Water Resource Baseline & Risk Assessment for the proposed Harmony Kusasalethu Mine Pipeline Project

Merafong City Municipality, Gauteng Province, South Africa

February 2023

CLIENT

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1 Introduction

1.1 Background

The modification of land use within a river catchment has the potential to degrade local water resources (Wepener *et al.,* 2005). Infrastructure which crosses or encroaches on a watercourse thus has the potential to negatively impact on local water resources and ecosystem services. In order to holistically manage water resources in South Africa, the use of standard water quality sampling methods is considered in-effective. Non-point and point source pollutants are dynamic and can fluctuate according to several factors such as rainfall, industrial discharges and extensive pollutant seepage. Aquatic ecology is permanently exposed to the dynamic conditions within water bodies and can therefore be an effective reflection of the environmental conditions within a management area. Wetland ecology ensures the protection of wetland systems which greatly reduces flood damage, particularly erosion, and ensures a steadier supply of water throughout the year. Considering this, the monitoring of wetland and aquatic ecology is regarded as an effective tool in water management strategies. This can therefore be used to assess the current state of any watercourse.

The Biodiversity Company (TBC) was appointed to undertake a wetland baseline and risk assessment for the proposed Harmony Kusasalethu Mine pipeline project (Figure 1-1). The proposed project entails installing two pipelines adjacent to each other, within the same pipeline corridor, from the Savuka Gold Plant to the Kusasalethu Plant. One of the pipelines will be used to pump backfill to the Kusasalethu Plant, which will then be flushed with water proposed to be returned to the Savuka Gold Plant via the second pipeline. The estimated distance of the pipelines are 7 750 meters. This report pertains to the assessment of the footprint for the proposed pipeline and associated activities.

To assess the baseline ecological state of the area and to present a detailed description of the receiving environment, a desktop assessment as well as a field survey was conducted during January 2023. Both levels of assessment entailed the detection, identification, and description of any locally relevant water resources. Furthermore, the manner in which these sensitive features may be affected by the proposed development was also investigated. A 500 m radius around of the proposed pipeline, which is the suggested regulation area for the identification of water resources in terms of the proposed project, has been demarcated and is referred to hereafter as the Project Area of Influence (PAOI).

This assessment was conducted in accordance with the amendments to the Environmental Impact Assessment Regulations, 2014 (No. 326, 7 April 2017) of the National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998). The approach has taken cognisance of the recently published Government Notice 320 in terms of NEMA dated 20 March 2020 as well as the Government Notice 1150 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 purpose of conducting the specialist study is to provide relevant input into the overall Environmental Authorisation application process, with a focus on the proposed project activities and their associated impacts. This report, after taking into consideration the findings and recommendations provided by the specialist herein, should inform and guide the Registered Environmental Assessment Practitioner (EAP) and regulatory authorities, enabling informed decision making as to the ecological viability of the proposed project.

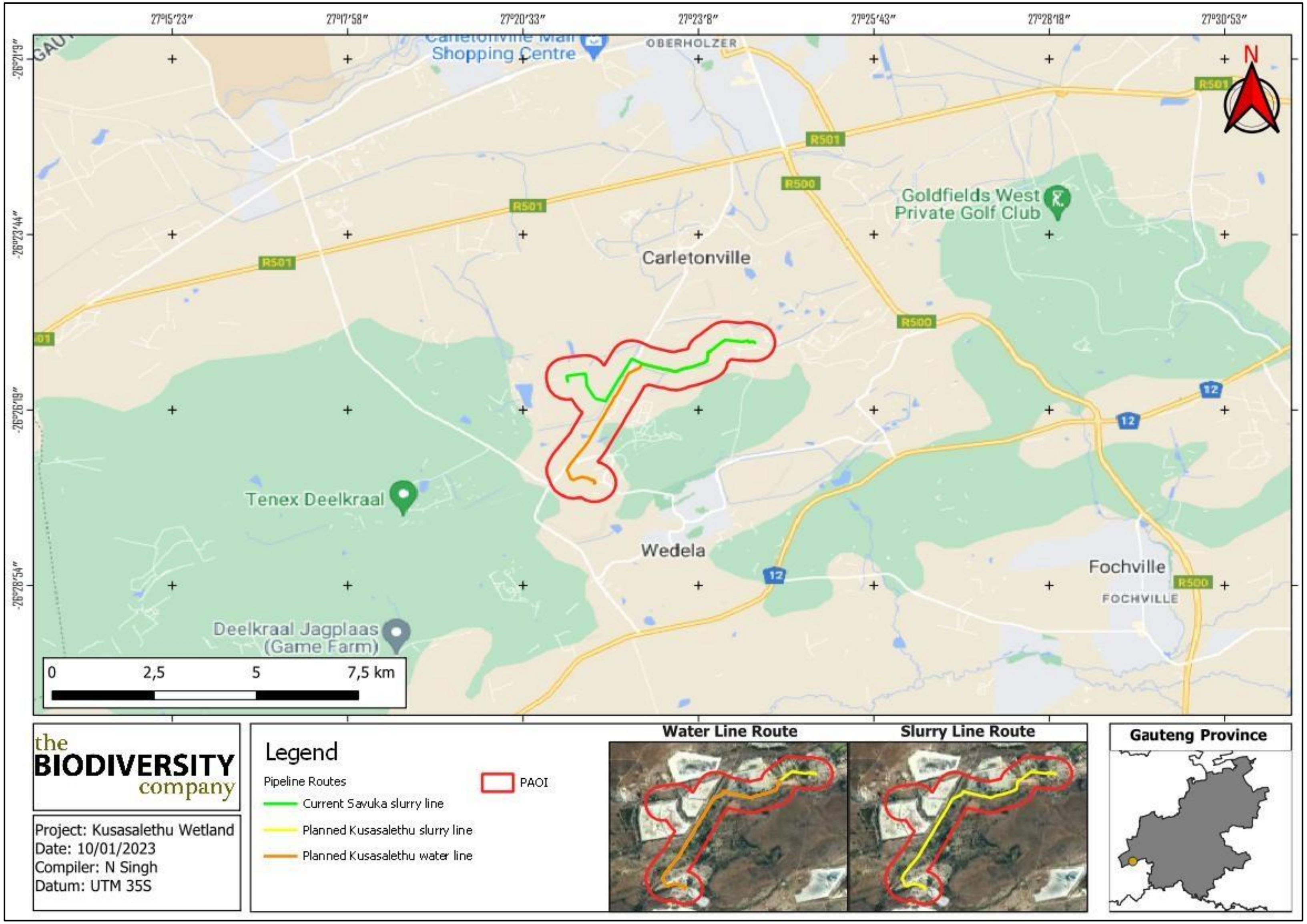

Figure 1-1 Map illustrating the location of the proposed project

1.2 Specialist Details

Report Name	**Wetland Baseline & Risk Assessment for the Proposed Harmony Kusasalethu Mine Pipeline Project**	
Reference	**Proposed Kusasalethu Mine Pipeline**	
Submitted to	EIMS ENVIRONMENTAL IMPACT MANAGEMENT SERVICES	
Wetlands Report Writer & Fieldwork	**Namitha Singh**	
	Namitha Singh is a wetland consultant with experience in wetland assessments, coastal geomorphology and estuary management. She possesses a BSc. Honours in Environmental Science and has worked on projects related to residential developments, infrastructural developments, sand mining and general natural resource management.	
Riverine Report Writer & Fieldwork	**Michael Ryan (Cand. Sci. Nat 125128)**	MRyan
	Michael Ryan is a candidate registered specialist (125128) who works in the fields of Riverine Ecology and Hydrology with 5 years of experience in baseline river assessments and aquatics, with his SASS5 accreditation. Michael Ryan received his B. Sc Honours degree (Geography) from the University of Witwatersrand. Michael specialises in surface water monitoring and aquatic systems as well as habitat delineations in the form of floodline determination. Michael has experience in projects which include pipelines; dams; road upgrades; power stations; mining; etc across multiple African countries	
Reviewer	**Andrew Husted**	
	Andrew Husted is Pr Sci Nat registered (400213/11) in the following fields of practice: Ecological Science, Environmental Science and Aquatic Science. Andrew is an Aquatic, Wetland and Biodiversity Specialist with more than 13 years' experience in the environmental consulting field.	
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.	

1.3 Terms of Reference

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

- The delineation, classification and assessment of wetlands within 500 m of the project area;
- Determining the ecological integrity of the local watercourses:
  - The assessment of water quality;
  - The assessment of habitat quality;
  - The assessment of biological responses;
- Conduct risk assessments relevant to the proposed activity;
- Recommendations relevant to associated impacts; and

- Report compilation detailing the baseline findings.

2 Key Legislative Requirements

2.1.1 National Water Act (NWA, 1998)

The 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 (Act No. 36 of 1998) (NWA) 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. Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DWS in terms of Section 21 (c) and (i).

2.1.2 National Environmental Management Act (NEMA, 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 Environmental Impact Assessment (EIA) process depending on the scale of the impact.

3 Project Area

The project area is situated in the town of Carletonville, within the Merafong City Local Municipality (GT484) of the greater West Rand District Municipality (DC48), in the Gauteng Province. The area is located approximately 3 km south of the town center of Carletonville along the 7th Avenue Road. The surrounding land use includes agricultural production (Crop and livestock), commercial power generation, and mining activities (see Figure 3-1).

3.1 Hydrological Setting

The hydrological setting of the project area is presented in Figure 3-2. The Kusasalethu Mine Pipeline Project is situated in the C23E quaternary catchments, within the Vaal Water Manage Area (WMA - 2). The proposed Kusasalethu Mine Pipeline Project will cross an unnamed river (C23E-01465 Sub Quaternary Reach) (SQR). This river reach is unnamed but will be titled the Kusasalethu River for the purposes of this report. The river system falls within the Highveld Ecoregion which has the geomorphological characteristics of an upper foothills river (class D). There are currently nine WMA areas which were formed by joining the old nineteen WMA, with the project area located within the old Upper Vaal WMA (8). The Upper Vaal WMA is a pivotal WMA in the country which lies in the eastern interior of South Africa. It is situated in a semi-arid part of the country with a mean annual precipitation of 600 to 800 mm. Large quantities of water are transferred into the area from two neighbouring areas, as well as water sourced from the Upper Orange River via Lesotho. Similarly, large quantities of water are transferred out to three other WMAs, which are dependent on water from the Upper Vaal WMA to meet much of their requirements. The area is characterised by extensive urbanization and industrial and mining activity, and activities include livestock farming and rain fed cultivation (StatsSA, 2010).

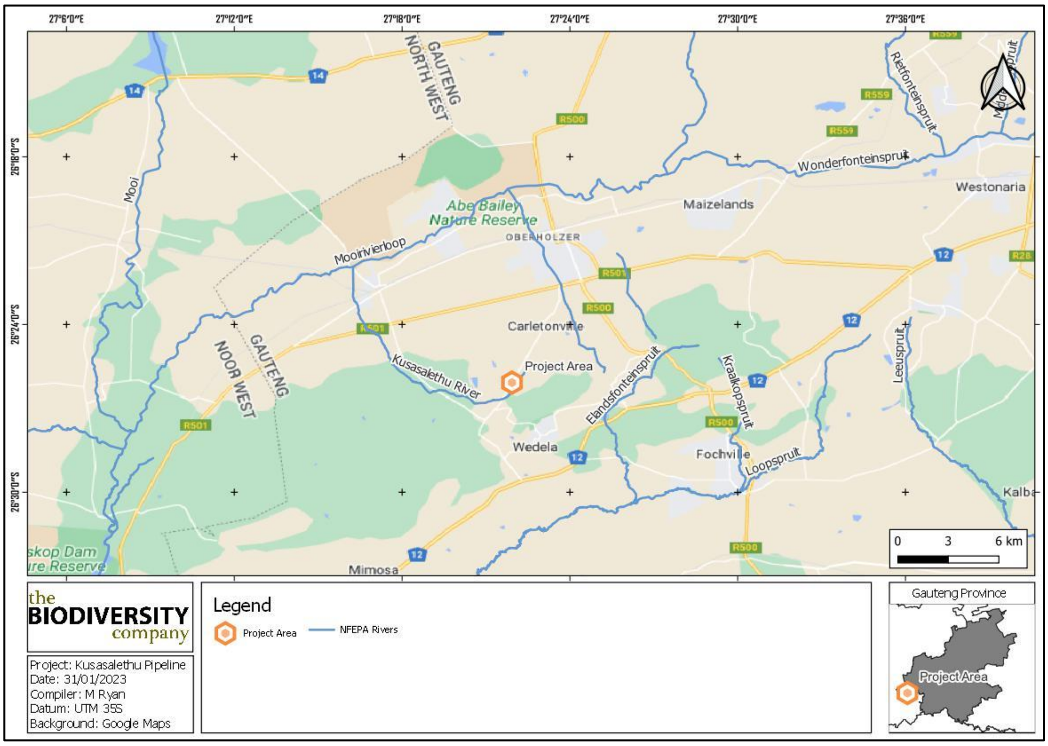

Figure 3-1 The location of the proposed Kusasalethu Pipeline

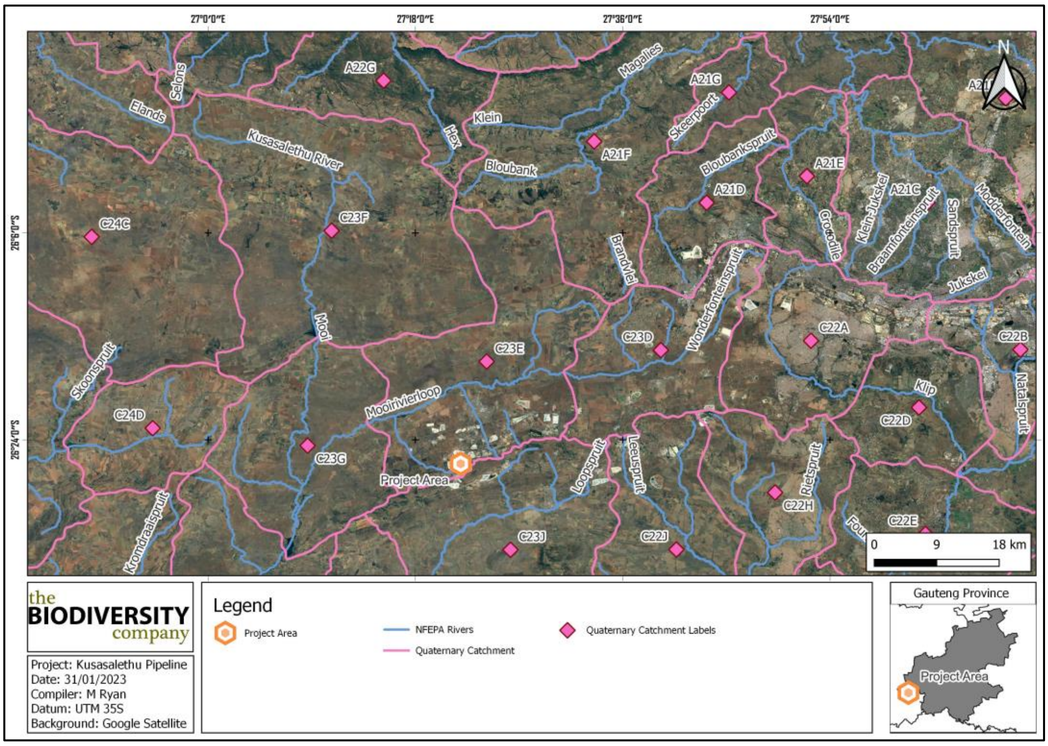

Figure 3-2 Hydrological context of the project area

4 Methods

A single wetland site visit was conducted on the 12th of January 2023, constituting a wet season survey.

4.1 Wetland Assessment

4.1.1 Identification and Mapping

The wetland areas were delineated in accordance with the DWAF (2005) guidelines, a cross section is presented in Figure 4-1. 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.

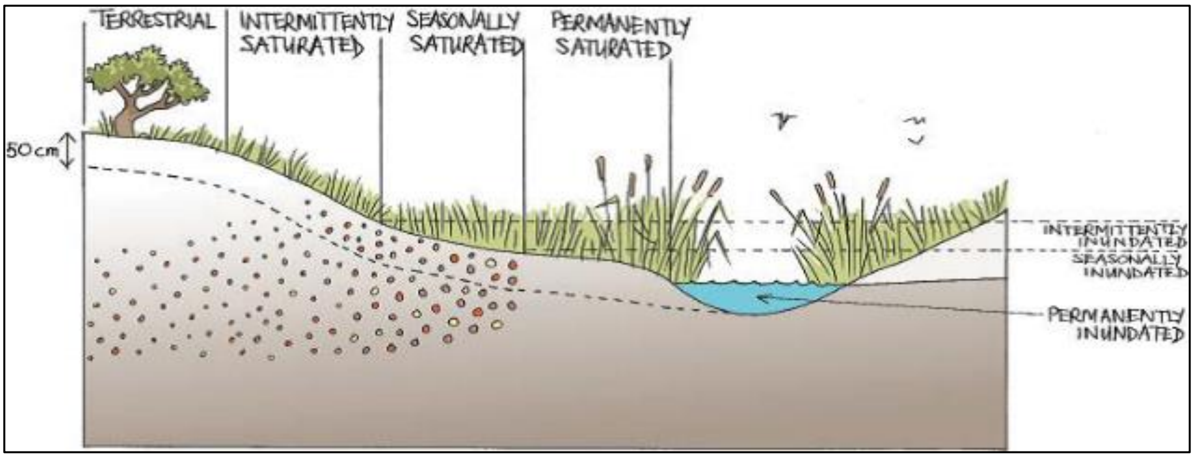

Figure 4-1 Cross section through a wetland, indicating how the soil wetness and vegetation indicators change (Ollis et al. 2013)

4.1.2 Delineation

The wetland indicators described above are used to determine the boundaries of the wetlands within the project area. These delineations are then illustrated by means of maps accompanied by descriptions.

