetland assessment (Figure 8-1). All identified HGM units were classified as having a High sensitivity while their associated buffers were assigned a Moderate-High sensitivity. Additionally, all artificial systems were classified as Moderate-Low and all other non-wetland areas within the 500 m regulated area were assigned a Low sensitivity from a wetland perspective.

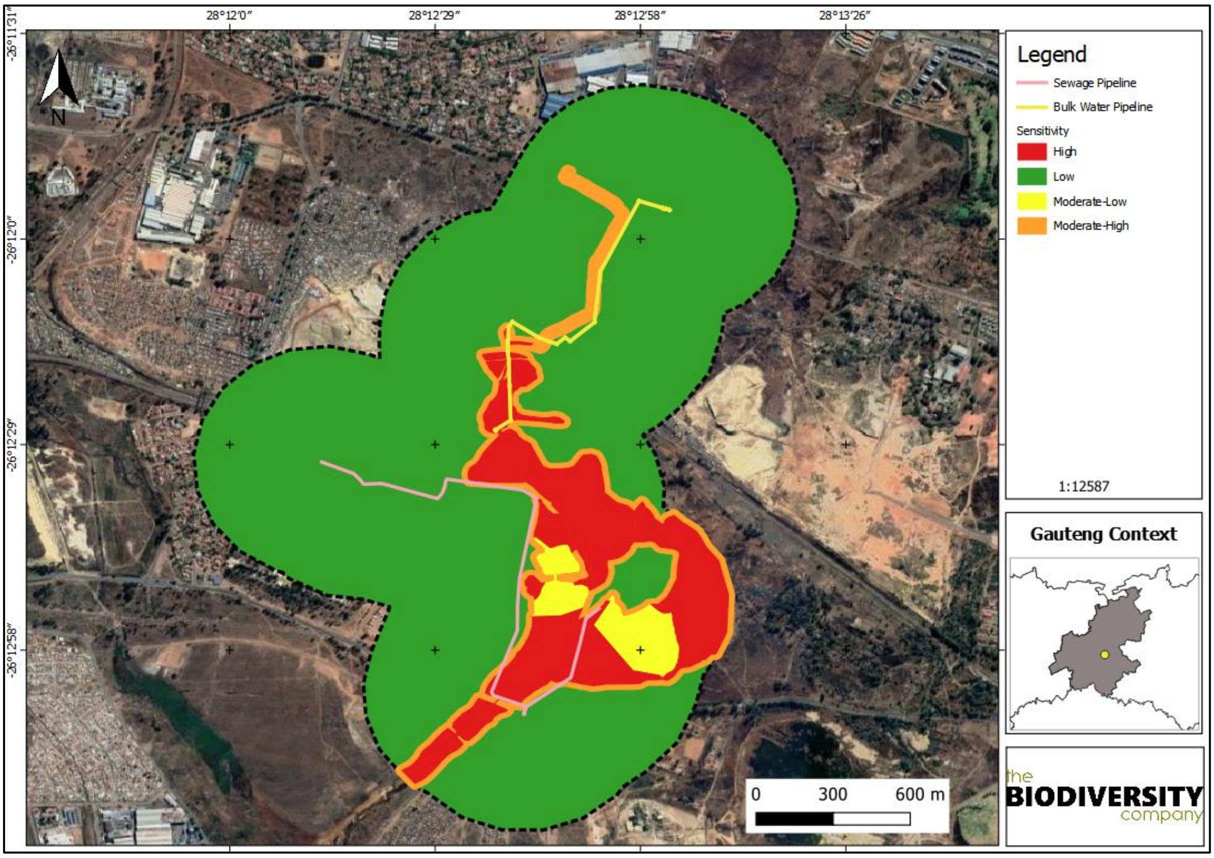


Figure 8-1 Wetland sensitivity map

9 Wetland Risk Assessment

The potential risks posed to wetlands as a result of the proposed project are detailed in Table 9-1. These ratings are based on the DWS Section 21 (c) and (i) Risk Assessment matrix. As decommissioning have been accounted for. Ratings are given for scenarios both with and without mitigation. Mitigation is listed alongside each impact.

Several potential impacts of Moderate significance to the receiving wetlands were identified in this risk matrix. However, following the effective implementation of the stipulated mitigation measures a number of these impacts have the potential to be reduced to a residual impact significance of Low. Overall, the activities associated with this critical service development are considered unlikely to negatively impact wetland systems to any appreciable level provided that the suggested mitigations measures are effectively implemented. The direct loss of wetland areas, the disturbance to soil profiles and the likely sedimentation of the receiving systems will result in a Moderate residual impact significance.

In terms of the cumulative impact, it is important to remember that the pipeline will be constructed within the disturbed catchment area. The pipeline is likely to inflict a negligible cumulative effect on wetlands within the project area relative to the much larger and considerably more adverse effects of, *inter alia*, mining and urban sprawl. However, taking into consideration the extent of the pipelines and the level of disturbance associated with the area, the fact that water and sewerage will be transported and the crossings required the overall cumulative impact is considered to be Moderate.

