Dwarsrivier Chrome Mine (Pty) Ltd

Draft Site Selection Report for the new Khulu Tailings Storage Facility (TSF)

Report Purpose

Final Report

Report Status

Final Report

Report Reference

EnviroGistics Ref.: 21828_F2

Departmental Ref.: 30/5/1/3/2/1(179) EM

Mining Right Ref: 30/5/1/3/2/1(179) EM

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EAPASA Reg. 306-2019; SACNASP Reg. 400198/09

8 July 2021

Author

Tanja Bekker is registered as a Professional Natural Scientist in the field of Environmental Science with the South African Council for Natural Scientific Professions (SACNASP) and is also a registered Environmental Assessment Practitioner (EAP) with the Environmental Assessment Practitioners Association of South Africa (EAPASA), a legal requirement stipulated by the National Environmental Management Act, 1998. She is further certified as an ISO 14001 Lead Auditor. Her qualifications include BSc. Earth Sciences (Geology and Geography), BSc. Hons. Geography, and MSc. Environmental Management. In addition to her tertiary qualifications, she obtained a Certificate in Project Management, and completed the Management Advancement Programme at Wits Business School.

With more than 19 years' experience in environmental management and the consulting industry, she follows a methodical and practical approach in attending to environmental problems and identifying environmental solutions throughout the planning, initiation, operation and decommissioning or closure of projects.

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Quality Control

Report Title	**DRAFT SITE SELECTION REPORT FOR THE KHULU TSF**	
Report Ref. No.	21828_F2	
Report Status	Final	
Report Purpose	For Submission	
	Signature	**Date**
Author	Tanja Bekker	20 June 2021
Reviewer	Michelle Pretorius	6 July 2021
	Applicant Approval	8 July 2021

Amendments

Report Ref:	Nature of Amendment	Date	Report Output Ref:
21282_D	Internal Reviews	26 March 2018	21828_D2
21828_D2	Update of layouts	23 June 2021	21828_D3
21828_D3	Including clarification regarding Engineering constraints around Site D	8 July 2021	21828_F
21828_F	Inclusions of updates to the groundwater section as a result of lasts fieldwork information	8 July 2021	21828_F2

Distribution

Distributed To:	Purpose:	Date	Format/Amount
Michelle Pretorius	External Review	15 March 2019	Electronic
Pieter Schoeman	Applicant input	26 March 2019	Electronic
Pieter Schoeman	Applicant input	24 June 2021	Electronic
Michelle Pretorius	External Review	24 June 2021	Electronic
Tanja Bekker	Inclusion of Applicant Comments	4 July 2021	Electronic
Tanja Bekker	Inclusion of External review	6 July 2021	Electronic
Pieter Schoeman	For Applicant approval	6 July 2021	Electronic
Tanja Bekker	Inclusion of Applicant Review	8 July 2021	Electronic
Pieter Schoeman	For Applicant approval	8 July 2021	Electronic
Submitted with Environmental Scoping Report	Stakeholder Review	23 July 2021	Hard Copy and Electronic Copy

Executive Summary

Dwarsrivier Chrome Mine (Pty) Ltd (hereafter referred to as "Dwarsrivier Mine" or "the mine") is wholly owned by Assore Ltd ("Assore").

The mine originated as a result of neighbouring properties to the north and south thereof, which had existing chrome mining operations at the time of purchase in 1998. The owners of Dwarsrivier Mine therefore invested in a feasibility study for the Plant, the old Tailings Storage Facility and the mining of chrome. The designs for the opencast and underground mines then commenced. Approval to proceed with the final design and construction of work was given in July 1999 (http://www.assmang.co.za/chrome.asp). The mine ceased opencast operations in 2006 and is currently operating as an underground (trackless, board and pillar operation) mine, producing chromite ore, with a Dense Medium Separation and Spiral Beneficiation Plant. Dwarsrivier Mine currently produces approximately 200 000 tons of chromite ore per month.

The mine was previously owned by Assmang (Pty) Ltd ("Assmang") with a 50% share. This results from the approval by the Department of Mineral Resources (DMR) of the Section 11 Transfer in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA) of Dwarsrivier Mine from African Rainbow Minerals (ARM) to Assore. The change of ownership officially came into effect on 1 August 2016. All Environmental Authorisations and Waste Management Licences (WMLs) were transferred with approval issued by the Competent Authority (Department of Mineral Resources and Energy) (DMRE) during May 2019. Currently the Water Use Licence, 2008 (WUL, 2008) has also been transferred to Dwarsrivier Chrome Mine, with the WUL, 2011 and WUL, 2013 amendments currently pending.

Project Need

Dwarsrivier Mine is serviced by approximately 1200 permanent and 800 contractor employees. The majority of the employees are locals drawn from Lydenburg and villages around the mine, including Steelpoort Park, Kalkfontein and Buffelshoek.

In terms of the Fetakgomo-Greater Tubatse Local Municipality Integrated Development Plan (IDP), mining is regarded as an opportunity offered by the municipality, with the IDP stating that the mining activities and natural resources available in the area have created a definite potential to develop tourism and thereby to diversify the economic base of the municipality. When one further considers the importance of chrome in the global market it should be noted that according to an article by S&P Global Plats, 6 March 2017 (https://www.platts.com/latest-news/metals/tokyo/strong-chrome-demand-to-hold-but-views-divided-26678512), "strong demand for chromite feedstock of ferrochrome will continue to hold on the back of robust Chinese stainless steel output, but views are divided on whether global supply will move into deficit due to constraints of South African production to meet that demand, industry sources told S&P Global Platts Monday". According to the article, "sources said there are two possible scenarios arising from South Africa trying to meet Chinese demand amid stagnated output: the market will be short on chrome ore supply as other global suppliers will not be able to fully meet China's demand, or China will reduce dependency on South African chromite supply and diversify to other resources." According to the Mining Weekly Online (http://m.miningweekly.com/article/strong-outlook-for-recovering-ferrochrome-industry-merafe-2017-03-08/rep_id:3861): "The Chinese economy, on which the ferrochrome and chrome ore markets are heavily dependent, grew by 6.7% year-on-year, underpinning pleasing growth in stainless steel production. Ferrochrome-using stainless steel production is projected to grow by 3.5% in 2017 and by 3.8% in 2018, which should be followed by increased ferrochrome demand."

Dwarsrivier Mine is currently depositing at the existing North Tailings Storage Facility (TSF) at the eastern side of their process plant on Portion RE of the Farm Dwarsrivier 372. It is anticipated that the existing North TSF will reach its full capacity within the next three (3) to five (5) years. For this reason, additional storage capacity on site is required. The mine therefore proposes the development of a new TSF, to be referred to as the Khulu TSF, in order to accommodate tailings material once the full capacity of the NTSF is reached. In consideration of the above, the overall aim of the proposed activities is to ensure that a well designed tailings disposal system is operated on site to allow for the production requirements on site.

The mine initially identified seven (7) potential TSF sites, which have since been reduced to three (3) site alternatives, namely Sites B, C and D, with site B being the most favourable for the mine, based on the findings of the engineering study. Site F was also considered during the specialist investigations; however, this area was excluded from the future assessments due to the distance from the plant.

The surface areas and anticipated heights of the proposed Khulu TSF that each of the site alternatives can accommodate are as follows (please take note that the heights are approximate heights at this time and will be subject to further design finalisation):

- Site (TSF Option) B: 20 hectares (ha), 37m high;
- Site (TSF Option) C: 28ha, 29m high;
- Site (TSF Option) D: 21ha, 49m high.

Site Selection Process

The engineering component was undertaken by an independent company appointed by the mine, whilst the biophysical and socio-economic components were addressed as part of the specialist studies undertaken for the Khulu TSF EIA process and this site selection option analysis.

A standing engineering design principle is that the site conditions, as well as the physical and chemical properties of the tailings will define the basic TSF design requirements.

The most significant considerations in terms of siting of the TSF, were as follows:

- The impact on the health and safety of people and the environment as per the standards stipulated in SANS 10286, the Mine Health and Safety Act (Act No. 29 of 1996), the National Environmental Management Act (Act No. 107 of 1998) (NEMA) and related regulations and standards.
- The potential site topography defines whether a valley TSF, a side slope TSF or an impoundment TSF can be developed successfully. A combination of the TSF development methods can result as dictated by the topography. With the exception of Site B, the remainder of the site alternatives are located on rock outcrops or within mountainous hills and valleys.
- Type of tailings to be deposited. This relates to particle size distribution in terms of fine-grained or coarse-grained particles, as well as the clay mineralogy and salt content. This relates to the mine waste material's potential to pollute the environment. It is anticipated that the geochemical classification of the material will require a barrier lining system as prescribed in the NEMA regulations, similar to the liner system used at existing TSFs on the mine.
- High seismic activity. This is not applicable to the Dwarsrivier Mine area, with the exception of imposed seismicity due to mining activities.
- Cold weather conditions where freezing and permafrost create adverse conditions. This does not apply to the Dwarsrivier Mine area.
- Poor (low strength) foundation materials.
- High rainfall intensity. This is not the case with Dwarsrivier Mine area.

In addition to engineering considerations (including topography), the site alternatives were further assessed for preference in terms of each of the following specialist requirements:

- Soils, Land Use and Land Capability.
- Terrestrial Ecology;
- Hydrology/ Surface Water;
- Hydrogeology;
- Freshwater Resources (Wetlands);
- Visual Character;
- Air Quality;
- Heritage; and
- Social-economic.

Site Selection Outcomes

The outcomes of the Site Selection process are presented in the table below (where '1' indicates the preferred site alternative for each environmental aspect considered, and where '3' indicates the least preferred site alternative):

Discussion	Site B	Site C	Site D	Reference Section for more detail
Engineering				
Engineering considerations, including topography	1	3	2	Refer to Section 3.a.i
Engineering Outcomes	**1**	**3**	**2**	
Environmental				

Discussion	Site B	Site C	Site D	Reference Section for more detail
Engineering				
Soils, Land Use and Land Capability	2	3	1	Refer to Section 3.a.iii.1.d
Terrestrial Ecology	1	3	2	Refer to Section 3.a.iii.1.e
Hydrology/ Surface Water	1	3	2	Refer to Section 3.a.iii.1.f
Hydrogeology	2	3	1	Refer to Section 3.a.iii.1.g.1
Freshwater Resources (wetlands)	1	3	2	Refer to Section 3.a.iii.1.h
Visual Character	3	2	1	Refer to Section 3.a.iii.1.i -
Air Quality	2	3	1	Refer to Section 3.a.iii.1.j
Heritage	2	3	1	Refer to Section 3.a.iii.1.l
Socio-Economic	1	1	1	Refer to Section 3.a.iii.1.m
Ranking	15	24	12	-
Environmental Outcomes	**2**	**3**	**1**	

The following concluding statements were received from the specialist reports:

Soils, Land Use and Land Capability: Taking the above into consideration, from a soil, land use and land capability perspective, Site D is recommended as the preferred site for TSF development, in comparison to the other two (2) TSF alternatives given the proximity to existing mining infrastructure, thus eliminating the need for significant further disturbance of undisturbed soils in other areas within the mining area. However, considering the location of Site B and the fact that this is also located in close proximately to the mining activities, it is the view of the EAP that either Site B or D would be suitable options. As a result, Site B is also highlighted for consideration.

Terrestrial Ecology: from a long-term ecological maintenance perspective Option B is deemed to be the preferred option, as this site is already disturbed, is located adjacent the current mine operations and will not lead to the loss of habitat connectivity. This option does however pose a potential risk to the Groot Dwars River, which needs to be investigated in terms of mitigatory and management requirements.

Hydrology/ Surface Water: The site selection assessment indicated that the most preferred option from a surface water perspective is Site B, followed by Site D and C, respectively.

Hydrogeology: Site B scored similar to Site D and could therefore also be considered as a preferred alternative, provided that the risks identified are managed to avoid or minimise negative impacts on groundwater. The risks associated with Site B include the presence of the alluvial aquifer under or near the TSF footprint, the presence of potential preferential flow paths to groundwater and shallow groundwater level conditions.

Freshwater Resources: The construction of the proposed TSF within Option C or Option D has the potential to have an unacceptably high impact on the watercourse within each respective site. Such impacts may also potentially affect downstream systems. From a freshwater ecological perspective therefore, Option B is the preferred option, as no direct impacts arising from the construction and operation of the TSF within that location to the receiving freshwater environment are anticipated. Nevertheless, indirect impacts, including potential failure of the TSF, could occur and may potentially be detrimental to the Dwars River specifically, if suitable mitigation measures are not strictly implemented throughout all phases.

Visual Character: Site C has the smallest visible area and least number of visual receptors impacted, and is therefore ranked 1 (most favourable), followed by Site B and then Site D. Although Site C is the most favourable in terms of the criteria used to assess the TSF site alternatives, it must be noted that all alternatives fall within an area dominated by mining activities and infrastructure. Due to the visual aesthetics and sense of place of the area being previously altered from rural bushveld to mining, it is unlikely that the implementation of any of the TSF options would result in a significant visual impact.

Air Quality: This study comprises an environmentally conservative/'worst-case' air quality impact assessment and did not find predicted pollutant concentrations to exceed regulated ambient air quality standards. Further, impacts predicted at Site D were anticipated to be the lowest and as such, it is recommended that the proposed TSF be located at Site D.

Heritage and Palaeontology: Site D is the preferred site from a heritage point of view, but Site B can also be considered as this was previously agricultural land. Site B and D has previously been disturbed. For Site D, no heritage resources were identified inside the footprint area of this proposed TSF site alternative. At Site B, the stone wall foundations of a ruin and a possible Early Iron Age site was recorded. The study area is however disturbed, possibly by previous cultivation reducing the significance of the recorded finds. It should be noted that a cemetery occurs on the periphery of the site (Site C), and this area should be demarcated and avoided.

From a heritage point of view the heritage sensitivity associated with Site C is considered to be high due to the high number of sites in the impact area and this alternative is not recommended for the proposed development. It is recommended that the selected site should be subjected to a Heritage Impact Assessment.

Socio-Economic: It is concluded that either Site B, Site C or Site D would be most preferential from a socio-economic perspective.

Conclusion

As mentioned before, the demand for chrome has increased globally due to the increase in China Markets. Not allowing the development of the proposed Khulu TSF to take place will result in production capabilities of the mine being hampered as space for tailing material would be severely restricted. With the current TSF reaching its life of mine, a new facility is required to ensure ongoing mining and processing practices. Based on the site selection and taking all environmental aspects assessed and discussed above into consideration, **Site B** is the preferred site from an engineering design. Site C and Site B is very similar in rating and both could be considered as preferred options. However due to the location of the Site B to the plant and a more disturbed area, Site B is also recommended.

This Site B is located in close proximity to the existing Discard Dump. One key area for consideration based on the outcomes of the initial specialist studies are the management of groundwater should Site B be chosen. The underlying lithology at this site is potentially alluvium associated with the Dwars and Groot Dwars Rivers, which creates a major regional aquifer (this will be confirmed during the EIA phase of the project). Dwarsrivier Mine currently abstracts groundwater from this aquifer from BH D1 and D2, situated 725m southwest from Site B. Site B is not currently undermined, but future underground mining is planned for this area. Site B is furthermore underlain by both a fault and a dyke. These structures may act as preferential flow paths to groundwater. Dwarsrivier Mine is in the process of drilling and testing monitoring boreholes that target the dyke and fault present in order to quantify the extent to which these structures could act as preferential flow paths. The results of the drilling and testing programme are not yet available, but will be considered as part of a detailed geohydrological impact assessment to be completed for the project. The site is potentially situated within an existing watercourse (considering the alluvial aquifer), which suggests that shallow groundwater conditions may occur during the wet season. The site is also situated on or near the alluvial aquifer associated with the Klein and Groot Dwars Rivers. This must be confirmed should this site be developed further. Groundwater in this area has already been impacted by the historical TSF, the Plant and the discard dump. The Total Dissolved Solid (TDS) and nitrate (NO_3) concentrations in the nearest borehole (DRM3) confirm the poorest groundwater quality conditions for the four sites evaluated. The depth to groundwater at this site is the shallowest of all the sites evaluated (4,53m), which means that the barrier between the TSF and the aquifer is the smallest for all four sites. It is not thought that groundwater levels would rise to surface and thus into the liner system. The shallow groundwater is however flagged as a potential risk. Groundwater is not used in the immediate vicinity of Site B other than being monitored.

With the correct management measures, impacts identified could be addressed.

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1 INTRODUCTION

Dwarsrivier Chrome Mine, hereafter referred to as "Dwarsrivier Mine" or "the mine", is currently depositing tailings at the existing North Tailings Storage Facility (North TSF) located to the east of the Processing/ Beneficiation Plant, on the remaining portion of the farm Dwarsrivier 372KT. It is anticipated that the existing active North TSF will reach its full capacity sooner than anticipated (within the next three (3) to five (5) years) due to tonnage ramp-ups. For this reason, additional storage capacity on site is required.

The mine initially identified seven (7) potential site alternatives for the development of a new TSF (to be referred to as the Khulu TSF) and associated infrastructure, to increase its tailings disposal and storage capacity on site. These have been reduced to four (4) site alternatives, and later on to three (3) site alternatives (Sites B, C, and D), due to the initial engineering investigations, with Site B being the most favourable at this time, from an engineering and logistical perspective.

The extent and the current anticipated heights of the proposed TSF to be accommodated by each site alternative under consideration are as follows:

- Site B: 20 hectares (ha), 37m high;
- Site C: 28ha, 29m high; and
- Site D: 21ha, 49m high.

The following figure illustrates the location and extent of the initial seven (7) site alternatives considered.

Figure 1: Sites subjected to initial site selection by the applicant

The following figure illustrates the location of the remaining three sites, proposed for the future Khulu TSF, which will be considered as part of the EIA Application and Scoping Report, with the final selected site being presented in the EIA phase of this project.

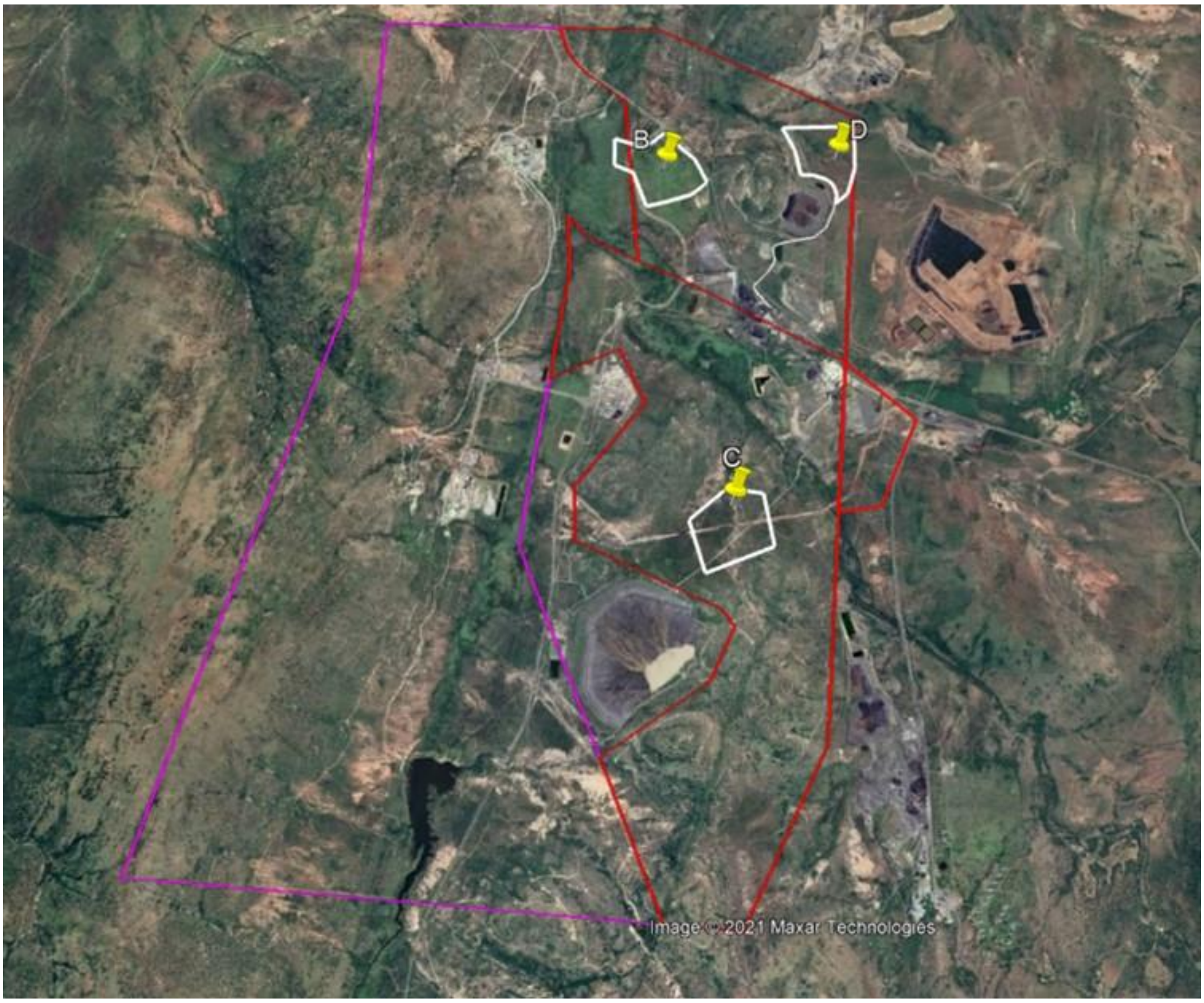


Figure 2: Sites which will be subjected to the EIA Application and Scoping process.

1.a Details of the Environmental Assessment Practitioner (EAP)

Table 1: Details of EAP

Name	Tanja Bekker
Designation	Environmental Assessment Practitioner
Postal Address	PO Box 22014, Helderkruin, 1733
Physical Address	21 Gladiolus Street, Roodekrans, 1724
Telephone Number	+27 (0) 82 412 1799
Cell Phone Number	+27 (0) 82 412 1799
Fax Number:	+ 27 (0) 86 551 5233
Email Address	tanja@envirogistics.co.za

1.a.i Expertise of the EAP

The following table presents a summary of the EAP's experience:

Table 2: Experience of EAP

Name	Position	Qualification	Professional Registrations	Experience
Tanja Bekker	Principal Practitioner	M.Sc. Environmental Management (RAU, now University of Johannesburg)	Registered with the Environmental Assessment Practitioners Association of South Africa (EAPASA; Reg No. 306/2019) Registered with the South African Council for Natural Scientific Professions (SACNASP: Pr.Sci.Nat; Reg No. 400198/09) Member of International Association of Impact Assessors (IAIA)	19 Years

Name	Position	Qualification	Professional Registrations	Experience
			Member of the Environmental Law Association of South Africa (ELA)	

Education

M.Sc. Environmental Management - RAU (University of Johannesburg)
B.Sc. Honours Geography - RAU (University of Johannesburg)
B.Sc. Earth Sciences (Geography & Geology) - RAU (University of Johannesburg)

Career Enhancing Courses

ISO 14000 Lead Auditors Course (WTH Management)
Certificate in Project Management (University of Pretoria)
Management Advance Programme (MAP 81) (Wits Business School)

Professional Affiliations

Registered member of EAPASA
Certified ISO 14001 Environmental Management System Auditor
Registered as a Professional Natural Scientist with SACNASP
Member of the South African affiliate of the IAIA
Member of the Environmental Law Association of South Africa (ELA)

Summary of the EAP's past experience

Ms. Bekker is registered as a Professional Natural Scientist in the field of Environmental Science with the South African Council for Natural Scientific Professions (SACNASP) and is also a registered Environmental Assessment Practitioner (EAP) with the Environmental Assessment Practitioners Association of South Africa (EAPASA), a legal requirement stipulated by the National Environmental Management Act, 1998 (NEMA). She is further certified as an ISO 14001 Lead Auditor. Her qualifications include BSc. Earth Sciences (Geology and Geography), BSc. Hons. Geography, and MSc. Environmental Management. In addition to these tertiary qualifications, she obtained a Certificate in Project Management, and completed the Management Advancement Programme at Wits Business School.

With more than 19 years' working experience in environmental management and the consulting industry and managing various Large Account Clients, she understands the South African Regulatory System, and can advise clients with due diligence on their environmental regulatory requirements and offer a solution driven service to their project life cycle. She is equipped with exceptional project management and coordination skills, which especially enhances the service she offers clients within the environmental permitting system.

Her key focus is environmental management and compliance with extensive experience in the mining industry. Project Management and Coordination of projects form a critical component of her duties, which include project planning, initiation of projects, client, authority and stakeholder consultation, specialist coordination, budget control, process control, quality control and timeframe management. Her interest lies in a client advisory capacity, being involved during due diligence investigations, pre-project development and assisting the client and engineering team in adding value to develop the project in an environmentally sustainable manner, considering client costs and liabilities, as well as considering the implication of environmental authorisation conditions and requirements on project deliverables. Her involvement in projects has spanned over the project life cycle from Due Diligence Investigations, Pre-Feasibility Investigations, Prospecting Right Applications, Mining Right Applications, Environmental Reporting and implementation and auditing of Environmental Management Plans and Authorisations.

1.b Details of the Applicant

Dwarsrivier Chrome Mine (Pty) Ltd (hereafter referred to as "Dwarsrivier Mine" or "the mine") is wholly owned by Assore Ltd ("Assore").

The mine originated as a result of neighbouring properties to the north and south thereof, which had existing chrome mining operations at the time of purchase in 1998. The owners of Dwarsrivier Mine, therefore invested in a feasibility study for the Plant, old Tailings Storage Facility (hereafter referred to as the "Old TSF") and the mining of chrome. The designs for the opencast and underground mines then commenced. Approval to proceed with the final design and construction of work was given in July 1999 (http://www.assmang.co.za/chrome.asp). The mine ceased opencast operations in 2006 and is currently operating as an underground (trackless, board and pillar operation) mine, producing chromite ore, with a Dense Medium Separation and Spiral Beneficiation Plant. Dwarsrivier Mine currently produces approximately 200 000 tons of chromite ore per month.

The mine was previously owned by Assmang (Pty) Ltd ("Assmang") with a 50% share. This results from the approval by the Department of Mineral Resources (DMR) (now the Department of Mineral Resources and Energy (DMRE)) of the Section 11 Transfer in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA) of Dwarsrivier Mine from African Rainbow Minerals (ARM) to Assore. The change of ownership officially came into effect on 1 August 2016. All Environmental Authorisations and Waste Management Licences (WMLs) were transferred with approval issued by the Competent Authority (Department of Mineral Resources and Energy) (DMRE) during May 2019. Currently the Water Use Licence, 2008 (WUL, 2008) has also been transferred to Dwarsrivier Chrome Mine, with the WUL, 2011 and WUL, 2013 amendments currently pending.

Table 3: Details of Applicant

Project applicant:	Dwarsrivier Chrome Mine (Pty) Ltd		
Registration no (if any):	2011/105280/07		
Trading name (if any):	N/A		
Responsible Person, (e.g. Director, CEO, etc.):	Environmental Representative		
Contact person:	Mr Pieter Schoeman		
Physical address:	The mine is situated 25km outside of Steelpoort on Portion 1 (Remaining Extent) and Portion 0 (Remaining Extent) of the farm Dwarsrivier 372KT and Portion 4 (a Portion of Portion 3) of the Farm De Grooteboom 373KT		
Postal address:	PO Box 567, Lydenburg		
Postal code:	1120	Cell:	+27 (0) 76 028 7680
Telephone:	+27 (0) 13 230 5300	Fax:	+27 (0) 13 230 5318
E-mail:	pieters@dwarsrivier.co.za		

1.c Environmental Authorisations

The mine is operating with all required environmental authorisations in terms of the following:

Table 4: List of Environmental Authorisations

#	Legislation	Licence	Reference	Date
1	Minerals Act, 1991	Approval for Dwarsrivier Phase II Chrome Project	OT6/2/2/426A	14 December 1999
2	NWA	Regulation 4b (GN704) Exemption for undermining 2006	16/2/7/B400/C83/1	12 September 2006 (no longer applicable, replaced by the WUL, 2008)
3	NWA	Overall Water Use Licence (WUL)	16/2/7/B400/C83	21 January 2008, updated 10 June 2021
4	MPRDA	Environmental Management Programme	-	December 2010
5	NWA	WUL – Tailings Dam	04/B41G/G/792	8 July 2011
6	National Environmental Management Act, 1998 (NEMA)	Environmental Authorisation for the proposed construction of a new Tailings Storage Facility	12/1/9-7/1e/GS4	9 July 2011
7	National Environmental Management: Waste Act, 2008 (NEMWA)	Waste Licence – Hazardous Waste Temporary Storage Facilities[1]	12/9/11/L290/5	21 July 2011
8	MPRDA	Dwarsrivier Mine Tailings Storage Facility Environmental Management Programme	LP30/5/1/3/2/1(179)EM	22 August 2011
9	MPRDA	Approval for Three Plants	LP30/5/1/3/2/1 (179)EM	11 January 2012
10	NEMWA	Waste Licence – Temporary General Waste Storage Facilities	12/4/10-A/1/GS3	29 March 2012
11	NEMA	Construction of a Low-Level Bridge over the Groot Dwarsrivier	12/1/9/1-GS22	11 June 2012
12	NEMA	Environmental Permission for Construction of a Bridge over the Springkaanspruit River	12/1/9/1-GS62	19 September 2013
13	NWA	WUL – River Crossings	04/B41G/CI/2240	4 October 2013

[1] Note that the licence holder has not and will not be commissioning the activity. The Environmental Authorisation has therefore not been implemented on site. The Licence Holder is not in contravention with the Environmental Authorisation.

#	Legislation	Licence	Reference	Date
14	NEMA	Section 24G Rectification	12/1/9-7/S24G/7-GS1	26 August 2014
15	NEMWA & NEMA (audited as part of this NEMA audit report, 2020)	Integrated Environmental Authorisation	179EM (2018)	15 February 2018
16	NEMA	Integrated Environmental Authorisation	179EM (2019)	29 May 2019
17	NEMA	Centralised Store	179EM	15 March 2021*

Copies of the Environmental Authorisations are available from Dwarsrivier Mine.

1.d Description of the Property

1.d.i Location of the Mine

Dwarsrivier Mine is situated approximately 60km northwest of Lydenburg, 25km south of Steelpoort and 63km northeast of Roossenekal in the Limpopo Province. The mine currently holds the surface rights for Portion 1 (Remaining Extent (RE)) and Portion 0 (RE) of the farm Dwarsrivier 372KT, as well as Portion 4 (a portion of Portion 3) of the farm De Grooteboom 373KT.

The operation is located in the Fetakgomo Tubatse Local Municipality, within the boundaries of the Sekhukhune District Municipality.

The R577 roadway that connects to the R555 (Lydenburg-Roossenekal road), is situated to the north of the Plant and mine offices. The overall area is characterised by intensive mining development. Various servitudes traversing the site are present, which include gravel roads, telephone lines and electricity lines. Please refer to Figure 3 illustrating the location of the proposed TSF site alternatives in relation to the Dwarsrivier Mine and Figure 4 for the cadastral setting of the mine.

Dwarsrivier Mine falls in the quaternary catchments B41G and B41H in the Olifants Water Management Area (WMA 4). All surface water draining from the properties ultimately flows into the Groot Dwarsrivier and the Klein Dwarsrivier, the confluence of which is located on the north-western portion of the property. From the confluence, the Dwarsrivier flows northwards into the Steelpoort River. Dwarsrivier Mine has an exemption (Reference Number 16/2/7/B400/C83/1) from the then Department of Water Affairs (DWA), now the Department of Water and Sanitation (DWS), which allows the operation to undermine the Groot Dwarsrivier.

Several of the neighbouring farms, namely Tweefontein 380JT, Thorncliffe 374KT, De Grooteboom 373KT and Dwarsrivier 372KT are owned by mining houses with existing and operational chrome and platinum mines. On the remainder of the neighbouring farms, agricultural activities take place in the form of stock grazing and the production of vegetables, lucerne and cotton.

Please refer to the following table for the registered name, administrative jurisdiction and summary of location of the TSF site alternatives.

Table 5: Property Information

Farm Name:	• Farm Dwarsrivier 372KT Portion 0 (Remaining Extent (RE)):
	  ○ TSF Site B
	  ○ TSF Site D
	• Farm Dwarsrivier 372KT Portion 1 (RE):
	  ○ TSF Site C
	• Farm Dwarsrivier 372KT Portion 6:
	  ○ Proposed Return Water Dam (RWD) for Option B

Magisterial district:	The mine falls within the Fetakgomo Tubatse Local Municipality, within the boundaries of the Sekhukhune District Municipality.
Distance and direction from nearest town:	Dwarsrivier Mine is situated approximately 25km southwest of Steelpoort and 60km from Lydenburg on the border between Limpopo and Mpumalanga Provinces. The mine itself falls under the jurisdiction of the Limpopo Province.
21 digit Surveyor General Code for each farm portion:	• Farm Dwarsrivier 372KT RE- T0KT00000000037200000 • Farm Dwarsrivier 372KT RE of Portion 1 - T0KT00000000037200001 • Farm Dwarsrivier 372KT Portion 6 - T0KT00000000037200006

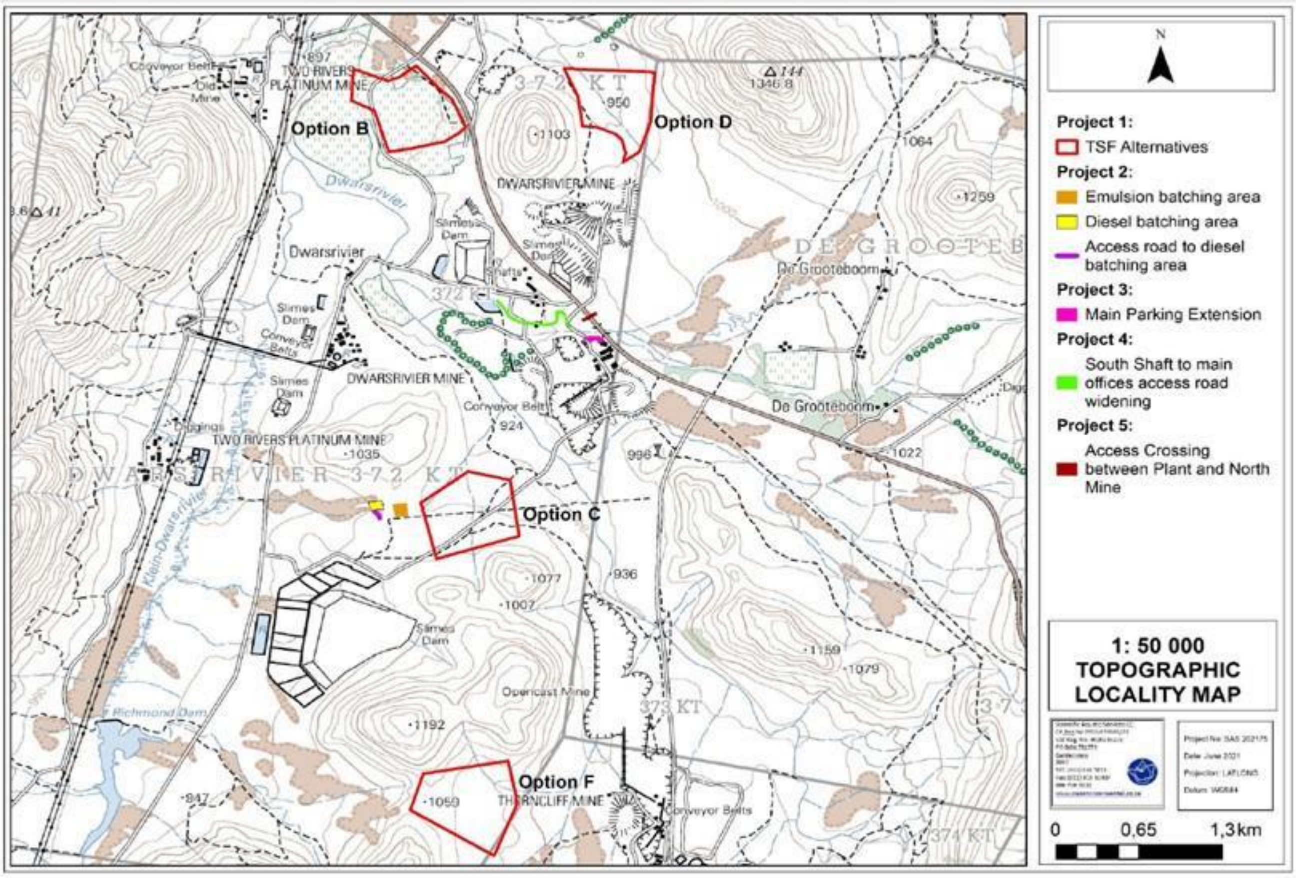


Figure 3: Local and Regional Setting of the proposed TSF site alternatives in relation to the Dwarsrivier Mine Mining Right Area (MRA) and surrounds

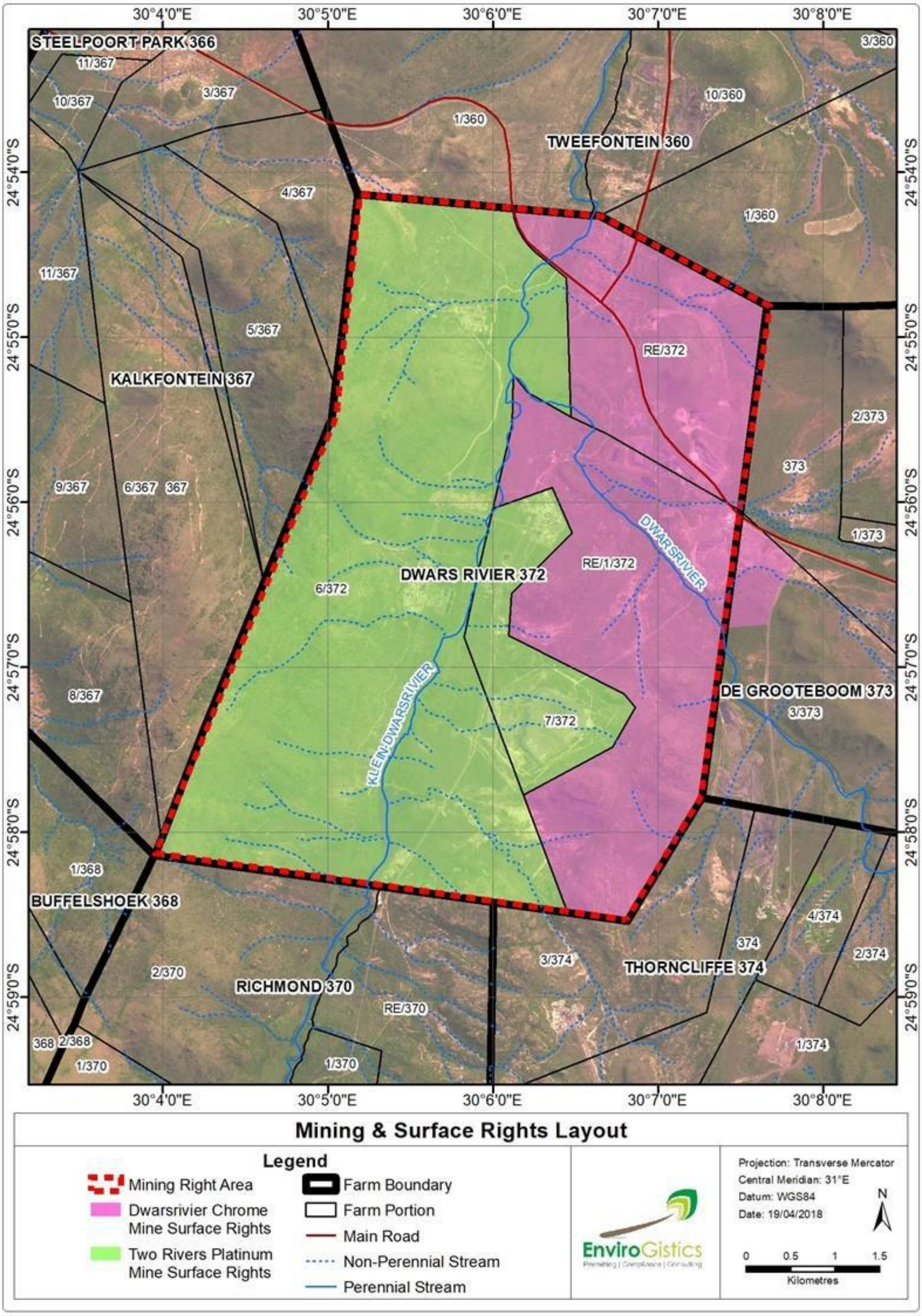


Figure 4: Cadastral Information

1.d.ii Ownership of Land

Dwarsrivier Mine has been mining chromite ore from the LG6 seam since 1999. Between 1999 and 2005, ore was mined using opencast methods. The six (6) pits have subsequently been mined out and backfilled with the exception of the South and North Pit portals from which access is gained to the underground workings. The current mine plan extends the life of the operations to the year 2042.