4.1.3 Functional Assessment

Wetland Functionality refers to the ability of wetlands to provide healthy conditions for the wide variety of organisms found in wetlands as well as humans. Eco Services serves as the main factor contributing to wetland functionality.

The assessment of the ecosystem services supplied by the identified wetlands was conducted per the guidelines as described in WET-EcoServices (Kotze *et al*. 2008). 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 (Table 4-1).

Table 4-1 Classes for determining the likely extent to which a benefit is being supplied

Score	Rating of likely extent to which a benefit is being supplied
< 0.5	Low
0.6 - 1.2	Moderately Low
1.3 - 2.0	Intermediate
2.1 - 3.0	Moderately High
> 3.0	High

4.1.4 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 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. The Present State categories are provided in Table 4-2.

Table 4-2 The Present Ecological Status categories (Macfarlane, et al., 2008)

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

4.1.5 Importance and Sensitivity

The importance and sensitivity of water resources is determined to establish resources that provide higher than average ecosystem services, biodiversity support functions or are particularly sensitive to impacts. The mean of the determinants is used to assign the Importance and Sensitivity (IS) category as listed in Table 4-3.

Table 4-3 Description of Importance and Sensitivity categories

IS 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**

4.1.6 Ecological Classification and Description

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 then also includes structural features at the lower levels of classification (Ollis *et al.,* 2013).

4.1.7 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.

4.2 Aquatics Assessment

A single high flow survey was conducted in 12th of January 2023, constituting a wet season survey. Standard methods were used to establish the baseline conditions of the considered river reaches. Details pertaining to the specific methodologies applied are provided in the relevant sections below.

4.2.1 Water Quality

Water quality was measured in situ using a handheld calibrated Extech® DO700 and EC500 multi-meter. The constituents considered that were measured included: pH, conductivity (µS/cm), water temperature (°C) and Dissolved Oxygen (DO) in mg/l.

4.2.2 Aquatic Habitat Integrity

The Intermediate Habitat Assessment Index (IHIA) as described in the Procedure for Rapid Determination of Resource Directed Measures for River Ecosystems (Section D), 1999 was used to define the ecological status of the Kusasalethu River reach.

The IHIA model will be used to assess the integrity of the habitats from a riparian and in-stream perspective. The habitat integrity of a river refers to the maintenance of a balanced composition of physico-chemical and habitat characteristics on a temporal and spatial scale which are comparable to the characteristics of natural habitats of the region (Kleynhans, 1996).

This model compares current conditions with reference conditions that are expected to have been present. Specification of the reference condition follows an impact-based approach where the intensity and extent of anthropogenic changes are used to interpret the impact on the habitat integrity of the system. To accomplish this, information on abiotic changes that can potentially influence river habitat integrity are obtained from surveys or available data sources. These changes are all related and interpreted in terms of modification of the drivers of the system, namely hydrology, geomorphology and physico-chemical conditions and how these changes would impact on the natural riverine habitats. The criteria and ratings utilised in the assessment of habitat integrity in the current study are presented in Table 4-4 and Table 4-5 respectively.

Table 4-4 Criteria used in the assessment of habitat integrity (Kleynhans, 1996)

Criterion	Relevance
Water abstraction	Direct impact on habitat type, abundance and size. Also implicated in flow, bed, channel and water quality characteristics. Riparian vegetation may be influenced by a decrease in the supply of water.
Flow modification	Consequence of abstraction or regulation by impoundments. Changes in temporal and spatial characteristics of flow can have an impact on habitat attributes such as an increase in duration of low flow season, resulting in low availability of certain habitat types or water at the start of the breeding, flowering or growing season.
Bed modification	Regarded as the result of increased input of sediment from the catchment or a decrease in the ability of the river to transport sediment. Indirect indications of sedimentation are stream bank and catchment erosion. Purposeful alteration of the stream bed, e.g. the removal of rapids for navigation is also included.
Channel modification	May be the result of a change in flow, which may alter channel characteristics causing a change in marginal instream and riparian habitat. Purposeful channel modification to improve drainage is also included.
Water quality modification	Originates from point and diffuse point sources. Measured directly or alternatively agricultural activities, human settlements and industrial activities may indicate the likelihood of modification. Aggravated by a decrease in the volume of water during low or no flow conditions.
Inundation	Destruction of riffle, rapid and riparian zone habitat. Obstruction to the movement of aquatic fauna and influences water quality and the movement of sediments.
Exotic macrophytes	Alteration of habitat by obstruction of flow and may influence water quality. Dependent upon the species involved and scale of infestation.
Exotic aquatic fauna	The disturbance of the stream bottom during feeding may influence the water quality and increase turbidity. Dependent upon the species involved and their abundance.
Solid waste disposal	A direct anthropogenic impact which may alter habitat structurally. Also, a general indication of the misuse and mismanagement of the river.
Indigenous vegetation removal	Impairment of the buffer the vegetation forms to the movement of sediment and other catchment runoff products into the river. Refers to physical removal for farming, firewood and overgrazing.
Exotic vegetation encroachment	Excludes natural vegetation due to vigorous growth, causing bank instability and decreasing the buffering function of the riparian zone. Allochtonous organic matter input will also be changed. Riparian zone habitat diversity is also reduced.
Bank erosion	Decrease in bank stability will cause sedimentation and possible collapse of the riverbank resulting in a loss or modification of both instream and riparian habitats. Increased erosion can be the result of natural vegetation removal, overgrazing or exotic vegetation encroachment.

Table 4-5 Descriptions used for the ratings of the various habitat criteria

Impact Category	Description	Score
None	No discernible impact or the modification is located in such a way that it has no impact on habitat quality, diversity, size and variability.	0
Small	The modification is limited to very few localities and the impact on habitat quality, diversity, size and variability are also very small.	1-5
Moderate	The modifications are present at a small number of localities and the impact on habitat quality, diversity, size and variability are also limited.	6-10
Large	The modification is generally present with a clearly detrimental impact on habitat quality, diversity, size and variability. Large areas are, however, not influenced.	11-15
Serious	The modification is frequently present and the habitat quality, diversity, size and variability in almost the whole of the defined area are affected. Only small areas are not influenced.	16-20
Critical	The modification is present overall with a high intensity. The habitat quality, diversity, size and variability in almost the whole of the defined section are influenced detrimentally.	21-25

4.2.3 Aquatic Macroinvertebrate Assessment

Macroinvertebrate assemblages are good indicators of localised conditions because many benthic macroinvertebrates have limited migration patterns or a sessile mode of life. They are particularly well-suited for assessing site-specific impacts (upstream and downstream studies) (Barbour *et al.,* 1999). Benthic macroinvertebrate assemblages are made up of species that constitute a broad range of trophic levels and pollution tolerances, thus providing strong information for interpreting cumulative effects (Barbour *et al.,* 1999). The assessment and monitoring of benthic macroinvertebrate communities forms an integral part of the monitoring of the health of an aquatic ecosystem.

4.2.3.1 Invertebrate Habitat

The invertebrate habitat at the site was assessed using the South African Scoring System version 5 (SASS5) biotope rating assessment as applied in Tate and Husted (2015). A rating system of 0 to 5 was applied, 0 being not available. The weightings for lowland rivers (slope class F) were used to categorize biotope ratings (Rowntree et al. 2000; Rowntree & Ziervogel, 1999).

4.2.3.2 South African Scoring System

The South African Scoring System version 5 (SASS5) is the current index being used to assess the status of riverine macroinvertebrates in South Africa. According to Dickens and Graham (2002), the index is based on the presence of aquatic invertebrate families and the perceived sensitivity to water quality changes of these families. Different families exhibit different sensitivities to pollution, these sensitivities range from highly tolerant families (e.g. Chironomidae) to highly sensitive families (e.g. Perlidae). SASS results are expressed both as an index score (SASS score) and the Average Score Per recorded Taxon (ASPT value).

Sampled invertebrates were identified using the “Aquatic Invertebrates of South African Rivers” Illustrations book, by Gerber and Gabriel (2002). Identification of organisms was made to family level (Thirion *et al.,* 1995; Dickens and Graham, 2002; Gerber and Gabriel, 2002).

All SASS5 and ASPT scores are compared with the SASS5 Data Interpretation Guidelines (Dallas, 2007) for the Highveld – Lower Ecoregion (Figure 3). This method seeks to develop biological bands depicting the various ecological states and is derived from data contained within the Rivers Database and supplemented with other data not yet in the database.

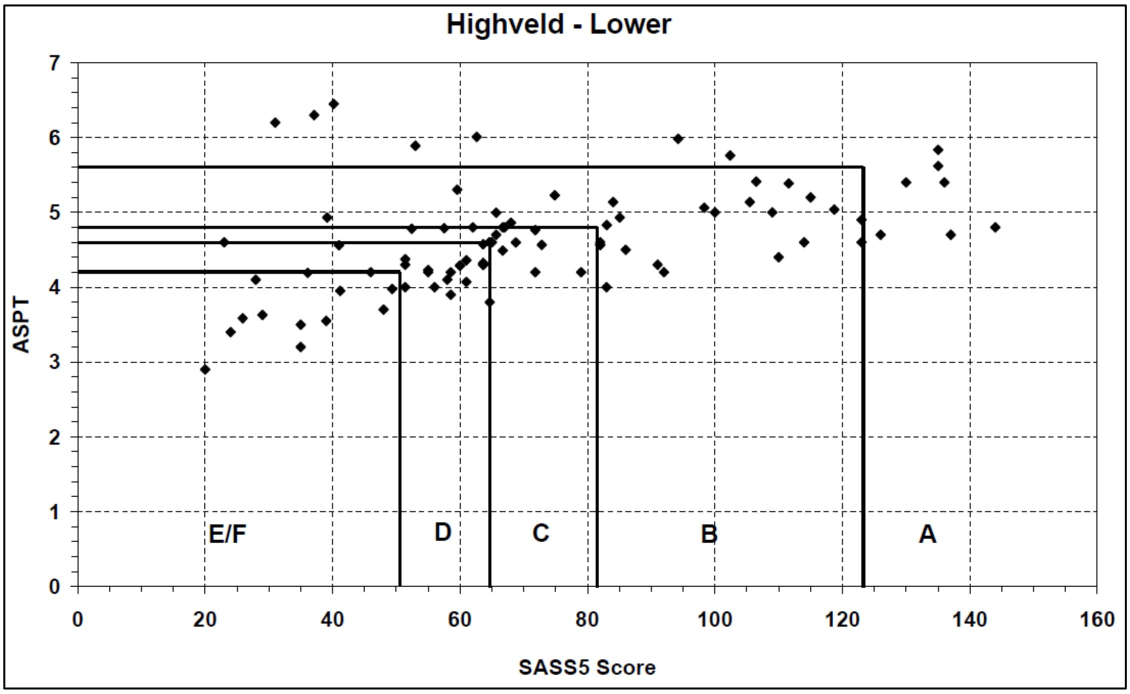

Figure 4-2 Biological Bands for the Highveld – Lower Ecoregion, calculated using percentiles

4.3 Fish Presence

Fish were sampled through minnow traps and electroshocking. All fish were identified in the field and released at the point of capture, in order not to cross fish populations. Fish species were identified using the guide Freshwater Fishes of Southern Africa (Skelton, 2001). The identified fish species were compared to those expected to be present for the quaternary catchment. The expected fish species list for the reach was developed from a literature survey to compare to the sampled species at site. Different fish species represent different sensitivities to water chemistry, habitat and flow which considered as part of the Fish Response Assessment Index (FRAI) (Kleynhans *et al*., 2007 and Skelton 2001).

4.4 Fish Sensitivities

Fish have different sensitivities or levels of tolerance to various aspects that they are subjected to within the aquatic environment. These tolerance levels are rated with a sensitivity score as presented in Table 4-6. These tolerance levels are scored to show each fish species' sensitivity to flow and physico-chemical modifications.

Table 4-6 Intolerance rating and sensitivity of fish species

Sensitivity Score	Tolerance/Sensitivity Level
0-1	Highly tolerant = Very low sensitivity
1-2	Tolerant = Low sensitivity
2-3	Moderately tolerant = Moderate sensitivity
3-4	Moderately intolerant = High sensitivity
4-5	Intolerant = Very high sensitivity

4.5 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). The significance of the impact is calculated according to Table 4-7.

Table 4-7 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.

4.6 Assumptions and Limitations

The following assumptions and limitations are applicable for this assessment:

- It is assumed that all information received from the client is correct, with nothing withheld;
- The focus area was based on the spatial files provided by the client and any alterations to the area and/or missing GIS information would have affected the area surveyed;
- Only a single season survey was conducted for the respective study, which would constitute a wet season survey. Thus, temporal trends were not investigated;

- Only the proposed pipeline route was provided to the specialist; and
- The GPS used for the survey has a 5 m accuracy and therefore any spatial features may be offset by 5 m.

5 Results and Discussion

5.1 Desktop Baseline

5.1.1 Vegetation Type

The project area falls within the Gauteng Shale Mountain Bushveld (SVcb10) vegetation type. The distribution of this vegetation type is spread across the Gauteng and North-West Provinces, occurring mainly on the Gastrand Ridge south of Carletonville-Westonaria-Lenasia. Furthermore, the vegetation type occurs on a ridge running from Magaliesberg in the west to south-eastern Pretoria in the east.

The vegetation consists of semi-open thicket dominated by a variety of woody species including *Senegalia caffra, Rhus leptodictya, R. magalismontana and, Cussonia spicata* (to name a few). While the understory below the woody vegetation is dominated by a variety of grasses.

The conservation status of the Gauteng Shale Mountain Bushveld is Vulnerable with a target of 24%. Approximately 2% of the vegetation type is conserved in Nature Reserves and National Parks. Furthermore, approximately 21% of the area within the SVcb10 type is transformed by urban developments, mines and quarries and, cultivation (Mucina & Rutherford, 2006).

5.1.2 Soils and Geology

According to the land type database (Land Type Survey Staff, 1972 - 2006), the project area is characterised by two land types namely Fb 5 and Fb 15. The Fb land type consists of Glenrosa and/or Mispah soil forms with the possibility of other soils occurring throughout. Lime is generally present within the entire landscape.

The geology of this region is dominated by shale, clastic sediments, and andesite from the Pretoria Group (Transvaal Supergroup). Additionally, a portion of the area is underlain by Malmani dolomites of the Chuniespoort Group (Transvaal Supergroup) (Mucina & Rutherford, 2006).

5.1.3 Climate

The SVcb type is characterised by summer rainfall, very dry winters, and a mean annual precipitation of ranging from 600-700mm (Mucina & Rutherford, 2006). The rainfall gradient increases from west to east together with higher elevations. Frost is frequent and is more intense in the west and south of the region.

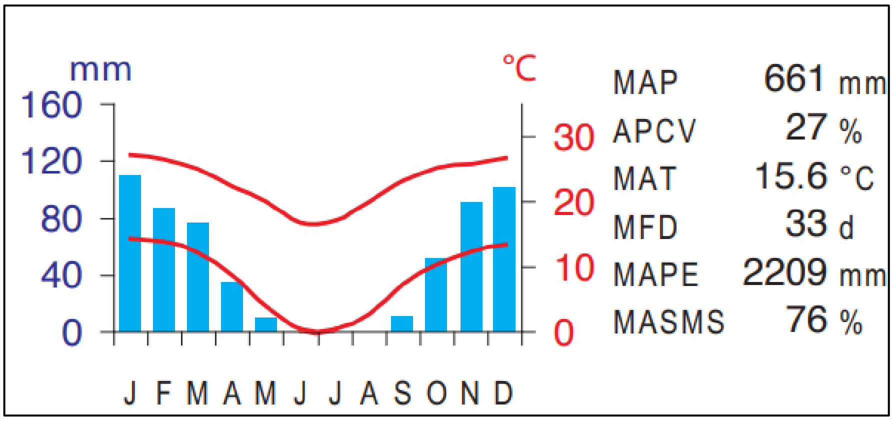

Figure 5-1 Climate for the Gauteng Shale Mountain Bushveld region (Mucina & Rutherford, 2006)

5.1.4 South African Inventory of Inland Aquatic Ecosystems

The South African Inventory of Inland Aquatic Ecosystems (SAIIAE) wetland dataset is a recent outcome of the National Biodiversity Assessment (NBA, 2018) and, was a collaborative project by the South African National Biodiversity Institute (SANBI) and the Council for Scientific and Industrial Research (CSIR). The SAIIAE dataset provides further insight into wetland occurrences and extents building on the information from the NFEPA, as well as other datasets.

