AQUATIC RESOURCES ASSESSMENT

Northam Zondereinde Platinum Mine 3 Shaft

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2019/10/14	21863_SWA_0	21863_SWA_1	Update – new layout

DECLARATION OF INDEPENDENCE

Specialist Name	Mr. D. Botha
Declaration of Independence	I declare, as a specialist appointed in terms of the National Environmental Management Act (Act No 108 of 1998) and the associated 2014 Environmental Impact Assessment (EIA) Regulations, 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 48 and is punishable in terms of section 24F of the Act.
Signature	
Date	2019/10/14

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The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken and Prism Environmental Management Services and its staff reserve the right to modify aspects of the report including the recommendations if and when new information becomes available from ongoing research or further work in this field, or pertaining to this investigation.

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EXECUTIVE SUMMARY

Prism Environmental Management Services was requested by **Northam Platinum Limited** to undertake an aquatic resources assessment to delineate and asses the possible impacts on the aquatic resources for the proposed #3 shaft project. This, specifically to inform the Environmental Impact Assessment (EIA) and Water Use License for the proposed activities.

Northam Platinum Limited proposes to undertake activities linked to the development of a new shaft and related infrastructure.

Due to the Zondereinde Mine's Western Block's distance from the existing No 1 and 2 Shafts, which access the ore body it was decided to provide additional access to the ore body nearer to the mining operations. This access will be via two raise bored shafts from surface to 5 level which is 1,520 m below collar. In addition, these new mining areas will require additional ventilation which will be provided by a downcast ventilation shaft and 2 up-cast ventilation shafts; five vertical shafts in total.

The shafts will be positioned on two constructed terraces one for the up-cast ventilation shafts (Terrace 2) and one for the two access shafts and downcast ventilation shaft (Terrace 1). The two terraces will require a servitude between them for services. The servitude will carry buried power cables from the main consumer substation to the ventilation shafts.

A servitude will be required between the current Zondereinde operations and terrace. This servitude will carry service water, sewerage, backfill slurry, power cables, mud return pipeline and overhead power lines.

Overhead power lines will be installed to connect Terrace 1 to the adjacent Eskom high voltage overhead lines. Two existing potable water pipelines will be diverted within the terrace area (Terrace 1) and an off-take to the new facility will be done from the newly installed diversion pipeline.

The current paved road from the R510 to the current shaft and concentrator facility will be diverted around Terrace 1 and an additional unpaved road will be required from the existing paved road to Terrace 2. Infrastructure to support shafts and associated services will be constructed and installed as part of the project.

The 3 Shaft project area are located at 24°50'56.02"S | 27°18'41.71"E, just east of the R510 and within the Waterberg Magisterial District, Limpopo Province (here after referred to as the study site/s). The study site is located in quaternary catchment A24F in the Limpopo Water Management Area (WMA1). The study area falls within the Savanna Biome (Biome 07), the Bushveld Basin Level-1 Ecoregion (Ecoregion 8) (Kleynhans *et al*., 2005).

The field investigations concluded that two (2) natural aquatic systems could be affected by the activities. Same is draining into the Bierspruit Spruit.

The hydrogeomorphic wetland units identified were also assessed in respect to its location in the landscape.

The wetland units found:

- NP#3_UCVB1 was found on a plain draining towards the North-West into the Bierspruit. This system is both supplied by natural and artificial sources.
- NP#3_DL was found on a plain draining towards the North. This system is both supplied by natural and artificial sources.

Two aquatic resources will be impacted by the services and upgrades of services and road network. These will be minor impacts on the systems as the existing infrastructure and servitudes will be utilised in most instances.

The wetland and drainage line have low ecological value and is degraded due to historical activities and ongoing anthropogenic activities. The impact areas are limited and with the necessary mitigation and rehabilitation most of the current function will remain intact. This to ensure sustainability of the system.

For this reason, it can be supported that the proposed development activities may go-ahead if the required buffers are maintained and the resource drivers preserved. The rehabilitation of the wetland is vital to recover the required ecological function. The wetland drivers must be enhanced as part of the rehabilitation of the affected areas. In respect of the construction phase, it is important to ensure that the required erosion protection measures linked to the crossing sections be carefully designed and installed. Silt transportation to the downstream system must also be carefully managed.

The project can be supported, should all the mitigation measures be implemented and monitored against to ensure compliance. This will ensure mitigation to acceptable levels.

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1 INTRODUCTION

Prism Environmental Management Services was requested by **Northam Platinum Limited** to undertake an aquatic resources assessment to delineate and asses the possible impacts on the aquatic resources for the proposed 3 shaft project. This, specifically to inform the Environmental Impact Assessment (EIA) and Water Use License for the proposed activities.

1.1 Project Description

Northam Platinum Limited proposes to undertake activities linked to the development of a new shaft and related infrastructure.

Due to the Zondereinde Mine's Western Block's distance from the existing No 1 and 2 Shafts, which access the ore body it was decided to provide additional access to the ore body nearer to the mining operations. This access will be via two raise bored shafts from surface to 5 level which is 1,520 m below collar. In addition, these new mining areas will require additional ventilation which will be provided by a downcast ventilation shaft and 2 up-cast ventilation shafts; five vertical shafts in total.

The shafts will be positioned on two constructed terraces one for the up-cast ventilation shafts (Terrace 1) and one for the two access shafts and one downcast ventilation shaft (Terrace 2). The two terraces will require a servitude between them for services. The servitude will carry buried power cables from the main consumer substation to the ventilation shafts.

A servitude will be required between the current Zondereinde operations and Terrace 2. This servitude will carry service water, sewerage, backfill slurry, mud return pipelines, power cables and overhead power lines.

Overhead power lines will be installed to connect Terrace 1 to the adjacent Eskom high voltage overhead lines. The existing two potable water pipelines will be diverted within the terrace area (1) and an off-take to the new facility will be done from the newly installed diversion pipeline.

The current paved road from the R510 to the current shaft and concentrator facility will be diverted around Terrace 1 and an additional unpaved road will be required from the existing paved road to Terrace 2.

Infrastructure to support shafts will include:

Terrace 1:

The purpose of Terrace 1 is to house a full shaft infrastructure that supports the downcast and access shafts.

The terrace will be constructed by excavating and removing the heaving clay layer of approximately 2 m and filling and compacting graduated fill to provide a stable base for the mounting of the facilities (The clay will be stored for rehabilitation on a topsoil storage facility and the fill material will be sourced from waste rock available on the mine site).

A stormwater collecting, and evaporation dam will be provided adjacent to the terrace. The storm water will be collected from a series of storm water drains on and around the periphery of the terrace.

The terrace will be secured with fencing and will have two entrance/exit points namely for pedestrians and for delivery and commercial vehicles. Personnel will enter the shaft complex from either the parking area or from the designated bus and taxi rank. Each of the entry points will be controlled from the main security gate house.

In order to effectively utilise the two access shafts and the down cast ventilation shaft the following facilities will be provided for on the terrace:

- Shaft bank area
- Two headgears
- 3 Shafts
- Transfer conveyor belt from headgear to silos
- Reef silo
- Waste silo
- Salvage yard
- Store yard
- Store building
- Explosive yard
- Compressor house
- Two winder houses
- Refrigeration plant
- Bulk air coolers – 3 off
- Potable water tank
- Service water tanks
- Storm water dam and drainage
- Parking
- Taxi/bus rank
- Gate house
- Office blocks
- Change houses
- Backfill remix tanks
- Engineering workshop
- Lamp room
- Eskom yard
- Main consumer substation
- Emergency generators

- Terraced area
- Sewerage sump

Terrace 2:

The purpose of Terrace 2 is to house the two up-cast ventilation shafts (3A and 3B shafts) each equipped with two ventilation fans. The shafts will be positioned 75 m apart. The ventilation shafts will be raise-bored, unlined and will be 4.6 m diameter holes once completed. The fans are connected to the shafts by means of steel ventilation ducts. The fans will discharge the underground air vertically from the fan chambers. The fan power will be fed from the main shaft consumer substation via buried cables to not interfere with the existing Eskom power lines.

The terrace will be constructed by excavating and removing the heaving clay layer of approximately 2 m and filling and compacting graduated fill to provide a stable base for the mounting of the fans and substation.

(The clay will be stored for rehabilitation on a topsoil storage facility and the fill material will be sourced from waste rock available on the mine site). The terraced area will be secured with fencing and a gate to prevent unauthorised entry to the machinery. Access to the terrace will be by unpaved road from the existing mine paved road. The storm water runoff will be collected in a drain system and channelled along the access road to the main road storm water disposal drains.

1.1.1 Study Site Location

The #3 Shaft project area are located at 24°50'56.02"S | 27°18'41.71"E, just east of the R510 and within the Waterberg Magisterial District, Limpopo Province *(here after referred to as the study site/s)* Figure 1-1, Figure 1-2 and Figure 1-4. The study site is located in quaternary catchment A24F in the Limpopo Water Management Area (WMA1) (Figure 1-4). The study area falls within the Savanna Biome (Biome 07), the Bushveld Basin Level-1 Ecoregion (Ecoregion 8) (Kleynhans *et al.,* 2005) (Figure 1-5).

1.1.2 Scope and Purpose

The aim of this study was to undertake an aquatic resources assessment to delineate the aquatic resources and to determine the possible impacts on the resources. This, specifically to inform the Environmental Impact Assessment (EIA) and Water Use License Application (WULA) for the proposed activities.

1.2 Overview of Specialist

Prism EMS has conducted the required aquatic resources specialist assessment on site to inform the Environmental Impact Assessment (EIA) and Water Use License Application (WULA) for the proposed activities. The team under lead of Mr. D. Botha has conducted the assessment. The details of the team are tabularised in Table 1-1.

Table 1-1: Details of Specialist

Specialist	Mr. D. Botha – Wetland Specialist
Company:	Prism EMS
Qualifications:	M.A. Environmental Management B.A. Hons. Geography & Environmental Management, B.A. Humanities Post Higher Education Diploma Wetland and Wetland Delineation *(DWAF Accredited Short Course)* Soil Classification and Wetland Delineation – Short Course – *Terrasoil Science* Tools for Wetland Assessment – *Rhodes University* SASS5 Aquatic Biomonitoring Training – *Department of Water Affairs, Ground Truth* Wetland Plant Taxonomy – *Water Research Commission* Hydropedology and Wetland Functioning – *Water Business Academy / Terra Soil Science*
Experience:	16 Years
Affiliation/ Registration	SACNASP Registered Scientist – Pr.Sci.Nat. (119979) Founder Member of Environmental Assessment Practitioners Association of South Africa (EAPASA) Member of the International Association for Impact Assessors (IAIAsa) (1653) Member of the Gauteng Wetland Forum Member of the South African Wetland Society
Address:	No 17 Coldstream Office Park, Coldstream Street, Little Falls
Tel:	087 985 0951
Fax:	086 601 4800
Email:	dewet@prismems.co.za

Designation	**Name**	**Qualification**	**Professional Registration**	**Role**
		Specialist Team		
Aquatic Specialist	Mr. P. Singh	MSc Aquatic Health (Cum Laude) BSc.Hons (Biodiversity & Conservation) BSc (Bot & Zoo) Rand Water Water Purification of Drinking Water – *Rand Water Vereeniging* Ecotoxicity Test Methods and Validation - *Golder Associates Research Laboratory* *Wetland Management Course: Ecology, Hydrology, Biodiversity, Legislation, Delineation and Management (University of the Free State)* SASS5 Accredited Practitioner *(DWS and WRC)* 6 Years' Experience	Pr.Sci.Nat. (116822)	Peer Review

