FINAL DRAFT

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BAKABUNG PLATINUM MINE
Amendment of Environmental Authorisation and Waste Management Licence

Prepared for:	Bakubung Minerals (Pty) Ltd.
Prepared by:	Knight Piésold (Pty) Ltd.
Proposal Number:	RI 301- 00509/11
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Project Number
RI 301- 00509/11

AMENDMENT OF ENVIRONMENTAL AUTHORISATION AND WASTE MANAGEMENT LICENCE

BAKUBUNG PLATINUM MINE

Rev	Description	Date
01	Issued in Draft	October 21, 2020
02	Issued in Final Draft	March 23, 2021

Prepared for:	Bakubung Minerals (Pty) Ltd.
Prepared by:	Knight Piésold (Pty) Ltd.
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EXECUTIVE SUMMARY

INTRODUCTION AND PROJECT OVERVIEW

Bakubung Minerals (Pty) Ltd is the owner of Bakubung Platinum Mine (BPM), currently operating on the farm Frischgewaagd 96JQ (Portions 3, 4 and 11). Bakubung Minerals (Pty) Ltd holds the mining right for BPM. The mine is located near Ledig, 2 km south of the Pilanesberg Game Reserve and Sun City in the North West Province. Two reefs are being mined for Platinum Group Elements - platinum, palladium, rhodium, and gold, with copper and nickel as by-products. The mine falls within the Rustenburg and Moses Kotane Local Municipalities of the Bojanala District Municipality (Figure 1).

The mine received its mining right with approval of its Environmental Impact Assessment (EIA) in 2009 and a Water Use Licence from the Department of Human Settlements, Water and Sanitation (DHSWS) in 2010. Subsequently, the mine has applied for other authorisations and amendments.

This amendment by Knight Piésold (Pty) Ltd is based on BPMs wish to re-optimise the process in order to make its operations financially viable. The mine capacity was authorised for 3 MT/annum, but BPM wishes to approach this capacity in a phased approach - 1 Mt/annum (immediate) and 2 MT/annum (by 2024).

The specific changes to the project which forms part of this EIA amendment is:

- Capacity change from 3 MT/annum to 1 MT/annum and 2 MT/annum
- Construction of an additional Tailings Storage Facility (TSF) on Frischgewaagd Farm

LEGAL FRAMEWORK

Prior to the commencement of the proposed project, environmental authorisation is required from various government departments. These include:

- Amendment of the environmental authorisation and waste management license from the Department of Mineral Resources (DMR) in terms of both the National Environmental Management Act No. 107 of 1998 (NEMA) and National Environmental Management: Waste Act No. 59 of 2008 (NEM:WA). The proposed project incorporates several listed environmental and waste activities. The EIA regulations being followed for this project are Regulation 982 of 04 December 2014.
- A water use license from the DHSWS in terms of the National Water Act No. 36 of 1998 (NWA) for the new TSF and associated infrastructure. The water uses to be applied for are: 21 (g): Evaporation Pond associated with the TSF, 21 (g): New TSF, 21 (c) & (i) for activities (TSF, evaporation pond) within 500m of a wetland. Exemption in terms of GN 704 is not required.

STAKEHOLDER ENGAGEMENT

As part of the stakeholder engagement process, authorities and interested and affected parties (IAPs) were notified of the project, given the opportunity to submit questions and comments to the project team, and review the background information document and Amendment report. All comments received have been included and addressed in the amendment report. Further comments arising from the public review period will be handled in a similar manner.

The draft EA and WML amendment report was made available for public review from 21 October to 20 November 2020. During this review period comments were received, which required additional studies to be undertaken and previous studies to be updated. The sections that have been revised within this amendment report are indicated with underlined text.

IMPACTS AND MITIGATION MEASURES

This report provides an assessment of the potential impacts of the proposed project and provides measures to prevent or mitigate the impacts.

The potential impacts associated with the proposed project activities and infrastructure can be categorised into those that have low, medium and high significance in the unmitigated scenario. All three categories of impacts require a measure of mitigation which, if successfully implemented will reduce the significance of the impacts and the related residual risk.

The table below provides a summary of the potential impacts in no particular order of importance. L = Low, M = Medium and H = High.

Project activity or issue	Potential impact	+ / -	Before mitigation	After mitigation
Visual				
Clearance of vegetation Increase in heavy vehicles Construction of the base of the TSF	Alteration to the visual quality of the study area due to the physical presence and construction activities. The TSF will have a low impact on key residential and some public road views in the area. Mitigation measures are feasible and would result in a reduction in impact if the mitigation measures are effectively implemented and managed in the long term.	-	**L**	**L**
The TSF will increase in height. Security lights will be installed	Alteration to the visual quality of the study area due to the physical presence, scale and size of the new TSF. The project becomes more visible for people travelling along the R565 and the R556 as well as residents from Ledig. Mitigation measures are possible but will not be able to hide/screen the proposed activities completely since the upper levels of the TSF will break the tree horizon, which makes it more visible.	-	**M**	**M**
Increase in heavy vehicles during the removal of structures and the transport of material for rehabilitation. Preparation of soils.	Creating dust by removal of structures and the movement of vehicles, during the soil preparation for rehabilitation. Mitigation measures are feasible and would result in a drop in impact at closure if they are effectively implemented and managed.	-	**L**	**L**
Removal of structures, planting of vegetation, rehabilitation of the area.	Alteration to the visual quality of the study area by removing structures and rehabilitating the area.	+	**L**	**L**
Air Quality				
General construction activities	Impacts on human health	-	**L**	**L**
	Increased nuisance dustfall rates	-	**L**	**L**
Operation of new TSF	Impacts on human health	-	**L**	**L**
	Increased nuisance dustfall rates	-	**L**	**L**
Decomissioning of TSF	Impacts on human health	-	**L**	**L**
	Increased nuisance dustfall rates	-	**L**	**L**
Closure of TSF	Impacts on human health	-	**L**	**L**
	Increased nuisance dustfall rates	-	**L**	**L**

Project activity or issue	Potential impact	+ / -	Before mitigation	After mitigation
Development of project	Impact on climate change	-	M	L
Noise				
General construction activities	Increase in noise at sensitive receptors	-	L	L
Operation of new TSF	Increase in noise at sensitive receptors	-	L	L
Soil				
Construction, Operation and Closure of TSF Project	Soil loss	-	H	M
	Loss of land capability	-	M	M
	Contamination of soil	-	M	L
Terrestrial Flora and Fauna				
Vegetation clearing and earth works	Habitat loss and modification - Marikana Thornveld	-	H	H
Vegetation clearing and earth works	Habitat loss and modification - Secondary Vegetation	-	H	M
Vegetation clearing and earth works	Habitat fragmentation	-	H	M
Vegetation clearing and earth works	Establishment and spread of alien invasive species	-	M	L
Vegetation clearing and earth works	Soil erosion and sedimentation of drainage features	-	L	L
Vegetation clearing and earth works, vehicle collisions, trapping in fences, excavations and trenches.	Mortality and disturbance of fauna.	-	M	L
All project related activities	Loss and disturbance of species of conservation concern.	-	M	L
Aquatics and Wetland				
Construction of surface infrastructure	Loss of watercourse habitat	-	H	M
	Sediment mobilisation: Deposition and erosion in watercourses	-	M	L
	Surface Water Pollution	-	L	L
	Encroachment of alien species into watercourse	-	M	M
Operation of TSF	Loss of watercourse habitat	-	H	M
	Sediment mobilisation: Deposition and erosion in watercourses	-	M	L
	Surface Water Pollution	-	L	L
	Encroachment of alien species into watercourse	-	M	M
Decommissioning or Closure of the TSF	Loss of watercourse habitat	-	H	M
	Sediment mobilisation: Deposition and erosion in watercourses	-	L	L
	Surface Water Pollution	-	L	L
	Encroachment of alien species into watercourse	-	M	M
Socio-Economics				
Construction, Operation and Closure of TSF Project	Community expectations	-	M	M
	Dust from social and health perspective	-	M	M
	Skills development	+	H	H

Project activity or issue	Potential impact	+ / -	Before mitigation	After mitigation
	Job creation	+	M	M
	Local economy	+	M	H
	Increase in social ills	-	M	M
Groundwater				
Groundwater contamination during Construction	Hydrocarbon spills from machinery	-	M	L
Groundwater contamination during Operation	Groundwater contamination from liner leakage	-	M	L
Groundwater contamination during Operation	Groundwater contamination from leaking infrastructure	-	M	L
Groundwater contamination after decommissioning	Groundwater contamination from liner leakage	-	M	L

ENVIRONMENTAL STATEMENT

The assessment of the proposed project presents the potential for significant negative impacts to occur (in the unmitigated scenario in particular) on the bio-physical, cultural, and socio-economic environments both on the project sites and in the surrounding area. With mitigation, these potential impacts can be prevented or reduced to acceptable levels.

It follows that, provided the EMP is effectively implemented, there is no environmental, social, or economic reason why the project should not proceed.

UMBIKO OFINGQIWE

ISETHULO NENCAZELO EFINGQIWE YEPHROJEKTHI

IBakubung Minerals (Pty) Ltd ingumnikazi weBakubung Platinum Mine (BPM), njengamanje esebenza epulazini iFrischgewaagd 96JQ (Izingxenye 3, 4 no-11). IBakubung Minerals (Pty) Ltd inelungelo lemayini ye-BPM. Le mayini itholakala ngaseLedig, okungu-2 km ukuya eningizimu yePilanesberg Game Reserve naseSun City eSifundazweni SaseNyakatho-Ntshonalanga. Kunemigodi emibili embiwelwa i-Platinum Group Elements - i-platinum, i-palladium, i-rhodium, negolide, bese kuba yithusi ne-nickel njengemikhiqizo ephuma eceleni. Le mayini ingaphansi kukaMasipala Wendawo YaseRustenburg NeMoses Kotane kaMasipala WesiFunda SaseBojanala (Isithombe 1).

Le mayini yathola ilungelo layo lokumba izimayini ngokugunyazwa ngumthetho woKuhlaziya Umthelela Emvelweni (EIA) ngo-2009 kanye neLayisense Yokusebenzisa Amanzi eMnyangweni Wezokuhlaliswa Kwabantu, Ezamanzi Nokuthuthwa Kwendle (i-DHSWS) ngo-2010. Ngemva kwalokho, imayini ifake izicelo zezinye isigunyazo nezichibiyelo.

Lesi sichibiyelo esenziwe yiKnight Piésold (Pty) Ltd sisekelwe kuma-BPM ahlose ukuphinda enze inqubo isebenze kahle ukuze imisebenzi yayo ikwazi ukukhokheleka ngokwezimali. Umthamo wemayini wagunyazelwa i-3 MT/ngonyaka, kodwa i-BPM ifisa ukufinyelela lo mthamo ngezigaba ngezigaba - 1 Mt/ngonyaka (ngokushesha) bese kuba u-2 MT/ngonyaka (makufika u-2024).

Izinguquko ezithile kuphrojekthi eziyingxenye yalokhu kuchitshiyelwa kwe-EIA yilezi:

- Ukuguqulwa komthamo kusuka ku-3 MT/ngonyaka kuye ku-1 MT/ngonyaka naku-2 MT/ngonyaka
- Ukwakhiwa kwenye iNdawo Yokugcina Izinsalela (TSF) ePulazini I-Frischgewaagd

UHLAKA LOMTHETHO

Ngaphambi kokuqala kwephrojekthi ehlongozwayo, kudingeka isigunyazo esiphathelene nezemvelo eminyangweni ehlukahlukene kahulumeni. Leyo minyango ibandakanya:

- Ukuchitshiyelwa kwesigunyazo sezemvelo nelayisense yokuphathwa kwemfucuza evela eMnyangweni Wezimbiwaphansi (i-DMR) ngokwemigomo yoMthetho Kazwelonke Wokuphathwa Kwemvelo OnguNombolo 107 ka-1998 (i-NEMA) noMthetho Kazwelonke Wokuphathwa Kwemvelo: UMthetho Wemfucuza Ongunombolo 59 ka-2008 (i-NEM:WA). Iphrojekthi ehlongozwayo ididiyela imisebenzi eminingana ebaluliwe yezemvelo nemfucuza. Imithethonqubo ye-EIA elandelwayo kule phrojekthi nguMthethonqubo 982 wangomhla ka-4 kuDisemba 2014.
- Ilayisense yokusebenzisa amanzi evela e-DHSWS ngokoMthetho Kazwelonke Wamanzi OnguNombolo 36 ka-1998 (i-NWA) kwi-TSF entsha nengqalasizinda ehambisana nayo. Izinto ezizocelelwa ukusetshenziselwa amanzi yilezi: 21 (g): IChibi Lokuhwamukisa elihambisana ne-TSF, 21 (g): I-TSF Entsha, 21 (c) no-(i) yemisebenzi (i-TSF, ichibi lokuhwamukisa) ngaphakathi kuka-500m wendawo eyixhaphozi. Ukukhululwa emithethweni ngokwemigomo ye-GN 704 akudingeki.

UKUBANDAKANYWA KWABABAMBIQHAZA

Enqubweni yokubandakanya ababambiqhaza, iziphathimandla nalabo abanentshisekelo nabathintekayo (IAP) baziswa ngale phrojekthi, banikwa ithuba lokuletha imibuzo nezimvo ethimbeni lephrojekthi, nokuba babuyekeze ulwazi oluyisisinda somqulu wombiko noNokuchibiyela. Konke

ukuphawula okwatholakala kufakiwe futhi kusingathiwe embikweni wokuchibiyela. Okunye ukuphawula okuvela esikhathini sokubuyekeza komphakathi kuzosingathwa ngendlela efanayo.

Umbiko wokuchibiyela umbhalo we-EA ne-WML wavulelwa ukubuyekezwa ngumphakathi kusukela ngomhla ka-21 ku-Okthoba kuya kumhla ka-20 kuNovemba 2020. Phakathi neleso sikhathi sokubuyekeza, imibono yamukelwa, eyayidinga ukuba kwenziwe olunye ucwaningo nokuba kuthuthukiswe ucwaningo lwaphambilini. Izigaba ezibuyekeziwe kulo mbiko wokuchibiyela ziboniswe ngombhalo odwetshelwe.

IMITHELELA NEZINYATHELO ZOKUYINCIPHISA

Lo mbiko uveza imithelela engaba khona yephrojekthi ehlongozwayo, usho nezinyathelo zokunqanda noma zokunciphisa imithelela.

Imithelela engase ibangelwe yimisebenzi yephrojekthi ehlongozwayo nenggalasizinda ingahlukaniswa ngezinhlu eziwumonakalo ophansi, omaphakathi nophakeme esimweni esingakathathelwa izinyathelo zokunciphisa imithelela. Zonke le zinhlu ezintathu zemithelela zidinga isilinganiso esithile sezinyathelo zokuyinciphisa, okuyothi uma zenziwe ngempumelelo, zinciphise umonakalo wemithelela kanye nezingozi zayo eziza kamuva.

Ithebula elingezansi liveza uhlu, olungahleliwe ngokubaluleka, oluchaza kafushane imithelela engase ibe khona. L = Phansi, M = Maphakathi noH = Phezulu.

Umsebenzi noma inkinga ngephrojekthi	Umthelela ongase uvele	+ / -	Ngaphambi kwezinyathelo zokuwunciphisa	Ngemva kwezinyathelo zokuwunciphisa
Okubonakalayo				
Ukususwa kwezimila Ukwanda kwezithuthi ezinkulu Ukwakhiwa kwesisekelo se-TSF	Ukushintsha kwezinga ebonakala ngalo indawo ecwaningwayo ngenxa yezinto ezingokoqobo esezikhona nemisebenzi yokwakha. I-TSF izoba nomthelela ophansi ezindaweni zokuhlala eziyinhloko nezinto ezibukwa emigwaqweni endaweni. Izinyathelo zokunciphisa azinzima futhi zingaholela ekunciphiseni umthelela uma izinyathelo zokunciphisa zenziwa ngempumelelo futhi zilawulwa isikhathini eside esizayo.	-	**L**	**L**
I-TSF izokwenyuka ngobude. Kuzofakwa amalambu ezokuphepha	Ukushintsha kwezinga ebonakala ngalo indawo ecwaningwayo ngenxa yezinto ezingokoqobo esezikhona, ububanzi nobukhulu be-TSF entsha. Le phrojekthi ibonakala kakhulu kubantu abahamba ngomgwaqo u-R565 no-R556 nakubahlali baseLedig. Izinyathelo zokunciphisa zingenzeka zona kodwa ngeke zikwazi ukufihla/ukuyisitha yonke imisebenzi ehlongozwayo ngoba izingxenye ezinde ze-TSF zizobonakala kakhudlwana.	-	**M**	**M**
Ukwanda kwezithuthi	Ukudaleka kothuli ngokususwa	-	**L**	**L**

Umsebenzi noma inkinga ngephrojekthi	Umthelela ongase uvele	+ / -	Ngaphambi kwezinyathelo zokuwunciphisa	Ngemva kwezinyathelo zokuwunciphisa
ezinkulu phakathi nokususwa kwezakhiwo nokuthuthwa kwempahla eyovuselelwa. Ukulungiswa kwenhlabathi.	kwezakhiwo nokuhamba kwezithuthi, ngesikhathi kulungiselelwa ukuvuselelwa kwenhlabathi. Izinyathelo zokunciphisa zingenzeka futhi zingaholela ekuncipheni komthelela lapho kuvalwa uma zenziwa futhi zilawulwa ngempumelelo.			
Ukususwa kwezakhiwo, ukutshalwa kwezimila, ukuvuselelwa kwendawo.	Ukushintsha kwezinga ebonakala ngalo indawo ecwaningwayo ngokususa izakhiwo nokuvuselela indawo.	+	L	L
Izinga Lomoya				
Imisebenzi yokwakha ejwayelekile	Imithelela empilweni yabantu	-	L	L
	Ukwanda kwezintuli ezigulisayo	-	L	L
Ukusebenza kwe-TSF entsha	Imithelela empilweni yabantu	-	L	L
	Ukwanda kwezintuli ezigulisayo	-	L	L
Ukuyeka kokusebenza kwe-TSF	Imithelela empilweni yabantu	-	L	L
	Ukwanda kwezintuli ezigulisayo	-	L	L
Ukuvalwa kwe-TSF	Imithelela empilweni yabantu	-	L	L
	Ukwanda kwezintuli ezigulisayo	-	L	L
Ukuthuthukiswa kwephrojekthi	Umthelela esimweni sezulu	-	M	L
Umsindo				
Imisebenzi yokwakha ejwayelekile	Ukukhula komsindo ezinzweni ezizwela kakhulu	-	L	L
Ukusebenza kwe-TSF entsha	Ukukhula komsindo ezinzweni ezizwela kakhulu	-	L	L
Inhlabathi				
Ukwakha, Ukusebenza Nokuvalwa KwePhrojekthi Ye-TSF	Ukuphela kwenhlabathi	-	H	M
	Ukulahleka kwamandla omhlaba	-	M	M
	Ukungcola kwenhlabathi	-	M	L
Izimila Nezilwane Zasendle				
Ukususwa kwezimila nokuhlelenjwa komhlaba	Ukuphelelwa nokushintshwa kwendayo yazo - iMarikana Thornveld	-	H	H
Ukususwa kwezimila nokuhlelenjwa komhlaba	Ukuphelelwa nokushintshwa kwendayo yazo – Izimila Eziza Kamuva	-	H	M
Ukususwa kwezimila nokuhlelenjwa komhlaba	Ukucekeleka phansi kwendawo yazo	-	H	M
Ukususwa kwezimila nokuhlelenjwa komhlaba	Ukusunguleka nokusabalala kwezidalwa eziyingozi	-	M	L
Ukususwa kwezimila nokuhlelenjwa komhlaba	Ukonakala kwenhlabathi nokucekeleka phansi kwezindlela zokuhamba kwamanzi	-	L	L

Umsebenzi noma inkinga ngephrojekthi	Umthelela ongase uvele	+ / -	Ngaphambi kwezinyathelo zokuwunciphisa	Ngemva kwezinyathelo zokuwunciphisa
Ukususwa kwezimila nokuhlelenjwa komhlaba, ukushayisana kwezithuthi, ukubambeka efensini, emigodini nasemiseleni	Ukufa nokuphazamiseka kwezilwane.	-	M	L
Yonke imisebenzi ehlobene nephrojekthi	Ukulahleka nokuphazamiseka kwezidalwa ezingaphansi kokulondolozwa kwemvelo.	-	M	L
Izinto Zasemanzini Namaxhaphozi				
Ukwakhiwa kwenggalasizinda engaphezulu	Ukuphela kwemigudu yamanzi	-	H	M
	Ukuzika: Ukubeka nokuguguleka kwemizila yamanzi	-	M	L
	Ukungcola Kwamanzi Angaphezulu	-	L	L
	Ukungena kwezidalwa eziyingozi emizileni yamanzi	-	M	M
Ukusebenza kwe-TSF	Ukuphela kwemigudu yamanzi	-	H	M
	Ukuzika: Ukubeka nokuguguleka kwemizila yamanzi	-	M	L
	Ukungcola Kwamanzi Angaphezulu	-	L	L
	Ukungena kwezidalwa eziyingozi emizileni yamanzi	-	M	M
Ukuyekwa Noma Ukuvalwa Kwe-TSF	Ukuphela kwemigudu yamanzi	-	H	M
	Ukuzika: Ukubeka nokuguguleka kwemizila yamanzi	-	L	L
	Ukungcola Kwamanzi Angaphezulu	-	L	L
	Ukungena kwezidalwa eziyingozi emizileni yamanzi	-	M	M
Ezomnotho Nezenhlalo				
Ukwakhiwa, Ukusebenza Nokuvalwa KwePhrojekthi Ye-TSF	Ukuba magange komphakathi	-	M	M
	Uthuli ekuhlaleni nasezimpilweni	-	M	M
	Ukuthuthukiswa kwamakhono	+	H	H
	Ukwakhiwa kwamathuba emisebenzi	+	M	M
	Umnotho wendawo	+	M	H
	Ukwanda kwezinkinga zomphakathi	-	M	M
Amanzi Angaphansi Komhlaba				
Ukungcola kwamanzi angaphansi komhlaba ngesikhathi Kwakhiwa	Ukuvuza kwe-Hydrocarbon emishinini	-	M	L
Ukungcola kwamanzi angaphansi komhlaba phakathi noKusebenza	Amanzi angaphansi komhlaba angcoliswa ukuvuza kwe-liner	-	M	L
Ukungcola kwamanzi angaphansi komhlaba phakathi	Amanzi angaphansi komhlaba angcoliswa yinggalasizinda ezivuzayo	-	M	L

Umsebenzi noma inkinga ngephrojekthi	Umthelela ongase uvele	+ / -	Ngaphambi kwezinyathelo zokuwunciphisa	Ngemva kwezinyathelo zokuwunciphisa
noKusebenza				
Ukungcola kwamanzi angaphansi komhlaba ngemva kokuyeka ukusebenza kwayo	Amanzi angaphansi komhlaba angcoliswa ukuvuza kwe-liner	-	**M**	**L**

ISITATIMENDE SEZEMVELO

Ukuhlolwa kwephrojekthi ehlongozwayo kwembula amathuba okwenzeka kwemithelela engemihle (ikakhulukazi esimweni esingathathelwanga izinyathelo zokunciphisa) ezintweni eziphilayo, emasikweni, nakwezenhlalo nezomnotho kokubili ezizeni zephrojekthi nasezindaweni ezingakuzo. Ngokuthatha izinyathelo zokunciphisa, le mithelela engase yenzeke ingavinjelwa noma yehliselwe emazingeni amukelekayo.

Lokhu kuyokwenzeka, ingobo nje uma i-EMP isetshenziswa ngempumelelo, uma singekho isizathu sezemvelo, sezenhlalo, noma sezomnotho esivimbela ukuqhubeka kwephrojekthi.

TSHOBOKANYO E KHUTSHWANE

KETAPELE LE TSHOBOKANYO YA POROJEKE KA KAKRETSO

Bakubung Minerals (Pty) Ltd ke bone beng ba Bakubung Platinum Mine (BPM), moepo o mo nakong eno o leng mo polasing ya Frischgewaagd 96JQ (Dikarolo 3, 4 le 11). Bakubung Minerals (Pty) Ltd e na le tetlelelo ya go epa diminarala ya BPM. Moepo ono o gaufi le Ledig, dikhilomitara di le 2 kwa borwa jwa Pilanesberg Game Reserve le Sun City mo Porofenseng ya Bokone Bophirima. Go epiwa mo makekemeng kgotsa mo dirifeng tse pedi go batliwa Mefuta ya Setlhopha sa Polatiamo (*Platinum Group Elements*) - e leng polatinum, palladium, rhodium, le gouta gammogo le kopore le nickel tse di tswang mo go yone. Moepo ono o mo go Mmasepala wa Selegae wa Rustenburg le wa Moses Kotana wa Mmasepala wa Kgaolo wa Bojanala (Setshwantsho 1).

Moepo o neilwe tshwanelo ya go epa le tumelelo ya Tshekatsheko ya go Amega ga Tikologo *(Environmental Impact Assessment [*EIA]) ya yone ka 2009 le Laesense ya Tiriso ya Metsi e e neilweng ke Lefapha la Bonno jwa Batho, Metsi le Ntsholeswe *(Department of Human Settlements, Water and Sanitation* [DHSWS]) ka 2010. Morago ga moo, moepo o dirisitse dithebolelo tse dingwe le dipaakanyo.

Phetolo eno e e dirwang ke Knight Piésold (Pty) Ltd e thailwe mo keletsong ya BPM ya go oketsa tiro eno gore e kgone go dira ditiro tseno ka madi a e nang le one. Moepo ono o reboletswe go dirwa ka 3 MT/ka ngwaga, lefa go ntse jalo BPM e batla go dira tiro eno ka makgaoganyane - 1 Mt/ka ngwaga (gone jaanong) le 2 MT/ka ngwaga ka 2024).
Diphetolo tse tota di tlileng go dira mo porojekeng eno tse e leng karolo ya phetolo eno ya EIA ke:

- Phetolo ya bogolo go simolola ka 3 MT/ka ngwaga go ya go 1 MT/ka ngwaga le 2 MT/ka ngwaga.
- Go agiwa ga Lefelo le lengwe la Bolatlhelo jwa Dilatlhiwa (*Tailings Storage Facility* [TSF]) mo Polasing ya Frischgewaagd

THULAGANYO YA SEMOLAO

Pele ga tshimololo ya porojeke e e kopelwang, go batlega thebolelo ya go dira tiro mo tikologong mo mafapheng a a farologaneng a puso: One a akaretsa:

- Go fetolwa ga thebolelo ya tikologo le laesense ya taolo ya dilatlhiwa e e newang ke Lefapha la Dimenerala *(Department of Mineral Resources* [DMR]) go ya ka, ka bobedi National Environmental Management Act No. 107 of 1998 (NEMA) le National Environmental Management: Molao wa Dilatlhiwa (Water Waste No. 59 wa 2008 (NEM-WA) Porojeke e e kopelwang e kopanyeletsa ditiro di le mmalwa tse di kwadilweng tsa tikologo le dilatlhiwa. Melawana ya EIA e e dirisiwang mo porojekeng eno ke Molawana 982 wa 04 Sedimonthole 2014.
- Laesense ya tiriso ya metsi e e newang ke DHSWS go ya ka National Water Act No. 36 wa 1998 (NWA) wa TSF e ntšha le dikago tse di tsamaisanang le yone. Ditiriso tsa metse tse di tshwanetseng go kopelwa ke: 21 (g): Letangwana la Mouwane le le tsamaisanang le TSF, 21 (g): TSF, 21 (c) e ntšha le (i) ya ditiro (TSF, letangwana la mouwane) tse di dirwang mo 500m ya mogobe. Go sa tlamete go ya ka GN 704 ga go tlhokege.

GO TSAYA KAROLO GA BANALESEABE

Jaaka karolo ya tiro ya go buisana le banaleseabe, bathati le batho ba ba nang le kgatlhego le ba ba amegang (bo-I&AP) ba ne ba itsisiwe ka porojeke, ba newa tsholo ya go romela dipotso le ditshwaelo kwa setlhopheng sa porojeke, le go newa tshono ya go romela dipotso le ditshwaelo kwa setlhopheng sa porojeke, le go tlhatlhoba tokumente ya tshedimosetso ya tlhaloso le pego ya Phetolo. Ditshwaelo tsotlhe tse di amogetsweng di tsentswe le go diragadiwa mo pegong ya phetolo. Ditshwaelo tse dingwe tse di nnileng teng ka nako ya tshekatsheko ya botlhe di tla tshwarwa ka ka tsela e e tshwanang.

Go dirilwe gore terafote ya phetolo ya EA le ya WML e nne teng gore e tlhatlhobiwe ke botlhe go simolola ka 21 Diphalane go ya go 20 Ngwanaatsele 2020. Ka nako ya tlhatlhobo eno go ne ga amogelwa ditshwaelo, se se neng sa tlhoka gore go dirwe dipatlisiso tse dingwe gape le gore dipatlisiso tsa nako e e fetileng di ntšhafadiwe. Dikarolo tse di tlhatlhobilweng mo pegong eno ya phetolo di bontshiwa ka mafoko a a thaletsweng.

DIKAMEGO LE dIKGATO TSA GO DI FOKOTSSA

Pego eno e naya tshekatsheko ya dilo tse di ka nnang tsa ama mo porojeke e e kopelwang eno le go naya dikgato tsa go thibela kgotsa go fokotsa dilo tseo tse di ka amang.

Dilo tse di ka nnang tsa ama tse di tsamaisanang le ditiro tsa porojeke e e kopelwang eno le dikago le ditsela di ka bewa ka ditlhopha tsa tse eseng tsa sepe gotlhelele, tse di magareng, le tse dikgolo fa e le gore ga go a fokodiwa go ama ga tsone. Ditlhopha tsotlhe tse tharo tsa dikamego di tlhoka dikgato dingwe tsa go laola seemo tse, fa di dirilwe sentle di tla fokotsang bogolo jwa kafa porojeke eno e amang ka teng.

Lenaneothalo le le fa tlase le naya tshobokanyo ya tsela e porojeke e ka amang ka teng mme ga le a rulaganngwe ka botlhokwa jwa gone. T = Kwa Tlase, M = Magareng le G = Kea Godimo.

Tiro ya porojeke kgotsa bothata	Kafa porojeke e ka nnang ya ama ka gone	+ / -	Pele ga phokotso ya go ama	Morago ga phokotso ya go ama
Tse di bonwang				
Go rengwa ga ditlhatsana Koketsego ya dikoloi Go agiwa ga motheo wa TSF	Go fetolwa ga boleng jwa klefelo la patlisiso ka baka la batho ba ba nnang mo go lone le ditiro tsa go aga. TSF e tla nna le kamego e e kwa tlase mo diponong tsa dikago tsa bonno tsa konokono le ditsela dingwe tsa botlhe tsa mo lefelong leo. Dikgato tsa go fokotsa go ama di ka kgonega mme di tla felela ka go fokotsega ga kamego fa e le gore dikgato tsa go fokotsa kamego di dirwa sentle le go laolwa mo nakong e telele.	-	**L**	**L**
TSF e tla tlhatlosiwa boleele. Go tlile go tsenngwa dipone tsa tshireletso	Go fetolwa ga boleng jwa kafa lefelo la patlisiso le lebegang ka teng ka baka la batho ba ba nnang mo go lone le ditiro tsa go aga, selekanyo le bogolo jwa TSF e ntšha. Batho ba ba tsamaya ka tsela ya RE565 le R556 gammogo le ba ba batho ba ba nnang mo Ledig ba kgona go bona porojeke eno. Go ka kgonwa go tsaya dikgato tsa go fokotsa go amega mme di ka se kgone go fitlha/sira ditiro tse di kopelwang gotlhelele ereka dikarolo tse di kwa godimo	-	**M**	**M**

Tiro ya porojeke kgotsa bothata	Kafa porojeke e ka nnang ya ama ka gone	+ / -	Pele ga phokotso ya go ama	Morago ga phokotso ya go ama
	tsa TSF di tlile go nna ditelele mo di tla bonalang go tswa kgakala.			
Koketsego ya dikoloi tse dikgolo ka nako ya go tlosa dikago le go tsamaisiwa ga matheriale wa go busetsa lefelo mo maemong. Go baakanngwa ga mmu.	Go dira dithole fa go tlosiwa dikago le fa dikoloi di ntse di tsamaya, ka nako e go baakanngwang mmu gore lefelo le busediwe mo maemong. Dikgato tsa go fokotsa go ama di ka kgonega mme di tla felela ka go fokotsega ga kamego fa projeke e tswalwa fa e le gore di dirwa le go laolwa sentle.	-	L	L
Go tlosiwa ga dikago, go lemiwa ga dimela, go baakanngwa ga lefelo.	Go fetolwa ga boleng jwa lefelo la patlisiso ka go tlosiwa ga dikago le go busediwa ga lefelo mo maemong.	+	L	L
Boleng jwa Mowa				
Ditiro tsa kago ka kakaretso	Go amega ga boitekanelo jwa batho	-	L	L
	Koketso ya lerole le le tshwenyang	-	L	L
Ditiro tsa TSF e ntšha	Go amega ga boitekanelo jwa batho	-	L	L
	Koketso ya lerole le le tshwenyang	-	L	L
Go emisiwa ga TSF	Go amega ga boitekanelo jwa batho	-	L	L
	Koketso ya lerole le le tshwenyang	-	L	L
Go tswalwa ga TSF	Go amega ga botsogo jwa batho	-	L	L
	Koketso ya lerole le le tshwenyang	-	L	L
Go dirwa ga porojeke	Go amega ga phetogo ya tlelaemete	-	M	L
Modumo				
Ditiro tsa kago ka kakaretso	Koketsego ya modumo mo bathong le diphologolong tse di sa utlwaneng le one	-	L	L
Ditiro tsa TSF e ntšha	Koketsego ya modumo mo bathong le diphologolong tse di sa utlwaneng le one	-	L	L
Mmu				
Ditiro tsa go Aga, go Dirwa le go Tswalwa ga Porojeke ya TSF	Go latlhega ga mmu	-	H	M
	Go senang bokgoni ga lefatshe	-	M	M
	Kgotlelo ya mmu	-	M	L
Dimela le Diphologolo tsa Lefatshe Leo				
Go remiwa ga dimela le go baakanngwa ga lefatshe	Go latlhegelwa ke bonno ga diphologolo le go baakanngwa ga jone - Sekgwa sa Ditlhare tse di Mitlwa sa Marikana	-	H	H
Go remiwa ga dimela le go baakanngwa ga lefatshe	Go latlhegelwa ke bonno ga diphologolo le baakanngwa ga jone - Ditlhare tsa Morago ga go Kgorelediwa ke Porojeke	-	H	M
Go remiwa ga dimela le go	Go kgaoganngwa ga bonno jwa diphologolo	-	H	M

Tiro ya porojeke kgotsa bothata	Kafa porojeke e ka nnang ya ama ka gone	+ / -	Pele ga phokotso ya go ama	Morago ga phokotso ya go ama
baakanngwa ga lefatshe				
Go remiwa ga dimela le go baakanngwa ga lefatshe	Go tsenngwa le go anama ga diphologolo tse di tswang ka kwantle	-	M	L
Go remiwa ga dimela le go baakanngwa ga lefatshe	Go kgothega ga mmu le go wela kwa tlase ga metsi ga leswe le le tswang	-	L	L
Go rengwa ga ditlhare le go baakanngwa ga lefatshe, go thulana ga dikoloi, go tshwarwa ke difense, go epiwa le mesima	Go swa le go kgoreletsega ga diphologolo	-	M	L
Diporojeke tsotlhe tse di amanang le ditiro tseno	Go latlhega le go kgoreletsega ga diphologolo tse di tshwanetseng go kgorelediwa.	-	M	L
Matangwana le Megobe				
Go agiwa ga dikago le ditsela tsa fa godimo ga lefatshe	Go latlhegelwa ke bonno jwa mo metsing	-	H	M
	Go kgobokanngwa ga leswe le le welang kwa tlase ga metsi: Go wela mo metsing le go kgothega ga lone	-	M	L
	Kgotlelo ya Metsi a a fa Godimo ga Lefatshe	-	L	L
	Go kgorelediwa ga diphologolo tse eseng tsa lefelo leno mo melatswaneng	-	M	M
Ditiro tsa TSF	Go latlhegelwa ke bonno jwa mo metsing	-	H	M
	Go kgobokanngwa ga leswe le le welang kwa tlase ga metsi: Go wela mo metsing le go kgothega ga lone	-	M	L
	Kgotlelo ya Metsi a a fa Godimo ga Lefatshe	-	L	L
	Go kgorelediwa ga diphologolo tse eseng tsa lefelo leno mo melatswaneng	-	M	M
Go busediwa mo maemong kgotsa go Tswalwa ga TSF	Go latlhegelwa ke bonno jwa mo metsing	-	H	M
	Go kgobokanngwa ga leswe le le welang kwa tlase ga metsi: Go wela mo metsing le go kgothega ga lone	-	L	L
	Kgotlelo ya Metsi a a fa Godimo ga Lefatshe	-	L	L
	Go kgorelediwa ga diphologolo tse eseng tsa lefelo leno mo	-	M	M

Tiro ya porojeke kgotsa bothata	Kafa porojeke e ka nnang ya ama ka gone	+ / -	Pele ga phokotso ya go ama	Morago ga phokotso ya go ama
	melatswaneng			
Ikonomi le kafa e Amang Batho ka teng				
Ditiro tsa go Aga, go Dirwa le go Tswalwa ga Porojeke ya TSF	Ditebelelo tsa baagedi ba lefelo	-	**M**	**M**
	Lerole le le amang batho le botsogo jwa bone	-	**M**	**M**
	Go tlhabololwa ga bokgoni	+	**H**	**H**
	Go tlhamiwa ga ditiro	+	**M**	**M**
	Ikhonomi ya lefelo	+	**M**	**H**
	Koketsego ya mathata a batho	-	**M**	**M**
Metsi a a kafa tlase ga lefatshe				
Kgotlelo ya metsi a a kafa tlase ga lefatshe ka nako ya Kago	Go tshololwa ga *hydrogen* le *carbon* tse di tswang mo metšhineng	-	**M**	**L**
Kgotlelo ya metsi a a kafa tlase ga lefatshe ka nako ya Ditiro tsa Porojeke	Kgotlelo ya metsi a a kafa tlase ga lefatshe ke tse di tswang mo kolotsaneng	-	**M**	**L**
Kgotlelo ya metsi a a kafa tlase ga lefatshe ka nako ya Ditiro tsa Porojeke	Go kgotlelwa ga metsi a a kafa tlase ga lefatshe ke tse di tswang mo dikagong le ditsela	-	**M**	**L**
Kgotlelo ya metsi a a tswang kafa tlase ga lefatshe le go busediwa mo mannong ga lefelo	Go kgotlelwa ga metsi a a kafa tlase ga lefatshe ke tse di tswang mo kolotsaneng	-	**M**	**L**

POLELWANA KA TIKOLOGO

Tshekatsheko ya porojeke e e kopelwang e ka nna ya baka kamego e kgolo e e sa siamang ka tsela e e rileng (bogolo jang fa bothata jono bo sa thibelwa) mo mafelong a go nang le diphologolo le dimela tsa tlhago le ikonomi le loago mo lefelong la porojeke eno le mo tikologong. Dikamego tse di ka diragalang tseno di ka thibelwa kgotsa tsa fokodiwa gore e nne tse di amogelegang, fa go ka tsewa dikgato tsa go bo fokotsa.

Ka baka la seo fa EMP e diragadiwa sentle, ga go na lebaka la tikologo, la loago, kgotsa la ikonomi la gore porojeke eno e se ka ya tswelela.

TABLE OF CONTENTS

PAGE

TABLES

FIGURES

APPENDICES

Specialist Studies
Appendix D1
Visual Impact Assessment
Appendix D2
Air Quality Impact Assessment
Appendix D3
Noise Impact Assessment
Appendix D4
Terrestrial Impact Assessment
Appendix D5
Aquatic Impact Assessment
Appendix D6
Water Quality Monitoring Report
Appendix D7
Groundwater Impact Assessment
Appendix D8
Social Impact Assessment
Appendix D9
Heritage Impact Assessment
Appendix E
Overall Mine EMP and Emergency Response Plan

ABBREVIATIONS

AOS ..... Apparent Operating Size
BID ..... Background Information Document
BPDM ..... Bojanala Platinum District Municipality
BPM ..... Bakubung Platinum Mine
CBA ..... Critical biodiversity areas
CBR ..... California Bearing Ratio
CCL ..... Compacted clay layer
CEC ..... Cation exchange capacity
DAFF ..... Department of Agriculture Forestry and Fisheries
dBA ..... A-weighted decibel
DEA ..... Department of Environmental Affairs
DEFF ..... Department of Environment, Forestry and Fisheries
DMRE ..... Department of Mineral Resources and Energy
DHSWS ..... Department of Human Settlements, Water and Sanitation
EA ..... Environmental Authorisations
EAP ..... Environmental Assessment Practitioner
EIA ..... Environmental impact assessment
EIS ..... Ecological Importance and Sensitivity
EMF ..... Environmental Management Framework
EMP(r) ..... Environmental management programme (report)
EAPASA ..... Environmental Assessment Practitioners South Africa
ESA ..... Ecological Support Area
GCL ..... geosynthetics clay liner
GDT ..... Groundwater Decision Tool
GQM ..... Groundwater Quality Management
GN R ..... General Notice (Regulation)
Ha ..... Hectares
HGM ..... Hydrogeomorphic
IWWMP ..... Integrated Water and Waste Management Plan
IAPs ..... Interested and/or affected parties
IBA ..... Important Bird Area
JKA ..... Jongens Keet Associates
Km ..... Kilometres
LCT ..... leachable concentration threshold
LOM ..... Life of mine
m ..... Meters
mamsl ..... Metres above mean sea level
mbgl ..... Metres below ground level
mm ..... Millimetres
MOD ..... Moisture Density Relationship
MR ..... Mining Right
MPRDA ..... Mineral and Petroleum Resources Development Act, 2002
MTPA ..... Mega tonne per annum
NAAQS ..... National Ambient Air Quality Standards

NDCR ..... National Dust Control Regulations
NEMA ..... National Environmental Management Act, 1998
NEMAQA ..... National Environmental Management: Air Quality Act, 2004
NEMBA ..... National Environmental Management: Biodiversity Act, 2004
NEM:WA ..... National Environmental Management: Waste Management Act, 2008
(N)FEPA ..... (National) Freshwater Ecosystem Priority Areas
NHRA ..... National Heritage Resources Act, 1999
NO2 ..... Nitrogen dioxide
NPAES ..... National Protected Area Expansion Strategy
NSR ..... Nearest Sensitive Receptors
NWA ..... National Water Act, 1998
NWBSP ..... North West Biodiversity Sector Plan
NWREAD ..... North West Department of Rural, Environment & Agricultural Development
PCD ..... Pollution Control Dam
PES ..... Present Ecological State
PGE / PGM ..... Platinum Group Elements / Metals
PM10 ..... Particulate matter less than 10 micron diameter
PPP ..... Public Participation Process
RQO ..... Resource Quality Objectives
SACNSP ..... South African Council for Natural Scientific Professionals
SAHRA ..... South African Heritage Resources Agency
SAHRIS ..... South African Heritage Resources Information System
SANBI ..... South African National Biodiversity Institute
SANS ..... South African National Standards
SAR ..... Southern access road
SLR ..... SLR Consulting (Africa) (Pty) Ltd
SLP ..... Social and Labour Plan
SO2 ..... Sulphur dioxide
TCT ..... Total Concentration Threshold
ToPS ..... Threatened or Protected Species
TSF ..... Tailings Storage Facility
TSP ..... Total suspended particles
UV ..... Ultraviolet
WML ..... Waste Management Licence
WRD ..... Waste Rock Dump
WUL(A) ..... Water Use License (Application)

1 INTRODUCTION

1.1 BACKGROUND

Bakubung Minerals (Pty) Ltd is the owner of Bakubung Platinum Mine (BPM), currently operating on the farm Frischgewaagd 96JQ (Portions 3, 4 and 11). Bakubung Minerals (Pty) Ltd holds the mining right for BPM. The mine is located near Ledig, 2 km south of the Pilanesberg Game Reserve and Sun City in the North West Province. Two reefs are being mined for Platinum Group Elements - platinum, palladium, rhodium, and gold, with copper and nickel as by-products. The mine falls within the Rustenburg and Moses Kotane Local Municipalities of the Bojanala District Municipality (Figure 1).
The mine received its mining right with approval of its Environmental Impact Assessment (EIA) in 2009 and a Water Use Licence from the Department of Human Settlements, Water and Sanitation (DHSWS) in 2010. Subsequently, the mine has applied for other authorisations and amendments. Table 1 provides a summary of all the environmental authorisations and permits held by BPM.

Table 1: Rights, permits, licences and authorisations

Year Obtained	Reference Number	Type	Activities authorised
2009	NW 30/5/1/2/2/339 MR	Mining Right EMPr	• Full mine including processing plant, Mimosa TSF, WRD etc.
2010	26064730	Water Use Licence	• 21(a) abstraction from underground workings • 21(f) water treatment plant • 21(g) WRD; Setting Dams; PCDs; Sewage Holding Tank. • 21 (j) Removing water from underground
2014	NWP/EIA/40/2014	Basic Assessment for Mine Housing on site	• Township Establishment: >200 residential erven, 2 Crèches and 2 Churches, bulk water supply pipeline reservoir
2017	07/A22F/CGI/5132	Water Use Licence	• 21(g) Dust suppression, ore stockpile, TSF, PCD3, PCD4, RWD, sludge drying • 21 (c & i) Two culverts; two bridges, erosion nick points, noise attenuation berms; various pipelines, three powerlines.
2017	NW 30/5/1/2/3/2/339 EM	Integrated Environmental Authorisation and Waste Management Licence	• Construction and expansion of existing TSF, RWD, PCDs • Relocation of crusher • Reprocessing of WRD • Erosion control measures • Noise reduction berm • Roads • Ventilation shaft • Storage of general and hazardous waste • Construction of Phase 1A

Year Obtained	Reference Number	Type	Activities authorised
			Housing • Solar Power Plant • Stockpiles • Pipelines • Other associated infrastructure

1.2 AMENDMENT APPLICATION

This amendment by Knight Piésold (Pty) Ltd is based on BPMs wish to re-optimise the process in order to make its operations financially viable. The mine capacity was authorised for 3 MT/annum, but BPM wishes to approach this capacity in a phased approach - 1 Mt/annum (immediate) and 2 MT/annum (by 2024).
The specific changes to the project, are which forms part of this EIA amendment is:

- Capacity change from 3 Megaton per annum (MTPA) to 1 MTPA and 2 MTPA
- Construction of an additional TSF on Frischgewaagd Farm
- Change of liner for stock pad area.

BPM is proposing an additional TSF on the farm Frichgewaagd 96 JQ (portion 11), while the approved TSF will be constructed during phase 2 on farm Mimosa 81JQ. Refer to Figure 2 which shows the location of both the authorised (future) and proposed (immediate) TSFs, and their coordinates.