Two wetland types were identified by means of this dataset which incorporate three channelled valley-bottom wetlands and four unchannelled valley-bottom wetlands (Figure 5-2). Majority of these wetlands occur within the PAOI, a considerable distance away from the proposed pipeline. The larger channelled valley-bottom and unchannelled valley-bottom wetland occur in closer proximity to the proposed pipeline, with the footprint crossing over the channelled valley-bottom.

All of the channelled valley-bottom wetlands, together with the largest unchannelled valley-bottom wetland have ecological state conditions within the “D/E/F” range, representing systems that are largely, critically and seriously modified respectively. The unchannelled valley-bottoms in the western PAOI, closer to the end of the existing slurry pipeline has a category “C” condition which refers to a moderately modified state. The remaining unchannelled valley-bottom wetland occurring on the PAOI border was classified to be of an “A/B” condition which is deemed largely natural.

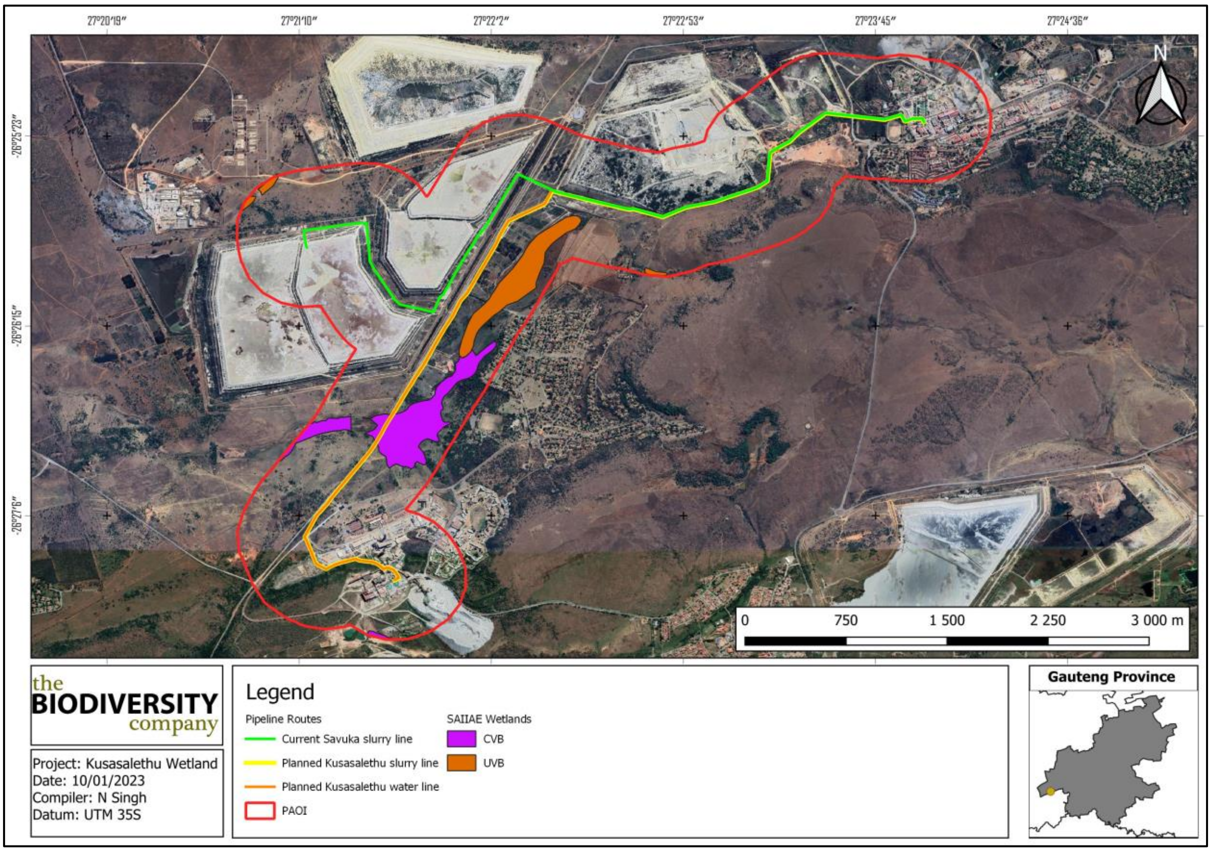

Figure 5-2 SAIIAE wetlands located within PAOI

5.1.5 National Freshwater Ecosystem Priority Areas

The National Freshwater Ecosystem Priority Areas (NFEPA) wetland dataset is a collaborative project between multiple stakeholders such as CSIR, the WRC and SANBI. The objective of the project was to identify priority areas to conserve and protect as well as to promote sustainable water use, thereby assisting in meeting the biodiversity goals for freshwater habitats set out in all levels of government (Nel et al. 2011).

In comparison to the SAIIAE dataset, the NFEPA dataset represents two wetland types classified as hillslope seepages and wetland flats (Figure 5-3). Many of the wetlands in this dataset are in fact artificial systems such as dams, reservoirs, and water treatment ponds, some of which have been decommissioned and no longer exist. Majority of the wetlands have conditions classified as “Z1” and “Z3”, which represent heavily to critically modified systems.

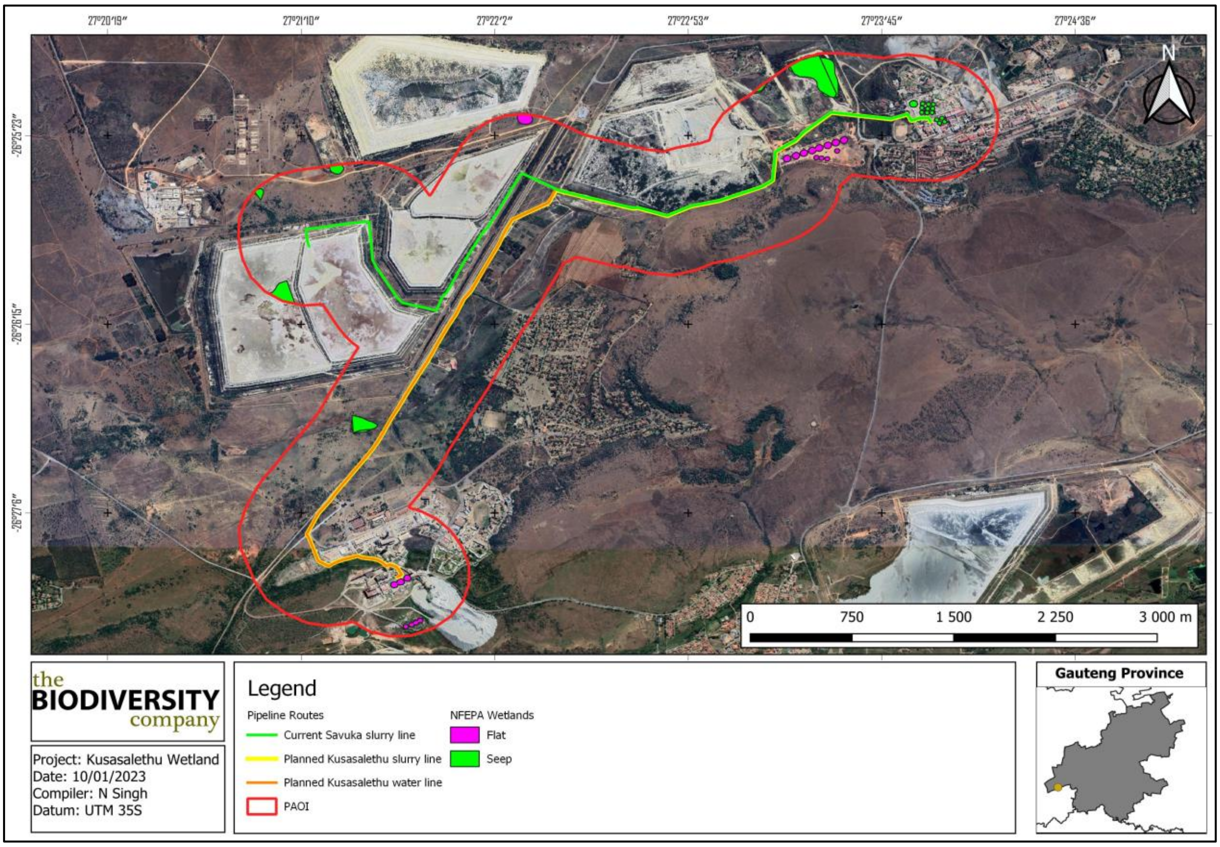

Figure 5-3 NFEPA Wetlands identified within the PAOI

5.1.6 NFEPA’s for sub-quaternary catchments

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 the National Water Act (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).

According to Nel *et al.* (2011), the Kusasalethu Mine Pipeline Project which crosses the C23E-01465 SQR (Kusasalethu River) falls within the 1465 and1436 a sub-quaternary catchment (SQC) (Figure 5-4 and Figure 5-5). Both of these catchments are considered upstream management areas for the Mooi River system downstream, which is considered a River NFEPA and fish sanctuary. These catchments are therefore crucial to manage potential modification as they will affect downstream SQC’s. Any potential modification should therefore be mitigated as far as possible.

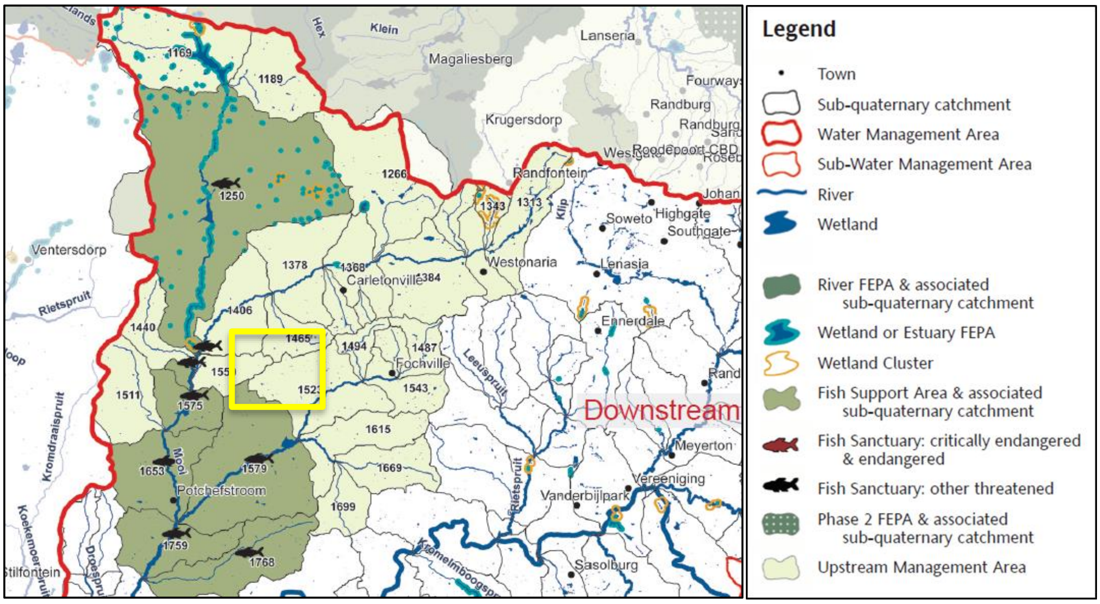

Figure 5-4 Map illustrating fish and river FEPAs for the project area, the project area is represented by the yellow square (Nel et al., 2011)

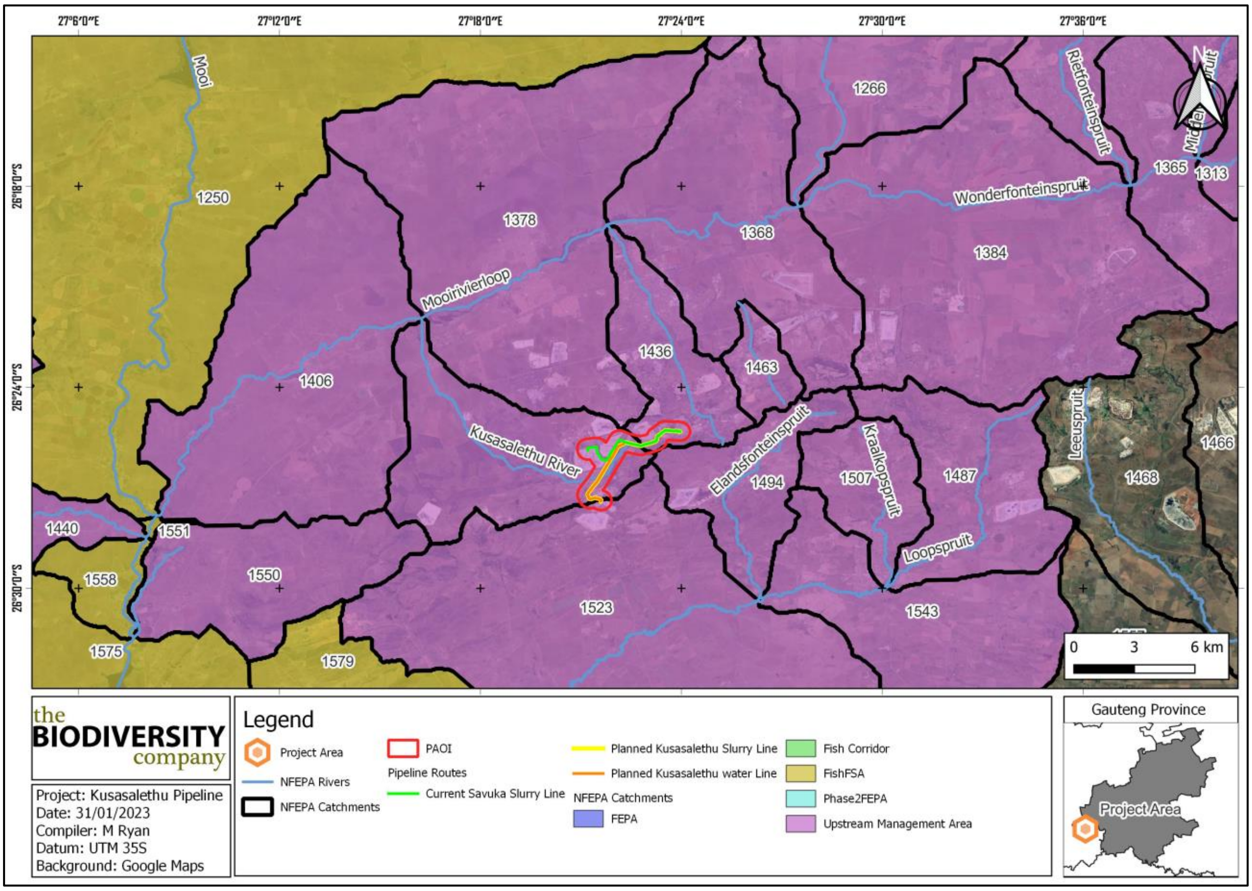

Figure 5-5 Layout of the proposed development area in relation to the riverine National Freshwater Priority Areas

5.1.7 Present Ecological Status (PES) of sub-quaternary reach

Desktop information for SQR associated with the Kusasalethu Mine Pipeline Project was obtained from DWS, 2014 (Table 5-1). The C23E-01465 (Kusasalethu River) which flows to the south of the Harmony Kusasalethu Gold Operations was not assessed during the DWS, 2014 assessments. The reason given by the department is that the reach is not connected to main stem of river however according to the imagery (Figure 5-6) the system is. Regardless of this, desktop data had to be supplemented from the downstream Mooirivierloop River reach (C23E-01378 SQR's). The desktop PES of the C23E-01378 SQR's is classed as largely modified (class D) (Table 5-1). The largely modified state of the reach was due to large to serious impacts to instream habitat, wetland and riparian zone continuity, flow modifications and moderate potential impacts on physico-chemical conditions (water quality).

Figure 5-6 Imagery of the C23E-01465 (Kusasalethu River) (GoogleEarth, 2022)

Table 5-1 Summary of the Present Ecological State of the SQRs associated with the Kusasalethu Mine Pipeline project area

SQR Importance and Sensitivity	Score
C23E-01465 (Kusasalethu River)	
Present Ecological Status	N/A
Ecological Importance	Low
Ecological Sensitivity	Very Low
Default Ecological Category	N/A
C23E-01378 (Mooirivierloop River)	
Present Ecological Status	Largely Modified (class D)
Ecological Importance	Moderate
Ecological Sensitivity	Low
Default Ecological Category	Moderately Modified (class C)

5.1.8 Topographical Inland Water and River Lines

The topographical inland and river line data for “2627” quarter degree was used to identify potential wetland areas within the PAOI. This data set indicates multiple inland water areas classified as non-perennial pans, large reservoirs, marsh vleis and, dams (Figure 5-7). Furthermore, a few non-perennial drainage lines were indicated which mainly drain the hillier areas toward a longer central non-perennial stream. In many instances the inland water areas occur within the path of the non-perennial drainage features.