Assmang bought the farm Dwarsrivier 372KT (Portions 1 and the Remaining Extent), including all surface and mineral rights, in October 1998. In 2002, the mine purchased a portion of the farm De Grootteboom 373KT, subdividing this portion into Portion 4 (a portion of Portion 3).

The mine holds the surface rights on Portion 0 (RE) and Portion 1 (RE) of the farm Dwarsrivier 372KT and Portion 4 (a Portion of Portion 3) of the farm De Grootteboom 373KT. The mining rights are held over Portion 0 (Remaining Extent), Portion 1 (Remaining Extent), Portion 6 and Portion 7 of the farm Dwarsrivier 372KT. The surface rights of Portions 6 and 7 of the farm Dwarsrivier 372KT are owned by Two Rivers Platinum Mine (TRP).

The property details are presented in the following table:

Table 6: Landownership

Farm Name	Portion	Title Deed Number	Property Size	Ownership	Mining Rights
Dwarsrivier 372KT	0 (RE)	T24/2021	489.1915ha	Dwarsrivier Chrome Mine (Pty) Ltd	Dwarsrivier Chrome Mine (Pty) Ltd
Dwarsrivier 372KT	1	T24/2021	842.6880ha	Dwarsrivier Chrome Mine (Pty) Ltd	Dwarsrivier Chrome Mine (Pty) Ltd
De Grootteboom 373KT	Portion 4 (a Portion of Portion 3)	T24/2021	52,1993ha	Dwarsrivier Chrome Mine (Pty) Ltd	Dwarsrivier Chrome Mine (Pty) Ltd
Dwarsrivier 372KT	6	48140/2005PTA	1878.9867ha	Two Rivers Platinum (Pty) Ltd	Assore Ltd
Dwarsrivier 372KT	7	T9520/2008PTA	260.7750ha	Two Rivers Platinum (Pty) Ltd	Assore Ltd

2 PROJECT DESCRIPTION

Dwarsrivier Mine is currently depositing tailings at the existing North TSF, east of the Beneficiation Plant, on Portion RE of the Farm Dwarsrivier 372KT. The North TSF was designed to contain production tonnages for 23 years, with 29 000 tonnes for the first two (2) years of operation and the remaining twenty one (21) years at a deposition rate of 17 280 tonnes per month. It is anticipated that the existing North TSF will reach its full capacity within the next three (3) to five (5) years. For this reason, additional storage capacity on site is required.

The mine initially identified seven (7) potential TSF sites, which have since been reduced to three (3) site alternatives (Sites B, C and D), with Site B being the most favourable for the mine. The extent and the current anticipated heights of the proposed TSF to be accommodated by each site alternative under consideration are as follows:

- Site (TSF Option) B: 20 ha, 37m high;
- Site (TSF Option) C: 28ha, 29m high; and
- Site (TSF Option) D: 21ha, 49m high.

2.a Location

Three TSF site alternatives are being investigated:

- Farm Dwarsrivier 372KT Portion 0 (RE):
  - TSF Site B
  - TSF Site D

- Farm Dwarsrivier 372KT Portion 1 (RE):
  - TSF Site C
- Farm Dwarsrivier 372KT Portion 6:
  - Proposed Return Water Dam (RWD) for Option B

2.a.i Site B (TSF Option B)

Site B is located northwest of the Beneficiation Plant and the existing Waste Rock Dump. This Site is located to the north of the proposed expansion of the Discard Dump. The earmarked expansion of the Discard Dump, has received an Environmental Authorisation on 15 February 2018 from the DMRE. Please see the location of the Discard Dump expansion in relation to Site B below.

Figure 5: Site B in relation to the Discard Dump Expansion (in yellow)

The following photograph indicates the view of the proposed site, taken from the southern side of Site B (from the top of the existing Discard Dump).

Figure 6: Site B

Site B is a preferred due to its proximity to the Plant and other services, which are located around 1.3km to the south of Site B. The footprint of this site is planned at about 20ha.

2.a.ii Site C (TSF Option C)

Site C is located west of the Groot Dwarsrivier, about 1.6km south of the Beneficiation Plant. A non-perennial drainage channel, which is an unnamed tributary of the Groot Dwarsrivier, traverses this site alternative.

The following photograph indicates the view of the northern section of Site C, taken from the eastern side of the site.

Figure 7: Site C

The footprint of this site is planned at about 28ha, and is the largest in extent of the three (3) options.

2.a.iii Site D (TSF Option D)

Site D is located to the north of the existing North TSF, about 1.4km from the Beneficiation Plant. The footprint of this site is planned at about 21ha.

A non-perennial drainage channel, which is an unnamed tributary of the Dwarsrivier traverses this site. The following photograph indicates the view to the proposed site in a northerly direction. The photograph was taken from the access road.

Figure 8: Site D

2.a.iii.1.a Operational Setting

The final TSF will likely follow a similar construction and deposition method than the existing North TSF. The selected TSF will therefore be:

- A lined facility;
- A lined Return Water Dam (RWD);
- Associated infrastructure (pipelines, and roads); and
- The tailings deposition method will be either a dry deposition, spigot, cyclone or day wall (likely dry deposition through a filter press technology).

The following table presents the typical considerations in the operational setting of the proposed facility.

Table 7: Operational Setting for each site alternative

Discussion	Site B	Site C	Site D
Height of TSF (m)	37	29	49
Area (ha)	20	28	21
Clean water diversions	5 000m³ excavation 1 000m concrete lining	20 000m³ excavation 1 900m concrete lining	45 000m³ excavation 1 400m concrete lining
Deposition rate (t/month)	34 172		
Methodology	Tailings piping to Filter Press and from there the dry material will be deposited onto the new facility. Return water pipeline will be in place from Filter press to the Plant or to the proposed RWD.		
Final Side Slope	1:3		
Duration to required capacity	300 months (25 years)		
Liner	Class C liner – Type 3 Waste		
Slurry and return water pumping distance (m)	1 300	2 760	1 753

2.a.iv Description of the Activities to be undertaken

The infrastructure and activities that will form part of the proposed project will include the following:

- Planning Phase:
  - Ensure the implementation of Legal Requirements (Environmental Permits and Authorisations).
- Construction Phase:
  - Land and footprint clearance;
  - Topsoil stripping and stockpiling;
  - Establishment of surface infrastructure (liner and seepage collection systems, slurry and water pipelines, laydown areas and an office area); and
  - Waste management.
- Operational Phase:
  - Operation of the Khulu TSF;
  - Operation of the pipeline system; and
  - Waste management.
- Closure Phase:
  - Ensure the implementation of Legal Requirements (Environmental Permits);

- Rehabilitation of TSF and associated sites;
- Dismantling and decommissioning of infrastructure and buildings, including product stockpiles;
- Earth moving, shaping and ripping of soil;
- Cessation of Labour Contracts; and
- Waste management.

2.b Need and Desirability of the Proposed Activities

Currently Dwarsrivier Mine is serviced by approximately 1 200 permanent and 800 contractor employees. The majority of the employees are locals drawn from Lydenburg and villages around the mine, including Steelpoort Park, Kalkfontein and Buffelshoek.

As discussed in the previous section, and with specific reference to the Fetakgomo Tubatse Local Municipality Integrated Development Plan (IDP), mining is regarded as an opportunity offered by the municipality, with the IDP stating that the mining activities and natural resources available in the area have created a definite potential to develop tourism and thereby to diversify the economic base of the municipality. When one further considers the importance of chrome in the global market it should be noted that according to an article by S&P Global Plats, 6 March 2017 (https://www.platts.com/latest-news/metals/tokyo/strong-chrome-demand-to-hold-but-views-divided-26678512), "strong demand for chromite feedstock of ferrochrome will continue to hold on the back of robust Chinese stainless steel output, but views are divided on whether global supply will move into deficit due to constraints of South African production to meet that demand, industry sources told S&P Global Platts Monday". According to the article, "sources said there are two possible scenarios arising from South Africa trying to meet Chinese demand amid stagnated output: the market will be short on chrome ore supply as other global suppliers will not be able to fully meet China's demand, or China will reduce dependency on South African chromite supply and diversify to other resources." According to the Mining Weekly Online (http://m.miningweekly.com/article/strong-outlook-for-recovering-ferrochrome-industry-merafe-2017-03-08/rep_id:3861): "The Chinese economy, on which the ferrochrome and chrome ore markets are heavily dependent, grew by 6.7% year-on-year, underpinning pleasing growth in stainless steel production. Ferrochrome-using stainless steel production is projected to grow by 3.5% in 2017 and by 3.8% in 2018, which should be followed by increased ferrochrome demand."

In consideration of the above, the overall aim of the proposed activities is to ensure that a well designed tailings disposal system is operated on site to allow for the production requirements on site. As mentioned before, the existing NTSF was designed to contain production tonnages for 23 years, with 29 000 tonnes for the first two (2) years of operation and the remaining twenty one (21) years at a deposition rate of 17 280 tonnes per month. The deposited tonnage rate was later revised to 33 500 tonnes per month for the first two years, which is higher than originally designed for, and is anticipated to reduce the expected life of 23 years and for this reason additional storage capacity on site is required.

2.c Period for which the Environmental Authorisation is required

The Environmental Authorisation is required for the life of TSF, which is in excess of 25 years.

3 ALTERNATIVE ASSESSMENT

The site selection process involved an engineering component as well as a biophysical and socio-economic component.

The mine initially identified seven (7) potential sites for construction of the Khulu TSF, which have since been reduced to three (3) site alternatives (Sites B, C, and D), with Site B being the most favourable for the mine based on the engineering studies.

The engineering component was undertaken by an independent company appointed by the mine, whilst the bio-physical and socio-economic components were addressed as part of the specialist studies undertaken for the EIA process and this site selection option analysis, which will feed into the EIA process.

A standing engineering design principle is that the site conditions, as well as the physical and chemical properties of the tailings will define the basic design requirements of the TSF.

The most significant considerations in terms of site conditions are:

- The impact on the health and safety of people and the environment as per the Mine Health and Safety Act (Act No 29 of 1996), standards stipulated in SANS 10286, NEMA and related regulations and standards.
- The potential site topography defines whether a valley TSF, a side slope TSF, an impoundment TSF or a combination of the aforementioned development methods can be developed successfully. With the exception of Site B, the remainder of the site alternatives considered are located on rock outcrops, within mountainous hills or valleys.
- Type of tailings to be deposited. This relates to particle size distribution in terms of fine grained or coarse grained particles, as well as the clay mineralogy and salt content. This relates to the mine waste material's potential to pollute the environment. It is anticipated that the geochemical classification of the material will require a barrier lining system as prescribed in the NEMA regulations, similar to the liner system used at existing TSFs.
- High seismic activity. This is not applicable to the Dwarsrivier Mine area, with the exception of imposed seismicity due to mining activities.
- Cold weather conditions where freezing and permafrost are adverse conditions. This does not apply to the Dwarsrivier Mine area.
- Poor (low strength) foundation materials.
- High rainfall intensity. This is not the case with Dwarsrivier Mine area.

The site alternatives were further assessed for preference in terms of each of the following specialist requirements:

- Soils, Land Use and Land Capability;
- Terrestrial Ecology;
- Hydrology/ Surface Water;
- Hydrogeology and Groundwater conditions;
- Freshwater Resources (Wetlands);
- Visual Character;
- Air Quality;
- Heritage; and
- Socio-economic setting.

The assessments were based on the primary risks associated with a TSF which include the following:

Land sterilisation (including land use, ecology, palaeontology, heritage resources)

A TSF typically covers a fairly large area, sterilising the land use at least until decommissioning. Depending upon the prior land use or the soil potential of the site, the socio-environmental impact will differ. Preferably, land with low agricultural potential should be used, but watercourses should not be impacted. The impact on the fauna and flora should not compromise the sustainability of the species affected. Significant archaeological site should also be avoided.

Slurry spillages

Slurry spillages most commonly occur at valves, but could occur along the slurry pipe route, particularly as pipes deteriorate over time. The mitigation measures could include:

- Appropriate specifications of pipelines;
- Monitoring of pipe wear, pipe turning, maintenance and replacement;
- Additional containment precautions at sensitive areas along pipe route, i.e. stream crossing, bends etc.;
- Locating all valves in contained and walled areas; and
- Immediate clean up and rehabilitation in the event of spills.

Slope failures and mudflows

The prevention of slope failures and mudflows should be guarded against by the following means:

- Controlled rate of deposition so tailings gain sufficient strength to be self-supporting;
- Slopes developed at sufficiently shallow angles to ensure theoretically high factors of safety;
- Filter drains installed around the perimeter of the dam to control the phreatic surface (water) level that adversely affects slope stability;
- Operate with minimal free water on the surface to aid consolidation (density and strength gain) and maximise freeboard (stormwater holding capacity);
- Instigate routine surveillance and monitoring of the identified risk performance criteria (piezometric levels, freeboard);
- Provide off-dam containment facilities for storm water containment; and

- Operate the facility under the supervision of suitably qualified and experienced personnel.

Surface water contamination and Freshwater Habitat destruction

Surface water running off a TSF is deemed to be contaminated. A TSF should therefore be designed to comply with Government Notice 704 (GN704) in terms of the National Water Act, 1998 (NWA), which stipulates that clean and dirty water should not mix more than once in 50 years. This is achieved by:

- Siting the TSF so that extraneous clean water can be diverted away from facility;
- Constructing peripheral collection trenches, containment paddocks and dams that are sized to accommodate the 1:50 (24 hour) year design storm with an additional 800mm freeboard safety margin; and
- Making the TSF the primary water source for the Beneficiation Plant to instil motivation to effectively manage the water on and around the facility.

Ground water contamination

Unless fully lined, seepage will occur from a TSF. In most instances, the significant aspects of seepage from TSFs are the quality and quantity of that seepage and the impact that this may have on the receiving environment, i.e. the surrounding water and the underlying aquifer. The following could be implemented to mitigate the occurrence and impact of seepage:

- Exploration, investigation and analysis of the current geo-hydrological regime and predictive modelling of the potential impact arising from the TSF. Regular updating of a geo-hydrological model to provide early warning signals should significant seepage be detected;
- Instigation of monitoring systems to be able to assess and react to changing conditions;
- Installation of filter drains to capture some interstitial water prior to it seeping into the underlying soils; and
- Minimising the amount of free water held on the dam to reduce recharge.

Airborne contamination

Dust emanating from a TSF can be a significant impact, particularly if located in frequent wind areas. Measures to mitigate the impact include:

- Plant trees on the perimeter to act as windbreak; and
- Upstream development of the TSF allowing simultaneous rehabilitation as close behind the active working area where possible.

Aesthetics

A TSF imposes an intrusive new skyline into the environment. The visual impact can be improved by:

- Planting trees around the perimeter and on the TSF as it develops;
- Designing and developing the facility with more natural looking rounded corners and curved flanks rather than straight lines with sharp corners;
- Developing the facility with flatter slopes;
- Establishing vegetation simultaneously with deposition or as early as possible on the TSF side slopes;
- Sitting the facility where it has less intrusive impact; and
- The TSF site alternatives under consideration are generally located within uninhabited areas and generally on side hills of mountains, such that some of the impact will be mitigated.

Based on the outcomes of the various specialist assessments undertaken, the sites were ranked as follows:

- Preferred (1);
- Second Option (2);
- Least Preferred (3); and
- Fatal Flaw (FF).

3.a Details of the Alternatives Considered

3.a.i Engineering Criteria

All the selected TSF site alternatives, with the exception of Site B, are located in hilly mountainous terrain. Due to the general classification of the tailing material in terms of the National Environmental Management: Waste Act, 2008 (NEMWA) lining requirements, there is a high potential for similar requirement to be imposed on the selected TSF site and final TSF design. In terms of construction of the TSF, the potential risks include the following:

- Steep side-slopes for equipment and machinery;
- An avalanche of large boulders due to construction induced vibrations and adjacent mining activities;
- A requirement for extensive pre-work preparations including access roads, barricades, and related protection and construction-related establishment, as well as rehabilitation after completion of construction;
- The presence of water crossings; and
- Construction preparedness requirements including permits and restrictions that can potentially delay or extend the duration of construction.

3.a.i.1 Site B (TSF Option B)

Site B is a preference due to its proximity to the plant and other services, located about 1.3km south of the site. The footprint of this site is planned at about 20ha. The footprint area is located on areas previously characterised by agricultural activities and therefore it is unlikely that any protected species would be present in this area.

The site is also located 18m below the plant in terms of elevation which provides for more effective transportation of tailings. The area in question does not require any relocation of infrastructure and will further also not require any river crossings. The constructability of the site also allows for the least cut and fill requirements of the three (3) site options.

This site will require a RWD of about 58 000m^3. The Return Water Dam will be located across the public road, on portion 6 of the farm Dwarsrivier, but will be 100m from the 1:100yr floodline. This portion of land is owned by Two Rivers Platinum Mine, and for this reason the mine will have to enter into landownership and use agreements.

As per the other three options, this option will may also include a filter press. It is currently planned that this technology will be located on the existing Discard Dump footprint, from where the dried material will be trucked or conveyed to the proposed TSF.

This site will provide an operational facility of about 20 years.

The conditions of Site B are as follows:

- Site B is located about 1.3km at the northern side of the Beneficiation Plant on relatively flat topography. The site slopes towards the west, and is also readily accessible from this direction;
- The direct access for piping between Site B and the Beneficiation Plant navigates alongside an existing tarred road and electrical power line south of the Plant;
- The site is located approximately 200m from the 1: 100-year flood line of a river towards the west;
- A model of the site was developed to assess the capacity of the potential TSF within the available area. This allowed a high level cost assessment of the TSF;
- Site B will require stormwater diversion infrastructure of approximately 1 000m in length at the eastern upstream flank of the potential TSF; and
- The RWD will have to be positioned downstream of the access road at the western flank of the potential TSF.

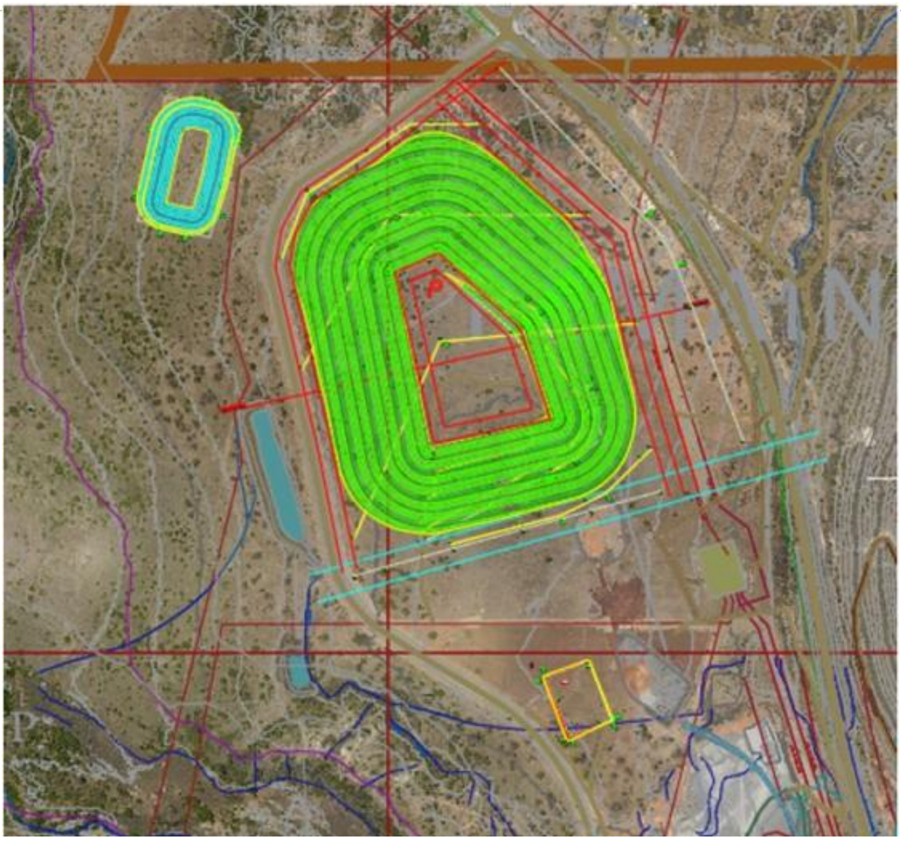


Figure 9: Site B Layout

Engineering constraints identified includes:

- Proximity of public road;
- Eskom powerline servitudes – haulage under powerline;
- Tweefontein underground mining; and
- Possible future underground mining.

3.a.i.2 Site C (TSF Option C)

Site C is located about 2.3km from the Plant and other services. The footprint of this site is planned at about 28ha, the largest in extent of the three (3) options. The area is characterised by a fairly steep topography. The vegetation comprises of grass and trees, with protected species present. Another component which is considered in this area is the presence of graves which will require potential removal permits if approved. The logistical arrangement of this site will necessitate pipeline and road crossings of the Dwarsrivier from the proposed TSF to the plant.

The site is also located 5.5m above the plant in terms of elevation and will require the road and pipeline crossings of the Dwarsrivier. The area in question will necessitate the relocation of low voltage powerlines.

The site is undermined, but considered stable for the purposes of the TSF design at this time.

This site will require a RWD of about 64 000m^3. The RWD will be constructed in a valley and well designed storm water diversions will be required.

The conditions of Site C are as follows:

- Site C is located towards the south of the Beneficiation Plant. The site slopes towards the north and is readily accessible from the west;
- The site has a large surface area available for siting of a TSF;
- The site is located approximately 400m from the 1:100-year flood line of a river towards the northern side;
- The installation of slurry delivery pipelines and return water pipelines will be required across a river between the site and the Beneficiation Plant;
- In terms of the conceptual layout for the site (Figure 10), the resultant starter wall will have an expected height of approximately 7m located at the north flank, with a length of 610m;

- Stormwater diversion trenches and bunds with a combined length of approximately 1 732m will be required at the southern upstream flank; and
- Extension of Site C to the west is constricted by an existing TSF owned by another mine, towards the north and south by steep hills and mountain rock outcrops, and towards the west by a flood line of a down-gradient river.

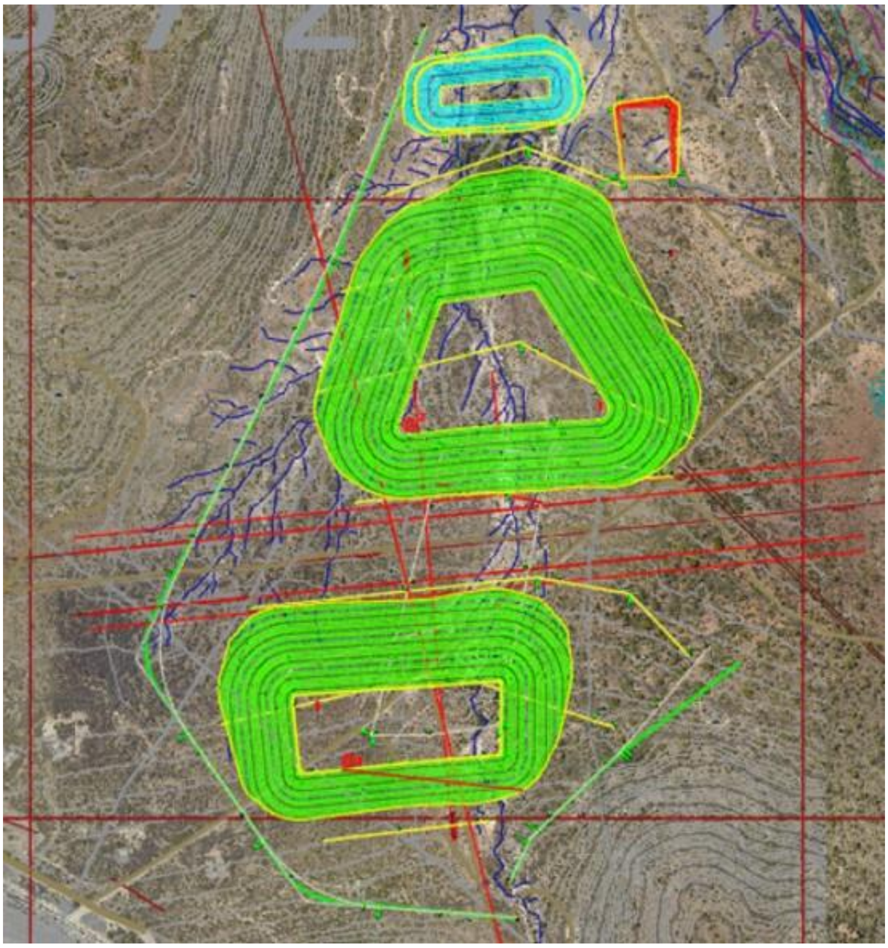


Figure 10: Site C Layout

Engineering constraints identified includes:

- Eskom servitude and TRP pipeline (this will split the site into two compartments);
- Underground mining is present (limit to 100m depth);
- Smaller powerlines will require removal; and
- Ruins/graves are present.

3.a.i.3 Site D (TSF Option D)

A non-perennial drainage channel, which is an unnamed tributary of the Dwarsrivier, traverses Site D. The site is located 1.4km (pipeline route 1.8km) upgradient, east of the plant, near the existing North TSF. The vegetation comprises of grass and trees, with protected species present.

The site is 29m above the Plant, which provides the most constraints in terms of elevation of the three (3) options.

This site will require a RWD of about 66 000m^3. The current engineering considerations identify the location of the RWD not as ideal due to the proximity of the non-perennial drainage channel and the challenge of construction of storm water management berms.

The conditions of Site D are as follows:

- Site D is located to the north of the Beneficiation Plant. The site is adjacent to the existing North TSF and partially hidden behind the mountain 'koppie';
- The site has a surface area available for siting a TSF within a valley between mountains;
- The site is located approximately 1 500m from the 1:100-year flood line of a river towards the west of the site, but within a non-perennial drainage channel;

- A portion of the identified area will be located over backfilled areas (on the western side);
- There are mining activities upgradient and to the east and northeast of the site.

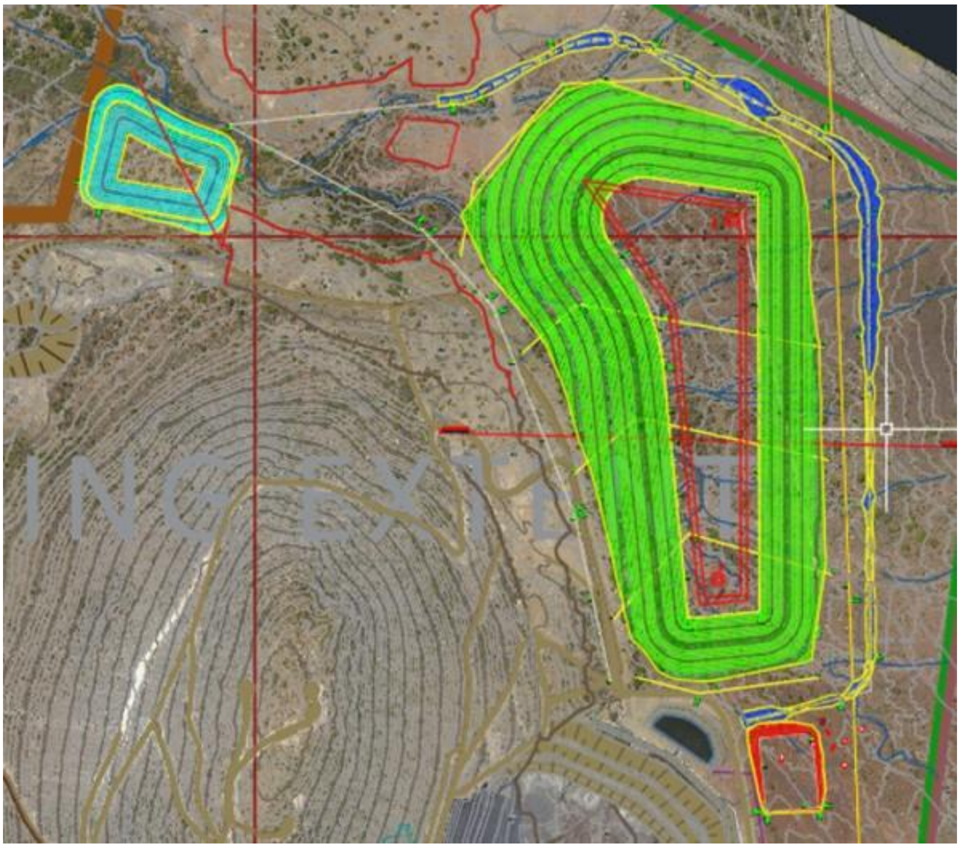


Figure 11: Site D Layout

Engineering constraints identified includes:

- Diversion of non-perennial drainage line;
- Lion ropeway;
- Hillside; and
- Backfilled opencast pits.

3.a.i.4 Engineering Comparison

The tables below summarise the findings of the comparison of location considerations in terms of engineering requirements. Based on the outcomes of the Engineering Site Selection conducted by Jones and Wagner, Site B is the preferred site in terms of technical, cost and environmental considerations (as identified by the Engineering team following a desktop assessment), followed by Site D and then Site C.