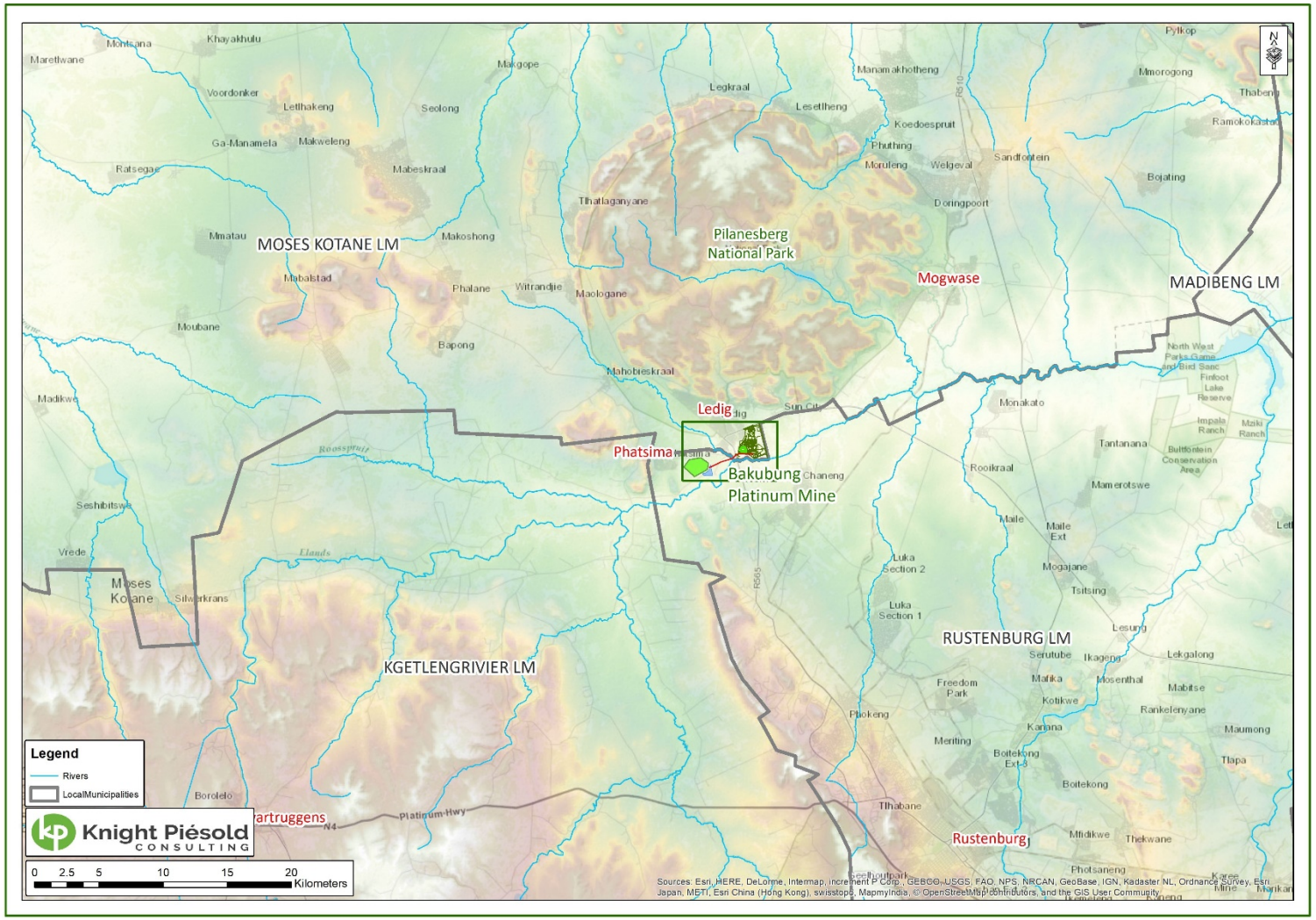

Figure 1: Regional Setting

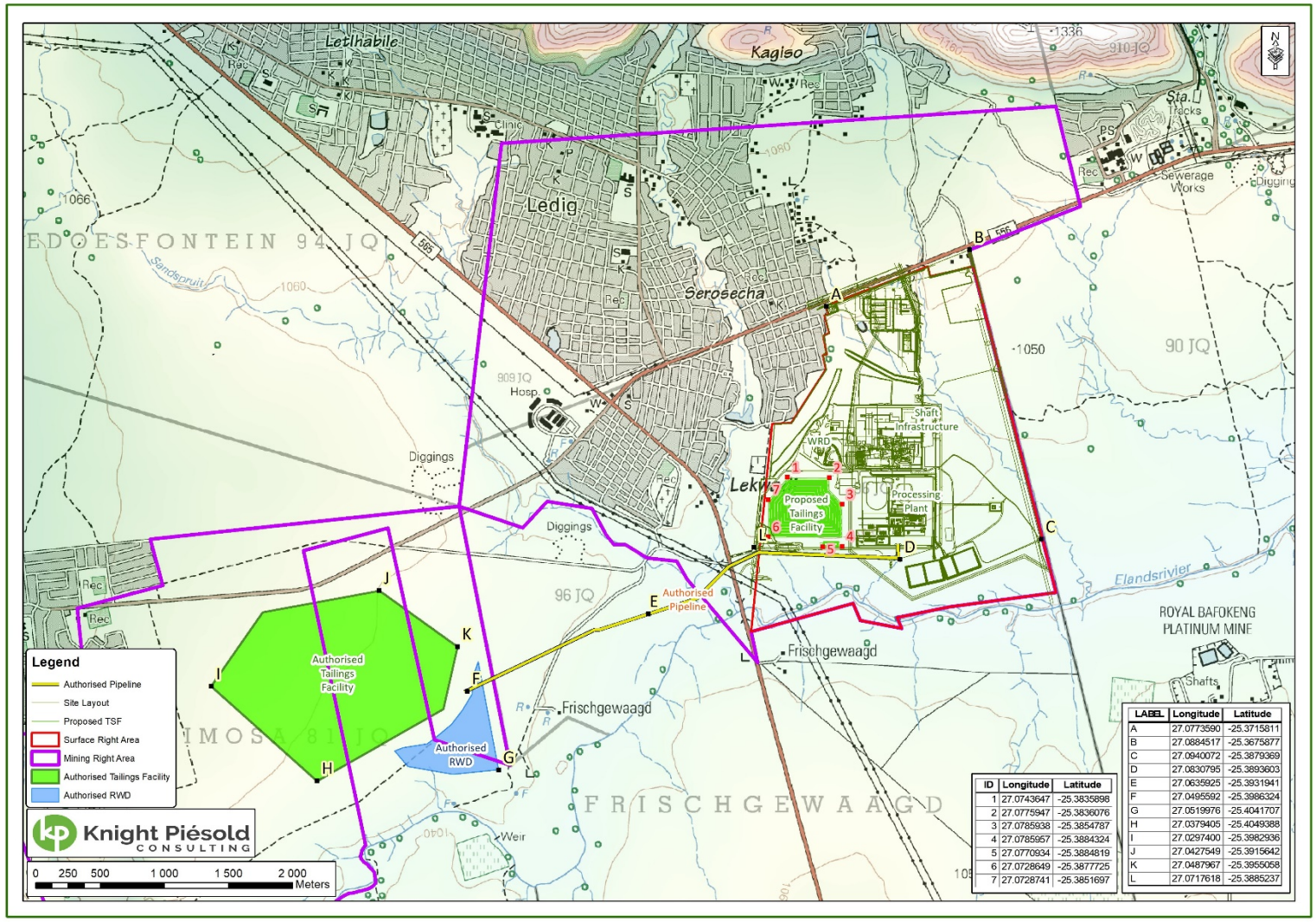

Figure 2: Authorised and proposed TSFs

1.3 Legal Framework

The following approvals are required before the amendments to the project can be implemented:

- Amendment of the environmental authorisation and waste management license from the Department of Mineral Resources and Energy (DMRE) in terms of both the National Environmental Management Act No. 107 of 1998 (NEMA) and National Environmental Management: Waste Act No. 59 of 2008 (NEM: WA). The proposed project incorporates several listed environmental and waste activities. The EIA regulations being followed for this project are Regulation 982 of 04 December 2014.
- The listed activities triggered are detailed in Table 2.

Table 2: Listed Activities Triggered by the Project

Listing Notice and Number	Governing Legislation	Competent Authority
GN 984 (1)	NEMA	DMRE
GN 921 Cat B (7)	NEMWA	

- In terms of Government N 961 of July 2019, a Screening Report generated through the Department of Environment, Forestry and Fisheries (DEFF) web-based platform should be submitted with the application for environmental authorisation. The North West Department of Rural, Environment & Agricultural Development (NWREAD) also provides a platform to generate a report of the site in relation to the Bojanala Platinum District Municipality's (BPDM's) Environmental Management Framework (EMF). Refer to Appendix A1 for the Screening and Appendix A2 for the NWREAD Reports.
- A water use license from the DHSWS in terms of the National Water Act No. 36 of 1998 (NWA) for the new TSF and associated infrastructure. The water uses to be applied for are: 21 (g): Evaporation Pond associated with the TSF, 21 (g): New TSF, 21 (c) & (i) for activities (TSF, evaporation pond) within 500 m of a wetland. Exemption in terms of GN 704 is not required.

Other approvals/permits needed for the proposed project prior to construction may include:

- Permit from Department of Agriculture Forestry and Fisheries in terms of the National Forests Act, 84 of 1998 to remove or damage any protected plant species.
- Prior to the destruction or relocation of heritage resources, permits will need to be obtained from the South African Heritage Resources Agency (SAHRA).

1.4 DETAILS OF ENVIRONMENTAL ASSESSMENT PRACTIONER (EAP)

Project Manager and Author
Name of Practitioner: Mrs. Tania Oosthuizen
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Technical Reviewer
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Tania Oosthuizen is a Senior Environmental Scientist with 16 years of experience. She is registered as a Professional Natural Scientist (Pr. Sci. Nat. 114500) with the South African Council for Natural Scientific Professionals (SACNASP) and is a member of the Environmental Assessment Practitioners South Africa (EAPASA). Tania has a master's degree in environmental management from the North-West University. She has considerable experience with managing complex environmental authorisation projects, water use license applications and environmental due diligence projects. Tania has work experience in South Africa, eSwatini, Namibia, Malawi, Tanzania, Zambia, Ghana and Zimbabwe.

Amelia Briel is the Manager for the Environmental Section of KP South Africa, with 17 years of experience in Environmental Management, within the mining and water infrastructure field. She is a registered Professional Natural Scientist. Amelia manages the Environmental Section at Knight Piésold and oversees all projects at a strategic level. She specialises in large-scale Environmental and Social Impact Assessments, Stakeholder Consultation, Feasibility Studies, Risk Assessments, Mine Closure Plans, Environmental Monitoring and Compliance. Amelia has experience in various African countries in terms of delivering regulatory approvals in line with local requirements, but also delivering projects to international best practice standards.

1.5 PROPERTY DESCRIPTION

Table 3 provides the property details for the full mining right area as well as for the site of the current amendment. Figure 3 shows the farm portions and landownership in and around the mine, and Figure 4 shows BPM in relation to protected areas.

Table 3: Property Details

	Entire Mine	This Amendment
Farm Name	• Remaining extent and portions 1, 3, 4, 11 of the farm Frischgewaagd 96 JQ • The remainder of the farm Mimosa 81JQ.	Frischgewaagd 96 JQ, portion 11
Application area (Ha)	2 343 ha	The proposed TSF and evaporation dam is approximately 27 ha
District Municipality	Bonjala Platinum District Municipality	Bonjala Platinum District Municipality
Local Municipality:	Moses Kotane and Rustenburg Local Municipalities	Moses Kotane Local Municipality
21-digit Surveyor General Code for each farm portion	T0JQ00000000009600001 T0JQ00000000009600003 T0JQ00000000009600004 T0JQ00000000009600011 T0JQ00000000009600000 T0JQ00000000008100000	T0JQ00000000009600011

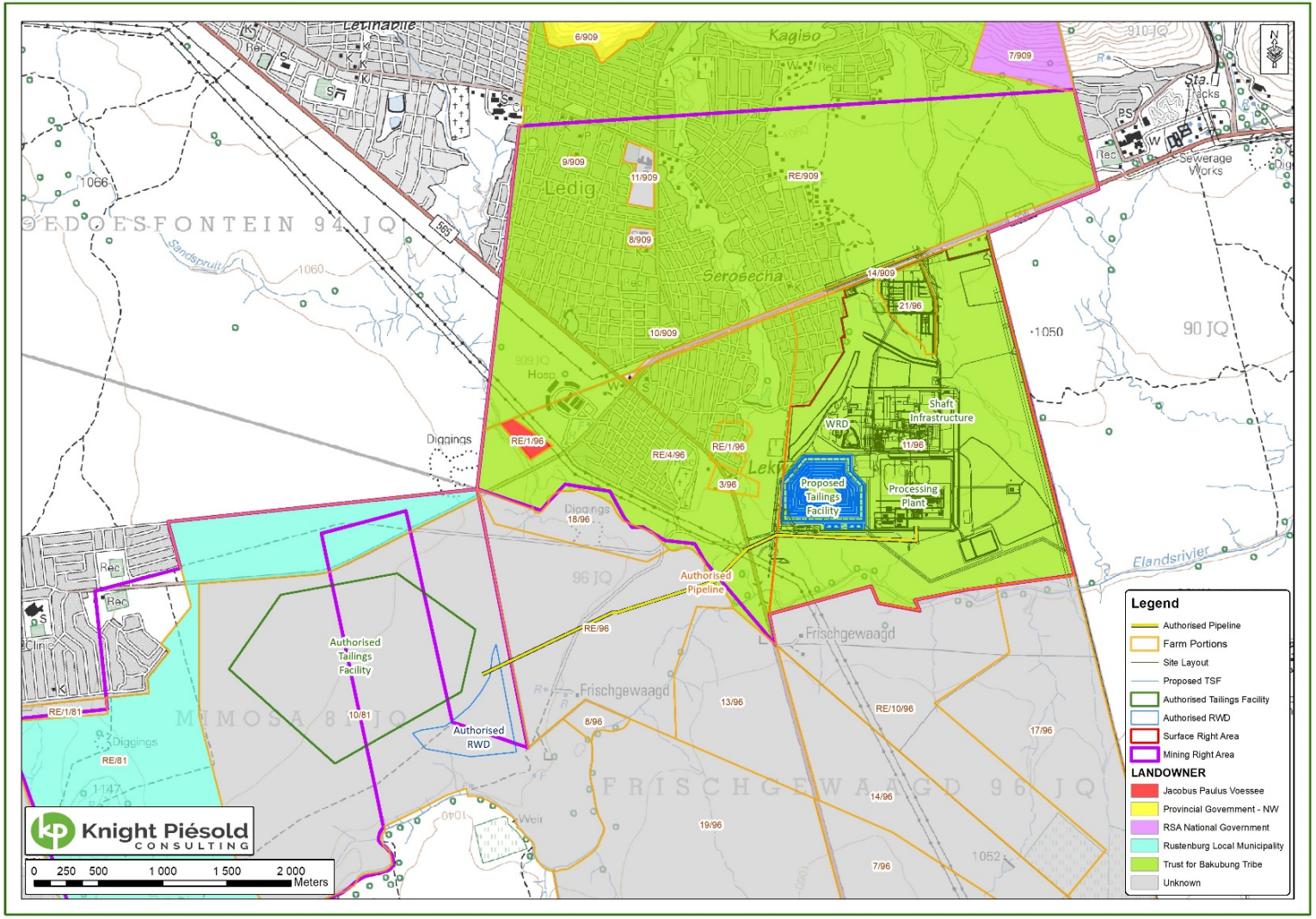


Figure 3: Farm portions and land ownership map

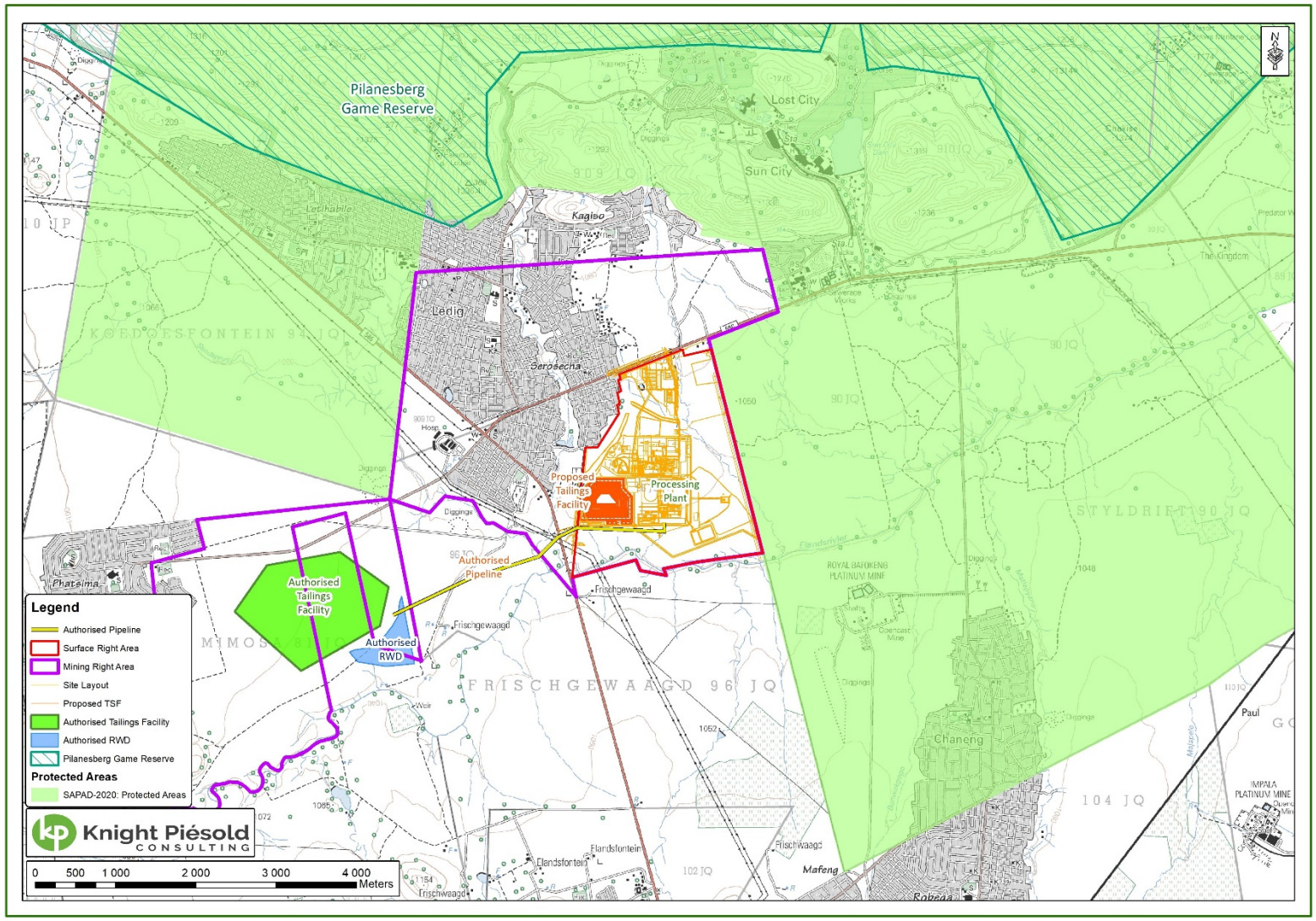


Figure 4: BPM in relation to protected areas

1.6 REPORT OUTLINE

This document has been prepared in accordance with Section 21(1)(a) of the NEMA EIA Regulations, which stipulate requirements for the contents of amendment reports. Table 4 provides a summary of the requirements together with the section in the report where it is addressed.

Table 4: EIA Report Requirements

Reporting Requirement	Section
An assessment of all impacts related to the proposed change	5.2
Advantages and disadvantages associated with the proposed change	7
Measures to ensure avoidance, management and mitigation of impacts associated with such proposed change	6
Public Participation	3

2 PROJECT DESCRIPTION

BPM is undertaking a project to design, build and operate a 1 MTPA capacity platinum ore concentrator plant and ramp it up to 2 MTPA over time. The concentrator plant is already authorised.

2.1 CONCENTRATOR PLANT

The concentrator plant is already authorised. The only change in the plant is the phasing from 1 MTPA to 3 MTPA. The mine plans to process 1 MTPA for five years before ramping up to 2 MTPA and then 3 MTPA after seven years.

2.2 TAILINGS STORAGE FACILITY

Information for this section was taken from (Knight Piésold , 2021). The design report is attached in Appendix B.

2.2.1 GENERAL

The Bakubung TSF consists of the following design elements:

- A 1 m high toe wall comprising of rockfill from the existing waste rock dump founded on the coarse residual norite providing containment during the early deposition into the facility.
- A Class C barrier system beneath the TSF, paddocks and evaporation ponds.
- A network of seepage collection drains constructed in the basin of the TSF and immediately upstream of the toe wall
- Toe paddocks to contain runoff and silt eroded from the outer slopes of the facility
- A concrete lined solution trench to channel filter discharge and runoff from the outer slopes to the evaporation pond.
- Two evaporation ponds with two compartments positioned at the lowest point of the solution trenches situated at the South Eastern side of the TSF to contain the seepage discharge.
- A perimeter access road to allow suitable access around site
- A stone pitched clean water diversion channel to divert clean stormwater around the TSF.

2.2.2 CAPACITY

2.2.2.1 INTRODUCTION

A 2019 survey of the existing site conditions was made available to KP by Wesizwe for the purposes of this design. Infrastructure situated within the boundaries of the proposed site for the TSF will need to be cleared for the development of the TSF. The TSF is required to contain an average tonnage profile of 1 Mtpa for a maximum period of 7 years. The tailings delivery system will be using conveyor coming from the filter plant on skid footings. From the conveyor, wheeled & telescopic stackers and then dozers will be implemented for the final placing.
Due to this being a filtered tailings facility, it has been assumed that the facility will be constructed by a system of conveyors and spreader, the TSF will be constructed in 7 m lifts until the final height is reached. The equipment will stack the tailings and the tailings will be spread and compacted using

mobile equipment. To achieve the required capacity, a total of seven lifts will be required. Each lift will have a 7 m wide bench.

2.2.2.2 TAILINGS PRODUCTION

The TSF is required to contain an average tonnage profile of 1 Mtpa for a minimum period of 7 years. A summary of the size parameters of the TSF and evaporation pond is given in Table 5 and Table 6.

Table 5: TSF Size Parameters

Parameter	Value
Area within the toe wall	21.6 Ha
Final Elevation of TSF	1 089 mamsl
Area of TSF at final elevation	2.8 Ha
Height of TSF above lowest point	± 48 m
Storage capacity available	7.6 Mt @ 1 089 mamsl

Table 6: Evaporation Pond Size Parameters

Parameter	Value
Area within the crest	0.88 Ha
Depth of evaporation pond above lowest point	0.9 m
Storage capacity available	27 128 m^3 @ Max level

2.2.3 UNDERDRAINAGE LAYER AND MONITORING SYSTEM

Although no groundwater was encountered during the geotechnical investigation, the under-drainage layer will form part of the barrier system to collect any leakage that may penetrate the barrier system and any water seeping underneath the TSF.

The under-drainage layer will comprise of finger drains at 50 m centre to centre. The finger drain will comprise a 110 mm diameter slotted pipe connecting into a main 160 mm solid pipe, a nonwoven geotextile wrapped around the pipe and clean river sand of at least 150 mm thick. The pipes have been designed for the normal leakage rate considering a 10% diameter water level and a factor of safety of higher than 3, whilst a 50% diameter water level and a factor of safety 5 for the highest leakage rate.

The finger drains will be arranged in a herringbone system and the trenches will be 300 mm wide by 300 mm deep. As the drainage layer is below the compacted clay layers of the barrier system, the drainage material will need to be from a clean source to avoid pollution of groundwater. The herringbone system will discharge into the solution trenches running outside the perimeter of the TSF monitoring the leakage rate and the efficiency of the barrier system.

For the evaporation pond the same herringbone drain will be applied, with pipes daylighting in a monitored sump.

2.2.4 BARRIER SYSTEM DESIGN

2.2.4.1 TAILINGS CLASSIFICATION

A sample of the tailings was submitted to Waterlab (Pty) Ltd for analysis and the results to EnChem Consultants to classify the tailings.

The following was noted from the analysis:

- The platinum tailings are neutral with paste pH of 7.4, which is within the landfilling limits of pH >6 and <12.
- The final pH of the leach solution was measured as 7.4, i.e., the sample only slightly increased the starting pH of the distilled water used to extract the sample.
- The average concentrations of cobalt, copper, manganese, nickel, and vanadium exceed the lowest threshold value of TCT0 but are all less than TCT1.
- None of the parameters of concern leached at a concentration greater than their LCT0 value.
- According to waste regulations GN 635, the sample classifies as a Type 3 waste, as for some elements TC is greater than TCT0 but ≤TCT1. However, no species leached at concentrations ≥LCT0, which is equal to the South African Drinking Water Standard or, if a value is not defined in SA, an International Standard. In addition, the sample leached very low soluble solids as the TDS value was measured as only 60 mg/l.
- The moisture content of the sample was 12.5% and would classify as a dry waste as the value is well below the landfill limit of 40%.
- The sample consists of the following major elements, i.e., at concentrations >1%; Al, 2.12%; Ca, 1.68%; Cr, 1.36%; Fe, 6.48%; Mg, 8.32%; and Si. 14.88%. These elements will be present as their oxides.

GN 636 requires a Class C barrier system for a Type 3 waste. The regulations allow the use of alternative materials such as geosynthetics composite drainage for drainage, geotextiles for protection and geosynthetics clay liner (GCL) for compacted clay liner proven to exhibit equivalent performance to the natural materials indicated.

2.2.4.2 BARRIER SYSTEM DESIGN

TSF

The Class C barrier system proposed for the TSF is presented in Figure 5. The barrier system will extend over the toe wall including the paddocks, ending in an anchor trench along the crest of the outer paddock berm.
From the excavation upwards the following notes on the barrier design are applicable:

- The base of the excavation shall be ripped and recompacted to 93% Standard Proctor density and moisture content between 0 and 2% of optimum moisture content.
- Underdrainage monitoring system shall be constructed excavating 300 mm for 300 mm wide, 110 mm perforated pipe wrapped in a needle punched nonwoven geotextile with an apparent opening size (AOS) of less than 200 microns (SANS 12958) and a California Bearing Ratio (CBR) of not less than 1.5 kN (SANS 12236) encased in clean river sand.
- The compacted clay liner (CCL) shall be constructed in 2 x 150 mm thick layers compacted to 95%Standard Proctor density at a moisture content between 0 and +2% of optimum moisture content. The in-situ colluvium and fine grained norite shall be selected and used for the compacted clay liner.
- The geomembrane shall be a 1.5 mm thick HDPE dual textured manufactured in accordance with Gri-gm13 (Geosynthetics Institute, 2013).

- The protection geotextile shall be a nonwoven needle punched geotextile with a unit mass of 1500 gr/m^2 in accordance with SANS 9864 and a CBR 13KN accordance with SANS 12236 made from polyester continuous filament.
- The drainage layer will comprise 160 mm diameter slotted pipe surrounded by 13 mm washed stone and covered by a needle punched nonwoven geotextile with an apparent opening size of less than 86 µm (SANS 12956) and Minimum Hydraulic Conductivity of 2x10-7 m/s (SANS 11058) and 30% porosity.
- 500 mm cover layer of filtered tailings will be deposited throughout the entire facility as a cover protection against UV degradation of the geotextile and to allow access to the facility by mechanical equipment. No machinery shall be allowed to access unprotected areas. The cover layer shall be installed within 3 months from installation of the geotextile. Any access to the facility shall be built with a gradient of 1:5 minimum.

By the toe wall, the barrier system will require a separation geotextile between the compacted clay liner and the rockfill. A 150 mm layer of coarse grained norite compacted to 90% Proctor will be placed over the rockfill and a nonwoven geotextile of 1500 gr/m^2 will act as a separator between the coarse grained norite and the CCL to avoid migration of the CCL in the rockfill.

Evaporation Pond

The Class C barrier system proposed for the evaporation pond is presented in Figure 6 below.

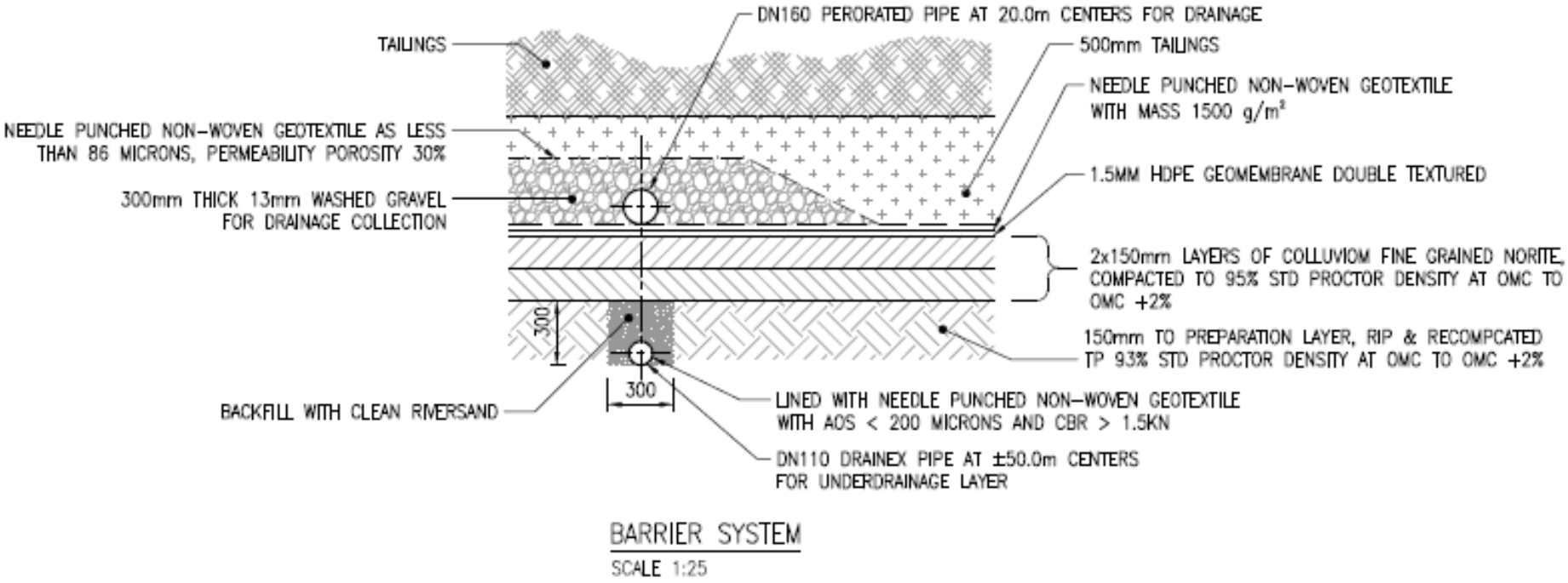


Figure 5: TSF Barrier System Detail

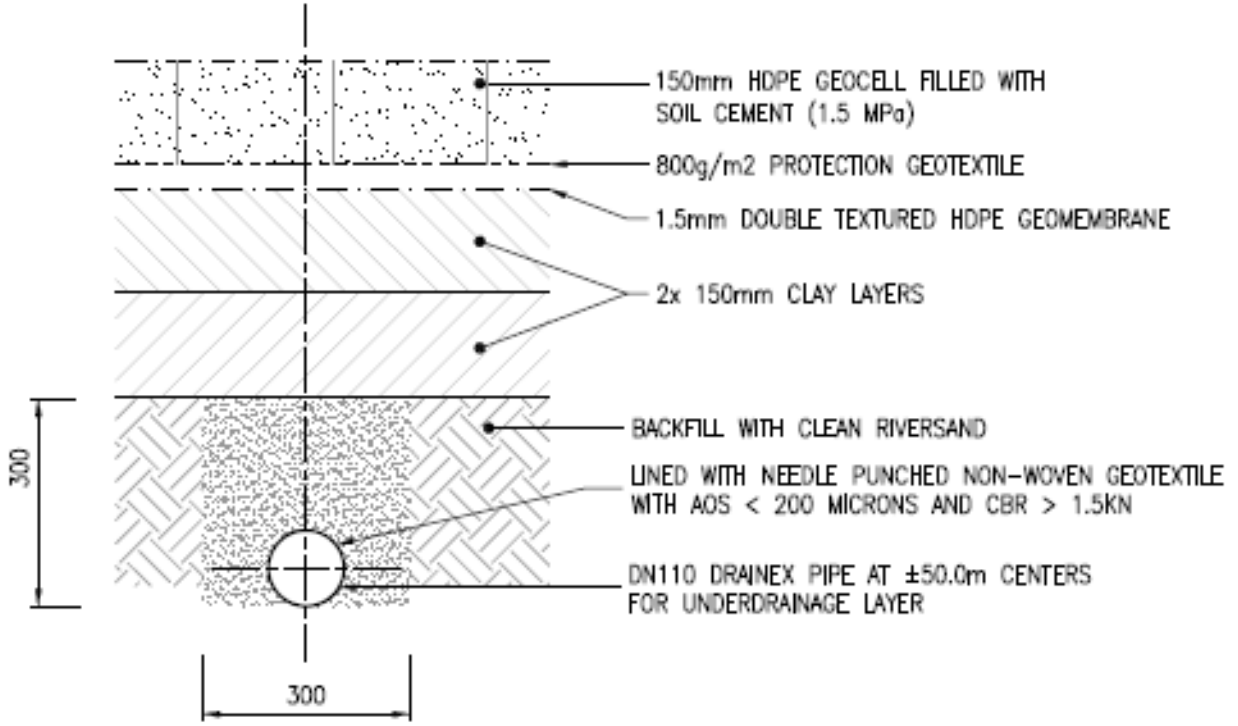


Figure 6: Evaporation Pond - Typical Barrier System Detail

From the excavation upwards the following notes on the barrier design are applicable:

- The base of the excavation shall be ripped and recompacted to 93% Standard Proctor density and moisture content between 0 and 2% of optimum moisture content.
- Underdrainage monitoring system shall be constructed excavating 300 mm for 300 mm wide, 110 mm perforated pipe wrapped in a needle punched nonwoven geotextile with an apparent opening size (AOS) of less than 200 microns (SANS 12958) and a CBR of not less than 1.5 kN (SANS 12236) encased in clean river sand.
- The compacted clay liner (CCL) shall be constructed in 2 x 150 mm thick layers compacted to 95% Standard Proctor density at a moisture content between 0 and +2% of optimum moisture content. The in-situ colluvium and fine grained norite shall be selected and used for the compacted clay liner.
- The geomembrane shall be a 1.5 mm thick HDPE dual textured manufactured in accordance with GRI-GM13 (Geosynthetics Institute, 2013).
- The protection geotextile shall be a nonwoven needle punched geotextile with a unit mass of 800 gr/m^2 in accordance with SANS 9864 and a 6 mm hole in accordance with SANS 13433 made from polyester or polypropylene fibres.
- 150 mm HDPE geocell characterised by a cell wall length of 356 mm and a tensile strength of 7 KN/m in accordance with ISO 13426-1 filled with a soil cement characterised by a compressive strength of 1.5 MPa at 100% Moisture Density Relationship (MOD) AASHTO.

2.2.5 SURFACE WATER MANAGEMENT

2.2.5.1 METHODOLOGY

The TSF surface water management is designed to be a closed dirty water system with a clean water diversion for the small catchment upstream of the TSF. The slope of the natural ground falls to the south-east which allows for the approach to be adopted. Figure 7 shows the configuration of the clean and dirty water infrastructure:

- The existing dirty water channel for the dirty catchment upstream of the TSF is indicated by the orange dashed line and directs water to the PCD (this is already constructed and falls outside the scope of this study)
- The clean water catchment (blue shaded area) is diverted around the TSF via a stone pitched clean water diversion channel (blue dashed line) that discharges to culverts under the access road and into the natural catchment
- The TSF dry stack constitutes the dirty catchment (red shaded area) with runoff from the TSF embankments to be contained in lined paddocks and allowed to evaporate
- A concrete lined solution trench (red dashed line) runs around the perimeter of these paddocks and directs runoff from the outer embankment of the paddocks and drainage from the TSF to lined eastern and western evaporation ponds (purple shaded areas).

The waste classification for the system dictates that a Class C barrier system is required for the containment of Type 3 waste (runoff and drainage in the evaporation ponds and the paddocks) with the arrangement depicted in Figure 7.
The sizing of the various infrastructure components was guided by the requirements set out in GN704. The requirements dictate that the clean and dirty water systems be sized such that each system is capable of containing/conveying the resulting flow from a 1 in 50-year storm event without spilling. The channels are thus designed to contain the peak discharge from the runoff emanating

from the 1 in 50-year storm event. The paddocks and the evaporation ponds were sized on the results of a water/evaporation balance, with the system stress tested by adding a 50-year storm event.

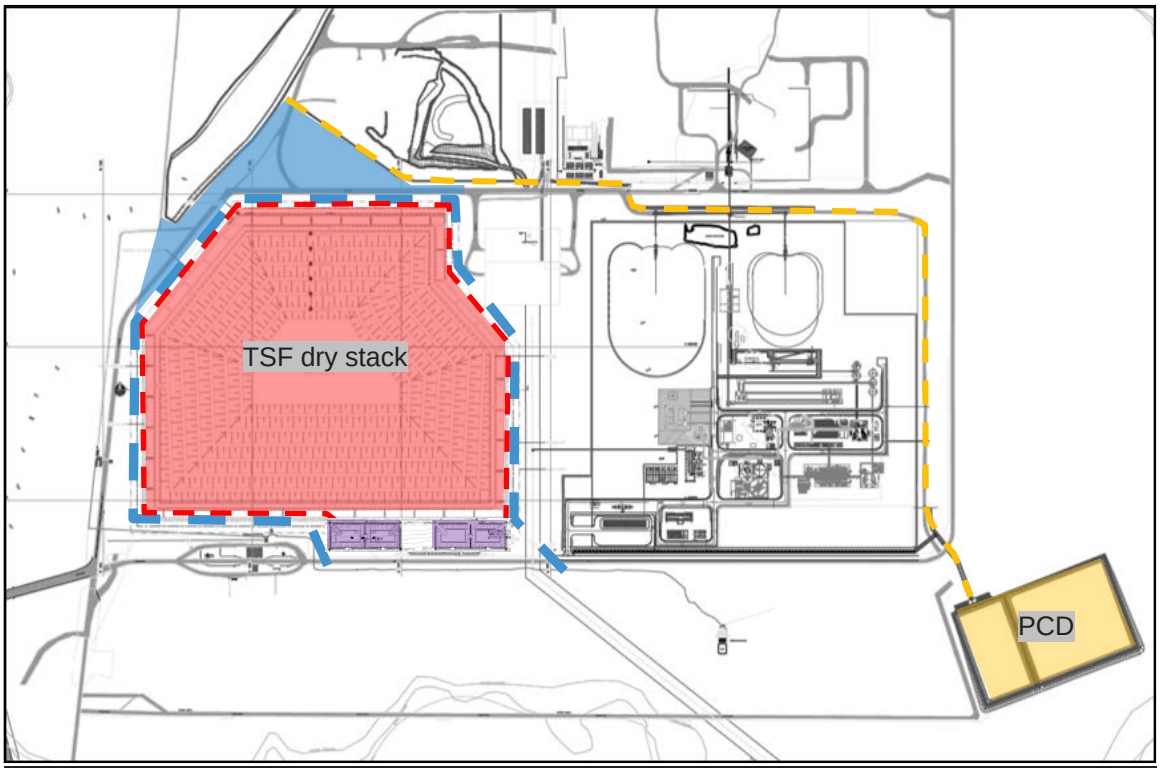


Figure 7: Schematic Showing Surface Water Infrastructure

2.2.5.2 CHANNEL SIZING

According to Government Notice No. 704 (GN704) of 1999, effort must be made to isolate the dirty areas to prevent the runoff from the “clean” areas from entering the dirty areas, and the dirty areas from entering the clean areas. This will be achieved by constructing concrete lined dirty water solution trenches around the perimeter of the paddocks, and constructing a stone pitched clean water diversion around the solution trench.

The peaks flow calculated for the clean water diversion was calculated separately for flow that will be diverted around the east and west of the TSF. For simplicity of construction, a single channel size will be specified for both channels. The clean water channels will discharge through existing culverts under the existing access road and then into the natural drainage system. The dirty water solution trench will discharge directly into the evaporation ponds located at the south-east corner of the TSF.

Table 7 summarises the sizing of the channels, while Table 8 summarises the key hydraulics parameters. The flow in the clean water diversion channels is subcritical, while the flow in the solution trench is supercritical. The Froude number for the flow on the milder slope (1:200) of the solution trench is 1.02 which means that the flow will be unstable (regular surface distortions). The flow depth for this flow is only 0.20 m which allows for sufficient freeboard to contain the flow despite the flow distortions.

Table 7: Channel Sizing

	Clean water diversion	Dirty water channels
Bottom Width (m)	1	1
Lining Type	Stone pitching	Concrete
Manning's coefficient	0.036	0.016
Side Slopes (V:H)	1:2	1:1.5
Minimum channel depth	0.7	0.5

Table 8: Hydraulic Properties of Channels

	Clean water diversion	Clean water diversion	Dirty water channels	Dirty water channels
Channel Slope (V:H)	1:100	1:200	1:100	1:200
Flow Rate (m^3/s)	0.68	0.68	0.47	0.47
Flow Depth (m)	0.37	0.44	0.20	0.25
Flow Velocity (m/s)	1.07	0.83	1.78	1.40
Froude Number	0.68	0.49	1.41	1.02
Flow Regime	Sub critical	Sub critical	Super critical	Super critical

2.2.5.3 TOE PADDOCKS AND EVAPORATION PONDS

The toe paddocks and eastern and western evaporation ponds have been designed to receive dirty water as inflow, with the only outflow being evaporation. A monthly water balance was developed to assess the performance of the structures. Figure 8, Figure 9, and Figure 10 show the typical cross section of the paddocks, the plan view of the evaporation ponds, and the typical cross section of the evaporation ponds, respectively. The evaporation ponds consist of two ponds (east and west), each containing two compartments. The primary compartments are sized such that they can receive flow from the solution trenches and will fill up and evaporate based on the seasonal precipitation and evaporation rates, while the secondary compartments provide storage capacity for containing spillage from the primary compartments.

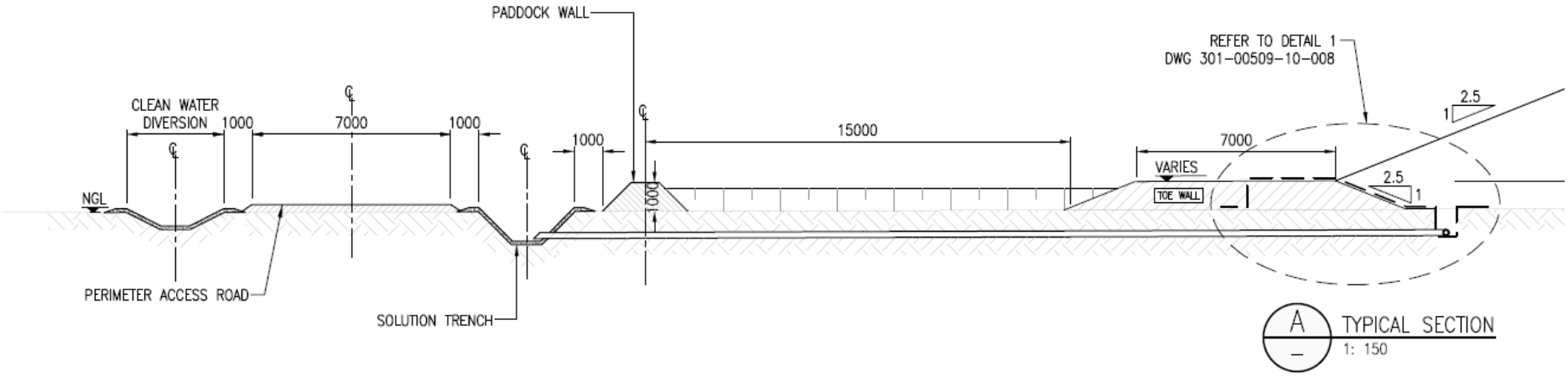


Figure 8: Typical detail of TSF Paddocks and Clean and Dirty Trenches

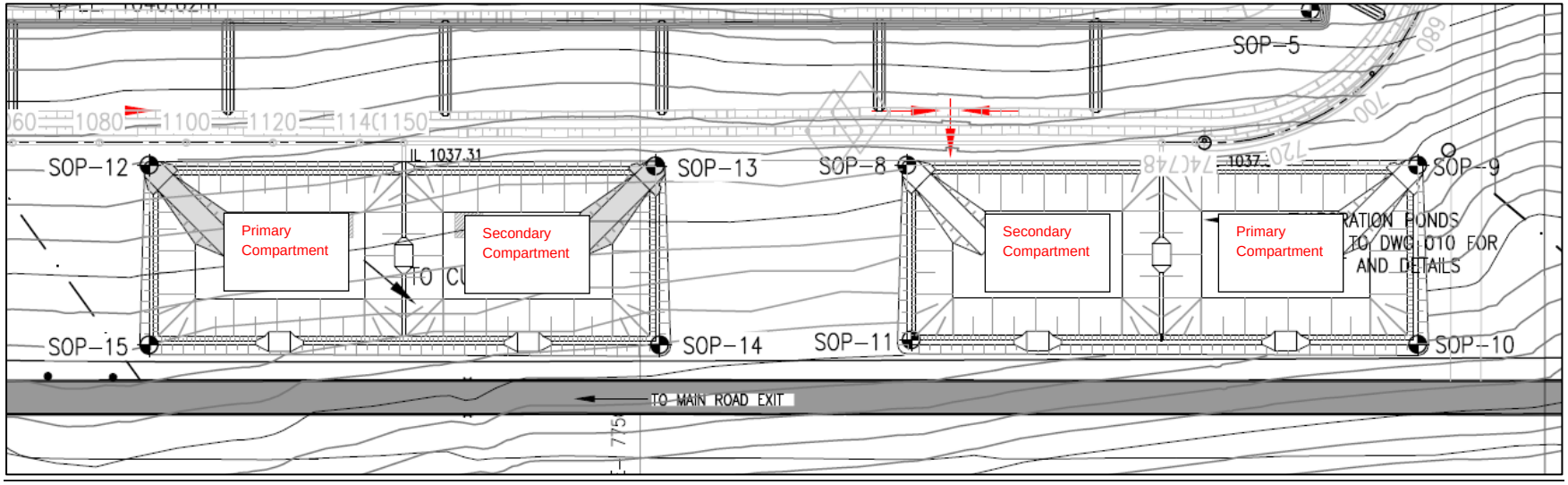


Figure 9: Evaporation Pond Layout

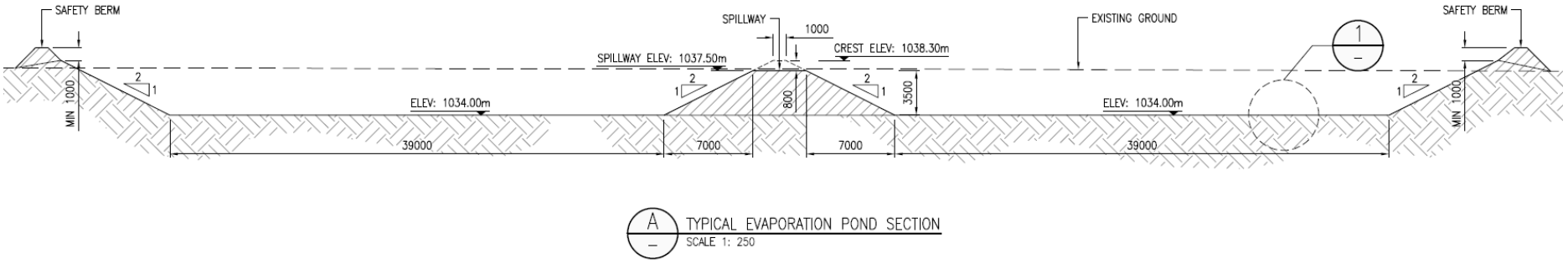


Figure 10: Typical Cross Section for Evaporation Pond Compartments

2.2.5.4 TOE PADDOCKS

The paddocks have been designed to accommodate the runoff generated from the TSF embankments at the full TSF height. This is done to account for the maximum possible runoff from the embankments. The walls are 1.3 m high, 25.0 m from the crest of the TSF toe berm to the crest of the paddock berm, and approximately 50.0 m wide (refer Figure 8 for paddock cross section). The size of the paddocks was determined through a monthly water balance that tested the system under three conditions:

1. Average climatic conditions
2. Containment for a 1 in 50-year wet season applied to the 2nd year after fully developed TSF
3. Containment of the 1 in 50-year 7-day storm occurring in the wet season of the 2nd year after fully developed TSF.

During average climatic conditions, the maximum water level in the paddocks is expected to be 0.56 m, with the paddocks emptying seasonally due to evaporation alone. The occurrence of a 1 in 50-year storm event (237 mm over 7 days) will result in higher runoff from the embankments but is contained within the paddocks with a water level of ~1.27 m. Water levels in the paddocks after this storm will remain high and will take several seasons to return to normal operating conditions due to evaporation alone, but will be fully contained in the paddocks; it is recommended that pumps be used to draw down the water level as quickly as possible after a storm event. The paddock system was also modelled against a 1 in 50-year wet season, with the maximum water level in the paddocks rising to 0.71 m.
The sizing of the paddocks is such that there should be no spilling over the paddock embankment for precipitation events that are less than or equal to the 1 in 50-year wet season or 1 in 50-year storm events.

2.2.5.5 EVAPORATION POND

The system was tested for the same conditions as set out for the evaporation paddocks. Each compartment will have a base capacity of 4 400 m^3 with a depth of 3.5 m from basin invert to the spillway invert between compartments, and a depth of 4.3 m from basin invert to the overflow spillway (pond capacity).

2.2.6 DRAINAGE COLLECTION LAYER

A drainage collection layer will be placed on top of the geomembrane on the barrier system as finger drains at a 20 m distance centre to centre. The drainage layer will comprise 160 mm diameter slotted pipe surrounded by 13 mm washed stone and covered by a nonwoven geotextile. The finger drain will have a trapezoidal shape a top width of 1 m, an overall height of 300 mm and side slopes of 1 (vertical) in 3 (horizontal) as per Figure 11 . The TSF base will have a slope of 1.5% from the higher side of the TSF to the lower side and the drainage pipes will have a minimum longitudinal slope of not less than 1%.