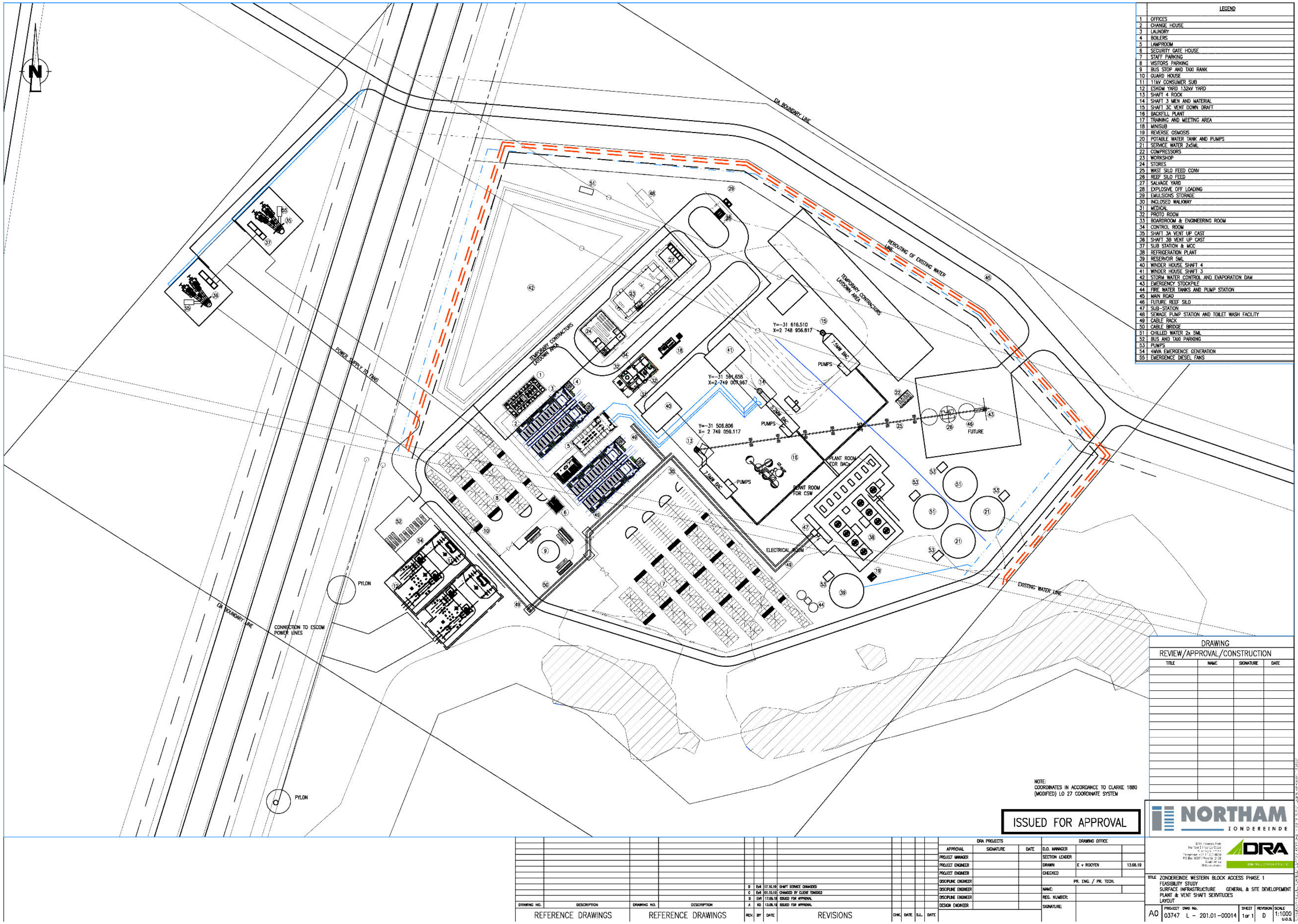

Figure 1-1: Proposed Activities

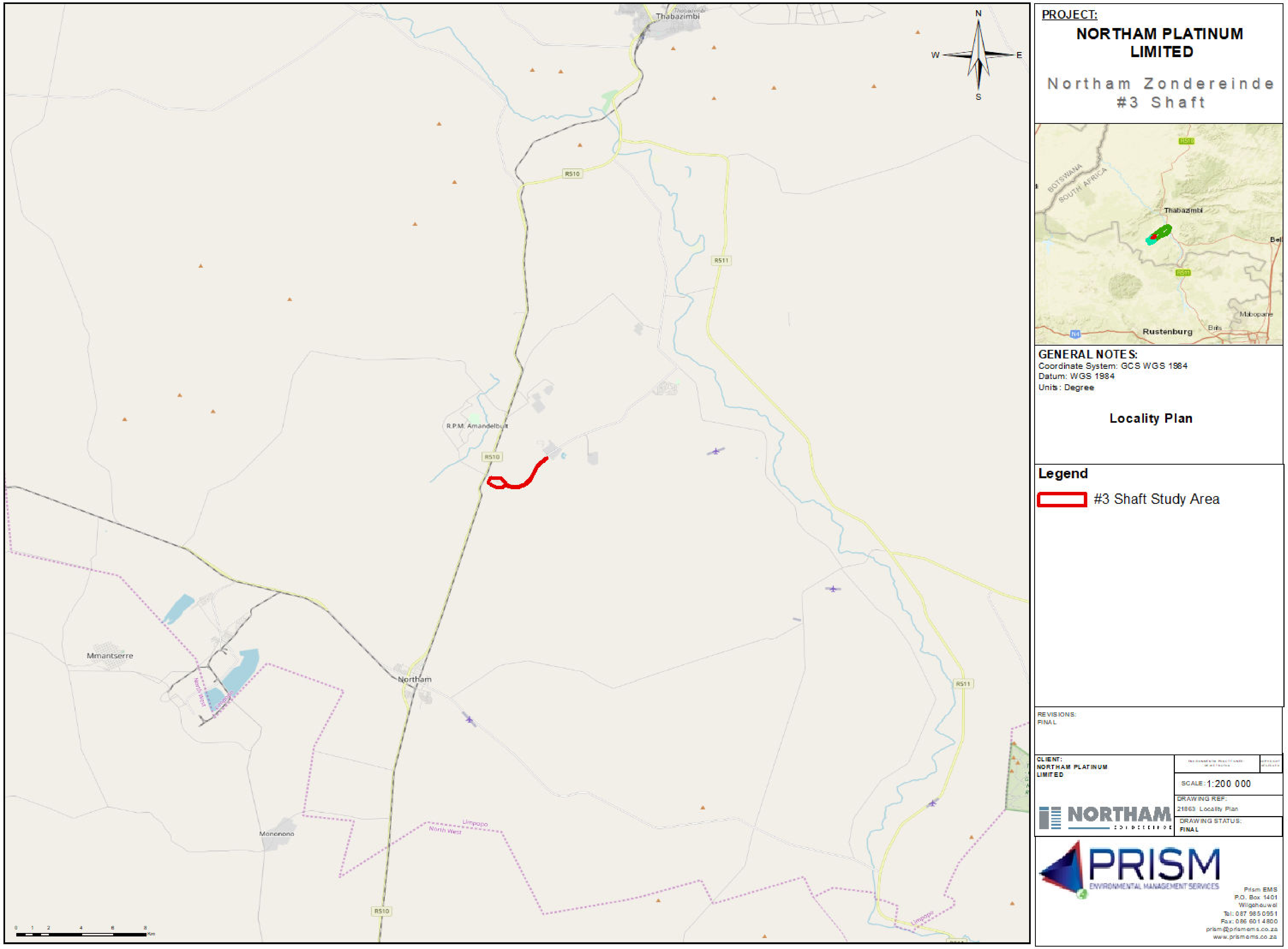

Figure 1-2: Locality Plan

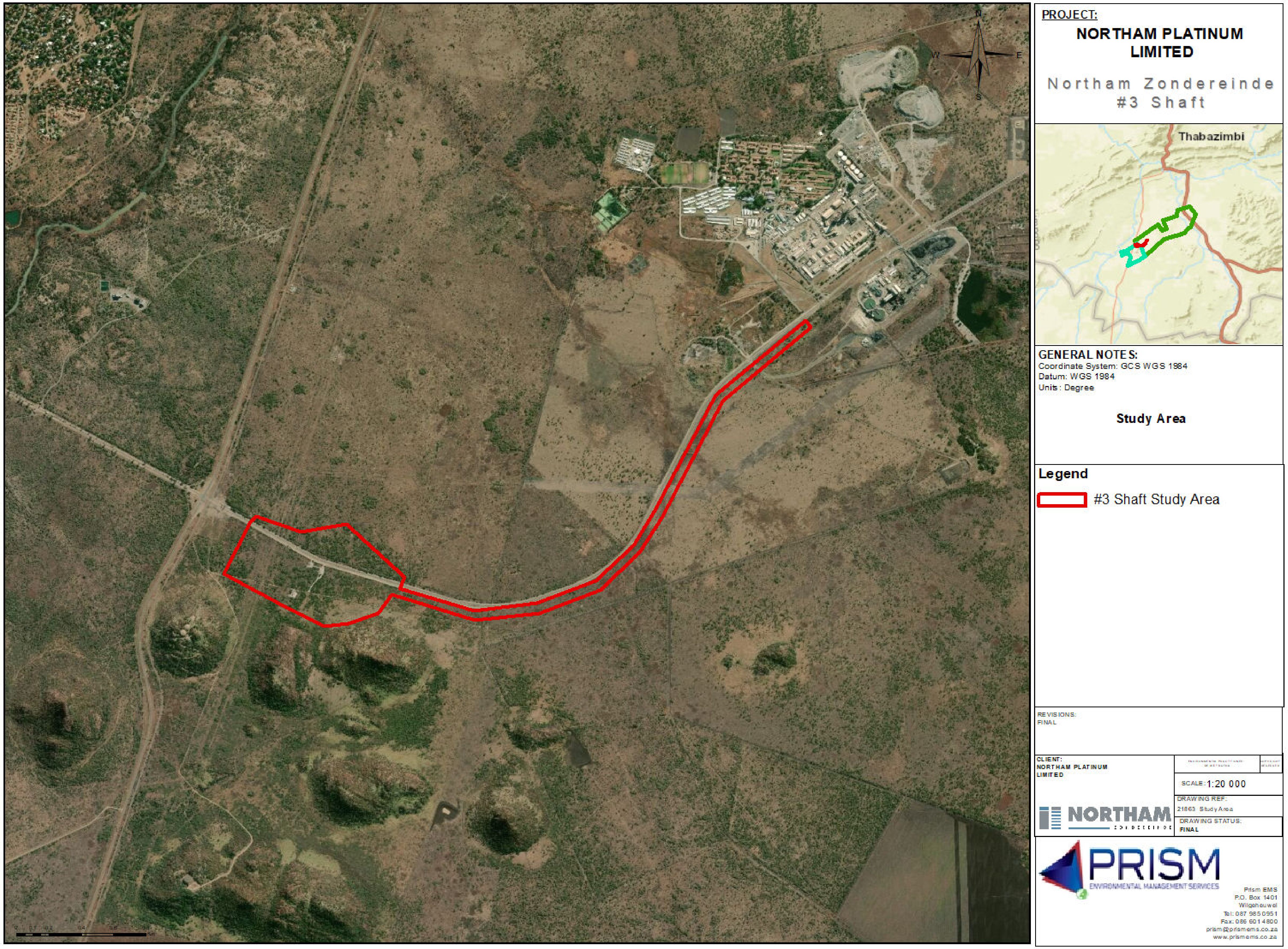

Figure 1-3: Aerial Photograph of Study Area

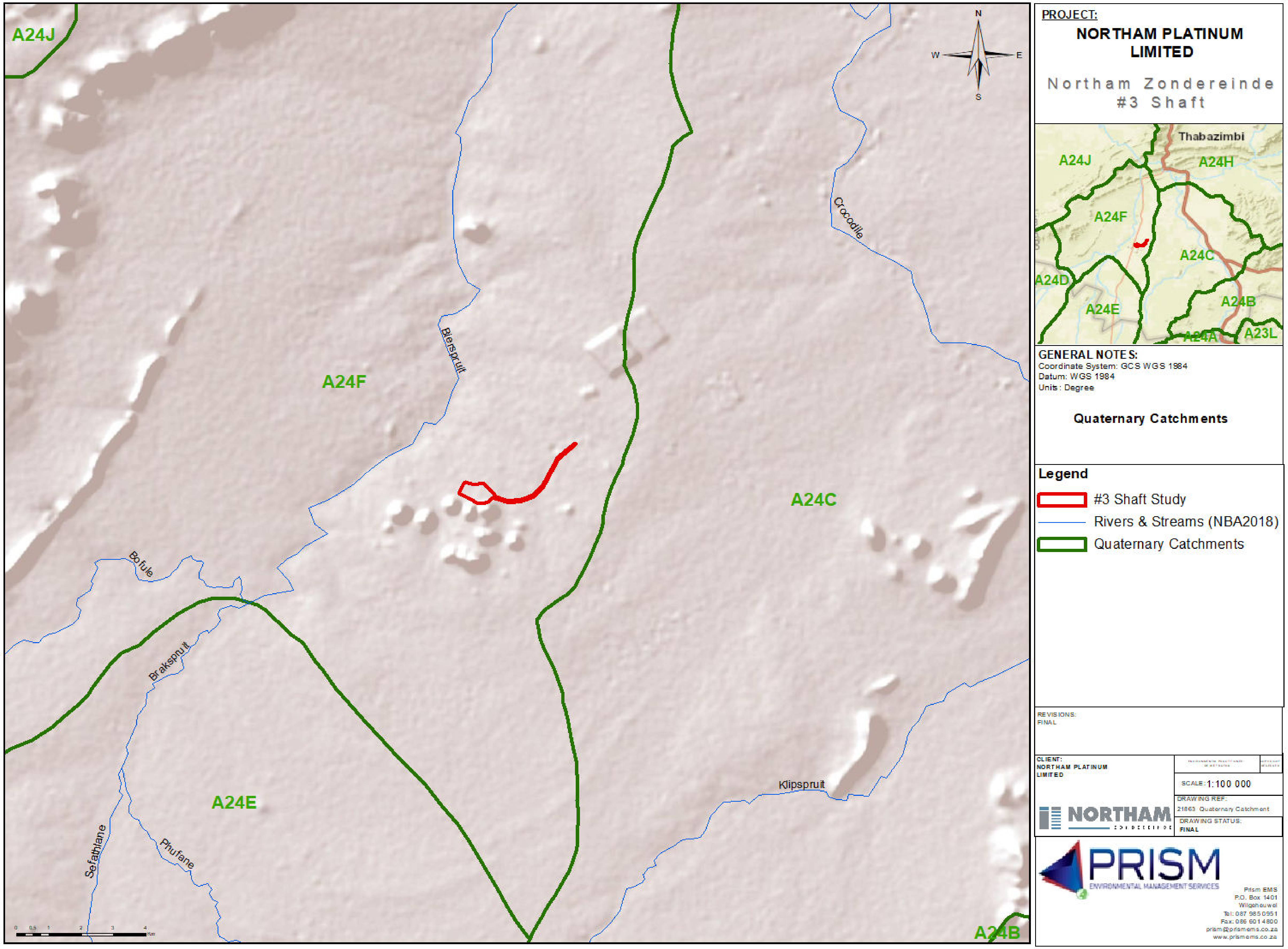

Figure 1-4: Map of the Catchment Areas

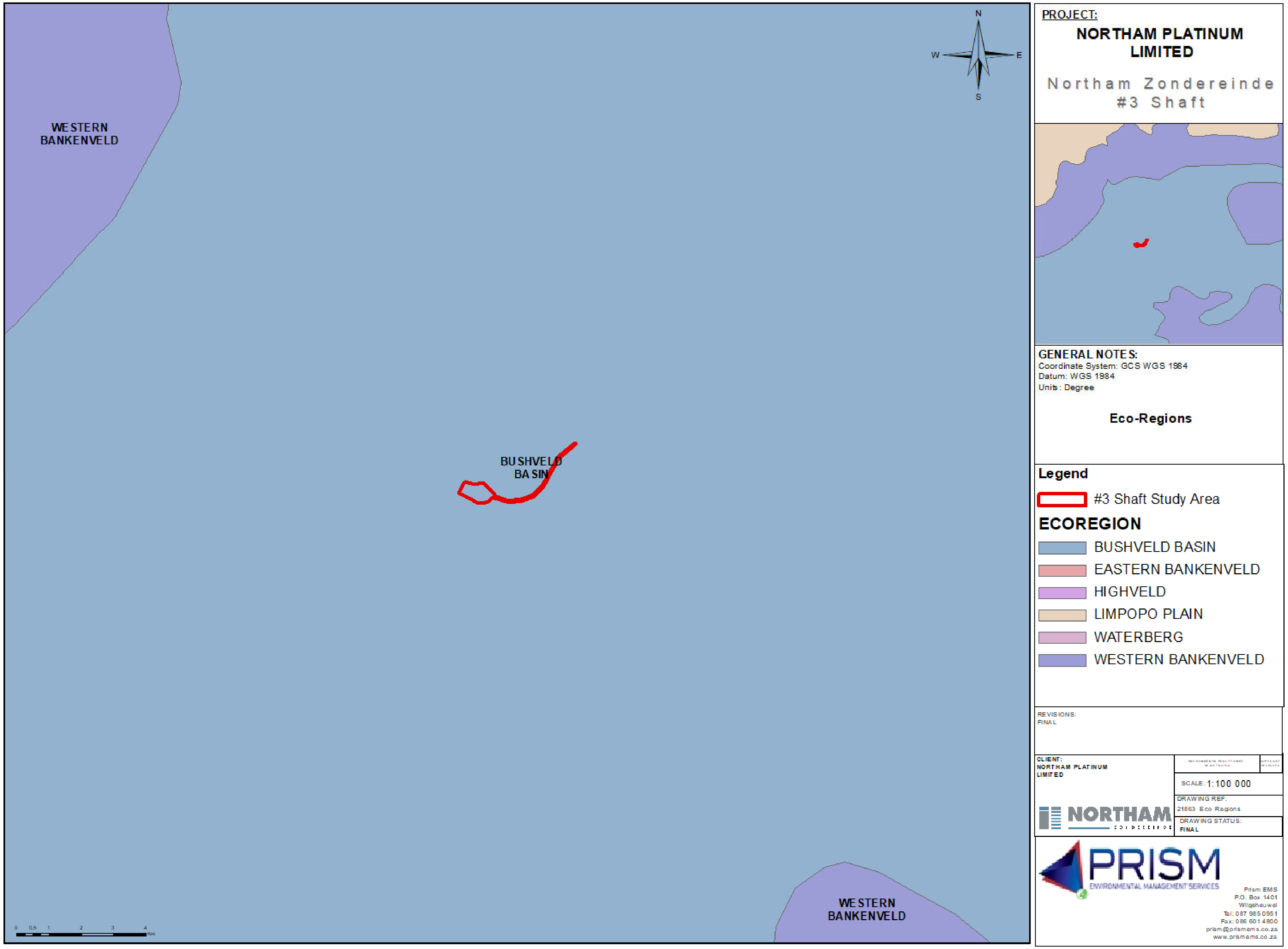

Figure 1-5: Map of the study sites Eco-Regions (DWAF; 2005)

2 REPORT OUTLINE

Appendix 6 of GN 982 of 4 December 2014 provides the requirements for specialist reports undertaken as part of the environmental authorisation process. In line with this, Table 2-1 provides an overview of Appendix 6 together with information on how these requirements have been met.

Table 2-1. Specialist Report Requirements

Requirement from Appendix 6 of GN 982 of 4 December 2014 [as amended]	Chapter
(a) Details of - (i) the specialist who prepared the report; and (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae	Chapter 1.2
(b) Declaration that the specialist is independent in a form as may be specified by the competent authority	*Declaration of Independence*
(c) Indication of the scope of, and the purpose for which, the report was prepared	Chapter 1
(cA) an indication of the quality and age of base data used for the specialist report;	Chapter 6
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Chapter 7
(d) The duration date and season of the site investigation and the relevance of the season to the outcome of the assessment	Chapter 4
(e) Description of the methodology adopted in preparing the report or carrying out the specialised process, inclusive of equipment and modelling used.	Chapter 4
(f) Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives.	Chapter 6
(g) Identification of any areas to be avoided, including buffers	Chapter 6
(h) Map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers	Chapter 6
(I) Description of any assumptions made and any uncertainties or gaps in knowledge	Chapter 5
(j) Description of the findings and potential implications of such findings on the impact of the proposed activity, or activities.	Chapter 6 Chapter 7
(k) Mitigation measures for inclusion in the EMPr	Chapter 8.1
(I) Conditions for inclusion in the environmental authorisation	Chapter 8 Chapter 9
(m) Monitoring requirements for inclusion in the EMPr or environmental authorisation	Chapter 8

Requirement from Appendix 6 of GN 982 of 4 December 2014 [as amended]	Chapter
(n) Reasoned opinion - (i) whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and (ii)if the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Chapter 8