In accordance with the GA in terms of section 39 of the NWA, for water uses as defined in section 21 (c) or section 21 (i) a GA does not apply *"to any water use in terms of section 21 (c) or (i) of the Act associated with the construction, installation or maintenance of any sewer pipelines, pipelines carrying hazardous materials and to raw water and waste water treatment works".* Based on this, a General Authorisation is not permissible for the project.

Table 9-1 DWS Risk Impact Matrix for the proposed pipeline upgrade (Andrew Husted Pr Sci Nat 400213/11)

Activity	Aspect	Impact	Mitigation Scenario	Severity					Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Control Measures
				Flow Regime	Water Quality	Habitat	Biota	Severity											
Construction																			
Site clearing and preparation	Clearing of vegetation and stripping and stockpiling topsoil as well as storage of equipment.	Direct loss, disturbance and degradation of wetlands.	Without	2	2	3	3	5	2	2	9	2	2	5	1	10	90	**M**	• Restrict all construction related activities to within the proposed pipeline servitude. • Adhere to the prescribed wetland buffers for secondary activities. Restrict all secondary activities (e.g. laydown yards, storage areas, cement mixing and equipment to outside of wetlands and their prescribed buffers. • Consider above ground crossings over wetland areas. Alternatively, open trench crossings are permissible but backfilling and rehabilitation must be undertaken. • Open trench crossings must be achieved during the dry season period. • Indicate delineated wetlands on site layout plans. • Load wetland spatial data onto a GPS and use it to mark out the positions where the pipeline will enter and exits the prescribed buffer on the boundary of a wetland. Try to reduce the disturbance footprint and the unnecessary clearing of vegetation on either side of the trench as far as possible when traversing wetlands. • At crossing points restrict all construction activities to a 10 m corridor of the pipeline route. • Demarcate the 10 m construction corridor as well as the prescribed m buffer on the ground (e.g. pained wooden poles). • Construct as far as possible during winter when flow volumes are lowest, prioritise this for crossing sites. This will reduce impacts to wetlands due to soil poaching and vegetation trampling under peak saturation levels. Additionally, the risk of vehicles getting stuck and further degrading the vegetation integrity is lowest during this time.
			With	2	2	2	2	2	2	2	7	2	1	5	1	9	63	**M**	

Activity	Aspect	Impact	Mitigation Scenario	Severity					Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Control Measures
				Flow Regime	Water Quality	Habitat	Biota	Severity											
		Increased bare surfaces, runoff and potential for erosion and resulting sedimentation of the wetlands	Without	3	3	3	3	3	2	2	7	3	3	1	1	8	56	M	• Keep the trench excavation neat and tidy. Only stockpile on one side of the trench (the same side as the excavator tracks). Separate topsoil and sub-soil, and backfill in same order. • Ensure soil stockpiles and concrete / building sand are sufficiently safeguarded against rain wash. • Mixing of concrete must under no circumstances take place in any wetland or the prescribed buffers. Scrape the area where mixing and storage of sand and concrete occurred to clean once finished. • Do not situate any of the construction material laydown areas within any wetland or prescribed buffer. • No machinery should be allowed to be parked in any wetlands. • Ensure topsoil is spread back over trench area. • Flatten and lightly till (no deeper than 30 cm) excavated / cleared areas to encourage vegetation establishment as soon as possible.
			With	1	1	1	1	1	2	2	5	3	1	1	1	6	30	L	
		Degradation of wetland vegetation and the introduction and spread of alien and invasive vegetation	Without	1	1	3	1	1.5	1	2	4.5	3	3	5	1	12	54	L	• Promptly remove all alien and invasive plant species that may emerge during construction (i.e. weedy annuals and other alien forbs) must be removed. • The use of herbicides is not recommended in or near wetlands (opt for mechanical removal). • Appropriately stockpile topsoil cleared from the project area. This can be used for rehabilitation of the servitude. • Clearly demarcate construction footprint, and limit all activities to within this area. • Minimize unnecessary clearing of vegetation. • Landscape and re-vegetate all denuded areas as soon as possible.
			With	1	1	2	1	1.25	1	2	4.25	3	1	5	1	10	43	L	
Installation of infrastructure	Trench excavation	Increased sediment loads to downstream reaches	Without	3	3	2	2	2.5	2	2	6.5	3	3	5	1	12	78	M	• See mitigation for increased bare surfaces, runoff and potential for erosion • Re-instate topsoil and lightly till disturbance footprint. • At all crossings install sandbags on downstream side of the footprint to trap sediment until the site has been constructed and vegetation has re-established.
			With	2	2	2	2	2	2	2	6	2	2	5	1	10	60	M	