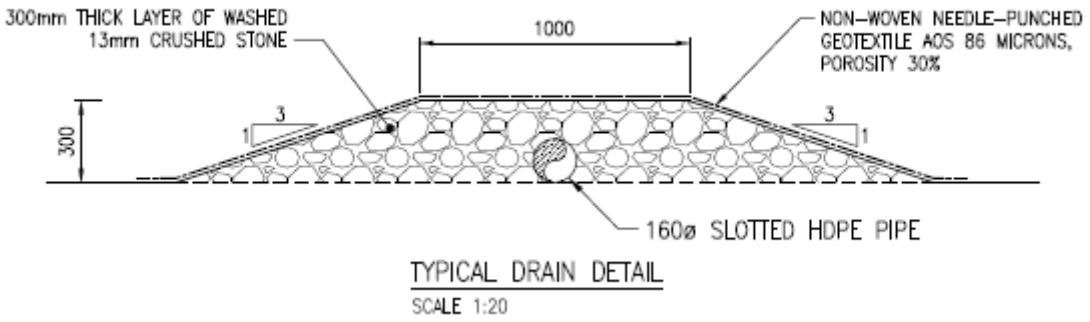


Figure 11: Drainage Collection System

2.2.7 TAILINGS DELIVERY

The tailings will be delivered to the TSF via a conveyor system from the mine as shown on Drawing No. 301-00509/10-008 in Appendix B. The design of the conveyor system and spreader will be conducted during the detailed design phase of the project by others.

2.2.8 ROADS

There will be a 7-meter-wide perimeter road between the clean water diversion channel and the solution trench as shown on drawing 301-509/10-005 of Appendix B. The roads may act as a fire break as well in the event of veld fires.

2.2.9 CLOSURE CONSIDERATION

The TSF will be constructed in 7 m lifts (7 lifts in total to its final height). It is assumed for rehabilitation that while a lift is being constructed, rehabilitation will be taking place on the lift below. The reasons for the rehabilitation are as follows:

- Slope stability – if excessive infiltration is allowed, this could lead to a build-up of water in the TSF and the additional pore pressure would decrease the shear strength of the material reducing the factor of safety.
- Erosion control – the vegetation anchors the topsoil layer and reduces the flow velocity of the run-off which reduces erosion.
- Leachate control – the topsoil layer reduces infiltration into the TSF thus reducing the volume of contaminated water.

The proposed rehabilitation will include covering the surface of the facility with a 300 mm layer of material excavated from the basin of the TSF and reshaping the plateau area with a slope of 3% to reduce infiltration. The material will be fertilised and grassed.

3 PUBLIC PARTICIPATION

3.1 OBJECTIVES OF PUBLIC PARTICIPATION

The public participation process (PPP) plays an integral role in informing Interested and Affected Parties (IAPs) as well as the organs of state; of a proposed project/activity. It entails the disclosure of all pertinent information to IAPs to aid in the decision-making process. In addition, the process allows for IAPs to contribute local knowledge and raise comments that may be related to project planning and design. The objectives of the process for the BPM Amendment were as follows:

- To provide information on the proposed updates
- To answer questions or address concerns
- To record the comments and concerns of stakeholders in an objective way for inclusion in the Amendment report and IWULA.

This section will provide an overview of the public participation process conducted.

3.2 NOTIFICATION OF INTERESTED AND AFFECTED PARTIES

The IAPs were informed of the proposed project by the mechanisms listed below. Proof of notification is included in Appendix C1.

Background Information Document (BID): A BID was prepared for IAPs to provide a brief description of the proposed project activity, information regarding the applicable legislation and process as well as the details of the EAP. The BID was sent out to the IAP database on 23 March 2020 via email and hand delivered to the relevant ward councillors on 7 May 2020.

Site Notices: A2-site notices were placed at 1.) Ledig Supermarket, 2.) Banana General Dealer 3.) Leo Cash and Carry, 4) Menati Cash and Carry 5) Obadiah General Dealer and 6) BPM Main Entrance. The site notices contained information on the nature of the activity, the application process, as well as details of the EAP. The site notices were provided in both English and Tswana. On 17 March 2021 site notices in English, Setswana and isiZulu were placed at most of the same venues as follows: 1.) Bakubung Ba Ratheo Tribal Authority, 2.) Obadiah General Dealer, 3.) Surprise Supermarket, 4.) Peace Shop and 5.) Banana General Dealer.

Newspaper advertisement: A newspaper advertisement was placed in The Rustenburg Herald on 6 May 2020. Further advertisements were placed in the Rustenburg Herald on 14 October 2020 and in Platinum weekly on 16 October 2020. For the second round of public review, the advertisements were also translated into Setswana and placed in Rustenburg Herald on 17 March 2021 and in Platinum weekly on 19 March 2021.

Executive Summary: For the second round of public review, the Executive Summary was also translated into advertisements were also translated into Setswana and isiZulu.

Stakeholder engagement forum: Knight Piésold presented the project to the members of the stakeholder engagement forum on 22 September 2020 at Bakubung Bush Lodge. The attendees participated in the meeting in their languages of choice and were responded to in their respective language.

3.3 ACCESS AND OPPORTUNITY TO COMMENT ON ALL WRITTEN SUBMISSIONS

The draft EA and WML amendment report together with the specialist reports was made available for public review from 21 October to 20 November 2020 on the Knight Piésold website and in hard copy at Ledig Tribal Office. During this review period comments were received, which required additional studies to be undertaken and previous studies to be updated. Refer to Appendix C2 for the Issues and Concerns Report.

The following was also undertaken to inform the public and registered IAPs of the availability of the draft report:
Emails and text messages: Emails and text messages will be sent to I&APs to notify them of the availability of the report for review.
Newspaper advertisement: The availability of the Draft EA and WML amendment report was be advertised in two local newspapers (Rustenburg Herald and Platinum Weekly).

3.4 SUMMARY OF COMMENTS RECEIVED

All comments received to date has been documented in the Issues and Concerns Report (Appendix C2).

3.5 NOTIFYING INTERESTED AND AFFECTED PARTIES OF THE DECISION

The decisions from DMRE and DHSWS will also be communicated to registered IAPs by means of a letter via email and will include the applicable appeals procedures for both processes.

4 BASELINE ENVIRONMENT

The baseline information was derived from the latest specialist studies undertaken in 2020 as well as the previous EIA undertaken (SLR, 2016). This baseline section focusses on the areas where project amendments are proposed.

4.1 TOPOGRAPHY

According to GPT (2020), the planned TSF site is flat, and the surface topography slopes slightly in a southerly direction between elevations 1050 metres above mean sea level (mamsl) and 1029 mamsl, a slope of 2.4% (Figure 12). The site is situated within the A22F quaternary catchment.
Local drainage is towards the Elands River that flows from southwest to northeast located to the south of the site. On a larger scale, drainage occurs towards the generalised flow of the Crocodile River which flows from south to north towards the Limpopo River.

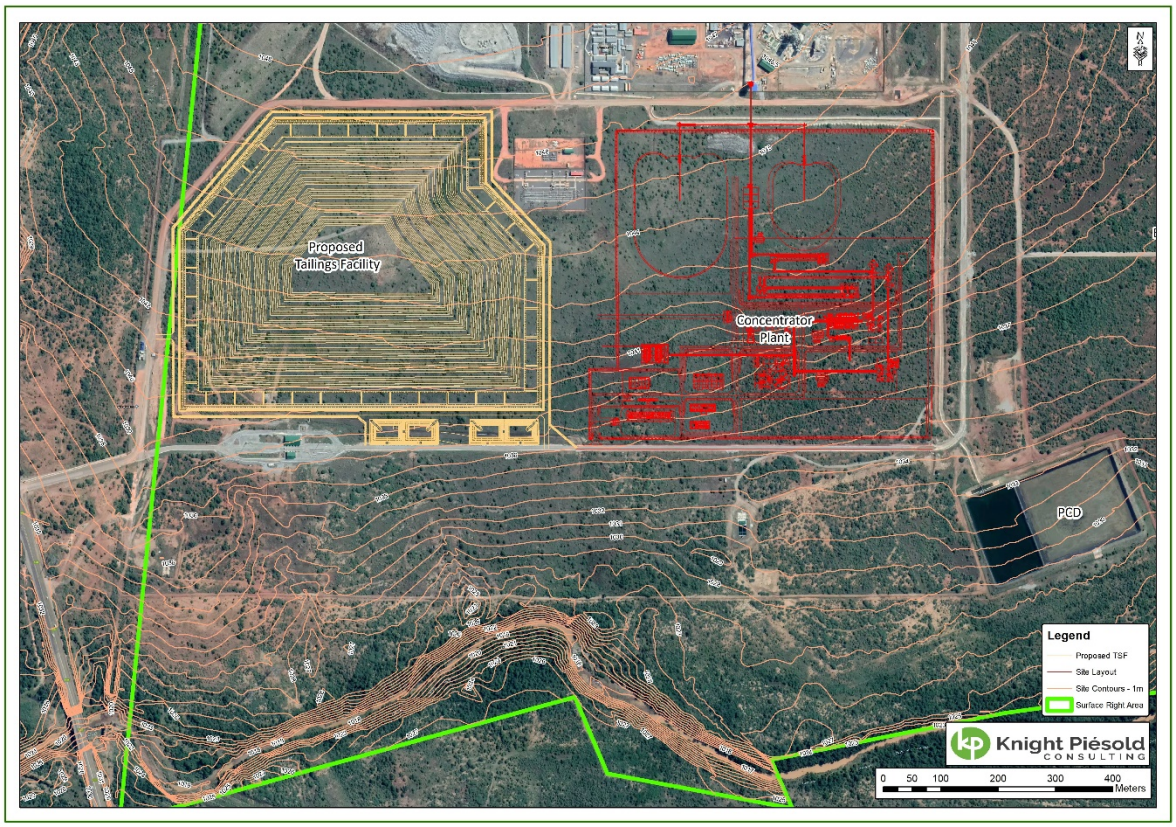


Figure 12: Site Topography

4.2 VISUAL

As part of this amendment process, a Visual Impact Assessment was undertaken (Green Tree Environmental Consulting, 2021). The full report is available in Appendix D1.

4.2.1 VISUAL CHARACTER

The study site is located in an area that is characterised by several land uses, including mining, tourism, human settlements (townships), grazing and agricultural fields. The study area has a slightly rolling topography that is created by the Elands River. Other rivers that contribute to the rolling topography of the surrounding areas are the Leragane, Bonwakgogo and Matlapyane Rivers, the Pilanesberg is located to the north of the study site, to the south and the east of the study area are several koppies and mountains. Refer to Figure 13 to Figure 15 for panoramas illustrating the character and nature of the study area and Figure 16, which indicates the location of the viewing points.

The study area falls within the Savanna Biome and is classified as the Zeerust Thornveld (SVcb 3) according to Mucina and Rutherford (2006). The conservation status for the vegetation unit is least threatened and approximately 16% of the land has been transformed primarily by cultivation and urban or built-up areas. Mining has also drastically altered the character of this landscape in this Biome. The area, pre-mining, was largely dominated by natural vegetation, open to short thorny woodland with an herbaceous layer of mainly grasses.

The landscape types are discussed in terms of their visual appeal in the Section below to determine the baseline (i.e., quality of the visual resource) of the study area.

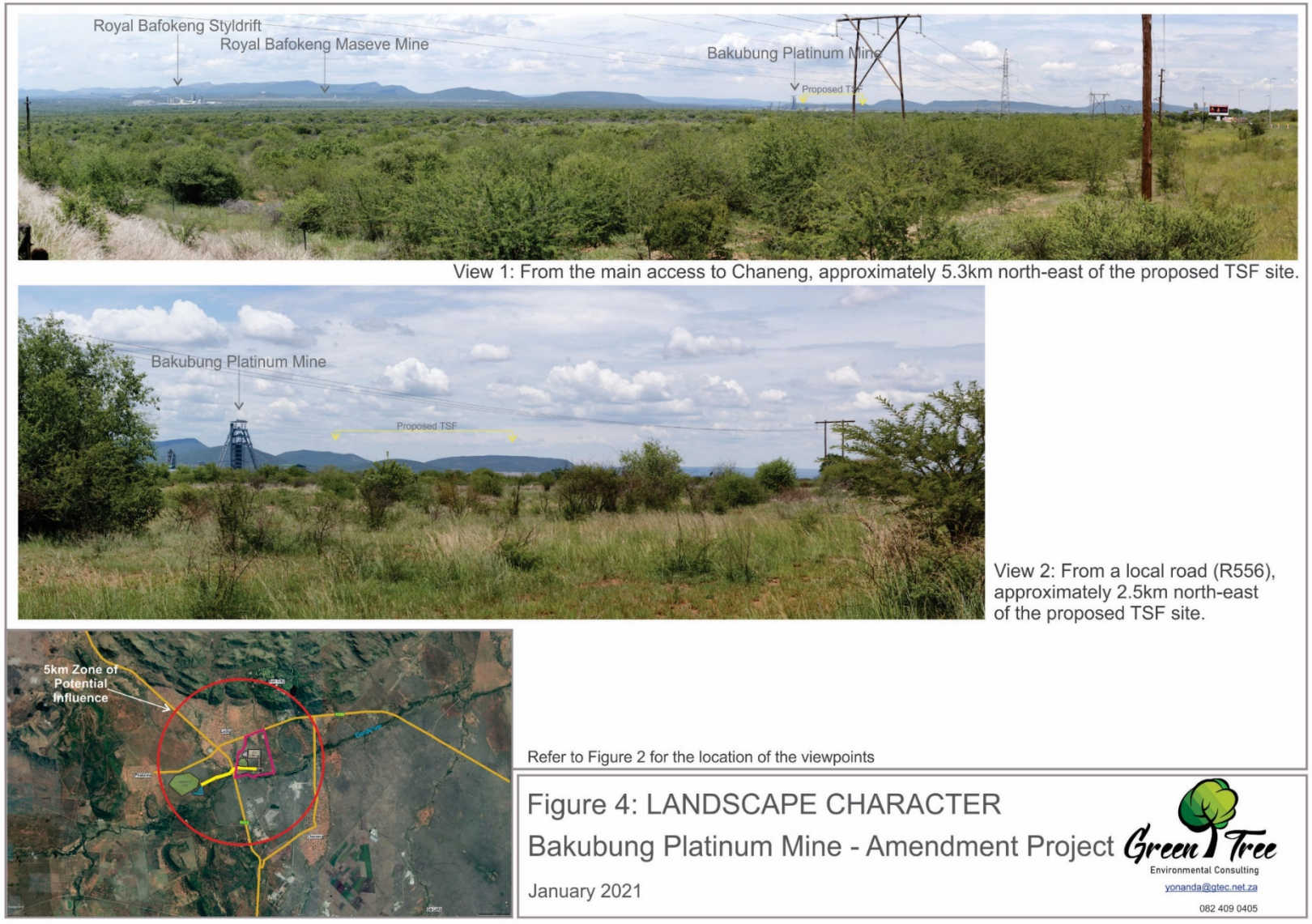


Figure 13: Landscape Character 1

Figure 14: Landscape Character 2

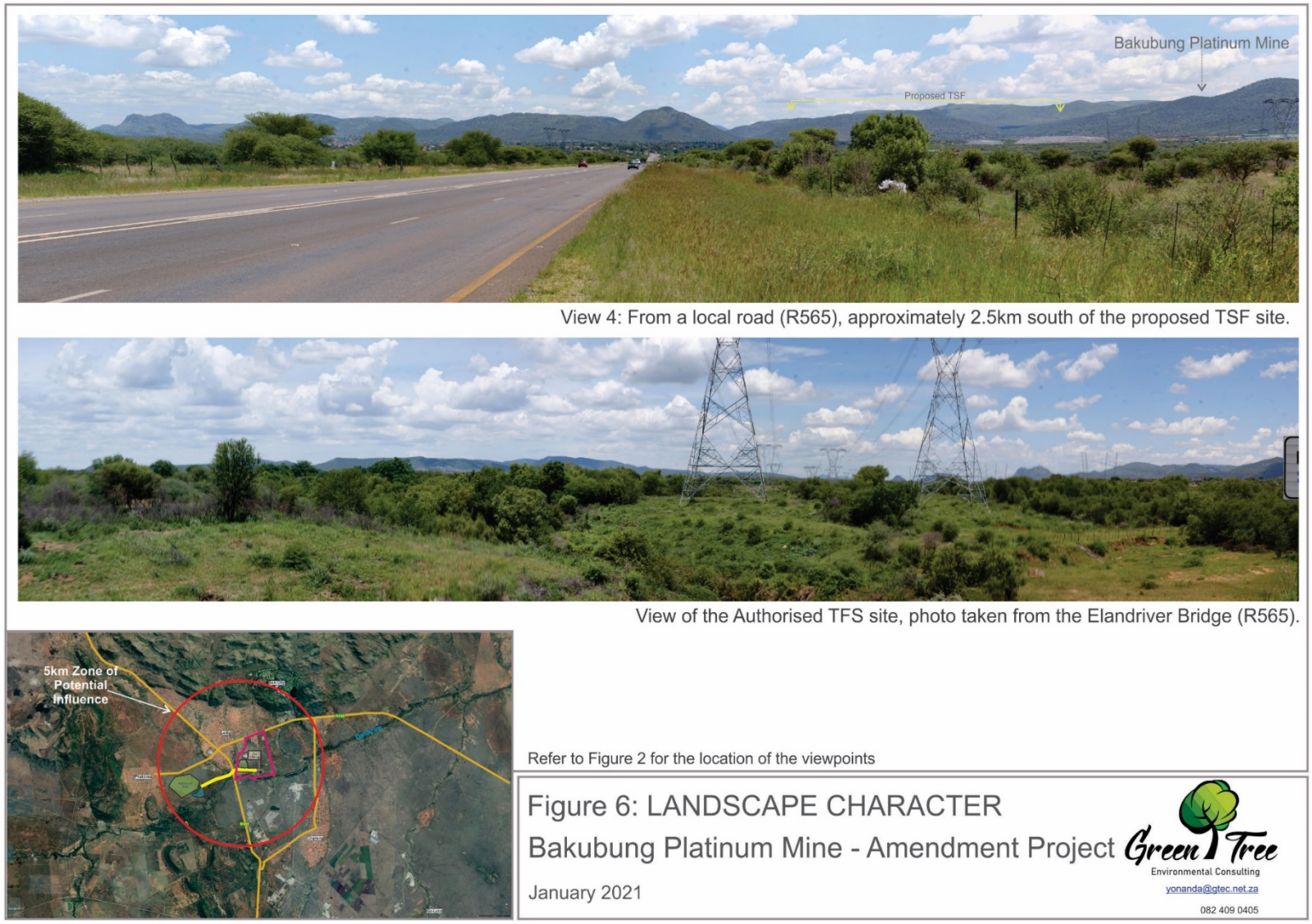


Figure 15: Landscape Character 3

4.2.2 VISUAL RESOURCE

4.2.2.1 VISUAL RESOURCE VALUE / SCENIC QUALITY

The scenic quality of the study area is primarily derived from the combination of land-uses described in the section above as well as the landscape character (topography, vegetation cover, mountains and rivers), as illustrated in Figure 13 to Figure 15. The area is characterised by mining activities not just within the study area but within the general area as well as settlements and tourist attractions, the natural component includes the Pilanesberg Mountains, the koppies, Elands River and the woodlands, refer to Figure 16.

The visual resource value of the study area is considered to be *moderate*. The once natural/pastoral landscape has been compromised by the intrusion of mining related activities and settlements but the natural features such as the mountains and woodland are still prominent within the study and general area.

4.2.2.2 SENSE OF PLACE

The sense of place for the study area derives from the combination of all landscape types and their impact on the senses. The sense of place of the study area is mainly dominated by the industrial/urban feeling created by the mining activities as well as the settlements within the study area. This sense of place changes when moving outside the study area and can basically be divided into an industrial/urban sense of place for receptors located along the R565 and towards the south of the study area, this sense of place is created by the mining activities, industrial activities and settlements located along the main access road towards Rustenburg. Receptors located towards the north, south-west and east of the study area will experience a more pastoral sense of place created by the natural landscapes.

4.2.2.3 SENSITIVITY OF VISUAL RECEPTORS/ VIEWERS

Within the context of the study area and the region, the following receptors (Table 9) were identified as potential sensitive viewers during the site visit. It should however be noted that most of the viewers from the settlements and local roads, located within the study area, has been exposed to the mining activities. Refer also to Figure 16, which identifies their location relative to the Project site.

Table 9: Potential Sensitivity of Visual Receptors – the Project

High	Moderate	Low
Resident staying within the settlements (Ledig, Phatsima and Chaneng) that are located within close proximity to the study site (View 2). Tourist visiting the various tourist attractions such as Sun City, Pilanesberg and Kingdom Resort.	Locals and visitors travelling through the study area on the local roads (View 3 and 4).	People working within the study area and travelling along local roads whose attention may be focused on their work or activity and who therefore may be potentially less susceptible to changes in the view.

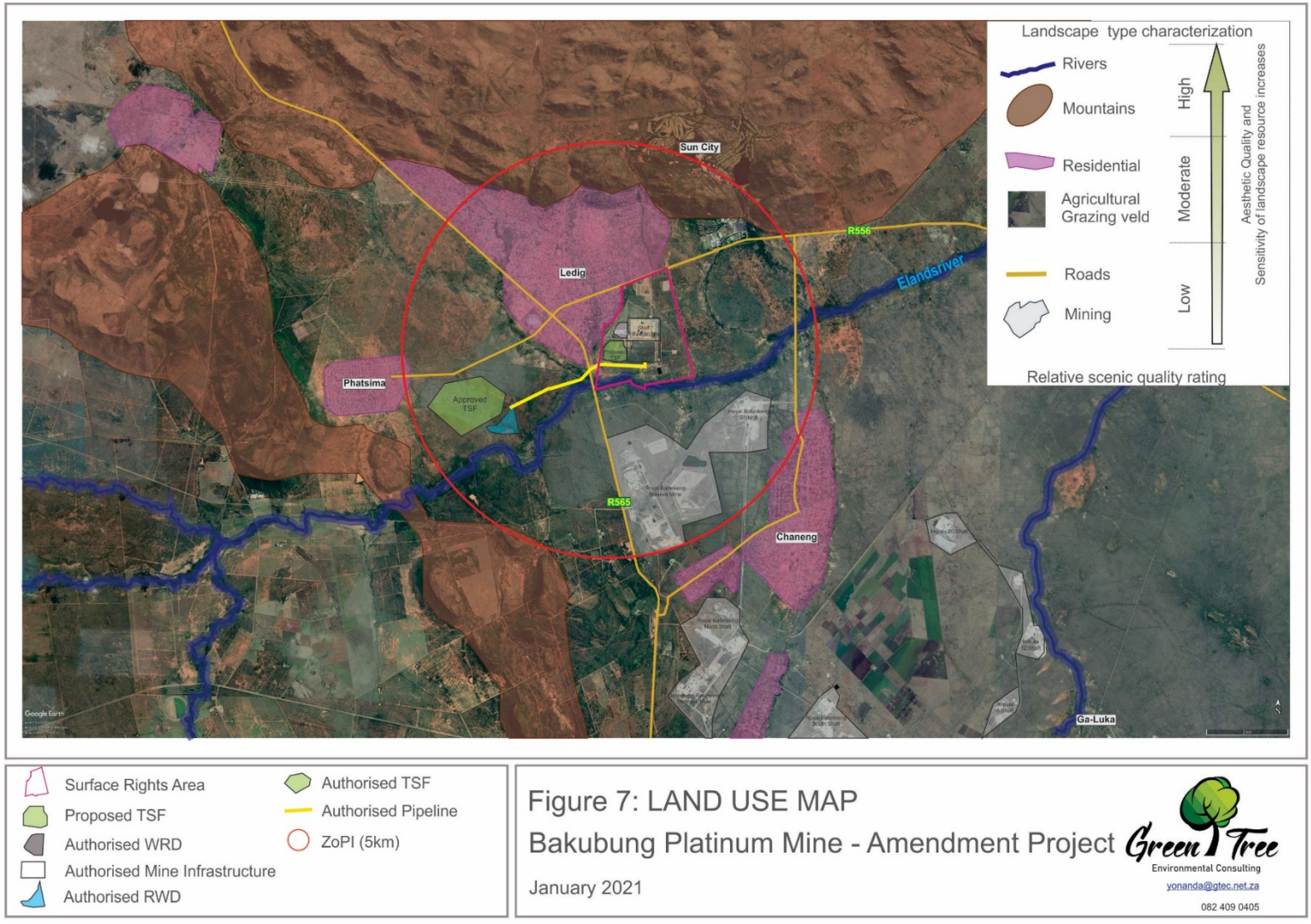


Figure 16: Land use Map showing sensitive receptors (residential)

4.3 GEOLOGY

4.3.1 REGIONAL SETTING

Indicated by the published geological map of the area, Sheet 2526 Rustenburg (1:250 000), the regional area is underlain by gabbro and norite of the Rustenburg Layered Suite, Bushveld Complex, Vaalian Era (GPT, 2020). A syenite dyke is indicated to the south of the site, while a north west-south east trending fault is indicated to the west of the site (Figure 17).

4.3.2 LOCAL SETTING

Locally the area is underlain by gabbro-norite of the Rustenburg layered suite and these units outcrop in the areas around drainages where the covering soil layer has been eroded. The soil cover on the site consists of a dark brown to black, firm loamy clay with abundant vegetation roots. This soil is dispersive and expansive and forms large cracks when moisture is driven off. Locally the soil is referred to as black “turf”.

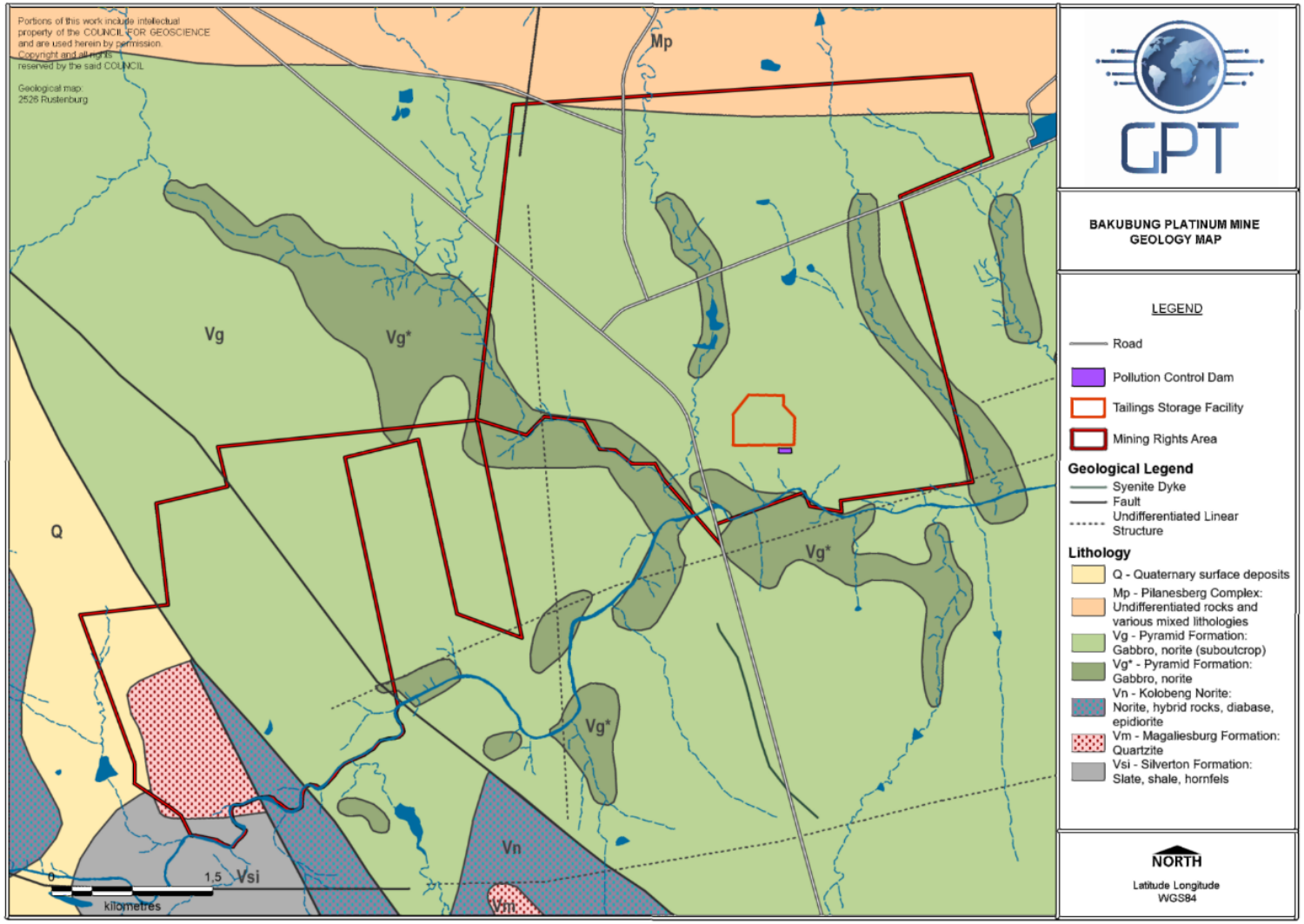


Figure 17: Geology Map of the Study Area (GPT, 2020)

4.4 CLIMATE

4.4.1 REGIONAL CLIMATE RAINFALL

According to (Gemini, 2016) the climatic condition of the eastern region of the province where the project site is located is largely temperate. The project area falls within the central bushveld climatic region. The average temperature is ~ 19°C, with the average maximum in the summer months being 30°C and the minimum in the winter months being 2°C. The annual rainfall averages 631 mm, with the highest rainfall in the summer months. Wind speeds can range from 5 -10 m/s from the west and west-north west.
The Mine falls in a region of hot summers and mild winters where the historic data from the weather stations report that:

- Summer maximum temperatures range between 25 and 30°C but can increase to over 30°C for extended periods,
- Winter days are usually mild with temperatures averaging between 18 and 23°C, and
- During mid-winter, the minimum temperatures drop close to 0°C.

4.4.2 PERIOD AVERAGE AND MONTHLY AVERAGE WINDS AT BPM

The period wind field and diurnal variability in the wind field are shown in Figure 18, while the seasonal variations are shown in Figure 19. The wind field is dominated by winds from the east. The strongest winds (>6 m/s) occurred mostly from the west. Calm conditions occurred 1.5% of the time, with the average wind speed over the period of 2.74 m/s. Wind from the west having greater speeds were greater during the day with a higher frequency of calm conditions (1.6% during the day) than during the night (1.3% during the night). Day-time shows a dominant easterly component to the wind field and during the night winds from the east decrease and the east-north-easterly winds dominate but only slightly in comparison to the easterly winds. Strong winds in excess of 6 m/s occurred most frequently during spring followed by summer. Calm conditions occurred most frequently during the autumn and winter months.

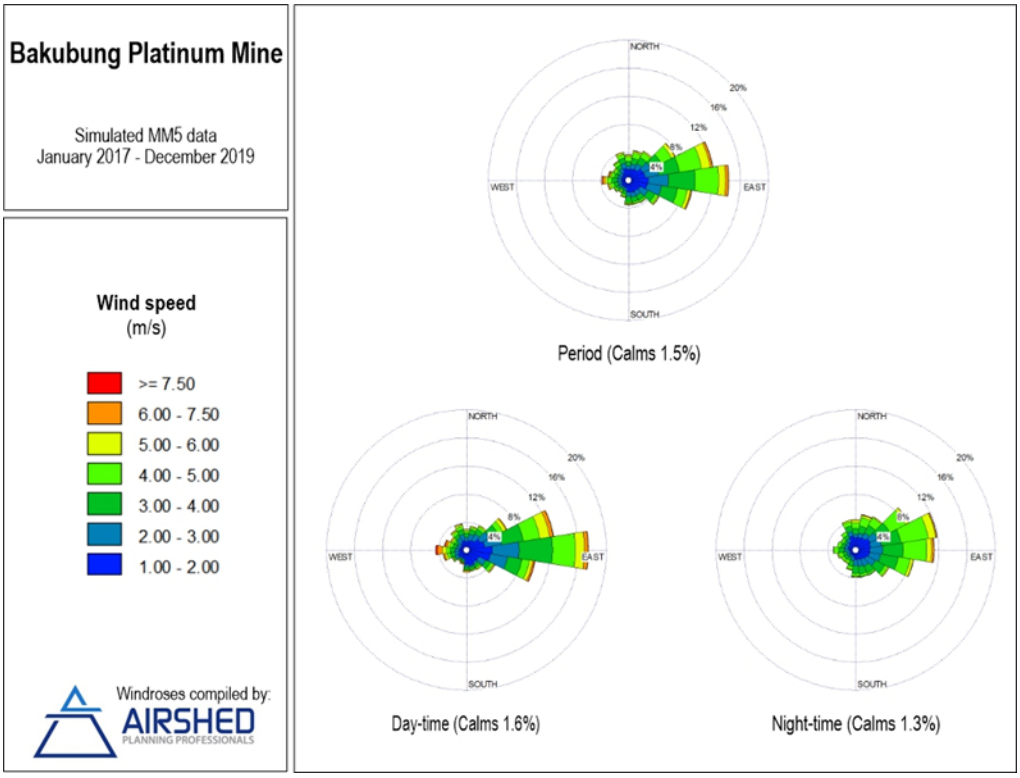


Figure 18: Period, day- and night-time wind roses (AERMET processed MM5 data, January 2017 to December 2019)

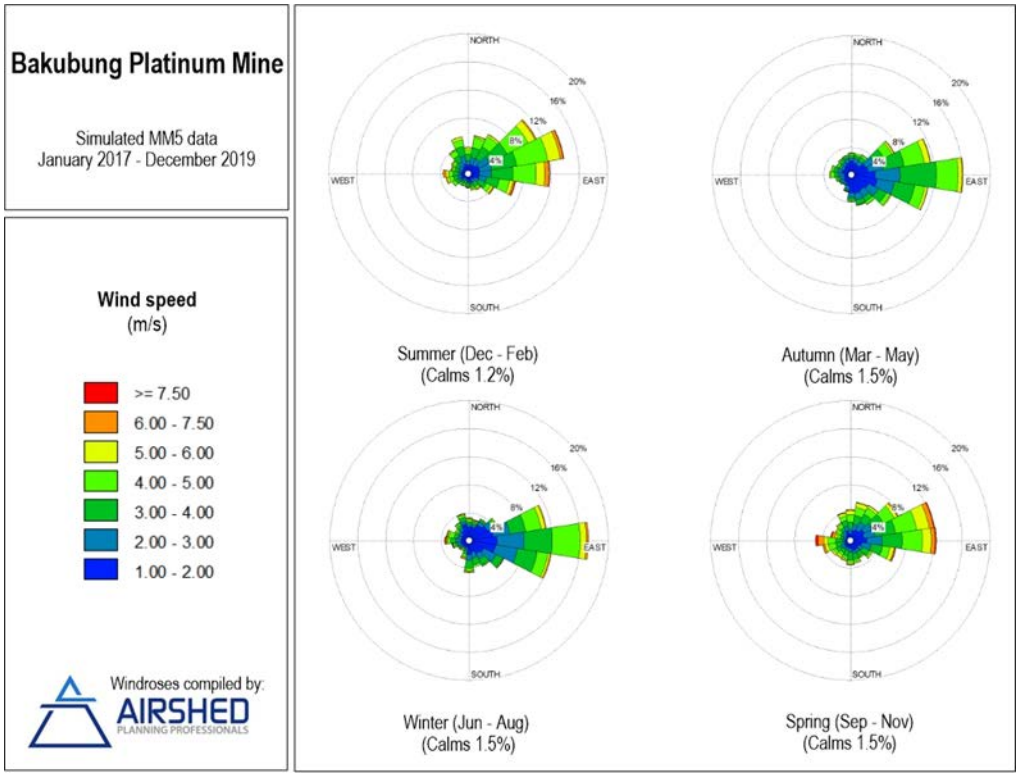


Figure 19: Seasonal wind roses (AERMET processed MM5 data, January 2017 to December 2019)

4.5 AIR QUALITY

As part of this amendment process, an Air Quality Impact Assessment was undertaken (Airshed, 2020 (a)). The full report is available in Appendix D2.

4.5.1 AFFECTED ENVIRONMENT

Air Quality Sensitive Receptors generally include places of residence and areas where members of the public may be affected by air pollution generated by the BPM activities. sensitive receptors within an 8 km radius of the operations include Ledig to the north, northwest and west as well as Sun City to the northeast, Chaneng to the southeast and Phatsima to the southwest, along with isolated homesteads and the Sundown Ranch Hotel to the south.
The topography is uneven and ranges from 1 000 mamsl near the project site to 1 480 mamsl north of the site (Figure 20). The land use in the area comprises primarily of mining, industries, residential and agriculture. Aside from the residential areas, individual homesteads and the Sundown Ranch Hotel near the BPM, agricultural areas were identified as environmentally sensitive areas.

4.5.2 EXISTING AIR QUALITY

The current air quality in the study area is mostly influenced by mining, processing, and industrial activities at other companies' operations, as well as farming activities, domestic fires, vehicle exhaust emissions and dust entrained by vehicles. These emission sources vary from activities that generate relatively course airborne particulates (such as farmland preparation, dust from paved and unpaved roads, and the mine sites) to fine particulate matter (PM) such as that emitted by vehicle exhausts, diesel power generators and processing operations. Other sources of PM include occasional fires in the residential areas and farm activities. Emissions from unpaved roads constitute a major source of emissions to the atmosphere in South Africa.

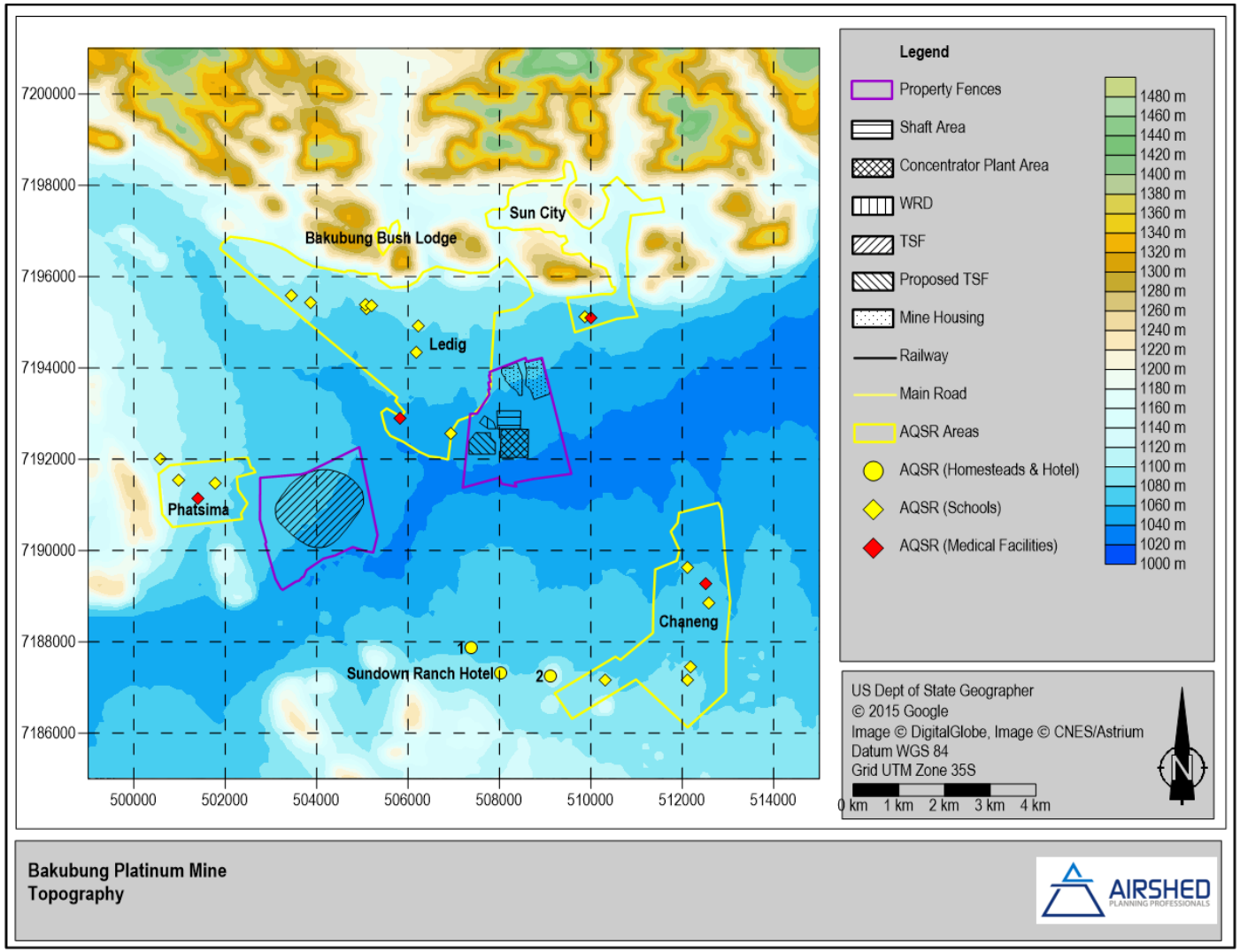


Figure 20: Location of BPM approved operations, proposed TSF, sensitive receptors included in the simulations and topography

4.5.3 SAMPLED DUSTFALL RATES

Dust fallout sampling is being undertaken at the site. The current monitoring network consist of 16 sites (eight non-residential sites and eight residential sites). Figure 21 shows the locations of the points. Table 10 provides a summary of the 2019 monitoring campaign. Although there were exceedances of the limits, the operations dustfall rates shown by the sampling complies in terms of the National Dust Control Regulations (NDCR) as there were no exceedances of more than two times per year at a site or for consecutive months at a site.

Table 10: Summary of dustfall rates

Pollutant	Data source	Compliance Assessment
Dustfall	Results of dustfall sampling at 16 locations for the period September 2008 to December 2019.	SA NDCR limit for residential areas of 600 mg/m^2-day was exceeded at the following residential sites: • Bakgofa Primary School – October 2008 • Bakgofa Primary School – July 2009 • Lekwadi Section – November 2012 • Lekwadi Section – December 2014 • Lekwadi Section – October 2015 • Kayalethu High School – September 2018 SA NDCR limit for non-residential areas of 1 200 mg/m^2-day was exceeded at the following non-residential sites: • Explosives magazine – January 2012 • Tailings North – January 2012 • Tailings Dam – July 2012 • Tailings North – November 2012

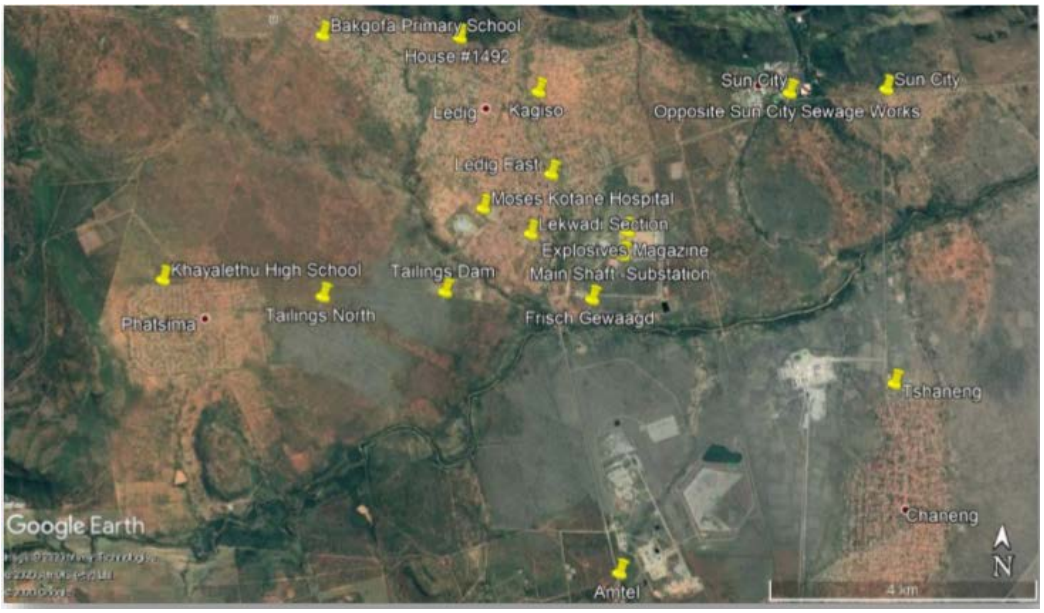


Figure 21: Bakubung Platinum Mine dustfall monitoring network

4.6 NOISE

As part of this amendment process, a Noise Impact Assessment was undertaken (Airshed, 2020 (b)). The full report is available in Appendix D3.

4.6.1 NOISE SENSITIVE RECEPTORS

Noise Sensitive Receptors (NSRs) generally include places of residence and areas where members of the public may be affected by noise generated by the mining activities. Only those within a 5 km radius of activities are likely to be affected; however, all NSRs within an 8 km radius were identified.

NSRs within an 8 km radius (Figure 22) of the operations include Ledig to the north, northwest and west as well as Sun City to the northeast, Chaneng to the southeast and Phatsima to the southwest, along with isolated homesteads and the Sundown Ranch Hotel to the south.

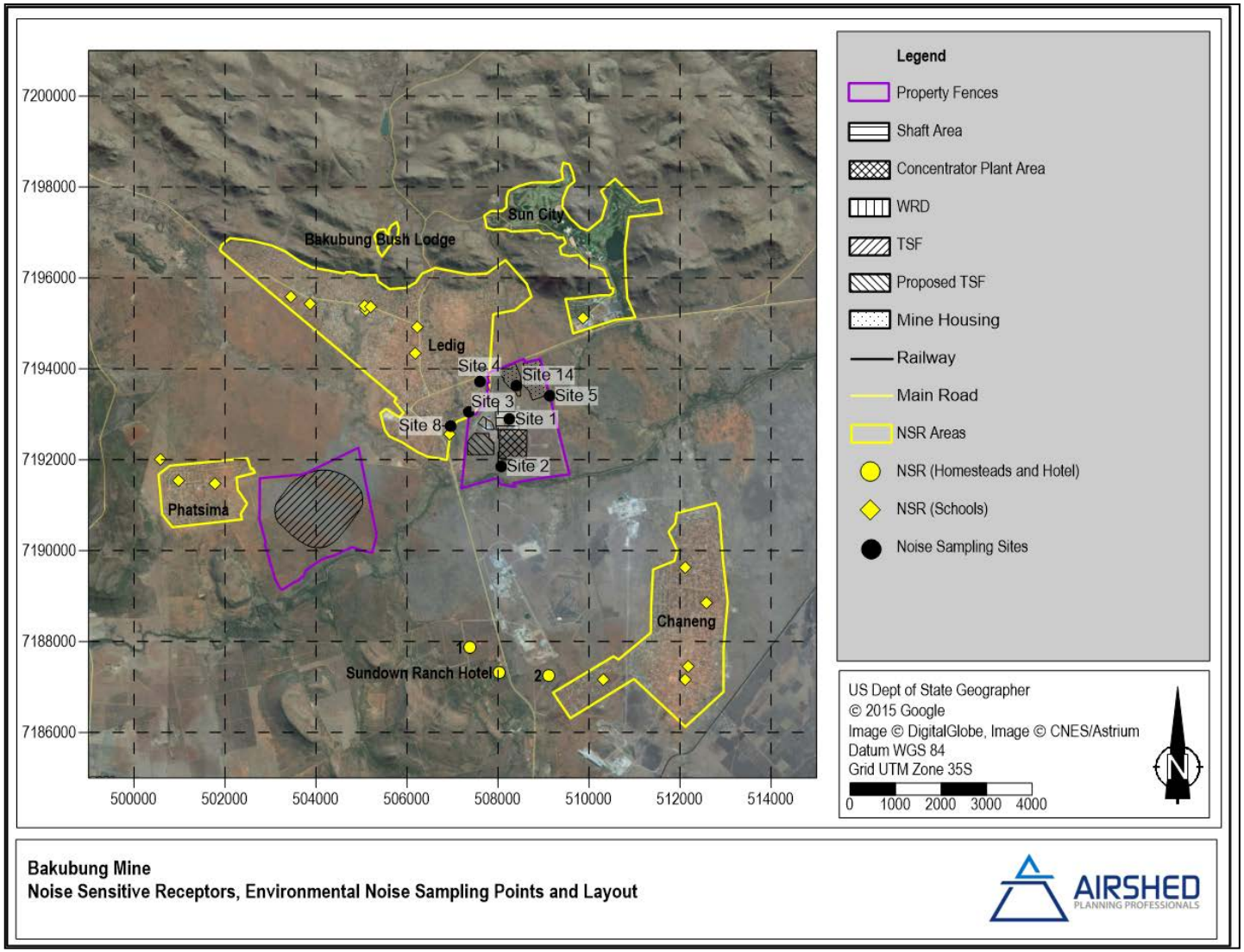


Figure 22: Study area, NSRs, and baseline noise measurement sites

4.6.2 NOISE SURVEY AND RESULTS

Day- and night-time noise measurements were conducted on the 4th and 5th of March 2020 at seven locations shown in Table 11 and Figure 22. Survey sites were selected taking into consideration the location of proposed activities, NSRs, accessibility and safety. The coordinates as well as a description of the noise sampling locations is given in Table 11.