Table 8: Engineering Assessment (Technical Aspects)

1	Site Selection Aspects											
2	Criteria	Weighting	Max score	Site B			Site C			Site D		
3				Measurement	Score	Weighted Score	Measurement	Score	Weighted Score	Measurement	Score	Weighted Score
4	Technical Aspects											
5	Technical											
6	Site Setting											
7	Site not undermined (opencast or underground)	5	5	N/A	5	25	100 - 250 m (DMR applications)	3	15	0 - 50 m mined from surface - areas very close to footprint	5	25
8	No planned future undermining	5	5	100 - 250 m	3	15	N/A	5	25	N/A	5	25
9	Suitability in terms of available space to accommodate TSF and related support infrastructure	5	5	Can accommodate life of +/-20 years, space may be insufficient to accommodate required life	4	20	Can accommodate life of 25 years, limited space available for extension	5	25	Can accommodate life of +/-20 years, space may be insufficient to accommodate required life	4	20
10	Proximity to plant & other services	5	5	1.3 km	5	25	2.3 km	2	10	1.4 km	4	20
11	Pipeline / stream crossing required	2	5	No	5	10	Yes - Dwarsrivier Stream	2	4	No	5	10
12	Accessibility of site (existing road network, accessibility)	2	5	Public road and mine gravel road	5	10	Existing mine gravel road, may require to be upgraded	3	6	Existing mine gravel road, may require to be upgraded	4	8
13	Elevation difference (filter press - in relation to plant)	2	5	18 m below plant	5	10	5.5 m above plant	4	8	29 m above plant	2	4
14	Surface water management infrastructure complications (depth / slope)	4	5	No additional excavation to flow depth, max. slope: 1V:27H	5	20	No additional excavation to flow depth, max slope: 1V:13H	3	12	5.5 m additional excavation to flow depth, max slope: 1V:15H, limited space for PC Dam - may need to be constructed in stream	1	4
15	Flexibility to accommodate possible future extension of TSF	1	5	Cannot be accommodated	1	1	Limited possibility	3	3	Difficult due to hill, undermined areas and position of PCD - limited posibility if Lion Ropeway is removed	1	1
16	Suitability of founding conditions (deeply weathered/mined/etc)	3	5	No obvious sign of rocky outcrops	5	15	Visible rock outcrop	4	12	No obvious sign of rocky outcrops, however possibility of rock at depth due to prevailing steep topography	4	12
17	Additional security requirements and considerations	1	5	Can use existing security set-up but additional security may be required	4	4	Relatively close to plant but requiring separate security	2	2	Can use existing security set-up but additional security may be required	4	4
18	Existing infrastructure (including third party) operational influence on TSF	4	5	Rock stockpile footprint (planned), Planned Eskom powerlines	3	12	Planned pipeline/powerline	4	16	Close proximity to North Shaft TSF and Lion Ropeway	3	12
19	Zone of influence on existing infrastructure (including third party infrastructure)	4	5	Public roads, Eskom powerlines, Two Rivers Stream	1	4	Powerlines, planned pipeline	3	12	Lion ropeway, 1.3 km to two rivers stream, public road, North Shaft TSF	2	8
20	Exploration boreholes to be sealed	1	5	Yes	3	3	Yes	3	3	Yes	3	3
21	Proximity to potential triggers which could cause Tailings instability	2	5	Future DCM U/G mining, Close to Tweefontein U/G tribute area	3	6	Undermined & U/G pillars stable	4	8	Close to DCM U/G mining, Tweefontein mine activities	2	4
22	Services to be relocated (including planned)	1	5	None	5	5	Low voltage powerlines	4	4	None	5	5
23	Space availability for filter press and associated infrastructure, including space for stacking tailings before placement	5	5	Filter Press Facility positioned on rock dump footprint - limited space for temporary stacking of tailings	3	15	Sufficent space for filter press and temporary stacking of tailings	5	25	Space available but limited - limited space for temporary stacking of tailings	3	15
24	Constructability											
25	Suitability of topography (2018 LiDAR survey)	5	5	Cut: 96 000 m3, Fill: 31 500 m3	5	25	Cut: 168 000 m3, Fill: 85 000 m3	4	20	Cut: 163 500 m3, Fill: 106 500 m3	2	10
26	Pipeline route complexity (crossing existing services and public infrastructure)	3	5	Crossing powerlines, may be within road servitude	4	12	Alignment through existing Plant internal roads and Stream Crossing - can be crossed at existing road crossing	3	9	Public road crossing, but could use existing crossing	3	9
27	Access ramp complexity	3	5	Steep, Requires curves	3	9	Steep, Requires curves	3	9	No significant curves required. Two separate access ramps for the split TSF	4	12
28	TOTAL: TECHNICAL		315			246			228			211
29												

Table 9: Engineering Assessment (Cost Aspects)

Cost Aspects											
Cost	Weighting	Max score	Site B			Site C			Site D		
			Measurement	Score	Weighted Score	Measurement	Score	Weighted Score	Measurement	Score	Weighted Score
CAPEX	40	40		38	1520		25	1000		22	880
Earthworks for TSF basin levelling		5	Cut: 96 000 m3, Fill: 31 500 m3	5		Cut: 168 000 m3, Fill: 85 000 m3	4		Cut: 163 500 m3, Fill: 106 500 m3	2	
~~Ground improvement~~			N/A			N/A			N/A		
TSF Liner area		5	197 000 m2	5		274 000 m2	3		209 000 m2	5	
Clean water diversions		5	5 000 m3 excavation, 1 000 m concrete lining	5		20 000 m3 excavation, 1 900 m concrete lining	4		45 000 m3 excavation, 1 400 m concrete lining	1	
PCD and related liner construction		5	Cut: 58 000 m3, Fill: 7 500 m3, Liner: 17 000 m2	4		Cut: 63 500 m3, Fill: 15 500 m3, Liner: 17 500 m2	3		Cut: 65 500 m3, Fill: 21 500 m3, Liner: 17 000 m2	2	
Slurry pipeline & pumping		5	1 300 m length, -18 m static head	5		2 760 m length, 5.5 m static head	3		1 753 m length, 26 m static head	4	
Filter press platform		5	4 700 m3 earthworks	5		16 500 m3 earthworks	3		26 500 m3 earthworks	1	
Return water pipeline & pumping		5	1 300 m length, 18 m static head	4		2 760 m length, -5.5 m static head [stream crossing]	3		1 753 m length, -26 m static head	4	
Closure cost requirements		5	TSF Capping: 197 000 m2, PCD - Cut: 58 000 m3, Fill: 7 500 m3	5		TSF Capping: 274 000 m2, PCD - Cut: 63 500 m3, Fill: 15 500 m3	2		TSF Capping: 209 000 m2, PCD - Cut: 55 500 m3, Fill: 9 500 m3	3	
OPEX	60	20		18	1080		11	660		18	1080
Slurry pipeline & pumping		5	171 kW/h required	5		409 kW/h required	3		286 kW/h required	4	
~~Filter press~~											
Return water pipeline & Pumping		5	1 300 m length, 18 m static head	4		2 760 m length, -5.5 m static head	3		1 753 m length, -26 m static head	5	
Tailings placement		5	100% tailings @ 250 m from filter press	4		61% tailings @ 30 m from filter press, 39% tailings @ 630 m from filter press	2		100% tailings @ 90 m from filter press	5	
Maintenance		5	Pipeline length: 1 300 m, 171 kW/h pumpstation	5		Pipeline length: 2 760 m, 409 kW/h pumpstation	3		Pipeline length: 1 753 m, 286 kW/h pumpstation	4	
TOTAL: COST		2800			2600			1660			1960

Table 10: Engineering Assessment (Environmental Aspects according to the desktop Engineering Study)

Environmental Aspects											
Environmental Aspects	Weighting	Max score	Site B			Site C			Site D		
			Measurement	Score	Weighted Score	Measurement	Score	Weighted Score	Measurement	Score	Weighted Score
Ground water											
Aquifer usage potential (classification)	2	5	Medium	3	6	Medium	3	6	Medium	3	6
Impact on potential downstream use	4	5	Medium	3	12	Medium	3	12	Medium	3	12
Cummulative Impact Potential (in addition to existing impact)	3	5	High	1	3	Medium	3	9	High	1	3
Surface water											
Proximity to wetlands / water course	5	5	130 m	3	15	150 m	3	15	0 m	1	5
Potential water quality impacts	5	5	Medium	3	15	Medium	3	15	High	1	5
Pipeline watercourse crossings	2	5	No	5	10	Yes	1	2	No	5	10
Economic											
Impact on agriculture	1	5	No	5	5	No	5	5	No	5	5
Ecology											
Biodiversity / Ecological Sensitive Areas	5	5	Medium	3	15	Medium/High	2	10	Medium/High	2	10
Located in CBA or Ecological Sensitive Area	5	5	Yes	1	5	Yes	1	5	Yes	1	5
Aesthetic/other											
Visual	2	5	High	1	2	Low/Medium	4	8	Medium	3	6
Noise	1	5	Low/medium	4	4	Low	5	5	Low	5	5
Proximity to people (nuisance factor/ air quality - dust)	5	5	High	1	5	Low	5	25	Medium	3	15
Proximity to roads (impact to traffic - dust)	3	5	Next to public road	1	3	No public road	5	15	No public road	5	15
Ruins / graves and associated applications	4	5	No	5	20	Yes (graves & ruins)	2	8	No	5	20
Stream crossing and applications	3	5	No	5	15	Yes	2	6	Yes	1	3
Pipeline crossing public roads and associated applications	2	5	May be in public road / powerline servitude	3	6	No	5	10	Yes	2	4
Pipeline crosssing powerlines and applications	2	5	Yes	2	4	Yes	4	8	No	5	10
Pipeline distance / disturbance	1	5	1 300 m	5	5	2 760 m	3	3	1 753 m	4	4
DMRE approval process for undermined sites	5	5	None	5	25	6 to 12 months approval process	1	5	None	5	25
TOTAL: ENVIRONMENT		300			175			172			168

Table 11: Engineering Assessment (Overall Rating)

Overall weighting											
Criterium	Max Points	Normalize	Site B			Site C			Site D		
			Measurement	Score	Points	Measurement	Score	Points	Measurement	Score	Points
Technical	30	0.095238	Technical	246	23.4	Technical	228	21.7	Technical	211	20.1
Cost	40	0.014286	Cost	2600	37.1	Cost	1660	23.7	Cost	1960	28.0
Environmental Aspects	30	0.100000	Environmental Aspects	175	17.5	Environmental Aspects	172	17.2	Environmental Aspects	168	16.8
TOTAL POINTS	100				78.1			62.6			64.9

)

3.a.i.4.a The type, design and/or technology/operational considerations of activity to be undertaken

The material parameters of the tailings to be deposited at the existing North TSF allowed a cyclone method of deposition; however, there are other deposition methods available for consideration where it may be rendered impractical to utilise the cyclone method. The available generally utilised tailings disposal methods include:

Impoundment disposal method

The method involves a containment wall constructed from foreign material, where the tailings material is deposited safely into the containment. This includes in-pit disposal methods where open pits or underground shafts are utilised to dispose the tailings material. This method has advantages including less emphasis on rate of rise and generally, pore pressure dissipation complications are less critical. However, the greatest disadvantage with the method is high costs of progressively and continuously raising the impoundment walls. The impoundment disposal method is relatively simplified in terms of deposition, where generally open-ended deposition is adequate.

Spigot disposal method

The spigot disposal method is generally in popular use, however, there are limitations with regards to the rate of rise (i.e. approximately 2.5m/yr.). The method generally results in self-raising the TSF with the tailings material. The operations must ensure freeboard availability as required in GN704 of the NWA. Since the tailings material is generally deposited, hydraulically cycles must be imposed to deposition to allow the tailings material to consolidate. The spigot disposal method requires specific infrastructure and operating conditions for success.

Cyclone disposal method

The cyclone disposal method comprises separation of a total tailings stream into fine grained tailings (overflow) and coarse grained tailings (underflow). Similar to the cyclone wall development, the method involves utilising the tailings material for sidewall building. The operator of the TSF must maintain freeboard similar to the spigot deposition method. The advantage with the method is high allowable rates of rise. The methods generally result in stable TSF due to the outer coarse material. The method requires specific infrastructure and operating condition for success.

Filter press method

The filter press methods involve equipment used in liquid/solid separation. The filter press separates liquids and solids utilising pressure filtration. A slurry/slimes is pumped into the filter press and is dewatered under pressure. The filter cake will be deposited via trucks or a conveyor system onto the TSF, and water will be recirculated to the plant or proposed RWD. The filter press will be designed based on the volume and type of slurry that needs to be dewatered.

This is currently considered the preferred technology for the deposition considerations, due to the reduction in water to be stored on the proposed TSF, and also the opportunity to recycle water through the plant.

Depending on the final location, the detailed type of TSF will be designed. This will be included into the EIA phase of the project.

3.a.ii The option of not implementing the activity

Should the project not be approved (No Go Option) the following implications may arise:

As mentioned before (Section 2.b), the demand for chrome has increased globally due to the increase in China Markets. With the current North TSF reaching its full capacity, a new facility is required to ensure ongoing mining and processing practices.

3.a.iii The Environmental Attributes associated with the Site Alternatives

As no significant changes in the location of infrastructure have been required based on the alternative discussions to date, the environmental attributes associated with the current site locations are presented.

3.a.iii.1 Baseline Information

3.a.iii.1.a Climate

WSP Consulting was appointed to undertake an Air Quality Assessment and Hydrospatial was appointed to undertake a Hydrological Assessment for the site selection process (Please refer to Annexure 5). The climatic information was sourced from these reports, as well as from available information pertaining to Dwarsrivier Mine.

3.a.iii.1.a.1 Temperature

The mine is situated in the Highveld Climate Region of South Africa. The average daily maximum temperature for summer (January) is 27 degrees Celsius (°C) and for winter 17°C. The average daily minimum temperatures vary between 13°C in January and 0°C in July. In terms of the 2019 Air Quality Site Selection Report, the highest monthly average temperature for 2015, 2016 and 2017 was 22.46°C, 21.84°C and 21.65°C, respectively, recorded during summer. The lowest monthly average temperature for 2015, 2016 and 2017 was 12.36°C, 12.77°C and 13.09°C, respectively, recorded during winter.

3.a.iii.1.a.2 Rainfall

The Mean Annual Precipitation (MAP) at the mine is estimated to range between 401 and 600mm per annum; with limited areas receiving rainfall ranging from 601 to 800mm. The mine receives most of its rainfall during the summer months.

3.a.iii.1.a.3 Humidity

According to the 2019 Air Quality Site Selection Report, the humidity in the region is moderate to high, with the annual average for 2015, 2016 and 2017 being 65.13%, 66.94% and 63.13%, respectively.

3.a.iii.1.a.4 Evaporation

The table below summarises all the different evaporation figures for the site area.

Table 12: Evaporation Summary

Type of Rainfall	Amount (mm)
Mean Annual Evaporation (MAE)	1677

The MAP is less than the MAE and therefore the site is classified as a water deficit site.

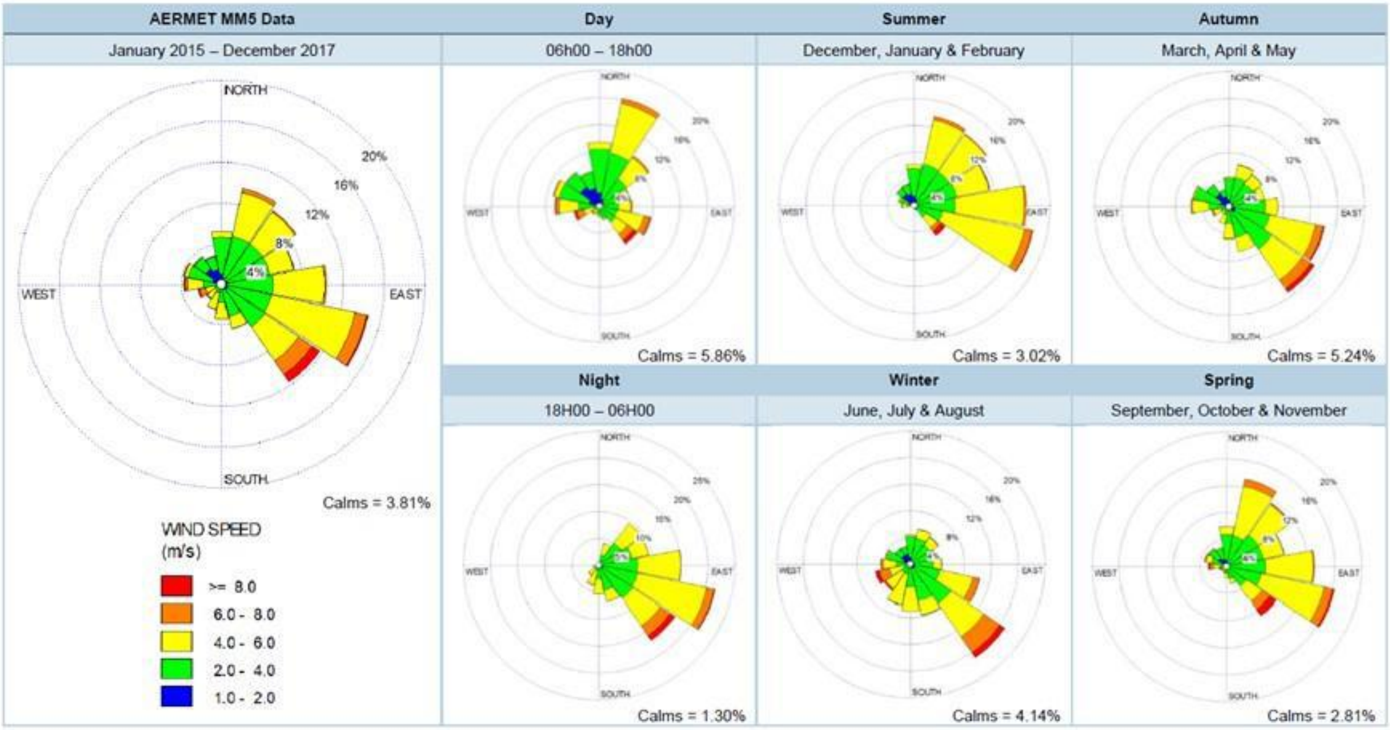
3.a.iii.1.a.5 Wind

Wind can play an important role in the potential distribution of fugitive dust resulting from the site. As the mine is situated in the Dwarsrivier valley, this gives rise to winds that are variable in terms of both speed and direction.

Wind roses (see the following figure) summarise wind speed and directional frequency at a location. Each directional branch on a wind rose represents wind originating from that direction. Each directional branch is divided into segments of colour, representative of different wind speeds.

Typical wind fields are analysed for the full period (January 2015 – December 2017); diurnally for day (06h00 – 18h00) and night (18h00 – 06h00); and seasonally for summer (December, January and February), autumn (March, April and May), winter (June, July and August) and spring (September, October and November). Over this period wind conditions at the mine had the following characteristics:

- Calm conditions occurred 3.81% of the time;
- Moderate winds from the east-south-east prevailed in the region with notable north-north-easterly, easterly and south-easterly components;
- Highest average wind speeds occurred from the southeast;
- North-north-easterly trajectories prevailed during the day, while east-south-easterly trajectories prevailed at night;
- East-south-easterly winds prevailed during spring and summer, while south-easterly winds prevailed in winter and autumn; and
- Highest average wind speeds occurred in spring.



Graph 1: Wind data.

3.a.iii.1.a.6 Extreme Weather Conditions

The incidents of extreme weather conditions for this area are included in the following table.

Table 13: Extreme Weather Conditions.

# of Days With	Jan	Feb	March	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Days Per Yr.
Thunder	6.	4.4	3.7	2.7	0.9	0.5	0.4	1.1	1.4	4.1	7.1	5.1	37.6
Hail	0.3	0.1	0.2	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.5	0.2	1.9
Fog	1.9	1.3	1.1	0.9	0.4	1.1	0.8	1.1	0.8	2.6	1.6	1.6	15.2
Snow	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.6

3.a.iii.1.a.7 Preferred Site Selection

Please refer to Section 3.a.iii.1.j discussing the Air Quality findings.

3.a.iii.1.b Topography

Hydrospatial was appointed to undertake the Hydrological and Visual Assessments for the site selection process (Please refer to Annexure 5). The topographic information was sourced from these reports, as well as from available information pertaining to Dwarsrivier Mine.

The farm Dwarsrivier 372KT, on which the mine is located, is traversed by the Groot Dwarsrivier and the Klein Dwarsrivier. The confluence of these rivers is also located on the property. The eastern portion of the property, where the chrome reserves outcrop, generally slopes in a westerly to south westerly direction, towards the Dwarsrivier. Adjacent to the river, slopes are gentle, in the order of 3°. Further upslope from the river, slope angles increase to as much as 40°.

However, the slopes are not always gradual with frequent small to relatively large koppies or hills formed from materials that are more resistant. Elevations on the farm Dwarsrivier vary from 900 – 1,200 m. The area generally drains in a northerly direction, via the Dwarsrivier systems on site. There are, however, a number of small westerly flowing, non-perennial tributaries of the Dwarsrivier near the old open cast sections. There is approximately 40m elevation change across the mine site, with elevations between 940 – 975 metres above mean sea level (mamsl).

TSF B is located about 1.3km northwest of the Beneficiation Plant and the existing Waste Rock Dump. This Site is located to the north of the proposed expansion of the Discard Dump. The site is possibly underlain by an alluvial aquifer, placing the facility in close proximity to a watercourse. This aspect will be further investigated as part of the groundwater studies during the EIA phase.

TSF Site C is located 1.6km southwest of the Beneficiation Plant. The TRP TSF is located 300m southwest of the site. The site is drained in a north-easterly direction by two non-perennial drainage lines towards the Groot Dwarsrivier.

TSF Site D is located 1.4km northeast of the Beneficiation Plant. The site is drained in a north-westerly direction by a non-perennial drainage line towards the Dwarsrivier. A number of small drainage lines drain the koppie located immediately east of TSF D towards the site. Open pit mining is taking place above these drainage lines along the koppie, as well as to the north of the site. The active TSF is located immediately south of the site.

3.a.iii.1.b.1 Preferred Site Selection

Please refer to 3.a.i presenting the outcomes of the engineering assessment, as well as Section 3.a.iii.1.f.1 for the hydrological outcomes.

3.a.iii.1.c Geology

iLEH was appointed to undertake the Hydrogeological Assessment for the site selection process (please refer to Annexure 6). The geological information was sourced from this report, as well as from existing available information pertaining to Dwarsrivier Mine.

Dwarsrivier Mine is situated in the eastern limb of the 2052 Ma (million year old) Bushveld Igneous Complex, the world's largest layered intrusion, comprising the emplacement of at least 7 x 105 cubic kilometres (km^3) of magma into the sediments of the Transvaal Supergroup. The chrome ore deposits form part of the Critical Zone of the Bushveld Complex. The chrome horizon that is mined is referred to as the LG6 (Lower Group 6) horizon. The chrome layer is overlain by anorthosite and pyroxenite. The layers have a regional dip of 13° west in this area, towards the centre of the Bushveld Igneous Complex. However, local variations in dip are common.

The Dwarsrivier ore body represents an open-ended structural synform, with a north-south orientated axis that plunges gently to the south. The mine is situated on the eastern limb of this synform. The geology overlying the chromite generally comprises pyroxenite and anorthosite.

3.a.iii.1.c.1 Preferred Site Selection

Please refer to Section 3.a.i presenting the outcomes of the engineering assessment, specifically relating to the future mining considerations.

3.a.iii.1.d Soils, Land Use and Land Capability

SAS was appointed to undertake a Soils, Land Use and Land Capability Assessment to provide input in terms of the site assessment of the soil characteristics on site for the site selection process (please refer to Annexure 3). The soil information was sourced from this report, the Topsoil Balance study undertaken by GCS during 2016, as well as from existing available information pertaining to Dwarsrivier Mine.

The following data is applicable to the mine in general, according to various data sources including, but not limited to, the Agricultural Geo-referenced Information System (AGIS) and the Limpopo Conservation Plan (2013) databases:

- The Soil and Terrain (SOTER) database indicates that the majority of the mine comprises strongly weathered acid soils with low base saturation, classified as Luvisols (LVk) with the remaining portions classified as Lithic Leptosols (LPq);
- The desktop assessment indicates that the majority of the mine has a moderate potential arable land capability (class III). While the remainder of the mine is suited to Wilderness land use (class VIII), as illustrated in Figure 17;
- According to the AGIS database, the livestock grazing capacity potential is estimated to be approximately 6 hectares per large animal unit (Morgenthal et al., 2005);
- The natural soil pH is estimated to be range between 6.5 and 7.4, indicating that the soils are anticipated to be slightly acidic to neutral, as interpolated from topsoil pH values obtained from the National Soil Profile Database (AGIS database);

- Geology 2001: According to the Geology 2001 dataset the majority of the mine is underlain by norite, while the remaining portion underlain by gabbro (Figure 12);
- According to the SOTER database and the 1:250 000 geological map of South Africa, the majority of the MRA as well as the TSF alternatives are underlain by Pyroxenite rock formations while the remaining portion of the MRA located to the west and the southern portion of TSF alternative F are underlain by Gabbro. Refer to (Figure 15).
- According to the Limpopo Conservation Plan version 2 (2013) (Figure 19) the majority of the study area is classified as a Critical Biodiversity Area (CBA) 1. CBA 1 areas are considered irreplaceable areas required to meet biodiversity and/or ecological processes targets, with no alternative sites available to meet these targets. One section of the western portion of the mine as well as the southern portion are considered to fall within a designated Ecological Support Area (ESA) 2. These are areas that are important for meeting ecological processes.

3.a.iii.1.d.1 Land Use

Current land use activities associated with the proposed TSF alternatives are largely dominated by wildlife and wilderness, encompassed by some mining operations in the surrounding areas. No current agricultural activities were observed within the proposed TSF alternatives and the surrounding areas. Site B is however an old agricultural field which has been laid to fallow. All TSF alternatives equally experience a MAP of less than 600mm per annum, which is not considered adequate to support unirrigated cultivated agriculture on a commercial scale. Furthermore, all proposed TSF alternatives comprise soils not ideal for either cultivated agriculture nor grazing on a commercial scale. Even though TSF alternative D contains patches of arable soils, the viability of agricultural crop cultivation on these soils in this area is low due to the limited extent of arable soils and land fragmentation as a result of mining related activities in the surrounding areas.

Land Capability classes for soil forms identified with the proposed projects can be summarised as follows:

Table 14: Land Capability Classes

Land Capability	Soil Forms
Arable – Class II	Hutton (Hu)
Arable – Class IV	Brandvlei (Br)
Grazing – Class VI	Glenrosa (Gs) and Mispah (Ms)
Wildlife/Wilderness (class VIII)	Witbank (anthrosols) (Wb)
Other	NA

According to the AGIS database, the livestock grazing capacity potential of the entire MRA and the three TSF alternatives is estimated to be approximately 6 hectares per large animal unit (Morgenthal et al., 2005).

3.a.iii.1.d.2 Topsoil Balance

A Topsoil Balance study was conducted by GCS during 2016. The areas occupied by surface infrastructure are part of the sites that will need rehabilitation during the post-mining or closure phase of the mine.

The volume of topsoil required for future rehabilitation is indicated to be 110,309.1m^3 and this volume is in excess of the available topsoil volume which stands at 104,651.6m^3. This means that 5,657.5m^3 of additional topsoil is required to meet all rehabilitation obligations at the mine as shown in the following table:

Table 15: Topsoil balance (presented in m^3)

Available Topsoil	Required Topsoil	Topsoil Balance
104 651.6	110 309.1	-5 657.5

The topsoil deficit could be attributed to loss of topsoil from stockpiles through water erosion. The mine's final rehabilitation, decommissioning and closure plan, points out the possibility of conversion of brick buildings and infrastructure currently serving as offices to other beneficial use upon closure of the mine (GCS, 2016). If the aforementioned plan is finally implemented, the available topsoil will be sufficient for post closure rehabilitation since the area occupied by the brick buildings will no longer need any rehabilitation.

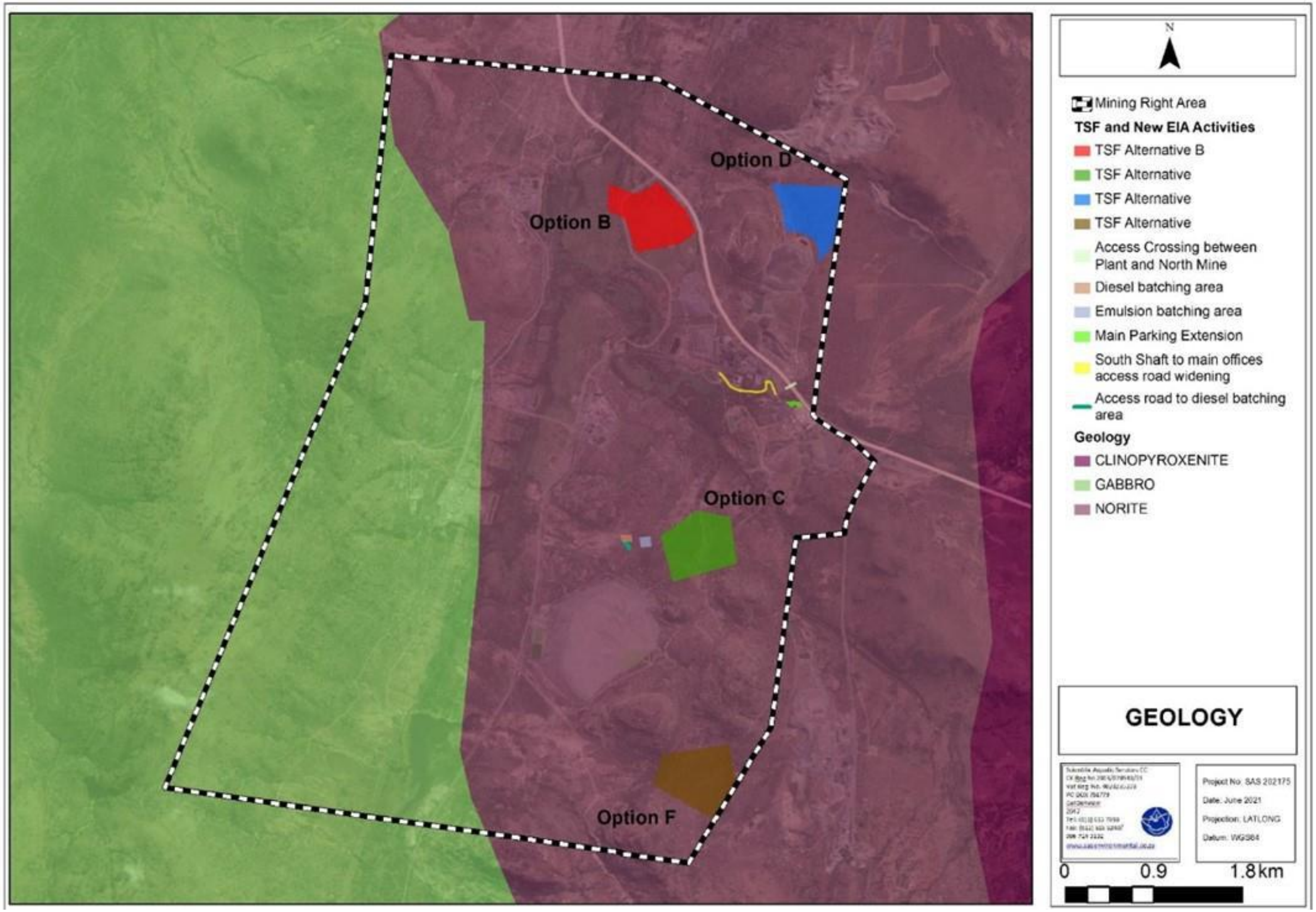


Figure 12: Geology of the Dwarsrivier Mine and TSF site alternatives.

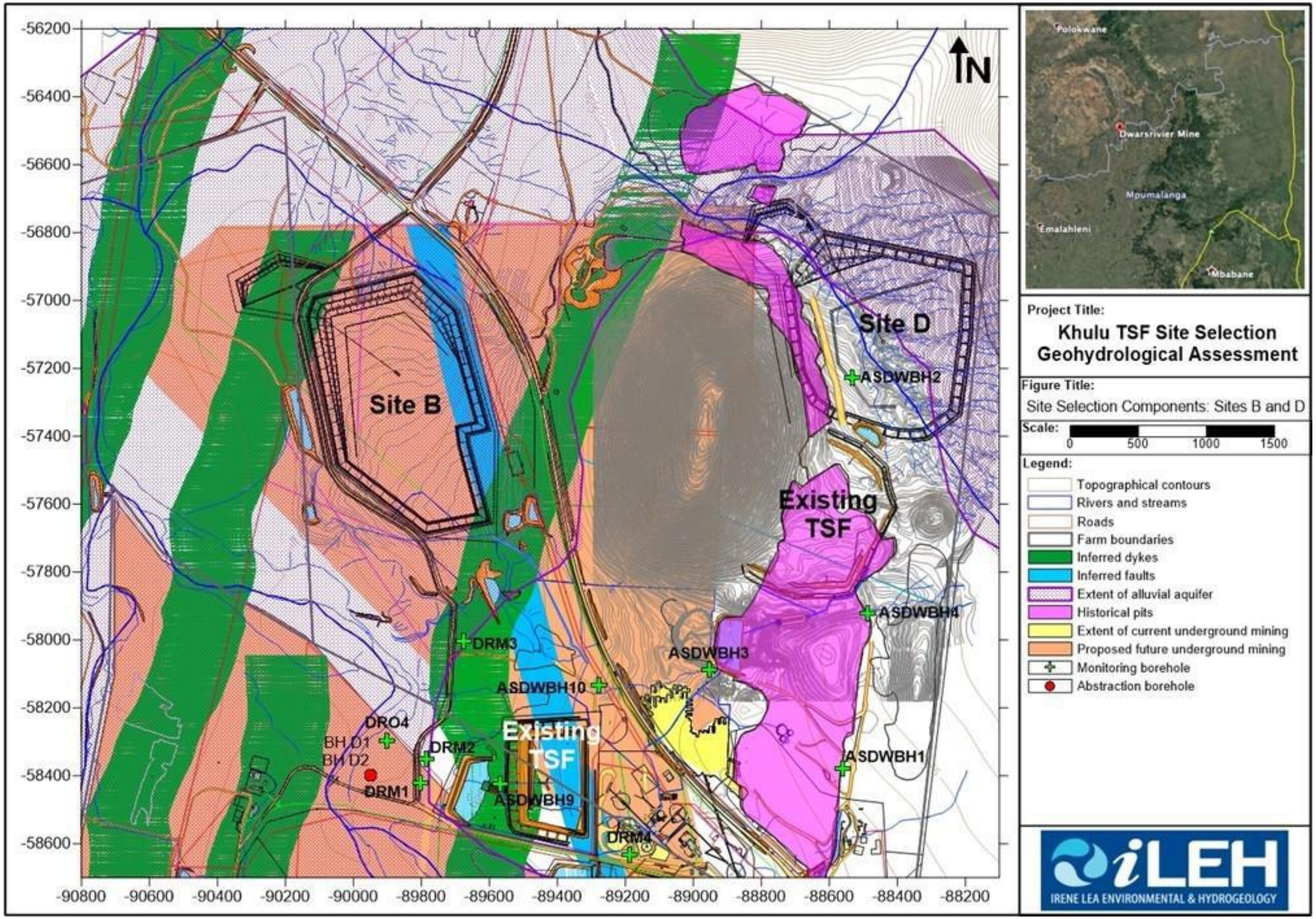


Figure 13: Geological Structures of the Dwarsrivier Mine and TSF site alternatives (Site B and D)

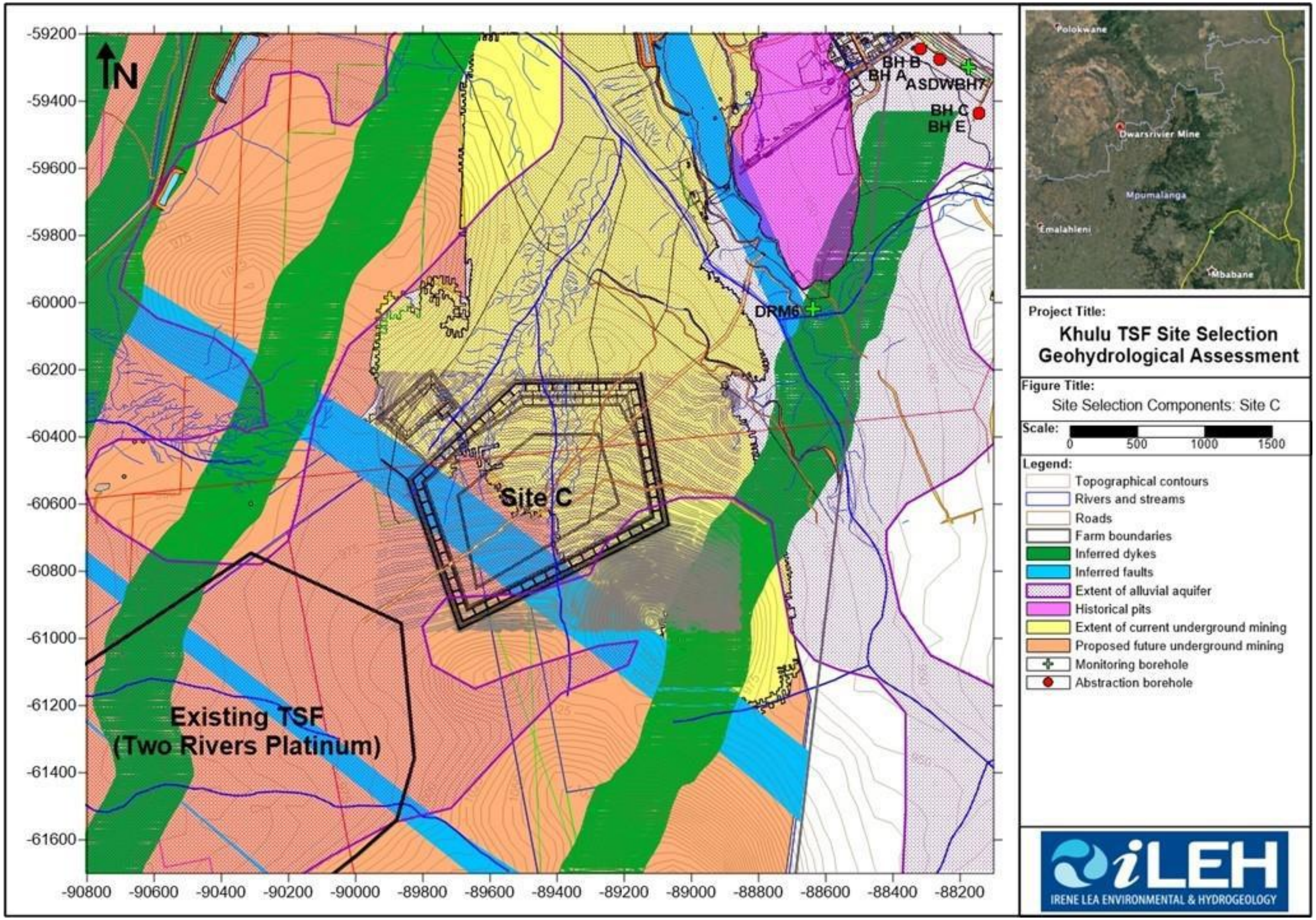


Figure 14: Geological Structures of the Dwarsrivier Mine and TSF site alternatives (Site C)