(o) Description of any consultation process that was undertaken during the course of preparing the specialist report	Chapter 4
(p) A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
(q) Any other information requested by the competent authority	N/A

3 LEGISLATION AND GUIDELINES

The generic term 'wetland' is used worldwide and includes specific ecosystems such as bogs, coastal lakes, estuaries, fens, floodplains, mangroves, marshes, mires, moors, pans, peatlands, seeps, sloughs, springs, swamps, vlei and wet meadows (Mays, 1996; DWAF, 2005). Regardless of the local name given to wetlands, the driving force of all wetlands is the interplay between land and water, and the consequent characteristics that reflect both (Cowan, 1999). Any part of the landscape where water accumulates for long enough and often enough to influence the plants, animals and soils occurring in that area, is referred to as a wetland (DWAF, 2005). Wetlands comprise approximately 6% (8.5 km^2 x 103) of the world's land surface and are found in every climate from the tropics to the frozen tundra (Mays, 1996).

Several definitions for wetland and wetland areas exist. Two of the most common wetland definitions used in South Africa is the National Water Act (NWA) (Act 36 of 1998) and the Ramsar definition are provided below:

National Water Act, 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."*

South Africa, being a contracting party to Ramsar, also uses the definition accepted by the convention. Article 1.1 of the convention defines wetlands as (Cowan, 1999; Koester, 1989):

> *"Areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters."*

Wetlands are defined as those areas that have water on the surface or within the root zone for long enough periods throughout the year to allow for the development of anaerobic conditions. These conditions create unique soil conditions (hydric soils) and support vegetation adapted to these flood conditions.

Hydric soils develop a grey or sometimes greenish or blue-grey colour, as a result of the chemical reduction of iron (gleying). Hydric soils that are seasonally flooded are characterised by the formation of mottles, which are relatively insoluble, enabling them to remain in the soil long after it has been drained. Consequently, it is possible to identify wetland areas on the basis of soil colour, using a standard colour chart, as matrix hue and chroma decrease, while mottle hue and chroma initially increase and then decrease the more saturated the soils become Table 3-1.