Table 11: Environmental Noise Sampling Locations

Site	Longitude	Latitude	Description
1	27.082050	-25.380767	Close to mine crushers, 0.5 km northeast of proposed TSF
2	27.080233	-25.390117	Southeast of the proposed TSF
3	27.073117	-25.379200	0.5 km north-northwest of the proposed TSF
4	27.075533	-25.373217	1.2 km north of the proposed TSF
5	27.090783	-25.376117	1.6 km northeast of proposed TSF
8	27.069117	-25.382050	0.5 km west-northwest of the proposed TSF
14	27.083606	-25.374148	At proposed mine housing, 1.2 km north-northeast of the proposed TSF

Acoustic observations made during the survey are summarised in Table 12 and Figure 23. The day-time acoustic climate at the seven sampling points was heavily influenced by local noise generating sources, with the mining activities only audible at Sites 1 (on-site) and 2 during the day. Noise sources at Sites 3, 4, 8 and 14 which are located either in or nearby Ledig residential area was mostly influenced by local sources such as community activity, vehicle traffic and domestic animals. The acoustic climate at Point 5, located close to a rarely used public road, was predominantly influenced by insects and birds. Air traffic was also noted at Sites 8 and 14. Considering Site 3 lies between these two sites it is also likely to be affected by air traffic but not at the time of the sampling.

Measured day-time L_{A90} levels (Table 13) indicate that, with the exception of Point 1 located on-site and Point 4 which is located within the Ledig residential area, day-time background noise levels are low, and isolated noise incidents, which were observed to have L_{AFmax} values of between 46.4 dBA (Site 2) to 63.5 dBA (Site 5), lead to higher average L_{Req}'s. At Site 1 the mine operations surrounding the sampling point leads to a continuous higher background noise level.

Average day-time continuous noise levels ($L_{Req,d}$) at Sites 2, 8 and 14 (Table 12) were typical of rural areas, while levels at Sites 3 and 5 were more akin to suburban districts with little road traffic (Table 12). The acoustic climate at Site 4 during the day is mostly determined by local activity, such as community noise and vehicles with noise levels like urban districts. Site 1, as previously discussed, is most significantly influenced by mining operations.

The mining activities could be distinguished at Sites 1 and 2 by the sampler, it is should be noted that the lowest day-time continuous levels were recorded at Site 2 (Table 12). This Site is located the furthest from the current mining (closets to the proposed TSF) (Figure 22), but is situated away from any other influences, such as the mine's operations, domestic animals, roads or communities.

Measured continuous night-time noise levels ($L_{Req,n}$) were higher than typical rural areas as given by SANS 10103 at Sites 2, 3, 4, 8 and 14 sampling locations (Table 12), and more akin to suburban districts, while Site 5 was more like an urban environment than rural environments. It was noted that mining activities could be heard at almost all sampling locations during the night. Although Site 1 would be classified as an industrial district, the night-time noise levels were below the typical outdoor noise level for industrial districts and was closer to urban/central business district levels.

It should be noted that background noise levels (L_{A90}) were higher at six sampling points (excluding Site 1) (Table 13) during the night compared to during the day. It was also observed by the field technician that while mining operations could generally not be heard during the day (except at Site 1 at the mine operations and the most isolated location, Site 2), some mining operations (not necessarily the BPM operations) could be heard at all sampling points during the night. This could be explained by atmospheric temperature gradients. On a sunny day, temperature decreases with altitude and creates a 'shadowing' effect for sounds. On clear nights, temperatures my increase with altitude thereby 'focusing' sound on the ground surface. Noise impacts are therefore generally more significant during the night. It should also be noted that wind speeds were generally higher during the day-time measurements than during the night-time measurements.
It should be noted that while the operator observed that mining activities could be heard at most of the sampling locations during the night, the sampling was done in March, when insects are abundant, and background noise due to insects was also noted at each sampling location. It is recommended that a noise survey campaign be undertaken in the winter months to estimate the noise impact of mining operations in the absence of insect noise.

Table 12: Baseline noise measurement survey results

Site	Day/night	Day-time	Night-time
	$L_{R,dn}$ (dBA)	$L_{Req,d}$ (dBA)	$L_{Req,n}$ (dBA)
1[(c)]	61.6	55.6	55.6
2[(b)]	**47.5**	33.8	**42.2**
3[(b)]	**55.0**	**47.6**	**49.2**
4[(b)]	**60.4**	**52.1**	**54.8**
5[(b)]	**48.3**	**48.0**	**38.7**
8[(b)]	**47.8**	39.4	**42.1**
14[(b)]	**49.4**	43.8	**43.3**

Notes: Bold blue figures indicate exceedance of the SANS rating levels for outdoor noise according to district types

(a) Rural district classification
(b) Currently rural district classification but will likely be more like suburban district with little road traffic when fully operational
(c) Industrial district classification

Table 13: Baseline noise measurement survey details and broadband results

Site	Local Start Time	Duration	Noise Climate	L_{AFmax} (dBA)	L_{Aleq} (dBA)	L_{A90} (dBA)
Day-time						
1	10:18	15 Minutes	Mining Operations, Welding, Workshop, Birds, Road traffic	69.1	55.6	51.0
2	11:35	15 Minutes	Mining operations, Crushers, Birds, Wind, Distant road traffic	46.4	33.8	27.0
3	13:35	15 Minutes	Music, Community, Road Traffic, Birds, Insects, Wind Gusts	60.2	47.6	34.3
4	14:12	15 Minutes	Insects, Birds, Community, Road Traffic	59.3	52.1	44.6
5	15:32	15 Minutes	Birds, Insects	63.5	48.0	33.8
8	12:00	15 Minutes	Air Traffic, Birds, Insects, Road Traffic, Wind Gusts, Community	52.8	39.4	28.0

Site	Local Start Time	Duration	Noise Climate	L_{AFmax} (dBA)	L_{Aleq} (dBA)	L_{A90} (dBA)
14	14:55	15 Minutes	Wind, Birds, Insects, Community, Air Traffic	58.5	43.8	31.1
Night-time						
1	22:02	15 Minutes	Mining operations, Workshop, Sirens, Insects	57.4	55.6	50.4
2	22:33	15 Minutes	Insects, Mining Operations, Road Traffic	42.7	42.2	33.3
3	1:34	15 Minutes	Mining Operations, Insects, Domestic Animals	49.4	49.2	44.5
4	1:09	15 Minutes	Road Traffic, Music, Insects	55.4	54.8	49.9
5	23:20	15 Minutes	Insects, Distant Mining Operations	39.6	38.7	34.1
8	2:06	15 Minutes	Mining Operations, Road Traffic, Insects, Domestic Animals	42.4	42.1	38.4
14	0:41	15 Minutes	Mining Operations, Insects, Sirens	43.7	43.3	41.1

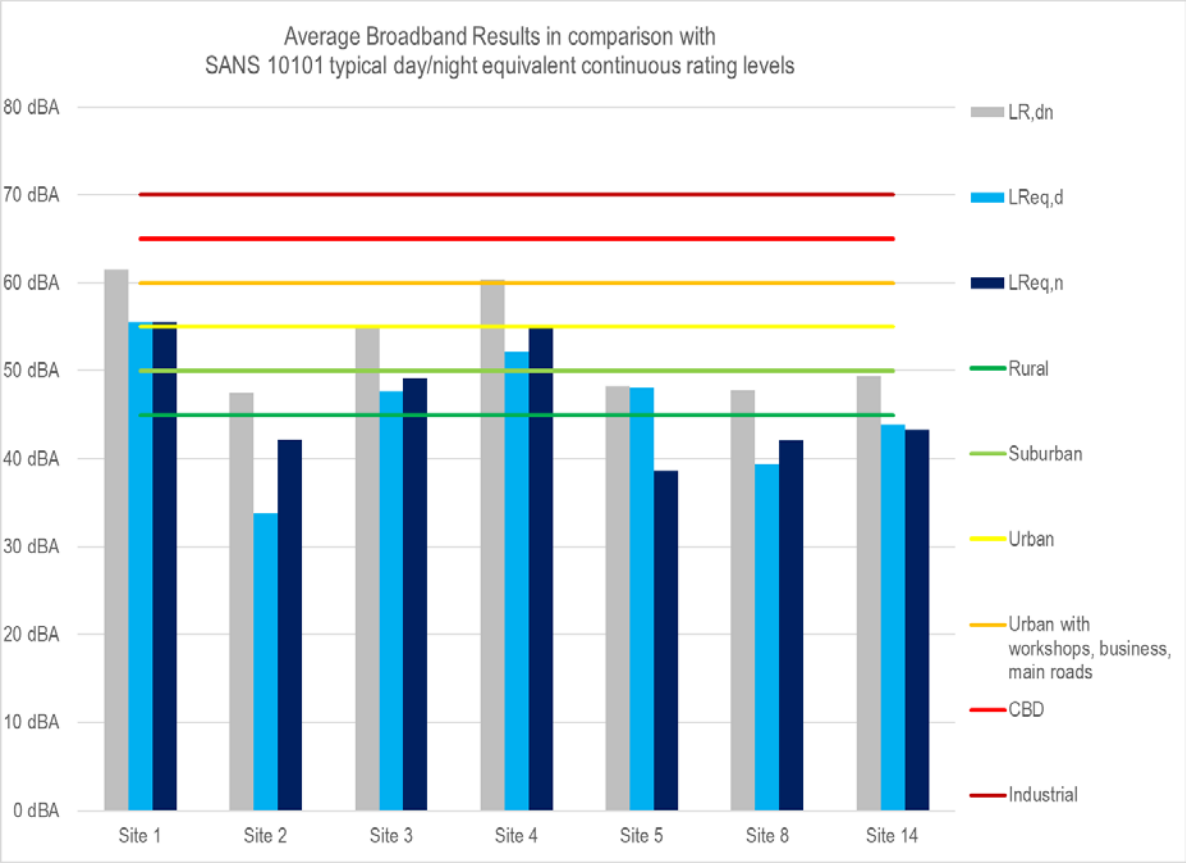


Figure 23: Logged $L_{Req,d}$, $L_{Req,n}$ and $L_{Req,dn}$ – day-time and night-time sampling

4.7 SOILS AND LAND CAPABILITY

4.7.1 SOIL FORMS

In the previous EIA (SLR, 2016), the soil, land use and land capability information for the TSF and plant area was sourced from the soil, land use and land capability study conducted by Rehab Green CC (2007) as part of the approved EIA and EMP of 2008.

The area where the additional TSF and associated infrastructure is proposed is characterised by the Arcadia soil form. Refer to Table 14 and Figure 24 below.

4.7.2 SOIL CHEMICAL PROPERTIES

SLR (2016) discusses the general chemical properties of the soils (Rehab Green, 2007) as follows:
The average pH values of the black clay soils (Arcadia form) varied from 7.1 - 8.4 indicating neutral to fairly alkaline conditions. Free lime was not found in the soil matrix during the field assessment although small lime nodules were frequently found at depths below 700 mm. The average pH values of the red, fine structured soils (Shortlands form) varied from 6.0-6.9 indicating slightly acid to neutral conditions. The average pH values of alluvial and colluvial soils along the Elands River (Oakleaf and Valsrivier forms) varied from 6.5-8.1, which indicated slightly acid to fairly alkaline conditions.
The average phosphorus values varied from 0.09-4.38 mg/kg indicating very low concentrations. The average cation values for K, Ca and Mg indicated moderate to high concentrations, thus moderate to high fertility. The average Na concentrations and calculated exchangeable sodium percentage was low and indicated the absence of sodic soils. The cation exchange capacity (CEC) values of the black clay soils were high (27.5-57.2 cmol(+)/kg) and indicated fairly unstable conditions which can lead to serious soil erosion in sensitive landscapes. The CEC values of the other soils varied from 6.2-18.2 cmol(+)/kg) which is fairly low to moderate and indicated low to moderate erodibility.
SKR (2016) further reported that the 2016 soil assessment indicated that the soils of the study area do have the capacity to buffer chemical change. The soils are high in 2:1 swelling-shrinking clays which have the capacity to sorb high levels of cationic heavy metals, especially under near neutral to slightly alkaline pH values and oxidising conditions. However, these soils can reach a saturation point in terms of metal sequestration.

4.7.3 SENSITIVITY

High potential arable land, drainage lines and wetland soils prone to erosion are considered by the specialists to be sensitive soil resources. For the plant and TSF areas, the sensitive landscapes are near and around the drainage lines and the Elands River.

4.7.4 LAND USE

The area for the additional TSF is currently used by the mine as construction of the plant area has commenced. The surrounding land uses include mining, grazing, cultivation, natural vegetation, and residential (formal and informal).

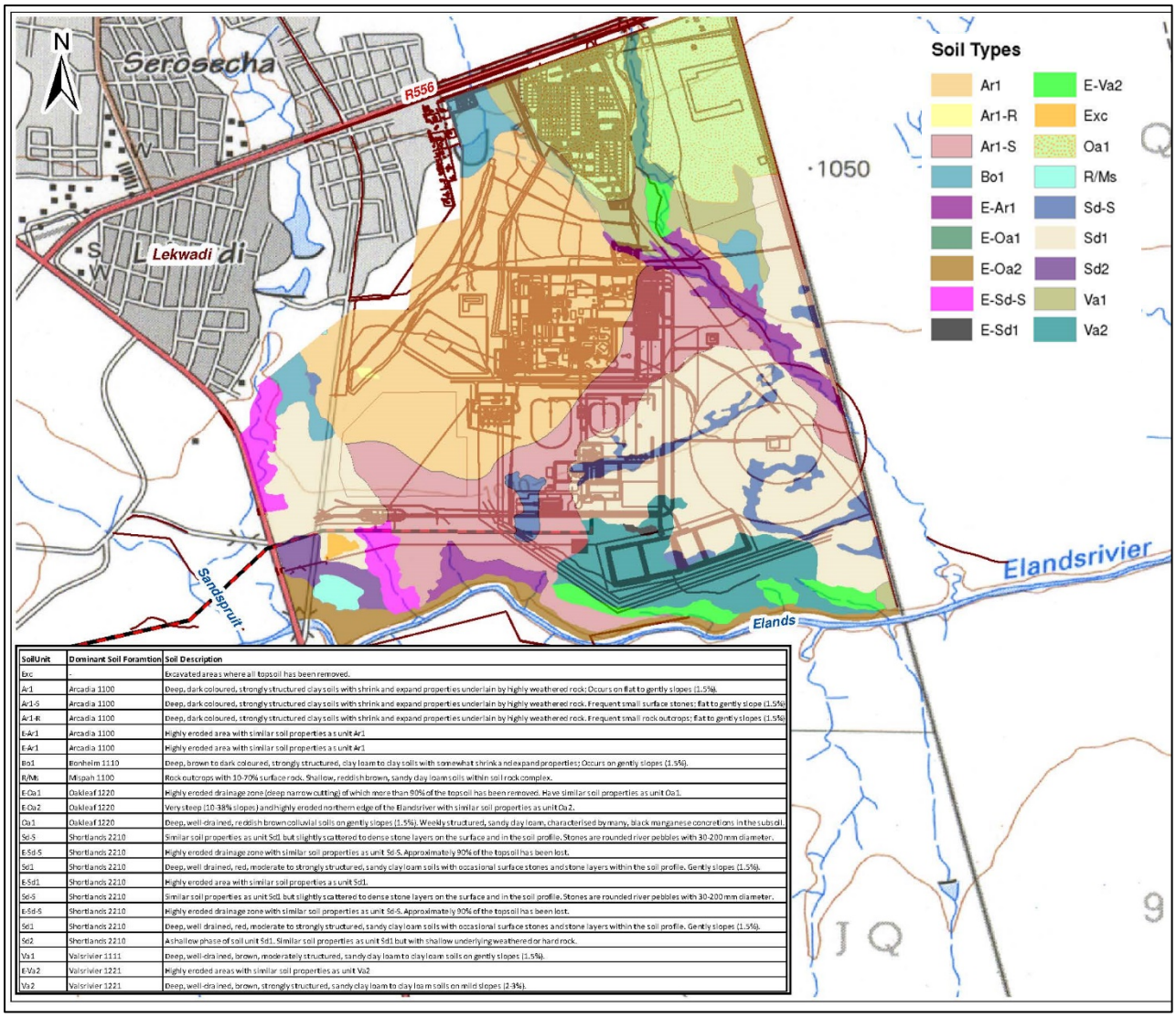
4.7.5 LAND CAPABILITY AND AGRICULTURAL POTENTIAL

With reference to Figure 25, the land capability at the additional TSF site is primarily grazing, with some marginal areas of arable land.

Table 14: Soil Forms and Associated Land Capabilities in the plant area (Rehab Green, 2007)

Soil Unit	Dominant Soil Formation	Soil Description
Exc -		Excavated areas where all topsoil has been removed.
Ar1	Arcadia 1100	Deep, dark coloured, strongly structured clay soils with shrink and expand properties underlain by highly weathered rock; Occurs on flat to gently slopes (1.5%).
Ar1-S	Arcadia	Deep, dark coloured, strongly structured clay soils with shrink and expand

Soil Unit	Dominant Soil Formation	Soil Description
	1100	properties underlain by highly weathered rock. Frequent small surface stones; flat to gently slope (1.5%)
Ar1-R	Arcadia 1100	Deep, dark coloured, strongly structured clay soils with shrink and expand properties underlain by highly weathered rock. Frequent small rock outcrops; flat to gently slopes (1.5%)
E-Ar1	Arcadia 1100	Highly eroded area with similar soil properties as unit Ar1
E-Ar1	Arcadia 1100	Highly eroded area with similar soil properties as unit Ar1
Bo1	Bonheim 1110	Deep, brown to dark coloured, strongly structured, clay loam to clay soils with somewhat shrink and expand properties; Occurs on gently slopes (1.5%).
R/Ms	Mispah 1100	Rock outcrops with 10-70% surface rock. Shallow, reddish brown, sandy clay loam soils within soil rock complex.
E-Oa1	Oakleaf 1220	Highly eroded drainage zone (deep narrow cutting) of which more than 90% of the topsoil has been removed. Have similar soil properties as unit Oa1.
E-Oa2	Oakleaf 1220	Very steep (10-38% slopes) and highly eroded northern edge of the Elandsriver with similar soil properties as unit Oa2.
Oa1	Oakleaf 1220	Deep, well-drained, reddish brown colluvial soils on gently slopes (1.5%). Weekly structured, sandy clay loam, characterised by many, black manganese concretions in the subsoil.
Sd-S	Shortlands 2210	Similar soil properties as unit Sd1 but slightly scattered to dense stone layers on the surface and in the soil profile. Stones are rounded river pebbles with 30-200 mm diameter.
E-Sd-S	Shortlands 2210	Highly eroded drainage zone with similar soil properties as unit Sd-S. Approximately 90% of the topsoil has been lost.
Sd1	Shortlands 2210	Deep, well drained, red, moderate to strongly structured, sandy clay loam soils with occasional surface stones and stone layers within the soil profile. Gently slopes (1.5%).
E-Sd1	Shortlands 2210	Highly eroded area with similar soil properties as unit Sd1.
Sd-S	Shortlands 2210	Similar soil properties as unit Sd1 but slightly scattered to dense stone layers on the surface and in the soil profile. Stones are rounded river pebbles with 30-200 mm diameter.
E-Sd-S	Shortlands 2210	Highly eroded drainage zone with similar soil properties as unit Sd-S. Approximately 90% of the topsoil has been lost.
Sd1	Shortlands 2210	Deep, well drained, red, moderate to strongly structured, sandy clay loam soils with occasional surface stones and stone layers within the soil profile. Gently slopes (1.5%).
Sd2	Shortlands 2210	A shallow phase of soil unit Sd1. Similar soil properties as unit Sd1 but with shallow underlying weathered or hard rock.
Va1	Valsrivier 1111	Deep, well-drained, brown, moderately structured, sandy clay loam to clay loam soils on gently slopes (1.5%).
E-Va2	Valsrivier 1221	Highly eroded areas with similar soil properties as unit Va2
Va2	Valsrivier 1221	Deep, well-drained, brown, strongly structured, sandy clay loam to clay loam soils on mild slopes (2-3%



SoilUnit	Dominant Soil Foramtion	Soil Description
Exc	-	Excavated areas where all topsoil has been removed.
Ar1	Arcadia 1100	Deep, dark coloured, strongly structured clay soils with shrink and expand properties underlain by highly weathered rock; Occurs on flat to gently slopes (1.5%).
Ar1-S	Arcadia 1100	Deep, dark coloured, strongly structured clay soils with shrink and expand properties underlain by highly weathered rock. Frequent small surface stones: flat to gently slope (1.5%
Ar1-R	Arcadia 1100	Deep, dark coloured, strongly structured clay soils with shrink and expand properties underlain by highly weathered rock. Frequent small rock outcrops; flat to gently slopes (1.5%
E-Ar1	Arcadia 1100	Highly eroded area with similar soil properties as unit Ar1
E-Ar1	Arcadia 1100	Highly eroded area with similar soil properties as unit Ar1
Bo1	Bonheim 1110	Deep, brown to dark coloured, strongly structured, clay loam to clay soils with somewhat shrink a ndexpand properties; Occurs on gently slopes (1.5%).
R/Ms	Mispah 1100	Rock outcrops with 10-70% surface rock. Shallow, reddish brown, sandy clay loam soils within soil rock complex.
E-Oa1	Oakleaf 1220	Highly eroded drainage zone (deep narrow cutting) of which more than 90% of the topsoil has been removed. Have similar soil properties as unit Oa1.
E-Oa2	Oakleaf 1220	Very steep (10-38% slopes) and highly eroded northern edge of the Elandsriver with similar soil properties as unit Oa2.
Oa1	Oakleaf 1220	Deep, well-drained, reddish brown colluvial soils on gently slopes (1.5%). Weakly structured, sandy clay loam, characterised by many, black manganese concretions in the subsoil.
Sd-S	Shortlands 2210	Similar soil properties as unit Sd1 but slightly scattered to dense stone layers on the surface and in the soil profile. Stones are rounded river pebbles with 30-200 mm diameter.
E-Sd-S	Shortlands 2210	Highly eroded drainage zone with similar soil properties as unit Sd-S. Approximately 90% of the topsoil has been lost.
Sd1	Shortlands 2210	Deep, well drained, red, moderate to strongly structured, sandy clay loam soils with occasional surface stones and stone layers within the soil profile. Gently slopes (1.5%).
E-Sd1	Shortlands 2210	Highly eroded area with similar soil properties as unit Sd1.
Sd-S	Shortlands 2210	Similar soil properties as unit Sd1 but slightly scattered to dense stone layers on the surface and in the soil profile. Stones are rounded river pebbles with 30-200 mm diameter.
E-Sd-S	Shortlands 2210	Highly eroded drainage zone with similar soil properties as unit Sd-S. Approximately 90% of the topsoil has been lost.
Sd1	Shortlands 2210	Deep, well drained, red, moderate to strongly structured, sandy clay loam soils with occasional surface stones and stone layers within the soil profile. Gently slopes (1.5%).
Sd2	Shortlands 2210	A shallow phase of soil unit Sd1. Similar soil properties as unit Sd1 but with shallow underlying weathered or hard rock.
Va1	Valsrivier 1111	Deep, well-drained, brown, moderately structured, sandy clay loam to clay loam soils on gently slopes (1.5%).
E-Va2	Valsrivier 1221	Highly eroded areas with similar soil properties as unit Va2
Va2	Valsrivier 1221	Deep, well-drained, brown, strongly structured, sandy clay loam to clay loam soils on mild slopes (2-3%).

Figure 24: Soil Types in the Plant Area (SLR, 2016)

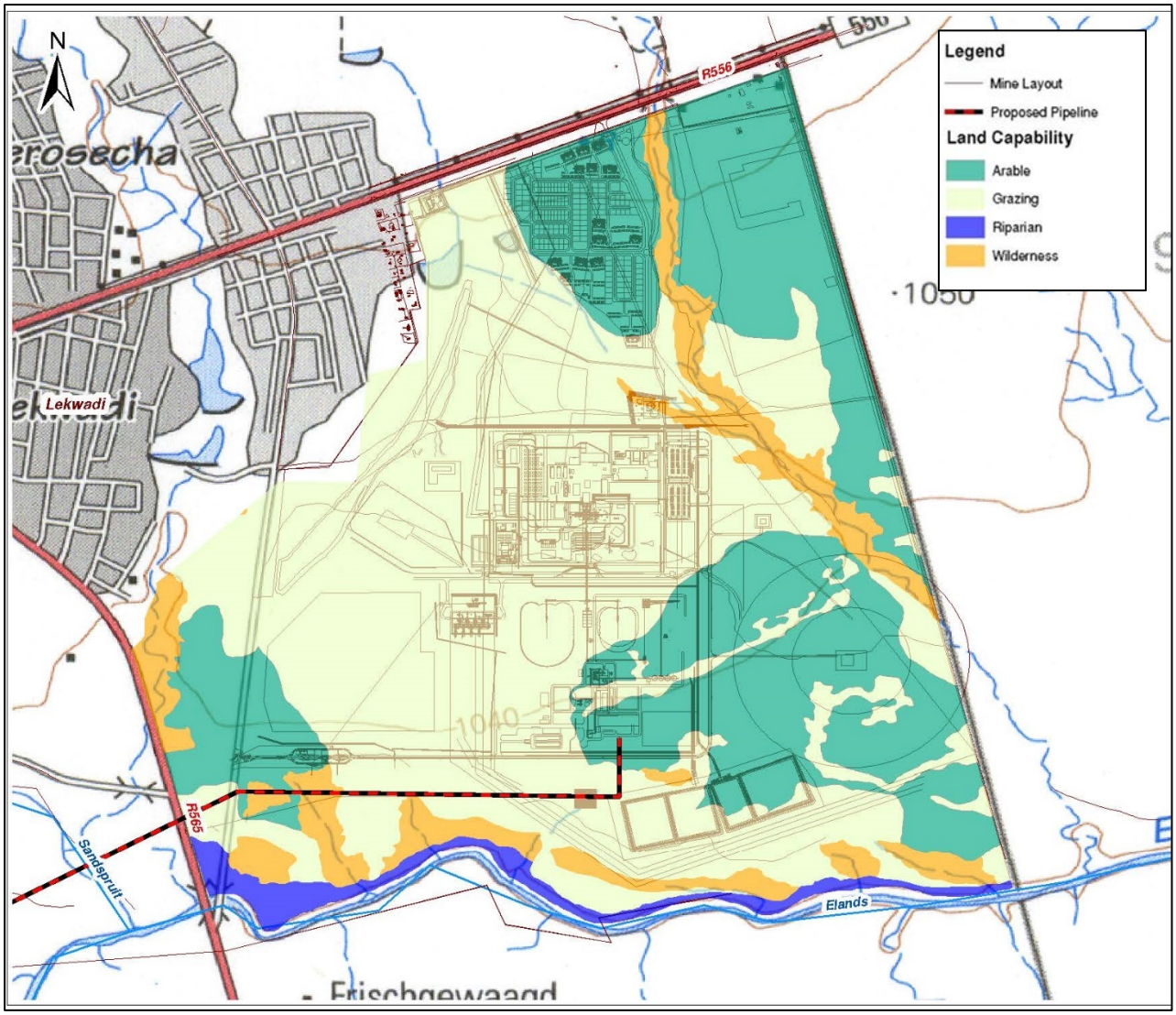


Figure 25: Land Capability in the Plant Area (SLR, 2016)

4.8 TERRESTRIAL BIODIVERSITY

As part of this amendment process, a Terrestrial Ecology Impact Assessment was undertaken (Hawkhead, 2021). The full report is available in Appendix D4.

4.8.1 GENERAL BIOPHYSICAL ENVIRONMENT

The study area is located in the savanna biome. The North West Biodiversity Sector Plan (NWBSP) as developed by the North West Department of Economic Development, Environment, Conservation and Tourism (NW DEDECT, 2015) delineate the study area as Zeerust Thornveld with some of the land to the south of the Frischgewaagd section and Eland's River as Marikana Thornveld, Figure 26. (De Castro & Brits, 2016 (c)) determined that although the study area show some physiognomic similarities to Zeerust Thornveld, it is more closely aligned to Marikana Thornveld (SVcb 6) in both dominant species and general composition.

The attributes of the savanna biome and both Zeerust Thornveld and Marikana Thornveld, are summarised in Appendix D4.

4.8.2 CONSERVATION CONTEXT

Across its range large areas of Marikana Thornveld have been transformed by cultivation, urbanisation, alien species encroachment and mining (Mucina & Rutherford, 2011). This vegetation type is therefore categorised as a Vulnerable Ecosystem. According to the National List of Threatened Ecosystems (NEMBA, 2011), Zeerust Thornveld is not considered a threatened vegetation type.

4.8.2.1 NORTH WEST BIODIVERSITY SECTOR PLAN (2015)

According to the North West Biodiversity Sector Plan (NW DEDECT, 2015), which aims to map Critical Biodiversity Areas (CBAs) and ecological support areas (ESAs) at a provincial level, the study area as well as the Frischgewaagd section and much of the surrounding landscape (excluding transformed areas mostly associated with Ledig community and other mines), are designated Critical Biodiversity Area Category 2 (CBA 2) - Figure 27.
Critical Biodiversity Areas are portions of land that need to be maintained in a natural or semi-natural state in order to ensure the continued existence and functioning of species and ecosystems, and the delivery of ecosystem services (NW DEDECT, 2015). In summary, areas designated as CBA 2 usually comprise land with a combination of the following traits:

- Ecosystems and species fully or largely intact and undisturbed
- Areas of intermediate irreplaceability (i.e., some flexibility with regard to meeting biodiversity targets)
- Biodiversity features that are approaching but have not surpassed their limits of acceptable change.

The criteria resulting in the CBA 2 designation for the study area by is that the land is regarded as 'Natural Corridor Linkage' and 'Natural Protected Area Buffer' (within 5 km of the Pilanesberg Game Reserve). However, based on their work in the area (De Castro & Brits, 2016 (c)) contend that the NWBSP (2015) mapping is partly inaccurate, as large areas that have been mapped as CBA 2 are in fact, transformed by mining and cultivation, and are thus characterised by either no vegetation (permanently transformed) or secondary vegetation.

4.8.2.2 PROTECTED AREAS

Pilanesberg Game Reserve[1] (Pilanesberg) is a formally protected conservation area, situated approximately 2.6 km to the north of the study area (Figure 4). The reserve is managed by the North West Parks and Tourism Board and is approximately 49 580 ha in extent.
Pilanesberg encompasses an eroded volcano that is more than one billion years old. The reserve is characterised by varied habitats, including woodland, grassland, riparian areas and numerous rocky areas and hillslopes. A diverse and abundant wildlife assemblage is present, including numerous large mammals (Big Five) and many raptors.
Pilanesberg Game Reserve is a recognised Important Bird Area (IBA). The main IBA triggers for the reserve include the breeding presence of the globally threatened Kori Bustard and Secretary Bird, as well as the European Roller (Marnewick, Retief, Theron, & Wright, 2015). Regionally threatened species present in the reserve include Verreauxs' Eagle (also breeding in the reserve), Lanner Falcon, African Finfoot, African Grass Owl, Yellow-billed Stork, Yellow-throated Sandgrouse, and the Marabou Stork (Marnewick, Retief, Theron, & Wright, 2015).

[1] Sometimes referred to as Pilanesberg National Park. Pilanesberg is a provincial park and not managed by the South African National Parks.

In addition, and aligned to its importance as a conservation area, Pilanesberg Game Reserve is also a popular and important eco-tourism destination, with numerous recreational camps, lodges, and hotel facilities.

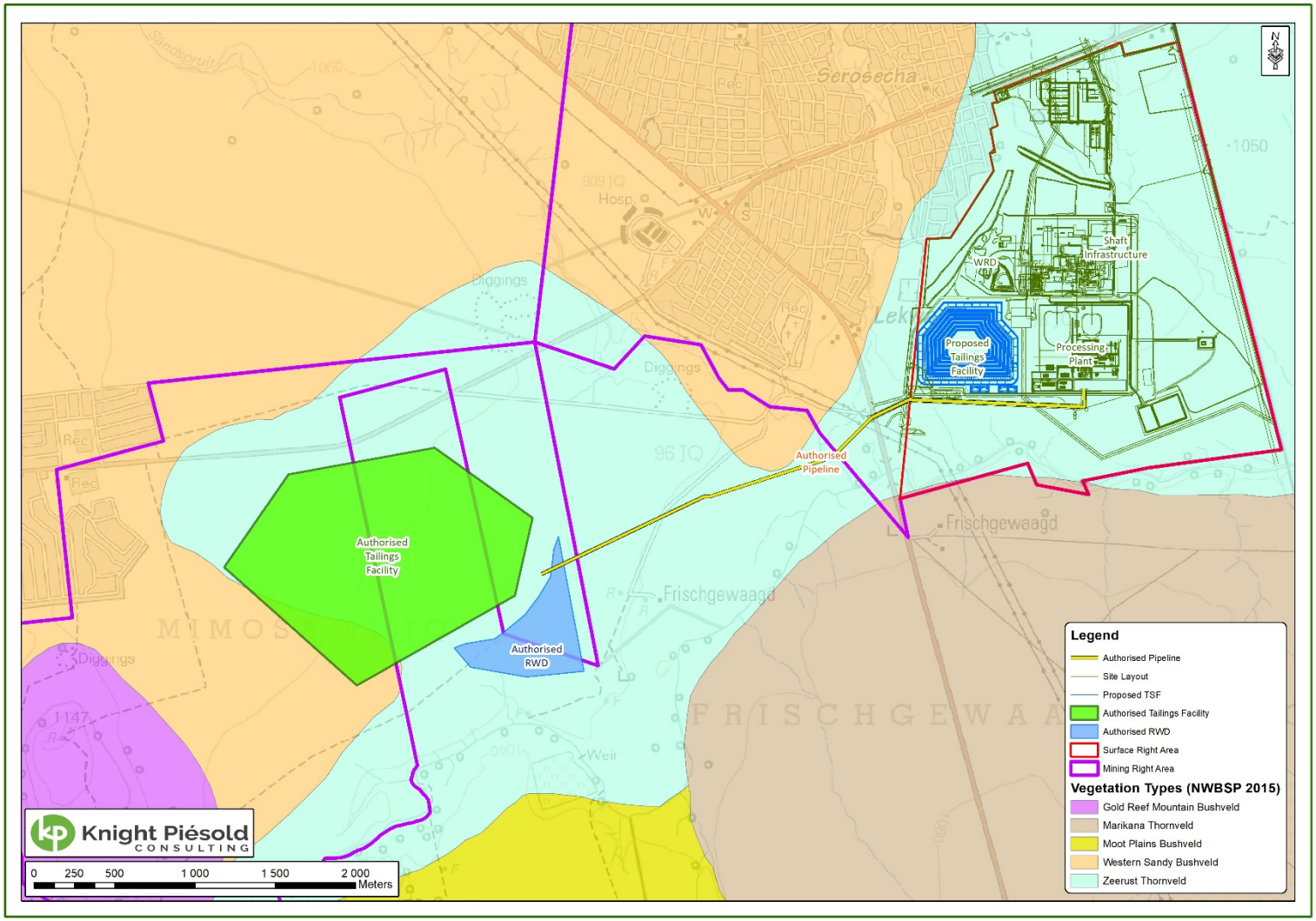


Figure 26: Study area in relation to the refined vegetation type map produced by the (NW DEDECT, 2015). Proposed TSF location shown in dark blue.

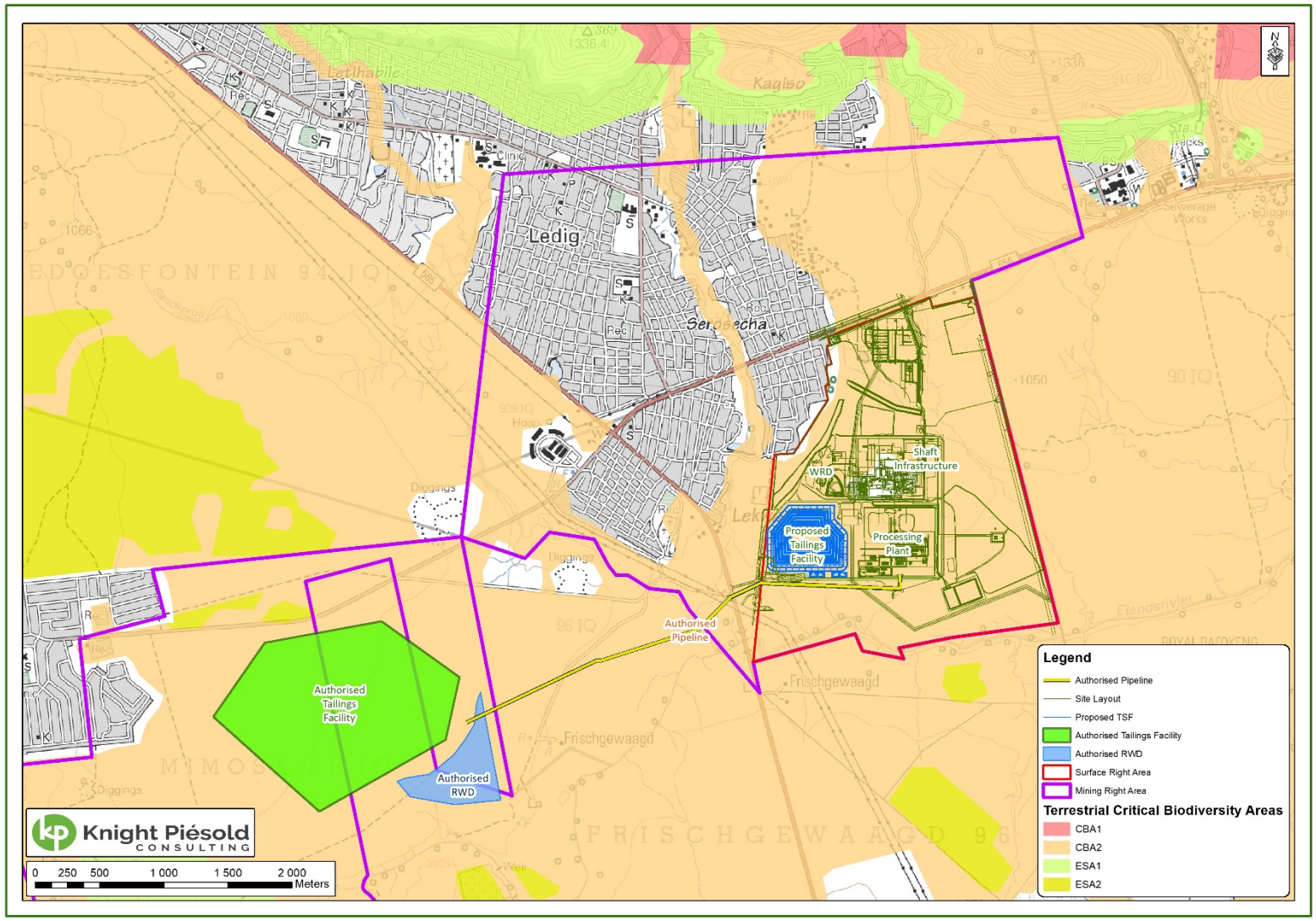


Figure 27: Study area in relation to the North West Biodiversity Sector Plan (NW DEDECT, 2015). Proposed TSF location shown in dark blue.

4.8.3 GENERAL CHARACTERISTICS AND LANDSCAPE CONTEXT

The study area is located within the main operational area of the Frischgewaagd section of Bakubung Platinum Mine. The site is bordered to the west by the current mine entrance road (gravel) and a razor-wire fence that is approximately 2 m in height (Plate 1). This razor-wire fence encloses the entire Frischgewaagd section, although portions of it have apparently been illegally dismantled by local community members.

The new mine entrance gate and entrance road (tarred) border the study area to the south (at the time of the field visit, neither were fully operational) (Plate 2), while a large rock dump is located immediately north of the site (Plate 3). A small electrical substation (Plate 4) and the main mine complex are positioned to the north-east of the study area. Although most of the land immediately east of the study area is currently undeveloped, construction activities for the Concentrator Plant on this portion of the Frischgewaagd section are in progress.

The topography of the study area is flat to slightly undulating, with a gradual slope southward, toward the Elands River. A drainage channel has been excavated along the southern boundary of the study area. This transports stormwater from the site, via stormwater culverts under the new entrance road, into natural drainage lines that drain into the Elands River. Portions of the study area have been disturbed; an area of disturbed vegetation associated with a suspected old topsoil deposit dominates the north-east of the study, while a network of formal and informal pedestrian foot-pathways and vehicle tracks traverse across the study area (Plate 5).

Plate 1 :Gravel access road and razor-wire boundary fence

Plate 2 : New tarred entrance road to the south of the study area.

Plate 3 :Existing rock/spoil dump and gravel entrance road north of the study area.

Plate 4 : Electrical substation to the north-east of the study area.

Plat path through the centre of the study area.

4.8.4 VEGETATION CHARACTERISTICS OF THE STUDY AREA

In their vegetation assessment of the Frischgewaagd section, De Castro and Brits (2016 (c)) identified eight vegetation and land-cover types. Of these, two are relevant to the study area, namely Secondary Vegetation and Marikana Thornveld. A general description of these communities based on 2021 field observations and De Castro and Brits (2016 (c)) are presented below, while a vegetation map is shown in Figure 28.

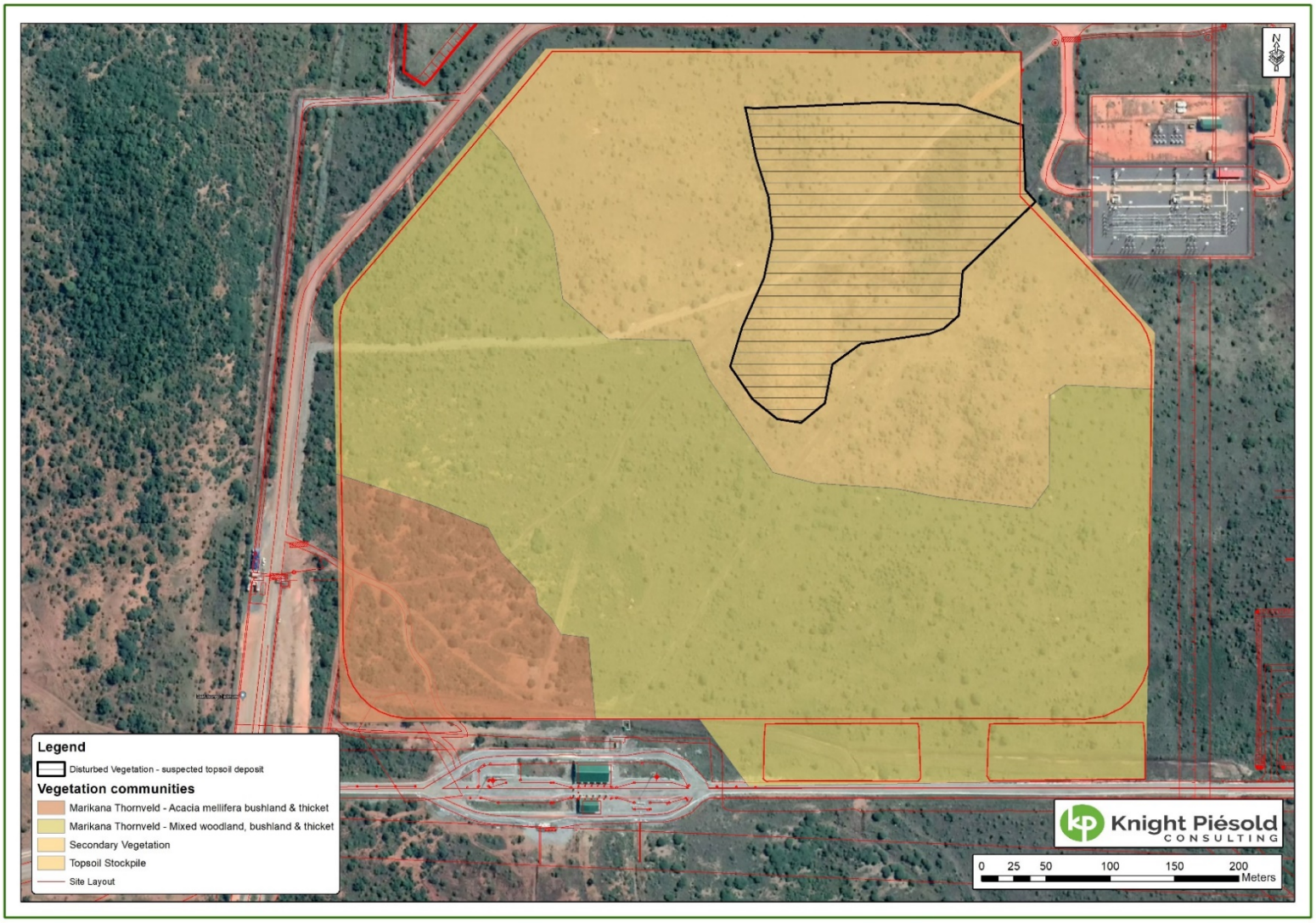


Figure 28: Vegetation community map of the study area.

4.8.4.1 SECONDARY VEGETATION

Most of the northern portion of the study area comprises secondary vegetation, which is in a fairly advanced stage of secondary succession. De Castro and Brits (2016a) indicate that much of the Frischgewaagd section that comprises this community would likely have been cultivated, heavily grazed and browsed by livestock, and frequently burnt in the past.

In the study area, vegetation structure generally comprises low and fairly open savanna (Plate 6). Common woody species recorded include *Asparagus laricinus* and *Vachellia tortilis*. Common herbaceous species include the grasses *Aristida bipartita*, *Bothriochloa insculpta, Eragrostis lehmanniana and Sorghum versicolor, as well as several weedy forbs such as Acalypha indica, Bidens bipinnata* and Zinnia peruviana** (*denotes alien species).

A prominent feature in this vegetation community is a suspected old topsoil deposit, which is located in the north-east corner of the study area. In comparison to the surrounding land, this area is elevated (about 0.5 to 1 m in height) and undulating. It appears to have revegetated naturally (Plate 7) and is dominated by alien weedy species. The annual alien herb *Zinnia peruviana* was the most visibly prominent taxa at the time of the field visit and has colonised large portions of the topsoil deposit. Other commonly recorded herbaceous species include *Acalypha indica*, *Bidens bipinnata*, Bidens pilosa**, *Gomphocarpus fruticosa, Schkuhria bipinnata** and *Tagetes minuta*.* Recorded grasses include *Andropogon shirensis, Aristida bipartita* and *Dichanthium annulatum*. Scattered woody species were noted and included *Gymnosporia polyacantha*, *Searsia lancea* and *Vachellia tortilis*.

Despite its disturbed condition, no declared alien invasive species were observed on the revegetated topsoil deposit or in the remaining areas of this vegetation community during the field visit. Similarly, no flora species of conservation concern were observed.

Areas of secondary vegetation have low species richness and do not contain suitable habitat for species of conservation concern (De Castro & Brits, 2016 (c)). These areas (excluding the suspected topsoil deposit, which is highly disturbed) do however, provide suitable supporting habitat for fauna and will likely improve in condition over time if left undisturbed. This community is thus considered to have moderate botanical biodiversity conservation value and sensitivity, in line with the findings of De Castro and Brits (2016a) (Figure 29). The suspected topsoil deposit is a highly modified site, that is dominated by alien weed species. Accordingly, this feature is considered to have low botanical biodiversity conservation value and sensitivity (Figure 29).