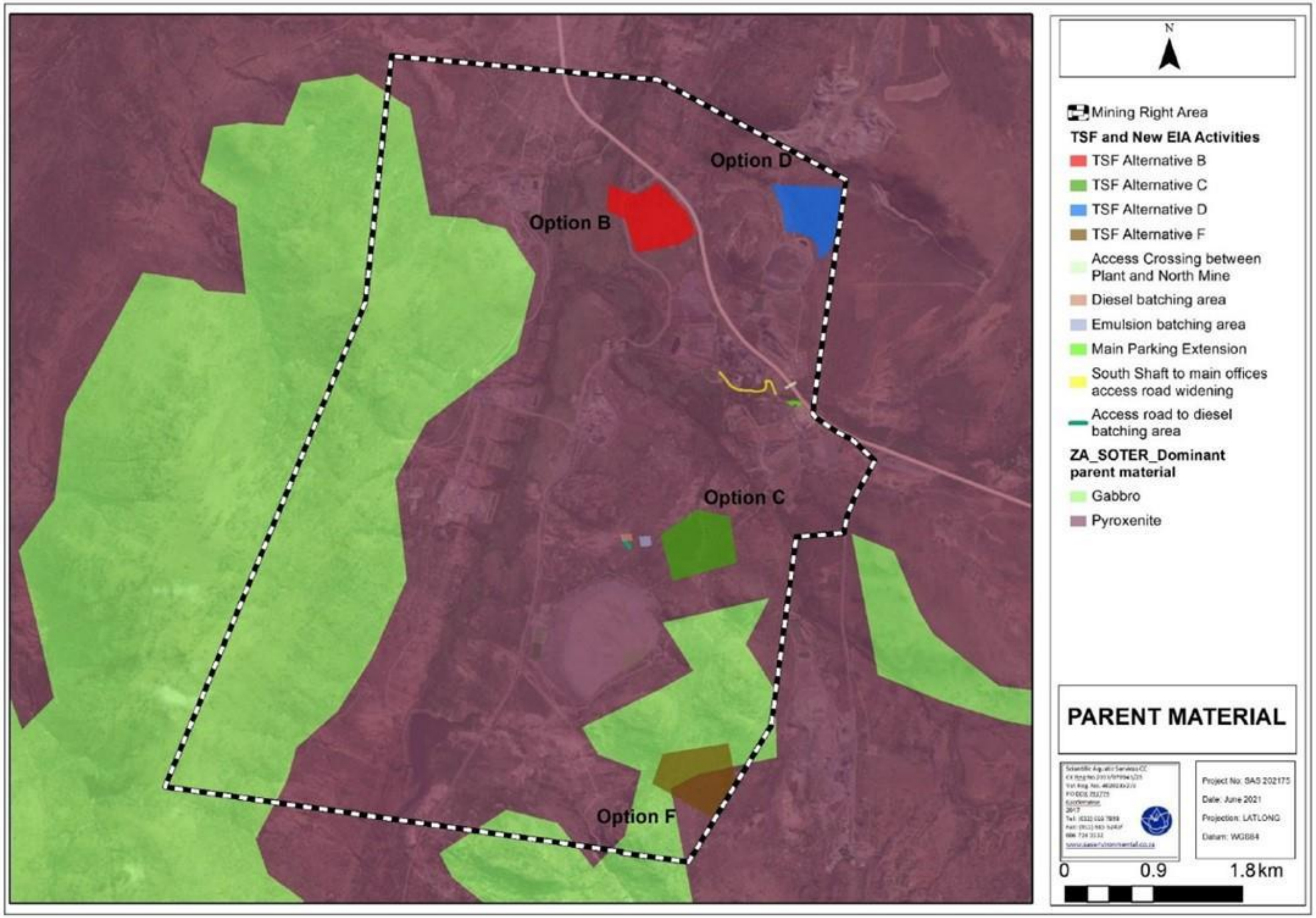


Figure 15: Parent material associated with the MRA and surrounding areas according to the SOTER database

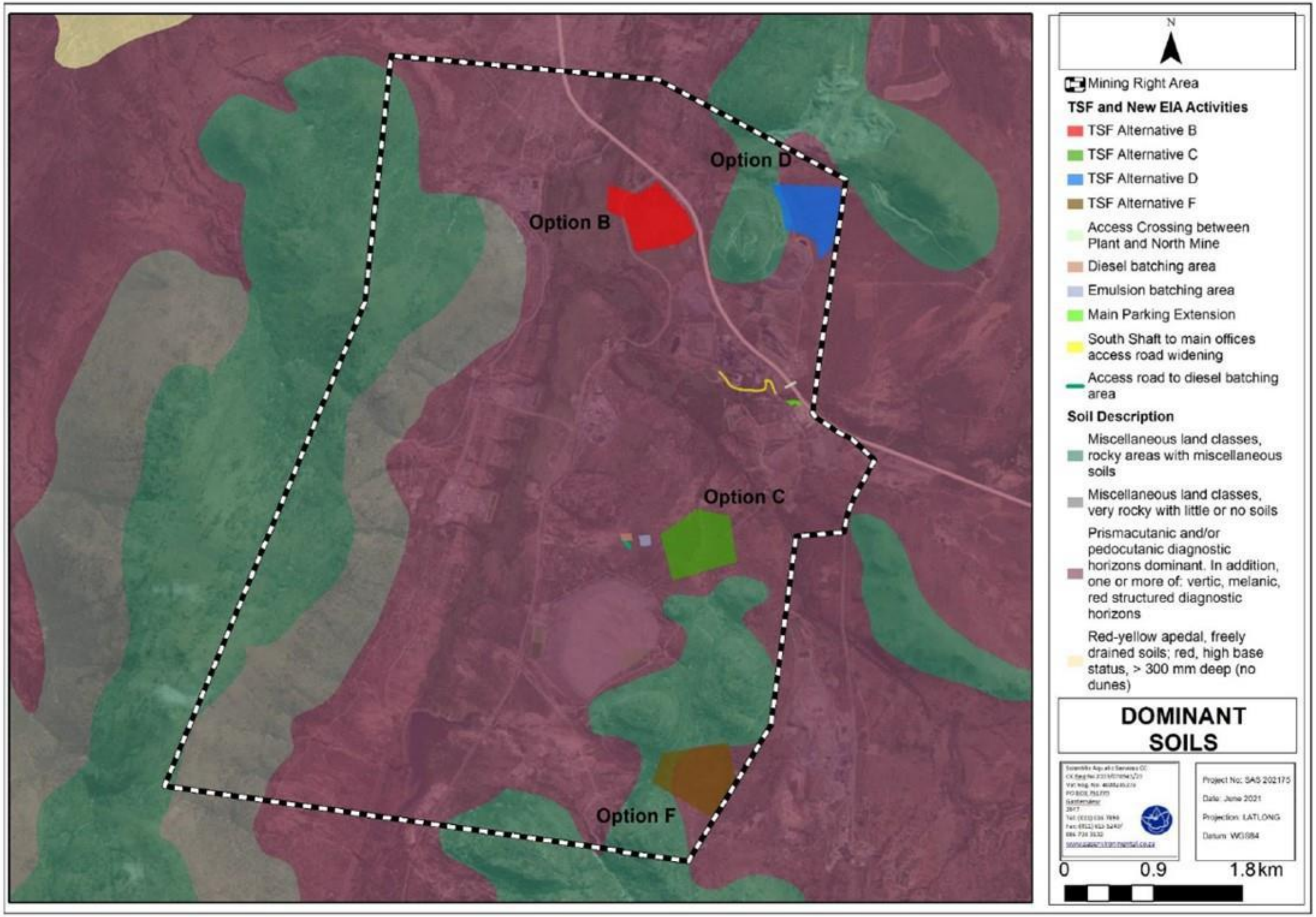


Figure 16: Dominant soils (2001) associated with the MRA and surrounding areas

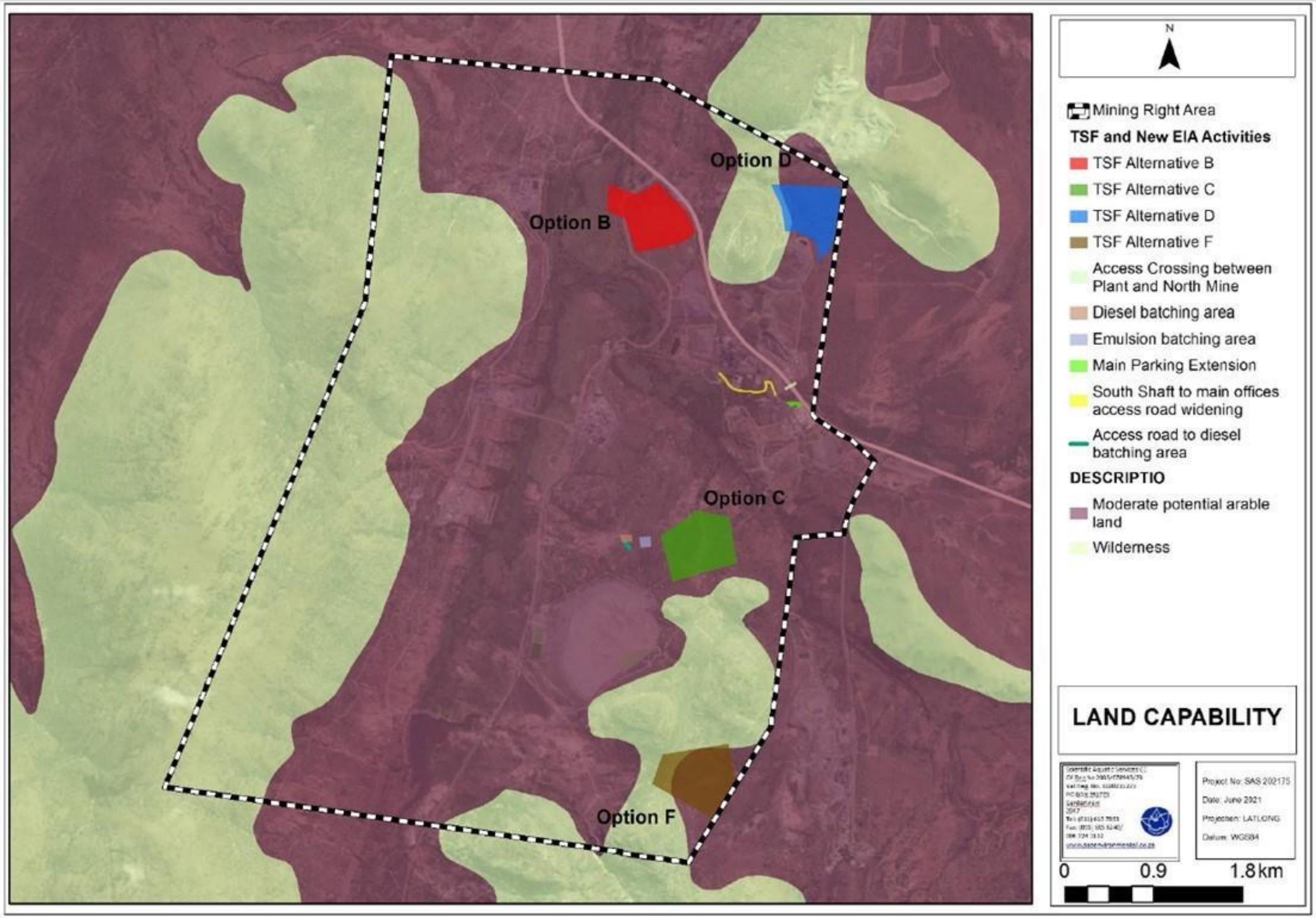


Figure 17: Land Capability

3.a.iii.1.d.3 Preferred Site Selection

The findings of this assessment, including soil limiting factors within the TSF site alternatives for soils, land capability and land use potential are summarised below:

Table 16: Overall Land Capability associated with the TSF site alternatives and constrains for agriculture

Site Alternative	B	C	D
Dominant soils	Bonheim	Arcadia, Immerpan and Mispah	Mispah, Glenrosa, Alluvial soils and Plooysburg
Dominant Land Use	Although no agricultural activities were identified with this TSF alternative area, this area has been historically used for cultivation, thus indicating its suitability for cultivation. This can be attributed to the soil effective rooting depth which was found to be somewhat deep. The clay content however increases in the subsoil, thus limiting rooting growth for most crops.	Wildlife and wilderness, with a freshwater feature traversing the central portion. Mining facilities are located within a 500m radius of this site, and no ongoing agricultural activities were observed within this area and immediate vicinity. The extent of the MRA also falls within Climate Capability Class 5, which is characterised by a moderately restricted growing season due to low temperatures, frost and/or moisture stress. Suitable crops may be grown at risk of some yield loss. No high agricultural potential soils were identified with this TSF alternative area. The area is characterised by shallow Mispah and highly clayey Arcadia as well as dispersive Immerpan soils, all not considered ideal for cultivation due to limiting factors such as shallow depth, high clay content and erosion hazard.	The current land use associated with TSF alternative D is mainly wildlife and wilderness, whilst the surrounding areas are characterised by mining operations to the north, east and south. The central portion of alternative D is characterised by a freshwater feature. No current agricultural activities were observed within TSF Site D and surrounding areas. The extent of MRA falls within Climate Capability Class 5, which is characterised by moderately restricted growing season due to low temperatures, frost and/or moisture stress. Suitable crops may be grown at risk of some yield loss.
Overall Land Capability	The identified Bonheim soil forms are considered somewhat suitable for cultivation (class III).	Grazing (Class V)	Grazing (Class V)
Limiting factors for Agriculture	These soils are regarded ideal for cultivated agriculture of selective crops, however the viability of agricultural crop cultivation of these soils in area is low due to land fragmentation by current mining and associated activities in the surrounding areas. In addition, these soils also cover a small area which is not sufficient for commercial agricultural production However, mitigation measures should be implemented accordingly.	Serious management constraints of Arcadia soils attributed to excessive stickiness when wet and hardening when dry due to high smectitic (expandable) clay minerals and high plasticity index values. Shallow effective rooting depth due to shallow indurated bedrock of the Mispah and Glenrosa soil forms.	Shallow effective rooting depth due to shallow indurated bedrock of the Mispah and Glenrosa soil forms. Lack of stability and low nutrient holding capacity of alluvial soil forms associated with the freshwater features.
Business Case	The impact of the proposed TSF development on the land capability of these soils is anticipated to be within acceptable levels, given the lack of high potential agricultural soils as well as the limiting climatic conditions (MAP less than 600 mm). Although the identified soils are not considered as prime agricultural soils, these	The impact of the proposed TSF development on the land capability of these soils is anticipated to be within acceptable levels, given the lack of high potential agricultural soils as well as the limiting climatic conditions (MAP less than 600 mm). Although the identified soils are not considered as prime agricultural soils, these soils may be important for potential small-scale grazing opportunities. The susceptibility of Arcadia soils to shrink under dry conditions and expand under moist conditions should be considered and	Although small patches of Plooysburg soil may potentially be considered suitable for cultivated agriculture, the viability of agricultural crop cultivation of these soils in this area is low due to land fragmentation resulting from mining related activities in the surrounding areas. These soils also cover a small area which is not sufficient for commercial agricultural production. The southern and western portions of this TSF alternative are already

Site Alternative	B	C	D
	soils may be important for potential small-scale grazing opportunities.	avoided where possible as this may cause undesired damage on the structural integrity of the surface infrastructure. Immerpan soils require strict erosion control measures due to their susceptibility to erosion. These soils collapse or disperse to form dissolved slurry when in contact with water. Furthermore, Immerpan soils are highly prone to erosion often leading to tunnel and gully erosion, thus the recommended best management approach to these soils is to avoid their disturbance. Maintaining vegetation cover of the soil is also important to minimise soil dispersion. Overall, from a soils point of view this site is not ideal for placement of infrastructure due to the occurrence of expansive clay and dispersive soils, as infrastructure may be damaged or displaced when soils come into contact with water.	degraded due to the ongoing mining activities in the immediate vicinity, with an access road traversing the western portion, causing land withdrawal for potential grazing. In addition, the ongoing mining activities to north and east of the TSF area further disqualify this area for cultivation and potential grazing due to the prospect of future mine expansion into the immediate vicinity. While there are small patches of arable soils, given the climatic constraints of the area (rainfall less than 600 mm per annum) and lack of irrigation options, the soils within this TSF option are not likely to contribute to national food production.
	2	3	1

Taking the above into consideration, from a soil, land use and land capability perspective, Site D is recommended as the preferred site for TSF development, in comparison to the other two (2) TSF alternatives given the proximity to existing mining infrastructure, thus eliminating the need for significant further disturbance of undisturbed soils in other areas within the mining area. However, considering the location of Site B and the fact that this is also located in close proximately to the mining activities, it is the view of the EAP that either Site B or D would be suitable options. As a result Site B is also highlighted for consideration.

3.a.iii.1.e Terrestrial Ecology

SAS was appointed to undertake a Terrestrial Ecological Assessment for the site selection process (please refer to Annexure 4). The ecological information was sourced from this report, as well as from existing available information pertaining to Dwarsrivier Mine.

The Dwarsrivier Mine is located in the Savanna Biome, within the Central Bushveld Bioregion. Ecological aspects relating to the vegetation of the area indicate that the majority of the Dwarsrivier MRA is located within the Sekhukhune Mountainlands listed threatened ecosystem (Figure 18 and Figure 19), which is considered to be Endangered, and within the Sekhukhune Mountain Bushveld vegetation type which is considered Least Threatened. The vegetation and landscape features are considered as dry, open to closed microphyllous and broad-leaved savanna on hills and mountain slopes that form concentric belts parallel to the north-eastern escarpment. Open bushveld, often associated with ultramafic soils, which often provide habitat for a high diversity of edaphic specialists, is present on southern aspects. Bushveld located on mountain slopes is generally taller than in the valleys, with a well-developed herbaceous layer. Bushveld located within valleys and dry northern aspects is usually dense, like thicket, with an herb layer comprising many short-lived perennials. Dry habitats contain a number of species with xerophytic adaptations, such as succulence and underground storage organs. Both man-made and natural erosion dongas occur on the foot slopes of clay soils rich in heavy metals.

The Dwarsrivier Mine falls within an area that is currently not protected (Figure 20).

According to the South African Protected Areas Database (SAPAD; 2020) the mine is located approximately 9.7km east of the De Hoop Private Nature Reserve (PNR), approximately 9 km southwest of the Berghoek PNR, and 11.6 km of the Steelpoort PNR (Figure 20). The National Protected Area Expansion Strategy (NPAES; 2009) database does not indicate any formally or informally protected areas to be situated within 10km of the MRA; however, it does indicate the Mpumalanga Mesic Grasslands Focus Area to be situated within the south-eastern corner of the MRA (Figure 20).

In terms of the Mining and Biodiversity Guidelines (2013), it should be noted that the majority of the mining area, with the exception of a small area within the northern portion falls within an area considered to be of Highest Biodiversity Importance (Figure 21). Highest Biodiversity Importance areas include areas where mining is not legally prohibited, but where there is a very high risk that due to their potential biodiversity significance and importance to ecosystem services (e.g. water flow regulation and water provisioning) that mining projects will be significantly constrained or may not receive necessary authorisations (Figure 21).

The proposed TSF Site Alternatives are all located within a CBA 1, as well as an area of Highest Biodiversity Importance according to the Mining and Biodiversity Guidelines (2013). Overall, the habitat within each TSF Alternative is largely representative of the Sekhukhune Mountain Bushveld vegetation type. Several floral and faunal SCC were observed within each TSF Site Alternative, with the exception of Site B, highlighting the ecological importance of each area (Figure 22).

Figure 18: The remaining extent of the Sekhukhune Mountain Bushveld associated with the five proposed projects according to the National Biodiversity Assessment (NBA, 2018)

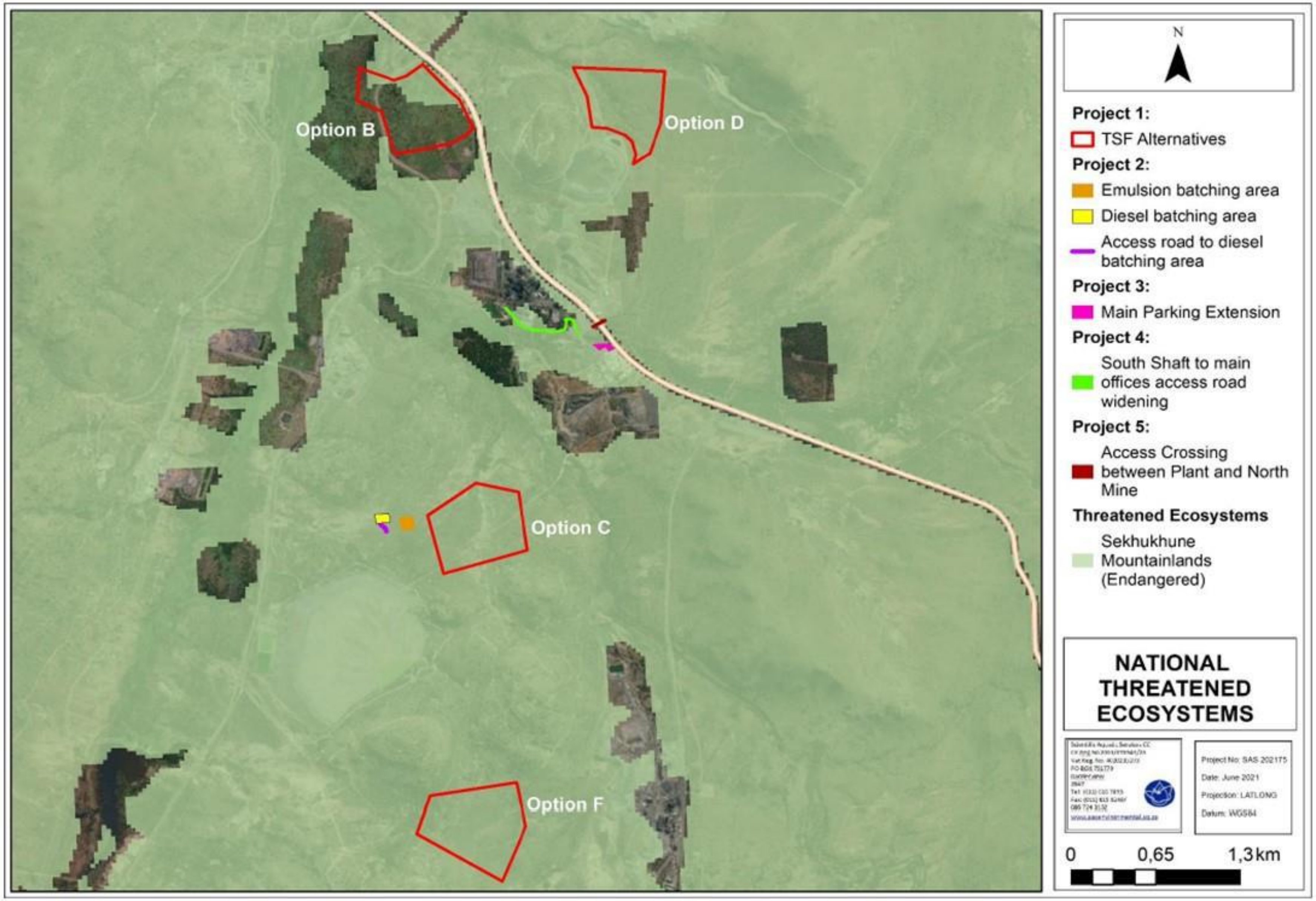


Figure 19: The Endangered Sekhukhune Mountainlands ecosystem associated with the MRA and TSF site alternatives (National Threatened Ecosystems, 2011)

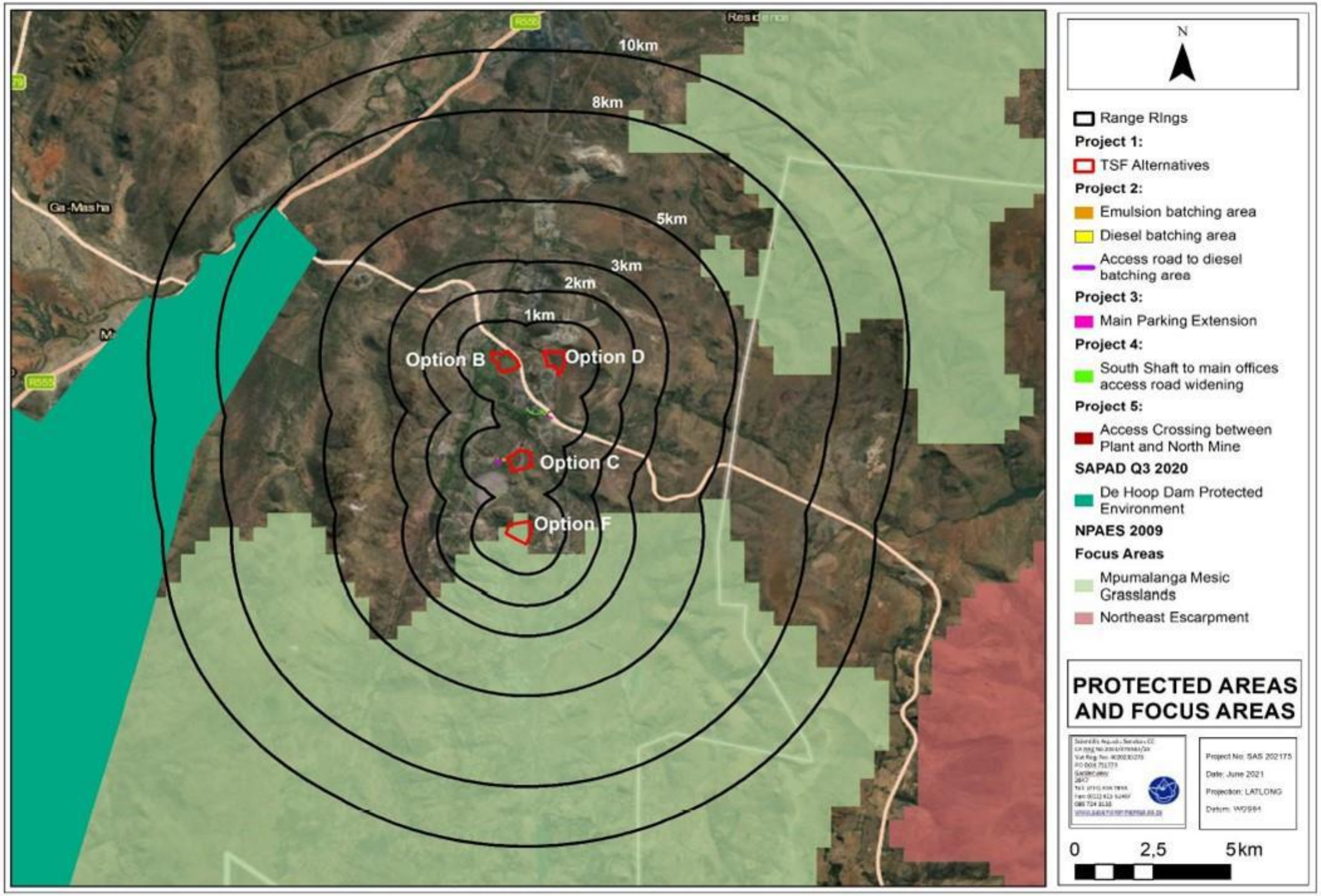


Figure 20: The protected area and focus area associated with the five proposed projects (SAPAD, 2020 and NPAES, 2009)

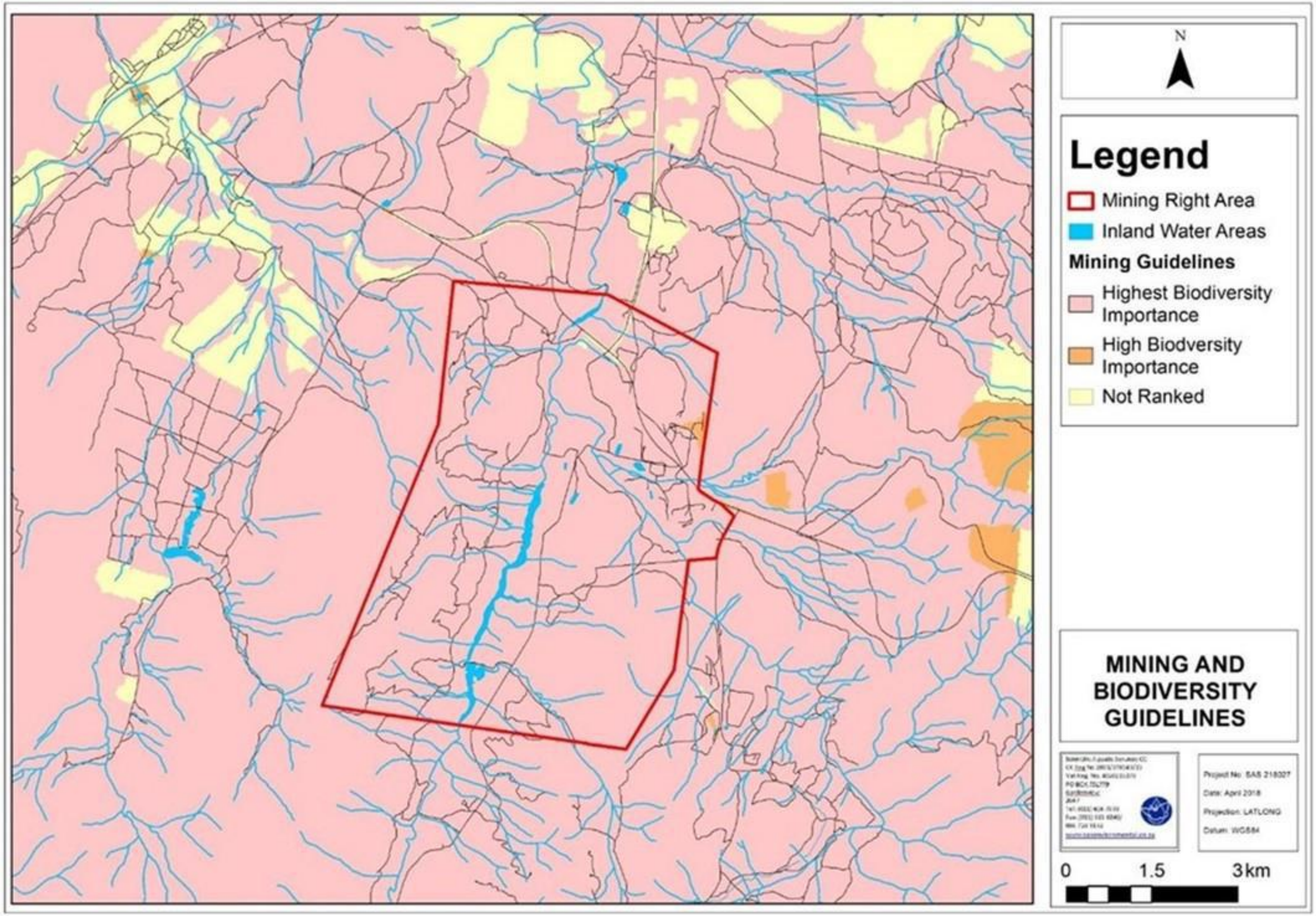


Figure 21: Importance of the MRA according to the Mining and Biodiversity Guidelines (2013)

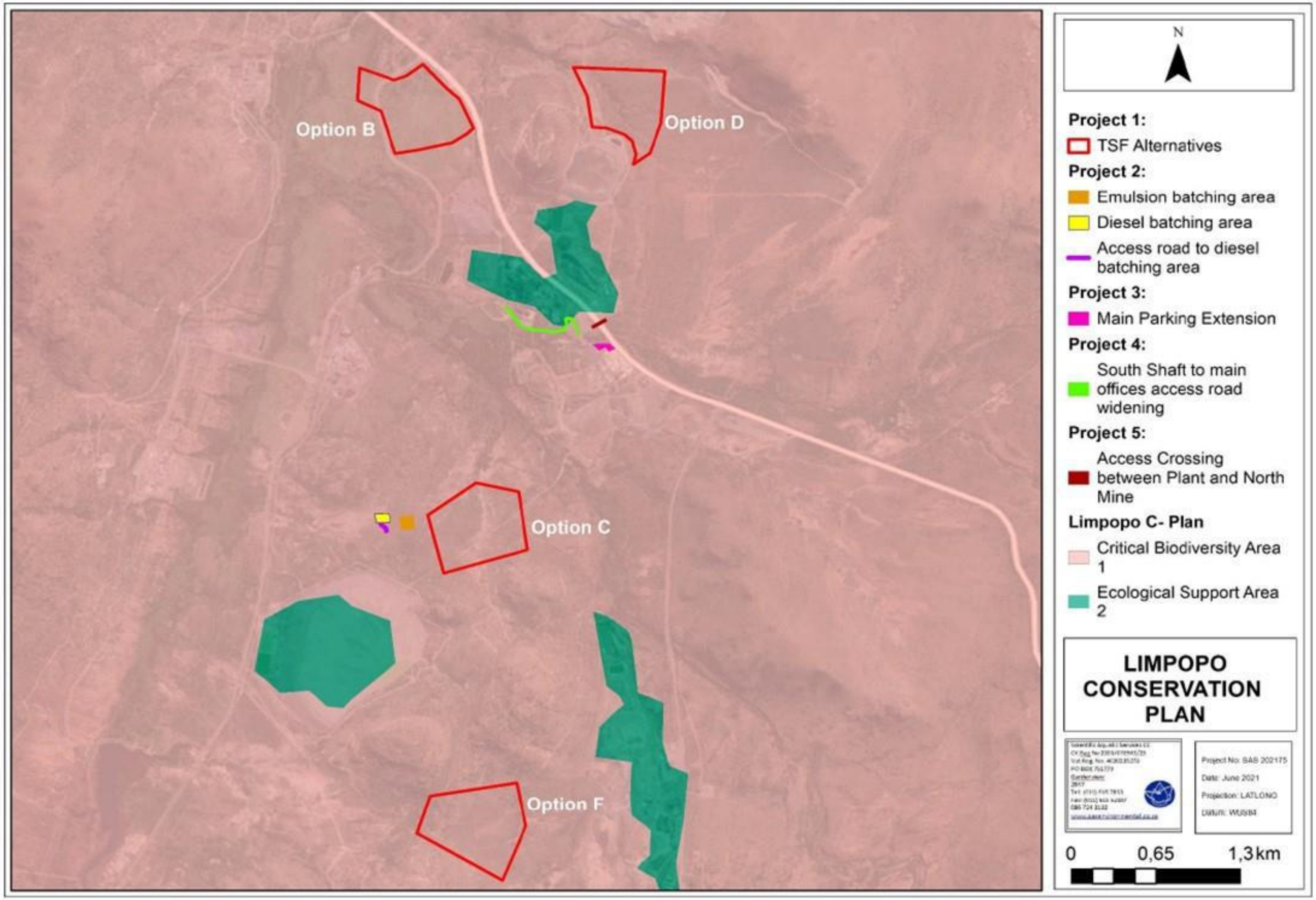


Figure 22: The Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) associated with the MRA according to the Limpopo Conservation Plan database (2013)

3.a.iii.1.e.1 Preferred Site Selection

The below table summarises the results obtained from the sight assessment and alternatives analysis for each TSF site alternative – please refer to Annexure 4 for the referenced figures in the table below:

Table 17: Terrestrial results and constraints associated with the TSF Alternatives

Alternative	B	C	D
Ecological Results	TSF Option B is located in a historically disturbed area, notably, an area that was used for agriculture. With the advent of mining, the old agricultural lands lay fallow and have subsequently been recolonised with a combination of indigenous vegetation and alien and invasive plants (AIP). As no structured rehabilitation has occurred and due to the exclusion of important ecological processes (herbivory and fire), the footprint area appears to remain in a sub-climax, bordering pioneer in some instances, stage of vegetative succession. The herbaceous layer comprises of only a handful of grass species, often present within large, homogenous swards that shift between these species in terms of dominance/abundance. The dominant grass species include *Aristidea adscensionis, Heteropogon contortus, Enneapogon cenchroides, Cymbopogon excavatus* and *Eragrostis* spp. No floral or faunal SCC were observed within the footprint area, further, given the current ecological condition of the footprint it is unlikely that any such species will occur herein. Overall the terrestrial habitat within Site B is in a degraded state, dominated by plant species associated with disturbed habitat and is not considered representative of the vegetation type (Sekhukhune Mountain Bushveld).	Largely undisturbed and intact floral and faunal habitat representative of the Sekhukhune Mountain Bushveld vegetation type with several faunal and floral SCC observed/known to occur within the TSF site alternative footprint. Located 300m upslope of the Groot Dwarsrivier, an essential ecological servitude, providing habitat and water resources to faunal species. A number of floral SCC were observed within TSF Option C including *Sclerocarya birrea* subsp *caffra* (NFA, Act 84 of 1998), *Lydenburgia cassinoides* (NFA, Act 84 of 1998) and *Boscia albitrunca* (NFA, Act 84 of 1998). One faunal SCC was observed within the proposed TSF area, namely *Pycna sylvia* (Cicada) with *Python natalensis* (African Python, VU) being previously recorded. Of importance is that *Pycna sylvia* appears to be largely endemic to the Dwars River Valley and is most commonly associated with the tree species *Vitex obovata* subsp *wilmsii* and as such loss of habitat and individuals in the area will have a significant knock-on effect on the overall population of this species in the valley. Of additional importance is the increased probability that species such as *Panthera pardus* (Leopard, Vulnerable, TOPS Listed), *Parahyaena brunnea* (Brown hyaena, NT, TOPS Listed), *Sagittarius serpentarius* (Secretary bird, VU), *Polemaetus bellicosus* (Martial Eagle, VU) and *Neotis denhami* (Denham's Bustard, NT) will occur within and utilise the area associated with Site C. The Groot Dwarsrivier, located to the north of the Site C forms a natural buffer and boundary between the proposed site and then mine itself. This, combined with no additional mining developments/activities in this locality has ensured that the overall ecology of the area remains relatively intact and less disturbed in comparison to areas north of the Dwarsrivier, where mining activities and	Located in an area that is surrounding by opencast mining activities as well as the current North TSF. Overall, the terrestrial habitat is considered to representative of the Sekhukhune Mountain Bushveld vegetation type. Edge effects from the surrounding mining activities were evident at Site D, however, these were still limited in extent and had not led to large scale habitat loss or degradation. A small number of individuals of the floral SCC *Sclerocarya birrea* subsp *caffra* were observed, while the floral SCC *Lydenburgia cassinoides* which is protected under the National Forest Act (Act 84 of 1998) were observed in far greater abundance, primarily associated with the drainage line. Additionally, several individuals of *Boscia albitrunca* (NFA, Act 84 of 1998) were also observed within the TSF area. No faunal SCC or signs thereof were observed within the proposed TSF area; however, it is likely that species such as *Panthera pardus* (Leopard, Vulnerable, TOPS 2015) and *Parahyaena brunnea* (Brown hyaena, NT, TOPS Listed) may move through the area from time to time while foraging. Additionally, species such as Sagittarius serpentarius (Secretary bird, VU), *Polemaetus bellicosus* (Martial Eagle, VU), *Neotis denhami* (Denham's Bustard, NT) and *Python natalensis* (African Python, VU) may occur within Site D, however it is likely that this will only be for short periods or when moving through the area due to the low levels of available food resources for these species. The tree species *Vitex obovata* subsp *wilmsii* was observed within the proposed TSF, however in low densities. This tree species has been generally associated with the endemic Cicada