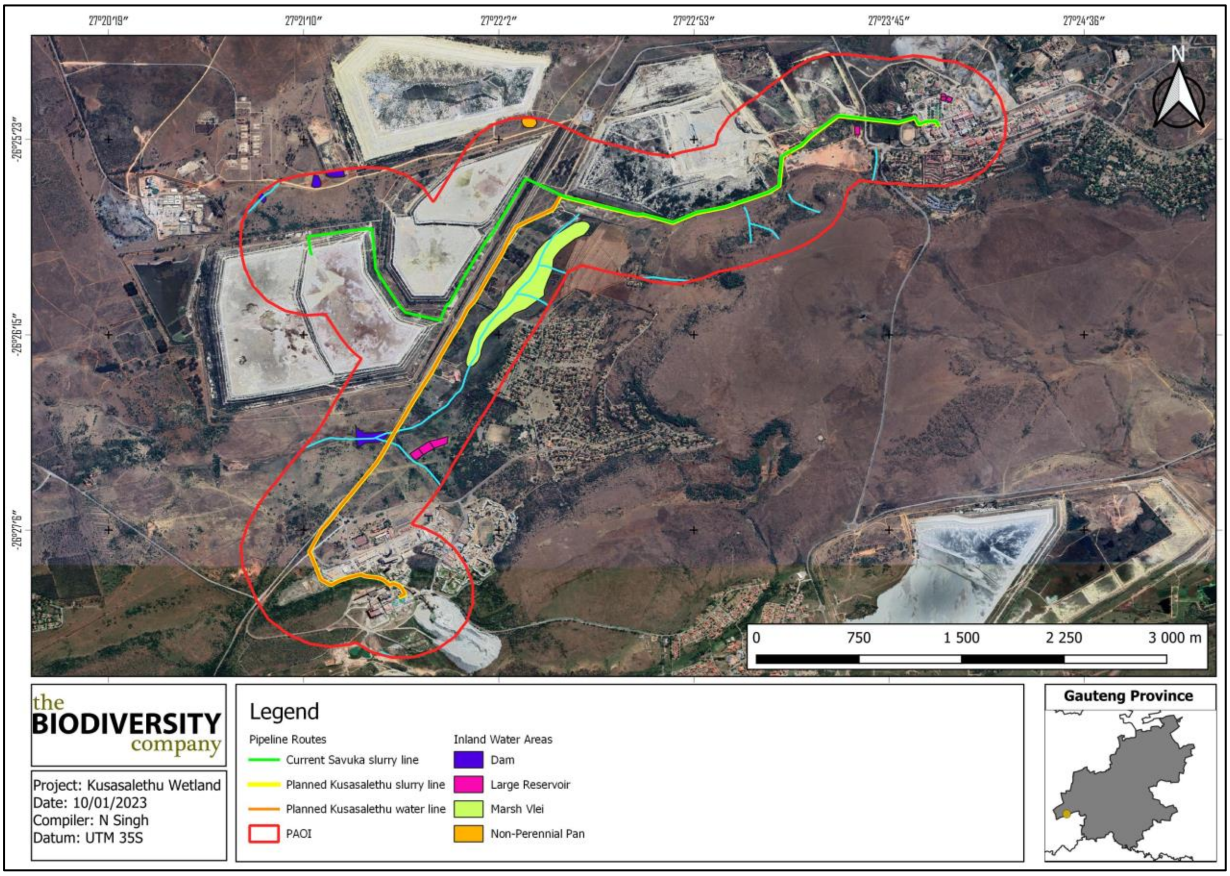

Figure 5-7 Topographical River line and inland water areas located within the PAOI

5.1.9 Terrain

The terrain of the PAOI has been analysed to determine potential areas where water is more likely to accumulate (due to convex topographical features, preferential pathways, or more gentle slopes).

Majority of the PAOI consists of mild gradient land, with the exception of some hillier and steeper terrain located in the north-east and south of the proposed pipeline.

5.1.9.1 Digital Elevation Model (DEM)

A Digital Elevation Model (DEM) has been created to identify lower laying regions as well as potential convex topographical features which could point towards preferential flow paths. The PAOI ranges from 1 578 to 1 706 meters above sea level (MASL). The lower lying areas (generally represented in dark blue) represent the area that will have the highest potential to be characterised as wetlands (Figure 5-8).

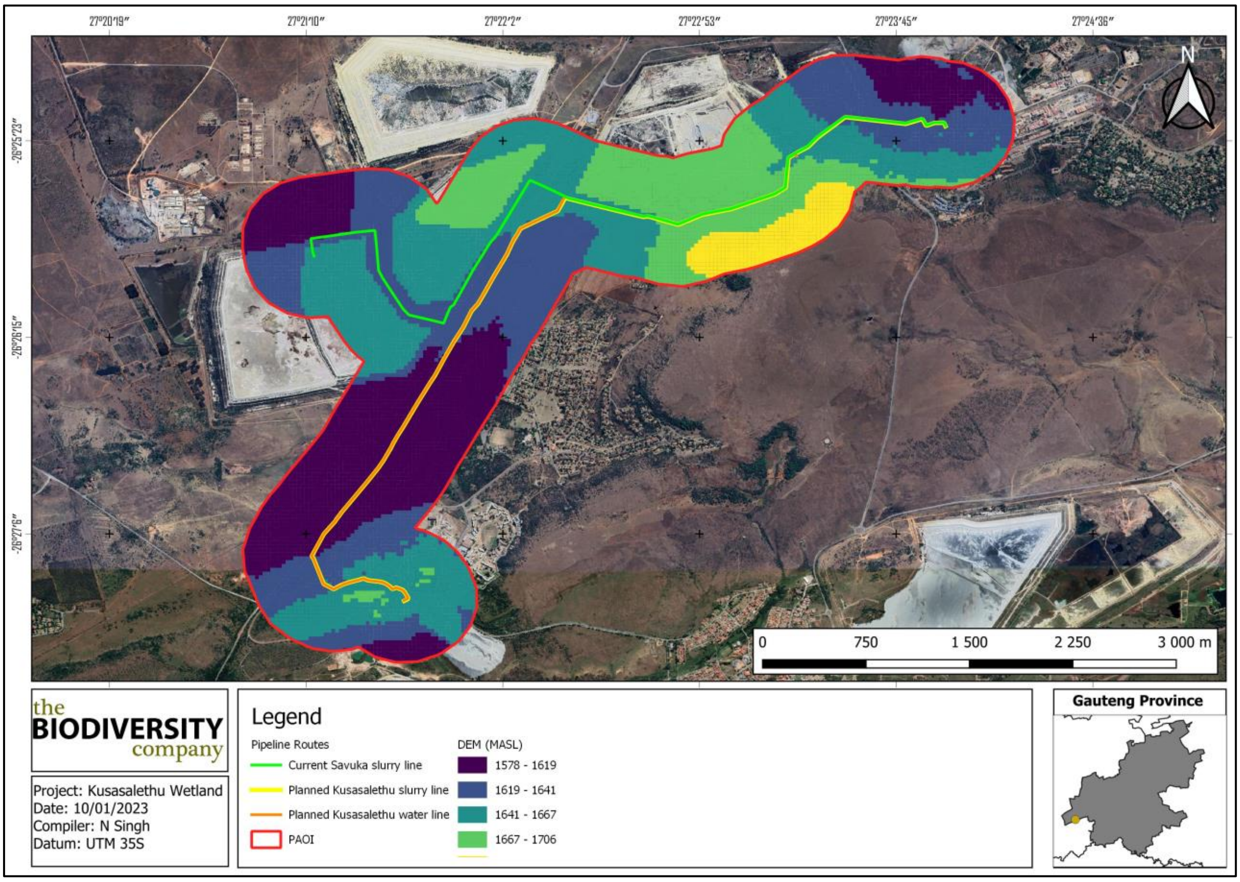

Figure 5-8 Digital Elevation Model of the PAOI

5.1.10 Strategic Water Source Areas

Strategic Water Source Areas are areas that supply a disproportionate amount of mean annual runoff to a geographical region of interest. The areas supplying ≥ 50% of South Africa's water supply (which were represented by areas with a mean annual runoff of ≥ 135 mm/year) represent national Strategic Water Source Areas (SANBI, 2013). According to the Strategic Water Source Areas (SWSAs) of South Africa, Lesotho and Swaziland, the project area is not located within the SWSAs with all SWSA aligned along the coast. These shapefiles were refined in 2017.

5.1.11 Freshwater Critical Biodiversity Area

According to the Gauteng conservation Plan Project for the freshwater biodiversity assessment of the Gauteng Province (SANBI, 2014), the Kusasalethu River channel is categorised as Critical Biodiversity Area (CBA) (Figure 5-9). The surrounding habitat of the project area are considered unclassified. This classification of the river reach as a CBA indicates its importance as a biological corridor.

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. CBAs are areas of high biodiversity value and need to be kept in a natural state, with no further loss of habitat or species (MTPA, 2014). Thus, if these areas are not maintained in a natural or near natural state then biodiversity targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity compatible land uses and resource uses (SANBI, 2017).

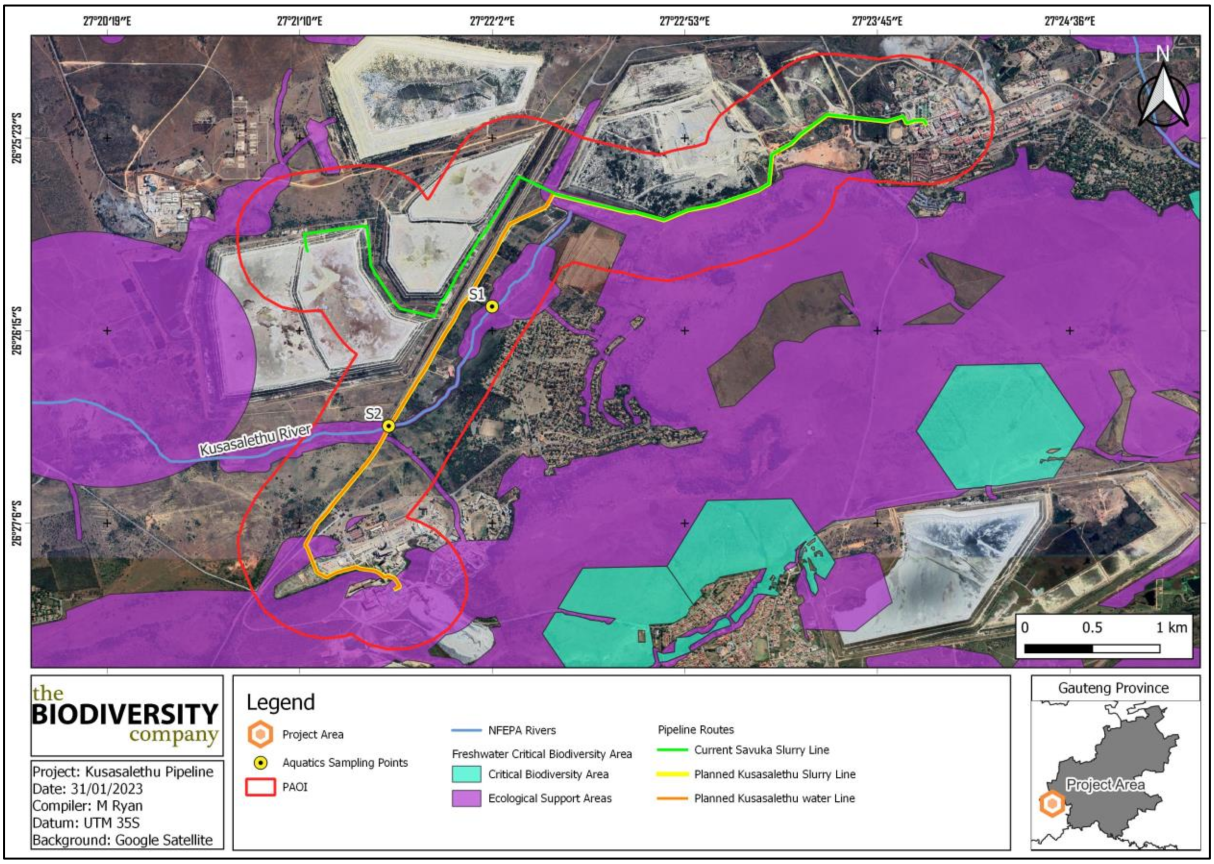

Figure 5-9 Illustration of the Freshwater Critical Biodiversity Areas within the project area (SANBI, 2008)

5.1.12 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 Threatened (LT), based on the proportion of each ecosystem type that remains in good ecological condition (Skowno *et al*., 2019). The Ecosystem Threat Status (ETS) of each river assessed was based on the extent to which the system had been modified from its natural condition (SANBI, 2018). According to the South African Inventory of Inland Aquatic Ecosystems (SAIIAE) released with the National Biodiversity Assessment (NBA) of rivers, the rivers which were superimposed on the aquatic ecosystem threat status indicate that the Kusasalethu River is considered a Critically Endangered system (Figure 5-10).

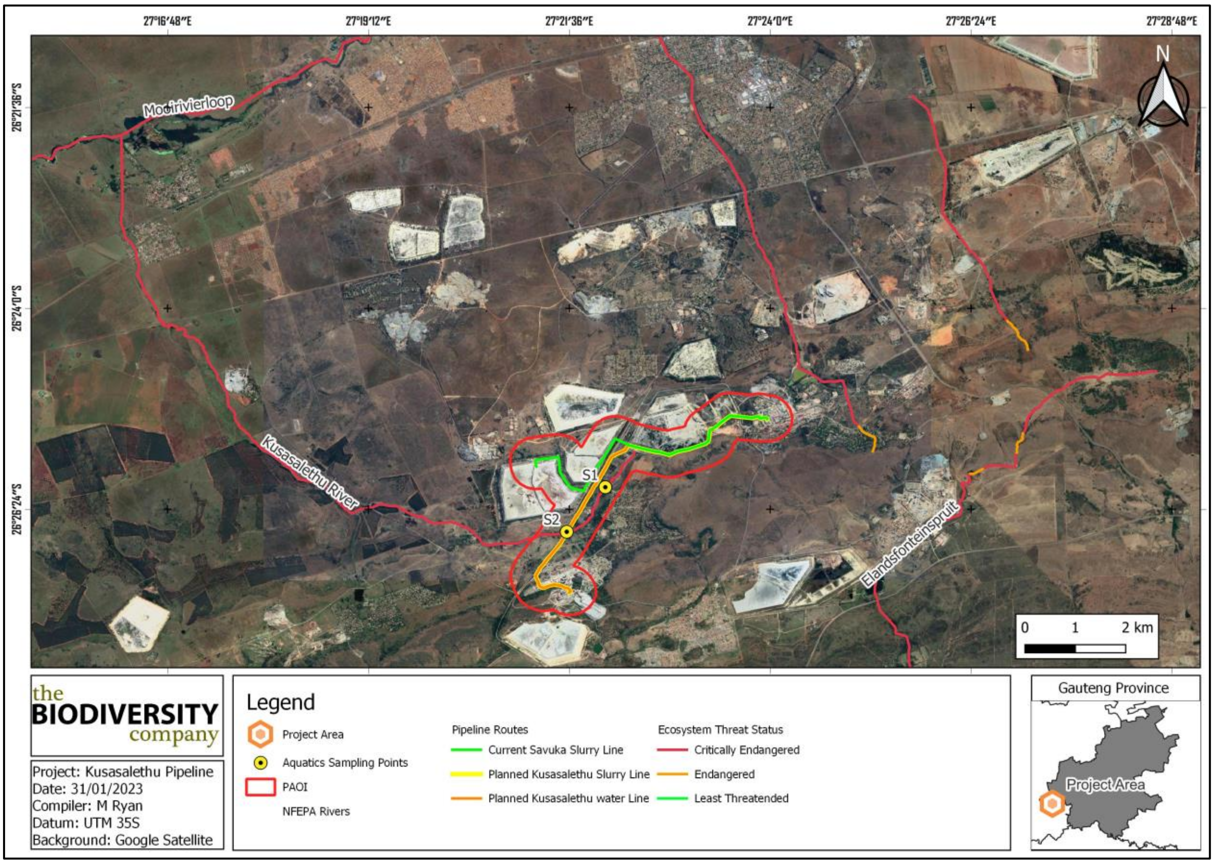

Figure 5-10 Illustration of the Ecosystem Threat Status of the project area (SANBI, 2018)

5.1.13 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 Ecosystem Protection Level (EPL) of each river assessed was based on the extent (expressed as a percentage) to which the system has their biodiversity target located within protected areas and are in a natural or near-natural ecological condition. Rivers in protected areas need to be in good condition (A or B ecological category) to be considered as protected. Well protected rivers have 100% located within protected areas, while moderately protected and poorly protected river ecosystem types have at least 50% and 5% of their biodiversity target in protected areas, respectively. Not protected rivers form less than 5% (SANBI, 2018).