Plate 6: Secondary vegetation

Plate 7: Ruderal vegetation characterising the suspected topsoil deposit

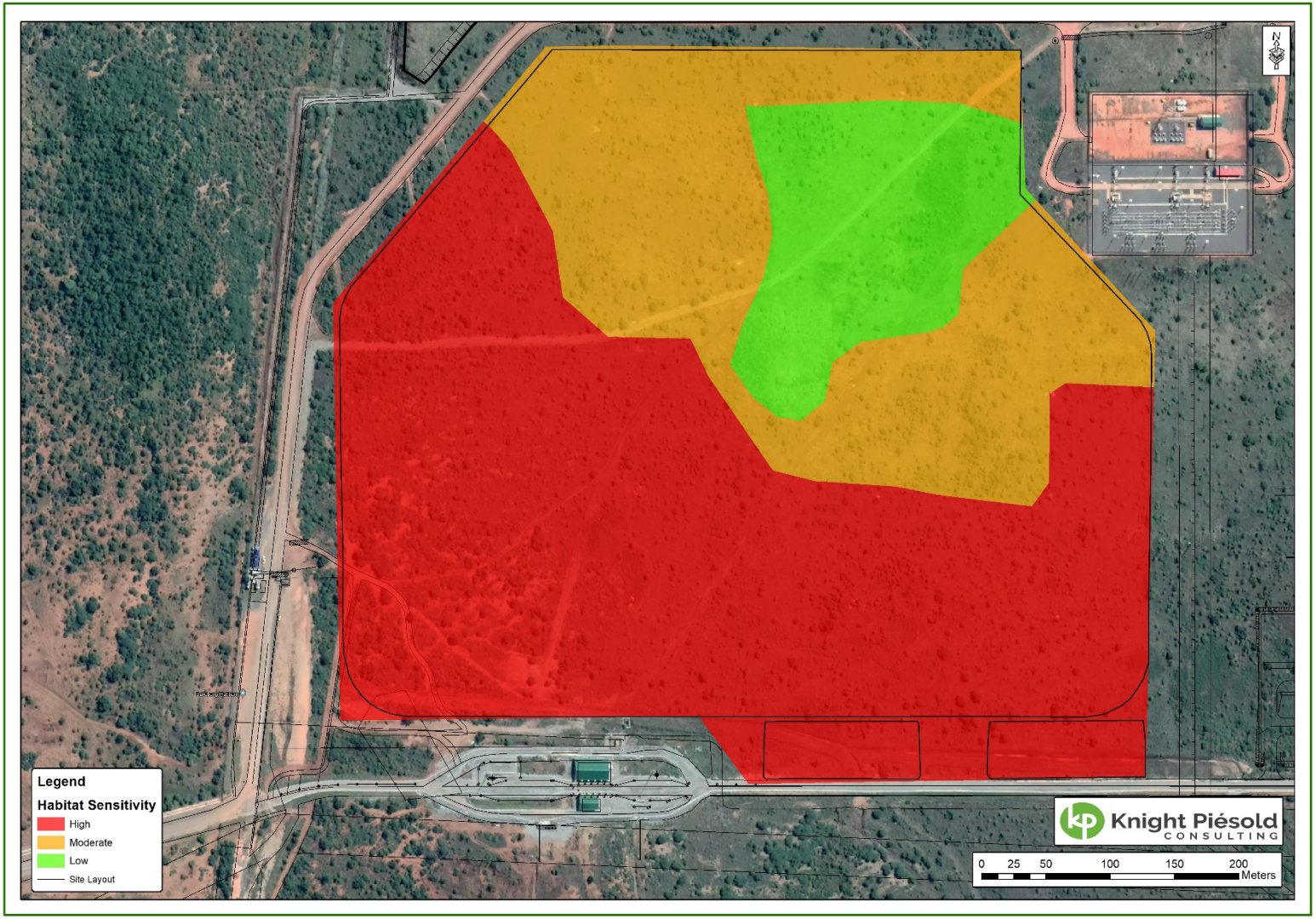


Figure 29: Sensitivity map of the proposed study area.

4.8.4.2 MARIKANA THORNVELD

This community characterises the southern portion of the study area. De Castro and Brits (2016a) indicate that historically, Marikana Thornveld would have covered the majority of the Frischgewaagd section. High levels of livestock grazing and browsing, coupled with fire, are likely to have reduced large tree density and increased shrub density (De Castro and Brits, 2016a).

General structure is short, open to closed woodland, with a well-developed grass layer (Plate 10 and Plate 11:). De Castro and Brits (2016a) parsed this community into two sub-units or forms; Mixed Bushland, Woodland and Thicket, and *Acacia mellifera*[2] Bushland and Thicket.

Mixed Bushland, Woodland and Thicket covers much of the central and south-east of the study area. Dominant woody taxa include the *Dichrostachys cinerea, Diospyros lycioides* and *Ziziphus zeyheriana,* which typically grow as small shrubs - *Diospyros lycioides* is a dominant species in localised thickets in this community. Other common larger woody taxa include *Grewia flava, Searsia lancea, Senegalia caffra, Vachellia karroo, Vachellia tortilis* and *Ziziphus mucronata*. Frequently recorded grasses include *Aristida bipartita, Cymbopogon pospischilii, Ischaemum afrum, Panicum coloratum*, *Themeda triandra* and *Trachypogon spicatus*.

The *Acacia mellifera* Bushland and Thicket community subunit is located over a small area in the south-west corner of the study area. In contrast to adjacent Mixed Bushland, Woodland and Thicket, this subunit in the study area is characterised by a more prominent 'large' tree component and a fairly patchy herbaceous layer that has been disturbed by various vehicle tracks. Woody species composition comprises a mixture of broad- and fine-leafed species, including the common *Grewia flava, Vachellia mellifer*a and *Searsia lancea*, as well as *Vachellia tortilis* and *Ziziphus mucronata*. Other less common woody taxa include *inter alia*, *Carissa bispinosa, Ehretia rigida, Euclea undulata* and *Senegalia erubescens*. Commonly recorded grasses include *Aristida canescens, Cymbopogon pospischilii, Panicum chloratum, Themeda triandra* and *Trachypogon spicatus*.

Common forb species include *Antizoma angustifolia*, *Commelina africana, C. erecta*, *Crabbea angustifolia* and *Syncolostemon pretoriae*. The succulent *Aloe dayana* is also abundant throughout this vegetation community. No species of conservation concern were recorded in the study area during the 2021 field visit. Similarly, despite localised disturbances, no declared alien invasive species were recorded.

Following their study of the Frischgewaagd section, De Castro and Brits (De Castro & Brits, 2016 (c)) noted that Marikana Thornveld is floristically species rich. They recorded one protected tree (*Boscia albitrunca*) in this vegetation community (not in the current study area) and suggest that one threatened species (*Drimia sanguinea*) has a moderate probability of occurrence – refer to Section 4.8.4.3. This community is thus considered to have high botanical biodiversity conservation value and sensitivity (De Castro & Brits, 2016 (c)) (Figure 29).

[2] *Acacia mellifera* is now known as *Senegalia mellifera*.

Plate 8: Mixed Bushland, Woodland and Thicket

Plate 9: Acacia mellifera Bushland and Thicket

4.8.4.3 FLORISTIC DIVERSITY

A total of 338 flora species have been recorded across the entire Frischgewaagd section (De Castro & Brits, 2016 (c)). This comprises 286 indigenous species and 52 naturalised alien species (De Castro & Brits, 2016 (c)). During the 2021 one-day site visit, 81 flora species were identified. For a list of flora species identified in the study area during the field visit, refer to Appendix D4.

Alien Invasive Species

Of the naturalised alien species recorded on Frischgewaagd section by De Castro and Brits (2016a), nineteen are declared alien invasive taxa according to NEMBA Alien Invasive Species Lists (2016) – listed in Table 15. Most of the alien species were recorded by De Castro and Brits (2016a) in areas of secondary vegetation or modified areas.

Table 15: Declared alien invasive species recorded in the Frischgewaagd section by (De Castro & Brits, 2016 (c))

Scientific Name	Common Name	NEMBA Category
Araujia sericifera	Moth Catcher	1b
Argemone ochroleuca	White-flowered Mexican Poppy	1b
Datura ferox	Large Thorn Apple	1b
Datura stramonium	Thorn Apple	1b
Eucalyptus camaldulensis	Saligna- Gum	1b or 2
Flaveria bidentis	Smelter's Bush	1b
Ipomoea purpurea	Morning Glory	1b
Melia azedarach	Seringa	1b
Morus alba	White Mulberry	3
Nicotiana glauca	Wild Tobacco	1b
Opuntia ficus-indica	Sweet prickly Pear	1b
Pennisetum clandestinum	Kikuyu	1b
Populus x canescens	Grey Poplar	1b
Ricinus communis	Castor Oil Plant	2

Sesbania punicea	Red Sesbania	1b
Solanum elaeagnifolium	Silver-leaf Bitter Apple	1b
Sorghum halepense	Johnson Grass	2
Verbena bonariensis	Wild Verbena	1b
Xanthium strumarium	Large Cocklebur	1b

During the 2021 field visit no declared alien invasive were recorded in the study area. Several non-declared alien weed species are common in areas of secondary vegetation and disturbed sites. These include, most commonly *Zinnia peruviana*, as well as *Bidens bipinnata, Bidens pilosa, Hibiscus trionum* and *Tagetes minuta*.

Flora Species of Medicinal Value

Flora species recorded in the study area during the 2021 field visit that have a purported medicinal value are listed in Table 16.

Table 16: Flora species of medicinal value

Scientific Name	Purported Use
***Asparagus* species**	Used for the treatment of tuberculosis, kidney ailments and rheumatism
Vachellia karroo	Used for the treatment of diarrhoea and dysentery.
Dichrostachys cinerea	Used to treat pain, back- and tooth ache, amongst other afflictions.
Elephantorrhiza elephantina	Used for the treatment of diarrhoea, dysentery and general stomach disorders.
Euclea undulata	Used to treat heart disease.
Gomphocarpus fruticosus	Used as snuff for headaches and tuberculosis.
Ziziphus mucronata	Bark infusion is used as an expectorant, while roots are used in the treatment of diarrhoea and dysentery.
Source: Medicinal uses as per Van Wyk, et al., (2009).	

Flora Species of Conservation Concern

Flora species that are considered to be of conservation concern include protected taxa, as listed in terms of the National Forests Act (Act No. 84 of 1998) or the National Environmental Management Biodiversity Act (Act No. 10 of 2004) (NEMBA ToPS List, 2007), as well as species considered threatened on the Red List of South African Plants.

Protected Flora

Two tree species recorded by (De Castro & Brits, 2016 (c)) during their field work are listed as protected in terms of the National Forests Act (Act No. 84 of 1998) (Table 17). Although *Sclerocarya birrea* subsp. *africana* was not recorded on the Frischgewaagd section, (De Castro & Brits, 2016 (c)) indicate that is likely to be present. *Boscia albitrunca* has been recorded on the Frischgewaagd section. Neither *Sclerocarya birrea* subsp. *africana* nor *Boscia albitrunca*, nor any other protected trees, were recorded in the study area during the 2021 field visit.

Table 17: Protected trees potentially occurring in the study area

Scientific Name	Family
Boscia albitrunca	Capparaceae

Sclerocarya birrea subsp. *africana*	Anacardiaceae

Threatened Flora

Based on historical records, (De Castro & Brits, 2016 (c)) listed 11 threatened flora species as potentially occurring at Bakubung Platinum Mine. Of these, the conservation statuses of five species have subsequently been downgraded; *Boophone disticha, Gunnera perpensa, Ilex mitis, Rapanea melanophloeos* and *Hypoxis hemerocallidea* were all previous assessed as 'Declining' on the National Red List but have been downgraded to 'Least Concern' (SANBI, 2020).

The remaining six species are all still threatened according to the National Red List (2020), with statuses ranging from Critically Endangered (*Aloe peglerae*) to Rare (*Frithia pulchra*). The six species are presented in Table 18, along with a probability of occurrence predicated on the De Castro and Brits (2016a) evaluation for the Frischgewaagd section. An additional species, *Cullen holubii* (Vulnerable), is highlighted as medium sensitivity feature by the environmental screening tool. This species favours sandy savanna areas and is known only from populations near Zeerust (west of the study area) and between Bela Bela and Pretoria (SANBI, 2020). Its probability of occurrence in the study area is therefore considered negligible. No threatened species were recorded in the study area during the 2021 field visit.

Plate 10: Mixed Bushland, Woodland and Thicket

Plate 11: Acacia mellifera Bushland and Thicket

Table 18: Red List flora species potentially occurring in the study area

Scientific Name	Family	Red List Status	Habitat Preferences*	Probability of Occurrence	Rationale
Adromischus umbraticola subsp. umbraticola	Crassulaceae	Near Threatened	South-facing rock crevices on ridges	Negligible	No suitable habitat
Aloe peglerae	Asphodelaceae	Critically Endangered	Shallow quartzitic soils on rocky north-facing slopes and ridges	Negligible	No suitable habitat
Cullen holubii	Fabaceae	Vulnerable	Savanna on sandy flats	Negligible	No suitable habitat and not known from area.
Drimia sanguinea	Hyacinthaceae	Near Threatened	Open savanna and woodland	Moderate	Suitable habitat present
Frithia pulchra	Aizoaceae	Rare	Shallow quartzitic soils on sandstones in savanna areas.	Low	Limited suitable habitat
Prunus africana	Rosaceae	Vulnerable	Favours evergreen and mistbelt forest	Negligible	No suitable habitat
Stenostelma umbelluliferum	Apocynaceae	Near Threatened	Favours black turf in open savanna, close to drainage lines.	Moderate	Suitable habitat is present
*Habitat preferences as per **(SANBI, 2020)**					

4.8.5 FAUNA CHARACTERISTICS OF THE STUDY AREA

This section provides a description of fauna recorded or potentially occurring in the study area, based on field observations, previous studies, and reference literature/datasets. Emphasis is placed on species of conservation concern.

4.8.5.1 MAMMALS

Based on historic distribution maps in Stuart and Stuart (2007) and MammalMap records (FitzPatrick Institute of African Ornithology, 2021), up to 93 mammal species potentially occur in the region in which the study area is located (Appendix D4). Anthropogenic disturbances, such as mining, urbanisation, and agriculture, have caused large-scale transformation and disturbance of habitats in the broader landscape, and this has negatively affected the abundance and diversity of mammals. Due to active conservation efforts, however, the Pilanesberg Game Reserve is likely to have retained a full mammal assemblage, which includes a number of large megafauna and species of conservation concern.

Ten mammal species were recorded by (De Castro & Brits, 2016 (b)) during their work at Bakubung Platinum Mine (Table 19). Apart from the Serval, the recorded species are all common taxa, with widespread distributions in savanna and grassland habitats. The most commonly observed species were Scrub Hare and Common Duiker (De Castro & Brits, 2016 (b)).

During the 2021 field visit, evidence of three mammal species was observed in the study area: Scrub Hare faecal droppings were recorded in an area of Secondary Vegetation; and although partially obscured by rain, the tracks of a small antelope (either Steenbok or Common Duiker) and possibly a Warthog, were also noted. These are all common taxa in savanna areas.

Table 19: Mammals recorded at Bakubung Platinum Mine

Common Name	Scientific Name	Red List Status	NEMBA ToPS Status	Provincial Protected Status (2016)	Recorded in the Study Area during 2021 field visit
Family Bovidae					
Steenbok	*Raphicerus campestris*	-	-	-	X
Common Duiker	*Sylvicapra grimmia*	-	-	-	X
Family Canidae					
Black-backed Jackal	*Canis mesomelas*	-	-	-	
Family Felidae					
Caracal	*Caracal caracal*	-	-	-	
Serval	*Leptailurus serval*	Near Threatened	Protected	Specially Protected	
Family Herpestidae					
Slender Mongoose	*Galerella sanguinea*	-	-	-	
Water	*Atilax paludinosus*	-	-	-	

Mongoose					
Family Hystricidae					
Porcupine	*Hystrix africaeaustralis*	-	-	-	
Family Leporidae					
Scrub Hare	*Lepus saxatilis*	-	-	-	X
Family Pedetidae					
Springhare	Pedetes capensis	-	-	-	
Family Suidae					
Common Warthog	*Phacochoerus africanus*	-	-	-	X
Source: Master list as per De Castro and Brits (2016 (b))**. Updated with 2021 field data.**					

During their study, (De Castro & Brits, 2016 (b)) recorded evidence of Serval (*Leptailurus serval*) along the TSF pipeline, between Frischgewaagd and Mimosa Sections. The Red List status of the Serval is Near Threatened. It is also listed as Protected in terms of the NEMBA Threatened or Protected Species (ToPS) list (NEMBA, 2013) and Specially Protected in terms of the North West Biodiversity Management Act (Act No. 4 of 2016).

De Castro and Brits (2016 (b)) highlighted 23 additional mammal species of conservation concern that could potentially occur in the region. At the time, most of these were considered species of conservation concern based on their 'Data Deficient' Red List status. Subsequently however, 13 of these taxa have been revaluated and classified as Least Concern on the most recent mammal Red List (Endangered Wildlife Trust, 2016). Currently, only 11 species are still considered threatened on the Red List and/or listed as nationally protected (Table 20).

Table 20: Mammal species of conservation concern potentially occurring in the study area

Family	Common Name	Scientific Name	Red List Status	NEMBA ToPS Status	Provincial Protected Status	Habitat Preferences*	Probability of Occurrence	Rationale
Canidae	Cape Fox	*Vulpes chama*	Least Concern	Protected	-	Range of habitats, including savanna	Low	High levels of disturbance
Erinaceidae	Southern African Hedgehog	*Atelerix frontalis*	Near Threatened	Protected	-	Range of habitats, including savanna	Moderate	Suitable habitat present
Felidae	Serval	*Leptailurus serval*	Near Threatened	Protected	Specially Protected	Range of habitats, including savanna and savanna	Moderate	Recorded by De Castro and Brits (2016b) along the TSF pipeline, between Frischgewaagd and Mimosa Sections. Possibly transitory through the study area.
	Black-footed Cat	*Felix nigripes*	Vulnerable	Protected	Specially Protected	Savanna and grassland habitats	Low	High levels of disturbance
Hyaenidae	Brown Hyaena	*Hyaena brunnea*	Near Threatened	Protected	-	Savanna and desert habitats	Low	High levels of disturbance
Manidae	Pangolin	*Smutsia temminckii*	Vulnerable	Vulnerable	-	Savanna habitats	Low	Very rare species, facing high levels of disturbance
Muridae	Vlei Rat	*Otomys auratus*	Near Threatened	-	-	Wetland habitats, but also grassland and savanna	Moderate	Suitable habitat present
Mustelidae	Cape Clawless Otter	*Aonyx capensis*	Near Threatened	Protected	Specially Protected	Riparian habitats	Low	No suitable habitat present
	Spotted-necked Otter	*Hydrictis maculicollis*	Vulnerable	Protected	-	Riparian habitats but favours open water bodies.	Low	No suitable habitat present
	African Weasel	*Poecilogale albinucha*	Near Threatened	-	Specially Protected	Savanna and grassland habitats	Moderate	Suitable habitat present
Soricidae	Swamp Musk Shrew	*Crocidura mariquensis*	Near Threatened	-	-	Moist grassland and wetland habitats	Low	Limited suitable habitat
*Habitat preferences as per Skinner and Smithers (1990)								

4.8.5.2 BIRDS

Based on records presented by the South African Bird Atlas Project 2 (SABAP2), the broader landscape has a high bird species richness, with 343 species collectively recorded in the pentads 2520_2705 and 2520_2700. These high counts are largely attributable to the presence of Pilanesberg Game Reserve, which has an unusually high observer coverage, compared to adjacent non-protected areas.

In total, 88 bird species were recorded during bird surveys at Bakubung Platinum Mine by De Castro and Brits (2016 (b)). These authors parsed the recorded species into four main bird assemblages, predicated on habitat type, viz; Thicket, Shrubland, Grassland and Secondary/Modified.

The most frequently observed bird species in thicket were Crested Francolin, Kalahari Scrub-robin, Chestnut-vented Titbabbler, Southern Bou Bou and the White-bellied Sunbird (De Castro & Brits, 2016 (b)). The shrubland assemblage recorded the greatest species richness of the four assemblages (n=58), with the most frequently recorded taxa consisting of Rattling Cisticola, Sabota Lark, Black-chested Prinia and Red-faced Mousebird (De Castro & Brits, 2016 (b)). In grassland habitats, Rufous-naped Lark was the most recorded taxa, followed by African Quailfinch and Cattle Egret (De Castro & Brits, 2016 (b)). Lastly, records in the Secondary/Modified assemblage were dominated by Common Myna, Cattle Egret, Pied Crow and House Sparrow (De Castro & Brits, 2016 (b)).

Thirty-two bird species were recorded as incidental observations during the 2021 field visit. Of these, 31 are common and widespread species in savanna and grassland habitats. One species is of conservation concern; a single White-backed Vulture (*Gyps africanus*) - Critically Endangered, was observed flying high above the Frischgewaagd Section. This species typically roosts in large Acacia trees, and favours large natural areas where it can locate and scavenge on carcasses. The observed individual is likely to roost in the Pilanesberg Game Reserve and was observed on an aerial search for carcasses across the broader landscape surrounding the reserve. Considering its location and the degree of local anthropogenic activities and disturbances, the study area is not considered to be important life-cycle habitat for this species.

During their field work, De Castro and Brits (2016 (b)) did not observe any bird species listed nationally as either threatened or protected. However, based on distribution ranges alone, up to 26 bird species of conservation concern potentially occur in the region (Table 21). This notwithstanding, considering the characteristics of the site and its environs, most of these have either a low or moderate probability of being present.

Table 21: Bird species of conservation concern potentially occurring in the study area

Family	Scientific Name	Common Name	Red List Status	NEMBA ToPS Status	Provincial Protected Status	Habitat Preferences*	Probability of Occurrence	Rationale
Accipitridae	*Polemaetus bellicosus*	Martial Eagle	Endangered	Vulnerable	Specially Protected	Range of habitats, including savanna	Low	Limited suitable habitat present and high levels of disturbance
	Aquila verreauxii	Verreaux's Eagle	Vulnerable	-	Specially Protected	Mountainous habitats	Low	No suitable habitat present.
	Aquila rapax	Tawny Eagle	Endangered	Vulnerable	Specially Protected	Savanna habitats	Low	Limited suitable habitat present and high levels of disturbance
	Gyps africanus	White-backed Vulture	Critically Endangered	Endangered	Specially Protected	Savanna habitats	Recorded gliding high above the Frischgewaagd Section	Limited suitable habitat present or foraging opportunities on-site and high levels of anthropogenic disturbance make it highly unlikely this species resides on-site.
	Gyps coprotheres	Cape Vulture	Endangered	Endangered	Specially Protected	Savanna and grassland habitats	Low	Limited suitable habitat present and high levels of disturbance
	Terathopius ecaudatus	Bateleur	Endangered	Vulnerable	Specially Protected	Savanna habitats	Low	Limited suitable habitat present and high levels of disturbance
	Torgos tracheliotus	Lappet-faced Vulture	Endangered	Endangered	Specially Protected	Range of habitats, including savanna	Low	Limited suitable habitat present and high levels of disturbance
	Circus macrourus	Pallid Harrier	Near Threatened	-	Specially Protected	Savanna and grassland habitats	Low	Limited suitable habitat present.
	Circus ranivorus	African Marsh Harrier	Endangered	Protected	Specially Protected	Grassland and wetland habitats	Low	Limited suitable habitat present.
Alcedinidae	*Alcedo semitorquata*	Half-collared Kingfisher	Near Threatened	-	Specially Protected	Riparian woodland and forest	Low	Limited suitable habitat present.
Ciconiidae	*Ciconia abdimii*	Abdim's Stork	Near Threatened	-	Specially Protected	Range of habitats, including savanna	Low	Limited suitable habitat present.

Family	Scientific Name	Common Name	Red List Status	NEMBA ToPS Status	Provincial Protected Status	Habitat Preferences*	Probability of Occurrence	Rationale
	Ciconia nigra	Black Stork	Vulnerable	Vulnerable	Specially Protected	Riparian habitats	Low	Limited suitable habitat present.
	Leptoptilos crumeniferus	Marabou Stork	Near Threatened	-	Specially Protected	Range of habitats, including savanna	Moderate	Suitable habitat is present.
	Mycteria ibis	Yellow-billed Stork	Endangered	-	Specially Protected	Wetland habitats	Low	No suitable habitat present.
Coraciidae	*Coracias garrulus*	European Roller	Near Threatened	-	Specially Protected	Savanna habitats	Moderate	Suitable habitat is present
Falconidae	*Falco biarmicus*	Lanner Falcon	Vulnerable	-	Specially Protected	Range of habitats, including savanna	Moderate	Suitable habitat is present
Glareolidae	*Glareola nordmanni*	Black-winged Pratincole	Near Threatened	-	Specially Protected	Grassland and wetland habitats	Low	Limited suitable habitat present.
Gruidae	*Anthropoides paradiseus*	Blue Crane	Near Threatened	Endangered	-	Grassland and wetland habitats	Low	Limited suitable habitat present.
Otididae	*Ardeotis kori*	Kori Bustard	Near Threatened	Vulnerable	-	Grassland and savanna habitats	Low	Limited suitable habitat present and high levels of disturbance
Pelecanidae	*Pelecanus rufescens*	Pink-backed Pelican	Vulnerable	Endangered	Specially Protected	Wetland habitats	Low	No suitable habitat present.
Phoenicopteriformes	*Phoenicopterus minor*	Lesser Flamingo	Near Threatened	-	Specially Protected	Wetland habitats	Low	No suitable habitat present.
	Phoenicopterus ruber	Greater Flamingo	Near Threatened	-	Specially Protected	Wetland habitats	Low	No suitable habitat present.
Pteroclidae	*Pterocles gutturalis*	Yellow-throated Sandgrouse	Near Threatened	-	Specially Protected	Savanna habitats	Moderate	Suitable habitat is present
Rostrtulidae	*Rostratula benghalensis*	Greater-painted Snipe		-	Specially Protected	Wetland habitats	Low	No suitable habitat present.
Sagittariidae	*Sagittarius serpentarius*	Secretarybird	Vulnerable	-	Specially Protected	Grassland and savanna habitats	Low	Limited suitable habitat present and high levels of disturbance
Tytonidae	*Tyto capensis*	African Grass Owl	Vulnerable	Vulnerable	-	Grassland and wetland habitats	Low	No suitable habitat present.
*Habitat preferences as per Roberts VII Multimedia								

4.8.5.3 HERPETOFAUNA (REPTILES AND AMPHIBIANS)

Based on historic distribution ranges presented in literature, 23 amphibian (du Preez & Carruthers, 2009) and 73 reptile species (Bates, et al., 2014) potentially occurring in the study area. Of these, four reptile and four amphibian species were recorded at Bakubung Platinum Mine by De Castro and Brits (2016 (b)) – these are listed in Table 22. No reptiles or amphibians were recorded during the 2021 field visit.

The African Bullfrog (*Pyxicephalus edulis*), which De Castro and Brits (2016 (b)) reported from a previous study, is listed as Protected and Specially Protected according to the NEMBA ToPS (2013) and North West Biodiversity Management Act (Act No. 4 of 2016) (North West Department of Rural, Environmental and Agricultural Development, 2016), respectively. The remaining seven herpetofauna taxa are common and widespread species in grassland and savanna habitats.

Two other herpetofauna of conservation concern potentially occur in the study area:

- The Southern African Python (*Python natalensis*) is not listed as threatened, but it is listed as Protected in terms of the NEMBA ToPS (2013) list. This species is found in a wide variety of habitats, but typically prefers riverine and rocky areas in savanna habitats (Bates, et al., 2014). The probability of this species occurring in the study area is considered moderate, as there is potential suitable habitat present; and
- The Giant Bullfrog (*Pyxicephalus adspersus*) is also not listed as threatened, but it is listed as Protected (Department of Environment, Forrestry and Fisheries, 2013). Giant Bullfrog favour seasonal shallow, grassy pans and vleis in open, flat areas of grassland and savanna (du Preez & Carruthers, 2009). The probability of this species occurring in the study area is considered low, as there is little suitable habitat present.

Table 22: Herpetofauna recorded at Bakubung Platinum Mine by De Castro and Brits (2016 (b))

Common Name	Scientific Name	Red List Status	NEMBA ToPS Status	Provincial Protected Status
Reptiles				
Family Elapidae				
Mozambique Spitting Cobra	*Naja mossambica*	Least Concern	-	-
Family Scincidae				
Striped Skink	*Trachylepis striata*	Least Concern	-	-
Variable Skink	*Trachylepis varia*	Least Concern	-	-
Family Viperidae				
Puffadder	*Bitis arietans*	Least Concern	-	-
Amphibians				
Family Bufonidae				
Guttural Toad	*Amietophrynus gutteralis*	Least Concern	-	-
Raucous Toad	*Amietophrynus rangeri*	Least Concern	-	-
Family Pyxicephalidae				
African Bullfrog	*Pyxicephalus edulis*	Least	Protected	Specially

Common Name	Scientific Name	Red List Status	NEMBA ToPS Status	Provincial Protected Status
		Concern		Protected
Common River Frog	*Amieta angolensis*	Least Concern	-	-

4.8.6 KEY ECOLOGICAL PROCESSES AND ATTRIBUTES

4.8.6.1 LANDSCAPE LINKAGES AND CORRIDORS

As a formal protected area, characterised by diverse habitats and an intact fauna assemblage, Pilanesberg Game Reserve is vitally important in biodiversity conservation in the North West Province. Areas of undeveloped natural and semi-natural habitat that surround the reserve play a vital role supporting and buffering the ecological processes within the reserve. Amongst other traits, habitat patches in the surrounding landscape are likely act as movement and dispersal corridors or 'steppingstones' for certain fauna and flora.

The landscape immediately surrounding the study area and the Frischgewaagd section comprises a mosaic of completely modified/transformed land (urban and mining) and areas of natural and semi-natural habitat. Numerous linear developments, such as large arterial roads, informal gravel roads/tracks, security and farm fences, and large electrical power lines, further fragment the landscape.

Land to the north and west of the study area (i.e., between the study area and the Pilanesberg Game Reserve) comprises the Ledig residential area. Little natural habitat is present, and where it does occur, it is typically disturbed by anthropogenic activities. Undeveloped patches in Ledig that were noted include two narrow drainage lines (Plate 12). These extend southward through Ledig and bypass the study area to the west and east of the Frischgewaagd section, before joining the Elands River. Although disturbed, they are likely to act as potential corridors between Pilanesberg Game Reserve, the Elands River and undeveloped areas to the south of the Frischgewaagd section. They may therefore be of ecological importance at a landscape-scale. Neither however, is likely to be impeded by the proposed development of the TSF in the study area or other planned infrastructure at Frischgewaagd.

The Elands River is located to the south of the study area (Plate 13). At this point, the river is characterised by a fairly broad river channel, flanked by riparian woodland. Most of the land to the south of the river comprises undeveloped, albeit fragmented savanna habitat. The Elands River will act as an important movement and dispersal corridor in the landscape. The proposed development of the study area is however, unlikely to affect the functionality of the Elands River as an ecological corridor. To maintain landscape connectivity, it is important that the land adjacent to the river in the Frischgewaagd section (i.e., between the new entrance road and the river) is designated a no-go area and strictly managed as a natural habitat corridor.

Plate 12: Drainage line in the Ledig residential settlement, located north-west of the Frischgewaagd section. The drainage line is flanked by homesteads. The mountains in the background are part of the Pilanesberg Game Reserve.

Plate 13: The Elands River to the south of the study area.

4.8.7 KEY ECOLOGICAL PROCESSES AND DRIVERS OF CHANGE

The following notes describe the key processes and drivers of change that are likely to be present in the landscape and their possible influence on the character of the terrestrial ecology of the study area.

4.8.7.1 FIRE

Fire is a key determinant of savanna ecosystem dynamics as it is a dominant driver of spatial and temporal heterogeneity across the landscape (Du Toit, Rogers, & Biggs, 2003). Through the large-scale and periodic removal of plant material, fire influences tree-grass ratios and plant species mixes (fire tolerant vs fire intolerant species) and therefore plays a key role determining vegetation structure, composition and function (Du Toit, Rogers, & Biggs, 2003).

Based on the abundance of moribund grass material observed during the 2021 field visit, fire appears to be an irregular occurrence in the study area and is probably actively excluded by mine management. Moreover, it is expected that the numerous vehicle roads/tracks, pedestrian paths, and concrete stormwater drains that are present in the landscape surrounding the study area are likely to function as effective firebreaks, limiting the encroachment of fire from neighbouring properties onto the study area. The exclusion of fire or reduction in its frequency is likely to lead to an increase shade and moribund tolerant grass species and a general increase in the abundance of woody species.

4.8.7.2 GRAZING BY UNGULATES

Overgrazing is a common cause of dryland degradation, leading to one or several recognised syndromes (Scholes, 2009). It occurs when grazing herbivores (both wildlife and domestic) are kept at excessive stocking rates and/or are able to concentrate their grazing to a limited foraging area without suitable rest periods. A common syndrome that can be linked to overgrazing, at least in part, is a change in plant species composition, that manifests as a combination of bush encroachment, a reduction in palatable grasses, and a reduction in grass productivity (Scholes, 2009).

It is likely that historic grazing has affected the composition of vegetation in the study area, as well as across most of the surrounding landscape. However, it is understood that currently grazing livestock,

such as cattle and goats, are actively excluded from the Frischgewaagd section. Herbivory is therefore unlikely to be a key ecosystem driver in the study area. This coupled with the absence of fire, is likely to favour flora species that are tolerant of underutilised savanna.

4.9 AQUATIC AND WETLAND ASSESSMENT

As part of this amendment process, Knight Piésold undertook an Aquatic and Wetland Assessment in February 2020. This report was updated in March 2021. The full report is available in Appendix D5.

4.9.1 AQUATIC

The baseline aquatic environment is described in this section, as taken from (Knight Piésold, 2021).

Invertebrate Habitat Assessment (IHAS)

The Elands river has a variety of habitat and biotopes available for macro-invertebrates. The sampled river reach had shallow slow flowing water at the upstream point, and shallow to deep slow flowing water at the downstream point.
The most dominant biotope upstream was stones in and out of current, bedrock and boulders along with limited marginal vegetation and Gravel Sand and Mud (GSM), with no aquatic vegetation. The downstream point was dominated by GSM, stones out of current and marginal vegetation. There was no aquatic vegetation or stones in current. Both sites had slow flowing runs and pools, with no significant riffles or rapids observed.

Aquatic Invertebrates

The proposed Ecological Category (EC) for the reach of the Elands River is a category D (Largely Modified). The SASS 5 protocol was used to sample macro-invertebrate assemblages of both BKB-U and BKB-D. Although the water levels and flow were low, the sampling sites provided sufficient habitat to allow for the sampling of macro-invertebrates.

Ichtyofuana (Fish)

Fish sampling was done by electro shocking which was limited to accessible areas within the stretch of river. Water clarity also played a role in sampling, as visibility was limited. The ecological category for the reach of the Elands River was a category D, and this was confirmed by the sampling undertaken up and downstream.

4.9.2 WETLAND

The baseline wetland environment is described in this section, as taken from (Knight Piésold, 2021).
Three hydrogeomorphic units were identified during the survey: river, channeled valley-bottom wetland and unchanneled valley-bottom wetland. The distribution of these is shown in Table 23 and Figure 30.

Ephemeral Channels
Seven ephemeral channels were identified during the site survey. Ephemeral channels only flow during rainfall periods and the flow is short lived as it is dependent on the inflow of water. Each channel was assessed based on the in-stream characteristics using the Intermediate Habitat Integrity (IHI) method to determine the Present Ecological State (PES).
The IHI method is a rapid method to assess the PES for such channels as these wetlands are difficult to assess using the WET-Health tools. The table below show the PES for each of these channels. All seven the ephemeral channels were determined to have a PES of C (moderately modified).

Table 23: Hydrogeomorphic (HGM) units identified during the survey numbered in accordance to Figure 19.

No	HGM Unit	Description	Size (Ha)
1	Ephemeral Channel	Located north west of project area and drains into small dam	0.52
2	Ephemeral Channel	North of project area channel that receives storm water run-off from the R556 and surrounding areas. Drains into an ephemeral dam	0.3
3	Ephemeral Channel	North of project area channel that receives storm water run-off from the R556 and surrounding areas. Drains into an ephemeral dam	0.25
4	Ephemeral Channel	The channel drains from the dam south towards the project area. The channel feeds the valley bottom wetland.	0.99
5	Ephemeral Channel	The channel originates to the north towards the Pilanesberg and receives surface water run-off from the catchment draining south adjacent to the project area where it joins the Elands River downstream of the mine.	11.97
6	Ephemeral Channel	Located to the south the channel drains into the Elands River	0.20
7	Ephemeral Channel	Channel towards the south west of the project area that drains south	1.45
8	Unchanneled Valley Bottom	Wetland located north of the project area, receives water from the upstream catchment. Due to some construction activities the wetland has been divided in two parts.	5.16
9	Channelled Valley Bottom	Drains south into the Sandspruit. The channel flows under the R565.	1.32
10	Ephemeral Drainage Channel	Drainage channel draining the mining area. The channel receives run-off from the cleared areas within the project area.	0.13
11	Ephemeral Drainage Channel	Drainage channel draining the mining area. The channel receives run-off from the cleared areas within the project area.	0.70
12	Ephemeral Drainage Channel	Located on the southern bank of the Elands River. The drainage channels was assessed as it falls within the 500 m buffer zone	0.28

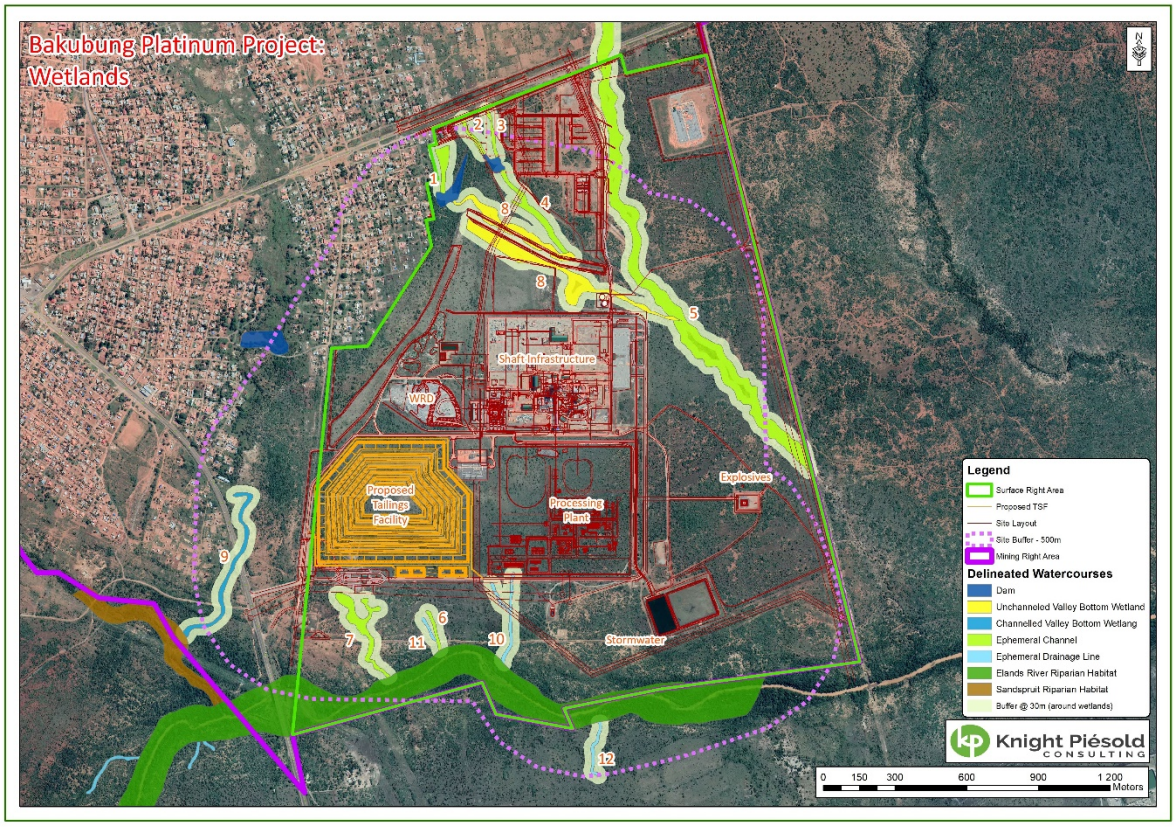


Figure 30: Delineated watercourse areas and associated buffers

Unchanneled Valley Bottom Wetland

Wetland 8 (Figure 30) was classified as a unchanneled valley bottom wetland that drains into the ephemeral channel to the east of the project area. The wetland area has been separated in two because of a noise berm was constructed. The construction of the area for the water tanks and road to the staff accommodation has also altered the flow of water within the wetland. No culvert has been created for the water to flow under the road and has caused water to dam on the western section. The valley bottom wetland receives water from all the ephemeral channels that flow south and flows through the wetland.

The overall WET Health for the HGM unit within the project area, given its relative contributions from each component, indicates a health category of C. The wetland presents good vegetation cover which minimises soil erodibility and sedimentation during rainfall events. The Category C wetland indicates that the wetland is in a moderately modified state.

Channeled Valley Bottom Wetland

A channeled valley bottom wetland was identified to the west of the project area. The wetland drains towards the south into the Sandspruit. The wetland was confirmed during the survey but was not assessed as the mine should not have an impact on the wetland though it is located within the 500 m radius of the mining area.

A level 1 WET-Health assessment was undertaken for the channeled valley bottom wetland. The results indicate that it is a Category C.

Ephemeral Drainage Line

There is currently no prescribed method for the determination of the PES for drainage lines but for the purpose of the survey the IHI method was adapted to use the in-stream assessment. The drainage lines are located to the south of the project area draining into the Elands river. The drainage lines

might be impacted due to surface water run-off from the mining area. The overall ecological state for the drainage lines are a Category B (Largely Natural) with the current impacts associated. The drainage lines might deteriorate in future as the surface run-off might increase or the drainage lines be lost due to construction of additional surface infrastructure.

Ecological Importance and Sensitivity (EIS) Assessments

According to (DWAF, 1999), “ecological importance" of a water resource is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales. "Ecological sensitivity" refers to the system’s ability to resist disturbance and its capability to recover from disturbance once it has occurred. The EIS was conducted according to the DWAF guidelines (1999) for the one HGM unit found in the wetland system. Results for the EIS are presented in Table 24.

Table 24: Interpretation of median scores for biotic and habitat determinants to determine the EIS

Determinant	Ephemeral Channel (1)	Ephemeral Channel (2)	Ephemeral Channel (3)	Ephemeral Channel (4)	Ephemeral Channel (5)	Ephemeral Channel (6)	Ephemeral Channel (7)	Valley Bottom without a Channel (8)	Valley Bottom with a Channel (9)	Ephemeral Drainage Line (10)	Ephemeral Drainage Line (11)	Ephemeral Drainage Line (12)
PRIMARY DETERMINANTS												
Rare & Endangered Species	1	1	1	1	1	1	1	1	1	0	0	0
Populations of Unique Species	1	1	1	1	1	1	1	1	1	0	0	0
Species/taxon Richness	0	0	0	0	2	0	0	2	2	0	0	0
Diversity of Habitat Types or Features	1	1	1	1	2	1	1	2	2	1	1	1
Migration route/breeding and feeding site for wetland species	1	1	1	1	1	1	1	1	1	1	1	1
Sensitivity to Changes in the Natural Hydrological Regime	2	2	2	2	3	2	2	2	2	2	2	2
Sensitivity to Water Quality Changes	2	2	2	2	4	2	2	4	4	1	1	1
Flood Storage, Energy Dissipation & Particulate/Element Removal	3	3	3	3	3	3	1	3	3	3	3	3
MODIFYING DETERMINANTS												
Protected Status	0	0	0	0	0	0	0	0	0	0	0	0
Ecological Integrity	1	1	1	1	3	1	1	3	3	1	1	1
TOTAL	12	12	12	12	20	12	10	19	19	9	9	9
MEDIAN	1	1	1	1	2	1	1	2	2	1	1	1
OVERALL ECOLOGICAL SENSITIVITY AND IMPORTANCE	**Low/Marginal**	**Low/Marginal**	**Low/Marginal**	**Low/Marginal**	**Moderate**	**Low/Marginal**	**Low/Marginal**	**Moderate**	**Moderate**	**Low/Marginal**	**Low/Marginal**	**Low/Marginal**
Ecological Management Class	**D**	**D**	**D**	**D**	**C**	**D**	**D**	**C**	**C**	**D**	**D**	**D**

4.10 SURFACE WATER

4.10.1 HYDROLOGY

The natural topography around the site slopes to the south with stormwater draining to the Elands River, which flows away from the site. The slope ranges from approximately 1H:100V to 1V:30H. There are two tributaries of the Elands River that are located near the Bakubung site, with one running near the eastern boundary and the other within the Ledig community.

Figure 31 shows the 1 in 100 year recurrence flood line analysis contained in the EnviroSource report. While the layout within the footprint of the filtration plant and the tailings dry stack have changed, the overall footprint is still the same and therefor the results of the EnviroSource flood line analysis are considered to still be relevant. None of the mine infrastructure is located within the 1 in 100-year recurrence flood line or withing 100 m of a natural water course.

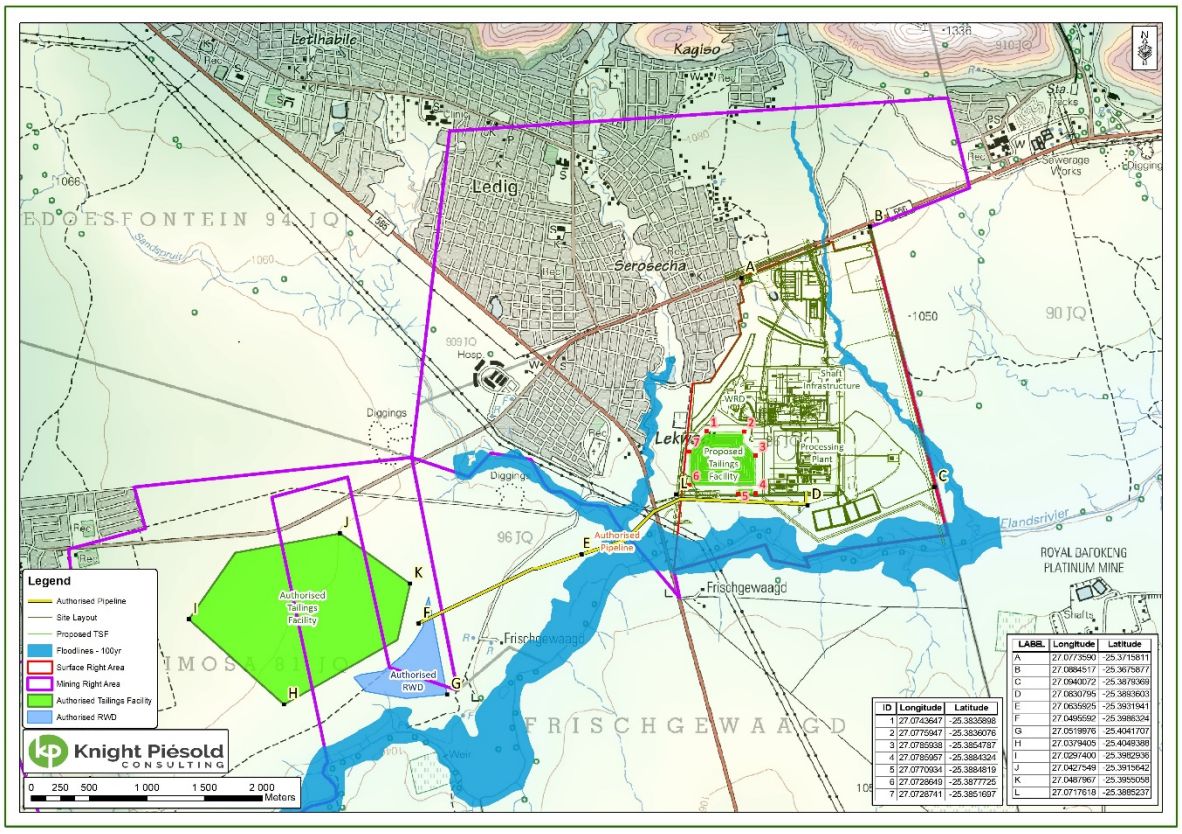


Figure 31: 1:100-year recurrence flood line (adapted from (Envirosource, 2016))

4.10.2 WATER QUALITY

BPM is undertaking monthly and quarterly monitoring of ten groundwater localities and four surface water localities on the Frischgewaagd and Mimosa farms, as shown in Table 25 and Figure 32.