Alternative	B	C	D
		edge effects have led to habitat degradation. The varying landscape with rocky koppies and areas of sheetrock further provide important areas of niche habitat for numerous faunal and floral species including *Platysaurus orientalis* (Sekhukhune Flat Lizard). Additionally, these areas of sheetrock and rocky outcrops provide habitat for endemic species such as *Platysaurus orientalis fitzsimonsi* (Fitzsimon's Flat Lizard) and *Hadogenes polytrichobothrius* (Burrowing Scorpion). Overall, the terrestrial habitat within Site C is considered intact and of high habitat integrity, with many of the floral species observed considered representative of the Sekhukhune Bushveld. Small scale edge effects were evident as a result of the construction of access roads and old drill pads; however, these have not led to significant habitat degradation.	species *Pycna sylvia*, with this Cicada predominantly calling from this tree species. No Cicadas were heard calling during the assessment, nor have they been heard during previous assessments in the area. This may be due to the low density of Vitex trees or unsuitable soils in which to lay its eggs; alternatively due to the lifecycles of this species, no Cicadas may have emerged in the area at the time of assessment. Habitat connectivity has been compromised to a degree as a result of the surrounding mining activities, roads, fences and mining-related infrastructure. As such, it is unlikely that the habitat within Site D will provide long term permanent habitat for large mammal species, with the proposed TSF area acting more as a conduit of movement. Overall, the terrestrial habitat within Site D is considered to be in good condition, with many of the floral species observed considered representative of the Sekhukhune Bushveld. Edge effects from the surrounding mining activities were evident. However these were still limited in extent and had not led to large scale habitat loss or degradation. Overall the vegetation structure is indicative of a mature system, dominated by large trees with a well-developed herbaceous layer and understory.
Business Case	Site B is located within a CBA 1 as well as an area of highest biodiversity importance according to the mining and biodiversity guidelines. Option B is however the only option that is not located within an area listed on the NBA (2018) or the National Threatened Ecosystems (2011). The site assessment and previous studies indicated that the habitat within the footprint is not representative of the vegetation type, notably due to the area being historically cleared for agriculture. Post agricultural land use did not include formal rehabilitation or revegetation, rather allowing for natural recolonisation of plant species to occur. Currently, the footprint is dominated by pioneer and sub-	Site C is located within a CBA 1 as well as an area of highest biodiversity importance according to the mining and biodiversity guidelines. The site assessment and previous studies indicated that the habitat is still largely intact and comprises numerous floral species indicative of the Sekhukhune Bushveld areas. Several floral SCC were observed within the proposed TSF, while it is likely that several faunal SCC will utilise the proposed TSF foraging, as a movement corridor and for permanent habitat. The construction of TSF Option C will result in the loss of floral and faunal species and SCC while leading to the loss of a significant portion of intact habitat. Additionally, the	Site D is located within a CBA 1 as well as an area of highest biodiversity importance. The site assessment and previous studies indicated that the habitat is still largely intact and comprises numerous floral species indicative of the Sekhukhune Bushveld areas. Several floral SCC were observed within the proposed TSF, while it is likely that several faunal SCC will utilise the proposed TSF for foraging and as a movement corridor. The development of this TSF will result in the loss of the aforementioned floral species located within the project footprint and will also impact the movement and habitat connectivity of faunal species. However, cognisance of the

Alternative	B	C	D
	climax grass species indicative of disturbed lands. The construction of the TSF in this locality will not impact on any floral or faunal SCC. Further the development herein will not impact on faunal species movement or habitat connectivity, as the site is located in an already disturbed and fenced off area. There is however the risk that the proposed TSF poses to the Groot Dwarsriver. Should the TSF fail, or any spills/leaching occur, it will have a significant impact on the freshwater system not just at the point of contact but also further downstream. Provided the risk of leaching of tailings or contaminated water from the associated infrastructure can be suitably managed so as to not impact the Groot Dwarsrivier , this proposed footprint is considered suitably from a terrestrial ecological point, as no ecologically intact and important vegetation will be cleared. The risk of failure from the TSF however needs to be considered from a freshwater ecological standpoint.	location of the TSF will lead to loss of habitat connectivity for faunal species and also further limit access to and from the important areas of habitat and water resource provided by the Groot Dwarsrivier. Additionally, the location of the TSF will necessitate the upgrading and widening of the access road and the laying of additional TSF related infrastructure such as pipelines, which will result in further vegetation clearing and loss of habitat connectivity. The additional risk posed by Option C is the relative proximity (300m) of the TSF to the Groot Dwarsrivier. Should the TSF fail, or any spills/leaching occur, it will have a significant impact on the freshwater system not just at the point of contact but also further downstream. Additionally, TRP mine has now placed a pipeline to their new TSF which traverses the footprint of this option. As such, from an ecological and risk management perspective Site C is deemed unsuitable.	surrounding activates must be taken, and it is evident that this proposed option is already located in an area of extensive mining activities, including ongoing open cast mining and an already existing TSF belong to Dwars River Mine. Due to the location of the existing Dwarsrivier Mine TSF, minimal additional TSF related infrastructure (roads, pipelines and so forth) will need to be constructed and laid, reducing the overall impact of the proposed project. Additionally, TRP is planning on constructing a second TSF to the east of the proposed Option D TSF of Dwars River Mine. The construction of this TSF will result in the loss of habitat connectivity and significantly impact on faunal species movement. As such, should Dwarsrivier Mine opt to select an alternative site, it is likely that the receiving environment will be impacted upon nonetheless as a result of the construction of the TRP TSF. Although the TSF Option D will result in the loss of habitat, impact on species and decrease habitat connectivity, taking into consideration the continued mining activities and future construction plans of the area, Site D should be considered over Option C.
	1	3	2

The proposed TSF Options are all located within a Critical Biodiversity Area (CBA) 1 as well as an area of highest biodiversity importance according to the mining and biodiversity guidelines. Overall, the habitat within Sites C and D is largely representative of the Sekhukhune Bushveld, whilst Site B is not considered to be representative of the vegetation type. Several floral and faunal SCC were observed within TSF Option C and D but not B. The table above summarises the results obtained from the sight assessment and alternatives analysis for each proposed TSF.

Sites C and D are located within areas which are considered relatively intact, and representative of the Sekhukhune vegetation type and as such differentiation between options cannot be made simply on habitat quality.

Site B is located within an area that has been historically disturbed, lacking ecologically intact habitat. Development herein will lead to no loss of intact habitat or faunal and floral SCC. The footprint is dominated by plant species indicative of disturbed areas as well as several alien plant species. Site C is located to the south of the Groot Dwarsrivier and is the furthest removed from the current Dwarsrivier Mine mining activities and edge effects. As such, the habitat herein is still largely intact and provides habitat to numerous faunal and floral species, both common and SCC. Additionally, construction of these options will require additional pipelines and road networks to be constructed, resulting in further habitat loss and degradation. Whilst the habitat and importance of Site D is similar in most respects to Site C, it must be noted that the proposed locality of TSF Option D is in close proximity to the current Dwarsrivier Mine TSF, requiring less supporting infrastructure. In addition to this, TRP Mine has also recently developed their new TSF to the east of Site D. Edge effects from this combined with the ever-expanding opencast mining operations to the east and north of site D are further adding to the cumulative impacts in that immediate area. Habitat connectivity has been lost due to TRP's new TSF, and as such, should Site D be selected, it will have minimal impact on species movement, as this has already been largely compromised.

Taking the above into consideration, from a long-term ecological maintenance perspective site B is deemed to be the preferred option, as this site is already disturbed, is located adjacent the current mine operations and will not lead to the loss of habitat connectivity. This option does however pose a potential risk to the Groot Dwarsrivier, which needs to be investigated in terms of mitigatory and management requirements.

3.a.iii.1.f Hydrological Setting

Hydrospatial was appointed to undertake the Hydrological Assessment for the site selection process (please refer to Annexure 5). The water setting information was sourced from this report, as well as from existing available information pertaining to Dwarsrivier Mine.

Dwarsrivier Mine is located in WMA 4: Olifants, and the greater part of the mine falls within Quaternary Catchment Area B41G (refer to Figure 23). Water drainage on site is in different directions as follows:

- Some water drains toward the Sprinkaanspruit;
- Some water drains to the Klein Dwarsrivier;
- Some water drains toward the Groot Dwarsrivier; and
- Predominant flow direction of natural drainage of water on site is in a western direction.

The non-perennial stream which has been diverted in the past for the purposes of the opencast operations, drains into the Klein Dwarsrivier, which has its confluence with the Tubatse (Steelpoort) River about 10km downstream of the mine. The Steelpoort River joins the Olifants River approximately 60km to the north. It should be noted that it is the remnants of this diversion which now serves as a drainage channel north of the Truck Parking Area.

The Groot Dwarsrivier has its origin on the farm De Berg 71JT some 33.75km (measured in a straight line) to the south of the confluence of the Groot Dwarsrivier with the Klein Dwarsrivier. The Klein Dwarsrivier has its origin on the farm, Uysedoorns 47JT, approximately 25.3 km (measured in a straight line) to the south of this river's confluence with the Groot Dwarsrivier. The Springkaanspruit enters the Groot Dwarsrivier from the east some 1.6km upstream from the confluence of the Groot and Klein Dwarsrivier, and has its origin on the watershed between the farms Zwakwater 377KT and Schuins 378KT, some 15.4km (measured along its longest collector) to the east of its confluence with the Groot Dwarsrivier. Refer to Figure 23 for the freshwater resources associated with the sites.

Site C is located in quaternary catchment B41G, Site D in quaternary catchment B41H, and Site B is mostly located in B41G barring a small section of the northern part which is located in B41H.

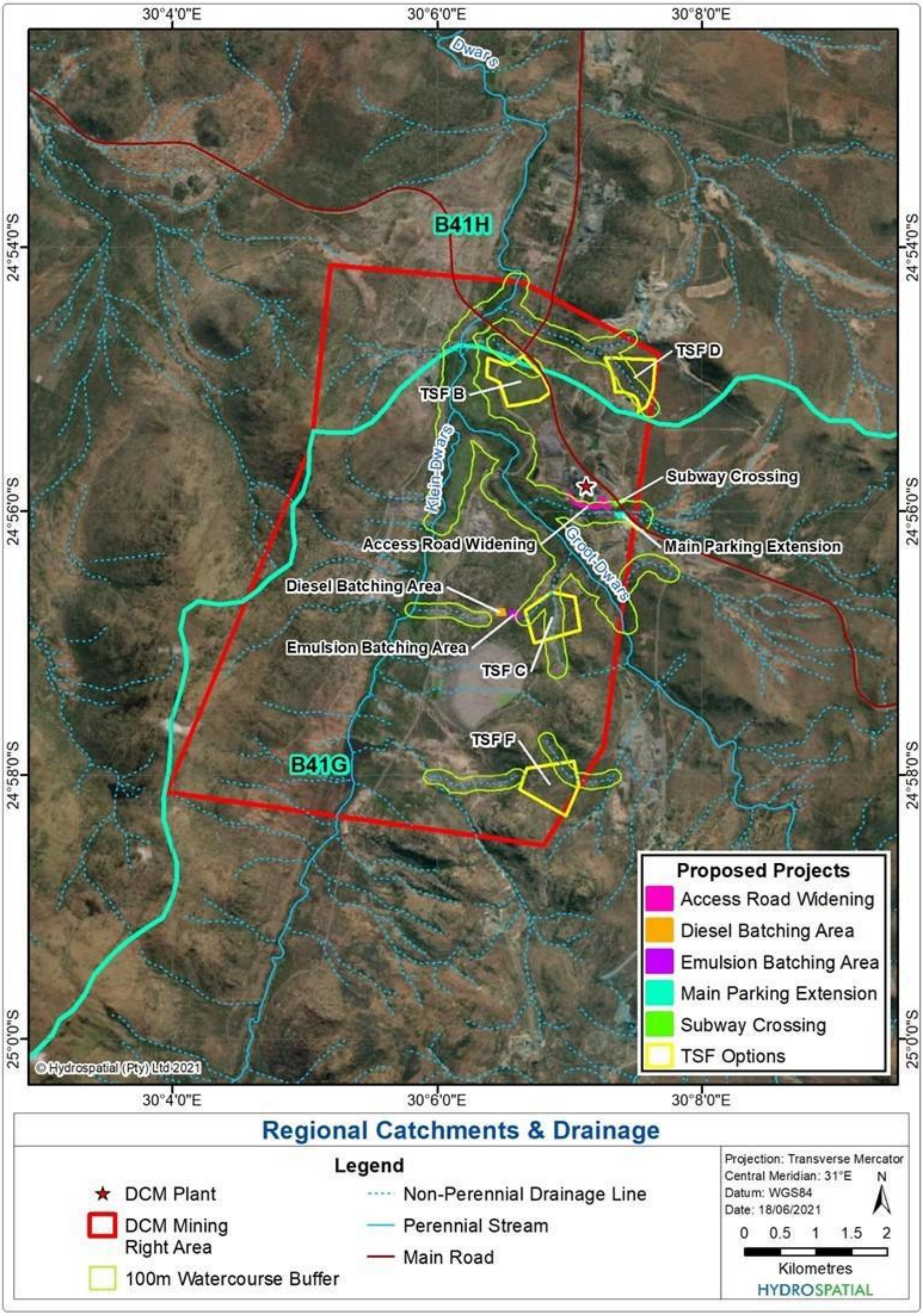


Figure 23: Quaternary Catchments

3.a.iii.1.f.1 Preferred Site Selection

In terms of the hydrological assessment, the following legal considerations are important in the assessment of the preferred site:

National Water Act (Act No. 36 of 1998)

According to section 21 of the National Water Act (Act No. 36 of 1998) (hereafter NWA), the following sections are relevant in terms of water uses –

(c) Impeding or diverting the flow of water in a watercourse; and

(i) Altering the bed, banks, course or characteristics of a watercourse.

Government Notice 704

According to Regulation 4 of Government Notice 704 (GN704), promulgated in terms the NWA, no person in control of a mine or activity may –

(a) Locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year flood line or within a horizontal distance of 100 metres from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on water-logged ground, or on ground likely to become water-logged, undermined, unstable or cracked; and

(b) Carry on any underground or opencast mining, prospecting or any other operation or activity under or within the 1:50 year flood line or within a horizontal distance of 100 m from any watercourse or estuary, whichever is the greatest.

Exemption from the above requirements may be applied for, in terms of Regulation 3 of GN704.

The following General Criteria were considered:

TSF Proximity to Drainage Lines

The rivers and drainage lines indicated on the 1:50 000 topographical map 2430CC Kennedy's Vale, in the vicinity of the TSF site alternatives, were buffered by 100m. This was done to assess the proximity of the TSF options to drainage lines. Furthermore, it is a GN704 Regulation requirement, that tailings dams and associated infrastructure, are placed beyond a 100 m horizontal distance from a watercourse, unless exemption is obtained from the DWS.

Catchment Diversion Area

The topography was assessed to determine the extent of the catchment areas that would need to be diverted around the TSF site alternatives. The larger the diversion area, the higher the negative impact on the streams and drainage lines, as it will not be possible to divert all upslope runoff around the TSF options.

Surface Water Quantity

The selected TSF will be operated as a closed system (as required by GN704) i.e. no discharge of dirty water from the TSF into the environment. Therefore, the larger the TSF area, the more rainwater captured by the TSF, resulting in less runoff and quantity reporting to the downslope streams.

Surface Water Quality

The position of the TSF site alternatives, in relation to surrounding mining activities and downslope water quality, was assessed to determine the alternative that would result in the least disturbance to surface water quality from potential seepage and spillages.

Site Selection outcomes:

3.a.iii.1.f.1.1 TSF Proximity to Drainage Lines

The 100m drainage line buffers for Sites B, C and D are indicated on Figure 24 to Figure 26 respectively. The following table indicates the number of drainage lines within 100m of each of the TSF site alternatives, as well as the distance. Since each of the TSF site alternatives fall within 100m of two drainage lines, the ranking is based on the distance of the TSF site alternatives to the drainage lines.

Table 18: Number of drainage lines within 100 m and distance to TSF options

TSF Option	No. of Drainage Lines within 100 m of TSF	Distance of Drainage Line to TSF	Rank
B	0	>100m	1
C	2	0m and 0m	3
D	2	0m and 63m	2

3.a.iii.1.f.1.2 Catchment Diversion Area

The catchment areas that would need to be diverted around TSF site alternatives B, C and D are indicated on Figure 24 to Figure 26, respectively. As mentioned previously, the larger the catchment area that would need to be diverted, the higher the impact on the drainage line and downslope streams. The following table indicates the catchment areas that would need to be diverted along with the assigned ranking.

Table 19: Catchment diversion areas for the TSF options

TSF Option	Catchment Diversion Area	Rank
B	36.16 ha	2
C	24.7 ha	1
D	97.7 ha	3

3.a.iii.1.f.1.3 Surface Water Quantity

The larger the area of the TSF, the more rainwater it will capture, resulting in less runoff reporting to the downslope streams. The TSF areas are indicated in the following table, along with the assigned ranking.

Table 20: Areas of the TSF options

TSF Option	Area	Rank
B	20 ha	1
C	28 ha	3
D	21 ha	2

3.a.iii.1.f.1.4 Surface Water Quality

No mining activities are located within the catchment area of the drainage lines at Site C. Exposed exploration roads are located in the upslope catchment area of TSF B, as well as what appears to be old borrow pit areas along the northern side of the footprint area. Mining activities are located within the catchment area of Site D, and include the Dwarsrivier Mine North TSF, as well as upslope open pit mining along the koppies to the east and north.

In terms of the potential of the TSF options to negatively alter the surface water quality, the drainage lines associated with Site C have the greatest potential to be altered (as no mining activities are taking place within the catchment), followed by Site B, and then Site D. The assigned rankings are indicated in the following table.

Table 21: Potential for surface water quality to be altered for the TSF site alternatives

TSF Option	Comment	Rank
B	Some disturbance in upslope catchment in terms of mining roads.	2
C	No mining activities in catchment. Highest potential to alter surface water quality.	3
D	Some mining activities in catchment. Intermediate potential to alter surface water quality.	1

3.a.iii.1.f.2 Preferred Site

The site selection assessment indicated that the most preferred option from a surface water perspective is Site B, followed by Sites D and C, respectively.

Table 22: Hydrological Site Selection Outcomes (1 preferred, 3 least preferred)

Consideration	Site B	Site C	Site D
TSF proximity to drainage lines	1	3	2
Catchment diversion area	2	1	3
Surface water quantity	1	3	2
Surface water quality	2	3	1
Outcomes	1	3	2

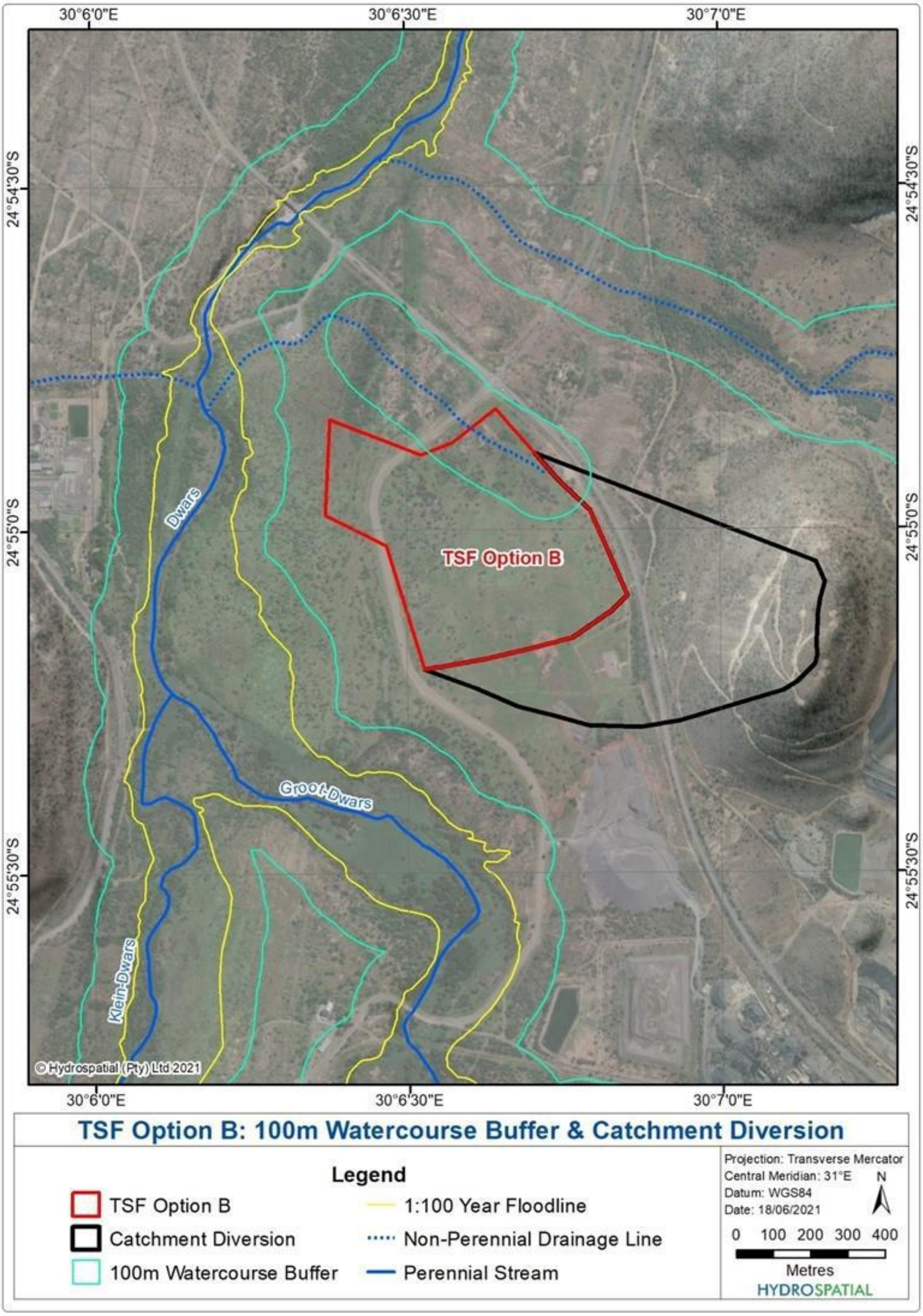


Figure 24: 100m drainage line buffer and catchment diversion for TSF Site B

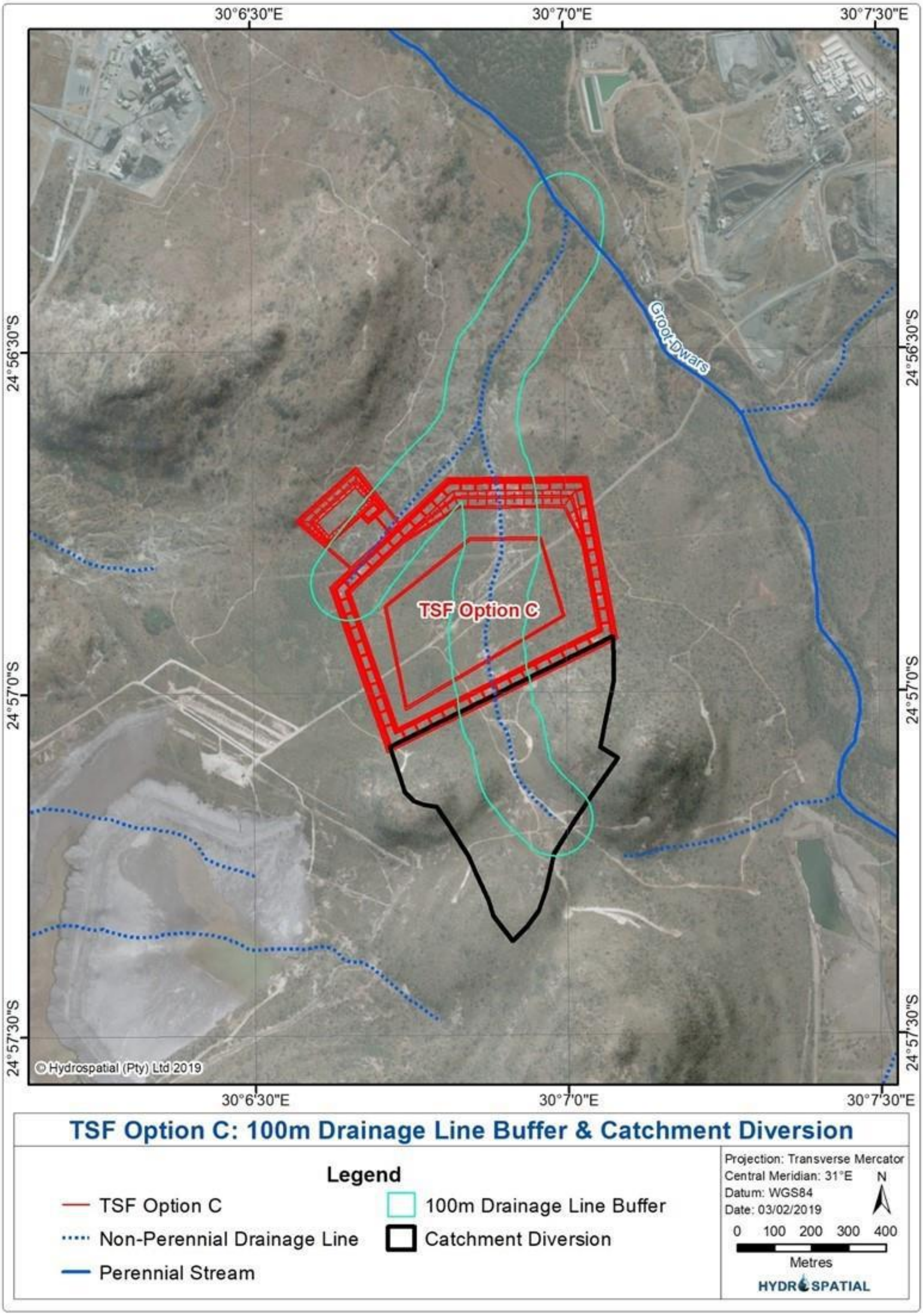


Figure 25: 100m drainage line buffer and catchment diversion for TSF Site C

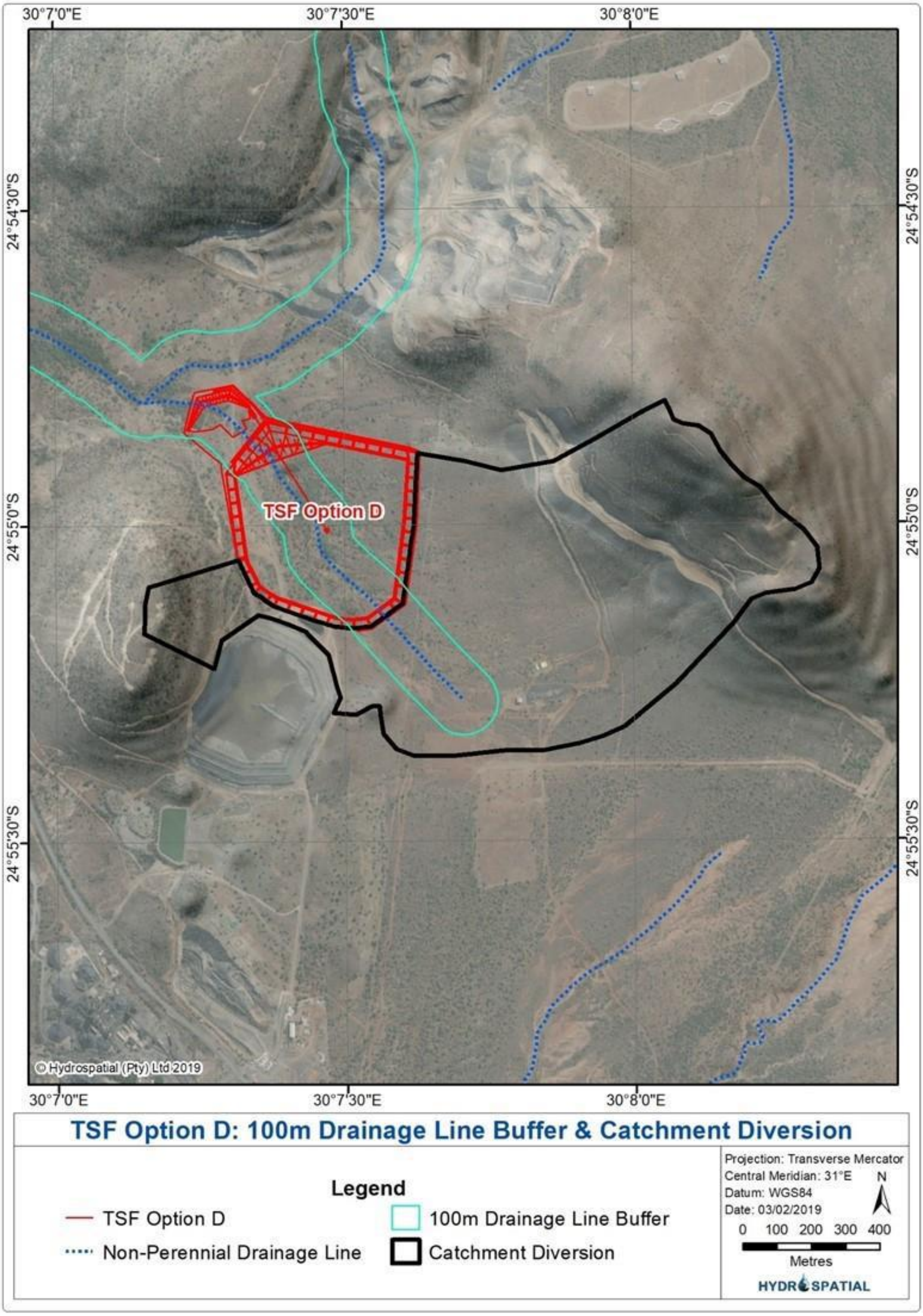


Figure 26: 100m drainage line buffer and catchment diversion for TSF Site D

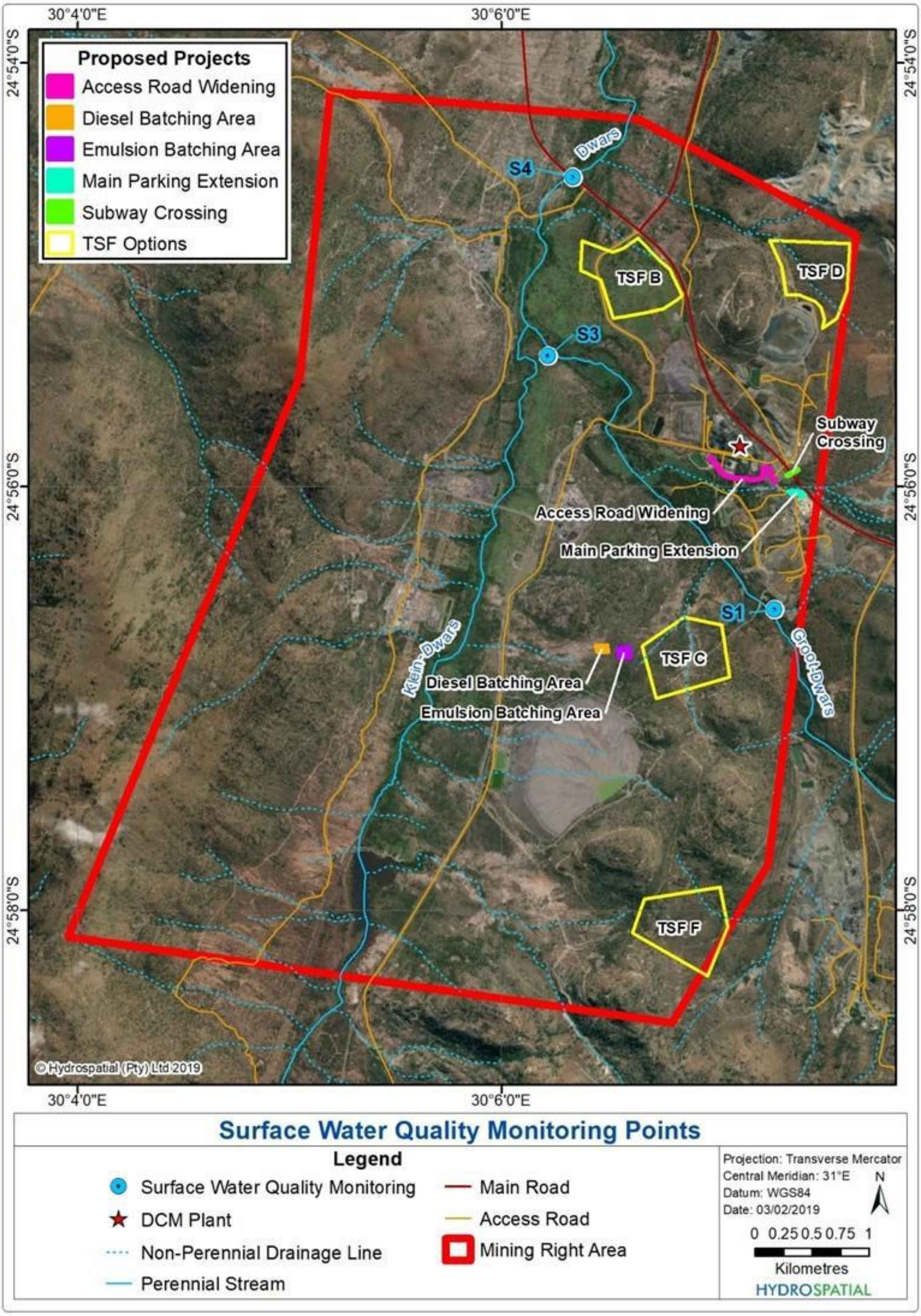


Figure 27: Surface water quality monitoring points

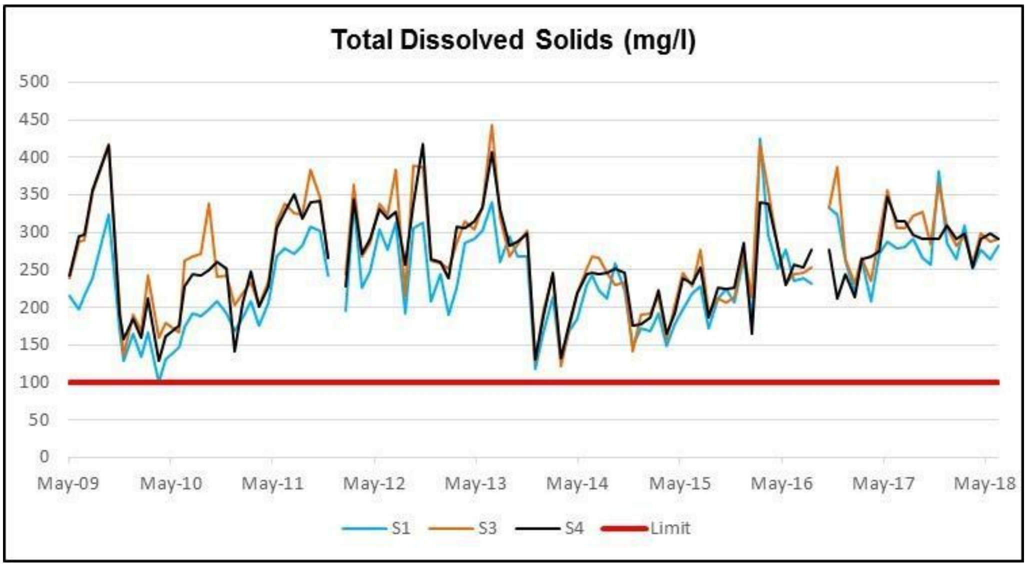


Figure 28: Long term trends in TDS concentrations

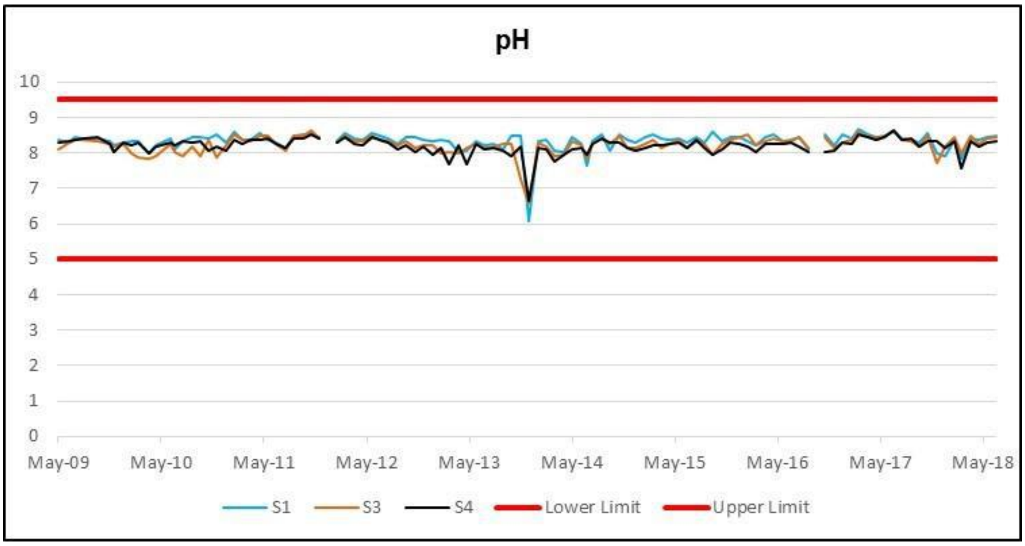


Figure 29: Long term trends in pH levels

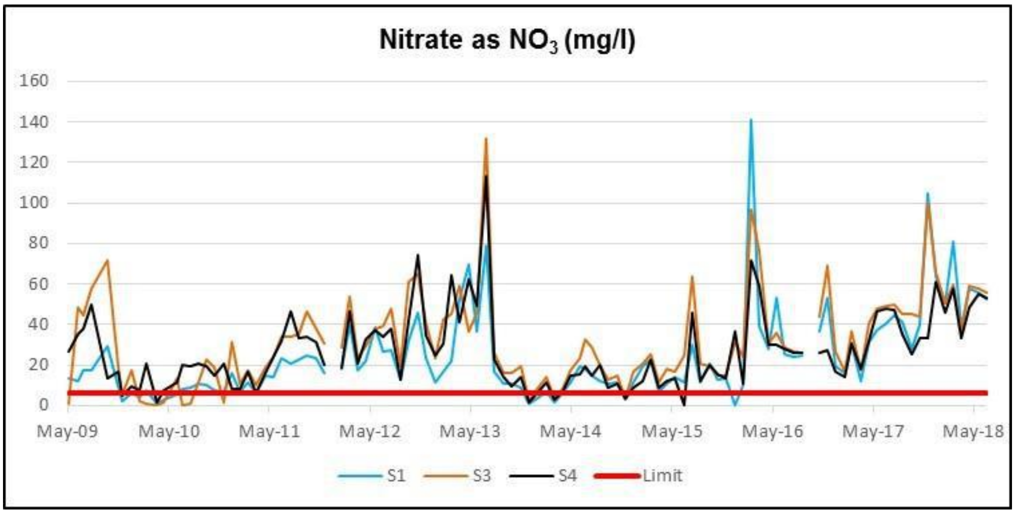


Figure 30: Long term trends in nitrate concentrations

3.a.iii.1.g Hydrogeological Setting

iLEH was appointed to undertake the Hydrogeological Assessment for the site selection process (please refer to Annexure 6). The hydrogeological information was sourced from this report, as well as from existing available information pertaining to Dwarsrivier Mine.