Table 3-1: Relationship between degree of wetness (wetland zone), soil-physiochemistry and vegetation (Kotze *et al.*, 1994)

Degree of wetness			
	Temporary	**Seasonal**	**Permanent / Semi-permanent**
Soil Depth (0cm – 10cm)	Matrix chroma: 1-3 Few / no mottles Low / intermediate OM Non-sulphuric	Matrix chroma: 0-2 Many mottles Intermediate OM Seldom sulphuric	Matrix chroma: 0-1 Few / no mottles High OM Often sulphuric
Soil Depth (40cm – 50cm)	Few / many mottles Matrix chroma: 0-2	Many mottles Matrix chroma: 0-2	No / few mottles Matrix chroma: 0-1
Vegetation	Predominantly grass species	Predominantly sedges and grasses	Predominantly reeds and sedges

Vegetation distribution within wetlands is related to the flooding regime. Terrestrial plants are not tolerant of flooding within the root zone for periods long enough to cause anaerobic conditions and are thus found on drier soil conditions. The distribution of wetland plants is related to their tolerance of different flooding conditions, and their distribution within a system can be used as an indication of the wetness of an area.

Typically, indicators of soil wetness based on soil morphology correspond closely with vegetation distribution, since hydrology affects soils and vegetation in systematic and predictable ways. However, in systems where the hydrological regime has been modified due to human activities, vegetation distribution will not vary systematically with soil morphology. The response of vegetation to alteration of hydrological conditions is rapid (months / years), whereas the response of soil morphology to such alteration is slow (centuries). Therefore, lowering of the water table or reduction of surface flows, may lead to rapid establishment of terrestrial vegetation, whereas the soil morphology will retain indicators of wetness for a lengthy period. Soil morphology forms the basis of wetland delineation nationally, following international protocols, mainly because it provides a long-term indication of the "natural" hydrological regime. However, soil morphology cannot be considered to necessarily reflect the current hydrological conditions of the site where the hydrological regime has been altered, and in such circumstances, vegetation provides the best indication of the distribution of wetlands as it best reflects current hydrological conditions (Figure 3-1).

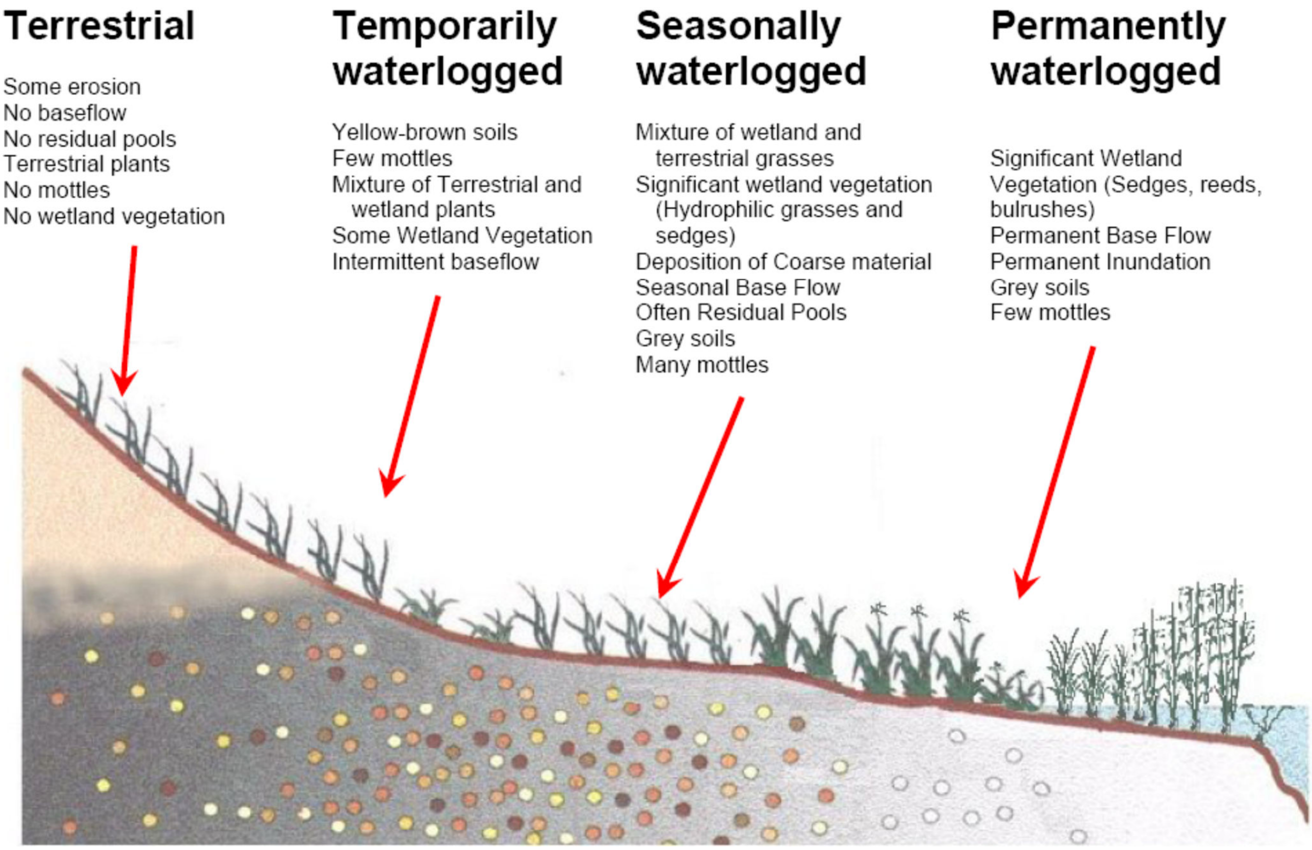

Figure 3-1: Cross section through a wetland, indicating how the soil wetness and vegetation indicators change along a gradient of decreasing wetness, from the middle to the edge of the wetland. (Reproduced by Sivest from Kotze (1996), DWAF Guidelines)

Wetland vegetation is adapted to shallow water table conditions. Due to water availability and rich alluvial soils, wetland areas are usually very productive. Tree growth rate is high and the vegetation under the trees is usually lush and includes a wide variety of shrubs, grasses and wildflowers.

3.1 EIA Applicable Legislation

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

The proposed development triggers a number of activities in terms of National Environmental Management Act (NEMA) that relates to the aquatic resources. These are listed in Table 3-2.

Table 3-2: Listed Activities in terms of NEMA

Government Notice Number	Activity and Listing Number	Description
GN 983 of 4 December 2014 as amended	Activity 12 Listing Notice 1	The development of— (ii) infrastructure or structures with a physical footprint of 100 square metres or more; where such development occurs— (a) within a watercourse;
GN 983 of 4 December 2014 as amended	Activity 19, Listing Notice 1	The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse;

An Environmental Impact Assessment (EIA) is undertaken.

3.2 Water Use Applicable Legislation

3.2.1 National Water Act (Act No 36 of 1998) (NWA)

The NWA is the primary regulatory legislation; controlling and managing the use of water resources as well as the pollution thereof and is implemented and enforced by the Department of Human Settlements, Water and Sanitation (DHSWS[1]). Section 21 of the NWA lists water uses that must be licensed unless it is listed in the schedule (existing lawful use) and/or is permissible under a general authorisation, or if a responsible authority waives the need for a Water Use Licence.

The following listed water uses according to Section 21 of the NWA are triggered for the proposed project and linked to the aquatic resources identified:

- Section 21(c): impeding or diverting the flow of water in a watercourse
- Section 21 (i): altering the bed, banks, course or characteristics of a watercourse.

These water uses requires an application for a Water Use License which can be lodged at the DHSWS.

[1] Previously referred to as the Department of Water and Sanitation (DWS)

4 METHODOLOGY

4.1 Wetland Assessment

4.1.1 Desktop Assessment

A preliminary delineation of the Wetland boundary was undertaken using aerial photograph interpretation. Historical records and reports were consulted. The Department of Human Settlements, Water and Sanitation database was also consulted to obtain historical data for the study area. The National Wetland Map version 5 (NWM5) as presented by South African National Biodiversity Institute (SANBI) was also scrutinised (Van Deventer *et al*, 2019). Historical data and official approvals were also consulted during the assessment.

4.1.2 Field Investigation

The field investigation was undertaken during December 2018 and September 2019 to assess and corroborate the delineated Aquatic resource zones present on the survey area.

The field procedure for the wetland delineation was conducted according to the Guidelines for delineating the boundaries of a wetland set out by the Department of Water Affairs and Forestry (DWAF 2005/8). Due to the transitional nature of wetland boundaries, the different wetland zones are often not clearly apparent. However, the wetland edge can be determined accurately. The delineations are based on scientifically defensible criteria and are aimed at providing a tool to facilitate the decision-making process regarding the assessment of the significance of impacts that may be associated with the proposed developments.

The wetlands were delineated by considering the following wetland indicators (DWAF 2005/8):

- Terrain unit indicator helps identifying those parts of the landscape where wetlands are most likely to occur. Wetlands occupy characteristic positions in the landscape and can occur on the following terrain units: crest, midslope, footslope, and valley bottom;
- 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 hydrophytic vegetation associated with frequently saturated soils.

The following procedure was followed during the delineation of the wetland boundaries and zones:

- A desktop delineation of the larger wetland area was undertaken using satellite imagery of the study site;
- Areas for verification were identified; and
- Identified areas were then assessed in the field with boundaries being recorded using a GPS.

4.1.3 Mapping

Mapping of the wetland boundaries was done by computerised processing utilising GPS tools and GIS modelling.

4.2 Wetland Classification

SANBI's "Further development of a proposed National Classification System for South Africa" was used to verify the classification of the wetlands within the study area (SANBI, 2009). The wetlands were classified up to level four, which includes the system, regional setting, landscape unit and hydrogeomorphic unit.

Table 4-1: Wetland classification level 1 - 4

Level 1: System	Level 2: Regional setting	Level 3: Landscape unit	Level 4: Hydrogeomorphic (HGM) unit			
Connectivity to open ocean	Ecoregion	Landscape setting	HGM type	Longitudinal zonation / landform	Drainage - outflow	Drainage - inflow
			A	B	C	D
INLAND	DWAF Level 1 Ecoregions	SLOPE	Channel (river)	Mountain headwater stream	Not applicable	Not applicable
				Mountain stream	Not applicable	Not applicable
				Transitional river	Not applicable	Not applicable
				Rejuvenated bedrock fall	Not applicable	Not applicable
			Hillslope seep	Not applicable	With channel outflow	Not applicable
					Without channel outflow	Not applicable
			Depression	Not applicable	Exorheic	With channel inflow
						Without channel inflow
					Endorheic	With channel inflow
						Without channel inflow
					dammed	With channel inflow
						Without channel inflow
		VALLEY FLOOR	Channel (river)	Mountain stream	Not applicable	Not applicable
				Transitional river	Not applicable	Not applicable
				Rejuvenated bedrock fall	Not applicable	Not applicable
				Upper foothill river	Not applicable	Not applicable
				Lower foothill river	Not applicable	Not applicable
				Lowland river	Not applicable	Not applicable
				Rejuvenated foothill river	Not applicable	Not applicable
				Upland floodplain river	Not applicable	Not applicable
			Channelled valley-bottom wetland	Valley-bottom depression	Not applicable	Not applicable
				Valley-bottom flat	Not applicable	Not applicable
			Unchannelled valley-bottom wetland	Valley-bottom depression	Not applicable	Not applicable
				Valley-bottom flat	Not applicable	Not applicable
			Floodplain wetland	Floodplain depression	Not applicable	Not applicable
				Floodplain flat	Not applicable	Not applicable
			Depression	Not applicable	Exorheic	With channel inflow
						Without channel inflow

Level 1: System	Level 2: Regional setting	Level 3: Landscape unit	Level 4: Hydrogeomorphic (HGM) unit			
					Endorheic	With channel inflow
						Without channel inflow
					dammed	With channel inflow
						Without channel inflow
			Valleyhead seep	Not applicable	Not applicable	Not applicable
		PLAIN	Channel (river)	Lowland river	Not applicable	Not applicable
				Upland floodplain river	Not applicable	Not applicable
			Floodplain wetland	Floodplain depression	Not applicable	Not applicable
				Floodplain flat	Not applicable	Not applicable
			Unchannelled valley-bottom wetland	Valley-bottom depression	Not applicable	Not applicable
				Valley-bottom flat	Not applicable	Not applicable
			Depression	Not applicable	Exorheic	With channel inflow
						Without channel inflow
					Endorheic	With channel inflow
						Without channel inflow
			Flat	Not applicable	Not applicable	Not applicable
		BENCH (Hilltop/saddle/shelf)	Depression	Not applicable	Exorheic	With channel inflow
						Without channel inflow
					Endorheic	With channel inflow
						Without channel inflow
			Flat	Not applicable	Not applicable	Not applicable

The Hydrogeomorphic wetland units identified will be describe individually as per Marneweck and Batchelor (Marneweck & Batchelor; 2002).