The project area was superimposed on the ecosystem protection level map to assess the protection status of aquatic ecosystems associated with the development (Figure 5-11). This indicates that the aquatic ecosystems associated with the project area are rated as *not protected.*

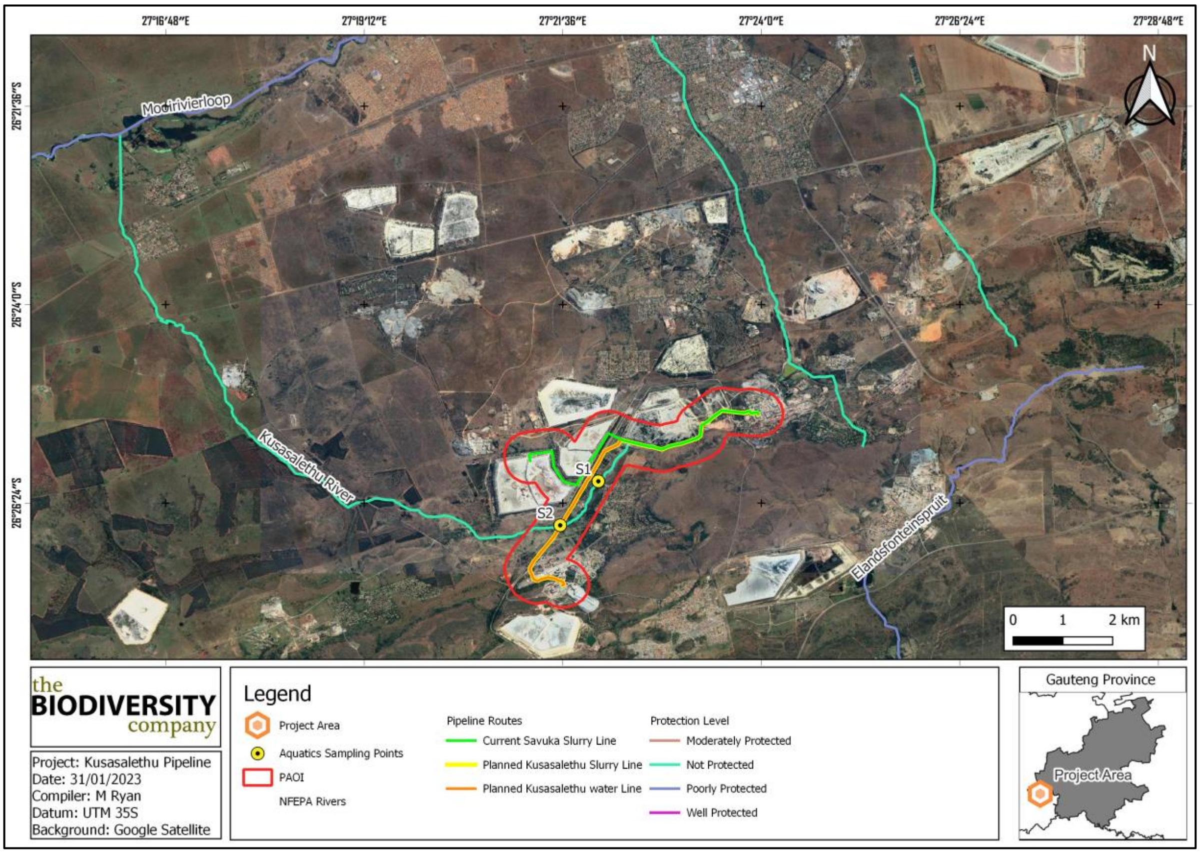

Figure 5-11 Illustration of the Ecosystem Protection Level of the project area (NBA, 2018)

5.1.14 Spatial Sensitive Mapping

This approach has also taken cognisance of the recently published Government Notice 320 in terms of NEMA dated March 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” (DWS, 2020). The National Web Based Environmental Screening Tool (NWBEST) has characterised the aquatic sensitivity of the project area as “very high” - requiring an assessment (Figure 5 1). This is a result of the Aquatic CBA’s (Figure 5-9) and SAIIAE Wetlands (Figure 5-2 and Figure 5-3) within the area. The freshwater ecology of the immediate project area and further downstream areas are considered sensitive to disturbance from a hydrological and biological perspective. This will include all watercourses within the project area which are considered sensitive due to their relatively small spatial scale when compared to terrestrial habitat with a large demand for the ecosystem services which they provide.

MAP OF RELATIVE AQUATIC BIODIVERSITY THEME SENSITIVITY

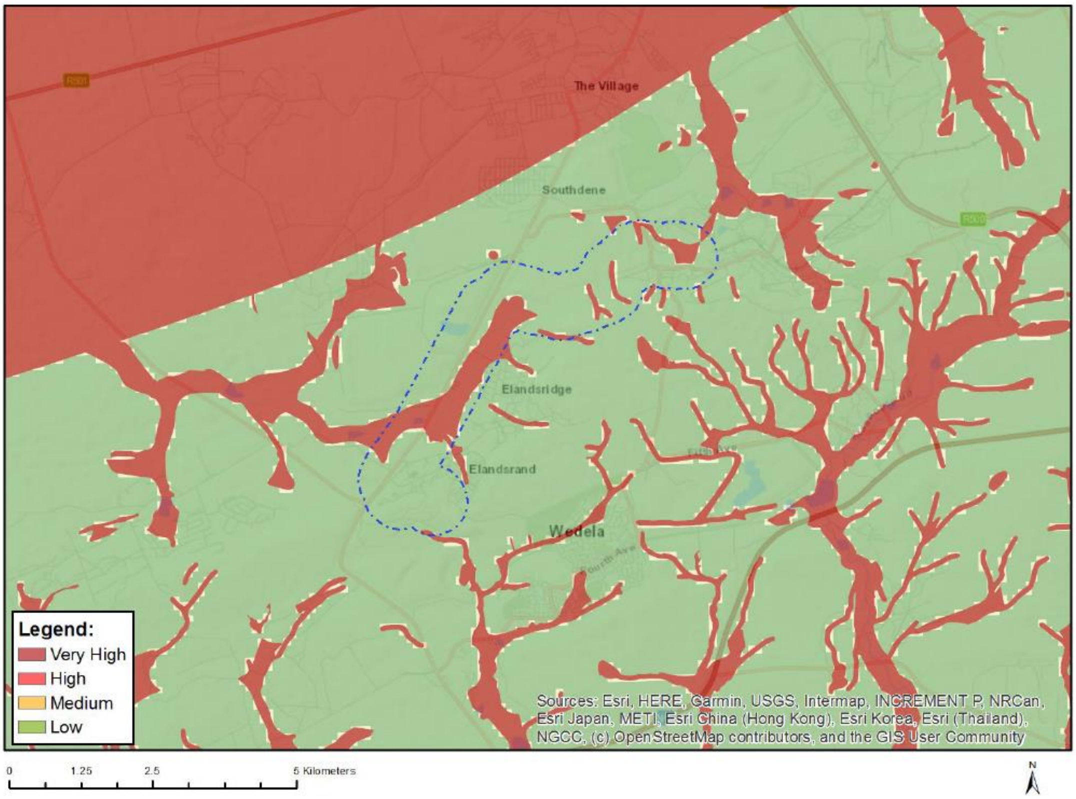

Figure 5-12 Aquatic Biodiversity Combined Sensitivity (National Web based Environmental Screening Tool)

5.2 Expected Fish Species

An expected species list was generated from DWS (2014), and Skelton (2011) for the C23E-01378 SQR's (Mooirivierloop River) as the downstream SQR which fish migrations would likely form part of, as the C23E-01465 SQR was not assessed. A total of 5 fish species are expected to occur in the Mooirivierloop River reach which are presented in Table 5-2. The conservational status of fish species was assessed against the IUCN database 2023 (IUCN, 2023).

The expected species are generated on a reach basis, and the occurrence of all species in the system is unlikely as different species are specialists of different habitats which are present along a reach. The Mooirivierloop River reach does however have great diversity of habitat however lacks and therefore a wide range of fish species are expected. The Kusasalethu River lack full connectivity according to desktop data and therefore some species may be absent however the reach contains adequate habitat diversity for all expected species.

Table 5-2 Expected fish species

Species	Common Name	IUCN Status (2023)
Clarias gariepinus	Sharptooth Catfish / Barbel	LC
Enteromius anoplus	Cubbyhead Barb	LC
Enteromius paludinosus	Straightfin Barb	LC
Pseudocrenilabrus philander	Southern mouth-brooder	LC
Tilapia sparrmanii	Banded Tilapia	LC

LC - Least Concern, NT – Near Threatened, VU - Vulnerable

An analysis of the sensitivities of the expected fish species was also completed which indicate that the average sensitivity for the expected fish species within the Kusasalethu River is 1.6 for changes in flow and physio-chemical alterations (Table 5-3). This indicates that the community is tolerant to changes in physio-chemical composition and flow of the system.

Table 5-3 Fish community assessment for February 2022 (Kusasalethu River)

Species/Site	Sensitivity	
	No-flow	Phys-chem
Clarias gariepinus	1.7	1
Enteromius anoplus	2.3	2.6
Enteromius paludinosus	2.3	1.8
Pseudocrenilabrus philander	1	1.4
Tilapia sparrmanii	0.9	1.4
Total Native Species Sampled		
Total Expected Native Species	**1.6**	**1.6**
% Fish Community Sampled		

0 = Absent; 1 = Present; * - no data available; Species in red text are alien invasives

6 Field Assessment

6.1 Wetland Assessment

6.1.1 Delineation and Description

During the site visit, three HGM units were identified within the PAOI that relate to the proposed development of the pipelines (Figure 6-2). The wetland types were classified as channelled valley-bottom (HGM 1), unchannelled valley-bottom (HGM 2) and artificial (HGM 3) (Figure 4-1). Only the natural systems were considered for further assessment, therefore HGM 3 was excluded. Although, all three units are linked, occurring in series from one of the artificial wetlands upstream, to the unchannelled valley-bottom and lastly, the channelled valley-bottom. The remaining delineated artificial wetlands occur below the tailing storage facilities within the PAOI, most commonly in rectangular depressions that support an accumulation of water. Furthermore, the tailing storage facilities themselves support artificial wetland development through the continual input of deposits that contain water, as well as by providing depressions that can store water from rainfall events.

A single perennial drainage feature was identified within HGM1 and was classified as a "C-Section stream" attributed to the system always being saturated. HGM 2 occurs upstream of this and would have historically been sustained by the same stream feature. However, the wetland is now mainly sustained by artificial inputs, with natural sources contributing little due to extensive modifications of the wetland area and its surrounds.

Figure 6-1 Photographical evidence of the different wetlands (A, E & H), Hydrophytic vegetation (C, F, G, I & J) and hydromorphic soils (D & K). A&B) Channelled valley-bottom wetland, C) Typha Capensis, D) Gleyed subsoil indicative of water logging, E) Unchannelled valley-bottom wetland, F) Foreground - Schoenoplectus spp., Background - Phragmites australis, G) Schoenoplectus spp., H) Artificial wetland occurring below tailings facilities I) Cyperus longus, J) Imperata cylindrica, K) Soil mottling indicative of frequent saturation

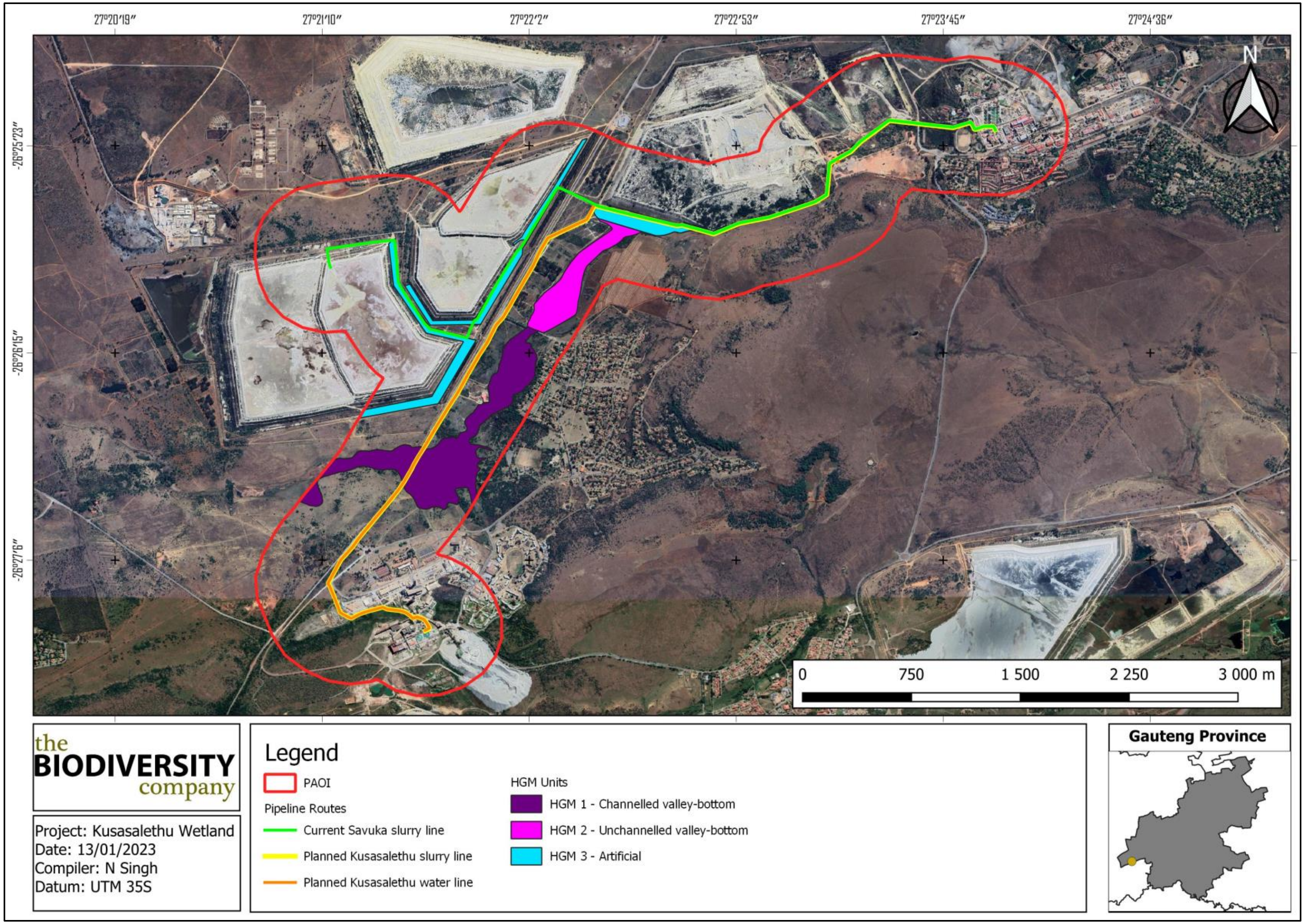

Figure 6-2 Delineation and location of the different HGM units identified within the PAOI

6.1.2 Unit Setting

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 steep and the deposition thereof in cases of low relief. Figure 6-3 presents a diagram of a typical channelled valley-bottom, showing the dominant movement of water into, through and out of the system.

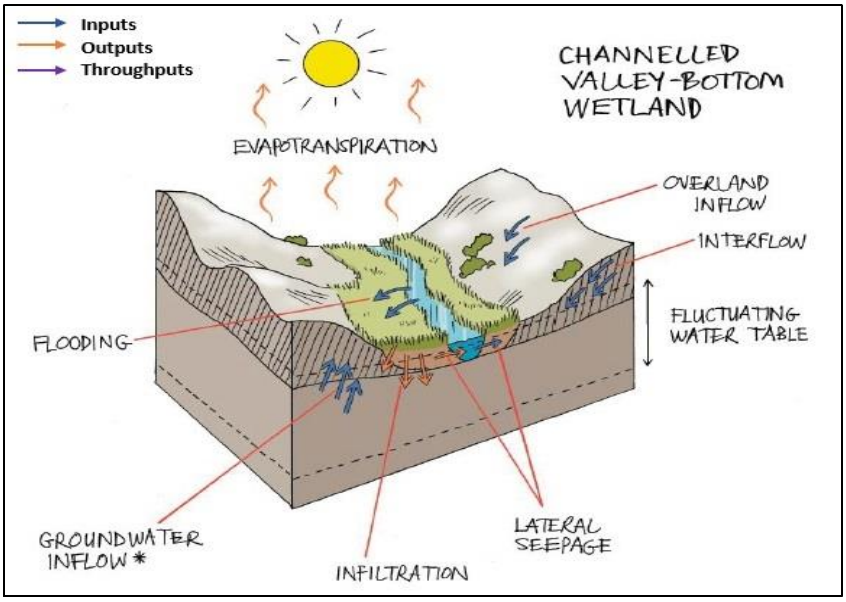

Figure 6-3 Amalgamated diagram of a typical channelled valley bottom, highlighting the dominant water inputs, throughputs and outputs, SANBI guidelines (Ollis et al. 2013)

Unchannelled valley-bottom wetlands are typically found on valley floors where the landscape does not allow high energy flows and supports the diffuse flow of water. Figure 6-4 presents a diagram of a typical unchannelled valley-bottom wetland, showing the dominant movement of water into, through and out of the system.