There are three main aquifers found in the area according to the past hydrogeological studies undertaken for the Dwarsrivier Mine. These include:

- A shallow weathered aquifer present in the upper 20m of the geological succession.
- A fractured rock aquifer consisting of fractured pyroxenites, anorthosites and norites. The depth to weathering in this aquifer varies from 0 – 32m, but is on average 8 – 10m below surface. Pockets of deeper weathering are associated with faulting and/or jointing. The intersection of fractures in exploration boreholes suggests that the majority of fractures occur within the upper 60m of the geological succession. Deeper fracturing is however found to a depth of 200m. Information from monitoring boreholes suggests that water-bearing fractures typically occur to a depth of 40m.
- An alluvial aquifer present in the floodplains of the Groot- and Klein Dwarsrivier. In this aquifer, the lithology varies from large boulders to fine silty material. Monitoring boreholes drilled into this aquifer suggests that it is 20m thick on average.

Dwarsrivier Mine monitors 17 boreholes around the operations, of which 16 are stated in the WULs. The boreholes are indicated on the following figure.

Groundwater is used as water supply to the operations. Groundwater is abstracted from six boreholes. Their locations are also indicated on the following figure. Past and current groundwater abstraction patterns are summarised in the following table. This information represents average volumes from the mine's monitoring database.

From a groundwater perspective, the following are considered risks:

- The presence of the alluvial aquifer associated with the Klein- and Groot Dwarsrivier relative to the TSF footprint area. This aquifer is formed by unconsolidated alluvium and is unconfined. It is therefore vulnerable to the impact of surface sources of potential contamination, like that associated with the proposed Khulu TSF.
- The presence of a preferential flow path with high permeability near or under the footprint of the proposed TSF. Such flow paths may be associated with faults and dykes, such as those identified by GAP (2018). It is noted that the current monitoring borehole drilling and aquifer testing underway as part of the Khulu TSF project is geared at characterising the perceived preferential flow paths to groundwater.
- It is noted that the current monitoring borehole drilling and aquifer testing underway as part of the Khulu TSF project is geared at characterising the perceived preferential flow paths to groundwater. Provisional results obtained for aquifers present underneath the Site B footprint suggest that the faults and dyke that underly this area are potentially strong aquifers with high groundwater yields. This risk is highlighted based on preliminary results from groundwater monitoring borehole drilling and aquifer testing. A more detailed assessment will be provided in the EIA Phase report, once this fieldwork has been completed. However, the presence of potentially strong aquifers underneath the Site B footprint is identified as a potential risk.

It is noted that both risks listed above can be mitigated through selection and implementation of a suitable barrier system (liner) over the TSF footprint. The impact of liner failure, leakage through the liner or poor liner installation will however result in a higher risk to groundwater in the presence of the alluvial aquifer or a preferential flow path with high permeability.

The following groundwater-related fatal flaws were identified:

- The presence of a shallow groundwater table that may rise into the base layer of the liner of the TSF during the wet season.
- The TSF situated near existing groundwater users and therefore potentially impacting on existing use.
- The TSF not lined with a suitable barrier system, including HDPE layer(s).

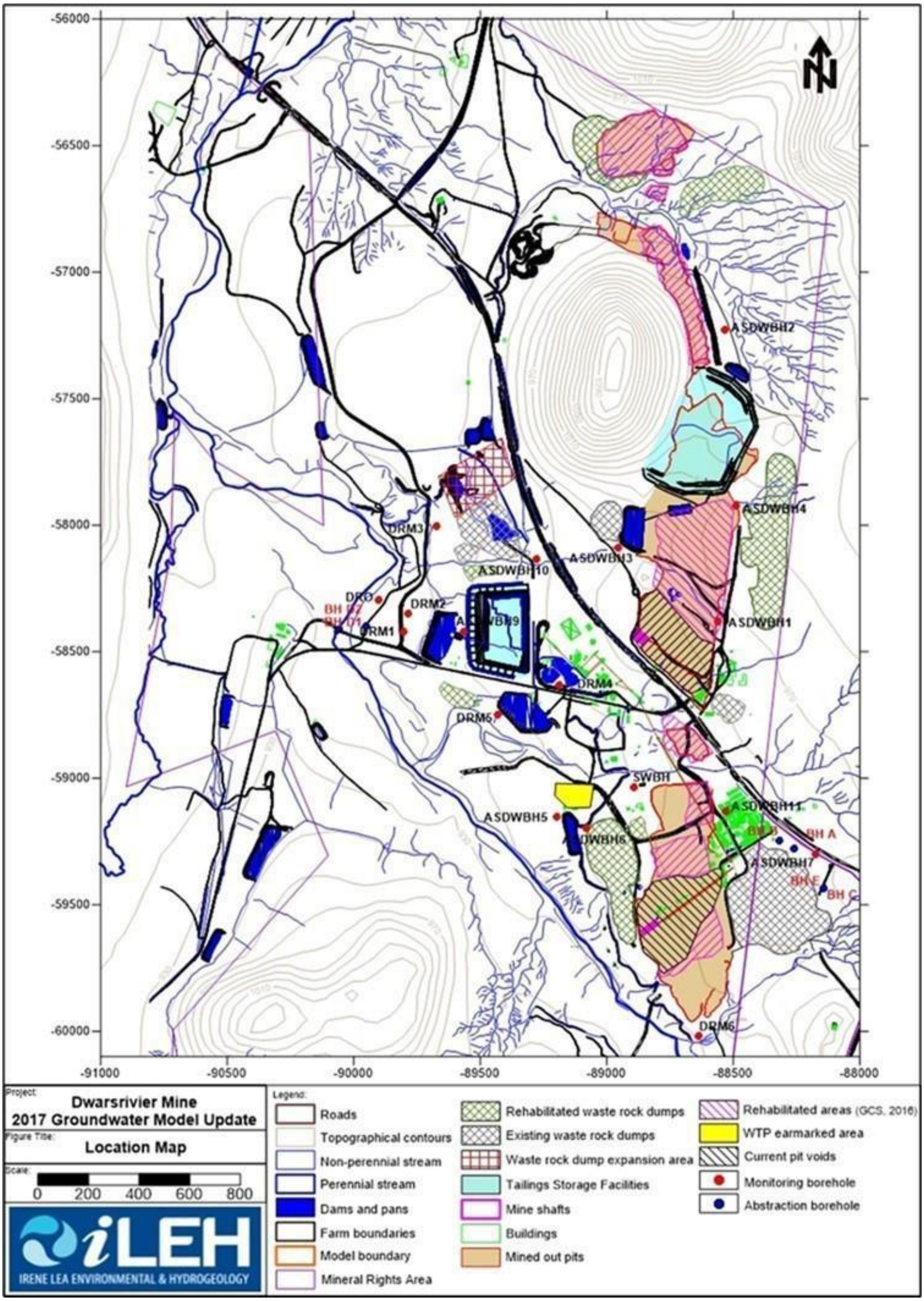


Figure 31: Groundwater Monitoring Points

3.a.iii.1.g.1 Preferred Site Selection

In order to complete the geohydrological site selection assessment, the criteria as presented in the table below were considered.

Table 23: Evaluation criteria

Criteria	Significance	Ranking
Current status of the aquifer(s)	The extent to which groundwater quality is already impacted upon at each site will determine the significance of additional impacts associated with the Khulu TSF. For example, the impact on a pristine aquifer is anticipated to be more significant.	Significantly impacted: 1 Moderately impacted: 2 Pristine aquifer conditions: 3
Proximity to preferential groundwater flow paths	Preferential flow paths to groundwater, which may include faults and dykes, will convey potential contamination from the site faster, thus resulting in adverse impacts on regional aquifers.	No known preferential flow paths: 1 One preferential flow path: 2 More than one preferential flow path: 3
Existing groundwater use	Potential contamination from the TSF may affect existing groundwater use, specifically groundwater abstraction by Dwarsrivier Mine.	No groundwater use: 1 Limited groundwater use: 2 Significant groundwater use: 3
Extent of undermining	Undermining of the site is expected to affect the stability of the TSF. Potential impacts anticipated with undermining include the risk of subsidence and the creation of additional groundwater preferential flow paths between the TSF and the aquifers.	No undermining: 1 Possible future undermining: 2 Existing/historical undermining: 3
Presence of rivers and streams	Available information suggests that groundwater discharges to watercourses (rivers and streams) as base flow. The presence of watercourses will therefore result in shallow groundwater level conditions. Potential contamination from the TSF may also have a negative impact on watercourses.	No watercourses present: 1 Non-perennial watercourses present: 2 Perennial watercourses present: 3
Data availability	If no information is available to characterise the aquifers present as part of this site selection assessment, erroneous outcomes may be achieved.	Information is available: 1 Limited information is available: 2 No information is available: 3

A summarised site description for each site alternative is presented in the following table. The information provided is based on the evaluation of the available information and on the components of significance to groundwater indicated on the two figures provided earlier in the report Figure 13 and Figure 14.

Table 24: Summary of site description

Component	Site B	Site C	Site D
Location	North of Discard Dump	Southwest of South Shaft	North of Northern TSF
Toe area of TSF	24ha	21ha	19ha
Duration of capacity	20	25	20
Existing impacts on groundwater	Discard Dump, Plant, Historical TSF	Historical pits, underground mining; TRP TSF	Northern TSF, historical pits, waste rock dumps
Underlying lithology's	Alluvium (risk)	Alluvium (risk)	Alluvium (risk)/Norite/ Anorthosite
Mining activities	Overlying possible future UG workings	Overlying existing UG workings	Overlying a backfilled and rehabilitated pit
Proximity to known faults	Overlying a fault (risk)	Overlying a fault (risk)	870m
Proximity to known dykes	Overlying 2 dykes (risk)	120m	380m
Surface drainage	Within an existing watercourse	Within an existing watercourse	Within an existing watercourse
Depth to groundwater table (Oct'18)	DRM3: 4,53m (risk)	DRM6: 9,03m	ASDWBH2: 16,12m

Component	Site B	Site C	Site D
Groundwater flow direction	Westerly	Westerly	North westerly
Groundwater quality (Jul '18)	DRM3: TDS: 1627mg/l NO_3: 279 mg/l	DRM6: TDS: 592mg/l NO_3: 34,1 mg/l	ASDWBH2: TDS: 556mg/l NO_3: 34,8 mg/l
Existing groundwater use	Monitoring	Monitoring	Monitoring
Nearest abstraction borehole	725m (BH D1+D2)	1270m ((BH C+E)	1690m (BH D1+D2)
Potential data gaps	Characterisation of potential preferential flow paths	Characterisation of potential preferential flow paths	Characterisation of potential preferential flow paths
Further work required	- Characterisation of aquifers - Groundwater impact assessment	- Characterisation of aquifers - Groundwater impact assessment	- Characterisation of aquifers - Groundwater impact assessment

The following can be concluded from the information presented in the table above:

Site B:

The underlying lithology at this site is alluvium associated with the Dwars and Groot Dwars Rivers, which creates a major regional aquifer. Dwarsrivier Mine currently abstracts groundwater from this aquifer from BH D1 and D2, situated 725m southwest from Site B. Site B is not currently undermined, but future underground mining is planned for this area. Site B is furthermore underlain by both a fault and a dyke. These structures may act as preferential flow paths to groundwater. Dwarsrivier Mine is in the process of drilling and testing monitoring boreholes that target the dyke and fault present in order to quantify the extent to which these structures could act as preferential flow paths. The provisional results from the drilling and testing programme suggests that strong aquifers are associated with these geological structures with potential high yields. This was identified as a potential risk, as detailed above. The site is situated within an existing watercourse associated with the alluvial aquifers, which suggests that shallow groundwater conditions may occur during the wet season. The site is also situated on or near the alluvial aquifer associated with the Klein and Groot Dwars Rivers. This must be confirmed should this site be developed further. Groundwater in this area has already been impacted by the historical TSF, the Plant and the discard dump. The total dissolved solid (TDS) and nitrate (NO3) concentrations in the nearest borehole (DRM3) confirm the poorest groundwater quality conditions for the four sites evaluated. The depth to groundwater at this site is the shallowest of all the sites evaluated (4,53m), which means that the barrier between the TSF and the aquifer is the smallest for all four sites. It is not thought that groundwater levels would rise to surface and thus into the liner system. The shallow groundwater is however flagged as a potential risk. Groundwater is not used in the immediate vicinity of Site B other than being monitored.

Site C:

This site is underlain by alluvium that forms part of the regional alluvial aquifer associated with the main rivers in the area, as for Site B. Site C is situated south of the Dwarsrivier Mine mining surface infrastructure, but is underlain by the existing underground workings at South Shaft. South Pit is situated 550m northeast of the site. The existing TRP TSF is situated approximately 150m southwest of this site. The site overlies a fault identified by GAP (2018), but the nearest dyke is 120m to the east. The footprint is located within an existing watercourse that drains towards the Groot Dwarsrivier. The depth to groundwater in the nearest borehole (DRM6) is 9m, which creates a larger barrier between the proposed TSF and the underlying groundwater table compared to Site B. Groundwater quality in this area has also been impacted on, especially in terms of NO_3 concentrations, but not to the same extent as at Site B. Groundwater is not used at this site other than for monitoring and the nearest groundwater abstraction boreholes (BH D1 and D2) are situated 1,270m to the northwest.

Site D:

The site is situated immediately north of the existing North TSF. The regional geological map suggests that the footprint is situated partly on alluvium and partly on norite/anorthosite. Groundwater in this area has already been impacted on by historical opencast mining, waste rock dumps and possibly by the North TSF. It is noted that the latter has an HDPE liner installed. This footprint is partially underlain by an old backfilled and rehabilitated opencast pit. It is however noted that the NTSF also overlies an old pit, which suggests that this situation can be overcome through implementation of the appropriate engineering solutions. This site is not underlain by the faults or dykes identified by GAP (2018). The site is situated in an existing watercourse, with surface water draining in a northeasterly direction towards the Dwarsrivier. The depth to groundwater in borehole ASDWBH2, situated within the designated footprint area, is however, 15.73m, which is the deepest groundwater table condition for the three sites evaluated. Groundwater quality is already impacted in this area, most notably in terms of NO_3 concentrations. The nearest Dwarsrivier Mine boreholes used for groundwater abstraction in this area are situated 1,690m southwest of the site.

Table 25: Groundwater Site Selection Outcomes (1 preferred, 3 least preferred)

Criteria	Site B	Site C	Site D
Current status of the aquifer(s)	1	2	1
Proximity to preferential groundwater flow paths	3 (risk)	2	1
Existing groundwater use	2	2	2
Extent of undermining	2	3 (risk)	3 (risk)
Presence of rivers and streams	3 (risk)	2	2
Data availability	1	2	1
Score	**2**	**3**	**1**

* Assumption as no data is available

Site B scored similar to Site D and could therefore also be considered as a preferred alternative, provided that the risks identified are managed to avoid or minimise negative impacts on groundwater. The risks associated with Site B include the presence of the alluvial aquifer under or near the TSF footprint, the presence of potential preferential flow paths to groundwater and shallow groundwater level conditions.

3.a.iii.1.h Freshwater Resources

SAS was appointed to undertake a Freshwater Resource Assessment for the site selection process (please refer to Annexure 7). The wetland and aquatic habitat setting information was sourced from this report, as well as from existing available information pertaining to Dwarsrivier Mine.

The areas are located in the Highest Biodiversity Importance areas include areas where mining is not legally prohibited, but where there is a very high risk that due to their potential biodiversity significance and importance to ecosystem services (e.g. water flow regulation and water provisioning) that mining projects will be significantly constrained or may not receive the necessary authorisations.

Sites C and the majority of Site B fall within an area defined as a Freshwater Ecosystem Priority Area (FEPA) catchment, with the remaining northern portion of Site B and the Site D located within an area considered a Fish Support Area (FSA). FEPAs achieve biodiversity targets for river ecosystems and threatened fish species and were identified in rivers that are currently in a good condition (A or B ecological category). Although the FEPA status applies to the actual river reach, the surrounding land and smaller stream network needs to be managed in a way that maintains the good condition of the river reach. Remaining fish sanctuaries in lower than an A or B ecological condition were identified as FSAs. Furthermore, the FSAs include sub-quaternary catchments important for migration of threatened fish species (Figure 32).

In term of the NFEPA Wetlands:

- No wetlands or rivers are indicated by the NFEPA database within any of the three TSF sites (Figure 33).
- The Dwarsrivier is located within the western portion of Site B's investigation area. The river is a designated FSA and is currently in a moderately modified ecological condition (Class C).
- The Groot-Dwarsrivier traverses the south-western portion of Site B's investigation area and the north-eastern portion of Site C's investigation area. This river is considered largely natural (Class B) and is a designated FEPA River (Figure 36 and Figure 37).

The TSF site alternatives fall within the Central Bushveld Group 1 Wetland Vegetation Type, considered critically endangered (CR) (Mbona et al, 2015).

According to the National Biodiversity Assessment NBA (2018): South African Inventory of Inland Aquatic Ecosystems (SAIIAE) dataset, the Dwarsrivier and Groot Dwarsrivier are largely modified. The Ecosystem

Protection Level (EPL) of the rivers are poorly protected and therefore the rivers are critically endangered (Ecosystem Threat Status (ETS)).

For the aquatic biodiversity theme, the three TSF site alternatives, with the exception of Site B and the entire Site D, are considered to have an overall aquatic sensitivity of very high, due to the area being classified as a FEPA catchment (NFEPA, 2011). The remaining northern portion of Site B and the entire Site D have a low aquatic sensitivity.

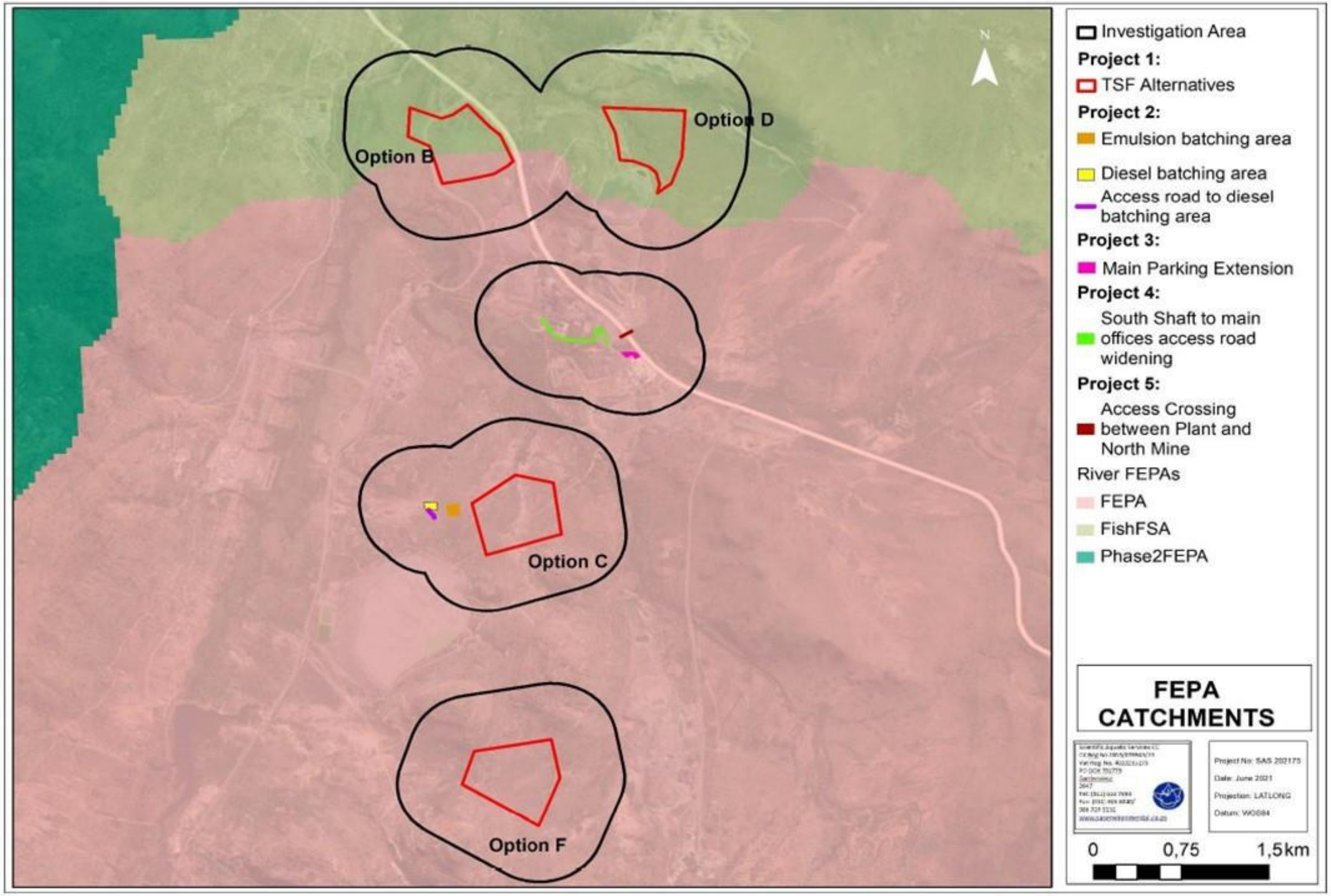


Figure 32: The wetland features identified as FEPA wetlands, according to the NFEPA Database (NFEPA, 2011).

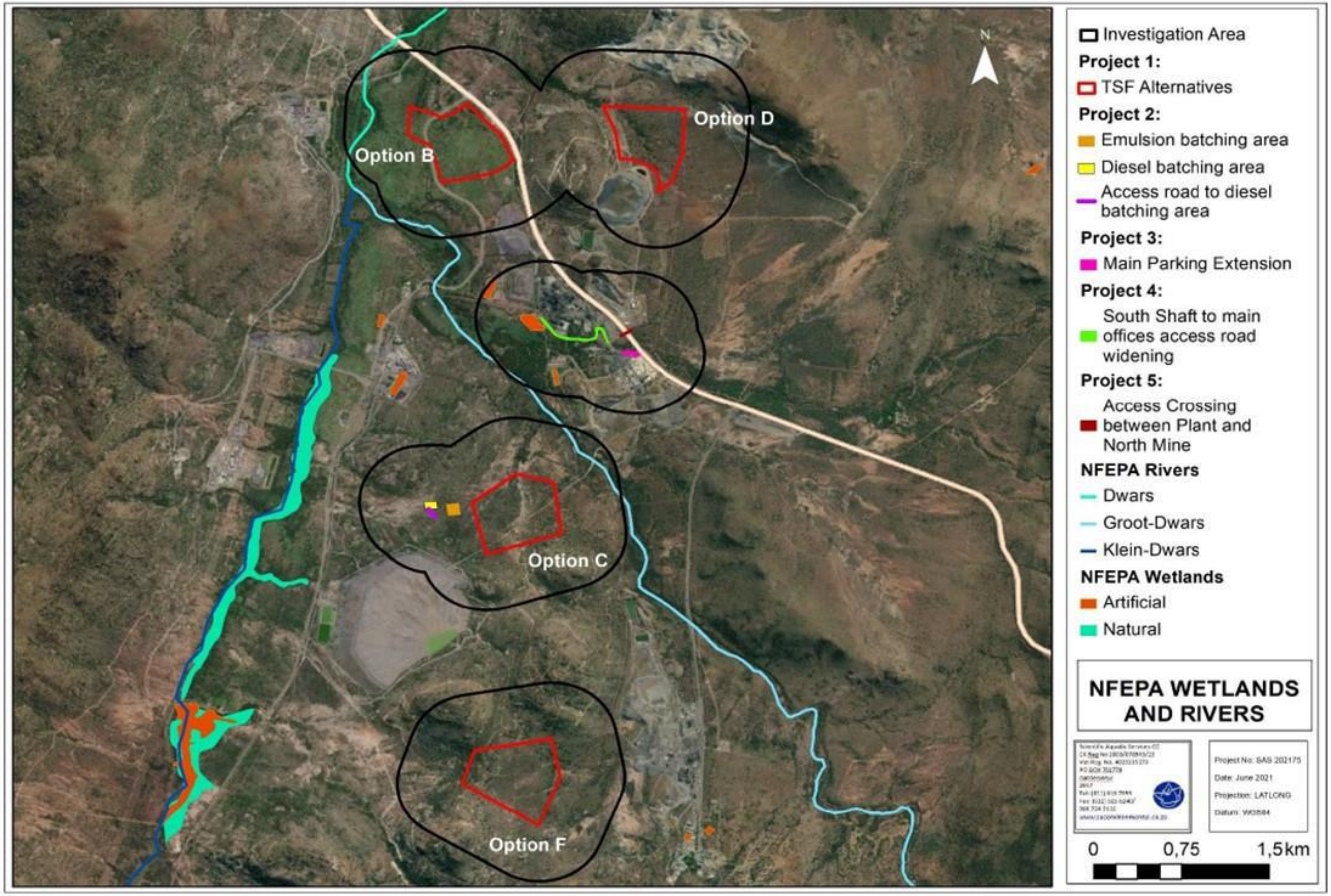


Figure 33: The natural and artificial wetland features, and rivers associated with the TSF site alternatives according to the NFEPA Database (NFEPA, 2011)

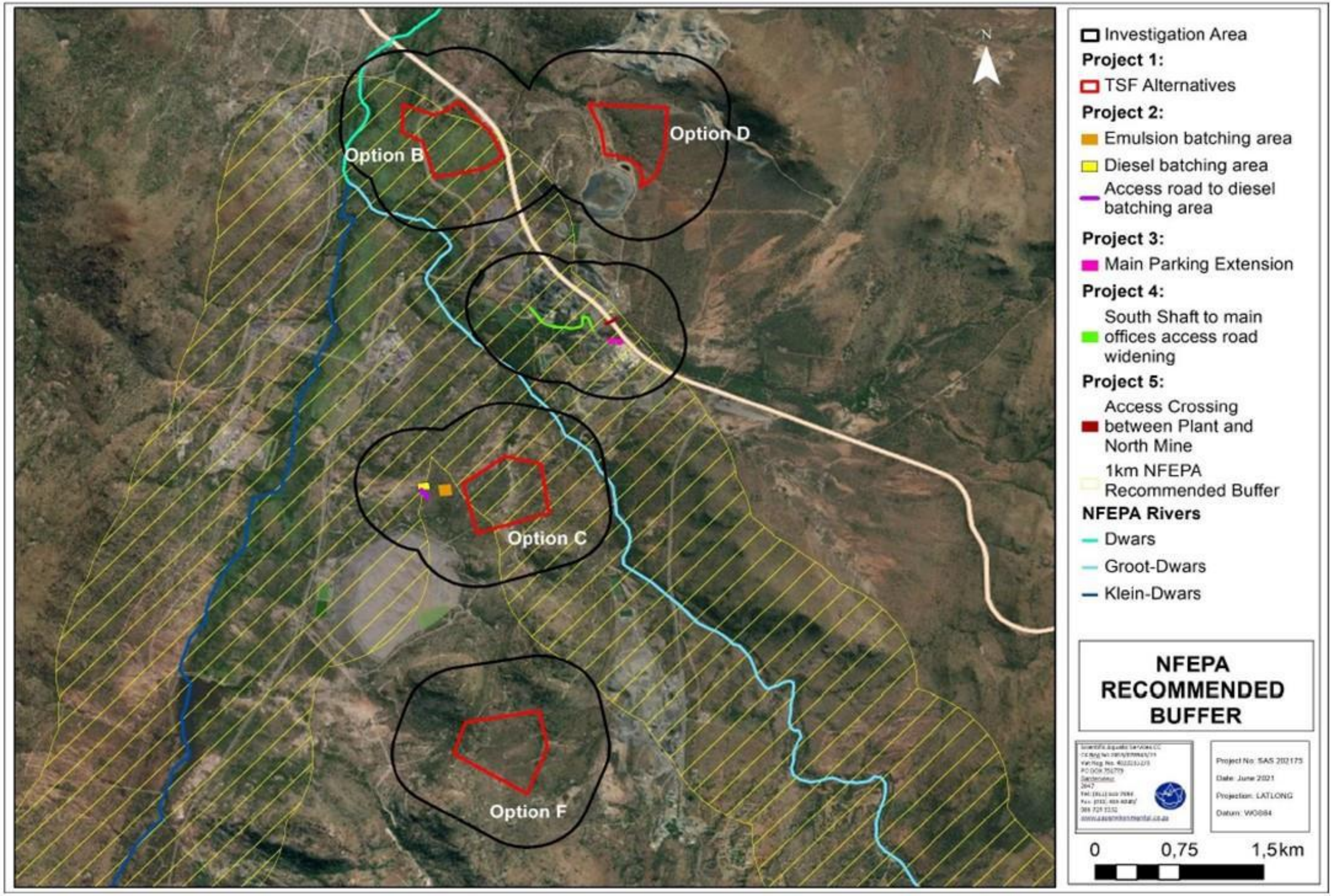


Figure 34: The 1 km recommended buffer around the FEPA Rivers, according to the NFEPA Database (2011)

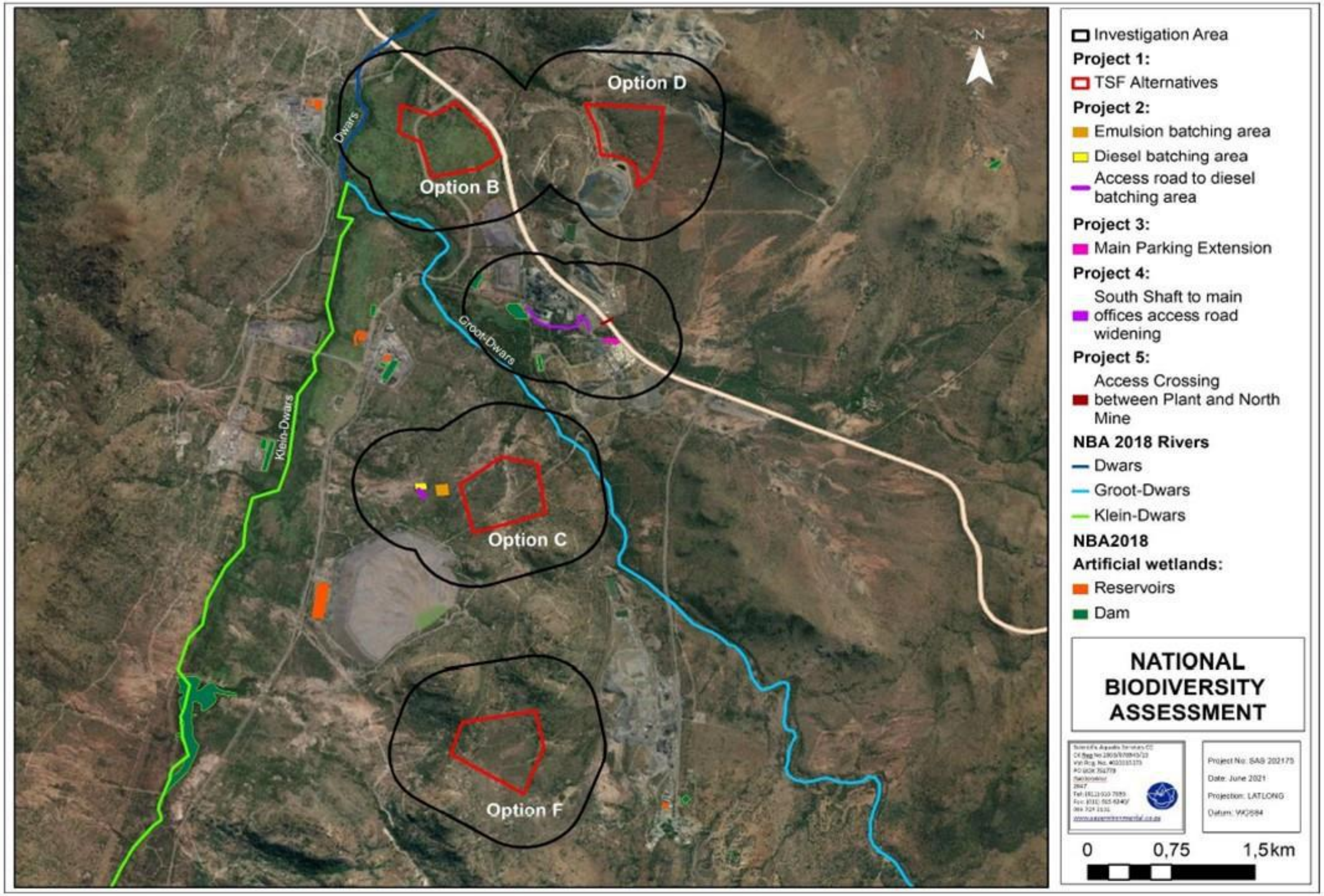


Figure 35: Artificial wetlands associated with the five proposed projects according to the National Biodiversity Assessment (NBA) (2018)