Table 25: Surface and Groundwater Monitoring Points

Name	Description	Coordinates	
		Latitude	Longitude
Groundwater localities			
FBH01D	Borehole on Frischgewaagd, down gradient	S25.38673	E27.07585
FBH02D	Borehole on Frischgwaagd, down gradient	S25.38498	E27.07824
FBH04D	Borehole on Frischgewaagd, down gradient	S25.38625	E27.08576
FBH05S	Borehole on Frischgewaagd, down gradient	S25.38098	E27.07233
FDB1	Borehole on Mimosa farm, upgradient	S25.39648	E27.07429
MBH01D	Borehole on Mimosa farm, down gradient	S25.40059	E27.03159
MBH03D	Borehole on Mimosa farm, down gradient	S25.39686	E27.04689
MBH04	Borehole on Mimosa farm, down gradient	S25.39277	E27.03087
MBH05	Borehole on Mimosa farm, down gradient	S25.39201	E27.04928
MBH06	Borehole on Mimosa farm, down gradient	S25.40556	E27.05078
Surface water localities			
SW1	Elands River upstream of mine	S25.41648	E27.03318
SW2	Elands River midstream along mine	S25.39313	E27.07504
SW3	Elands River down stream from mine	S25.39337	E27.09493
SW4	Mine water pond (PCD)	S25.38927	E27.08720

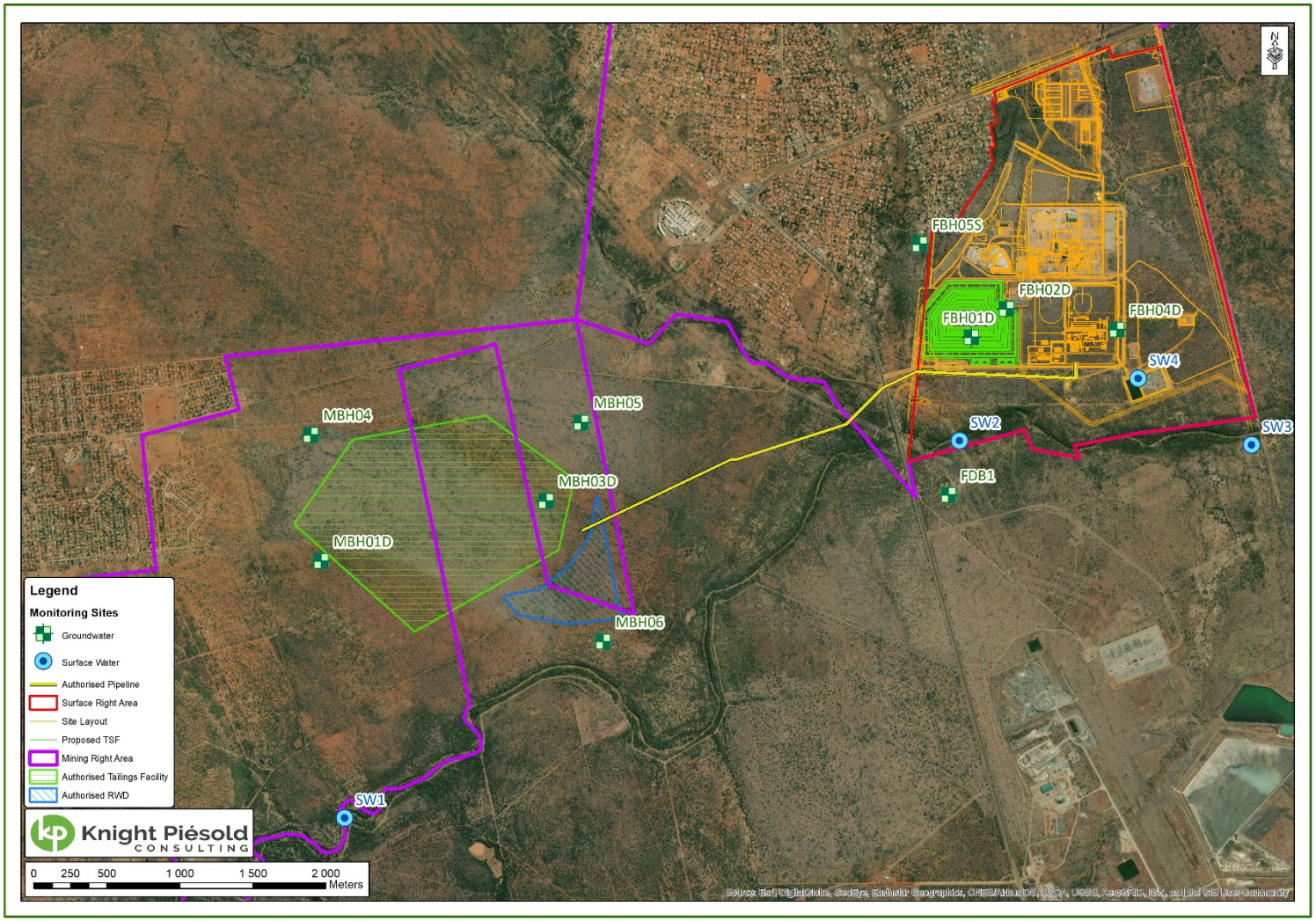


Figure 32: Surface and Groundwater Monitoring Points

The DHSWS issued a document entitled: Determination of Water Resource Classes and Resource Quality Objectives (RQO) for Makolo, Mtlabas, Crocodile (West) and Marico Catchments in February 2019 (DWS, 2019).
In terms of this report the Water Resource Class for the A22F catchment is Class II. The ecological category to be maintained is a C. Table 26 provides a summary of the RQOs of the applicable catchment.

Table 26: RQO for A22F (Extract from (DWS, 2019))

Component	Sub- component	Narrative RQO	Indicator	Numerical Limit RQO		
Quantity			Chloride	≤ 20mg /l (95th percentile)	Maintenance Low flows (m^3/s)	Drought flows (m^3/s)
					0.038	0.011
				Nov	0.048	0.014
				Dec	0.057	0.016
				Jan	0.081	0.023
				Feb	0.107	0.012
				Mar	0.105	0.027
				Apr	0.082	0.023
				May	0.06	0.017
				Jun	0.054	0.016
				Jul	0.047	0.014
				Aug	0.042	0.012
				Sep	0.038	0.011
Quality	Nutrients	Nutrient levels are high and must be reduced to meet the requirements of the aquatic ecosystem. Concentrations must be reduced to meet the prescribed C ecological category.	Orthophosphate (PO_4^-) as Phosphorus			
			Nitrate (NO_3^-) & Nitrite (NO_2^-) as Nitrogen	≤ 2.0 mg/l (50th percentile)		
	Salts	Salinity levels are significantly high. Instream salinity must be improved to support the aquatic ecosystem and the water quality requirements of the water users. Water quality must be improved to a C ecological category.	Electrical Conductivity	≤ 85 mS/m (95th percentile)		
			Sodium	≤ 100 milligrams/litre (95th percentile)		
			Sulphate	≤ 120 mg/l (95th percentile)		
			Chloride	≤ 120 milligrams/litre (95th percentile)		
	Pathogens	The presence of pathogens should pose a low risk to human health.	*Escherichia coli* (*E. coli*)	130 counts / 100 ml (95th percentile)		
	System Variables	pH range must be maintained within limits specified to support the aquatic ecosystem and water user requirements.	pH range	6.0 (5th percentile) and 9.0 (95th percentile)		
Quality		A baseline assessment to determine the present state instream turbidity is required.	Turbidity	A 10% variation from background concentration is allowed. Limits must be determined.		
	Toxics	The concentrations of toxicants must pose no risk to aquatic organisms and to human health.	Aluminium (Al)	≤ 0.1 mg/l (95th percentile)		
			Manganese (Mn)	≤ 0.15 mg/l (95th percentile)		
			Iron (Fe)	≤ 0.3 mg/l (95th percentile)		
			Lead (Pb) hard	≤ 0.0095 mg/l (95th percentile)		
			Zinc (Zn)	≤ 0.002 mg/l (95th percentile)		
Habitat	Instream	Habitat diversity should be maintained in a C ecological category or better. Important to maintain marginal vegetation and in-stream substrate (flow depth classes) for fish and macroinvertebrate diversity.	Index of Habitat Integrity, Rapid Habitat Assessment Method and Model, Geomorphic Assessment Index	Instream Habitat Integrity EC = C ≥ 62%		

Component	Sub- component	Narrative RQO	Indicator	Numerical Limit RQO
	Riparian habitat	Riparian vegetation should be maintained at a C ecological category. Alien vegetation control is required. Riparian zone development must be limited.	Index of Habitat Integrity, Vegetation Response Assessment Index	VEGRAI EC = C ≥ 70%
Biota	Fish	The fish community must be maintained in a D ecological category or better. An assessment of the fish community should be conducted annually to monitor against the prescribed ecological category.	Fish Response Assessment Index (FRAI).	Fish ecology category = D FRAI ≥ 42% Sample minimum of 4 species per 20min sample effort
	Aquatic macroinvertebrates	Macroinvertebrate assemblage must be maintained within a C category ecological condition or improved upon.	Response Assessment Index, and the South African Scoring System Version 5 (SASS5).	MIRAI EC = C 62 % SASS ≥ 110 ASPT ≥ 4.5
	Diatoms	Diatom assemblage must be maintained within a C ecological category or improved upon.	Specific Pollution Index	Diatom EC ≥ 62%
	Semi-aquatic biota	The suitability of this stretch of river to serve as a habitat for aquatic bird and mammal populations must be maintained through proper habitat management.	Aquatic birds/Indicator mammal species	A baseline assessment should be conducted to determine the aquatic bird community and representative mammal species along the river reach. There is a need to set a numerical RQO for density of animals/birds based on the available/collected data.

The last quarterly report of December 2020 (Aquatico, 2020) is available in Appendix D6. The following findings were recorded:

Groundwater

- The Physical water quality for most of the groundwater localities could be described as neutral, saline and very hard.
- All the groundwater localities exceeded the SANS 241-1:2015 drinking water standards in terms of at least one variable; the most being turbidity.
- Analysed nutrients were low and were within acceptable limits.
- All sampled localities were dominated by the bicarbonate anion while most were dominated by the magnesium cation.
- Total coliforms counts were detected at FBH01D and FBH02D.

Surface water

- The Elands River localities (SW1, SW2 and SW3) were recorded as dry on the day of sampling.
- For the pollution control dam (SW4), the Wesizwe Bakubung WUL (2010) guidelines as well as the General Authorization Limits were complied with in terms of the majority of variables measured with the exception of pH.
- Water quality of the PCD could be classified as marginal for domestic use according to the WRC (1998) QDWS classification system.
- Nutrients were low and were within acceptable limits.
- The RQO limits were exceeded in terms of pH and Na at SW4.
- Turbidity change at SW4 was below 10%, hence, complying with the RQO stipulations.

Figure 33 to Figure 36 provide time series graphs of the pH and TSF of surface and groundwater from March 2018 to March 2021.

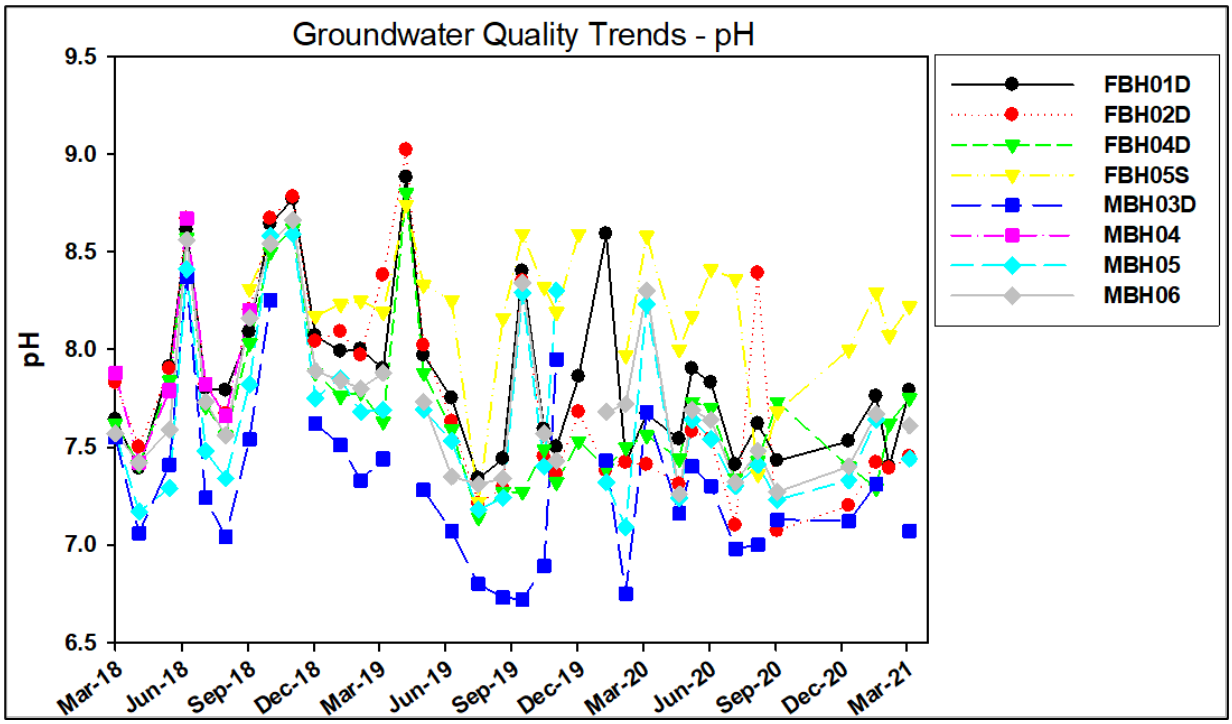


Figure 33: Groundwater quality trends - pH

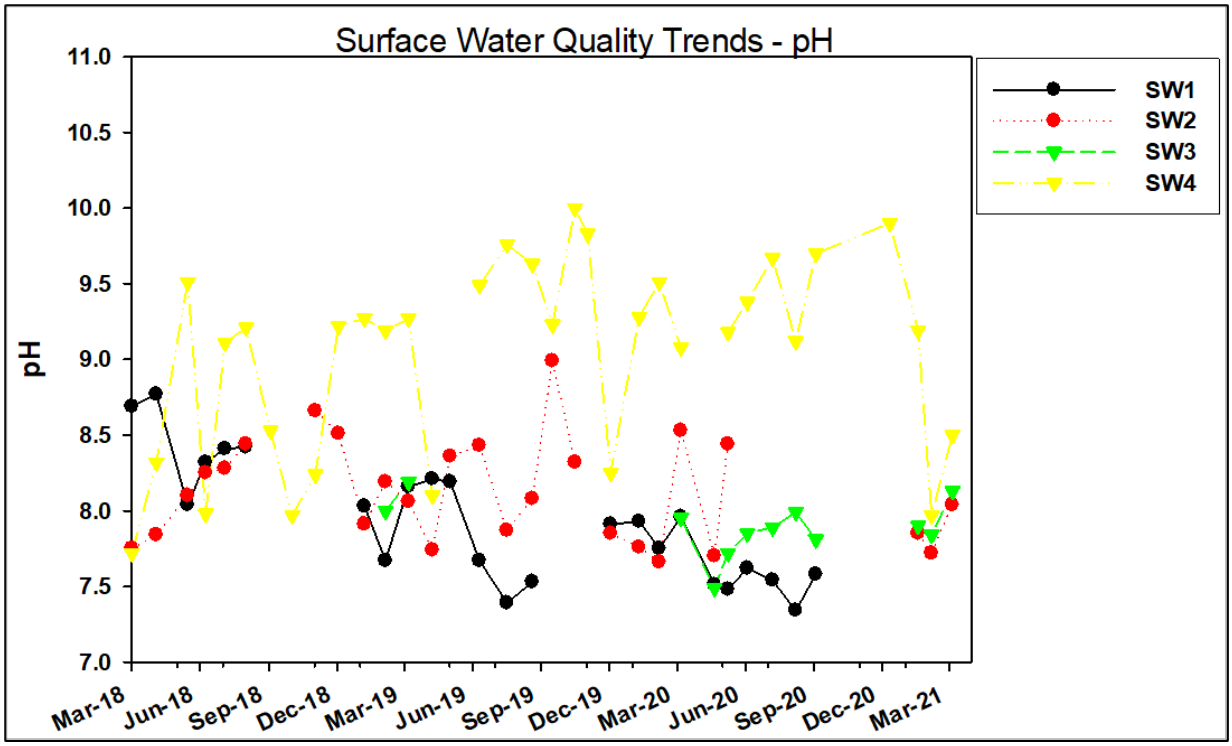


Figure 34: Surface water quality trends - pH

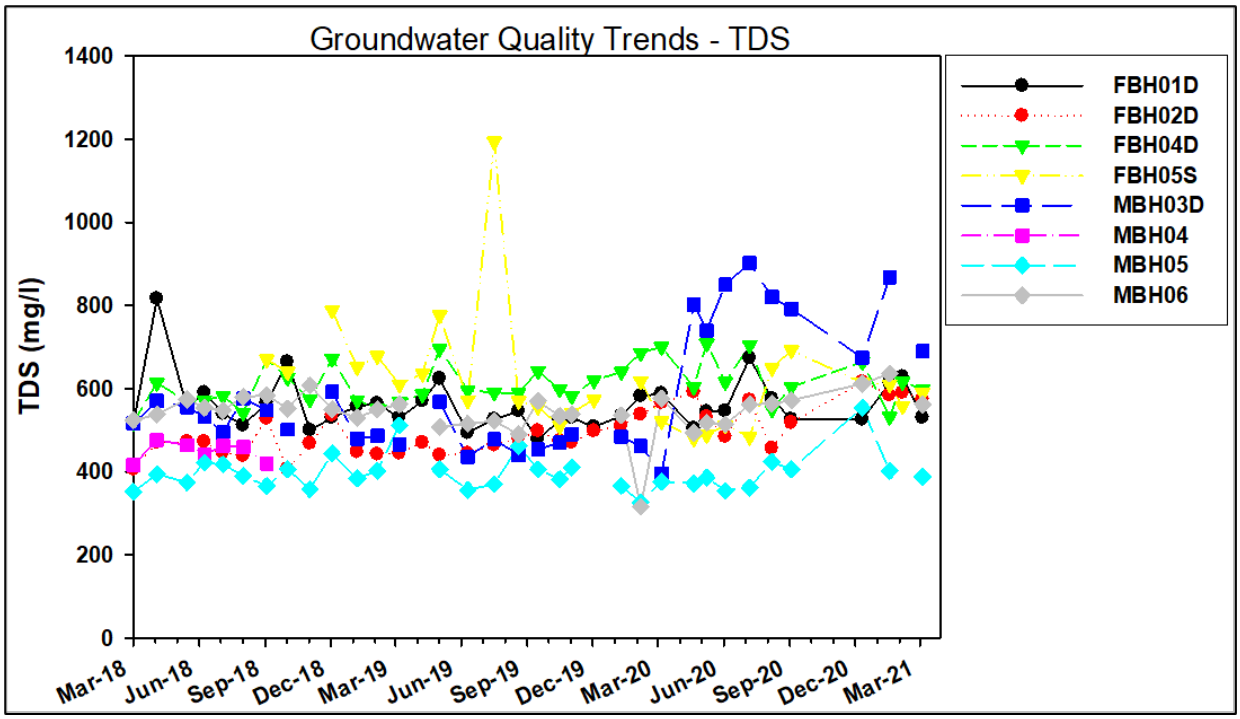


Figure 35: Groundwater quality trends - TDS

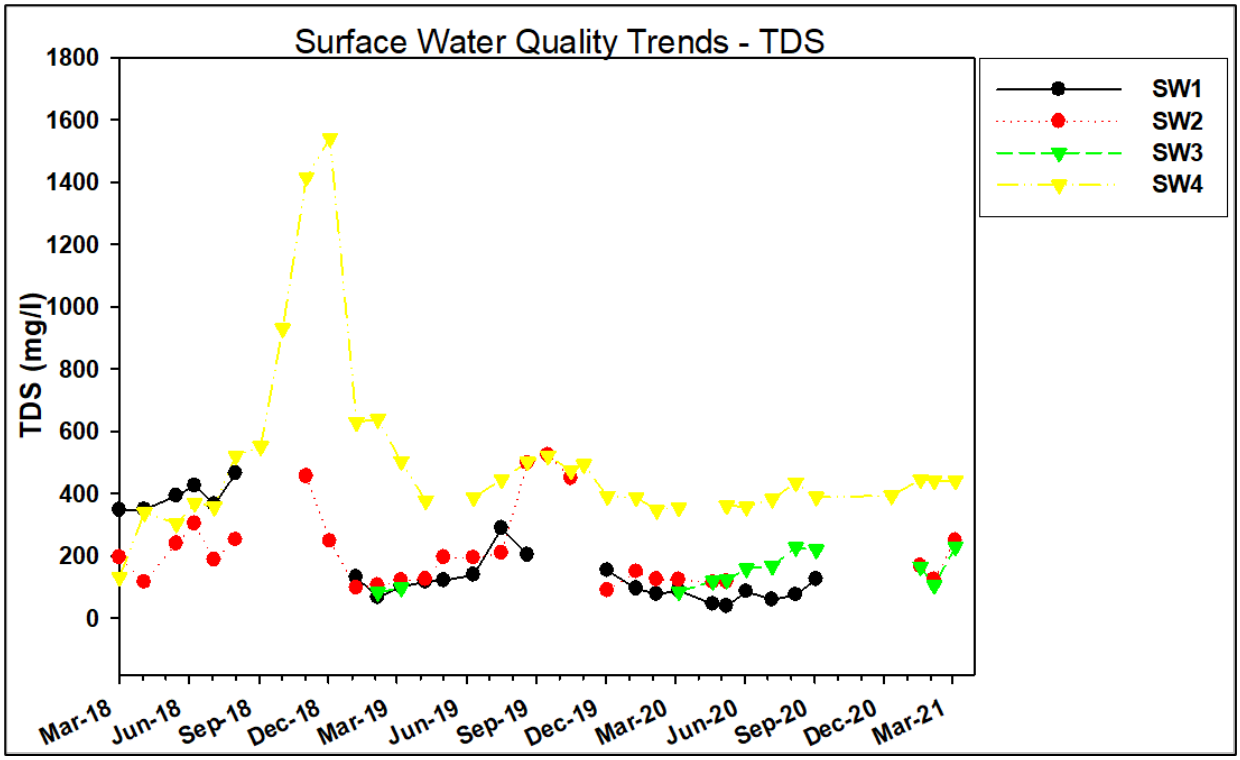


Figure 36: Surface water quality trends - TDS

4.11 GROUNDWATER

GPT Consulting Environmental Scientists undertook a Groundwater Impact Assessment for the Frischgewaagd TSF in 2020 (GPT, 2020). The full report is available in Appendix D7.

4.11.1 AQUIFER CHARACTERISATION

4.11.1.1 AQUIFER VULNERABILITY

The Groundwater Decision Tool (GDT) was used to quantify the vulnerability of the aquifer underlying the site using the below assumptions.

- Depth to groundwater below the site was estimated from water levels measured after drilling of the new boreholes to be at mean of ~21.36 mbgl
- Groundwater recharge of ~20 mm/a (4% recharge)
- Sandy clay Loam soil vadose zone
- Gradient of 1.2 % were assumed and used in the estimation.

The aquifer vulnerability for a contaminant released from surface to a specified position in the groundwater system after introduction at some location above the uppermost aquifer was determined using the criteria described below and assuming a worst-case scenario:

- Highly vulnerable (> 60), the natural factors provide little protection to shield groundwater from contaminating activities at the land surface
- Medium Vulnerable = 30 to 60%, the natural factors provide some protection to shield groundwater from contaminating activities at the land surface, however based on the contaminant toxicity mitigation measures will be required to prevent any surface contamination from reaching the groundwater table
- Low Vulnerability (< 30 %), natural factors provide relatively good protection and if there is little likelihood that contaminating activities will result in groundwater degradation
- The GDT calculated a vulnerability value of 43 %, which is medium.

4.11.1.2 AQUIFER CLASSIFICATION

The aquifer system in the study area can be classified as a “Minor Aquifer System”, based on the fact that although these aquifers seldom produce large quantities of water, they are important for local supplies and in supplying base flow for rivers.
In order to achieve the Aquifer System Management and Second Variable Classifications, as well as the Groundwater Quality Management Index, a points scoring system as presented in Table 27 and Table 28 was used.

Table 27: Ratings – Aquifer System Management and Second Variable Classifications

Aquifer System Management Classification		
Class	**Points**	**Study area**
Sole Source Aquifer System:	6	
Major Aquifer System:	4	
Minor Aquifer System:	2	2
Non-Aquifer System:	0	
Special Aquifer System:	0 – 6	

Second Variable Classification (Weathering/Fracturing)		
Class	**Points**	**Study area**
High:	3	
Medium:	2	2
Low:	1	

Table 28: Ratings - Groundwater Quality Management (GQM) Classification System

Aquifer System Management Classification		
Class	**Points**	**Study area**
Sole Source Aquifer System:	6	
Major Aquifer System:	4	
Minor Aquifer System:	2	2
Non-Aquifer System:	0	
Special Aquifer System:	0 – 6	
Aquifer Vulnerability Classification		
Class	**Points**	**Study area**
High:	3	
Medium:	2	2
Low:	1	

As part of the aquifer classification, a Groundwater Quality Management (GQM) Index is used to define the level of groundwater protection required. The GQM Index is obtained by multiplying the rating of the aquifer system management and the aquifer vulnerability. The GQM index for the study area is presented in Table 29.

The vulnerability, or the tendency or likelihood for contamination to reach a specified position in the groundwater system after introduction at some location above the uppermost aquifer, in terms of the above, is classified as medium.

The level of groundwater protection based on the Groundwater Quality Management Classification:

GQM Index = Aquifer System Management x Aquifer Vulnerability
= 2 x 2 = 4

Table 29: GQM Index for the Study Area

GQM Index	Level of Protection	Study Area
<1	Limited	
1 – 3	Low Level	
3 – 6	Medium Level	4
6 – 10	High Level	
>10	Strictly Non-Degradation	

4.11.1.3 AQUIFER PROTECTION CLASSIFICATION

A Groundwater Quality Management Index of 4 was estimated for the study area from the ratings for the Aquifer System Management Classification. According to this estimate a medium level groundwater protection is required for the aquifer. Reasonable and sound groundwater protection

measures based on the modelling will therefore be recommended to ensure that no cumulative pollution affects the aquifer, even in the long term.
DHSWS's water quality management objectives are to protect human health and the environment. Therefore, the significance of this aquifer classification is that measures must be taken to limit the risk to the following environments.

- The protection of the underlying aquifer.
- The protection of the Elands River and its tributaries

4.11.2 HYDRO-CENSUS

(GPT, 2020) reports that a hydrocensus was conducted in 2008, to record private groundwater use in the vicinity of the operations. A total of 66 boreholes were found. From this survey it was noted that the majority of the boreholes in the area are used for domestic and irrigation purposes. The mean yield in the boreholes were calculated as 1.5 l/s.

4.11.3 POTENTIAL POLLUTION SOURCE IDENTIFICATION

Refer to Section 2.2.4.1.

4.11.4 GROUNDWATER MODEL

The newly proposed TSF on Frischgewaagd farm will be lined using a Class C barrier system, as detailed in Section 2.2.4.
Should the lining remain undamaged, no impact on groundwater receptors can be expected. But linings are often damaged during construction or operations and leakage to the subsurface are thus possible. Three scenarios were modelled to cater for leakage, namely a 10% and 50% and 100% leakage. As dry deposition of material will be done, the only flow to the TSFs is recharge from rainwater. Recharge from rainfall to the TSF was estimated at 20% of mean annual rainfall. Table 30 provides the scenarios modelled.

Table 30: Scenarios modelled

Scenario	Leakage (%)	Effective recharge* (mm/year)	Effective recharge (m/day)
Minor liner leakage	10	12	0.00003
Major liner leakage	50	60	0.00016
No liner	100	120	0.0003

*Numbers are based on an annual rainfall of 590 mm/year and 20% recharge to the TSF.

Table 31: Calculated Leakage volumes

Scenario	Leakage (%)	Effective recharge (m/day)	Option 1 leakage volume (m^3/day)	Option 2 Leakage Volume (m^3/day)	Option 3 Leakage Volume (m^3/day)
Minor liner leakage	10	0.00003	6.95	5.8	11.5
Major liner leakage	50	0.00016	37.1	31.0	61.4
No liner	100	0.0003	69.5	58.2	115.1

A conservative tracer was specified in the groundwater transport model with a concentration of 100 (%) and predicting its concentration in space over time. Contamination over time is depicted for every scenario at 10, 25, 50 and 100 years after the TSF became operational. The Elands River is the only sensitive receptor in close vicinity to these sources, and impacts will be assessed in relation to the river.

4.11.4.1 MINOR LINER LEAKAGE

The groundwater contamination for a minor leakage of the liner is depicted in Figure 37 below. It follows from these figures that:

- Plume movement is very slow due to the low hydraulic conductivity and flat groundwater level, about 2 meter per year on average
- At this leakage rate the TSF has limited contamination impact and the plume does not reach the Elands River, even in 100 years.

4.11.4.2 MAJOR LINER LEAKAGE

The groundwater contamination for a major leakage of the liner is depicted as Figure 38 below. It follows from these figures that:

- Plume movement has accelerated somewhat to about 4 meter per year due to increased ponding of groundwater underneath the TSF
- Groundwater contamination from the TSF could now reach the Elands River, albeit in low concentrations and only after 100 years.

4.11.4.3 NO LINER

This option is not considered at this stage, but the results are presented here just for comparative purposes (Figure 39). It nevertheless confirms that an unlined scenario is unfavourable as the plume migration rate is significantly increased due to the increased ponding underneath the TSF.

4.11.4.4 CONCLUSIONS FROM MODELLING RESULTS

Based on the various scenarios modelled, it is concluded that:

- The proposed TSF locality is suitable, but the integrity of the liner will be important. Only minor leaks can be allowed if no impact on the river is desired.
- However, the hitherto unexplained deep groundwater levels could mean that the Elands River is unconnected to the groundwater level. In this scenario, the modelled contamination movement will not reach the river. This is an aspect that is worth further investigation.

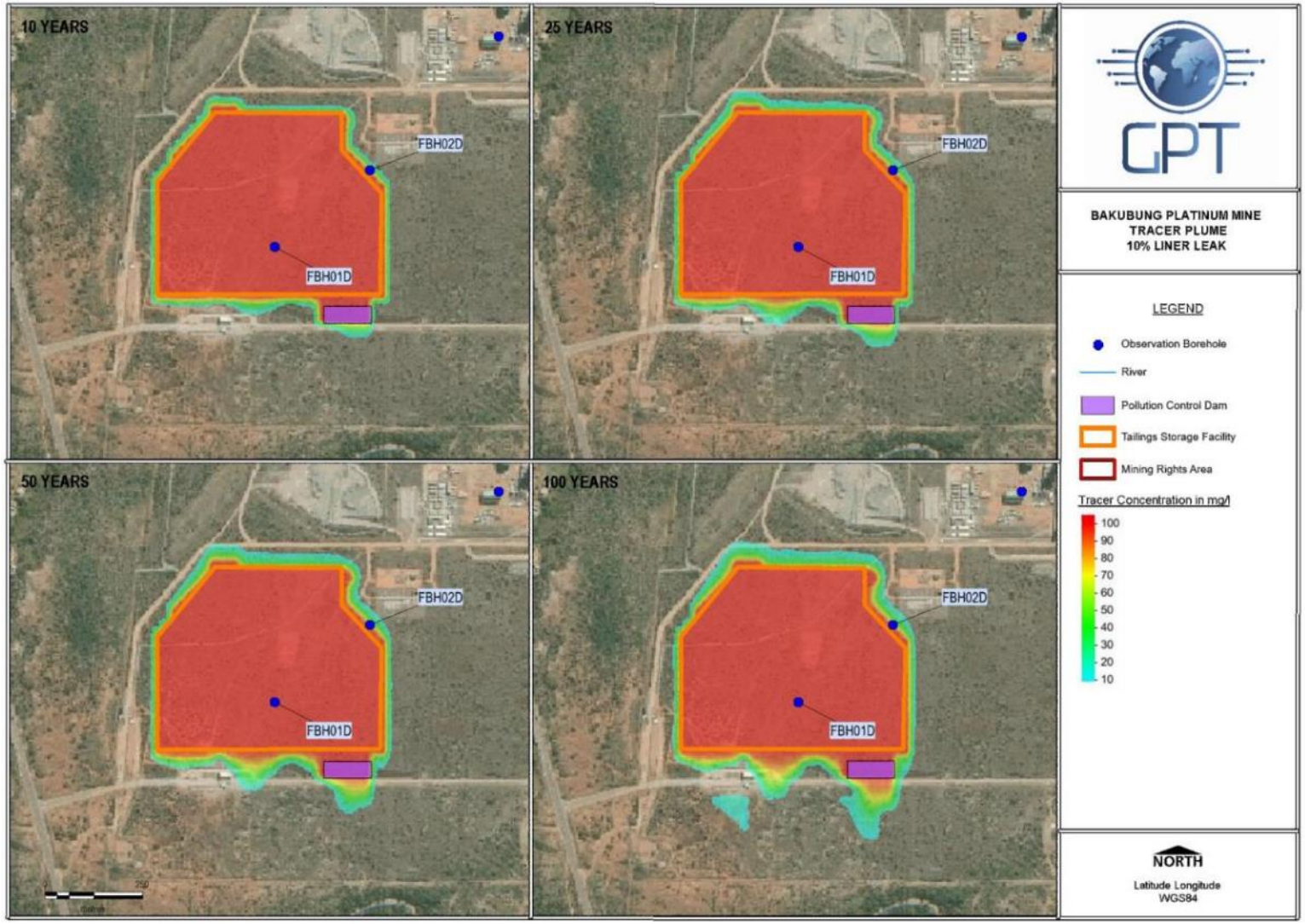


Figure 37: Impacts on the Elands River – Minor Leakage

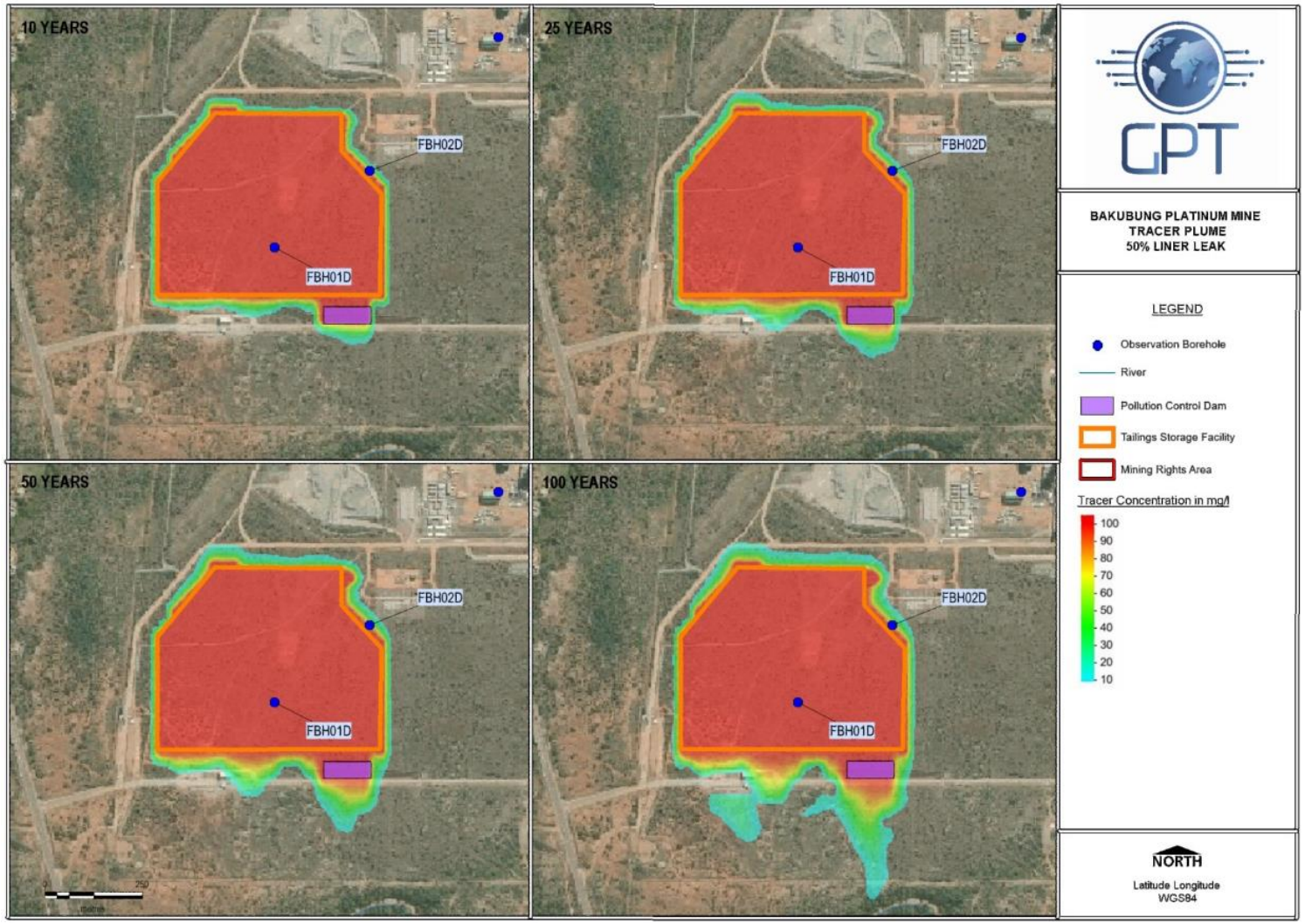


Figure 38: Impacts on the Elands River – Major Leakage

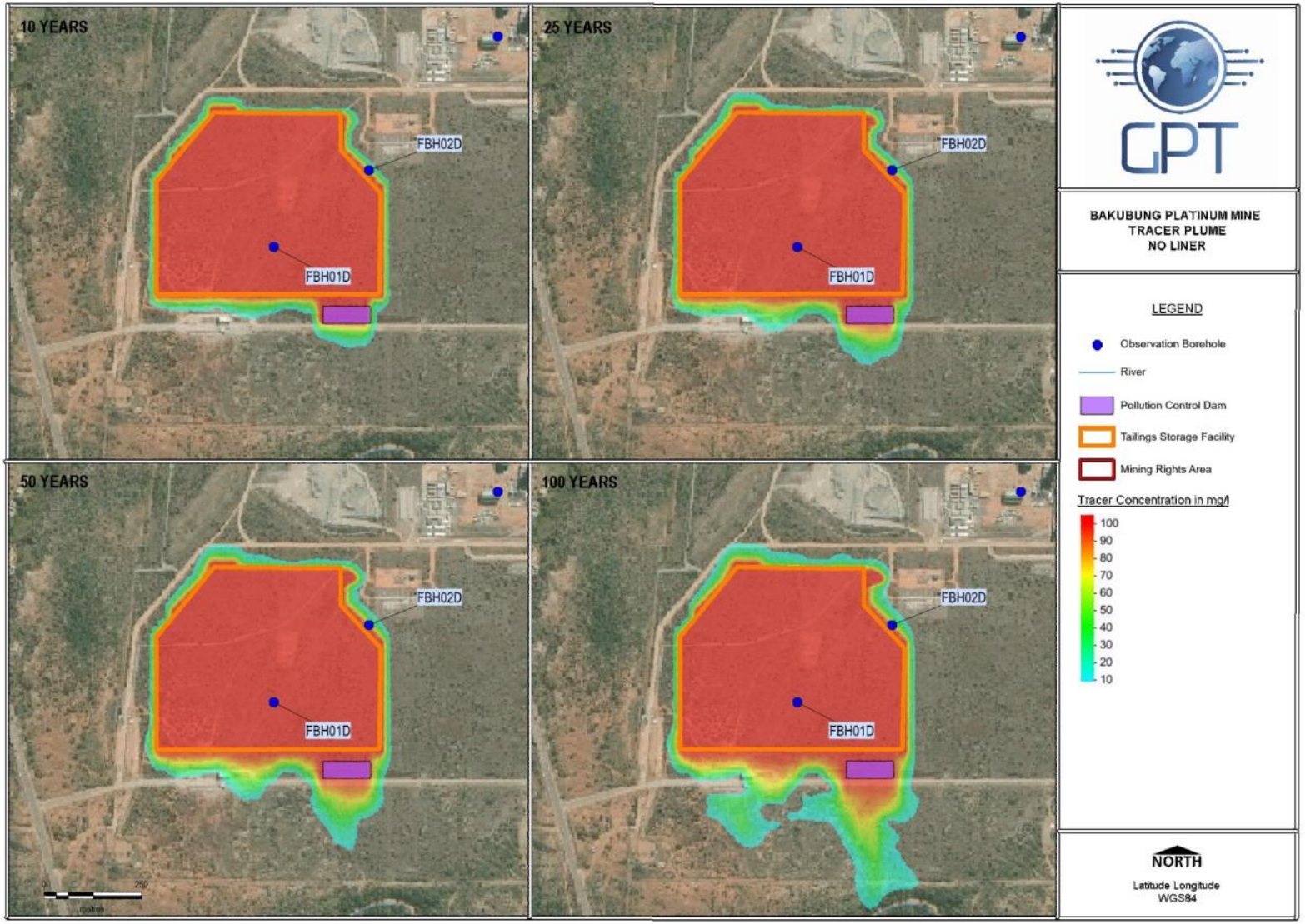


Figure 39: Impacts on the Elands River – No Liner

4.12 SOCIAL

A Social Impact Assessment (SIA) for the proposed amendments was undertaken (Equispectives, 2021). Refer to Appendix D8 for the full report, which is briefly summarised below.
The project is located in Ward 28 of the Moses Kotane local municipality that falls under the Bojanala Platinum District Municipality in the North West Province. The area is under the traditional authority of the Bakubung Ba Ratheo. Given the location of the mine, Wards 13, 14 and 30 of the Moses Kotane local municipality and wards 1 and 2 of the Rustenburg local municipality have also been included in the analysis. The area is predominantly rural with predominantly traditional land ownership. The Sun City resorts, and the Pilanesberg Game Reserve are in the area.
The main economic sectors in the Moses Kotane municipal area are tourism, manufacturing, agriculture, and mining. Besides Pilanesberg there are a number of smaller nature reserves in the area.

4.12.1 POPULATION DEMOGRAPHICS

The population within the study area is predominantly Black, comprising over 88 % of the population in all wards except for Ward 13 (81.7 %) and Ward 14 (86.8 %), wherein both the Pilanesberg Game Reserve and the Sun City resorts are located as the population composition within these two wards are mixed, including people from all population groups (Equispectives, 2021).
In terms of age, the population is relatively young, with an average age ranging between 27 – 32 years amongst the various wards, and more than two fifths of the population aged 24 years or younger (except in Ward 13 and 14, where the population is slightly older) (Equispectives, 2021).
The gender distribution amongst the wards is predominantly equal, with the exception of Wards 1 and 2 in the Rustenburg local municipality and Ward 13 of the Moses Kotane local municipality where the gender ratio is more male dominant (Equispectives, 2021). The male dominance is often expressed in mining areas, as most mine workers are male and have migrated to the area whilst their families remain in the area from which they migrated.
Setswana is the dominant home language across the districts, comprising 63.4 % of the North West, and being spoken by 53.9 % of the residents within the Rustenburg local municipality and 81.6 % within the Moses Kotane local municipality (Equispectives, 2021). Ward 30 of the Moses Kotane local municipality had the lowest concentration of Setswana speakers, with only 45.8 % of the local population speaking Setswana, whereas 39.9 % of the population speak IsiZulu (Equispectives, 2021).

4.12.2 EDUCATION

The education levels within the study area are considered low, as only 65.9 % of the North West population had obtained some form of secondary schooling, of which only 32.8 % had completed secondary school and only 7.4 % had obtained a form of higher education (Equispectives, 2021). The Rustenburg local municipality had a higher percentage of secondary school completion, where 39.8 % of the population had completed secondary school, of which 8.4 % had obtained higher education. The Moses Kotane local municipality presented 67.9 % of the population as having some form of secondary education, of which 32.7 % had completed secondary school and only 5.1 % had obtained some form of higher education. Within the study area, Ward 2 of the Rustenburg local municipality had the lowest percentage of secondary schooling completion, with only 31.1 % obtained, whereas Ward 13 of the Moses Kotane local municipality obtained the highest, with 61.1 % of the population completing secondary school (Equispectives, 2021).

4.12.3 EMPLOYMENT

The employment rate within the North West province is low, with only 37.1 % of the employable population, aged between 15 – 65 years, being employed, and of those who are employed, 68.3 % are employed within the formal sector, 14.9 % within the informal sector and 14.7 % employed by private households (Equispectives, 2021). The Rustenburg local municipality has the highest employment rate, with 49 % of the population employed whereas only 30.3 % of the population of the Moses Kotane local municipality is employed, indicating that the municipality had the lowest income generation (Equispectives, 2021).

Of the wards surveyed within the study area, Ward 2 of the Rustenburg local municipality had the highest employed population percentage, 47.8 % whilst Ward 13 of the Moses Kotane local municipality had 47.4 % of its local population employed (Equispectives, 2021). In contrast, Ward 13 of the Moses Kotane local municipality yielded the highest annual household income, with 29.1 % of the population earning above R 76 400 annually, of which 1.96 % earn above R 614 000 annually (Equispectives, 2021).

4.12.4 HOUSING

The housing of the population within the North West province is dominated by traditional residential housing (45.5 %), followed by formal residential housing (39.4 %), farms (7.9 %) and informal residential housing (3.9) (Equispectives, 2021). The provincial ratio differs immensely from that of the local municipalities, and further differing between the wards with Wards 2, 14, 28 and 30 most people live in areas classified as traditional residential, while the profile for Ward 13 looks slightly different and include relatively large formal residential and collective living quarters areas.

The dominant dwelling types used within the wards covered within the study area indicate a dominance of brick/concrete dwellings on separate stands/yards/farms within the wards, with Ward 30 having the highest concentration of these dwellings (78.4 %) (Equispectives, 2021). Other dominant dwelling types include informal dwellings such as shacks, both within yards and within informal settlements. The population residing within shacks within backyards vary between 7.5 – 26.6 % between the various wards, with Ward 1 of the Rustenburg local municipality hosting the highest percentage of these dwellings. Shacks in informal settlements comprise between 5.7 – 27.7 % between the wards and being the second most dominant dwelling type in Ward 2 of the Rustenburg local municipality (Equispectives, 2021).

4.12.5 ACCESS TO SERVICES

The majority of residents within the North West province obtain water from the municipal networks (73.6 %), while 15 % obtain water from boreholes and 4.5 % from water tankers and the remainder from other sources. Amongst the wards surveyed for the study area, the majority of households, ranging between 80.2 – 89.5 % obtain water from municipal connections, with the exception of Ward 30 of the Moses Kotane local municipality where only 66.1 % of residents have access to water form the municipal networks, while 12.5 % rely on boreholes and 14.0 % rely on water tankers for water (Equispectives, 2021).

Provincially, 83.3 % of the population have access to electricity, however, the percentages within the wards are higher, ranging between 90.9 % in Ward 1 of the Rustenburg local municipality through to 98.3 % in Ward 2 (Equispectives, 2021).

Sanitation within the province is dominated by the use of flush toilets (42.0 %) followed by pit latrine facilities without ventilation (33.8 %) (Equispectives, 2021). Amongst the wards of the study area, the use of the pit latrine facilities without ventilation dominates most of the wards, with the use thereof

exceeding 65.5 % in most of the wards, whereas only 29.0 % Ward 13 of the Moses Kotane local municipality utilise the unventilated pit latrines. In contrast, the use of flushing toilets is the dominant sanitation facility within Ward 13 of the Moses Kotane local municipality, with 48.7 % of the population having access to flushing toilets (Equispectives, 2021). In relation to refuse, most households within the study area have refuse removed by a local authority or private company at least once a week, with the lowest percentage observed in Ward 1 of the Rustenburg local municipality (Equispectives, 2021).

4.12.6 ACCESS TO SOCIAL INFRASTRUCTURE

There is limited access to social infrastructure such as schools, clinics, and recreational facilities in the area, but there is a government hospital in the community, namely the Moses Kotane Hospital and the police station located near the entrance to Sun City.

4.12.7 KEY STAKEHOLDERS

The following key stakeholder groups were identified:

- Government and parastatals
  - North West Province
  - Bojanala District Municipality
  - Moses Kotane Local Municipality
  - Rustenburg Local Municipality
  - Bakubung Ba Ratheo Traditional Authority
- Civil society
  - Surrounding communities
  - Private landowners
- Business
  - Pilanesberg Game Reserve
  - Sun City Resorts
  - Other tourism facilities.

4.13 HERITAGE

A Heritage Impact Assessment (HIA) for the proposed amendments was undertaken (PGS Heritage, 2020). Refer to Appendix D9 for the full report.
In summary, no evidence of any archaeological or heritage sites could be identified at the proposed TSF sites. As a result, no impact is expected from the proposed development on heritage. Furthermore, the study area is located within an area demarcated on the South SAHRA palaeontological sensitivity map as of insignificant/zero palaeontological sensitivity.
The HIA was submitted to SAHRA for comment through the South African Heritage Resources Information System (SAHRIS). Comment was received from SAHRA that they do not have any objection to the project. Refer to Appendix C1 for the response letter.

5 IMPACT ASSESSMENT

5.1 METHODOLOGY

Knight Piésold uses a simple, clearly defined method in order to accurately determine the significance of the predicted impact on, or benefit to, the surrounding natural and/or social environment. An impact assessment will contain a degree of subjectivity, as it is based on the value judgement of various specialists and Environmental Assessment Practitioners. The evaluation of significance is contingent upon values, professional judgement and dependent upon the environmental and community context. Ultimately, impact significance involves a process of determining the acceptability of a predicted impact to society.