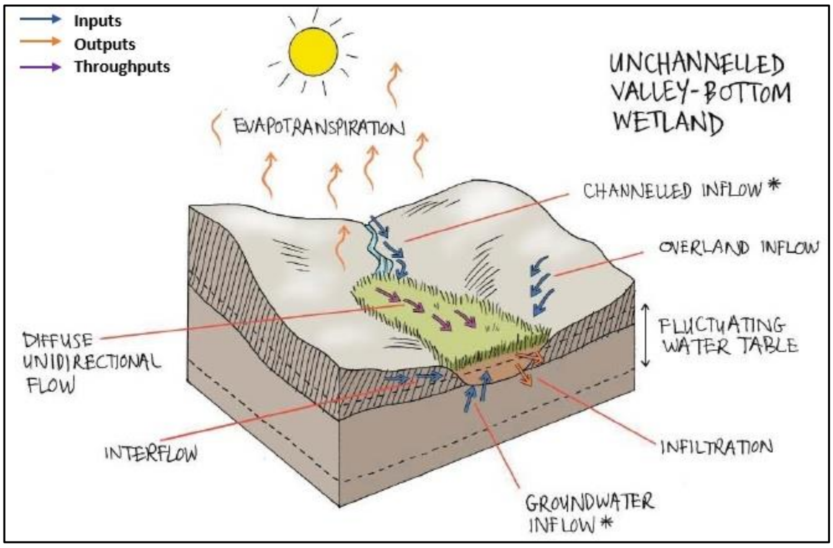

Figure 6-4 Amalgamated diagram of a typical unchannelled valley-bottom, highlighting the dominant water inputs, throughputs, and outputs, SANBI guidelines (Ollis et al. 2013)

The DWAF (2005) manual separates the classification of watercourses into three (3) separate types of channels or sections defined by their position relative to the zone of saturation in the riparian area. The classification system separates channels into:

- those that do not have baseflow ('A' Sections);
- those that sometimes have baseflow ('B' Sections) or non-perennial; or
- those that always have baseflow ('C' Sections) or perennial.

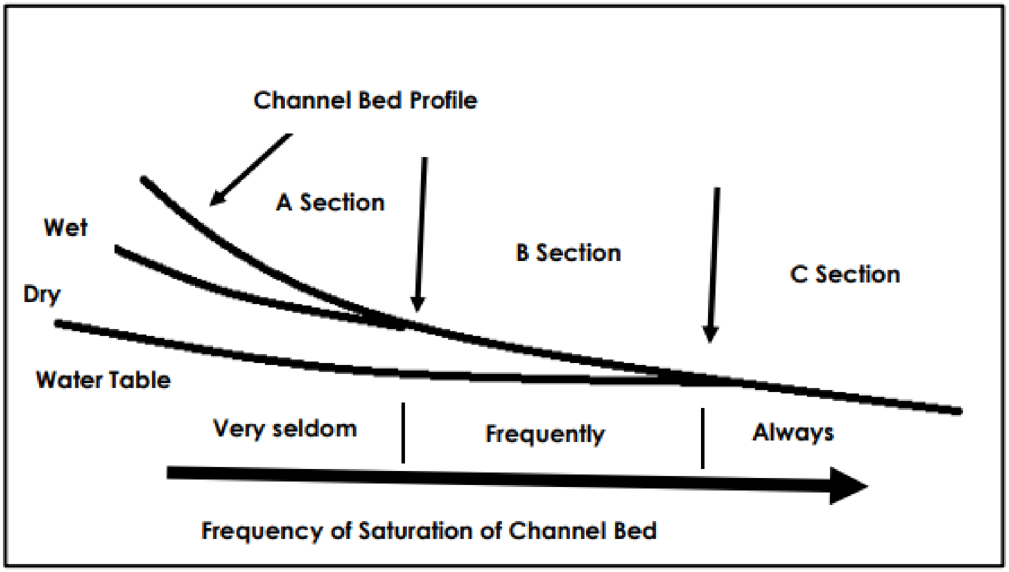

Figure 6-5 The watercourse classifications (DWAF, 2005)

6.1.3 General Functional Description

Channelled valley bottom wetlands tend to contribute less to sediment trapping and flood attenuation than other systems. However, they are well known for their potential to assimilate toxicants, nitrates and sulphates, especially in cases where sub-surface flows contribute to the system's water source (Kotze et al., 2009).

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

It is however important to note that the descriptions of the above-mentioned functions are merely typical expectations. All wetland systems are unique therefore, the ecosystem services ratings for the wetlands on site may differ slightly to the general expectation given by the nature of the wetland type in relation to its topographic setting.

6.1.4 Ecological Functional Assessment

The ecosystem services provided by the wetland units identified on site were assessed and rated using the WET-EcoServices method (Kotze *et al.,* 2008). The average ecosystem service scores for the delineated systems are illustrated in Table 6-1 and Figure 6-6. The ecosystem services scores of the delineated wetlands ranges from intermediate to moderately high. Ecosystem services contributing to these scores include flood attenuation, streamflow regulation, sediment trapping, phosphate assimilation, nitrate assimilation, toxicant assimilation and erosion control.

Table 6-1 Average ecosystem service scores for delineated wetlands

Moderately High	Intermediate
HGM 1	HGM 2

HGM 1 scored "Moderately High" on the provision of ecosystem services due to the nature of the wetland being a channelled valley-bottom system and, its supportive functional capabilities in relation to its surroundings. The vegetation in most undisturbed parts of the wetland is intact and dense, therefore the benefits from this are likely. For instance, the channel of the wetland is densely vegetated with hydrophytic reeds which assist in erosion prevention and water purification related to toxicant alleviation. Water quality improvement through toxicant removal is an essential service provided by this wetland because of the numerous inputs into the system from stormwater discharges and treated outputs from the mines through trenches and a canal system that feeds directly into the wetland. Furthermore, the width of the channel banks allows for flood attenuation and further supports toxicant removal attributed to the accumulation of shallow water that light can penetrate through. Apart from this, the wetland is an upstream source of water for other systems in the local catchment as well a drinking source for animals.

HGM 2 scored "Intermediate" in terms of ecosystem service provision. This is attributed to much of the wetland being modified, leaving only a narrow spans of wetland vegetation intact in some reaches of the wetland. Nevertheless, the wetland will provide attenuation functions during periods of exceptional flow and assist in the removal of toxicants as some output from the surrounding mining activity is expected to reach the system. Additionally, this wetland does contribute some flow to HGM1 and is well vegetated in certain portions which provides erosion control to some extent.

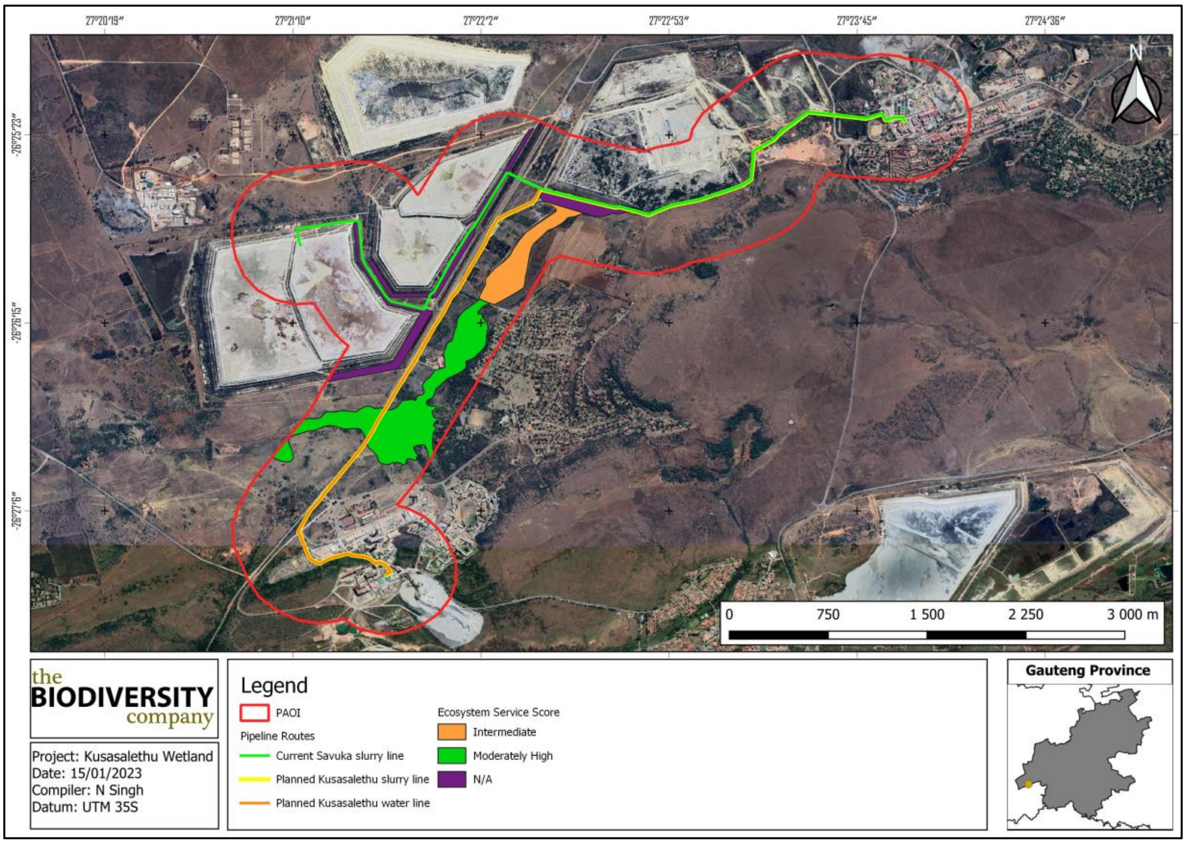

Figure 6-6 Average ecosystem services scores for the delineated wetlands

6.1.5 Ecological Health Assessment

The PES for the assessed HGM units is presented in Figure 6-7. Both, HGM 1 and HGM 2 scored an overall PES of “E” which represents a seriously modified ecosystem.

Both wetlands are extensively modified through anthropogenic influence and due to their relatively close proximity to mining activities of which they are a receiving environment to. The extent of HGM 2 has been altered through the encroachment of tree plantations. Alien invasive species such as, but are not limited to; *Arundo donax*, *Verbena bonariensis, Solanum mauritianum, Cortadaria jubata* and *Cortadaria Selloana* have established within and around the wetlands and have a great potential of propagating. A network of trenches and canals bisect HGM 1 and contribute impacts in the form of increasing flows, inducing erosion, inputting toxicants and degrading wetland area. Furthermore, there are several farm roads and tarred crossings with culverts that occur within the wetland boundaries. Additionally, there are pre-existing dams within the channel path of HGM 1 and there are disturbances to the wetland by roadworks on the wetland crossing. Cattle grazing and footpaths through the wetlands were also evident. Some impacts are shown in Figure 4-8.

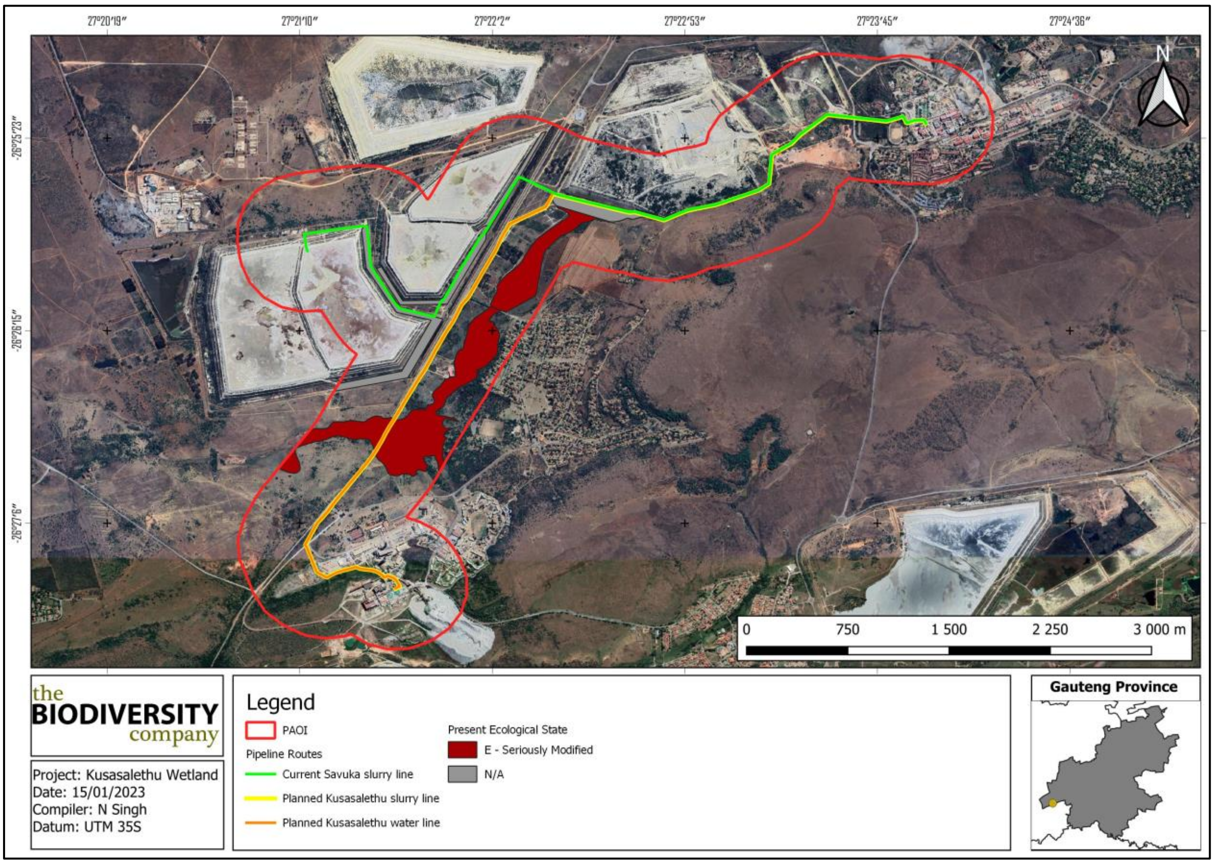

Figure 6-7 Overall present ecological state of delineated wetlands

Figure 6-8 ***Some of the impacts identified on site. A) Excavated trench draining into wetland, B) Example of the canal system that occurs within the wetland and subsequently drains into the river channel, C) Crossings over the wetland, D&G) Alien vegetation (left - Verbena bonariensis, right - Solanum mauritianum) and Cortadaria spp. E) Earthwork's operations near the wetland, F) Discharge in a trench at an artificial wetland***

6.1.6 Importance & Sensitivity Assessment

The results of the ecological IS assessment are shown in Table 6-2. Various components pertaining to the protection status of a wetland are considered for the IS, including Strategic Water Source Areas (SWSA), the NFEPA wetland vegetation (wet veg) threat status and the protection status of the wetland. The IS for the channelled valley-bottom and unchannelled valley-bottom wetlands have been calculated to be "High", which combines the high threat status and the low protection levels of the wetland.

Table 6-2 ***The IS results for the delineated HGM units***

HGM Type	NFEPA Wet Veg			NBA Wetlands			SWSA (Y/N)	Calculated IS
	Type	Ecosystem Threat Status	Ecosystem Protection Level	Wetland Condition	Ecosystem Threat Status 2018	Ecosystem Protection Level		
Channelled Valley Bottom	Central Bushveld Group 1	Critical	Not Protected	D/E/F Largely Modified	Critical	Not Protected	N	**High**
Unchannelled Valley Bottom	Central Bushveld Group 1	Critical	Not Protected	D/E/F Largely Modified	Critical	Not Protected	N	**High**

6.1.7 Buffer Requirements

It is worth noting that the scientific buffer calculation (Macfarlane *et al*., 2014) was used to determine the size of the buffer zones relevant to the proposed project. A pre-mitigation buffer of 32m and a post-mitigation wetland and watercourse buffer of 15 m (Figure 4-9) is recommended for the delineated wetlands in relation to the proposed development. Although, HGM 2 is not intersected by the proposed pipeline, a buffer was still recommended to ensure that no impact reaches the system. The buffer distances were attributed to pre-existing modifications of the land around the wetlands and the nature of the project which has the potential of minimally impacting on the wetland systems.

The suggested buffer in this report does not qualify as a relaxation to any other legislated buffers managed by the respective authorities (eg., DEA and DWS). Therefore, the relevant authorisations are still a requirement prior to project commencement.