4.3 Impact Assessment Methodology

As standardised impact assessment methodology was utilised to determine the impacts associated with the proposed installation. A summary of this methodology is provided below.

The **significance** of an impact is defined as the combination of the **consequence** of the impact occurring and the **probability** that the impact will occur. The nature and type of impact may be direct or indirect and may also be positive or negative, refer to Table 4-2: below for the specific definitions.

Table 4-2: Nature and type of impact

IMPACT	Nature and Type of Impact:		
	Direct	Impacts that are caused directly by the activity and generally occur at the same time and place as the activity	✓/✗
	Indirect	Indirect or induced changes that may occur as a result of the activity. These include all impacts that do not manifest immediately when the activity is undertaken, or which occur at a different place as a result of the activity	✓/✗
	Cumulative	Those impacts associated with the activity which add to, or interact synergistically with existing impacts of past or existing activities, and include direct or indirect impacts which accumulate over time and space	✓/✗
	Positive	Impacts affect the environment in such a way that natural, cultural and / or social functions and processes will benefit significantly, and includes neutral impacts (those that are not considered to be negative	✓
	Negative	Impacts affect the environment in such a way that natural, cultural and/or social functions and processes will be comprised	✗

Table 4-3 presents the defined criteria used to determine the **consequence** of the impact occurring which incorporates the extent, duration and intensity (severity) of the impact.

Table 4-3: Consequence of the Impact occurring

CONSEQUENCE	**Extent of Impact:**	
	Site	Impact is limited to the site and immediate surroundings, within the study site boundary or property (immobile impacts)
	Neighbouring	Impact extends across the site boundary to adjacent properties (mobile impacts)
	Local	Impact occurs within a 5km radius of the site
	Regional	Impact occurs within a provincial boundary
	National	Impact occurs across one or more provincial boundaries
	Duration of Impact:	
	Incidental	The impact will cease almost immediately (within weeks) if the activity is stopped, or may occur during isolated or sporadic incidences
	Short-term	The impact is limited to the construction phase, or the impact will cease within 1 - 2 years if the activity is stopped
	Medium-term	The impact will cease within 5 years if the activity is stopped
	Long-term	The impact will cease after the operational life of the activity, either by natural processes or by human intervention
	Permanent	Where mitigation either by natural process or by human intervention will not occur in such a way or in such a time span that the impact can be considered transient
	Intensity or Severity of Impact:	
	Low	Impacts affect the environment in such a way that natural, cultural and/or social functions and processes are not affected
	Low-Medium	Impacts affect the environment in such a way that natural, cultural and/or social functions and processes are modified insignificantly
	Medium	Impacts affect the environment in such a way that natural, cultural and/or social functions and processes are altered
	Medium-High	Impacts affect the environment in such a way that natural, cultural and / or social functions and processes are severely altered
	High	Impacts affect the environment in such a way that natural, cultural and / or social functions and processes will permanently cease

The probability of the impact occurring is the likelihood of the impacts actually occurring and is determined based on the classification provided in Table 4-4.

Table 4-4: Probability and confidence of impact prediction

	Probability of Potential Impact Occurrence:		
PROBABILITY	Improbable	The possibility of the impact materialising is very low either because of design or historic experience	
	Possible	The possibility of the impact materialising is low either because of design or historic experience	
	Likely	There is a possibility that the impact will occur	
	Highly Likely	There is a distinct possibility that the impact will occur	
	Definite	The impact will occur regardless of any prevention measures	

The significance of the impact is determined by considering the consequence and probability without taking into account any mitigation or management measures and is then ranked according to the ratings listed in Table 4-5.

Table 4-5: Significance rating of the impact

	Significance Ratings:	
SIGNIFICANCE	Low	Neither environmental nor social and cultural receptors will be adversely affected by the impact. Management measures are usually not provided for low impacts
	Low-Medium	Management measures are usually encouraged to ensure that the impacts remain of Low-Medium significance. Management measures may be proposed to ensure that the significance ranking remains low-medium
	Medium	Natural, cultural and/or social functions and processes are altered by the activities, and management measures must be provided to reduce the significance rating
	Medium-High	Natural, cultural and/or social functions and processes are altered significantly by the activities, although management measures may still be feasible
	High	Natural, cultural, and/or social functions and processes are adversely affected by the activities. The precautionary approach will be adopted for all high significant impacts and all possible measures must be taken to reduce the impact

The level of confidence associated with the impact prediction is also considered as low, medium or high (Table 4-6:).

Table 4-6: Level of confidence of the impact prediction

CONFIDENCE	Level of Confidence in the Impact Prediction:		
	Low	Less than 40% sure of impact prediction due to gaps in specialist knowledge and/or availability of information	
	Medium	Between 40 and 70% sure of impact prediction due to limited specialist knowledge and/or availability of information	
	High	Greater than 70% sure of impact prediction due to outcome of specialist knowledge and/or availability of information	

Once significance rating has been determined for each impact, management and mitigation measures must be determined for all impacts that have a significance ranking of Medium and higher in order to attempt to reduce the level of significance that the impact may reflect.

The EIA Regulations, 2014 [as amended] specifically require a description is provided of the degree to which these impacts:

- can be reversed;
- may cause irreplaceable loss of resources; and
- can be avoided, managed or mitigated.

Based on the proposed mitigation measures, the mitigation efficiency is also determined (Table 4-7) whereby the initial significance is re-evaluated and ranked again to effect a significance that incorporates the mitigation based on its effectiveness. The overall significance is then re-ranked and a final significance rating is determined.

Table 4-7: Mitigation efficiency

MITIGATION EFFICIENCY	Mitigation Efficiency		
	None	Not applicable	
	Very Low	Where the significance rating stays the same, but where mitigation will reduce the intensity of the impact. Positive impacts will remain the same	
	Low	Where the significance rating reduces by one level, after mitigation	
	Medium	Where the significance rating reduces by two levels, after mitigation	
	High	Where the significance rating reduces by three levels, after mitigation	
	Very High	Where the significance rating reduces by more than three levels, after mitigation	

The reversibility is directly proportional to the "Loss of Resource" where no loss of resource is experienced, the impact is completely reversible; where a substantial "Loss of resource" is experienced there is a medium degree of reversibility; and an irreversible impact relates to a complete loss of resources, i.e. irreplaceable (Table 4-8).

Table 4-8: Degree of reversibility and loss of resources

DEGREE REVERSABILITY & LOSS OF RESOURCES		
	Loss of Resources:	
	No Loss	No loss of social, cultural and/or ecological resource(s) are experienced. Positive impacts will not experience resource loss
	Partial	The activity results in an insignificant or partial loss of social, cultural and/or ecological resource(s)
	Substantial	The activity results in a significant loss of social, cultural and/or ecological resource(s)
	Irreplaceable	The activity results in the complete and irreplaceable social, cultural and/or ecological loss of resource(s)
	Reversibility:	
	Irreversible	Impacts on natural, cultural and/or social functions and processes are irreversible to the pre-impacted state in such a way that the application of resources will not cause any degree of reversibility
	Medium Degree	Impacts on natural, cultural and/or social functions and processes are partially reversible to the pre-impacted state if less than 50% resources are applied
	High Degree	Impacts on natural, cultural and/or social functions and processes are partially reversible to the pre-impacted state if more than 50% resources are applied
	Reversible	Impacts on natural, cultural and/or social functions and processes are fully reversible to the pre-impacted state if adequate resources are applied

4.4 Consultation Process

Consultation as part of the overall environmental authorisation process is being undertaken by Prism EMS - EAP. Prism EMS, aquatic resources specialist consulted with:

- The Prism EMS EAP team;

5 ASSUMPTIONS, GAPS AND LIMITATIONS

The study was limited to a snapshot view during two site assessments. The field investigation was undertaken on 6 December 2018 and 4 September 2019 to assess and confirm the delineated Aquatic Resource Zones present on the survey area. Weather conditions during the survey were favourable for recordings. The delineations were recorded by hand held GPS.

It must be noted that, during the process of converting spatial data to final output drawings, several steps are followed that may affect the accuracy of areas delineated. Due care has been taken to preserve accuracy. Printing or other forms of reproduction may also distort the scale indicated in maps. It is therefore suggested that the wetland areas identified in this report be pegged in the field in collaboration with the surveyor for precise boundaries.

A total assessment of all probable scenarios or circumstances that may exist on the study site was not undertaken. No assumptions should be made unless opinions are specifically indicated and provided. Data presented in this document may not elucidate all possible conditions that may exist given the limited nature of the enquiry.

It is unlikely that more surveys would alter the outcome of this study radically.

6 RESULTS AND FINDINGS

6.1 Wetland Delineation

6.1.1 Desktop Assessment

During the desktop investigation, one (1) possible area where wetlands could occur was identified on or in close proximity to the study site that would be affected by the proposed development activities. The National Wetland Map version 5 (NWM5) as presented by SANBI was also scrutinised and three artificial wetlands area were identified (refer to Figure 6-3) on or in close proximity to the study site that could be affected by the proposed activities.

6.1.2 Field Assessment

The field investigations were undertaken during December 2018 and September 2019 to assess and confirm the delineated Aquatic Resource Zones present on the survey area.

The field investigations concluded that two (2) natural aquatic systems could be affected by the activities. Same is draining into the Bierspruit Spruit.

6.1.2.1 Wetland Indicators

6.1.2.1.1 Terrain Unit Indicator

Terrain unit indicator helps identify those parts of the landscape where wetlands are most likely to occur. Wetlands occupy characteristic positions in the landscape and can occur on the following terrain units:

- Crest;
- midslope;
- footslope; and
- valley bottom.

The hydrogeomorphic wetland units identified were also assessed in respect to its location in the landscape. The wetland units found:

- NP#3_UCVB1 was found on a plain draining towards the North-West into the Bierspruit. This system is both supplied by natural and artificial sources.
- NP#3_DL was found on a plain draining towards the North. This system is both supplied by natural and artificial sources.

Refer to Table 6-1 and section 4.2 Wetland Classification for the classification of the terrain unit.