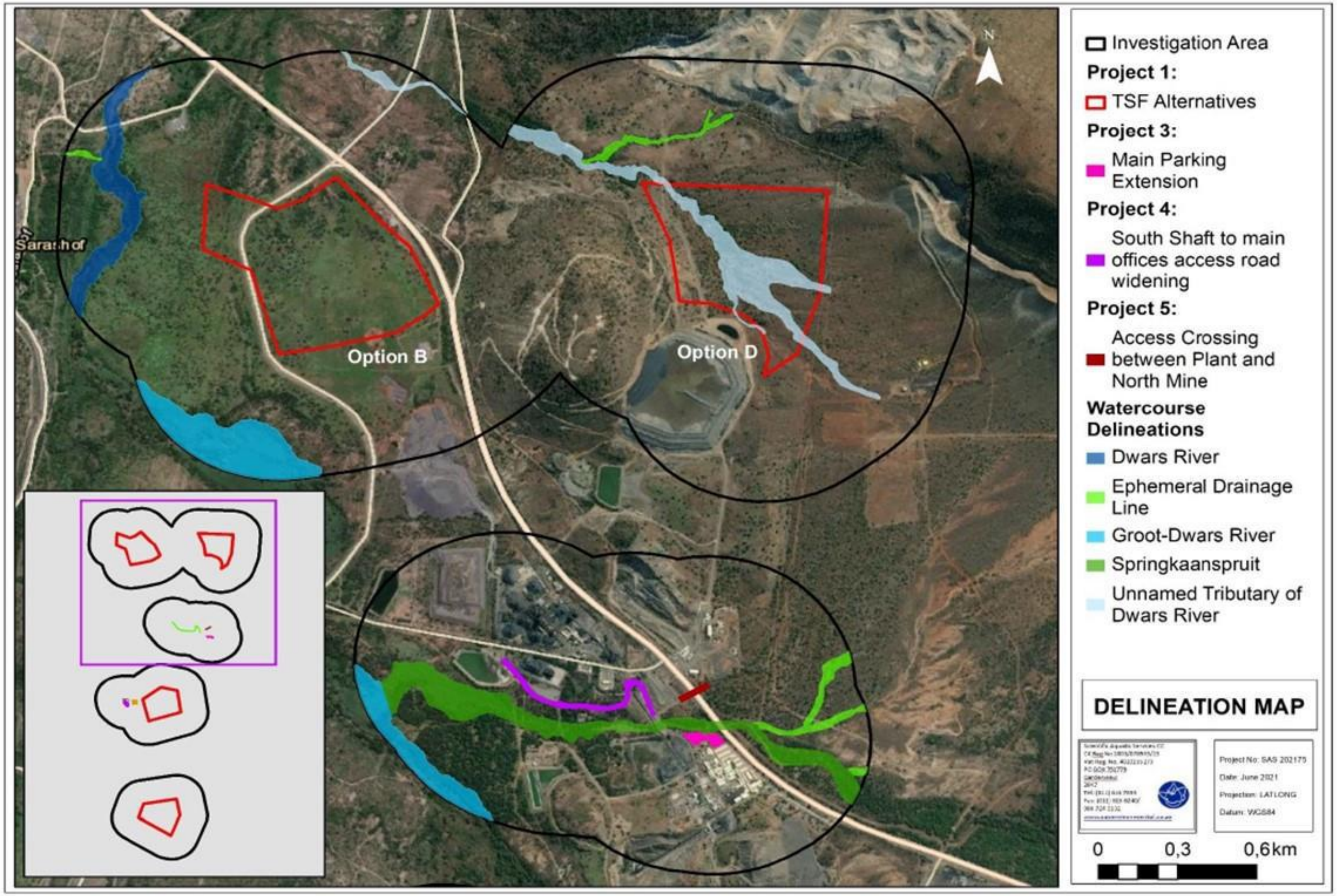


Figure 36: Identified watercourses within the vicinity of Projects 1,3, 4 and 5

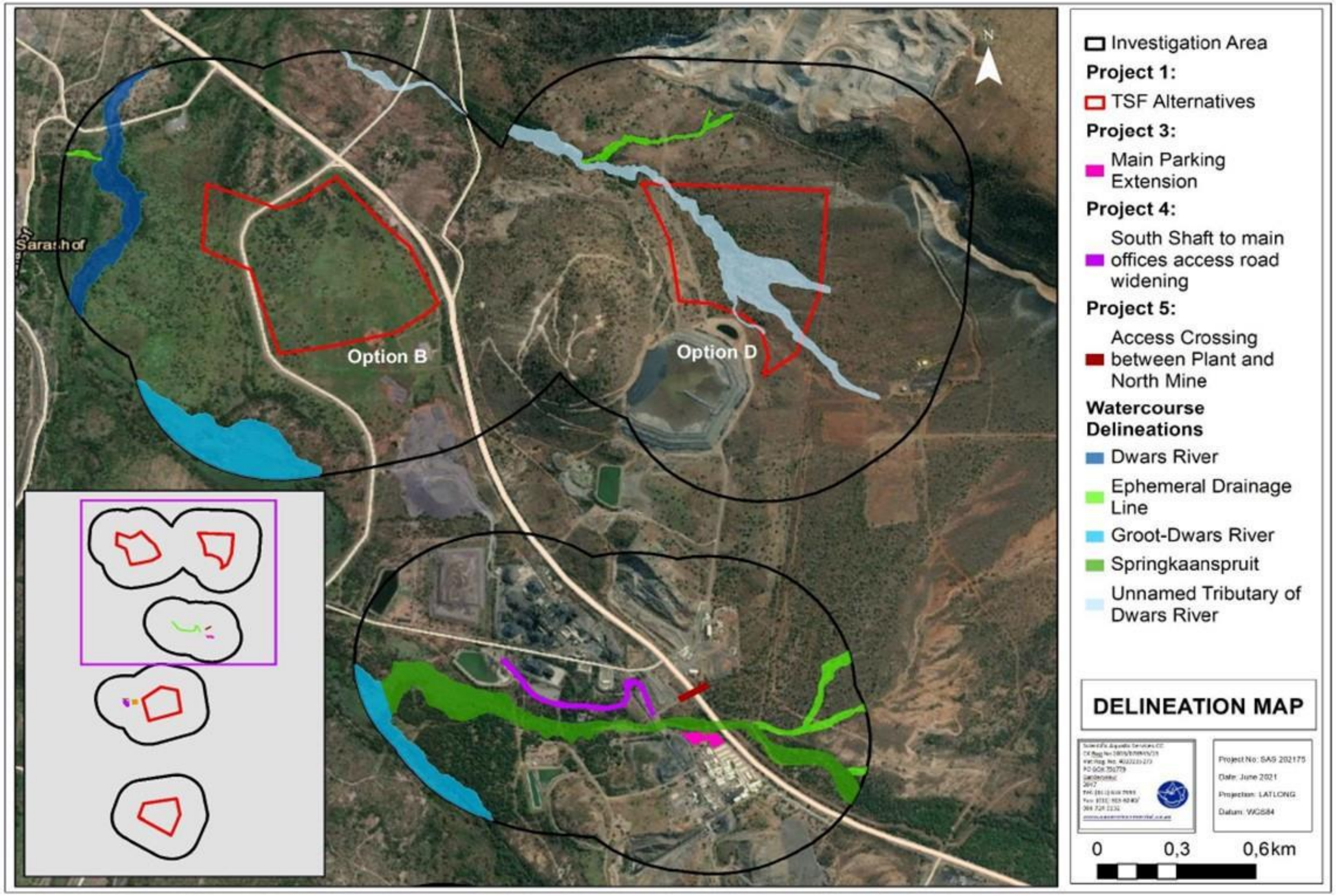


Figure 37: Identified watercourses within the vicinity of Projects 1 and 2

3.a.iii.1.h.1 Preferred Site Selection

Whilst a detailed assessment of the Present Ecological State (PES), Ecological Importance and Sensitivity (EIS) and ecological and socio-cultural services provision of these freshwater resources did not form part of the scope of work of this phase of the study, previous studies undertaken by SAS for the mine were consulted to supplement information obtained during the site assessment. The freshwater resources identified within each TSF site alternative are considered moderately modified, of moderate EIS, and likely to provide intermediate levels of ecological and socio-cultural goods and service provision.

The findings of this assessment, including limiting factors within each TSF site alternative are summarised below:

Table 26: Overall Land Capability associated with the TSF Alternatives and constrains for agriculture

Alternative	Site B	Site C	Site D
Freshwater ecology of site	No watercourses were identified within Site B. The site is located up-gradient and approximately 230m east of the Dwarsrivier. The site is also located approximately 350m south and down-gradient of an ephemeral, unnamed tributary of the Dwarsrivier.	A single freshwater resource, specifically an unnamed tributary of the Groot Dwarsrivier, traverses the central portion of the site. The reach of the freshwater resource within the site is approximately 1ha in extent. Whilst some impacts were noted (such as bank incision due to the naturally erosive nature of the soils in the vicinity), the resource is considered to be in a moderately modified to largely natural ecological condition.	An unnamed tributary of the Dwarsrivier was identified within the central portion of this site. SAS (2018) classified this resource as being in a PES Category B/C (largely natural to moderately modified) and of moderate EIS. The extent of this freshwater resource within the site is approximately 7.3ha.
Business Case	The construction of the proposed TSF in this location does not pose any direct threat to any watercourses. However, indirect impacts could potentially occur during construction such as contaminated stormwater runoff reaching the Dwarsrivier. Similarly, no direct impacts are envisaged during the operational phase should the proposed TSF be placed in this site; however, in the event of failure of the TSF, significant impacts to the Dwarsrivier could occur, particularly without appropriate mitigation.	Construction of the proposed TSF in this location poses a direct threat to the freshwater resource. Anticipated impacts include loss of riparian habitat, increased sedimentation and erosion of the resource, and possible impacts on the downstream system should an extreme event (such as a spill) occur. Furthermore, should the TSF be constructed in this site, additional support infrastructure (roads, pipelines, power lines etc.) would be required, which may potentially require freshwater resource crossings, thus increasing the risk of cumulative impacts on the freshwater ecology of the surrounding area.	Construction of the proposed TSF in this location poses a direct threat to the freshwater resource. Anticipated impacts as a result are identical to those identified for Site C. Taking into consideration the surrounding mining activities and anticipated encroachment thereof however, as well as proximity to the existing North TSF, utilisation of Site D could potentially reduce the impact on freshwater resources in the two other TSF alternatives and the greater MRA when considering this in comparison with the other two options. Consideration must be given to known future activities within the MRA.
Preferred Site (from a freshwater ecology perspective)	Preferred, since the placement poses no direct threat to any watercourses. Strict mitigation, including ensuring that the design and operation of the TSF does not lead to failure thereof, will be necessary to prevent any possible indirect impacts on the Dwarsrivier.	Not preferred.	Not preferred; however, it is acknowledged that utilisation of this site may assist in protection of the freshwater ecology within the greater MRA in comparison with the other two sites, provided that future expansion plans are taken into consideration during the site selection process.
Rating	1	3	2

The construction of the proposed TSF within Site C or Site D has the potential to have an unacceptably high impact on the watercourse within each respective site. Such impacts may also potentially affect downstream systems.

From a freshwater ecological perspective therefore, Site B is the preferred option, as no direct impacts arising from the construction and operation of the TSF within that location to the receiving freshwater environment are anticipated. Nevertheless, indirect impacts, including potential failure of the TSF, could occur and may potentially be detrimental to the Dwarsrivier specifically, if suitable mitigation measures are not strictly implemented throughout all phases.

Although no watercourses are directly associated with the remaining projects (i.e. not situated directly within the proposed project areas), the proposed Site B is possibly located over an alluvial aquifer, which places this area potentially in a watercourse (considering the alluvial aquifer as a watercourse).

3.a.iii.1.i Visual Character

Hydrospatial was appointed to undertake a Visual Assessment for the site selection process (please refer to Annexure 8). The visual setting information was sourced from this report.

The viewsheds within a 5km radius of TSF site alternatives B, C and D are indicated on Figure 39 to Figure 40**Error! Reference source not found.** respectively. Visual receptors identified include farmhouses, as well as the main roads in the area.

The following table provides a summary of the visible areas, and number of visual receptors impacted.

Table 27: Summary of the visible areas, number of visual receptors impacted and site selection rank

TSF Options	Visible Area (km^2)	No. of Visual Receptors Impacted
Site C	27.4	12
Site D	30.5	13
Site B	40.6	15

The following table presents the raking for the preferred site:

Table 28: Visual Site Selection Outcomes (1 preferred, 3 least preferred)

Consideration	Site B	Site C	Site D
Most Visible in terms of visual receptors	3	1	2
Outcomes	3	1	2

As can be observed, Site C has the smallest visible area and least number of visual receptors impacted, and is therefore ranked 1 (most favourable), followed by Site C, and then Site D. Although Site C is the most favourable in terms of the criteria used to assess the TSF site alternatives, it must be noted that all alternatives fall within an area dominated by mining activities and infrastructure. Due to the visual aesthetics and sense of place of the area being previously altered from rural bushveld to mining, it is unlikely that the implementation of any of the TSF options would result in a significant visual impact.

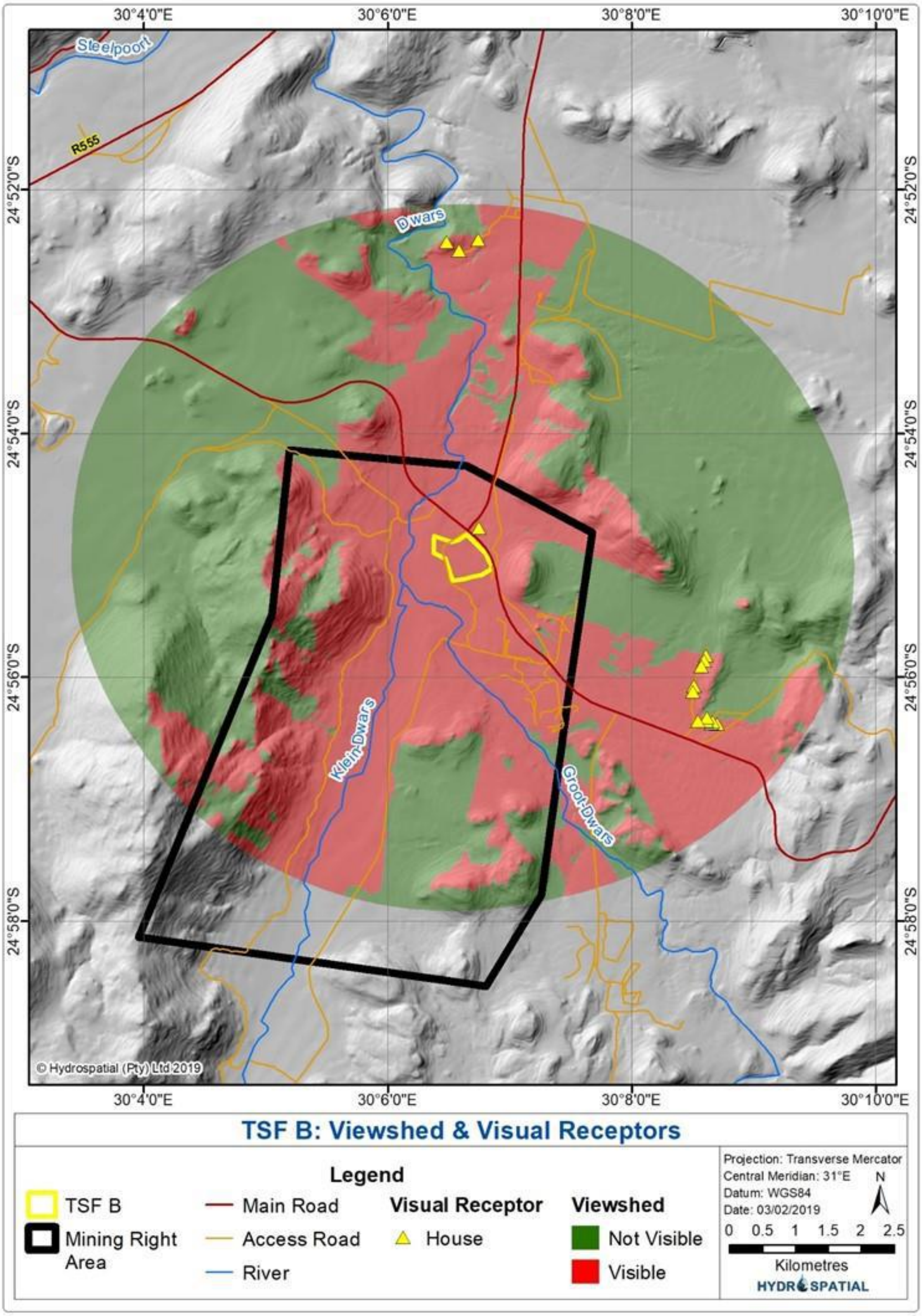


Figure 38: Viewshed and visual receptors for Site B

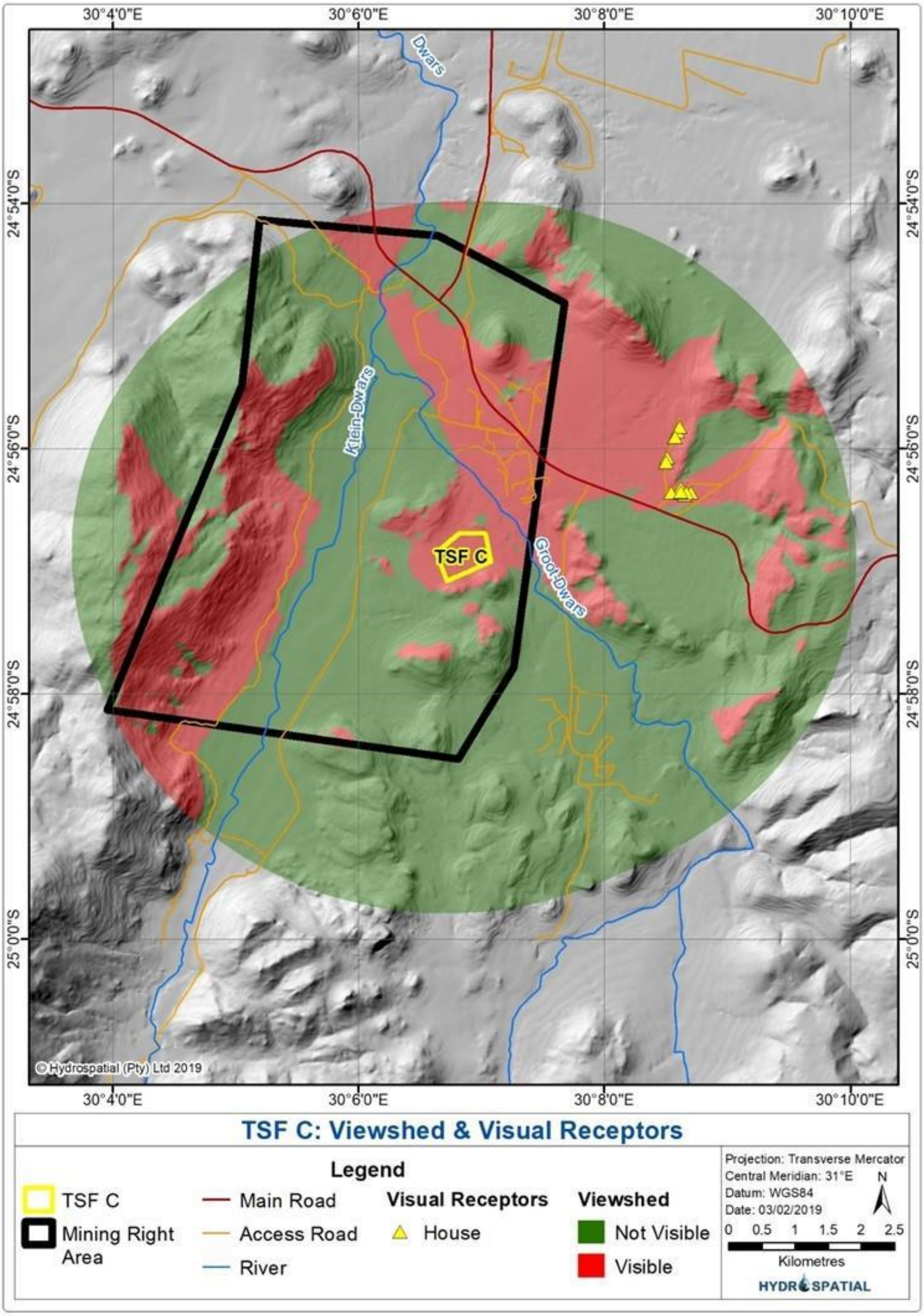


Figure 39: Viewshed and visual receptors for Site C

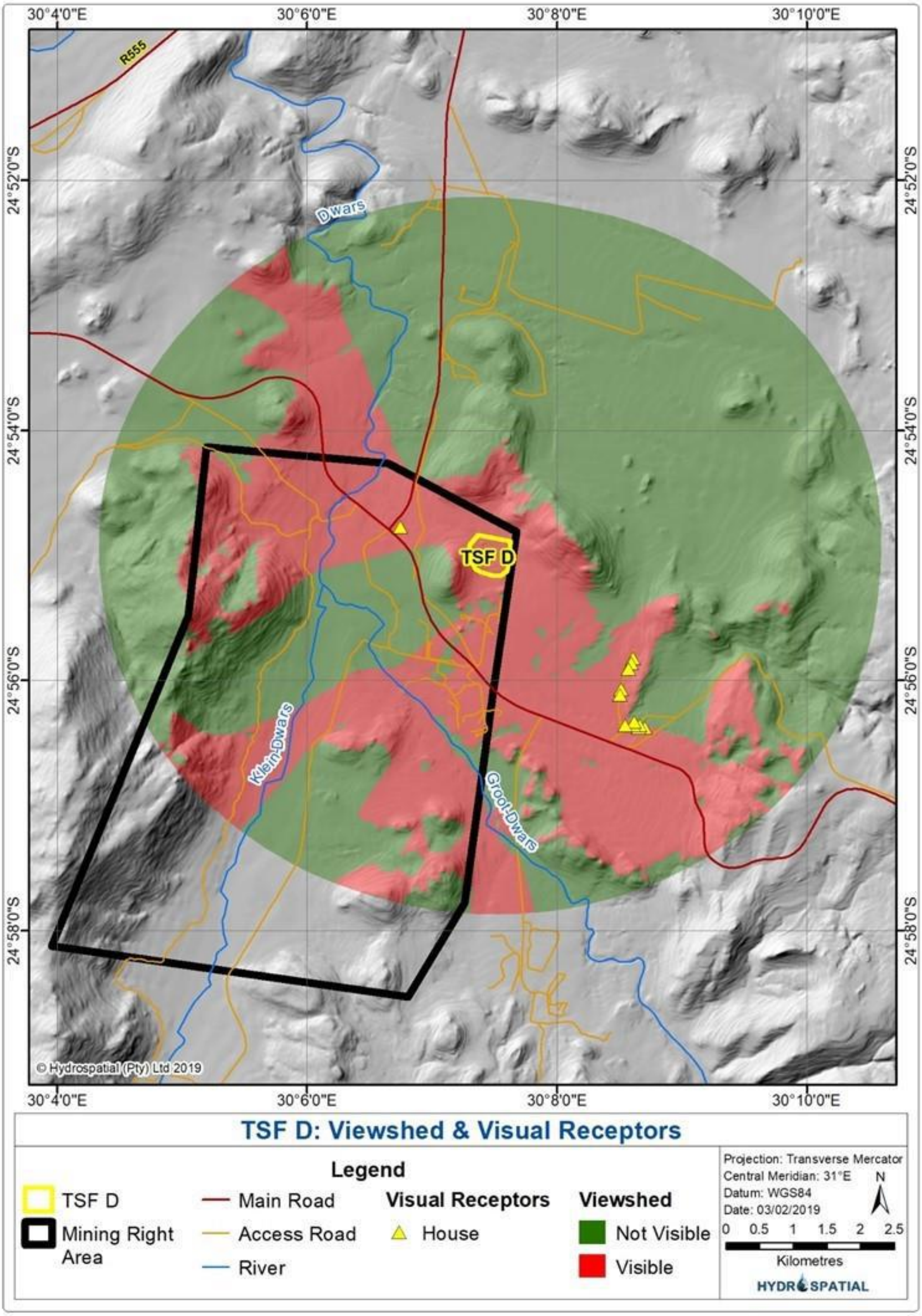


Figure 40: Viewshed and visual receptors for Site D

3.a.iii.1.j Air Quality

WSP Consulting was appointed to undertake the Air Quality Assessment for the site selection process (please refer to Annexure 9). The air quality setting information was sourced from this report, as well as from existing available information pertaining to Dwarsrivier Mine.

Sensitive receptors (i.e. places where sensitive individuals may be impacted, such as residences, schools and medical facilities) within a 10 km radius of the study site that have been selected for evaluation in this impact assessment are listed in the following table:

Table 29: Sensitive Receptors

ID	Receptor Name	Distance from Site B (km)	Distance from Site C (km)	Distance from Site D (km)	Longitude (ºS)	Latitude (ºE)
1	SR1 (Villages)	6.01	3.05	5.91	30.127585	24.973693
2	SR2 (Villages)	5.06	8.17	5.10	30.119396	24.869117

Possible emissions sources identified in the Dwarsrivier area that contribute towards the air quality status quo include mining, agriculture and vehicle tailpipe emissions along nearby roads.

Mining and Agricultural Activities

Mining is the predominant land use within the region, with existing and operational chrome and platinum mines in the surrounding area. Expected fugitive emissions from mining include wind erosion and material handling.

Additionally, agriculture is also one of the dominant land uses within the surrounding area, comprising mostly in the form of stock grazing and the production of vegetables, lucerne and cotton.

Emissions from agricultural activities are difficult to control due to the seasonality of emissions and the large surface area producing emissions (USEPA, 1995). Expected emissions resulting from agricultural activities include particulates associated with wind erosion, ploughing and burning of crop residue, chemicals associated with crop spraying and odiferous emissions resulting from manure, fertiliser and crop residue.

Dust associated with agricultural practices may contain seeds, pollen and plant tissue, as well as agrochemicals, such as pesticides. The application of pesticides during temperature inversions increases the drift of the spray and the area of impact. Dust entrainment from vehicles travelling on gravel roads may also cause increased particulates in an area. Dust from traffic on gravel roads increases with higher vehicle speeds, more vehicles and lower moisture conditions.

These are the most likely contributors of fugitive emissions from agricultural activities. However, it is noted that fugitive emissions from agricultural activities generally have confined impacts near to the source, limiting the regional impacts.

Vehicle Tailpipe Emissions

Atmospheric pollutants emitted from vehicles include hydrocarbons, carbon monoxide (CO), carbon dioxide (CO_2), nitrogen oxides (NO_x), sulphur dioxide (SO_2) and particulates. These pollutants are emitted from the tailpipe, from the engine and fuel supply system, and from brake linings, clutch plates and tyres. Hydrocarbon emissions, such as benzene, result from the incomplete combustion of fuel molecules in the engine. Carbon monoxide is a product of incomplete combustion and occurs when carbon in the fuel is only partially oxidised to carbon dioxide. Nitrogen oxides are formed by the reaction of nitrogen and oxygen under high pressure and temperature conditions in the engine. Sulphur dioxide is emitted due to the high sulphur content of the fuel. Particulates, such as lead, originate from the combustion process as well as from brake and clutch linings wear (Samaras and Sorensen, 1999).

Possible contributors to mobile combustion emissions include access roads surrounding the site. Neighbouring communities are likely to use these routes on a daily basis to access the mine.

Five monitoring points are assessed for dust fallout by the mine. These are indicated in the following table.

Table 30: Dust Monitoring Points

Sample Point	Sample Point Name
DWR 001	School
DWR 002	Far North Point
DWR 003	Parking Lot South Shaft
DWR 004	Discard Dump South Shaft
DWR 005	North Shaft

The following figure illustrates the location of these dust fallout monitoring points.

Figure 41: Dust Monitoring Locations

As mentioned before, there are five Dust Watch units installed and operational at the Dwarsrivier Mine, namely the DWR 001 unit, DWR 002 unit, DWR 003 unit, DWR 004 unit, and the DWR 005 unit. The fall-out dust standards from National Dust Control Regulations, 2013.

Based on the monitoring results available the dust fall out remains within the standards of 1,200 mg/m^2/day. The following figure presents the sensitive receptors close to the activities in question.

Figure 42: Proposed TSF site alternative locations and sensitive receptors within 10km radius

3.a.iii.1.j.1 Preferred Site Selection

A recommended Level 1 dispersion modelling platform, SCREEN3, was utilised to predict maximum hourly average ground-level downwind concentrations of pollutants emitted from the proposed TSFs. Peak concentrations were predicted to occur at 1,100 m for Site B, 800 m for Site C and 900 m for Site D. The closest sensitive receptor assessed in this study from Site C is villages (SR1), and the closest sensitive receptors to Site B and Site D are villages at SR2. Conversion factors recommended in the Regulations Regarding Dispersion Modelling were applied to the 1-hour average output concentrations to allow for comparison with NAAQS applicable to longer averaging periods. Key findings are as follows:

- Predicted ambient PM10 and PM2.5 concentrations as a result of emissions from all proposed TSF Sites B, C, and D are below the PM10 and PM2.5 NAAQS on a 24-hour and annual averaging period;
- Lowest predicted PM10 concentrations are anticipated at Site D with a maximum peak concentration of 10.31 µg/m³ and 2.06 µg/m³ on a 24-hour and annual averaging period;
- Lowest predicted PM2.5 concentrations are anticipated at Site D with a maximum peak concentration of 1.54 µg/m³ and 0.31 µg/m³ on a 24-hour and annual averaging period;
- From the screening assessment Site D was predicted as the most favourable in terms of air quality;
- Site D is located at the northern side of process plant which is adjacent to the existing TSF. Additionally, Site D is obstructed by the mountain 'koppie,' which is likely to reduce dust originating from the Site D; and
- It is noted that Site B is currently the preferred option for the TSF. The predicted PM10 concentrations from Site B have a maximum peak concentration of 16.88 µg/m³ and 3.38 µg/³3 on a 24-hour and annual averaging period respectively. Site B predicted concentrations are lower than those predicted for Site C. Predicted PM2.5 concentrations at Site B have a maximum peak concentration of 2.53 µg/m³ and 0.51 µg/m³ on a 24-hour and annual averaging period respectively.

Table 31: Air Quality Site Selection Outcomes (1 preferred, 3 least preferred)

Consideration	Site B	Site C	Site D
Predicted PM10 and PM2.5 Concentrations	1	1	1
Lowest predicted PM10 concentrations	2	3	1
Lowest predicted PM2.5 concentrations	2	3	1

Consideration	Site B	Site C	Site D
Location	2	3	1
Outcomes	2	3	1

This study comprises an environmentally conservative/'worst-case' air quality impact assessment and did not find predicted pollutant concentrations to exceed regulated ambient air quality standards. Further, impacts predicted at Site D were anticipated to be the lowest and as such, it is recommended that the proposed TSF be located at Site D.

It must be noted that the findings of this assessment have been based on emissions associated with the proposed TSF only and do not incorporate all sources from the Dwarsrivier Mine. Emissions from all sources at Dwarsrivier Mine will be assessed in the full Air Quality Impact Assessment once the preferred location has been determined.

3.a.iii.1.k Noise

A Noise Impact Assessment was conducted by dBAcoustics in May 2009 and this revealed the following sources of noise along the boundaries of the mine:

- traffic noise – both light motor vehicles and heavy-duty trucks;
- distant mine noise;
- mine activity noise;
- industrial noise; and
- ventilation noise.

No additional noise assessment was undertaken for the current application as the activities in question are located within the existing mining footprint and will purely be an expansion of existing facilities.

Of particular significance is the presence of the R577 regional road from Steelpoort to Lydenburg that transects the mine property and is adjacent to the main mining activities on Dwarsrivier Mine, most importantly the Beneficiation Plant, conveyor and workshops. Also important is the presence of four other mining operations in the vicinity of Dwarsrivier Mine.

These contribute noise directly to the ambient noise levels, but also indirectly through the presence of heavy duty and other traffic on the R577 and minor access roads to the mines. The area cannot be classified as rural according to Table 2 of SANS 10103 of 2008 due to the above factors.

The following conclusions were drawn from the results of the Noise Impact Assessment:

- The prevailing ambient noise levels along the boundary of the mining area are lower than the recommended noise level for an industrial area;
- The prevailing ambient noise levels are largely caused by emissions from a combination of noise sources;
- The significance of the noise impact from the activities at the proposed mine on the existing immediate environment will be medium according to the standardised risk matrix; and
- According to Table 5 of SANS 10103, the community response to the industrial type noise will be medium due to the higher prevailing ambient noise levels already experienced in this area from other mining activities.

3.a.iii.1.k.1 Preferred Site Selection

The proposed Khulu TSF site alternatives in question are all located within an area characterised by mining activities and should not have different impacts on the noise levels in the area.

3.a.iii.1.l Cultural and Heritage Setting

Heritage Contracts and Archaeological Consulting (HCAC) was appointed to undertake a Heritage and Paleontological Assessment for the site selection process (please refer to Annexure 10). The information was sourced from this report, as well as from existing available information pertaining to Dwarsrivier Mine.

This brief background study indicates that the general area under investigation has a wealth of heritage sites and a cultural layering dating to the following periods:

- Stone age sites;
- Iron Age sites; and
- Graves can be expected anywhere on the landscape.

Stone Age

South Africa has a long and complex Stone Age sequence of more than 2 million years. The broad sequence includes the Later Stone Age, the Middle Stone Age and the Earlier Stone Age. Each of these phases contains sub-phases or industrial complexes, and within these, we can expect regional variation regarding characteristics and time ranges. For Cultural Resources Management (CRM) purposes it is often only expected/ possible to identify the presence of the three main phases.

Yet sometimes the recognition of cultural groups, affinities or trends in technology and/or subsistence practices, as represented by the sub-phases or industrial complexes, is achievable (Lombard 2012). The three main phases can be divided as follows:

- Later Stone Age: associated with Khoi and San societies and their immediate predecessors. Recently to ~30 thousand years ago.
- Middle Stone Age: associated with Homo sapiens and archaic modern humans. 30-300 thousand years ago.
- Earlier Stone Age: associated with early Homo groups such as Homo habilis and Homo erectus. 400 000-> 2 million years ago.

Middle Stone Age isolated artefacts are found scattered over the landscape. Finds typically include radial cores, triangular points and flakes. These artefacts are scattered too sparsely to be of any significance (Van der Walt 2016).

The Iron Age

The Iron Age as a whole represents the spread of Bantu speaking people and includes both the pre-Historic and Historic periods. It can be divided into three distinct periods:

- The Early Iron Age: Most of the first millennium AD.
- The Middle Iron Age: 10th to 13th centuries AD
- The Late Iron Age: 14th century to colonial period.

The Iron Age is characterised by the ability of these early people to manipulate and work Iron ore into implements that assisted them in creating a favourable environment to make a better living. Most of the decorated pottery found in the study area belongs to the stylistic facies known as Eiland. This style dates to between 1550 AD and 1750 AD and was made by Sotho-Tswana people (Huffman 2007: 186-189). These Middle Iron Age Sites do not have any stone walling associated with them and is found close to cultivatable soil. Some stylistic Marateng pottery were also recorded presumably in association with Late Iron Age stone walled settlements. Marateng pottery dates to between 1650 AD and 1840 AD (Huffman 2007: 207).

Historical Information of the area

European occupation began in 1845 when trekkers established Ohrigstad and then Lydenburg a few years later. Originally, the trekkers were interested in ivory, but they also needed land and labour for agriculture. Tensions with African communities over these needs rose to such a point that the Trekkers attacked the Pedi capital in 1852. They failed, however, to destroy Pedi authority. Somewhat later, they negotiated a peace with Sekwati and traded cattle for land. Boers then started to establish farms in the region. GS Maree, for example, settled on Mareesburg in 1871. Tensions over land and labour increased again until the ZAR attacked the Pedi capital in 1876: this battle also failed to break Pedi resistance.

This brief historical outline helps to date some other sites in the study area. In particular, a number of settlements located around high meadows probably date from 1860 to 1880, when tensions were high but before major European occupation of local farms.

Anglo-Boer War

The Anglo-Boer War was the greatest conflict that had taken place in South Africa up to date. No sites relating to the war are known to occur in the MRA.

Known Sites

Based on the desktop study, a number of known sites were identified and mapped in relation to the proposed TSF sites alternatives. None of the previously known sites occur within the proposed site alternatives (see the following figure).