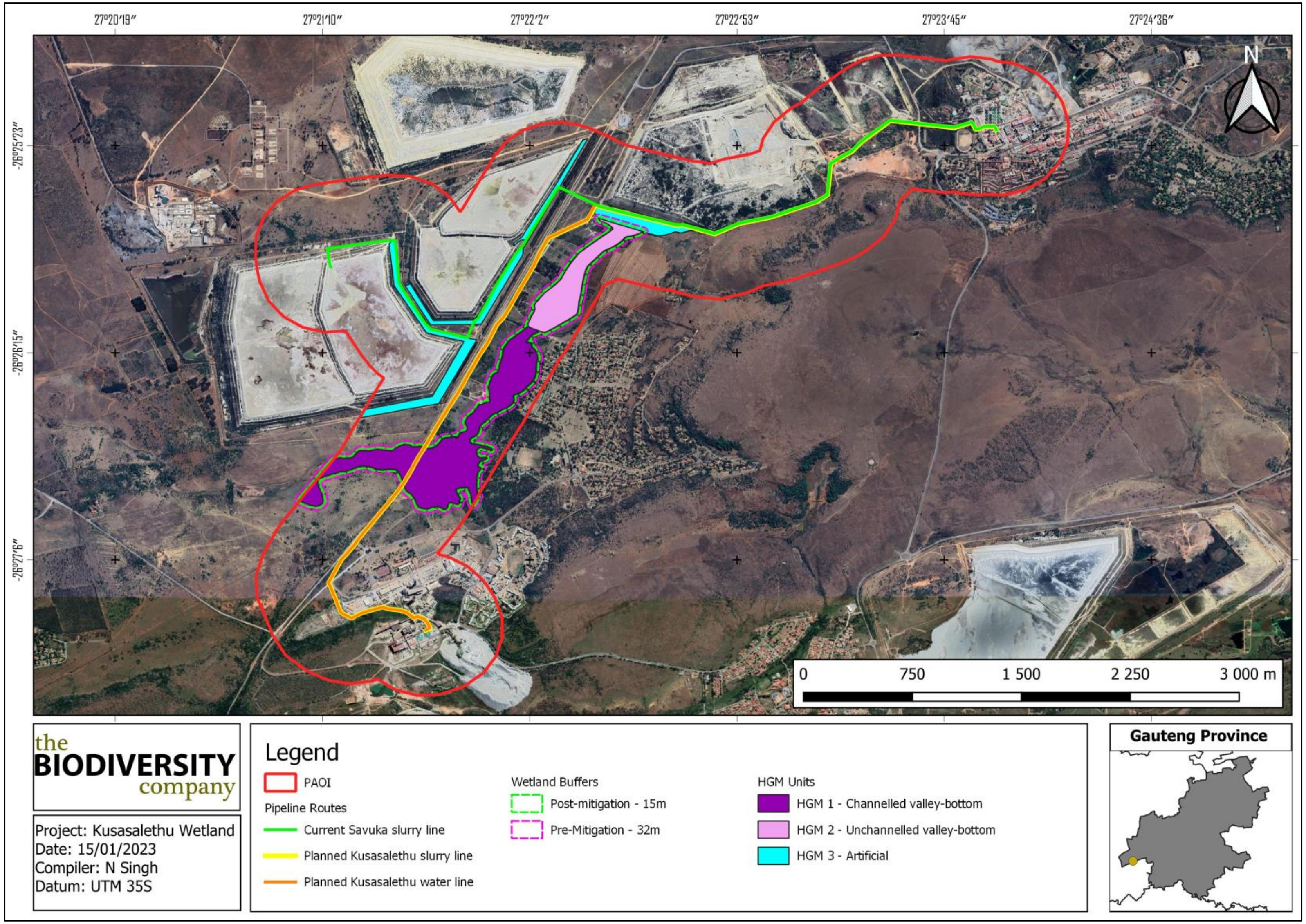

Figure 6-9 Wetland Buffer Map for the delineated wetlands within the PAOI

6.2 Aquatics Survey

6.2.1 Sampling Sites

The sampling points for the assessment were selected to adequately assess the current hydrological and geomorphological characteristics of the watercourses potentially traversed by the Kusasalethu Mine Pipeline Project to identify the potential risks that may result from construction and operation of the pipeline. This was done to gain a holistic image of the system and the habitat which may be affected. To achieve this, sites were selected along all accessible watercourses which fall within the 500 m regulated area of all the infrastructure. The resultant number of watercourses traversed resulted in a sampling methodology where multiple sites were selected along the NFEPA river. Site S1 was selected as a water quality site to assess the upstream influences with S2 selected to categories the current state of the reach by using the entire suite of listed methodologies above. The selected sampling location and the pictures can be seen in Table 6-3 as well as Figure 6-9, presented in a downstream direction.

Table 6-3 Photos, co-ordinates and descriptions for the sites sampled (January 2023)

Site	Upstream View	Downstream View
S1		
GPS-coordinates	26°26'8.14"S 27°22'1.83"E	
S2		
GPS-coordinates	26°26'40.10"S 27°21'34.19"E	

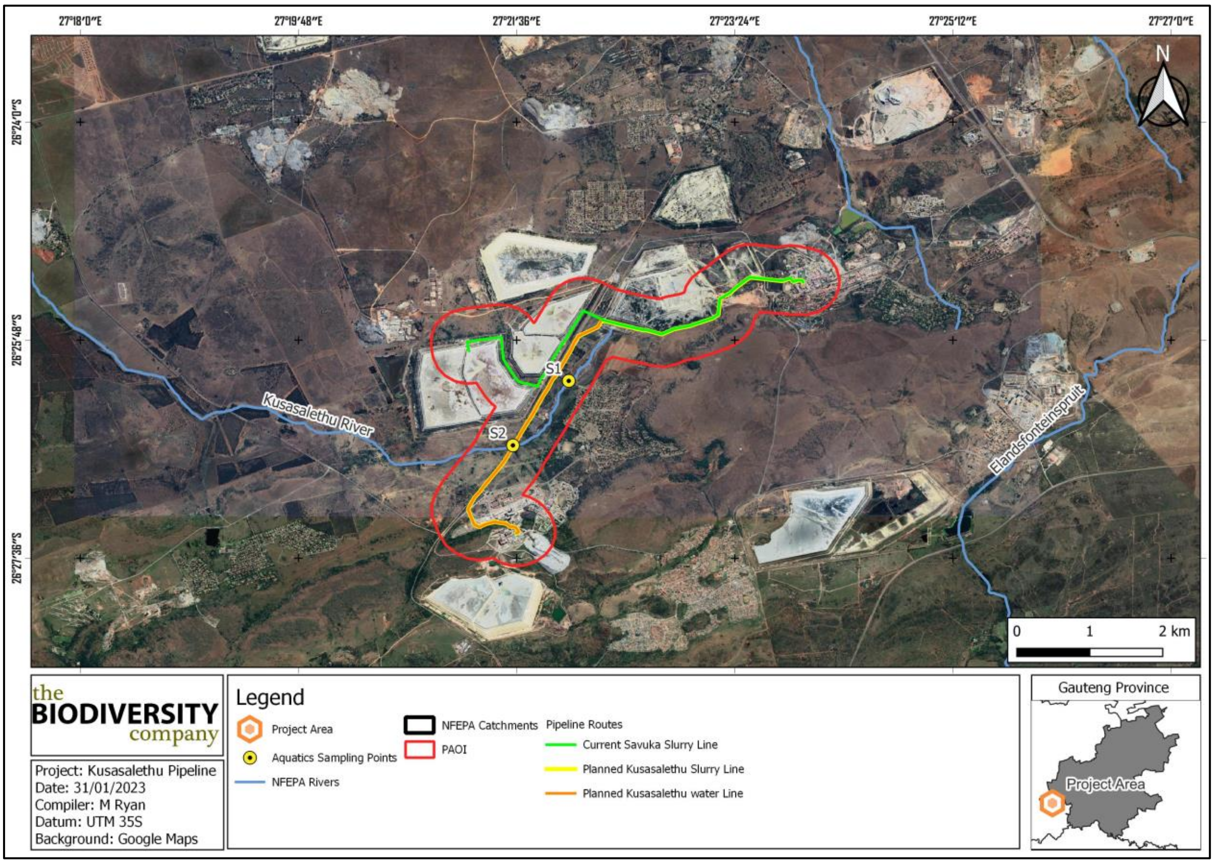

Figure 6-9 Selected sampling sites for the assessment.

6.2.2 *In situ* Water Quality

In-situ water quality analysis was conducted during the study at each pipeline crossing which contained water as well as the upstream site. Results have been compared to limits stipulated in the Target Water Quality Range (TWQR) for aquatic ecosystems (DWS, 1996) as well as the Resource Quality Objectives (RQO) (DWS, 2018). The Kusasalethu River reach does not have any RQOs and therefore the nearest downstream RQO was substituted which is the RQO for EWR 12 at Vermaasdrift along the Vaal River. The results of the January 2023 assessment are presented in Table 6-4.

Table 6-4 In situ surface water quality results (January 2023)

Site	pH	Electrical Conductivity (µS/cm)	Dissolved Oxygen (mg/l)	Temperature (°C)
TWQR*	**6.5-9***	**-**	**>5.00***	**5-30***
RQO**	**7.5-9.2**	**850**	**> 7.50**	**-**
S1	8.04	2390	5.6	23.2
S2	8.03	4260	6.0	22.5

*TWQR – Target Water Quality Range; RQO** - Resource Quality Objectives Levels exceeding guideline levels are indicated in red

In situ water quality for the Kusasalethu River indicates modified conditions as select parameters fall outside prescribed water quality limits. The dissolved solids as measured by electrical conductivity indicated concentrations well above the prescribed RQO limit of 850 µS/cm. Upstream concentrations are 2.8 times the prescribed limit and increase to 5 times the prescribed limit at the downstream site indicating a source of modification to the reach. Based on the proximity of the TSF of the Kusasalethu Gold Mine Operations, this presents a likely source of modification however this cannot be confirmed and is outside of the scope of work of this report. Dissolved oxygen concentrations within the reach are above prescribed TWQR limit (5.00 mg/l) however are below the prescribed RQO limit (7.50 mg/l). pH concentrations of the reach indicate alkaline conditions within the reach which are within both TWQR and RQO limits. Temperature concentration are within TWQR limits. Based on the above parameters presented a baseline has been established which indicates a modified system. The recorded parameters assessed indicate conditions which would hinder aquatic life; however, this assessment is not considered robust enough to make this definitive statement as chemical analysis is required to further understand the physiochemical conditions in the reach.

6.2.3 Habitat Integrity Assessment

The IHIA was completed for the Kusasalethu River as described in the IHIA methodology component of this study. The special framework of which constitutes a 5 km reach of the Kusasalethu River which would potentially be affected by the Kusasalethu Mine Pipeline Project. The results thereof are shown in Table 6-5.

Table 6-5 Intermediate Habitat Integrity Assessment for the Kusasalethu River reach

Criterion	Impact Score	Weighted Score
Instream		
Water abstraction	8	4.48
Flow modification	17	8.84
Bed modification	13	6.76
Channel modification	14	7.28
Water quality	15	8.4
Inundation	16	6.4
Exotic macrophytes	0	0
Exotic fauna	0	0
Solid waste disposal	6	1.44
Total Instream Score		56.4
Instream Category		D
Riparian		
Indigenous vegetation removal	16	8.32
Exotic vegetation encroachment	14	6.72
Bank erosion	12	6.72
Channel modification	14	6.72
Water abstraction	15	7.8
Inundation	16	7.04
Flow modification	15	7.2
Water quality	18	9.36
Total Riparian Score		40.12
Riparian Category		D

The results of the Intermediate Habitat Integrity Assessment for the Kusasalethu River indicates a largely modified state (class D) of the instream and riparian habitat. This indicates a large loss of natural habitat, biota and basic ecosystem functions has occurred within the reach. The system is highly largely modified as a result of the surrounding landuse which includes mining activity, residential areas and agriculture. Mining accounts for water abstraction for processing. Mining activity also accounts for discharge into the system by means of a canal system which enters the reach at Site 2 under the road bridge (Figure 6-10 and Figure 6-11). These two activities of abstraction and discharge result in flow modification within the reach. Channel modification results from encroaching landuse on the reach as well as from road crossings which form stationary anchors to the system and hinder natural river migration through the landscape over time (Figure 6-12). Indigenous vegetation removal resulted from the landuse change with exotic vegetation encroachment occurring within these disturbed areas. An example of observed alien invasive species within the watercourse include the NEMBA 1B *Cirsium vulgare* Alien Invasive Species (Figure 6-13). Instream modification has been a direct result of water quality degradation with the system presenting anaerobic conditions as well as elevated dissolved solids (Table 6-4). Furthermore, solid waste disposal is prolific within the reach (Figure 6-14). Bank erosion in the reach has resulted from cattle influence as they attempt to drink and cross the watercourse (Figure 6-15). This leads to bank collapse and sedimentation of the reach which further results in bed modification.

Figure 6-10 Canal system used by the mine for discharge

Figure 6-11 Confluence of the canal system and the Kusasalethu River at site S2

Figure 6-12 Road crossing (Box Culverts) over the Kusasalethu River

Figure 6-13 Cirsium vulgare, Nemba 1 B Alien Invasive Species

Figure 6-14 Example of observed litter within the Kusasalethu River

Figure 6-15 Bank erosion by cattle along the Kusasalethu River reach

6.2.4 Aquatic Macroinvertebrate Assessment

6.2.4.1 Macroinvertebrate Habitat

Biological assessments were completed at representative sites in the considered river reach. The results of the biotope assessment are provided below (Table 6-6)

Table 6-6 Biotope availability at the sites (Rating 0-5)

Biotope	Weighting (Upper Foothills)	S1
Stones in current	20	2
Stones out of current	10	0.5
Bedrock	5	0
Aquatic Vegetation	0.5	0
Marginal Vegetation In Current	2	1
Marginal Vegetation Out Of Current	2	3
Gravel	3.5	3
Sand	1	3
Mud	0.5	2
Biotope Score		30
Weighted Biotope Score (%)		14.5
Biotope Category (Tate and Husted, 2015)		E

The habitat availability within the Kusasalethu River represents poor habitat conditions (class E) within the reach. The reach is presented in Figure 6-16 which indicates the habitat availability. Erosion on the right bank and downstream of the riffles hindered the presence of marginal vegetation present. Marginal vegetation out of current was more prolific with multiple vegetation types present. No aquatic vegetation was present in the reach. The stones habitat was isolated to one rapid section of a set depth and flow class with stones out of current essentially absent. No bedrock was present in the reach. The substrate of the reach was predominantly compacted mud with isolated patches of sand resulting from the bank erosion. Gravel was found in isolated small patches amongst the stones habitat. The poor habitat presence indicates that the habitat availability would be a limiting factor for the diversity of macroinvertebrate communities within the Kusasalethu River.

Figure 6-16 Habitat availability within the Kusasalethu River reach

6.2.4.2 South African Scoring System

The aquatic macroinvertebrate results for the survey are presented in Table 6-7.

Table 6-7 Macroinvertebrate assessment results recorded during the survey (January 2023)

Site	SASS Score	No. of Taxa	ASPT*	Category (Dallas, 2007)**
S1	52	14	3.7	**Class D**

*ASPT: Average score per taxon; ** Highveld – Lower Ecoregion

The SASS5 assessment results generated SASS scores that are categorised as a class D for the Kusasalethu River reach (Dallas, 2007) which indicates largely modified conditions within the reach. There were 14 taxa sampled within the reach which are all considered tolerant (1-5 score) bar *Aeshnidae* (Figure 6-17), which is considered moderately tolerant (6-10). The present tolerant taxa include species such as Oligo*chaetes, Hirudinea, Potamonautidae, Coenagrionidae, Chironemidae, Phycidae and Planorbidae,* to name a few. Despite poor habitat within the reach, multiple tolerant species which were absent are still expected within the reach such as Hemiptera of which none were present at the time of survey. This therefore indicates modification within the reach.

Figure 6-17 Image of Aeshnidae

6.2.5 Fish Communities

Despite best practices and effort for ichthyofauna sampling in the Kusasalethu River, no fish species were collected at the time of the survey. Despite expected species considered tolerant to flow and physicochemical modification, their absence either indicates modification outside of the parameters these species are able to withstand, or these species never migrated upstream from the Mooirivierloop River SQR which the expected fish species was populated. Answering this question is outside the scope of this report as a baseline fish community has been established in the reach at no present species.

7 Risk Assessment

7.1 Potential Impacts

The impact assessment considered the anticipated direct and indirect impacts to the wetland systems because of the proposed pipeline (Table 5-1). The mitigation hierarchy as discussed by the Department of Environmental Affairs (2013) will be considered for this component of the assessment (see Figure 7-1). In accordance with the mitigation hierarchy, the preferred mitigatory measure is to avoid impacts by considering options in project location, sitting, scale, layout, technology and project/activity phasing to avoid impacts.