Table 6-1: Wetland Classification

Identified Wetland	Level 1: System	Level 2: Regional setting	Level 3: Landscape unit	Level 4: Hydrogeomorphic (HGM) unit	
	Connectivity to open ocean	Ecoregion	Landscape setting	HGM type	Longitudinal zonation / landform
				A	B
NP#3_UCVB1	INLAND	DWAF Level 1 Ecoregions	PLAIN	Un-channelled valley-bottom wetland	Valley-bottom flat
NP#3_DL	INLAND	DWAF Level 1 Ecoregions	PLAIN	Drainage line	

6.1.2.1.2 Soil Form and Soil Wetness Indicator

Soil erodibility in hydrologically transformed environments contributes to the difficulties to precisely determine wetland boundaries. This investigation focussed on the delineation of the wetland features based on soil hydro-morphology and landscape hydrology as observed in the catchment and on the study site.

Soils were found to be of a high clay content in general. Mostly slightly moist, grey black, firm, slickensided and shattered, silty clay with roots. Classified as Residual Norite (Jones&Wagner; 2019). The wetland seasonal and permanent zones reflected clayey soils. (Figure 6-1).

Figure 6-1: Soil samples

6.1.2.1.3 Vegetation Indicator

Upon the assessment of the area, the various wetland vegetation components were assessed and recorded. Dominant species were characterised as either wetland species or terrestrial species. Hydrophytic vegetation species were observed. Predominantly grass, rushes and sedge species were recorded. This unit was predominantly utilised to delineate the wetland (Figure 6-2).

Figure 6-2: Wetland vegetation

Table 6-2: Wetland indicator species noted during the assessment

Riparian / Wetland vegetation
Typha species
Cyperus species
Juncus species
Andropogan species

**Not all species listed, only most common indicators*

6.1.3 Mapping

Figure 6-3 indicates the National Wetlands Map version 5 Wetlands. Three artificial NWM5 wetlands are indicated on the Geographic Information Systems (GIS) layers that are in close proximity to the study site.

Figure 6-4 serves to conceptually present the location of the aquatic resources that could be affected by the proposed development activities on the site.

Figure 6-5 presents the aquatic resource buffer zones that are applicable and should be considered during the development to ensure appropriate mitigation and management of the activities.

A 32m buffer was applied to all the aquatic resources, this in accordance with the National Environmental Management Act (NEMA) listed activities and the biodiversity and mapping requirements. The NP#3_UCVB1 wetlands are fairly disturbed due to historical impacts (mostly upstream) and are of low ecological importance. NP#3_DL is a drainage line and is less sensitive to impacts and of low ecological importance. The applicable buffers must be maintained and treated in the same manner as the delineated aquatic resources. Rehabilitation of the buffer area is required. This conservation buffer should be utilised as the control area and will be adequate to assist with management and mitigation during the construction and operation phase.

Also, refer to the associated digital files presenting the wetland boundaries.

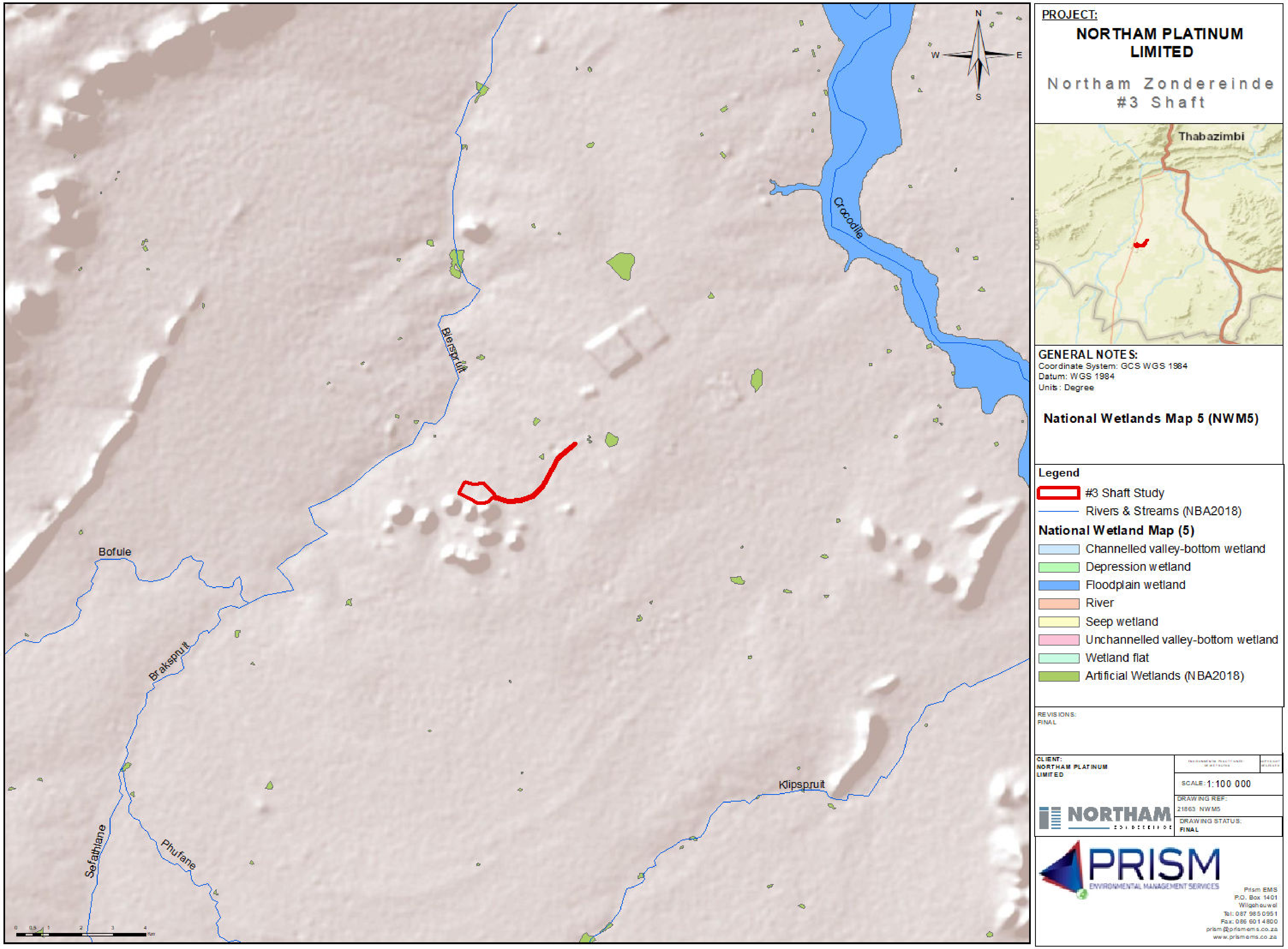

Figure 6-3: National Wetlands Map 5 (NWM5) (Van Deventer et al; 2019)