The purpose of the impact assessment is to identify and evaluate the likely significance of the potential impacts on identified receptors and resources according to defined assessment criteria. This is used to develop and describe measures that will be taken to avoid, minimise, reduce, or compensate for any potential adverse environmental effects and to report the significance of the residual impacts that remain following mitigation.

Methodology: The purpose of this methodological approach to impact assessments serves to identify economic, environmental, and social impacts of a potential project and the implications thereof which need to be considered during the planning stages. By predicting possible impacts during project planning and design, it provides the project planners with the opportunity to reduce adverse impacts and to provide alternatives to the decision makers of the project. By utilising this methodology, both environmental and economic targets can be reached, such as reducing cost and time of project implementation and design, avoided treatment/clean-up costs and impacts of laws and regulations, and finally, assisting with client approval of proposed projects.

Defining the Nature of the Impact: An impact is essentially any change to a resource or receptor brought about by the presence of the proposed project component or by the execution of a proposed project related activity. The terminology used to define the nature of an impact is detailed in Table 32.

Table 32: Impact nature

Term	Definition
Positive	An impact that is considered to represent an improvement on the baseline or introduces a positive change.
Negative	An impact that is considered to represent an adverse change from the baseline or introduces a new undesirable factor.

Significance rating system: The significance of potential impacts can be determined using the factors described below:

Significance of Impact: The significance of an impact can be derived from the following factors:

- Severity / magnitude M
- Reversibility R
- Duration of impact D
- Spatial extent S
- Probability P

Severity / Magnitude (M): The severity of an impact relates to the degree of alteration of the affected environmental component and it may be very low, low, medium, high, or very high.
Reversibility (R): Reversibility deals with the ability of an environmental component to return to its original characteristics, or close to its original characteristics, after a given environmental change has been caused by a project activity. Depending on the nature of the impact, the effects on the environment may be reversible, recoverable, or irreversible. A recoverable impact is one where specific action must be taken in order for the impact to be ameliorated. A reversible impact is one where the impact will be reversed without the application of rehabilitation measures.
Duration (D): Duration is defined by how long the impact may prevail.
Spatial extent (S): The extent indicates the geographical scope of the impact over a given environmental or social component. It may be contained to the site only, local, regional, national, or international. A local impact is one that has no immediate or subsequent effect outside of the specific area of the impact. A regional impact is one that has effects outside of the specific area and/or moment of the impact, but within a localised area. A national impact is one that has wide-ranging effects outside of the project area but within a national scope. An international impact is one that has wide-ranging effects that cross international boundaries. Some impacts may transform from one spatial extent to another and be “cumulative”.
Probability (P): The probability of occurrence refers to the likelihood of an impact occurring where no mitigation measures have been implemented.
Assessing significance: The Knight Piésold impact significance rating system is based on the following equation:

Significance of Environmental or Social Impact = Consequence x Probability

The consequence of an impact can be derived from the sum of following factors:

- Severity / Magnitude – the degree of change brought about in the environment.
- Reversibility – the ability of the receptor to recover after an impact has occurred.
- Duration – how long the impact may be prevalent.
- Spatial Extent – the physical area which could be affected by an impact.

The severity, reversibility, duration, and spatial extent are ranked using the criteria indicated in Table 33 and then the overall consequence is determined by adding up the individual scores and multiplying it by the overall probability (the likelihood of such an impact occurring). Once a score has been determined, this is checked against the significance descriptions indicated in Table 34.
Mitigation and Residual Impacts: It is expected that for the identified significant impacts, the project team will work with the client in identifying suitable and practical mitigation measures that are implementable. These measures will be fit for purpose, concise and clearly articulated. Mitigation that can be incorporated into the Project design in order to avoid or reduce the negative impacts or enhance the positive impacts will be developed. A description of these mitigation measures will also be included within the Environmental and Social Management Plan (ESMP).
Residual impacts are those impacts, which remain once the mitigation measures have been designed and applied. Once the mitigation is applied, each impact is re-evaluated (assuming that the mitigation measure is effectively applied) and any remaining impact is rated once again using the process outlined above. The result is a significance rating for the residual impact.

Table 33: Ranking Criteria

Severity / magnitude (M)	Reversibility (R)	Duration (D)	Spatial extent (S)	Probability (P)
5 – Very high – The impact causes the characteristics of the receiving environment/ social receptor to be altered by a factor of 80 – 100 %	5 – Irreversible – Environmental - where natural functions or ecological processes are altered to the extent that it will permanently cease. Social - Those affected will not be able to adapt to changes and continue to maintain-pre impact livelihoods.	5 – Permanent - Impacts that cause a permanent change in the affected receptor or resource (e.g. removal or destruction of ecological habitat) that endures substantially beyond the Project lifetime.	5 – International - Impacts that affect internationally important resources such as areas protected by international conventions, international waters etc.	5 – Definite - The impact will occur.
4 – High – The impact alters the characteristics of the receiving environment/ social receptor by a factor of 60 – 80 %		4 – Long term - impacts that will continue for the life of the Project but ceases when the Project stops operating.	4 – National - Impacts that affect nationally important environmental resources or affect an area that is nationally important/ or have macro-economic consequences.	4 – High probability – 80% likelihood that the impact will occur
3 – Moderate – The impact alters the characteristics of the receiving environment/ social receptor by a factor of 40 – 60 %	3 – Recoverable Environmental - where the affected environment is altered but natural functions and ecological processes may continue or recover with human input. Social - Able to adapt with some difficulty and maintain pre-impact livelihoods but only with a degree of support or intervention.	3 – Medium term - Impacts are predicted to be of medium duration (5 – 15 years)	3 – Regional - Impacts that affect regionally important environmental resources or are experienced at a regional scale as determined by administrative boundaries, habitat type/ecosystem.	3 – Medium probability – 60% likelihood that the impact will occur
2 – Low – The impact alters the characteristics of the receiving environment/ social receptor by a factor of 20 – 40 %		2 – Short term - Impacts are predicted to be of short duration (0 – 5 years)	2 – Local - Impacts that affect an area in a radius of 2 km around the site.	2 – Low probability - 40% likelihood that the impact will occur
1 – Minor – The impact causes very little change to the characteristics of the receiving environment/ social receptor and the alteration is less than 20%	1 – Reversible Environmental - The impact affects the environment in such a way that natural functions and ecological processes are able to regenerate naturally. Social - People/ communities are able to adapt with relative ease and maintain pre-impact livelihoods.	1 – Temporary - Impacts are predicted to be intermittent/ occasional over a short period.	1 – Site only - Impacts that are limited to the site boundaries.	1 – Improbable - 20% likelihood that the impact will occur

Table 34: Significance Definitions

Score According to Impact Assessment Matrix	Significance Definitions	Colour Scale Ratings	
		Negative Ratings	Positive Ratings
Less than 30 significance points indicate Low Significance	An impact of low significance is one where an effect will be experienced, but the impact magnitude is sufficiently small and well within accepted standards, and/or the receptor is of low sensitivity/value.	Low	Low
Between 30 and 60 significance points indicate Moderate Significance	An impact of moderate significance is one within accepted limits and standards. The impact on the receptor will be noticeable and the normal functioning is altered, but the baseline conditions prevail, albeit in a modified state.	Moderate	Moderate
More than 60 significance points indicate High Significance	An impact of high significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. An impact with high significance will completely modify the baseline conditions. A goal of the EIA process is to get to a position where the project does not have any high negative residual impacts, certainly not ones that would endure into the long term or extend over a large area. However, for some aspects there may be high residual impacts after all practicable mitigation options have been exhausted. It is then the function of regulators and stakeholders to weigh such negative factors against the positive factors, such as employment, in coming to a decision on the Project.	High	High

A detailed impact significance table for this amendment project is found in Table 36. The descriptions of each impact in this section should be read in conjunction with this table. The impacts are derived from new specialist studies undertaken 2020 and 2021. Not all specialist studies were redone in 2020 / 2021, as these areas were covered by specialist studies in 2016. The area where the additional TSF is proposed, was earmarked for a solar plant in the 2016 EIA.

5.2 IMPACT ASSESSMENT PER ENVIRONMENTAL ASPECT

5.2.1 TOPOGRAPHY

The construction, operation, and closure of a new TSF will have a definite and permanent impact on the natural topography of the area, which in turn will create a visual impact. However, the proposed TSF is within the boundaries of an existing mine, on an area previously earmarked for a solar power station. Therefore, within this context, the magnitude of the impact is reduced to moderate. During closure, the TSF will be capped and the visual impact will be reduced. The significance of this impact is rated as high before and after mitigation.

5.2.2 VISUAL

The visual impact of the project will be caused during the construction, when vegetation is cleared and the base of the TSF is constructed, during the operational phase, when the tailings is deposited, and lastly during the decommissioning/ closure phases. Activities associated with the Project will

mostly be visible during daytime and at night only the lights associated with the TSF will be visible and not necessarily the TSF itself.

In determining the visibility of the Project, the proposed height of the TSF was used (47m) and offsets equivalent to the height were used to generate the viewshed/ line of sight as illustrated in Figure 40.

It is clear from Figure 40 that people visiting the tourist attractions, such as Sun City and the lodges within the Pilanesberg will not have a view of the proposed project while staying at the facilities. The proposed project will however become visible when they travel on the local roads such as the R556 and the R565 or if the viewers/ receptors are on elevated areas such as hiking trails that are facing the project site. According to the line of sight (Figure 40) the proposed project should be marginally visible for viewers located at the Kingdom Resort, this is mainly due to the distance between the proposed project and the resort but also due to the dense vegetation and the possibility of buildings blocking or screening views within the Kingdom Resort.

The proposed project will be highly visible for residents staying in Ledig, especially from residential units located in the southern corner of Ledig which borders the proposed site. Chaneng and Phatsima is located just on the border of the Zone of Potential Visual Influence and the proposed project will be marginally visible from these viewing points.

Table 35 indicates the exposure of the various sensitive viewing areas.

Table 35: Sensitive Receptors – Visual Exposure

	Highly visible	Moderately visible	Marginally visible
	Foreground view i.e. 0 – 500m from Project Site	Middle-ground view i.e.500m to – 2km from Project Site	Background view i.e. 2.0km - 5,0km from Project Site
Ledig	X partially obstructed	X mostly obstructed	X mostly obstructed
Chaneng			X mostly obstructed
Phatisma			X mostly obstructed
Pilanesberg (Sun City and other lodges)			X obstructed
Kingdom Resort			X mostly obstructed
Local Road		X partially obstructed	
R556 and R565	X partially obstructed	X partially obstructed	X partially obstructed

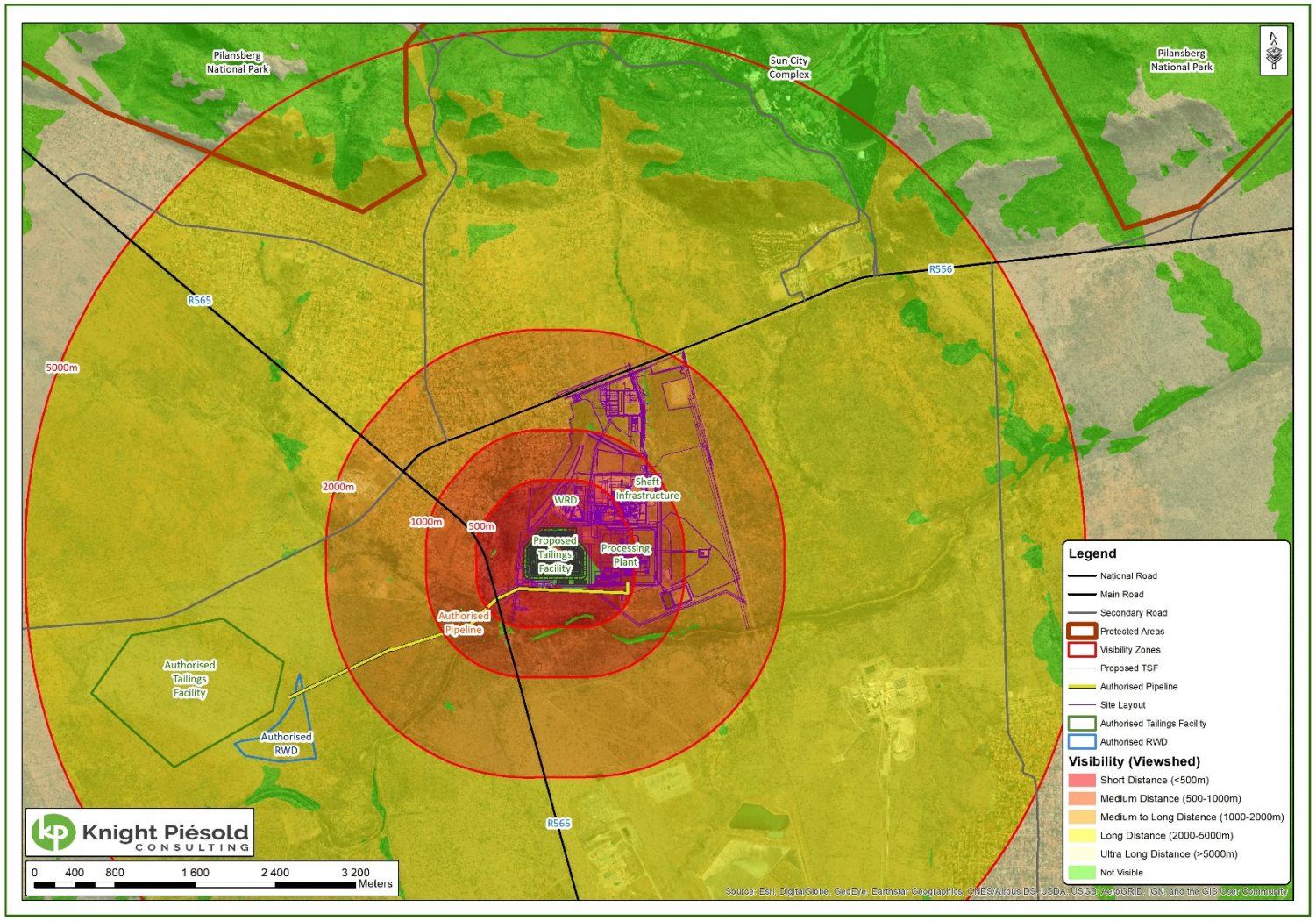


Figure 40: Line of Sight Viewshed Analysis

As illustrated in the viewshed/ line of sight, Figure 40, the Pilanesberg contributes to the effective screening of the proposed project towards viewers and specifically towards sensitive viewers located at the tourist destination within the Pilanesberg, such as Sun City.

Figure 13 to Figure 15 clearly illustrates the absorption capacity of the vegetation in the study area but also the surrounding areas. The study area forms part of the Marikana Thornveld which is characterised by woodlands. The study area has a dense woodland cover and therefore contributes to the partial screening of the proposed project from sections along the R556, R565, Ledig, Chaneng and Phatisma. It should be noted that in the beginning stage of the TSF the ability of the vegetation to screen the proposed TSF will be high but as the TSF starts to gain height it will cut the vegetation line (tree line) and will therefore become more visible over time.

Although the greater area (this includes the study area and the directly surrounding areas) is characterised by the natural features of the landscape, such as the woodlands and the mountains, this area has been compromised by mining related activities and human settlements. Therefore, when considering the landscape integrity, it can be said that the proposed project will have a high compatibility with the greater area. This is also relevant when considering the study area, the dominant feature within the study area is the Ledig settlement as well as the existing Bakubung Platinum Mine and the Royal Bafokeng Maseve Mine. The landscape integrity becomes highly compatible due to the existing land uses and sense of place created by these activities.

During the construction phase, the clearance of vegetation and increase in heavy vehicles will cause alteration of the visual quality of the study area due to the physical presence and construction activities. Mitigation measures are feasible and would result in a reduction in impact if the mitigation measures are effectively implemented and managed in the long term. This construction-phase impact is rated as low before and after mitigation. This impact is rated as moderate before and after mitigation during the operational phase and low during decommissioning.

The impact of the existing and surrounding mining activities already has a high negative effect on the visual environment and landscape of the area. The physical presence of the proposed Project will increase the visibility of the mining activities, especially for viewers located in Ledig (southern section that borders the project site) or travelling along the R565 and R556 and will therefore contribute to the negative impact on the landscape aesthetics of the area.

It should be noted that the overall Bakubung Platinum Mine Project will be implemented in phases and each phase will contribute to the cumulative negative impact of the Bakubung Platinum Mine on the visual resource or scenic quality of the area.

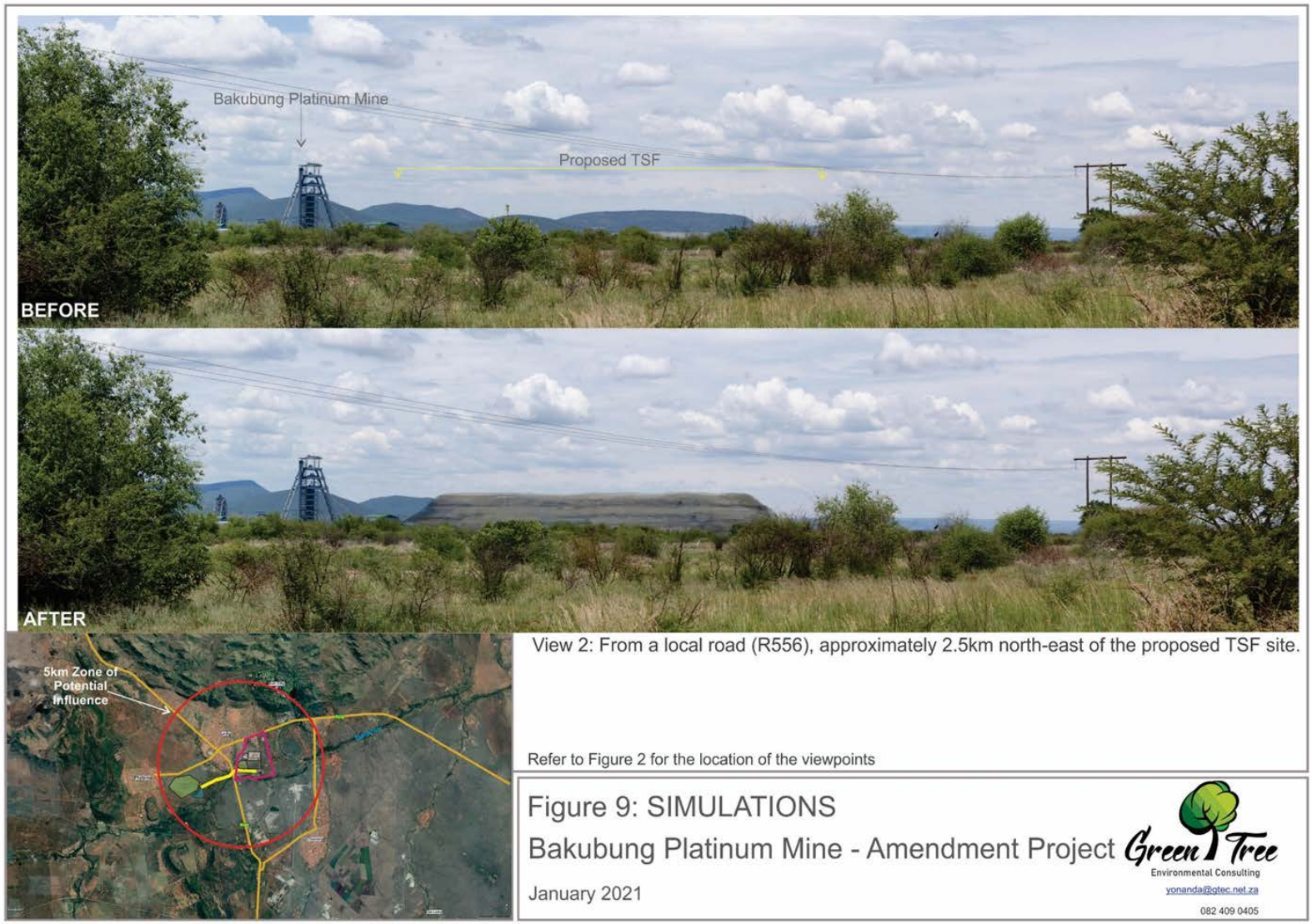


Figure 41: Simulation 1

Figure 42: Simulation 2

5.2.3 GEOLOGY

No impacts on geology are expected.

5.2.4 AIR QUALITY

The impacts on air quality are taken directly from (Airshed, 2020 (a)).

5.2.4.1 CONSTRUCTION PHASE

During the construction phase the following impacts are anticipated.

- *Potential for impacts on human health from increased pollutant concentrations associated with general construction activities*

  The sources of emissions would include site establishment in proposed additional operating areas; vegetation clearing; stripping and stockpiling of topsoil and other earthworks; collection, storage and removal of construction related waste; the construction of all required infrastructure; and the operation of mechanical equipment. It is unlikely that the long-term and short-term National Ambient Air Quality Standards (NAAQS) will be exceeded at sensitive receptors (with and without mitigation). The construction operations are likely to last for less than a year. The impact is rated as low before and after mitigation.

- *increased nuisance dustfall rates associated with general construction activities*

  The sources of emissions would include site establishment in proposed additional operating areas; vegetation clearing; stripping and stockpiling of topsoil and other earthworks; collection, storage and removal of construction related waste; the construction of all required infrastructure; and the operation of mechanical equipment. It is unlikely that the NDCR limit for residential areas will be exceeded at sensitive receptors (with and without mitigation). The construction operations are likely to last for less than a year. The rating is low without and with mitigation applied.

- *potential for impacts on global climate change from greenhouse gases associated with the project activities*

  The sources of emissions would include site establishment in proposed additional operating areas; vegetation clearing; stripping and stockpiling of topsoil and other earthworks; collection, storage and removal of construction related waste; the construction of all required infrastructure; and the operation of mechanical equipment. It is unlikely that the long-term and short-term NAAQS will be exceeded at sensitive receptors (with and without mitigation). The construction operations are likely to last for less than a year. The rating is low without and with mitigation applied.

5.2.4.2 OPERATIONAL PHASE

The following simulations were compiled to show the impact of the Frischgewaagd TSF only.

- *Inhalable particulate matter (PM10)*
  Simulated annual average PM10 concentrations do not exceed the NAAQS of 40 µg/m3 (Figure 43). The 24-hour NAAQS (4 days of exceedance of 75 µg/m3) are not exceeded off-site or at any sensitive receptors (Figure 44). Since the simulated results show that the

NAAQS are not exceeded, there is not a significant risk to human health at these receptors as a result of the proposed operations.

- *Respirable particulate matter (PM2.5)*
  Simulated annual average $PM_{2.5}$ concentrations do not exceed the NAAQS of 20 µg/m^3 (Figure 45). The 24-hour NAAQS (4 days of exceedance of 40 µg/m^3) are not exceeded. Since the simulated results show that the NAAQS are not exceeded, there is not a significant risk to human health at these receptors as a result of the proposed operations.
- *Fallout Dust*
  Based on the highest monthly simulated dustfall rates, the daily average dustfall rate does not exceed the NDCR residential limit of 600 mg/m²-day at any sensitive receptors and are below 400 mg/m²-day at all agricultural areas (Figure 46).

During the operational phase, the following impacts are anticipated.

- *Potential impact on human health from increased pollutant concentrations caused by activities associated with the proposed operations*

  It is unlikely that the long-term and short-term NAAQS will be exceeded at sensitive receptors (with and without mitigation). The proposed operations are proposed to last for 7 years. The rating is low without and with mitigation applied.

- *Potential Impact: Increased Nuisance Dustfall Rates Associated with the Proposed Operations*

  It is unlikely that the NDCR limit for residential areas will be exceeded at sensitive receptors (with and without mitigation). The proposed operations are proposed to last for 7 years. The rating is low without and with mitigation applied.

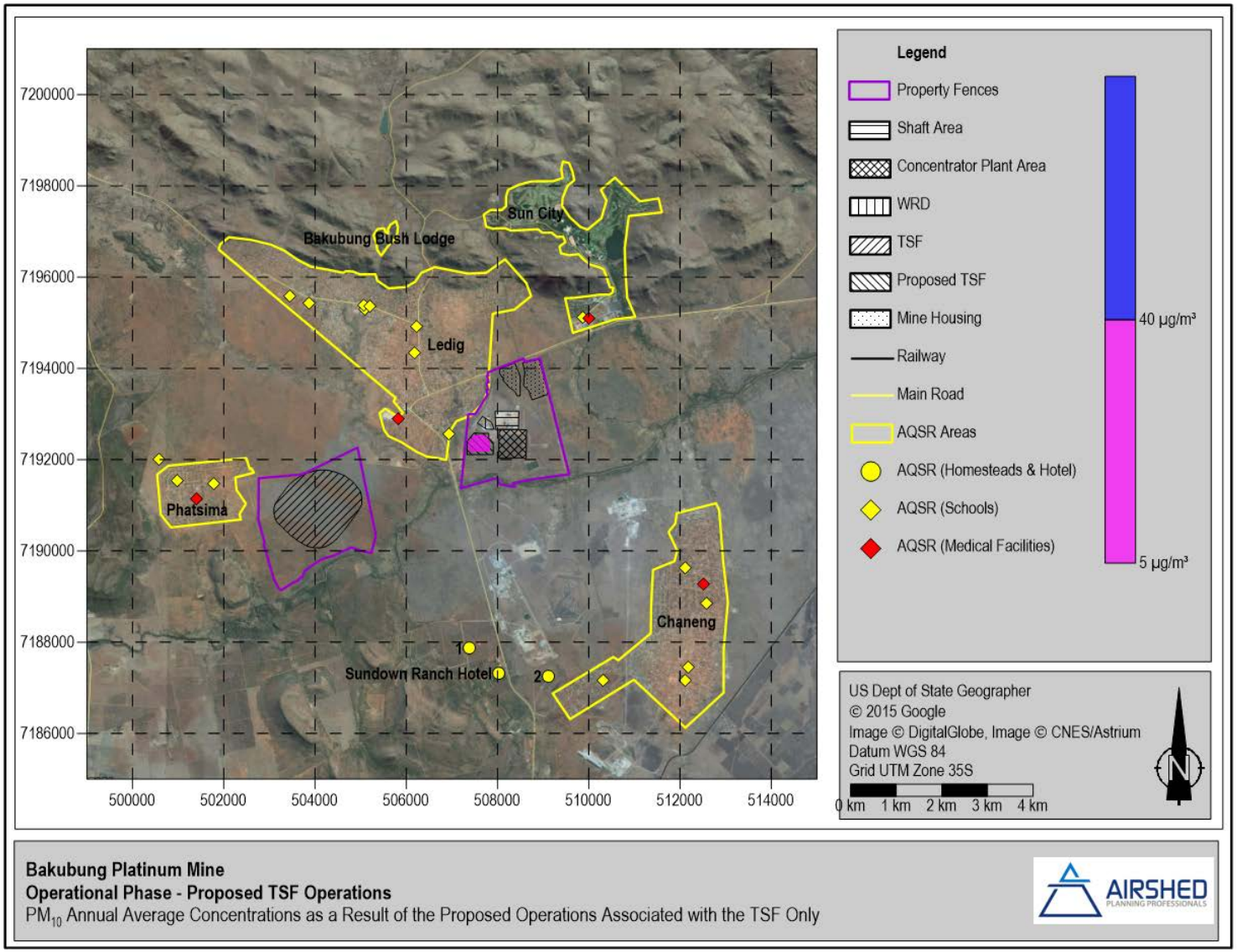


Figure 43: Proposed TSF - simulated annual average PM_{10} concentrations

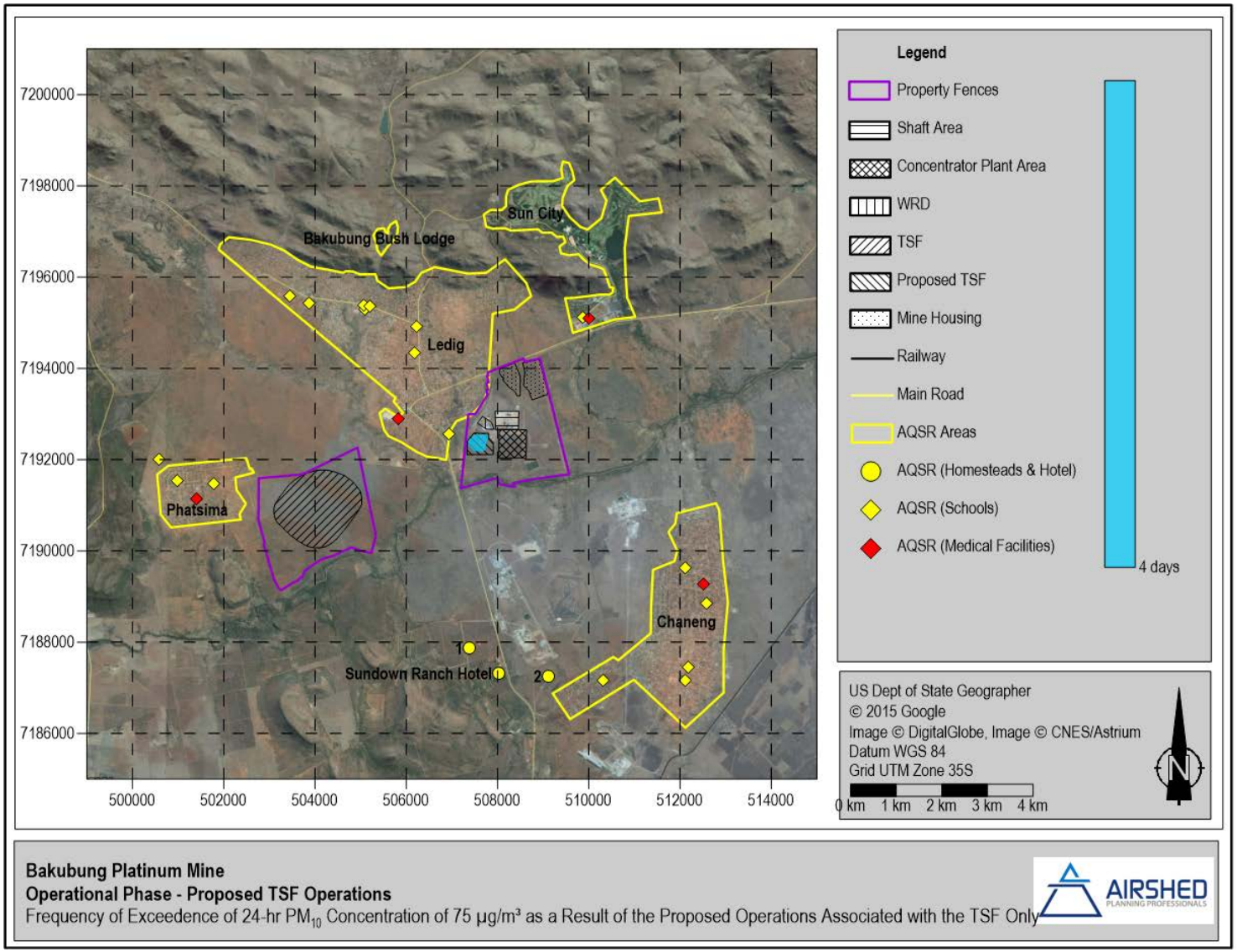


Figure 44: Proposed TSF - simulated area of exceedance of the 24-hour PM_{10} NAAQS

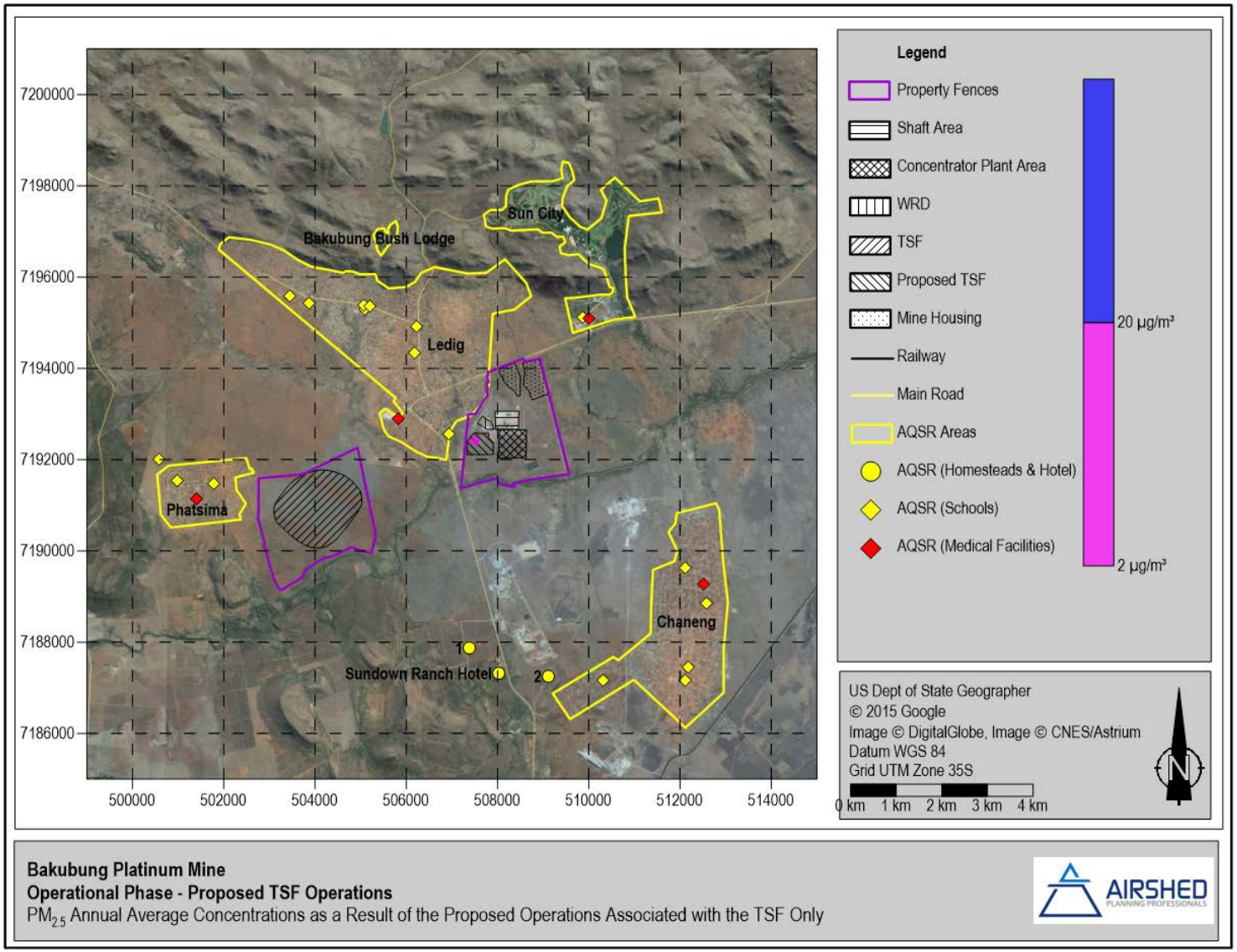


Figure 45: Proposed TSF - simulated annual average $PM_{2.5}$ concentrations

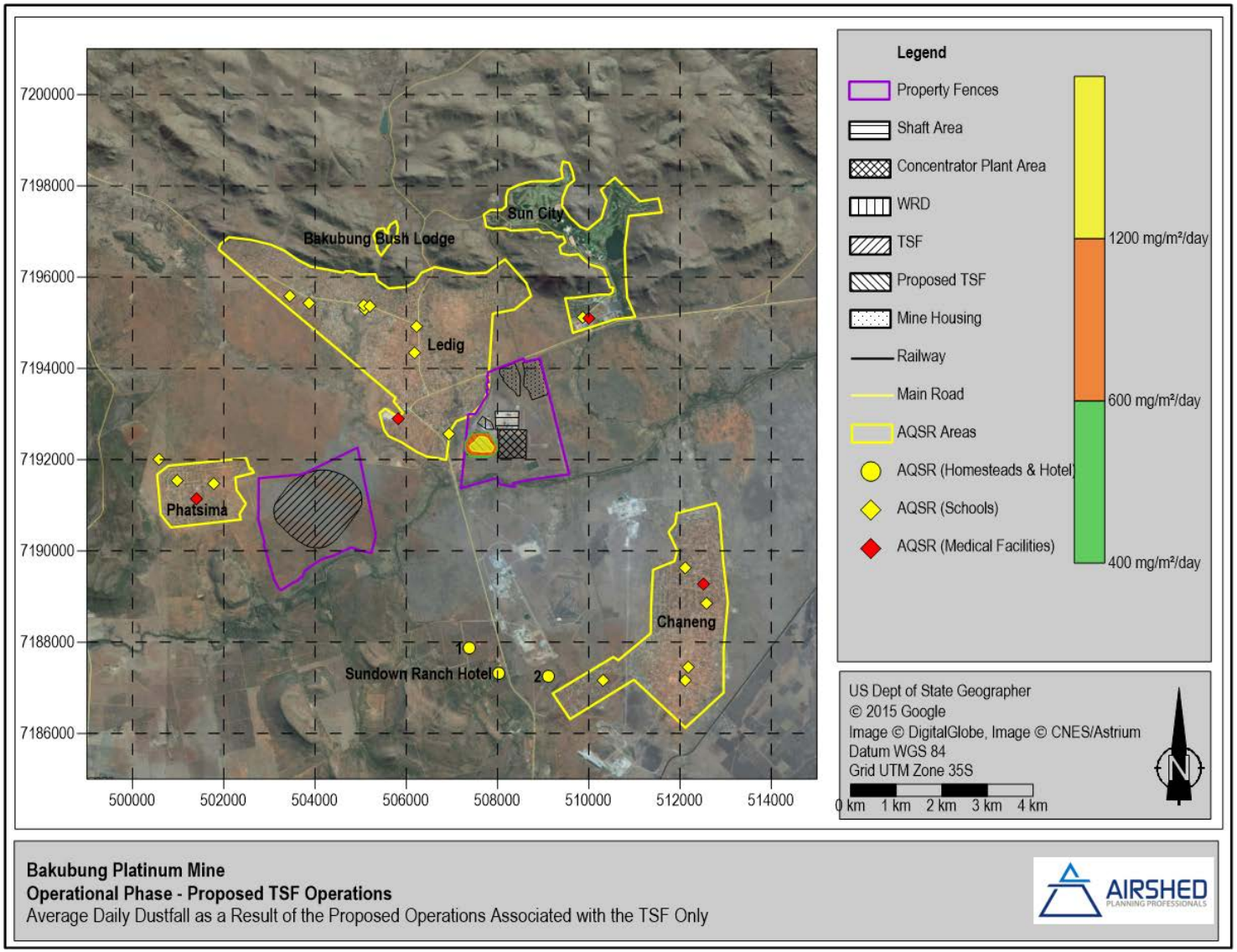


Figure 46: Proposed TSF - average daily dustfall rates based on simulated highest monthly dust fallout

5.2.4.3 DECOMISSIONING PHASE

It is not anticipated that the various activities would result in higher PM2.5 and PM10, GLCs and dustfall rates than the operational phase activities. The temporary nature of the decommissioning activities would likely reduce the significance of the potential impacts. The minimal activities during closure will likely result in insignificant potential impacts. A qualitative assessment of decommissioning and closure operations from the PM10 and TSP impacts perspective is discussed below.

- *Potential Impact on Human Health from Pollutant Concentrations Associated with Decommissioning Activities*

The sources of emissions would include the demolition of infrastructure and removal of material; topsoil reclaiming and covering of exposed areas; re-vegetation; and the operation of mechanical equipment. It is unlikely that the long-term and short-term NAAQS will be exceeded at AQSRs with mitigation in place, but it is probable that the short-term NAAQS limits will likely be exceeded in the case of unmitigated operations. The decommissioning operations are likely to last for a few years but impacts at AQSRs are likely to be intermittent. The rating is low without and with mitigation applied.

- *Nuisance Dustfall Rates Associated with Decommissioning Activities*

The sources of emissions would include the demolition of infrastructure and removal of material; topsoil reclaiming and covering of exposed areas; re-vegetation; and the operation of mechanical equipment. It is probable that the NDCR limit for residential areas will not be exceeded at AQSRs (with and without mitigation). The decommissioning operations are likely to last for a few years but impacts at AQSRs are likely to be intermittent. The rating is low without and with mitigation applied.

5.2.4.4 CLOSURE PHASE

- *8.2.3 Potential Impact E1: Impaired Human Health from Pollutant Concentrations Associated with Closure Activities*

The sources of emissions would include the site inspections and where necessary the addition of topsoil and vegetation, and the operation of mechanical equipment. It is unlikely that the long-term and short-term NAAQS will be exceeded at AQSRs (with and without mitigation). The operations will likely occur for less more than 5 year but less than 15 years but impacts at AQSRs are likely to be intermittent. The rating is LOW without and with mitigation applied.

- *8.2.4 Potential Impact E2: Nuisance Dustfall Rates Associated with Closure Activities*

The sources of emissions would include the site inspections and where necessary the addition of topsoil and vegetation; and the operation of mechanical equipment. It is probable that the NDCR limit for residential areas will not be exceeded at AQSRs (with and without mitigation). The operations will likely occur for less more than 5 year but less than 15 years but impacts at AQSRs are likely to be intermittent. The rating is LOW without and with mitigation applied.

5.2.5 NOISE

The noise impact assessment was taken directly from (Airshed, 2020 (b)). A qualitative assessment of the potential impacts due to the proposed TSF and associated infrastructure is discussed in this section. No environmental noise modelling was undertaken.

The main noise generating operations associated with the construction period for the proposed TSF are:

- Clearing of vegetation
- Excavation of soil for the proposed TSF liner
- Construction of the proposed TSF liner
- Transport of spoil material from vegetation clearing and excavation activities
- Excavation backfilling and compaction, as needed, and topsoil placement.
- Vehicle operations within the construction area consisting of movement
- Idling
- Reversing with reverse hooters.

The main noise generating infrastructure and operations associated with the operation of the proposed TSF are:

- Conveyor consisting of
    - Conveyor drive unit
    - Conveyor feed hopper and
    - Conveyor rollers
- Materials handing at the TSF
- Spreader on the TSF
- Traffic on service roads surrounding the TSF.

Construction and decommissioning activities are expected to result in local noise impacts of limited duration similar to or less significant than impacts associated with the operational phase, as detailed construction and decommissioning activities were not available.
Construction noise may be noticeable during civil works such as site clearance, or the use of pile drivers and the like. However, due to the overall types of activity and distance between main work sites and nearest sensitive receptors, there is a low likelihood of the noise levels exceeding 70 dB LAeq, and if so, this will be of short duration. The negative noise impacts are therefore considered to be of low significance at the nearest receptors.
Given the distance of sensitive receptors, the potential noise impacts from the operational phase of the project are likely to remain below the IFC Guideline Noise Levels, both during the day and night. The overall noise impacts are therefore deemed to be negative and of low significance prior to mitigation.
During decommissioning, much of the work will be broadly similar to construction activities, and as such, similar impacts are expected. Noise from decommissioning activities is likely to be perceptible at the closest noise sensitive properties during the key phases of the work.
Noise levels for decommissioning may be similar to that for construction, but of lesser intensity. Noise levels are unlikely to exceed 70 dB LAeq, which is a broadly acceptable criteria for decommissioning noise impacts given the type of activity and distance between the main work sites and nearest sensitive receptors. Noise impacts during decommissioning are therefore considered to be low prior to mitigation.

5.2.6 SOILS AND LAND CAPABILITY

The impact on soils and land use will be due to the stripping and stockpiling of soil for the construction and operation of the TSF. The soil impacts described below was adapted from (Rehab Green, 2007) and (De Castro & Brits, 2016 (a)).

5.2.6.1 SOIL LOSS

The stripping and stockpiling of topsoil will result in:

- Loss of the original spatial distribution of natural soil forms and horizon sequences which cannot be reconstructed similarly during the rehabilitation process.
- Loss of original topography and drainage pattern.
- Loss of original soil depth and soil volume.
- Loss of original fertility and organic carbon content.
- Compaction during rehabilitation which will adversely affect root development and effective soil depth.

The impact of soil loss during all phases phase is rated as high significance before mitigation and moderate significance after mitigation.

5.2.6.2 LOSS OF LAND CAPABILITY

Land capability is largely determined by soil properties and therefore the impact on land capability will be determined by the impact on soil. The removal of the topsoil will cause the existing arable and grazing land capability to cease completely. The site for the new TSF is not currently being utilised for agricultural activities and was earmarked for mining infrastructure, and within this context the impact on land capability is rated as moderate before and after mitigation.

5.2.6.3 CONTAMINATION OF SOIL

Soil contamination could be caused by hydrocarbon spillages during construction or operational activities on the mine, or because of a liner or infrastructure leakage. This impact is rated as moderate before mitigation and low after mitigation.

5.2.7 TERRESTRIAL ECOLOGY

Hawkhead Consulting, 2021 compiled a terrestrial ecology assessment report for the proposed tailings storage facility at Bakubung platinum mine. The terrestrial ecology section below is based on the (Hawkhead, 2021) report.

5.2.7.1 HABITAT LOSS AND MODIFICATION

Impact Character

Habitat loss refers to the removal of natural habitat. In terrestrial ecosystems this occurs through the vegetation clearing and earth works during construction. The immediate impact is the destruction of flora and fauna occurring in the development footprint. Habitat modification occurs when natural habitat is degraded or disturbed to the extent that it is compositionally and structurally dissimilar to reference habitat conditions. In severe cases of habitat modification, the mix of functional species-types is altered, and ecosystem functioning is impaired as a result. Both habitat loss and modification can lead to the impairment of ecosystem function at broader landscape scales, if remaining habitat is insufficient in size and heterogeneity to sustain ecological processes (also refer to habitat fragmentation).

Impact in Relation to Project

Direct habitat loss is the foremost negative impact of the proposed project, with approximately 31.52 ha of vegetation, comprising 12.40 ha of Secondary Vegetation and 19.12 ha of Marikana Thornveld likely to be completely cleared during the construction phase of the project. This impact is rated separately for the two main vegetation communities:

Marikana Thornveld

Prior to mitigation, this impact will have a very high magnitude and a permanent duration score. The spatial extent of the impact will be local, and the probability of occurrence is definite. The reversibility of the impact is irreversible. Prior to mitigation, habitat loss and modification of Marikana Thornveld is rated an impact of high significance (score 85).

Due to the nature of the proposed TSF development, habitat loss is difficult to avoid or significantly mitigate. However, steps can be taken to reduce the overall significance during all phases, but particularly during closure. With successful stabilisation and rehabilitation, impact magnitude can be reduced to high. Impact probability and duration will remain definite and permanent, respectively, while its spatial extent can be maintained at the site only. After mitigation, the impact score of habitat loss and modification of Marikana Thornveld is reduced (score 75) but remains an impact of high significance.

Secondary Vegetation

Prior to mitigation, this impact will have a high magnitude and a permanent duration score. The spatial extent of the impact will be local, and the probability of occurrence is definite. With active intervention during the closure phase, the reversibility of the impact is partly recoverable. Prior to mitigation, habitat loss and modification of Secondary Vegetation is rated an impact of high significance.

With successful rehabilitation, impact magnitude can be reduced to moderate, with reversibility rated as recoverable. Impact probability and duration will be high and long-term, respectively, while its spatial extent can be maintained at site only. After mitigation, habitat loss and modification of Secondary Vegetation is rated an impact of moderate significance.

5.2.7.2 HABITAT FRAGMENTATION

Impact Character

Habitat fragmentation occurs when habitat loss and modification cause the breakup of available natural habitat into smaller, discontinuous, and often isolated habitat patches. The ecological properties of remaining habitats patches are altered as a consequence, which negatively affects various important landscape-scale ecological processes, such propagule (seed) dispersal and fauna movement.

Impact in Relation to Project

The study area is an area of natural and semi-natural habitat. It is however, located in an operational mine characterised by large areas of transformation. The mine is enclosed by a razor-fence and numerous roads, tracks, pedestrian paths and stormwater features fragment the land surrounding the study area. This impact is rated of high magnitude that is irreversible before mitigation. It will be a permanent impact, with a local spatial extent and a high probability. Prior to mitigation, habitat fragmentation is rated an impact of high significance. With successful rehabilitation during the closure phase, the creation of secondary and supporting (corridor) habitats may restore some landscape connectivity that was lost due to fragmentation. This impact is therefore recoverable and rated of moderate magnitude after mitigation. Impact probability will be high and duration long-term, but spatial extent is likely to remain local. After mitigation, habitat fragmentation is rated an impact of moderate significance.

5.2.7.3 ESTABLISHMENT AND SPREAD OF ALIEN INVASIVE SPECIES

Impact Character

Disturbances caused by vegetation clearing and earth works can create conditions conducive to the establishment and spread of alien invasive vegetation. Alien plant infestations can spread exponentially, suppressing, or replacing indigenous vegetation. This may result in a breakdown of ecosystem functioning and a loss of biodiversity.