In accordance with the mitigation hierarchy, should complete avoidance, a minimisation of impacts, or rehabilitation of the affected watercourses be deemed impossible, the formulation and implementation of a wetland offset plan will be required to compensate for the loss of the natural systems. This plan does not negate the rehabilitation requirements for other partially or indirectly impacted systems.

Figure 7-2 below indicates the risk categories associated with the proposed development and associated activities. HGM 2 was found **NOT** to be “At-Risk” from the proposed development as the development footprint is located outside of the wetland boundary and its buffers. Resultingly, only HGM 1 was considered for a detailed risk assessment. The pre-mitigation risks determined for HGM 1 was “Moderate”. The risks to HGM 1 in respect of the proposed pipeline can be mitigated to a considerable level as the wetland is crossed over by the pipeline in an already disturbed location. The post-mitigation residual risk for HGM 1 that is associated with the proposed development is therefore regarded as “Low”.

Although HGM 2 was found **NOT** to be “At-Risk”, the wetland buffers should still be avoided and precautionary mitigatory measures suggested should still be followed through on to prevent any impacts from arising as the wetland does occur downslope of the proposed pipeline. The only impacts probable to the wetland are downslope sedimentation from excavation for the plinth installation and leakages into the wetland from the pipeline during its operational phase.

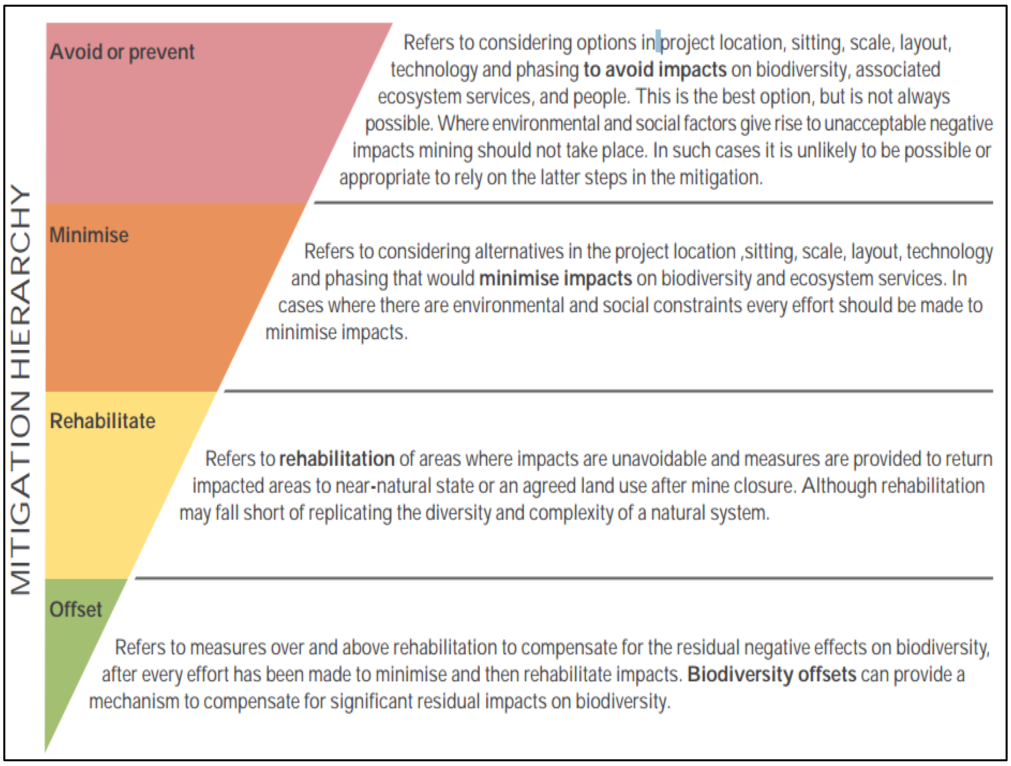

Figure 7-1 The mitigation hierarchy as described by the DEA (2013)

Table 7-1 Anticipated Impacts arising from the proposed development

Activity	Impacts
Clearing wetland vegetation	• Loss/degradation of wetland habitat • Potential erosion • Proliferation of alien invasive species
Excavating for concrete plinth installation	• Potential erosion and subsequent sedimentation of downstream watercourses • Altered surface flow conditions
Establishment of laydown areas and servitudes	• Disturbance of wetland habitat with altered surface flow conditions • Proliferation of alien invasive species
Operation of equipment and plant	• Disturbance within wetland habitat • Potential for the proliferation of species from inter-site movement of plant
Stochastic spills and leaks from plant and vehicles	• Loss/degradation of wetland vegetation/habitat • Soil contamination • Impaired water quality
Stockpiling excavated soil	• Potential proliferation of alien invasive species • Altered surface flow conditions • Sedimentation of downstream watercourses
Mixing/pouring and infilling for plinth stabilisation	• Pollution of wetland soils from spills and leaks of construction material • Indirect impairment to water quality
Spillages and leaks of the slurry and water pipeline once established	• Loss/degradation of wetland habitat • Soil pollution • Impaired water quality within wetland • Altered surface flows

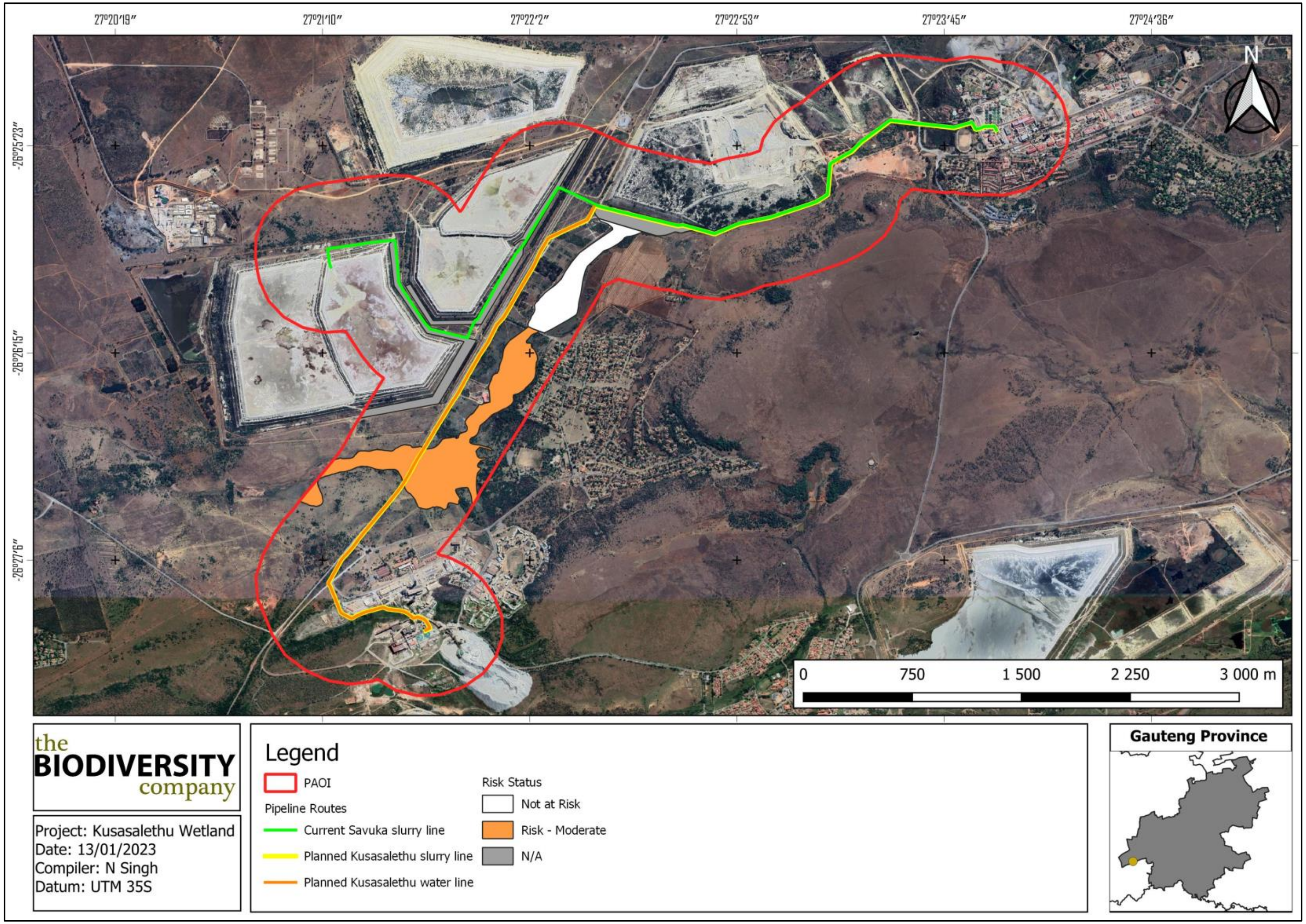

Figure 7-2 The identified pre-mitigation risk status for the wetlands within the PAOI

Table 7-2 DWS Risk Impact Matrix for the HGM 1 in relation to the proposed pipeline (Andrew Husted Pr Sci Nat 400213/11)

Andrew Husted (*Pr. Sci Nat* 400213/11)								
				Severity				
Activity	Flow Regime	Physico and Chemical (Water Quality)	Habitat (Geomorph and Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence
				Construction Phase				
Clearing wetland habitat and vegetation	2	2	3	2	2.25	1	2	**5.25**
Excavating for concrete plinth installation	2	2	1	1	1.5	2	1	**4.5**
Establishment of laydown areas and servitudes	2	2	2	2	2	2	2	**6**
Operation of equipment and plant	1	1	1	1	1	1	1	**3**
Stochastic spills and leaks from plant and vehicles	1	2	1	2	1.5	2	2	**5.5**
Stockpiling excavated soil	2	2	2	1	1.75	2	2	**5.75**
Mixing/pouring and infilling for plinth stabilisation	1	1	1	1	1	1	1	**3**
				Operational Phase				
Removal of vegetation - Creating bare sites and hardened surfaces for pipeline maintenance	2	2	2	2	2	1	2	**5**
Spillages and leaks from pipelines	2	3	1	2	2	3	2	**7**
Vehicle movement and equipment operation during maintenance	1	1	2	1	1.25	1	2	**4.25**

Table 7-2 DWS Risk Impact Matrix Continued for HGM 1 in relation to the proposed pipeline (Andrew Husted Pr Sci Nat 400213/11)

Andrew Husted (*Pr. Sci Nat* 400213/11)								
Activity	**Frequency of activity**	**Frequency of impact**	**Legal Issues**	**Detection**	**Likelihood**	**Significance**	**Without mitigation**	**With Mitigation**
Construction Phase								
Clearing wetland habitat and vegetation	2	4	5	1	12	63	Moderate	Low
Excavating for concrete plinth installation	1	3	5	2	11	49.5	Low	Low
Establishment of laydown areas and servitudes	1	4	5	3	13	78	Moderate	Low
Operation of equipment and plant	1	3	1	3	8	24	Low	Low
Stochastic spills and leaks from plant and vehicles	1	2	1	3	7	38.5	Low	Low
Stockpiling excavated soil	1	3	5	1	10	57.5	Moderate	Low
Mixing/pouring and infilling for plinth stabilisation	1	2	1	3	7	21	Low	Low
Operational Phase								
Removal of vegetation - Creating bare sites and hardened surfaces for pipeline maintenance	2	2	5	1	10	50	Low	Low
Spillages and leaks from pipelines	2	3	1	3	9	63	Moderate	Low
Vehicle movement and equipment operation during maintenance	2	3	1	2	8	34	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." Control measures listed do not replace the assigned mitigation measures and need to be applied in conjunction with as opposed to in place of.

7.2 Mitigation Measures

The following general mitigation measures are recommended as good practice to reduce the potential for exacerbated risks:

- The contractors used for the construction should have spill kits available prior to construction to ensure that any fuel, oil or hazardous substance spills are cleaned-up and discarded correctly;
- It is deemed important that the wetland areas be demarcated as sensitive areas;
- Laydown yards, camps or dumping of construction material should not be permitted within the sensitive zones;
- Where the proposed pipeline intersects a sensitive area:
  - Only the equipment and machinery necessary for the construction and erection of the pipeline should be allowed within the wetland boundary and should be parked sufficiently out of the boundary when not in use;
  - If concrete pouring is necessary to stabilise the plinths, formwork should be used to prevent spillages into the wetland and should be removed from the wetland boundary timeously;
- The number of concrete plinths used to support the pipeline should be kept to a minimum within the wetland boundary;
- During construction activities, all rubble generated must be removed from the site;
- The first 300 mm of soil must be stockpiled separate from the soil excavated deeper than 300 mm;
- Construction vehicles and machinery must make use of existing access routes as much as possible, before adjacent areas are considered for access;
- All chemicals and toxicants to be used for the construction must be stored outside the channel system and in a bunded area;
- All machinery and equipment should be inspected regularly for faults and possible leaks, these should be serviced off-site;
- 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);
- All removed soil and material must not be stockpiled within the wetland system. All stockpiles must be protected from erosion, stored on flat areas where run-off will be minimised, and be surrounded by bunds;
- Any exposed earth should be rehabilitated promptly by planting suitable vegetation (vigorous indigenous grasses) to protect the exposed soil;
- Where possible, pockets of undisturbed indigenous vegetation should be maintained in close proximity to laydown areas etc. to promote establishment during the rehabilitation phase;
- Monitoring of the pipeline should be frequent to promote early detection of spills or leaks and prevent widespread impacts;
- Alien vegetation should be manually removed and disposed of appropriately during the construction and rehabilitation phases of the project;
- All waste generated on-site during construction must be adequately managed. Separation and recycling of different waste materials should be supported and collection of waste should occur frequently.

8 Conclusion and Recommendation

8.1 Wetland Ecology

During the site assessment, two HGM units were identified and assessed within the project area of influence. These comprise of one channelled valley-bottoms and one unchannelled valley-bottom wetland. The wetlands both scored an overall PES score of class E – “Seriously Modified”, due to the modifications arising from anthropogenic influences and surrounding mining activities. The wetlands scored “High” importance and sensitivity scores due to the high threat status of both the wetland vegetation and units in combination with them being minimally protected. The average ecosystem service score was determined to range between “Intermediate” for HGM 2 and “Moderately High” for HGM 1 as different wetland types, wetland conditions and local settings persist. A post-mitigation buffer of 15m was assigned to the wetland systems.

8.2 Aquatic Ecology

The National Web Based Environmental Screening Tool (NWBEST) has characterized the aquatic theme sensitivity of the project area as “very high” for the watercourse. This is due to the Kusasalethu River which flows to the south of the Kusasalethu Gold Mine Operations, currently considered critically endangered habitat, which is poorly protected, however there is no sensitive species expected or sampled within the reach. Further the tributaries are considered a Critical Biodiversity Areas which flows through the landscape of habitat which is considered heavily modified. The ecological integrity of the receiving catchment at a desktop level is considered class D (largely modified).

The *in-situ* water quality results indicated modified conditions with elevated electrical conductivity and anoxic noted throughout the project area. The Habitat Integrity Assessment indicated largely modified (class D) instream and riparian habitat integrity. Large scale modification has resulted to both the active channel and riparian areas surrounding the reach. Despite poor habitat availability, the South African Scoring System version 5 (SASS5) results indicated a SASS category of a class D with many expected taxa absent, which indicates largely modified conditions within the reach. No fish species were sampled within the reach despite all expected species considered tolerant to flow and physicochemical modification.

8.3 Risk Assessment

The risk assessment concludes that HGM 2 is NOT “At-Risk” from the proposed development, however HGM 1 will be at “moderate” risk prior to mitigation. HGM 1 is likely to be directly impacted by the construction and operational phases of the proposed development since the wetland occurs within the development footprint. However, it is anticipated that the magnitude of impacts will not be substantial as the wetland area in proximity of the proposed development has suffered impacts and disturbances from other activities already and with the implementation of the mitigatory suggestions the residual risk can be brought to a “low” risk category. If impacts do arise from the operational and construction phases of the said development, they are likely to impact HGM 2 indirectly and insubstantially since the proposed development is situated sufficiently out of the wetland boundary and the recommended buffer.

8.4 Specialist Recommendation

Based on the results and conclusions presented in this report, it is expected that the proposed activities will pose low residual risks on the wetlands provided that the recommendations are met, thus no fatal flaws were identified for the project. The concluding decision on an applicable licence related to water use lies with the competent and responsible authority. However, based on the findings from the assessment, it is of the specialist opinion that the project should undergo authorisation.

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10 Appendices

Appendix A Specialist declarations

DECLARATION

I, Andrew Husted, declare that:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

Andrew Husted

Ecologist (Pr Sci Nat 400213/11)

The Biodiversity Company

February 2023

DECLARATION

I, Namitha Singh, declare that:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

Namitha Singh

Wetland Ecologist

The Biodiversity Company

February 2023

DECLARATION

I, Michael Ryan declare that:

- I act as the independent specialist in this study;
- 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 project;
- 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 study;
- 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 study;
- I undertake to disclose to the client 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 study 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.

MRyan

Michael Ryan

Riverine Ecology Specialist

The Biodiversity Company

February 2023