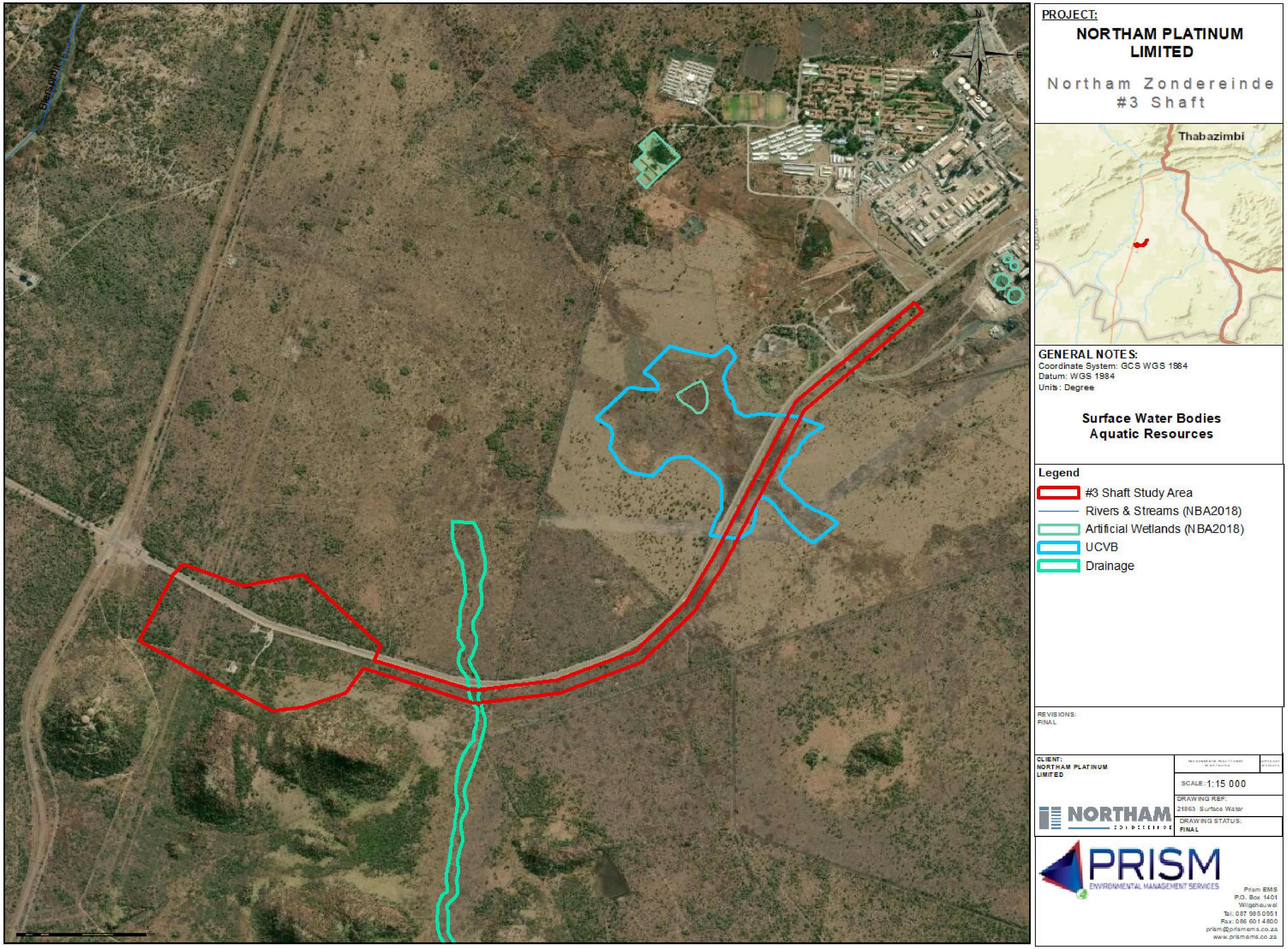

Figure 6-4: Aquatic Resource Delineation

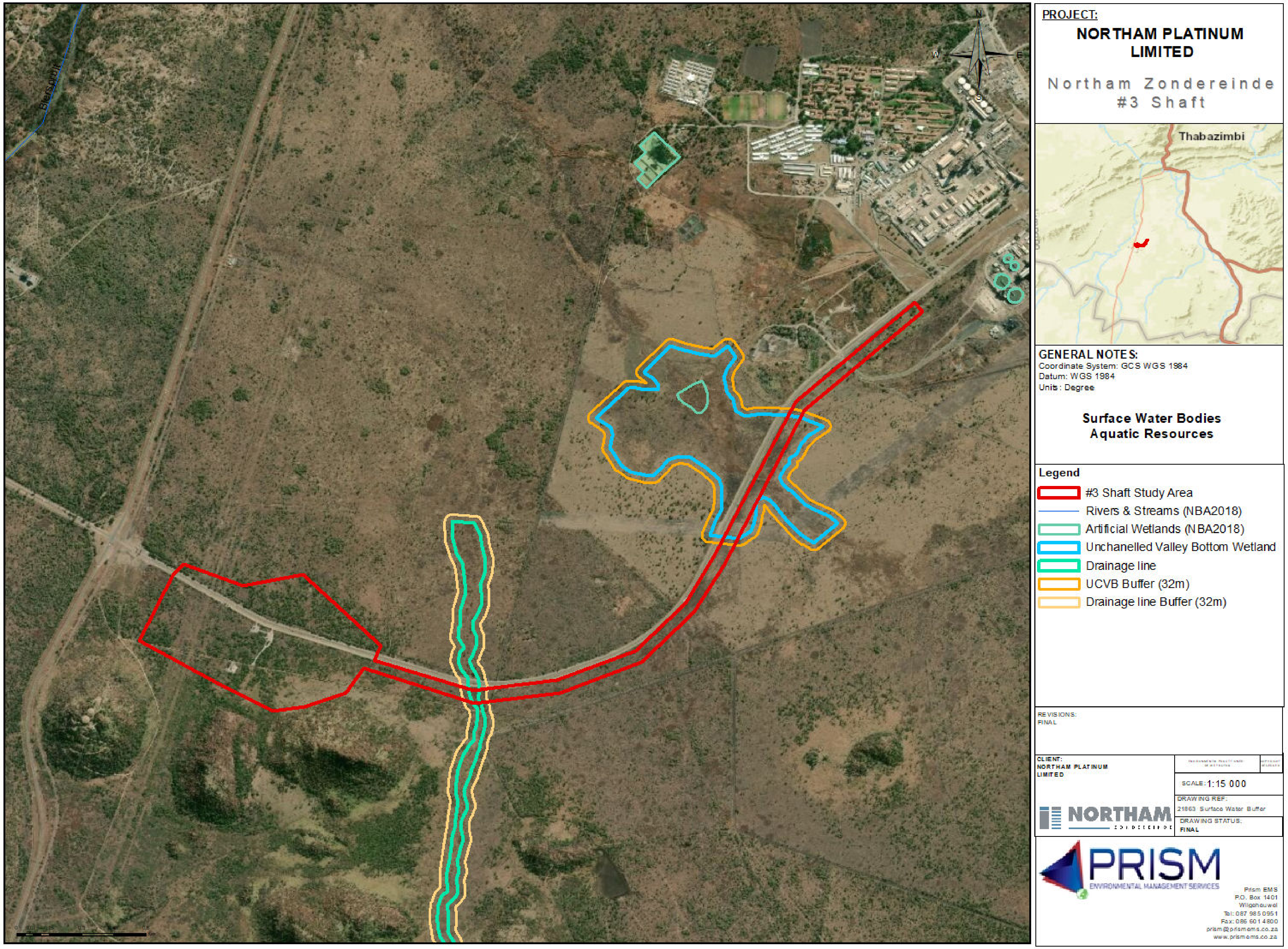

Figure 6-5: Aquatic Resource Buffer Zones

6.2 Wetland Classification

SANBI's classification for wetlands was used to classify the wetland units within the study area (SANBI, 2009). The wetland units were classified up to level four, which includes the system, regional setting, landscape unit and Hydrogeomorphic (HGM) unit. Figure 6-6 conceptually present the HGM units (Marneweck and Batchelor, 2002) and Figure 6-7 illustrates the HGM units (SANBI; 2013).

Two surface water bodies were identified during the field investigation.

The following Hydrogeomorphic wetlands were identified during the site evaluation:

- NP#3_UCVB1 –Un-Channelled Valley Bottom Wetland

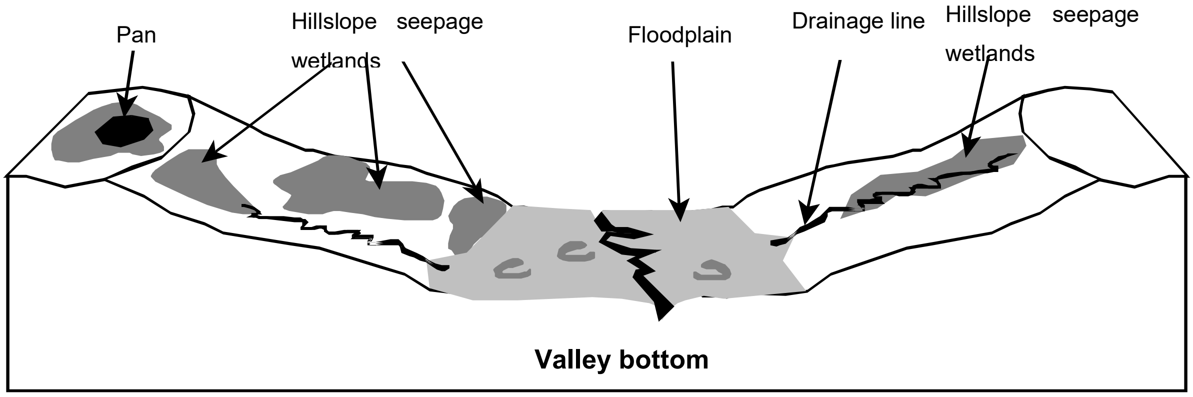

Figure 6-6: Wetland hydrogeomorphic (HGM) classification (Marneweck and Batchelor, 2002)

NP#3_DL – Drainage line. A drainage line was also identified. The drainage line is palustrine of nature and is bearing some wetland conditions due to non-natural input from the Magalieswater scour valve overtopping into the drainage.

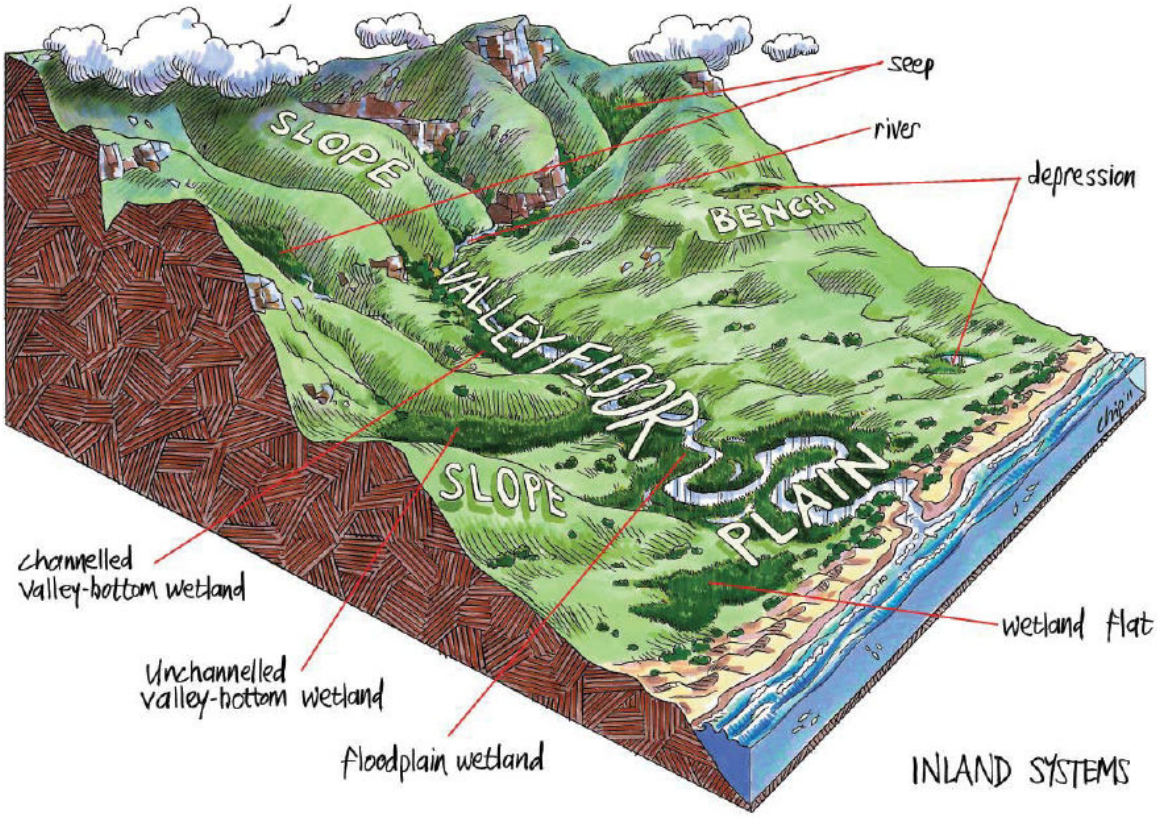

Figure 6-7: Wetland hydrogeomorphic (HGM) classification illustrated (SANBI; 2013)

6.2.1 Un-Channelled Valley Bottom Wetland

One Un-Channelled Valley Bottom Wetland Unit was identified (NP#3_UCVB1) in the study area. Figure 6-8 diagrammatically illustrates the HGM unit.

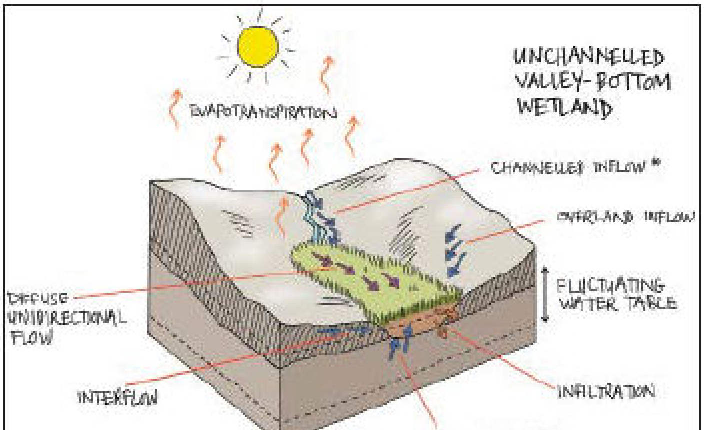

Figure 6-8: Un-Channelled Valley Bottom Wetland (SANBI; 2013)

6.2.2 Drainage line

A drainage line is classified as a watercourse in the National Water Act (NWA):

Water course: *(b) a natural channel in which water flows regularly or intermittently;*

One drainage line was identified (NP#3_DL) in the study area. Figure 6-9 diagrammatically illustrates the HGM unit.

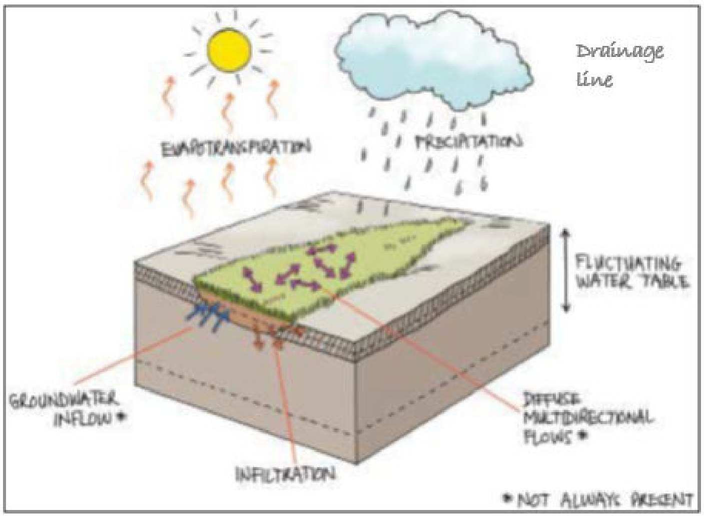

Figure 6-9: Drainage Line (*adapted from* SANBI; 2013)

6.2.3 Wetland Unit classification

SANBI's "Further development of a proposed National Classification System for South Africa" was used to verify the classification of the wetlands within the study area (SANBI, 2009). The wetlands were classified up to level four, which includes the system, regional setting, landscape unit and hydrogeomorphic unit (Table 4-1).