Impact in Relation to Project

Although no declared alien invasive flora species were recorded in the study area, several species have been previously recorded in the landscape surrounding the study area. Large-scale disturbances from vegetation clearing and earth works are likely to facilitate the local establishment and spread of alien invasive species. Before mitigation, impact magnitude is high, while duration is long term, and it has a high probability. The spatial extent of alien invasive species spread is local, but it is reversible. Prior to mitigation, the establishment and spread of alien invasive species is rated an impact of moderate significance. With the implementation of active control across all stages of the proposed project, coupled with active revegetation during closure, this impact can be reduced to a minor magnitude, with a temporary duration. Spatial extent will be maintained at the site only and probability at low. After mitigation this impact is rated to be of low significance.

5.2.7.4 SOIL EROSION AND SEDIMENTATION OF DRAINAGE FEATURES

Impact Character

Disturbance to existing vegetation coupled with earth works during construction, could lead to increase in soil erosion. Eroded material could mobilise and lead to increases in sediment load in adjacent drainage features.

Impact in Relation to Project

Before mitigation, this reversible impact is rated as having a moderate magnitude and medium-term duration. It is likely to have a local spatial extent and a medium probability of occurring. This results in an impact significance of low prior to mitigation. After mitigation, this impact can be reduced to a minor magnitude, with a temporary duration. Spatial extent will be maintained at the site only and probability at low. After mitigation, possible soil erosion and sedimentation is rated an impact of low significance.

5.2.7.5 MORTALITY AND DISTURBANCE OF FAUNA

Impact Character

Large or mobile fauna will move off to avoid disturbances caused by construction activities. However, smaller, and less mobile species may be trapped, injured and killed during vegetation clearing and earth works. Susceptible fauna includes amongst others, burrowing mammals (e.g., moles, rodents), nesting birds, reptiles and amphibians. Other common causes of fauna death or injury include:

- Vehicle collisions along access roads
- Hunting and snaring of larger fauna
- Trapping of fauna in fences, excavations, and trenches.

Impact in Relation to Project

Vegetation clearing and earth works during construction are likely to lead to the death/injury of small and/or less mobile fauna, such as rodents, nesting birds and small reptiles. Before mitigation, impact magnitude is moderate, while duration is short term, and it has a medium probability. The spatial extent of alien invasive species spread is restricted to the site only, but it is irreversible. Prior to mitigation, the mortality and disturbance of fauna is rated an impact of moderate significance. After mitigation, which includes active supervision during the construction phase, this impact becomes recoverable and can be reduced to a low magnitude, with a temporary duration. Spatial extent will be maintained at the site only and probability at low. After mitigation, the killing or injuring of fauna is rated to be of low significance.

5.2.7.6 LOSS AND DISTURBANCE OF SPECIES OF CONSERVATION CONCERN

Impact Character

Various project activities and their associated ecological impacts can lead to the loss or disturbance of species of conservation concern. Typical examples include, *inter alia*:

- Vegetation clearing and earth works can result in the direct destruction of both flora and fauna species of conservation concern
- Habitat loss, modification and fragmentation may render remaining habitat patches less acceptable to sensitive species, which may result in a reduction in species populations.

Impact in Relation to Project

No species of conservation concern have been recorded in the study area. There is however, a moderate probability that certain species may be present and/or occasionally move through the area in the case of fauna. Before mitigation, impact magnitude is high, while duration is medium term and it has a medium probability. The spatial extent of the impact is local, but it is partly reversible. Prior to mitigation, this impact is rated of moderate significance. With the implementation of proposed mitigation measures, this impact can be reduced to a low magnitude, with a short-term duration. Spatial extent will be maintained at the site only and probability at low. After mitigation this impact is rated to be of low significance.

5.2.7.7 CUMULATIVE IMPACTS

As the spatial domains of many ecological processes operate at broad-scales, land use changes in a portion of an ecosystem can cause a rescaling of the ecosystem as a whole, and result in changes in overall function (Hansen & DeFries, 2007). Development projects that cause habitat transformation and degradation may thus have negative ecological impacts that extend beyond the immediate project boundary.

Considering its size and location within an existing mining operation, the development of the TSF at Bakubung Platinum Mine is unlikely, in and of itself, to result in a significant attenuation of ecological processes at the landscape scale. It is noted however, that the broader landscape is spatially complex and characterised by large areas that have been transformed or disturbed. Remaining areas of undeveloped natural and semi-natural habitat in the landscape are therefore important in supporting and buffering the ecological process within nearby Pilanesberg Game Reserve.

The cumulative impact of the progressive loss and disturbance of natural habitat in the landscape surrounding Pilanesberg from urbanisation, mining and agriculture, is likely to negatively impact on the ability of the broader landscape to maintain the ecological supporting and buffering role that is

important to the ecosystem dynamics of the reserve. This in turn, may negatively impact the integrity and ecological processes within the reserve.

5.2.8 AQUATIC AND WETLAND

The impacts on the aquatic environment and wetland were taken directly from (Knight Piésold, 2021).

5.2.8.1 LOSS OF WATERCOURSE HABITATS

The construction of surface infrastructure on the mining area could impact on the watercourse habitat. The site layout indicates some overlap into the delineated watercourse areas as well as linear infrastructure that will cross the watercourses. The significance of the impact is deemed to be High before mitigation and Moderate with mitigation measures implemented.

5.2.8.2 SEDIMENT MOBILISATION

The increase surface water runoff from stockpiles, hardened surfaces and areas cleared of vegetation could lead to the deposition of sediment and increase erosion within the watercourses. The ecological and hydrological integrity of the watercourses will be altered. The significance of the impact is scored Moderate pre- and post-mitigation measures.

5.2.8.3 SURFACE WATER POLLUTION

Water quality in the watercourses could be impacted by sedimentation or by project related impacts such as spills and surface run-off from stockpile areas and the TSF. The significance of the impact is deemed to be Low before and after mitigation.

5.2.8.4 ENCROACHMENT OF ALIEN VEGETATION

The establishment and encroachment of alien plant species in watercourses, specifically after construction activities have created disturbances within watercourse habitats that opportunistic alien species can utilise. The significance of alien encroachment is ranked as being a Moderate impact before and after mitigation as the impact can be mitigated and controlled.

5.2.9 HERITAGE

No impact on heritage features is expected.

5.2.10 SOCIO-ECONOMIC

The following impacts will be triggered by the amendment of the Environmental Authorisation and Waste Management License for the BPM. Some of the impacts are existing impacts but have been included here because it will be caused by activities associated with the expansion. The socio-economic impacts of the project were obtained from Equispectives Research and Consulting Services' social impact assessment report (Equispectives, 2021)

5.2.10.1 COMMUNITY EXPECTATIONS

There are some local tensions in the community related to the management of community assets and other historical events. This has been a long-standing issue and continues to be a challenge for mines

in the area (Mataboge, 2013) (Mahikeng Mail, 2019). Due to the mistrust, and the expectations that some community members have, there is a strong possibility of local conflict. The current reality in South Africa is that communities tend to resort to violent protests if they feel that they are not heard. There is a risk that lives can be in danger and property damaged during these protests, and the mine should have emergency procedures in place should there be protests of this nature that endangers its assets and the lives of staff and community members.

Although some of the community expectations are realistic, the extent to which the mine can meet some of the expectations are limited. Unless the expectations of the community are managed carefully, this impact may pose a significant risk to the mine, on different levels. This impact can occur throughout the life of the mine and is rated as moderate before and after mitigation.

5.2.10.2 DUST FROM SOCIAL AND HEALTH PERSPECTIVE

The proposed construction will create dust, which will continue in the operational phase of the project. The dust potentially has health impacts and may impact on the grazing areas of subsistence farmers. Dust is also a significant nuisance factor, because even if it is in the legal limits, it is something that is visible to the communities. Health impacts that communities often ascribe to dust is asthma, sinusitis and allergies. It impacts on their quality of life where they feel they need to clean their houses more often and cannot hang washing outside. This impact will be worse during the construction phase but will continue for the life of the mine. It is rated as having a moderate significance before and after mitigation.

5.2.10.3 ECONOMIC IMPACTS AND SKILLS DEVELOPMENT FROM A SOCIAL PERSPECTIVE

The project will ensure job security for currently employed people, as they will be able to continue with their current jobs. This impact would be experienced on a wider level, since it will allow them to meet the needs of their family members. The new activities at the mine will create 86 new jobs and 1055 construction jobs. BPM has targets of at least 30 % local employment. Wages that employees receive will increase their spending power in the study area. This will be especially beneficial to retail and other service providers. The job creation will be a significant positive impact during the construction phase. There are high levels of poverty and unemployment in the area, and this may cause significant competition for jobs. This impact has a high, positive significance rating.

The mine will also continue to implement their skills development programmes required as a part of the SLP. This will allow more people to benefit from the skills development programmes as the mine develops. The DMRE requires that skills development plans must ensure that people obtain transferable skills. The skills development impact will continue for the life of the mine. In the SLP the BPM also commit to develop skills in the local communities, therefore this impact will be felt wider than the mine. This impact has a moderate positive significance rating.

Apart from the direct economic impacts of the proposed project, there may also be secondary economic opportunities that can potentially benefit local service providers. The use of local service providers will ensure that the local economy benefits directly from the proposed project. The positive impact of the mine on the local economy will continue for the life of the mine. The SLP also commits to secondary economic development in the area, and if it is implemented as planned should be a significant contribution. This impact has a moderate positive significance rating.

5.2.10.4 INCREASE IN SOCIAL PATHOLOGIES

The construction of the tailings dam will include specialised construction teams. It is not clear where the construction workers will be housed, but it is anticipated that the levels of activities in the local

areas will increase, especially during weekends. Depending on where they come from, workers will probably not be able to go home every weekend. People with access to more money and different value systems may mix with local community members.
In-migration triggers a dramatic rise in the “four M’s”: men, money, movement (influx), and mixing (i.e., the interaction between high and low disease prevalence groups). These factors are the conditions necessary to produce a surge in sexually transmitted diseases. Other drivers of the HIV epidemic that may be relevant for the project include high levels of alcohol and drug abuse, transactional and commercial sex, sexual and gender-based violence, migratory labour, poverty, income disparities and unequal access to prevention, treatment, and care. Another important consideration is the impact of contractors bringing in materials from other provinces, especially during the construction phase. The truck drivers are often required to stop overnight. The truck stops become “hot spots” with a considerable pull factor luring people with economic opportunities, including sex work. It is difficult to manage these transient factors, but it does contribute to the spread of the disease amongst transportation routes, and it is therefore important to consider the impact.
Given the high unemployment levels in the area, people may deploy livelihood strategies such as prostitution. Vulnerable parties such as young girls may also fall victim to sexual predators and there can be an increase in teenage pregnancies. Promiscuous behaviour can lead to an increase in the spread of sexually transmitted diseases. There may be an increase in alcohol and substance abuse due to these substances being more easily available. This impact is rated as having a moderate, negative impact significance rating.

5.2.11 GROUNDWATER

The possible impacts on groundwater are taken directly from (GPT, 2020). It can be summarised as follows:

- Construction phase impacts: Potential hydrocarbon contamination form construction machinery on the site. This impact is rated as moderate before mitigation and low after mitigation.
- Operational phase impact: Potential groundwater contamination resulting from pipe networks and transfer pump stations. This impact is rated as moderate before mitigation and low after mitigation.
- Operational phase impact: Potential groundwater contamination resulting from liner leaks under the TSF during the operation of the facility. This impact is rated as moderate before mitigation and low after mitigation.
- Decommissioning phase impact: Potential groundwater contamination resulting from liner leaks under the TSF after the decommissioning of the facility. This impact is rated as moderate before mitigation and low after mitigation.

Each of the expected impacts have been assessed using the matrix and a significance rating for each impact pre- and post-mitigation have been calculated.

Table 36: Impact Significance Ratings

Project activity or issue	Potential impact	Nature of impact		Significance before mitigation							Significance after mitigation as per EMP						
		+ / -	D/I/C	M	R	D	S	P	TOTAL	SP	M	R	D	S	P	TOTAL	SP
Visual																	
Clearance of vegetation Increase in heavy vehicles Construction of the base of the TSF	Alteration to the visual quality of the study area due to the physical presence and construction activities. The TSF will have a low impact on key residential and some public road views in the area. Mitigation measures are feasible and would result in a reduction in impact, if the mitigation measures are effectively implemented and managed in the long term.	-	D	2	1	2	2	3	21	**L**	2	1	2	2	2	14	**L**
The TSF will increase in height. Security lights will be installed	Alteration to the visual quality of the study area due to the physical presence, scale and size of the new TSF. The project becomes more visible for people travelling along the R565 and the R556 as well as residents from Ledig. Mitigation measures are possible but will not be able to hide/screen the proposed activities completely since the upper levels of the TSF will break the tree horizon, which makes it more visible.	-	D	3	1	5	2	5	55	**M**	3	1	5	2	4	44	**M**
Increase in heavy vehicles during the removal of structures and the transport of material for rehabilitation. Preparation of soils.	Creating dust by removal of structures and the movement of vehicles, during the soil preparation for rehabilitation. Mitigation measures are feasible and would result in a drop in impact at closure if they are effectively implemented and managed.	-	D	2	1	2	2	3	21	**L**	2	1	2	2	2	14	**L**
Removal of structures, planting of vegetation, rehabilitation of the area.	Alteration to the visual quality of the study area by removing structures and rehabilitating the area.	+	D	2	1	2	3	3	24	**L**	3	1	2	3	2	18	**L**
Geology																	
Air Quality																	
General construction activities	Impacts on human health	-	D	2	1	1	2	1	6	**L**	1	1	1	1	1	4	**L**
	Increased nuisance dustfall rates	-	D	2	1	1	2	1	6	**L**	1	1	1	1	1	4	**L**
Operation of new TSF	Impacts on human health	-	D	1	1	3	1	3	18	**L**	1	1	3	1	2	12	**L**
	Increased nuisance dustfall rates	-	D	1	1	3	1	1	6	**L**	1	1	3	1	1	6	**L**
Decomissioning of TSF	Impacts on human health	-	D	2	1	1	2	1	6	**L**	1	1	1	1	1	4	**L**
	Increased nuisance dustfall rates	-	D	2	1	1	2	1	6	**L**	1	1	1	1	1	4	**L**
Closure of TSF	Impacts on human health	-	D	1	1	1	1	1	4	**L**	1	1	1	1	1	4	**L**
	Increased nuisance dustfall rates	-	D	1	1	1	1	1	4	**L**	1	1	1	1	1	4	**L**
Development of project	Impact on climate change	-	D	1	3	2	5	3	33	**M**	1	3	2	5	2	22	**L**
Noise																	
General construction activities	Increase in noise at sensitive receptors	-	D	3	1	2	2	2	16	**L**	2	1	2	2	2	14	**L**
Operation of new TSF	Increase in noise at sensitive receptors	-	D	3	1	3	2	2	18	**L**	2	1	3	2	2	16	**L**
Soil																	
Construction, Operation and Closure of TSF Project	Soil loss	-	D	5	5	4	1	5	75	**H**	1	5	4	1	5	55	**M**
	Loss of land capability	-	D	1	5	4	1	5	55	**M**	1	3	4	1	5	45	**M**
	Contamination of soil	-	D	3	3	4	1	3	33	**M**	3	3	4	1	2	22	**L**
Terrestrial Flora and Fauna																	
Vegetation clearing and earth works	Habitat loss and modification - Marikana Thornveld	-	D	5	5	5	2	5	85	**H**	4	5	5	1	5	75	**H**

Project activity or issue	Potential impact	Nature of impact		Significance before mitigation							Significance after mitigation as per EMP						
		+ / -	D/I/C	M	R	D	S	P	TOTAL	SP	M	R	D	S	P	TOTAL	SP
Vegetation clearing and earth works	Habitat loss and modification - Secondary Vegetation	-	D	4	3	5	2	5	70	H	3	3	4	1	4	44	M
Vegetation clearing and earth works	Habitat fragmentation	-	C	4	5	5	2	4	64	H	3	3	4	2	4	48	M
Vegetation clearing and earth works	Establishment and spread of alien invasive species	-	I	4	1	4	2	4	44	M	1	1	1	1	2	8	L
Vegetation clearing and earth works	Soil erosion and sedimentation of drainage features	-	I	3	1	3	2	3	27	L	1	1	1	1	2	8	L
Vegetation clearing and earth works, vehicle collisions, trapping in fences, excavations and trenches.	Mortality and disturbance of fauna.	-	D	3	5	2	1	3	33	M	1	3	1	1	2	12	L
All project related activities	Loss and disturbance of species of conservation concern.	-	D	4	5	3	2	3	42	M	2	3	2	1	2	16	L
Aquatics and Wetland																	
Construction of surface infrastructure	Loss of watercourse habitat	-	D	5	5	5	1	4	64	H	4	5	5	1	3	45	M
	Sediment mobilisation: Deposition and erosion in watercourses	-	D	5	3	2	2	4	48	M	3	3	2	2	2	20	L
	Surface Water Pollution	-	D	4	3	2	2	2	22	L	4	3	2	2	2	22	L
	Encroachment of alien species into watercourse	-	D	4	3	2	1	3	30	M	3	3	2	2	3	30	M
Operation of TSF	Loss of watercourse habitat	-	D	5	5	5	1	4	64	H	4	5	5	1	3	45	M
	Sediment mobilisation: Deposition and erosion in watercourses	-	D	5	3	2	2	4	48	M	3	3	2	2	2	20	L
	Surface Water Pollution	-	D	4	3	2	2	2	22	L	4	3	2	2	2	22	L
	Encroachment of alien species into watercourse	-	D	4	3	2	1	3	30	M	3	3	2	2	3	30	M
Decommissioning or Closure of the TSF	Loss of watercourse habitat	-	D	5	5	5	1	4	64	H	4	5	5	1	3	45	M
	Sediment mobilisation: Deposition and erosion in watercourses	-	D	3	3	1	2	2	18	L	3	3	1	2	2	18	L
	Surface Water Pollution	-	D	3	3	2	2	1	10	L	3	3	2	2	1	10	L
	Encroachment of alien species into watercourse	-	D	4	3	2	1	3	30	M	3	3	2	2	3	30	M
Socio-Economics																	
Construction, Operation and Closure of TSF Project	Community expectations	-	D	3	3	4	2	4	48	M	3	3	4	2	3	36	M
	Dust from social and health perspective	-	D	3	5	4	2	4	56	M	2	5	4	2	3	39	M
	Skills development	+	D	4	3	5	3	5	75	H	5	3	5	3	5	80	H
	Job creation	+	D	2	3	4	2	4	44	M	3	3	3	2	5	55	M
	Local economy	+	I	3	3	3	2	4	44	M	4	3	4	2	5	65	H
	Increase in social ills	-	I	3	3	4	2	4	48	M	2	3	3	2	3	30	M
Groundwater																	
Groundwater contamination during Construction	Hydrocarbon spills from machinery	-	D	3	3	2	2	3	30	M	1	3	1	1	2	12	L
Groundwater contamination during Operation	Groundwater contamination from liner leakage	-	D	4	3	3	3	3	39	M	2	3	3	2	2	20	L
Groundwater contamination during Operation	Groundwater contamination from leaking infrastructure	-	D	3	3	2	2	3	30	M	2	3	2	1	2	16	L
Groundwater contamination after decommissioning	Groundwater contamination from liner leakage	-	D	3	3	2	2	3	30	M	2	3	3	2	2	20	L

6 ENVIRONMENTAL MANAGEMENT PLAN

The mitigation actions for all phases (construction, operation, decommissioning, and closure) are provided in Table 37.

Appendix E provides the overall EMPr of the mine. This includes the management actions from the approved EMPs (original mine (2008) and amendment (2016)). New measures that were not previously covered in these EMPs, or measures that have been updated have been underlined.

Table 37: Environmental Management Plan

Project activity or issue	Potential impact	Mitigating action
	Visual	
Construction, Operation and Closure of TSF Project	Alteration of topography and visual impact	• Minimise the amount of existing vegetation and topsoil to be removed with the construction of the Project and associated activities, especially the vegetation that forms a buffer between Ledig and the study site as well as the vegetation along the R565 which is currently screening the view towards the proposed project. • Ensure, wherever possible, natural vegetation is retained and incorporated into the site rehabilitation. • Execute earthworks so that only the footprint and a small 'construction buffer zone' around the proposed activities is exposed. In all other areas, the natural occurring vegetation, more importantly the indigenous vegetation should be retained, especially along the periphery of the site. • Remove or demolish all temporary infrastructure, and dispose of waste at appropriate waste facilities • Apply an ecological approach (instead of horticultural) if new vegetation is to be introduced to the site for rehabilitation and vegetative screening measures. • Use security lighting only where necessary and carefully directed, preferably away from sensitive viewing areas • Conduct concurrent rehabilitation of the TSF – rehabilitate the lower lift with each raising of the TSF • Close TSF in accordance with approved closure design.
	Soil	
Construction, Operation and Closure of TSF Project	Soil loss	• Remove topsoil (approximately 300 mm) from all areas to be disturbed during construction activities and stockpile it for rehabilitation purposes • Remove subsoil (the layer beneath the topsoil) from all areas to be disturbed during construction activities and stockpile it for rehabilitation purposes. • Store topsoil and subsoil in separate stockpiles • Ensure that topsoil stockpiles are shaped convexly and are no more than 2 m high • Monitor topsoil and subsoil stockpiles regularly to identify any alien plants, and remove these to prevent contamination of the seed bank • Take appropriate measures to protect topsoil and subsoil stockpiles from wind or water erosion, such as providing stormwater cut-off drains or using a breathable cover material or temporary vegetation cover.
	Loss of land capability	
	Contamination of soil	• Store hazardous substances in appropriately bunded areas. • Use a drip-tray when refuelling vehicles or machinery. • Clean up spills immediately, treat contaminated soil as hazardous waste and dispose accordingly

Project activity or issue	Potential impact	Mitigating action
Air Quality		
General construction activities	Impacts on human health Increased Nuisance Dustfall Rates	• Reduction of fugitive PM emissions through the watering of roads, stockpiles and inactive open areas and the use of screens. • Reductions of vehicle exhaust emissions through the use of better-quality diesel; and inspection and maintenance programs.
Operation of new TSF	Impacts on human health Increased Nuisance Dustfall Rates	• Vegetation and/or nets of side slopes.
Decommissioning and closure of TSF	Impacts on human health Increased Nuisance Dustfall Rates	• Reduction of fugitive PM emissions through the watering of roads, stockpiles and inactive open areas and the use of screens. • Reductions of vehicle exhaust emissions through the use of better-quality diesel; and inspection and maintenance programs.
Development of project	Impact on climate change	• Minimising the area cleared and adequate revegetation or the addition of vegetation around the project. • Reductions of vehicle exhaust emissions through the use of better-quality diesel; and inspection and maintenance programs.
Noise		
General construction activities	Increase in noise at NSRs	• Select 'low noise' equipment, or methods of work • Avoid dropping from heights • Regular inspection and maintenance of equipment • Establish a complaint register.
Operation of new TSF	Increase in noise at NSRs	• Use temporary noise barriers and use 'low noise' equipment (including alternative reversing alarms), where possible • Train construction staff on noise control plan during health and safety briefings • Select 'low noise' equipment, or methods of work • Use most effective mufflers, enclosures and low-noise tool bits and blades • Investigate use of alternatives to audible reversing alarms (such as broadband noise emitting models) or configure to maximise forward movements of mobile equipment • Use temporary noise barriers for small equipment, where required • Reduce throttle settings and turn off equipment when not used • Avoid clustering of mobile fleet near receptors and enforce rest periods for unavoidable maximum noise events • Ensure periods of respite are provided in the case of unavoidable maximum noise level events • Regularly inspect and mainten all equipment.
Terrestrial ecology (flora and fauna)		

Project activity or issue	Potential impact	Mitigating action
Construction, Operation and Closure of TSF Project	Habitat loss and modification	• Restrict vegetation clearing to the proposed TSF footprint only. • Demarcate the footprint to be cleared clearly prior to construction to prevent unnecessary clearing outside of this area. • Stockpile removed topsoil for use to rehabilitate the TSF. • Develop a suitable rehabilitation programme and implement it for all areas that were disturbed during construction, as well as the TSF. The programme should include: – Concurrent rehabilitation. – Stabilisation and active revegetation of all disturbed areas using locally occurring indigenous grass and tree species that are known to be common in Marikana Thornveld.
	Habitat fragmentation	• Manage the open, undeveloped natural habitat located to the south of the study area (i.e., between the new entrance road and Elands River) as a no-go natural corridor. No development or any form of disturbance should be permitted in this area.
	Establishment and spread of alien invasive species	• Develop an alien invasive species control programme specific to the TSF and/or incorporated in the mine's broader alien invasive species control programme. It should be implemented during all phases of the proposed project. It is recommended that the programme include: – A combined approach using both chemical and mechanical control methods. – Periodic follow-up treatments informed by regular monitoring. – Monitoring should take place in all disturbed areas, as well as adjacent undisturbed areas. • Rehabilitate all sites that were disturbed during the construction phase, as per the rehabilitation programme • Rehabilitate all disturbed footprints during the closure and rehabilitation phases, as per the rehabilitation programme.
Construction, Operation and Closure of TSF Project	Mortality and disturbance of fauna	• An ECO should be on-site during vegetation clearing to monitor and manage any wildlife-human interactions. The ECO should be trained in inter alia, snake handling and species identification. • Erect fences, as appropriate, to prevent fauna gaining access to construction and operational areas where they may be killed or injured. • Enforce a low-speed limit (recommended 20-40 km/h) on site to reduce wildlife collisions. • Strictly prohibit the handling, poisoning, and killing of on-site fauna by mine workers and contractors. • Ensure that employees and contractors are made aware of the presence of, and rules regarding fauna through suitable induction training and on-site signage.
	Soil erosion and sedimentation of drainage features	• Install erosion prevention measures prior to construction at all sites where erosion is likely to occur. Measures should include: – Low berms on approach and departure slopes to prevent flow concentration. – Sediment barriers along the lower edge of bare soil areas. • Install sediment traps across drainage lines and storm water channels to the south of the proposed TSF footprint where increased sedimentation is likely to become an issue. Sediment traps should be regularly maintained to ensure functionality. • Stabilise and revegetate any areas cleared of vegetation during construction using indigenous grass

Project activity or issue	Potential impact	Mitigating action
		species.
	Loss and disturbance of species of conservation concern	• Conduct a grid survey of the proposed TSF footprint prior to vegetation clearing to ensure that there are no flora species of conservation concern present • If flora species of conservation concern are encountered: – Develop a suitable ex situ conservation plan in consultation with the relevant authority. This is likely to include the relocation of plants (under permit) to an adjacent area of natural vegetation that is unlikely to be disturbed in the future. – Obtain clearing permits from the relevant authority to cleared protected trees.
	Loss of fauna species	• Limit transformation only to development footprints • Fence off surrounding untransformed vegetation • Maintain untransformed vegetation in a natural state • Mine infrastructure to be adequately rehabilitated after mining ceases. This includes stockpiles, tailings, rock dumps etc. • House construction teams off-site to reduce human presence on site • Report and monitor species of conservation-concern • Undertake monthly inspections of the perimeter fence to assess state of fence and determine if it is being breached by poachers • Conduct additional surveys if expansion of infrastructure is planned in the future.
	Aquatic Ecology	
Construction of surface infrastructure	Loss of watercourse habitat	• Disallow any infrastructure within the wetlands or within a 30 m buffer from any watercourse (including a wetland) • Demarcate the wetland areas during construction to ensure that no construction activities occur within these areas • Develop a watercourse rehabilitation plan for impacts not successfully mitigated • Develop and implement a stormwater management system to attenuate flood peak events • Prevent stormwater outflows from entering directly into watercourses. Instead ensure that flows are attenuated before release. • Designate a re-fuelling area and disallow refuelling within close proximity to any watercourse. • Store hazardous materials in a hazardous material zone with a bunded area. • Develop and implement an alien vegetation control plan to limit and manage the spread of alien vegetation within watercourses.
	Sediment mobilisation: Deposition and erosion in watercourses	
	Surface Water Pollution	
	Encroachment of alien species into watercourse	
	Socio-economic	
Construction, Operation and Closure of TSF Project	Community expectations	• Continue to invest in the BPM Stakeholder Relations Division • Continue to implement the grievance mechanism and ensure that it is community-friendly. Address and keep record of community grievances in a grievance register. It is important to have documented evidence of community/mine interactions. This will assist the mine to track the issues,

Project activity or issue	Potential impact	Mitigating action
		and the community to see what actions the mine has taken. • Include planning and budgeting for external conflict situations (such as roadblocks or invasions) in their emergency response procedure and ensure that their current insurance remains updated. They must also periodically review their stakeholder engagement plan to guide their interaction with stakeholders
	Dust from social and health perspective	• Continue to communicate the mitigation and monitoring measures to the affected parties, which is currently done through quarterly feedback sessions.
	Skills development Job creation Local economy	• Focus skills development plans on skills that the mine needs, and that are also transferable. Provide support to people after the training to ensure that their newly acquired skills can be implemented. • Continue to put measures in place to ensure the most effective local employment strategy. • Ensure a fair number of secondary economic opportunities are given to local contractors. A percentage of goods as determined by BPM and the relevant stakeholders must also be procured locally. Services and goods must be procured locally as far as reasonably possible. Aspects of this positive impact will occur by default when the construction force lives locally, and they utilise local services and support local shops. • Liaise with local training institutions to determine whether there are any opportunities to offer internships and practical experience for their students. Ensure that skills development requirements form part of their contracts with sub-consultants. The skills development requirements in their Social and Labour Plan (SLP) must continue to be implemented.
	Increase in social ills	• Include talks about the impact of promiscuous behaviour during toolbox talks. Develop an in-house infectious diseases strategy to address health issues within the workforce and align the strategy with a community HIV strategy implemented by a non-profit organisation. Local schools and communities living in traditional areas close to the project must be included in the strategy. The strategy should include voluntary counselling and testing and training of peer educators. A workforce code of conduct should be developed to maximise positive employee behaviour in the local community, and optimise integration • Extend the workplace programme for HIV beyond the company's operations, and include all contractors, suppliers, transportation companies and local communities. Make it a contractual requirement. The spread of HIV along transportation routes (roads and railways) is well documented, so this component of the project (transportation of all goods and services to and from the project site) needs special attention. – Select suppliers who have in-house HIV programmes and policies in place – Develop tailored behaviour change communication (BCC) materials such as mirror hanger messages and bumper stickers – Include condoms in the road safety kit – Work with truck company managers to ensure that their drivers receive adequate HIV training
Archaeology		

Project activity or issue	Potential impact	Mitigating action
Construction, Operation and Closure of additional TSF Site		• No heritage features were found on site; therefore, no mitigation measures are included
Groundwater		
Construction activities	Impact on surface and groundwater	• Take care to minimise contamination during the construction of the TSF and its associated services. Bund fuel storage and service areas to minimise groundwater contamination. • Line the TSF and evaporation dams with a Class C liner. • Minimise potential leakages by routing any pipes above ground in order to detect and limit leaks. • Update the groundwater monitoring programme with additional points to monitor the groundwater quality at the TSF as well as the evaporation dams. • Implement contamination interception measures if contamination is detected. This should consist of but not be limited to interception trenches (if the groundwater level is shallow enough) or interception boreholes. The water intercepted by these measures should be treated to the RQO of the Elands River before being released into the environment.

7 ADVANTAGES AND DISADVANTAGES

The proposed project and amendment could have the following advantages and disadvantages:

Advantages

- BPM will be able to continue their mine plan (i.e., reduced throughput) activities within their available budget.
- A smaller TSF than was previously applied is being proposed in a different area. By using a dry stack TSF, the mine will use less water, saving the natural resource which is scarce in South Africa.
- Dry stack tailings reduces groundwater impacts, as much less seepage is produced.

Disadvantages

- Bakubung Platinum Mine will have high volume of material to be processed, stockpiled at the mine. This will result in shortage of space due to storage of unprocessed ore material. The construction of the plant will not proceed due to unaffordability of the original operation.

8 PROPOSED MONITORING

8.1.1 SURFACE WATER MONITORING

The existing surface and groundwater monitoring programme is reflected in Figure 32 and Table 25. As prescribed by the 2017 WUL (07/A22F/CGI/5132), groundwater monitoring should be undertaken on a quarterly basis. The following parameters should be analysed: Electrical Conductivity (EC), pH, Total Dissolved Solids (TDS), total hardness, total alkalinity, calcium, magnesium, sodium, potassium, chloride, sulphate, fluoride, nitrate, iron, manganese, aluminium, chrome, copper, and nickel.
Neither the 2010 nor 2017 WUL provide guidance on the parameters or limits to be used for surface water monitoring.
Table 38 provides the compliance criteria used by (Aquatico, 2020) for their monthly monitoring programme.

Table 38: Compliance criteria used for assessing water quality at BPM

VARIABLE	UNITS	SANS 241-1:2015 Drinking Water Limits	General Authorisation Limit, Section 21f and h, 2013	WUL Water Quality Limits Groundwater	RQO Mokolo-Crocodile West Catchments
Electrical conductivity (EC) @ 25°C	mS/m	170	150	63.86	≤85
pH @ 25°C	pH	5.0/9.7	5.5/9.5	6 - 9.5	6 – 9
Total Dissolved solids @ 180°C	mg/l	1200	-		
Chloride (Cl)	mg/l	300	-		≤ 120
Sulphate (SO_4)	mg/l	500	-	28.59	≤ 120
Fluoride (F)	mg/l	1.5	1	0.53	
Nitrate (NO_3) as N	mg/l	11	15	0.26	4.5
Aluminium (Al)	mg/l	0.3	-		≤ 0.1
Arsenic (As)	mg/l	0.01	0.02		
Boron (B)	mg/l	2.4	1		
Barium (Ba)	mg/l	0.7	-		
Cadmium (Cd)	mg/l	0.003	0.005		
Chromium (Cr)	mg/l	0.05	-		
Copper (Cu)	mg/l	2	0.01		
Iron (Fe)	mg/l	0.3	0.3		≤ 0.3
Manganese (Mn)	mg/l	0.1	0.1		≤ 0.15
Calcium (Ca)	mg/l	-	-	48.13	
Sodium (Na)	mg/l	200	-	31.10	≤ 100
Magnesium (m)g	Mg/l			22.81	
Nickel (Ni)	mg/l	0.07	-		
Orthophosphate (PO_4) as P	mg/l	-	10		
Lead (Pb)	mg/l	0.01	0.01		≤0.0095
Antimony (Sb)	mg/l	0.02	-		

VARIABLE	UNITS	SANS 241-1:2015 Drinking Water Limits	General Authorisation Limit, Section 21f and h, 2013	WUL Water Quality Limits Groundwater	ROO Mokolo-Crocodile West Catchments
Selenium (Se)	mg/l	0.04	0.02		
Zinc (Zn)	mg/l	5	0.1		≤0.002
E.coli	CFU/100 ml	0	1000		130
Total coliform	CFU/100 ml	10	-		10% variation

WUL 07/A22F/CGI/5132 stipulates that six-monthly water quality and quantity monitoring reports must be submitted to the DHSWS.

8.1.2 GROUNDWATER MONITORING

The existing surface and groundwater monitoring programme is reflected in Table 25 and Figure 32. However, (GPT, 2020) has noted that no monitoring network currently exists for the planned TSF. The recommended boreholes are listed in Table 39 and the areas to site these monitoring boreholes are shown in Figure 47. These boreholes can be utilised for water level monitoring during operations, as well as groundwater quality monitoring after decommissioning of the site. The boreholes should be sited using geophysical methods.

However, a monitoring network should be dynamic. This means that the network should be extended over time to accommodate the migration of contaminants through the aquifer as well as the expansion of infrastructure and/or addition of possible pollution sources. A review on the monitoring network should be conducted annually.

Table 39: Proposed Groundwater Monitoring Positions

ID	Name	Latitude	Longitude	Depth	Status
1	MONBH1	-25,3853117	27,0727191	40	New
2	MONBH1	-25,3882390	27,0753810	40	New
3	MONBH1	-25,3887834	27,0777840	40	New
4	MONBH1	-25,3879949	27,0736156	40	New
5	MONBH1	-25,3849859	27,0782229	40	Existing

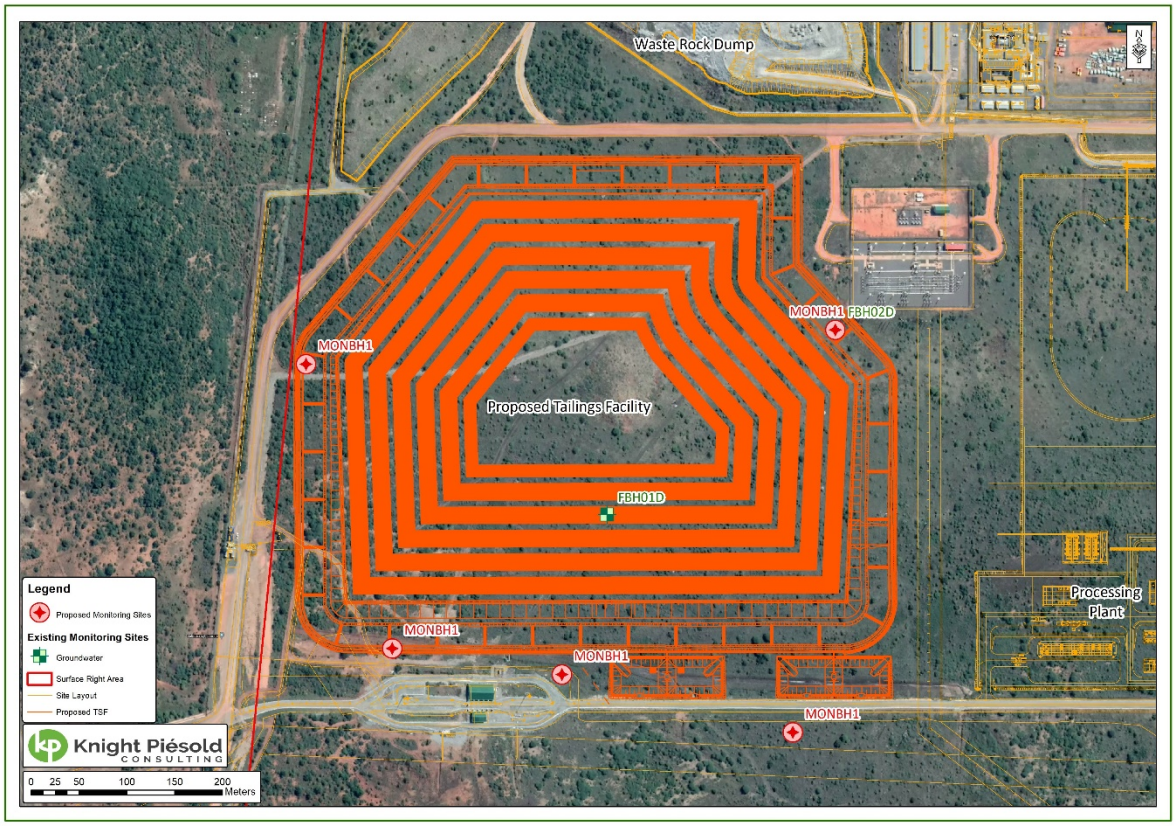


Figure 47: Additional groundwater monitoring points proposed

8.1.3 BIO MONITORING

The 2010 WUL (26064730) stipulates that an Aquatic Scientist must undertake monitoring for IHAS and SASS annually during summer and winter, to reflect the status of the river upstream and downstream of the mining activities.

This is being undertaken for BPM by Scientific Aquatic Services (SAS), and their latest report (April 2020) is available in Appendix C3.

The co-ordinates and descriptions for each of the sites assessed are presented in Table 40 and Figure 48.

Table 40: Site code, descriptions, and co-ordinates of the sample sites.

Site	Description	GPS co-ordinates	
		Latitude	Longitude
SW1	Upstream of the Bakubung Platinum Mine. Located approximately 1km upstream from the original SW1 site.	25°25'14.45"S	27° 1'26.39"E
SW2	The site is representative of the Elands River upstream of the mining area.	25°23'35.10"S	27° 4'27.78"E
SW3	The site is located downstream of the Bakubung Platinum Mine.	25°23'33.00"S	27° 5'44.10"E
SW4	Pollution Control Dam on the property of the Bakubung Platinum Mine	25°23'21.40"S	27° 5'11.83"E
BK1	Located on the Sandspruit, upstream of the proposed pipeline crossing.	25°23'32.54"S	27° 4'2.31"E
BK2	Located on the Sandspruit, downstream of the	25°23'38.41"S	27° 4'7.59"E

Site	Description	GPS co-ordinates	
		Latitude	Longitude
	proposed pipeline crossing. Any impact on the aquatic ecology as a result of the pipeline construction will be evident at this point.		
BK3	Located on the unnamed tributary of the Elands River, upstream of the proposed road crossing.	25°22'10.16"S	27° 5'3.70"E
BK4	Located on the unnamed tributary, downstream of the proposed road crossing. Any impact on the aquatic ecology as a result of the pipeline/road construction will be evident at this point.	25°22'56.01"S	27° 5'26.34"E
BK5	This ephemeral pan is located within the area of the proposed pipeline, road crossing and berm construction.	25°22'26.01"S	27° 4'40.70"E

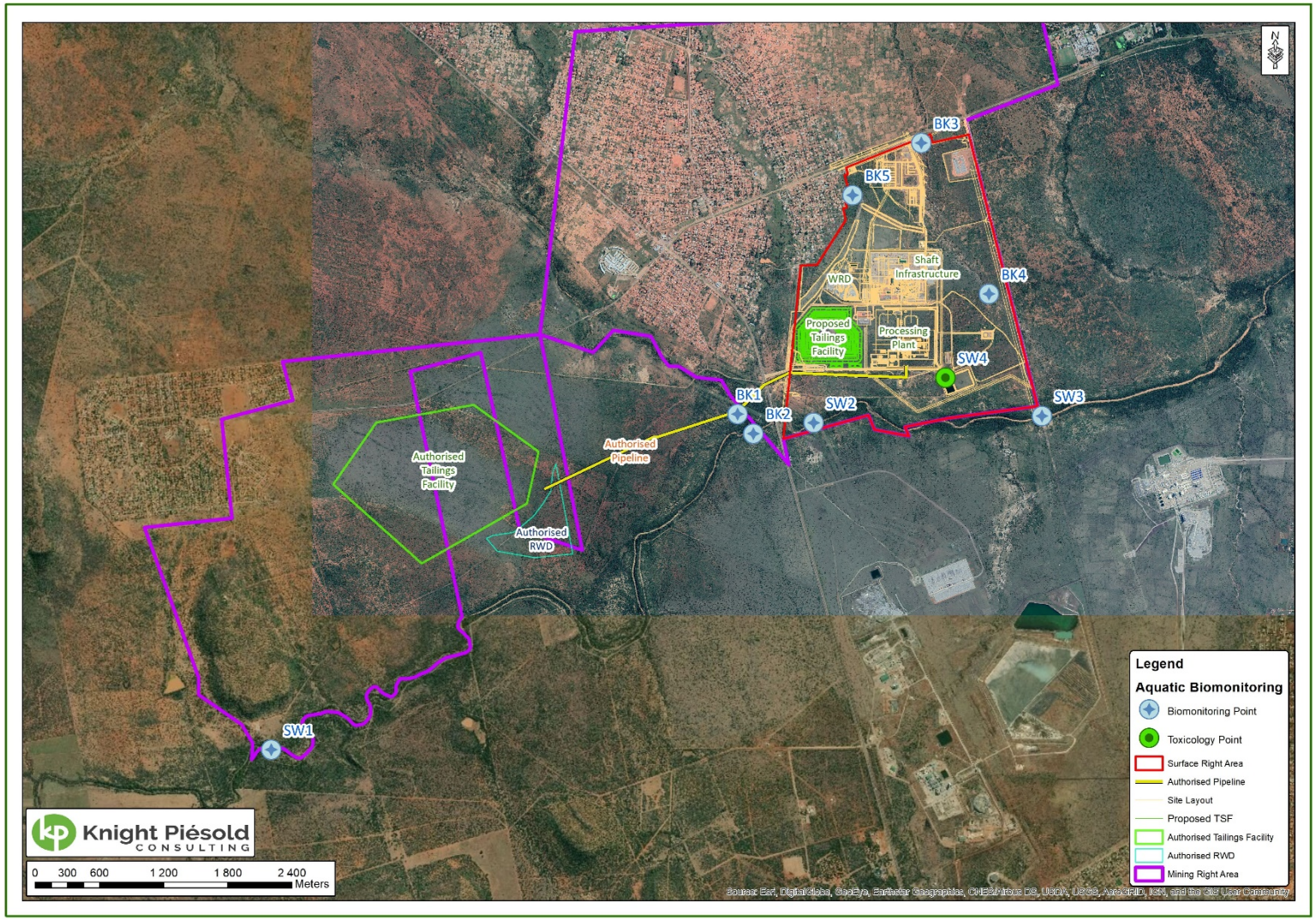


Figure 48: Aquatic Biomonitoring Points

9 CLOSURE COSTS

The closure costs for the changes in infrastructure and additional TSF has been calculated as **R 25 479 666,26** in terms of the DMRE Guideline (DMR, 2005) as shown in Table 41.

Table 41: Closure Costs for changes to infrastructure

No	Description	unit	A	B	C	D	E = A*B*C*D
			Master Rate 2021	Qty	Multiplication factor	Weighting Factor 1	Amount
1	Dismantling of processing plant and related structures (Including overland conveyers and power lines)	m^3	R 16,80		1,00	1,00	R 0,00
2 (A)	Demolition of steel buildings and structures	m^2	R 234,04		1,00	1,00	R 0,00
2 (B)	Demolition of reinforced concrete building structures	m^2	R 334,91		1,00	1,00	R 0,00
3	Rehabilitation of access roads	m^2	R 41,88		1,00	1,00	R 0,00
4 (A)	Demolition and rehabilitation of electrified railway lines	m	R 406,50		1,00	1,00	R 0,00
4 (B)	Demolition and rehabilitation of non-electrified railway lines	m	R 221,73		1,00	1,00	R 0,00
5	Demolition of housing or administration facilities	m^2	R 468,08		1,00	1,00	R 0,00
6	Opencast rehabilitation including final voids and ramps	ha	R 238233,07		1,00	1,00	R 0,00
7	Sealing of Shafts, Adits and Inclines	m^3	R 125,65		1,00	1,00	R 0,00
8 (A)	Rehabilitation of overburden and spoils	ha	R 163 585,06	5,68	1,00	1,00	R 902 351,72
8 (A).1	Stockpad 1 - Merensky Stockpad 2 - UG2			3,82 1,86			
8 (B)	Rehabilitation of processing waste deposits and evaporation ponds (salt)	ha	R 203 742,24		1,00	1,00	R 0,00
8 (C)	Rehabilitation of processing waste deposits and evaporation ponds (acid and metal)	ha	R 591764,04	30,52	0,90	1,00	R 16 253 509,37
8 (C).1	Dry Stack Tailings Facility -	ha		29,44			
8 (C).2	Return Water Dam	ha		1,08			
9	Rehabilitation of subsided areas	ha	R 136 977,85		1,00	1,00	R 0,00
10	General surface rehabilitation	ha	R 129 586,96		1,00	1,00	R 0,00
11	River Diversions	ha	R 129 586,96		1,00	1,00	R 0,00
12	Fencing	m	R 147,82		1,00	1,00	R 0,00
13	Water Management	ha	R 49 272,61		36,2	1,00	R 1 194 991,84
14	2 to 3 years maintenance and aftercare	ha	R 17 245,41		1,00	1,00	R 624 249,49
15 (A)	Specialist Study	Sum	5%	R 0,00	1,00	1,00	R 0,00
	Sub Total 1						**R 19 001 913,83**
						Weighting Factor 2	
1	Preliminary and General	%	6%	R 16 496521		1,10	R 1 254 126,31
2	Contingency	%	10%	R 16 496521			R 1 900 191,38
	Sub Total 2						R 22 156 231,53
	VAT	%	15%				R 3 323 434,73
	GRAND TOTAL						**R 25 479 666,26**

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11CERTIFICATION

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APPENDIX A

Screening Report & NW READ Report

APPENDIX A1

Screening Report

APPENDIX A2

NWREAD Report

APPENDIX B

TSF Design Report

APPENDIX C

Public Participation

APPENDIX C1

Proof of Public Participation

APPENDIX C2

Issues and Concerns Report

APPENDIX C3

Letters reviewed during 2020 review period.

APPENDIX D

Specialist Studies

APPENDIX D1

Visual Impact Assessment

APPENDIX D2

Air Quality Impact Assessment

APPENDIX D3

Noise Impact Assessment

APPENDIX D4

Terrestrial Impact Assessment

APPENDIX D5

Aquatic Impact Assessment

APPENDIX D6

Water Quality Monitoring Report

APPENDIX D7

Groundwater Impact Assessment

APPENDIX D8

Social Impact Assessment

APPENDIX D9

Heritage Impact Assessment

APPENDIX E

Overall Mine EMP and Emergency Response Plan