Activity	Aspect	Impact	Mitigation Scenario	Severity					Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Control Measures
				Flow Regime	Water Quality	Habitat	Biota	Severity											
		Contamination of wetlands with hydrocarbons due to machinery leaks and eutrophication of wetland systems with human sewerage and other waste.	Without	2	2	2	3	2.25	2	2	6.25	3	2	5	1	11	69	M	• Make sure all excess consumables and building materials / rubble is removed from site and deposited at an appropriate waste facility. • 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 wetland areas. • Regularly maintain stormwater infrastructure, pipes, pumps and machinery to minimise the potential for leaks. Check for oil leaks, keep a tidy operation, install bins and promptly clean up any spills or litter. • Provide appropriate sanitation facilities during construction and service them regularly.
			With	1	2	1	2	1.5	2	2	5.5	3	1	5	1	10	55	L	
	Backfilling of trench	Disruption of wetland soil profile and alteration of hydrological regime	Without	3	2	2	2	2.25	2	3	7.25	3	3	5	3	14	101.5	M	• Ensure that topsoil is appropriately stored and re-applied during trench backfilling. • Make sure that the soil is backfilled and compacted to accepted geotechnical standards to avoid conduit formation along the trench.
			With	2	2	2	3	2.25	2	2	6.25	3	2	5	1	11	69	M	
Operation																			
Routine operation and monitoring	Pipeline leaks	Increased water and sewerage inputs to downstream wetlands	Without	1	1	1	1	1	2	1	4	3	1	5	1	10	40	L	• Conduct regular inspections of manholes along both the pipeline routes and fix leaks timeously. Engineers should advise on the frequency of pressure tests to detect leaks. • Monitor water quality. • Install leak detection devices.
			With	1	1	1	1	1	2	1	4	3	1	5	1	10	40	L	
Decommissioning																			
Removal of pipeline infrastructure	Vehicle access	Degradation of wetland vegetation and proliferation of alien and invasive species	Without	2	2	2	2	2	1	2	5	3	2	5	1	11	55	L	• See mitigation for the impacts on direct loss, disturbance and degradation of wetlands and spread of alien and invasive plants.
			With	2	2	2	2	2	1	2	5	3	1	5	1	10	50	L	

Activity	Aspect	Impact	Mitigation Scenario	Severity					Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Control Measures
				Flow Regime	Water Quality	Habitat	Biota	Severity											
	Re-excavation of trench and backfilling of wetland soils	Disruption of wetland soil profile, hydrological regime and increased sediment loads	Without	3	2	2	2	2.25	2	1	5.25	3	2	5	2	12	63	M	• See mitigation for increased bare surfaces, runoff and potential for erosion and increased sediment loads during construction. • See mitigation for Disruption of wetland soil profile and alteration of hydrological regime.
			With	1	1	1	1	1	2	1	4	3	1	5	2	11	44	L	
Cumulative																			
Cumulative Impact	Wetland integrity	Deterioration in wetland integrity beyond the pipeline servitude	Without	2	2	3	2	2.25	1	3	6.25	3	2	5	1	8	50	M	• Adhere to the mitigation listed above • Consider above ground crossings over wetland areas. Alternatively, open trench crossings are permissible, but rehabilitation must be undertaken. • Remain within the existing pipeline servitude.
			With	2	2	2	2	2	1	2	5	3	2	5	1	7	35	M	

10 Recommendations

The following recommendations are applicable:

- A wetland rehabilitation plan must be compiled and implemented for the project. The plan must address the extent of the pipelines, and prioritise the proposed crossings areas;
- The extent of the buffer area where the pipelines will traverse the wetland must be visibly demarcated; and
- Toolbox talks must be facilitated with contractors and employees regarding the importance of wetlands and the need to avoid these systems where possible.

11 Conclusion

A number of wetlands were identified and delineated within the 500 m regulated area. The ecological status of these ranged from moderately modified to seriously modified. The ecological importance and sensitivity of the systems was determined to be moderate. The recommended ecological category for all wetland units was determined to be largely modified.

A conservative buffer zone was suggested of 24 m for the construction and operation phases respectively. The buffer zone will not be applicable for areas of the project that traverse wetland areas, however, for all secondary activities such as laydown yards, storage areas and camp sites, the buffer zone must be implemented.

Several potential impacts of Moderate significance to the receiving wetlands were identified in this risk matrix. Most of these impacts have the potential to be reduced to a residual impact significance of Low. A select few impacts would result in a Moderate residual impact significance.

In accordance with the GA in terms of section 39 of the NWA, for water uses as defined in section 21 (c) or section 21 (i) a GA does not apply *"to any water use in terms of section 21 (c) or (i) of the Act associated with the construction, installation or maintenance of any sewer pipelines, pipelines carrying hazardous materials and to raw water and waste water treatment works".* Based on this, a General Authorisation is not permissible for the project. The project may be favourably considered but all prescribed mitigation measures and recommendations must be considered by the issuing authority.

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