The wetlands were classified as per Table 6-3.

Table 6-3: Wetland Units classification

Unit	System	Regional setting	Landscape unit	Hydrogeomorphic unit
NP#3_UCVB1	INLAND	Bushveld Basin	Plain	Un-Channelled Valley Bottom Wetland
NP#3_DL	INLAND	Bushveld Basin	Plain	Drainage line

7 IMPACT ASSESSMENT

	IMPACTS			CONSEQUENCE			PROBABILITY	RANKING WITHOUT MITIGATION	IMPLEMENTATION OF MANAGEMENT MEASURES		RANKING WITH MITIGATION	DEGREE REVERSABILITY & LOSS OF RESOURCE	
	Type	Description	Nature	Extent (A)	Duration (B)	Intensity (C)	Probability (P)	Significance (A + B + C) X P	Mitigation and/or Management Measures	Mitigation Effectiveness	Significance	Loss of Resources	Reversibility
CONSTRUCTION PHASE													
Aquatic Resources	Direct	Water quality	Negative	*Local*	*Medium-term*	*Medium-High*	*Definite*	*Medium*	Stock-piling outside the wetland area, stormwater management, dry season construction, coffer damming, filtration.	*Medium*	*Low-Medium*	*Substantial*	*Medium Degree*
	Indirect	Silt	Negative	*Neighbouring*	*Medium-term*	*Medium*	*Highly Likely*	*Low-Medium*	Stock-piling outside the wetland area, stormwater management, dry season construction, coffer damming, filtration.	*Medium*	*Low*	*Partial*	*High Degree*
	Direct	Surface water run-off	Negative	*Local*	*Medium-term*	*Low-Medium*	*Highly Likely*	*Low-Medium*	Storm-water management.	*Medium*	*Low*	*Partial*	*High Degree*
	Indirect	Contamination of water from hazardous substances	Negative	*Neighbouring*	*Incidental*	*Medium*	*Possible*	*Low*	Limited use of machinery in the wetland area. No servicing of vehicles and equipment on site.	*High*	*Low*	*Partial*	*High Degree*
	Direct	Disturbance of natural system	Negative	*Local*	*Medium-term*	*Medium*	*Definite*	*Medium*	Stock-piling outside the wetland area, stormwater management, dry season construction, coffer damming, filtration.	*Medium*	*Low-Medium*	*Substantial*	*Medium Degree*
	Direct	Disturbance/pollution of sub-surface flow	Negative	*Local*	*Medium-term*	*Medium*	*Highly Likely*	*Medium*	Stormwater management, dry season construction, coffer damming, filtration, sub-surface drains.	*High*	*Low-Medium*	*Partial*	*High Degree*
	Direct	Disturbance of aquatic ecological systems	Negative	*Local*	*Medium-term*	*Medium*	*Highly Likely*	*Medium*	Stock-piling outside the wetland area, stormwater management, dry season construction, coffer damming, filtration.	*High*	*Low-Medium*	*Partial*	*High Degree*

	IMPACTS			CONSEQUENCE			PROBABILITY	RANKING WITHOUT MITIGATION	IMPLEMENTATION OF MANAGEMENT MEASURES		RANKING WITH MITIGATION	DEGREE REVERSABILITY & LOSS OF RESOURCE	
	Type	Description	Nature	Extent (A)	Duration (B)	Intensity (C)	Probability (P)	Significance (A + B + C) X P	Mitigation and/or Management Measures	Mitigation Effectiveness	Significance	Loss of Resources	Reversibility
OPERATIONAL PHASE													
Aquatic Resources	Direct	Water quality	Positive	*Neighbouring*	*Long-term*	*Medium*	*Highly Likely*	*Medium*	Rehabilitation of construction impacted area, continuous monitoring.	*Medium*	*Medium*	*No Loss*	*Reversible*
	Indirect	Silt	Positive	*Local*	*Long-term*	*Medium*	*Definite*	*Medium*	Rehabilitation of construction impacted area, continuous monitoring and maintenance.	*Medium*	*Medium*	*No Loss*	*Reversible*
	Direct	Surface water run-off	Positive	*Local*	*Long-term*	*Low-Medium*	*Highly Likely*	*Medium*	Rehabilitation of construction impacted area, continuous monitoring, storm water management.	*High*	*Medium*	*No Loss*	*Reversible*
	Indirect	Contamination of water from hazardous substances	Negative	*Site*	*Incidental*	*Low-Medium*	*Possible*	*Low*	Rehabilitation of construction impacted area, continuous monitoring, storm water management.	*High*	*Low*	*Partial*	*High Degree*
	Direct	Disturbance of natural system	Negative	*Neighbouring*	*Long-term*	*Low*	*Likely*	*Low*	Rehabilitation of construction impacted area, continuous monitoring.	*High*	*Low*	*Partial*	*High Degree*
	Direct	Disturbance/pollution of sub-surface flow	Negative	*Neighbouring*	*Long-term*	*Low*	*Likely*	*Low*	Rehabilitation of construction impacted area, continuous monitoring and silt management.	*High*	*Low*	*Partial*	*High Degree*
	Direct	Disturbance of aquatic ecological systems	Negative	*Neighbouring*	*Long-term*	*Low*	*Highly Likely*	*Low-Medium*	Rehabilitation of construction impacted area, continuous monitoring and silt management.	*High*	*Low*	*Partial*	*High Degree*

8 REASONED OPINION AND RECOMMENDATIONS

Two aquatic resources will be impacted by the services and upgrades of services and road network. These will be minor impacts on the systems as the existing infrastructure and servitudes will be utilised in most instances.

The wetland and drainage line have low ecological value and was degraded due to historical activities and ongoing anthropogenic activities. The impact areas are limited and with the necessary mitigation and rehabilitation most of the current function will remain intact. This to ensure sustainability of the system.

For this reason, it can be supported that the proposed development activities may go-ahead if the required buffers are maintained and the resource drivers preserved. The rehabilitation of the wetland is vital to recover the required ecological function. The wetland drivers must be enhanced as part of the rehabilitation of the affected areas. In respect of the construction phase, it is important to ensure that the required erosion protection measures linked to the crossing sections be carefully designed and installed. Silt transportation to the downstream system must also be carefully managed.

The project can be supported, should all the mitigation measures be implemented and monitored against to ensure compliance. This will ensure mitigation to acceptable levels.

8.1 Mitigation and Monitoring Requirements

Monitoring programmes can measure the success of mitigation implementations, monitor unforeseen impacts, and can be used as a feedback system to adjust or correct management of the wetlands.

The following are recommended:

- It is recommended that a WULA be submitted to the Department of Human Settlements, Water and Sanitation (DHSWS), as the proposed activities will trigger sections of Section 21 of the National Water Act [NWA], 1998 (Act No. 36 of 1998) that will require such an application;
- Together with the WULA, a rehabilitation and monitoring plan will have to be compiled and approved as supporting documents to the application;
- A wetland monitoring programme should be developed based on this baseline assessment and audited against post the rehabilitation activities. Feedback from the monitoring should be used to measure and mitigate further negative impacts, if found;
- The wetland monitoring occurring on a quarterly basis should be conducted by a skilled professional qualified in assessing and understanding the complex nature of wetlands and their associated drivers;
- It should be attempted to preserve complete wetland function (current status) if at all possible.
  - Wetland drivers should be protected as far as possible.
  - Wetland release into downstream aquatic resources should be rehabilitated, enhanced and monitored.
  - Water quality preservation is key. Monitoring should take place during the construction phase as per the Water Use License (WUL) requirements.
- Mitigation measures for the proposed development activities should be implemented, managed and monitored according to:
  - The following wetland ecosystem impact assessment conclusions, based on the results of the baseline survey:
    - Runoff from the construction areas may result in contamination of wetland and downstream aquatic habitat;
    - On site storm water management, must be implemented.
  - The following impacts may result in changes to the soil structure:
    - Heavy construction vehicles moving within the wetland areas;
      - Ingress and Egress must be managed to minimise impacts in respect of compaction of the wetland soils.
      - Single entry and exit points must be established.
    - Stockpiling;
      - As first option - Stockpiling must be located outside the delineated wetland and buffer boundaries.
      - Dedicated laydown and stockpiling areas must be identified. Special management rules will apply for same.
    - Spills from machinery;

        - The mixing of concrete; and
        - Clearing of vegetation for construction, and associated sedimentation and siltation.
    - The following aspects may result in reduction of ecosystem habitat integrity:
        - Dust and sediment runoff from construction activities;
        - Diesel and oil spill from equipment and machinery; and
        - Higher and faster water flow from the site that could cause soil erosion.
    - The following aspects may result in sedimentation of the associated aquatic systems:
        - Sedimentation due to increase runoff and dispensed soil particles and runoff from the affected areas; and
        - Increase in the velocity of the runoff from the exposed soil, due to construction.
    - The proposed activities must be initiated and constructed in such a way to prevent the reduction of natural water flow into the wetland and downstream which, in essence, is the driving factor in terms of water provision.
        - An approved stormwater management plan must be implemented.
        - Subsurface drains must be installed to assist in the aquatic driver sustainability across the full width of the wetland.
        - Velocity dissipation structures (such as reno mattresses) must also be installed to prevent water flowing through culverts to gain velocity. An increase in velocity will lead to channelisation of the wetland and soil erosion.
- The wetland integrity should be improved during the rehabilitation phase. This may entail the following:
    - Removal of alien and invasive plant species during the construction and operational phases.
    - Re-vegetation and landscaping the wetland and buffer areas with indigenous wetland plant species.
    - Stabilisation of gullies and drainage lines to prevent erosion.
    - Planting of indigenous herbaceous plants on shallow banks and indigenous woody vegetation on steep banks to increase stability of banks, thereby preventing erosion.
    - Implementation of topsoil management (stockpiling, topography shaping) and erosion control (berms, geotextiling, silt fences, hay bales and gabion structures).

9 CONCLUSION

The field investigations concluded that two (2) natural aquatic systems could be affected by the activities. Same is draining into the Bierspruit Spruit.

The hydrogeomorphic wetland units identified were also assessed in respect to its location in the landscape. The wetland units found:

- NP#3_UCVB1 was found on a plain draining towards the North-West into the Bierspruit. This system is both supplied by natural and artificial sources.

- NP#3_DL was found on a plain draining towards the North. This system is both supplied by natural and artificial sources.

Two aquatic resources will be impacted by the services and upgrades of services and road network. These will be minor impacts on the systems as the existing infrastructure will be utilised in most instances.

The wetland and drainage line have low ecological value and is degraded due to historical activities and ongoing anthropogenic activities. The impact areas are limited and with the necessary mitigation and rehabilitation most of the current function will remain intact. This to ensure sustainability of the system.

For this reason, it can be supported that the proposed development activities may go-ahead if the required buffers are maintained and the resource drivers preserved. The rehabilitation of the wetland is vital to recover the required ecological function. The wetland drivers must be enhanced as part of the rehabilitation of the affected areas. In respect of the construction phase, it is important to ensure that the required erosion protection measures linked to the crossing sections be carefully designed and installed. Silt transportation to the downstream system must also be carefully managed.

The project can be supported, should all the mitigation measures be implemented and monitored against to ensure compliance. This will ensure mitigation to acceptable levels.

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