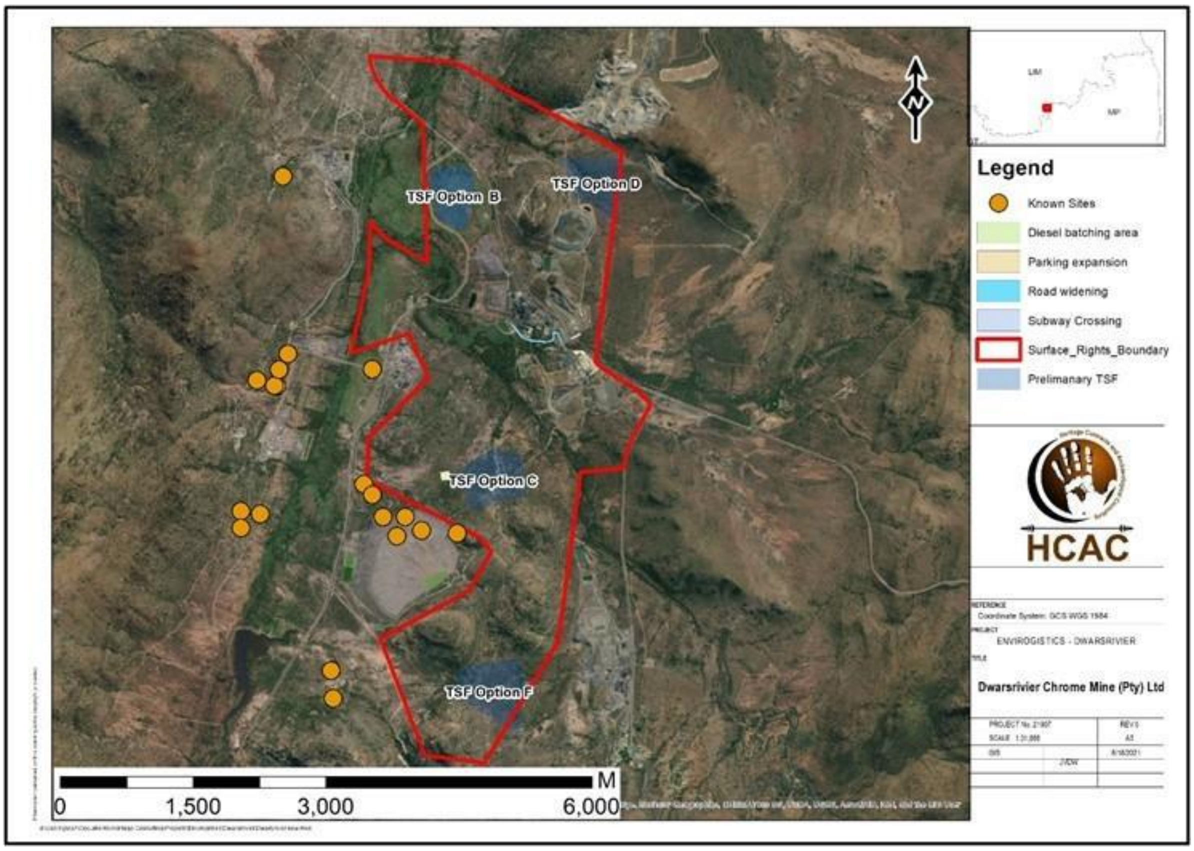


Figure 43: Known sites in relation to the Dwarsrivier Mine surface rights boundary.

Sites identified in proximity to potential TSF site alternatives are indicated in the following figure.

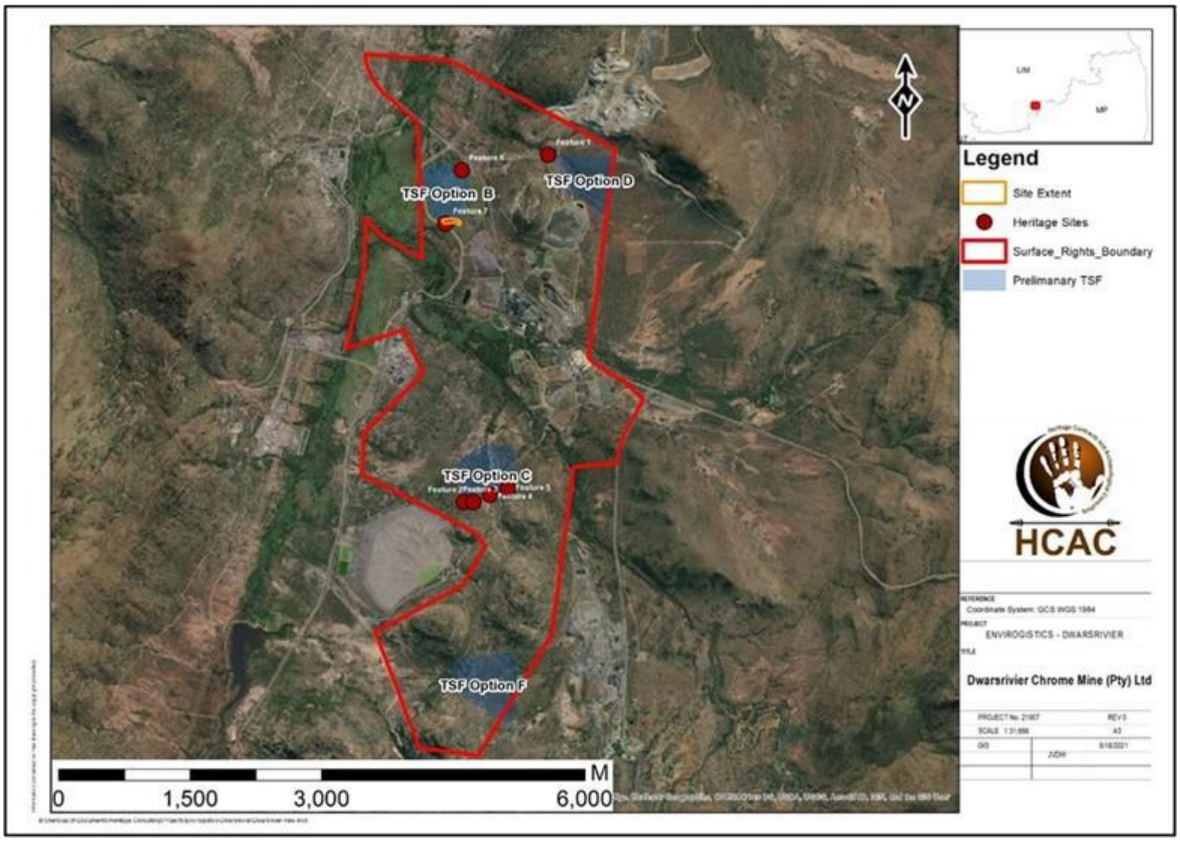
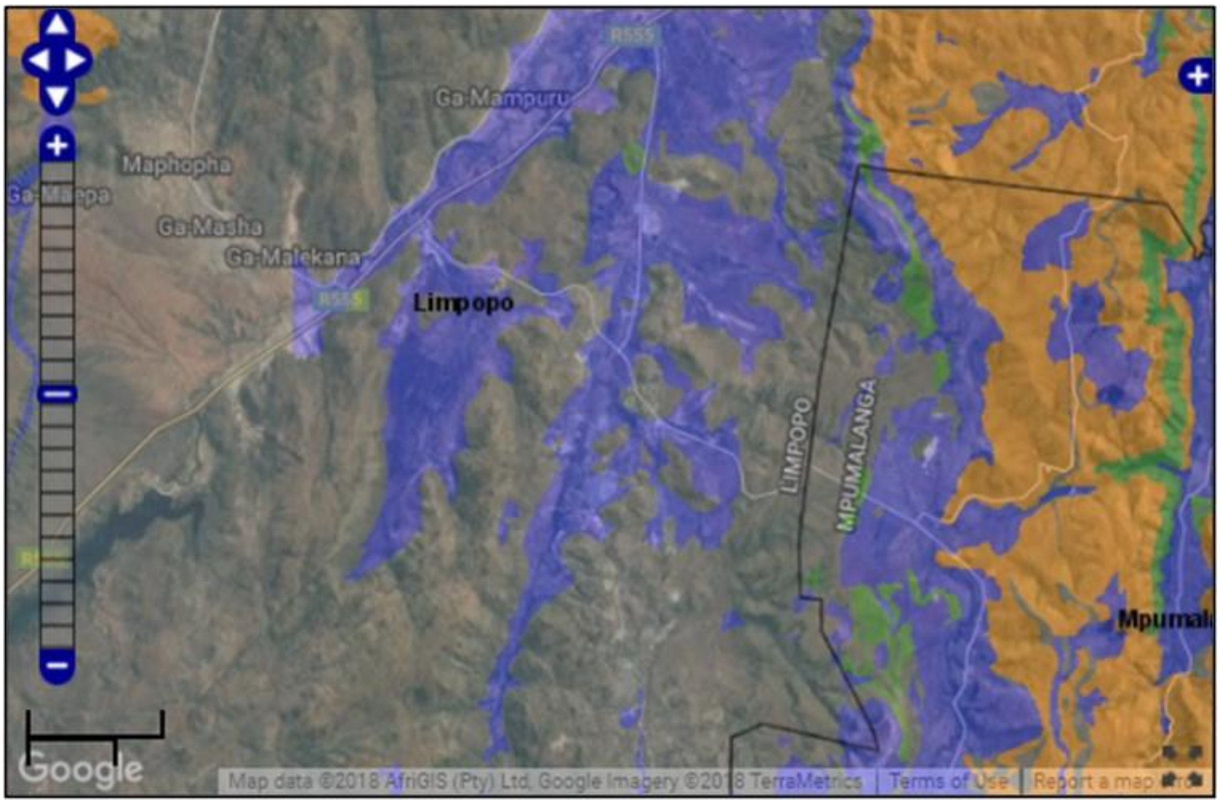


Figure 44. Locality map of the TSF site alternatives under investigation also indicating the heritage resources identified in each area.

Paleontological Sensitivities

The area is indicated as of insignificant and of low paleontological sensitivity on the South African Heritage Resources Agency (SAHRA) paleontological sensitivity map (see the following figure).



Colour	Sensitivity	Required Action
RED	VERY HIGH	Field assessment and protocol for finds is required
ORANGE/YELLOW	HIGH	Desktop study is required and based on the outcome of the desktop study, a field assessment is likely
GREEN	MODERATE	Desktop study is required
BLUE	LOW	No paleontological studies are required however a protocol for finds is required
GREY	INSIGNIFICANT/ZERO	No palaeontological studies are required
WHITE/CLEAR	UNKNOWN	These areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

Figure 45: Paleontological Sensitivity

3.a.iii.1.l.1 Preferred Site Selection

The potential heritage constraints relating to each site alternative were evaluated to determine the best-suited site for the proposed development from a heritage perspective.

Form a heritage point of view a number of factors were considered including the occurrence of heritage sites and whether the site has been previously disturbed (see the following table).

Table 32: Heritage Site Selection Outcomes (1 preferred, 3 least preferred)

Consideration	Site B	Site C	Site D
Archaeological and Palaeontological sites	2	3	1
Historical finds and Cultural landscape	2	1	1
Burials and cemeteries	1	1	1
Pristine Area	1	3	2
Outcomes	2	3	1

Based on the findings of this screening report Site D is the preferred site from a heritage point of view, but Site B can also be considered as this was previously agricultural land. Site B and D has previously been disturbed. For Site D, no heritage resources were identified inside the footprint area of this proposed TSF site alternative. At Site B, the stone wall foundations of a ruin and a possible Early Iron Age site was recorded. The study area is however disturbed, possibly by previous cultivation reducing the significance of the recorded finds. It should be noted that a cemetery occurs on the periphery of the site (Site C), and this area should be demarcated and avoided.

From a heritage point of view the heritage sensitivity associated with Site C is considered to be high due to the high number of sites in the impact area and this alternative is not recommended for the proposed development. It is recommended that the selected site should be subjected to a Heritage Impact Assessment.

3.a.iii.1.m Socio-Economic Setting

BathoEarth was appointed to undertake a Socio-Economic Assessment for the site selection process (please refer to Annexure 11). The socio-economic setting information was sourced from this report, as well as from existing available information pertaining to Dwarsrivier Mine.

General Setting

The Sekhukhune District Municipality (SDM) was established in December 2000. It consists of four Local Municipalities, namely Elias Motsoaledi, Ephraim Mogale, Fetakgomo Tubatse, and Makhuduthamaga Local Municipalities. The district is situated in the Limpopo Province, to the northwest of Mpumalanga and within the southern section of the Limpopo Province. The SDM covers an area of approximately 13,264m[2]. Most of the area is typical rural as only 5% of Sekhukhune population lives in urban areas.

The main urban centres are Groblersdal, Marble Hall, Burgersfort, Jan furse, Ohrigstad, Steelpoort and Driekop. Outside these major towns, one finds almost 605 villages which are generally sparsely populated and dispersed throughout the District[2].

The mine is situated approximately 25km south of the town of Steelpoort in the Limpopo Province. The Dwarsrivier Mine is accessed from the R577. The area falls under the jurisdiction of the Fetakgomo Tubatse Local Municipality.

According to the recent official demographic survey results (2016), the Fetakgomo Tubatse Local Municipality has a total population of 490 381 people (Statistics South Africa Community Survey, 2016).

There is overwhelming strong statistical evidence that the population is growing at an exponential rate. There are more females 251,923 (51%) than males 238,458 (49%) in the population pyramid. Of the total population within the Fetakgomo Tubatse Local Municipality, 223,214 are young people. The youth thus represent 46% of the total population figure[3].

The mine falls within Ward 27 of the Local Municipality which has a population of 12,527 (Statistics from 2011)[4]. The following villages are located in Ward 27: Moshate, Tsakane, Kalkontein, Mabelane, Makakatela, Kutullo A&B, Shushumela & Matepe, Kutullo C&D, Dithamaga and Madibeng[5].

Economic Development Sectors

Tourism

Tourism in Fetakgomo Tubatse Local Municipality is underdeveloped as most tourist attraction places are found beyond the boundaries of the municipality, particularly the world famous Blyde River Canyon and a couple of game farms such as the Malamala Game Reserve, as well as the Kruger National Park are found to the east of the municipal area.

Agriculture

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[2] www.sekhukhunedistrict.gov.za

[3] www.fgtm.gov.za

[4] www.wazimap.co.za

[5] Draft 2018/19 IDP/Budget for Fetakgomo Tubatse Local Municipality

Farming is an important economic resource as a wide range of products are cultivated owing to good soil conditions, the sub-tropical climate and reasonable access to water. The following type of products is produced: fruit, vegetables, grain, cotton, citrus, maize, tobacco and meat. The main resources that encourage agricultural production are the Olifants, Steelpoort and Spekboom Rivers, which provide water to the region. These sources of natural water are essential for present and long term irrigation of crops.

The table below indicates Agricultural Production areas.

Table 33: Agricultural Production (Departmental Report 2013)

Production	Total Tons	Total (ha)
Maize (ha)	3 022.9	30 144.59
Sorghum	2 575	8 638
Wheat	2 464	13 945
Sunflower	59	728.1
Groundnuts	13.6	14.9
Soya beans	152.4	3 060.9
Canola	0	50
Bambara nuts	0	633.6
Dry beans	1 560.2	3 092.2
Potatoes	107.7	1 975.3
Cabbage	104	957.6
Butternuts	21.9	200.1
Tomatoes	135.7	340.3
Citrus	1 430.5	10 073
Cotton	0	901.1
Tobacco	21	2222.7
Lucerne	515.8	1760.9
Table grapes	7.1	1390.2

Potential land for agricultural purposes is found on the river banks of three above mentioned rivers, however some of the land is not used optimally e.g. the land at Penge on the river bank of Olifants River and others.

Good agricultural land (Tswelopelo agricultural land) near Praktiseer and Bothashoek is invaded by illegal squatters leaving agricultural activities with not enough land for cultivation. The Tswelopele Agricultural Scheme in Praktiseer was a very good initiative but has been abandoned by the Department of Agriculture leaving the entire infrastructure vulnerable to theft.

No other region in the Fetakgomo-Greater Tubatse Local Municipality reveals a higher potential for desertion, resultant from overgrazing over a prolonged period by a highly impoverished rural population that struggles to plan and control their area. Their lack of skills prevents them from managing their resource for long-term production. This type of farming makes the region vulnerable to periodic droughts that affect both the regional resources and the potential to generate work opportunities for the unemployed.

Mining

The intrusion of the Volcanic Bushveld Igneous Complex into the sedimentary rock of the Transvaal System resulted in great metamorphism, which caused the introduction of many minerals including chrome, vanadium, platinum, asbestos and magnetite in the area.

- Chrome is mined extensively at Dilokong, Dwars-river, Dooringbosch, Tweefontein, Lannex Mine, Magareng, Thorncliffe, Helena, Mooihoek and the product is exported by rail and sea to overseas destinations.
- The following chrome mine is still under prospection: Lwala Mine.
- Vanadium is mined and smelted at only one mine and this product caters for most of the demand in the country.
- Platinum is found in the well-known Merensky Ridge and this resource accounts for more than 50% of all platinum resources on earth and is mined at Mototolo (XSTRATA), Marula Mine, Twickenham Mine, Modikwa Mine, Two Rivers Platinum Mine and Phokathaba Mine.
- The following platinum mines are still under prospection or at project stage Spitzkop Mine, De Grootteboom Mine, Nkwe Platinum Mine, Booysendal, Debrochen and Tjate Mine.
- Two Andalusite mines exist in the areas of Segororng and Modubeng, which are Rhino minerals and Annesley havecroft Mines.
- Granite is mined at Elephant's River Mine near Tjate village.
- Clay is mined at Atta Clay Mine and most of the product is used in the process of platinum production.

- Asbestos was mined at Penge and Taung, but because asbestos products have been banned worldwide, the mines were closed down and areas are to be rehabilitated.
- Slate is mined at Saringa Mine near Kgautswane village and is used to manufacture roof and floor tiles.
- Silica is mined for the production of sand and stone aggregate, and serves as a flux in the chrome smelting process.
- Magnetite is an iron-ore mined at Goede Hoop and transported to Emalahleni for the production of steel in the Highveld Steel Plant.
- Magnisite was mined extensively in the Burgersfort area, but as it does not meet the required standard anymore, mining operations were ceased.
- There are currently three chrome smelters operating in the area, namely Lion Ferrochrome (XSTRATA), ASA Metals at Ga-Maroga village and Tubatse Ferrochrome in Steelpoort.

Although there are several mines in the area, the existing resources remain unexploited. Investment in this sector is important as it brings with it investment in infrastructure, results in the creation of job opportunities and generates many other economic spin-offs. The lack of economic growth in the region warrants special attention and support to optimize the available opportunities. However, cognisance should be taken of the outflow of money from the mines in Greater Tubatse to other regions.

There are currently three chrome smelters operating in the area surrounding the Dwarsrivier Mine, namely Lion Ferrochrome (XSTRATA), ASA Metals at Ga-Maroga village and Tubatse Ferrochrome in Steelpoort.

3.a.iii.1.m.1 Preferred Site Selection

Site B

Site B would be 20ha and the TSF is planned to be 37 m in height. Site B is located to the south of the road crossing of the R577 and the Richmond Road. The latter is used as access road to the Two Rivers Platinum Mine. Site B is thus located to the east of the TRP access road and west of the R577. It is approximately 1.3 km north of the existing DCM plant.

Site B is located within an area where various other mining infrastructure is situated. Mining activities of DCM and TRP are to the south, west, east and southwest of the proposed site location. Power lines traverses to the east of site B. These lines are between 120m and 150m from the R577 and alongside the R577. It is thus not anticipated that the electricity infrastructure would be affected by the proposed TSF and no services and infrastructure would have to be moved, but haulage would have be undertaken beneath the power lines.

Access from within the mining area and the R577 could easily be obtained. This is a public road and should the R577 be used it could create disturbances and safety risks. Limited additional road infrastructure would be required with resultant limited costs in this regard. The site is also in close proximity to the existing mining activities and limited distances would have to be covered to access the site during the construction and operational phases. It is considered that the movement of workers to and from the site, as well as the movement of equipment during the construction and operational phases would result in some negative impacts if the R577 is used.

No residential areas are in close proximity to the site. The nearest residential settlement is approximately 10 km away along the R577. The facility is in close proximity to the existing plant and office complex which could result in air quality impacts and noise intrusions.

Although the facility would be highly visible from both these roads, the proposed TSF will blend it with the existing overall sense of place, as the area is already disturbed by existing mining activities. The development of the TSF will thus not create a new impact on the sense of place.

DCM currently holds the mining rights for Portion 1 (Remaining Extent (RE)) and Portion 0 (RE) of the farm Dwarsrivier 372KT and surface rights for the said portions. The area where site B is proposed is currently not used for other purposes e.g. farming, and therefore one can conclude that no significant land-use sterilisation would occur.

The change in the land use due to the development of the proposed Khulu TSF on Site B fits the surrounding land-use in the area which include mining activities and mining infrastructure. Site access would also be easily available from the existing mining activities and the R577 or Richmond Road.

It is considered that the movement of workers to and from the site, as well as the movement of equipment during the construction and operational phases would result in limited negative impacts due to the site's proximity to the existing plant and available roads. Safety and security issues associated with the movement of the personnel can be dealt with by the existing measures put in place by DCM should the internal gravel road be used. Additional measures might be required if the R577 would be used.

Site C

Site C is 28ha in extent and situated approximately 1.5km to the south west of the R577 and to the south of the Dwarsrivier Mine Beneficiation Plant. The facility proposed on Site C would be 29m in height. Access to the site would be obtained via an existing gravel road from the R577 from the main administrative buildings of the mine.

The existing mining activities of Dwarsrivier Mine are situated to the north of the site. Mining activities (TRP TSF) are situated to the west of this site alternative. Site C thus falls within an area that is currently used for mining activities, although the site itself seems to consist of relatively undisturbed natural vegetation.

No residential areas are located in close proximity to Site C. The nearest residential settlement is approximately 10km away along the R577. Visual impacts on neighbouring landowners/ operators could be possible. As there are existing mining infrastructure and associated activities undertaken in the area, the proposed TSF at Site C would, however, not result in visual impacts that differ from the existing mining activities in the area.

There is an existing access road to the site, thereby providing adequate access and reducing the costs of required road construction and infrastructure. The site is also in relatively close proximity to the existing mining activities and limited distances would have to be covered to access the site during the construction and operational phases.

It is considered that the movement of workers to and from the site, as well as the movement of equipment during the construction and operational phases would result in limited negative impacts due to the site's proximity to the existing Beneficiation Plant. Safety and security issues associated with the movement of the personnel can be dealt with by the existing measures put in place by the mine.

It is not clear whether there are any servitudes within close distance to the proposed site.

Site D

Site D is 21ha in extent and situated approximately 1km to the north of the R577. The TSF proposed on Site D would be 49m in height. Access to the site would be obtained via an existing gravel road from the R577 passing administrative buildings of the mine.

Existing mining activities to the north are visible. The site appears to be covered by natural vegetation. A distribution line servitude runs to the south of the site.

Existing mining activities and infrastructure are also situated to the south of the access road and to the south of the site (existing tailings facility). The area to the east of the proposed site is the property of the De Grooteboom Mine. Site D thus falls within an area currently used for mining activities.

No residential areas are located in close proximity to Site D. The nearest residential settlement is approximately 10km away along the R577. No negative visual impacts on landowners are thus anticipated. It is, however, anticipated that the proposed TSF, if constructed on Site D, could be highly visible to the users of road R577. As there are existing mining infrastructure and associated activities undertaken in the area, the proposed TSF at Site D would not result in new visual impacts, but would rather add to the existing visual impacts.

The existing access road could be used to access the site and limited additional road infrastructure would be required. Limited costs in this regard are thus foreseen. The site is also in close proximity to the existing mining activities and limited distances would have to be covered to access the site during the construction and operational phases.

It is considered that the movement of workers to and from the site, as well as the movement of equipment during the construction and operational phases would result in limited negative impacts, although the main road R577 would have to be crossed if transportation is required from the existing Beneficiation Plant situated to the south of the R577. This could pose some safety issues, but it is anticipated that it could be successfully mitigated. Safety and security issues associated with the movement of the personnel can be dealt with by the existing measures put in place by Dwarsrivier Mine.

Table 34: Criteria for site selection

Criteria	Site B	Site C	Site D
Mining related land-uses or similar land-uses in the area	Yes	Yes	Yes

Criteria	Site B	Site C	Site D
Presence of existing mining infrastructure in close proximity	Yes	Yes	Yes
Residential proximity	No	No	No
Possible negative visual impact on residents/land users/land owners that is different from existing visual impacts in area	No	No	No
Visual impacts for road users	Yes	No	Yes
Location suitability that could negatively affect the cost of the development	No	No	No
Distance from existing facilities and infrastructure (nearest: 1 and furthest: 4)	1	3	2 (R577 would have to be crossed)
Existing access roads	Yes	Yes	Yes
Status of access roads	Road upgrading could be required or R577 public road would be used with subsequent disturbances and safety risks	Road upgrading could be required	Road upgrading could be required
Presence of existing servitude in close proximity to the site	Yes Electricity servitude will not be affected, but haulages would be undertaken underneath lines	Yes Eskom servitude, but TRP pipeline traverses site	Yes
Negative impacts associated with the movement of workers to and from the site which cannot be mitigated	No Crossing and use of R577 public road	No	Yes Crossing of R577 public road to access site from existing mining activities
Safety and Security Issues that cannot be mitigated	No	No	No

Based on the assessment of the various proposed sites, the following concluding remarks should be noted:

- The location of existing mining infrastructure (whether from DCM or other mines) in close proximity to the sites was considered. The land-use for the sites thus seems compatible with mining development. With regards to the land-use and the presence of existing infrastructure to ensure a “goodness of fit”, all sites ranked equally.
- The development of Site F could be limited due to the proximity of the other mining activities undertaken by other mines in the area such as De Grooteboom Mining.
- Sites B, and C seem to have more pristine vegetation than Site D. The latter also have some existing mining activities just to the north of the site with associated disturbances to the natural vegetation. From a socio-economic perspective Site D is thus less pristine than Sites B, and C;
- All the sites have gravel access roads which would assist in reducing the costs of required road construction and infrastructure, although road upgrading might be required for all the different sites;
- Site C would have less visual impacts due to the distance of these sites to the public road and office complex. Sites B and D would be visible for road users of the R577. Site B would also be visible to road users that access the Two Rivers Platinum Mine complex. Considering the overall sense of place with the existing mining infrastructure, the negative impacts in this regard are deemed low.
- There are no residential developments in close proximity to any of the sites. In this regard all sites ranked equally.
- Sites B, is in closer proximity to existing infrastructure and from a costing perspective could thus be more economically effective to develop compared to C and D. Movement of equipment and workers would have to be done across shorter distances with resultant less negative impacts in this regard;
- It is considered that the movement of workers to and from the sites, as well as the movement of equipment during the construction and operational phases would result in limited negative impacts. Safety and security issues associated with the movement of the personnel can be dealt with by the existing measures put in place by DCM.
- Additional safety and security measures could be required to be implemented at the sites during the operational phase.
- It is concluded that Sites B, C and Site D can be developed from a socio-economic perspective. Environmental considerations and costing associated with the sites would determine which site would be most preferred.

Table 35: Socio-Economic Site Selection Outcomes (1 preferred, 3 least preferred)

Consideration	Site B	Site C	Site D
The location of existing mining infrastructure (whether from Dwarsrivier Mine or other mines)	1	1	1
Access	1	1	1
Residential developments		1	1
Proximity to existing infrastructure	1	1	1
Movement of workers	1	1	1
Outcomes	1	1	1

It is concluded that either Site B, C or Site D would be most preferential from a socio-economic perspective.

3.a.iv *The outcome of the Site Selection Matrix, Final Site Layout Plan*

The outcomes of the Site Selection are presented in the table below.

Table 36: Site Selection Matix (1 preferred, 3 least preferred)

Discussion	Site B	Site C	Site D	Reference Section for more detail
Engineering				
Engineering considerations, including topography	1	3	2	Refer to Section 3.a.i
Engineering Outcomes	**1**	**3**	**2**	
Environmental				
Soils, Land Use and Land Capability	2	3	1	Refer to Section 3.a.iii.1.d
Terrestrial Ecology	1	3	2	Refer to Section 3.a.iii.1.e
Hydrology/ Surface Water	1	3	2	Refer to Section 3.a.iii.1.f
Hydrogeology	2	3	1	Refer to Section 3.a.iii.1.g.1
Freshwater Resources (wetlands)	1	3	2	Refer to Section 3.a.iii.1.h
Visual Character	3	2	1	Refer to Section 3.a.iii.1.i -
Air Quality	2	3	1	Refer to Section 3.a.iii.1.j
Heritage	2	3	1	Refer to Section 3.a.iii.1.l
Socio-Economic	1	1	1	Refer to Section 3.a.iii.1.m
Ranking	15	24	12	-
Environmental Outcomes	**2**	**3**	**1**	

3.a.v *Statement motivating the preferred site*

The following concluding statements were received from the specialist reports:

Soils, Land Use and Land Capability: Taking the above into consideration, from a soil, land use and land capability perspective, Site D is recommended as the preferred site for TSF development, in comparison to the other two (2) TSF alternatives given the proximity to existing mining infrastructure, thus eliminating the need for significant further disturbance of undisturbed soils in other areas within the mining area. However, considering the location of Site B and the fact that this is also located in close proximately to the mining activities, it is the view of the EAP that either Site B or D would be suitable options. As a result, Site B is also highlighted for consideration.

Terrestrial Ecology: from a long-term ecological maintenance perspective Option B is deemed to be the preferred option, as this site is already disturbed, is located adjacent the current mine operations and will not lead to the loss of habitat connectivity or loss of potentially protected species. This option does however pose a potential risk to the Groot Dwars River, which needs to be investigated in terms of mitigatory and management requirements.

Hydrology/ Surface Water: The site selection assessment indicated that the most preferred option from a surface water perspective is Site B, followed by Site D and C, respectively.

Hydrogeology: Site B scored similar to Site D and could therefore also be considered as a preferred alternative, provided that the risks identified are managed to avoid or minimise negative impacts on groundwater. The risks associated with Site B include the presence of the alluvial aquifer under or near the TSF footprint, the presence of potential preferential flow paths to groundwater and shallow groundwater level conditions.

Freshwater Resources: The construction of the proposed TSF within Option C or Option D has the potential to have an unacceptably high impact on the watercourse within each respective site. Such impacts may also potentially affect downstream systems. From a freshwater ecological perspective therefore, Option B is the preferred option, as no direct impacts arising from the construction and operation of the TSF within that location to the receiving freshwater environment are anticipated. Nevertheless, indirect impacts, including potential failure of the TSF, could occur and may potentially be detrimental to the Dwars River specifically, if suitable mitigation measures are not strictly implemented throughout all phases.

Visual Character: Site C has the smallest visible area and least number of visual receptors impacted, and is therefore ranked 1 (most favourable), followed by Site B and then Site D. Although Site C is the most favourable in terms of the criteria used to assess the TSF site alternatives, it must be noted that all alternatives fall within an area dominated by mining activities and infrastructure. Due to the visual aesthetics and sense of place of the area being previously altered from rural bushveld to mining, it is unlikely that the implementation of any of the TSF options would result in a significant visual impact.

Air Quality: This study comprises an environmentally conservative/'worst-case' air quality impact assessment and did not find predicted pollutant concentrations to exceed regulated ambient air quality standards. Further, impacts predicted at Site D were anticipated to be the lowest and as such, it is recommended that the proposed TSF be located at Site D.

Heritage and Palaeontology: Site D is the preferred site from a heritage point of view, but Site B can also be considered as this was previously agricultural land. Site B and D has previously been disturbed. For Site D, no heritage resources were identified inside the footprint area of this proposed TSF site alternative. At Site B, the stone wall foundations of a ruin and a possible Early Iron Age site was recorded. The study area is however disturbed, possibly by previous cultivation reducing the significance of the recorded finds. It should be noted that a cemetery occurs on the periphery of the site (Site C), and this area should be demarcated and avoided.

From a heritage point of view the heritage sensitivity associated with Site C is considered to be high due to the high number of sites in the impact area and this alternative is not recommended for the proposed development. It is recommended that the selected site should be subjected to a Heritage Impact Assessment.

Socio-Economic: It is concluded that either Site B, Site C or Site D would be most preferential from a socio-economic perspective.

4 CONCLUSION

As mentioned before, the demand for chrome has increased globally due to the increase in China Markets. Not allowing the development of the proposed Khulu TSF to take place will result in production capabilities of the mine being hampered as space for tailing material would be severely restricted. With the current TSF reaching its life of mine, a new facility is required to ensure ongoing mining and processing practices. Based on the site selection and taking all environmental aspects assessed and discussed above into consideration, **Site B** is the preferred site from an engineering design. Site C and Site B is very similar in rating and both could be considered as preferred options. However due to the location of the Site B to the plant and a more disturbed area, Site B is also recommended.

This Site B is located in close proximity to the existing Discard Dump. One key area for consideration based on the outcomes of the initial specialist studies are the management of groundwater should Site B be chosen. The underlying lithology at this site is potentially alluvium associated with the Dwars and Groot Dwars Rivers, which creates a major regional aquifer (this will be confirmed during the EIA phase of the project). Dwarsrivier Mine currently abstracts groundwater from this aquifer from BH D1 and D2, situated 725m southwest from Site B. Site B is not currently undermined, but future underground mining is planned for this area. Site B is furthermore underlain by both a fault and a dyke. These structures may act as preferential flow paths to groundwater. Dwarsrivier Mine is in the process of drilling and testing monitoring boreholes that target the dyke and fault present in order to quantify the extent to which these structures could act as preferential flow paths. The results of the drilling and testing programme are not yet available, but will be considered as part of a detailed geohydrological impact assessment to be completed for the project. The site is potentially situated within an existing watercourse (considering the alluvial aquifer), which suggests that shallow groundwater conditions may occur during the wet season. The site is also situated on or near the alluvial aquifer associated with the Klein and Groot Dwars Rivers. This must be confirmed should this site be developed further. Groundwater in this area has already been impacted by the historical TSF, the Plant and the discard dump. The Total Dissolved Solid (TDS) and nitrate (NO_3) concentrations in the nearest borehole (DRM3) confirm the poorest groundwater quality conditions for the four sites evaluated. The depth to groundwater at this site is the shallowest of all the sites evaluated (4,53m), which means that the barrier between the TSF and the aquifer is the smallest for all four sites. It is not thought that groundwater levels would rise to surface and thus into the liner system. The shallow groundwater is however flagged as a potential risk. Groundwater is not used in the immediate vicinity of Site B other than being monitored.

With the correct management measures, impacts identified could be addressed.

Annexures

Annexure 1: EIA Application Communication

Annexure 2: EAP CV

Annexure 3: Soil Assessment

Annexure 4: Ecological Assessment

Annexure 5: Hydrological Study

Annexure 6: Hydrogeological Study

Annexure 7: Wetland and Freshwater Assessment

Annexure 8: Visual Assessment

Annexure 9: Air Quality Assessment

Annexure 10: Heritage Assessment

Annexure 11: Socio-Economic

Annexure 1: EIA Application Communication

mineral resources
& energy

Department:
Minerals Resources and Energy
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Enquiries Kolani T.C Ref: LP 30/5/1/2/3/2/1 (179) EM

E-Mail Address: thivhulawi.kolani@dmre.gov.za
Sub-Directorate: Mine Environmental Management

BY Email

The Mine Manager
Dwars Rivier Chrome Mine (Pty) Ltd
P O Box 567
STEELPOORT
2047

Attention: Mr Pieter Schoeman

Email:pieters@dwarsrivier.co.za

ACKNOWLEDGMENT OF AN APPLICATION FOR NEW CAPITAL PROJECT AND THE PROPOSED KHULU TAILINGS STORAGE FACILITY AND ASOCIATED INFRASTRUCTURE AT DWARS RIVIER CHROME MINE, SITUATED WITHIN SEKHUKHUNE DISTRICT MUNICIPALITY: LIMPOPO REGION.

I refer to the above-mentioned matter and confirm that your application for integrated Environmental Authorisation referred to as "IEA" lodged on **13 July 2021** is hereby acknowledged.

You are requested in terms of Section 24 K of National Environmental Management Act, Act 107 of 1998, as amended to consult the Scoping Report with Limpopo Department of Economic Development Environment and Tourism, Department of Water and Sanitation, Department of Agriculture Rural Development and Land Reform, District and Local Municipality where the proposed development project is situated and give them **30 days** commenting period.

Three hard copies of the final Scoping Report must be submitted in our office within **44 Calendar** days from the date of your application. The final Scoping Report must contain proof and results of consultation done in terms of Section 24 K of NEMA as well as consultation done in terms of Regulation 41 of 2014 EIA Regulation. In addition, the final Scoping Report must comply with Appendix 2 of 2014 EIA Regulation

Acknowledgement of your application does not grant you permission to commence with the activities applied for. Commencement of a listed activity without Granted WML constitutes an offence in terms of Section 49A (1) (a) of NEMA, 1998 (Act 107 of 1998) as amended and upon conviction for such an offence, a person is liable to a fine not exceeding R10 million or to imprisonment for a period not exceeding ten years, or to both such fine and such imprisonment.

Please note that failure to meet any prescribed time frame indicated above your application for WML will be considered lapsed and not be processed further, unless if an extension has been granted in terms of Regulation 3(7) of 2014 EIA Regulation.

Kind Regards

....

REGIONAL MANAGER:

MINERAL REGULATION- LIMPOPO REGION

DATE: 11/08/2021

mineral resources
& energy

Department:
Minerals Resources and Energy
REPUBLIC OF SOUTH AFRICA

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Enquiries Kolani T.C Ref: LP 30/5/1/2/3/2/1 (179) EM

E-Mail Address: thivhulawi.kolani@dmre.gov.za
Sub-Directorate: Mine Environmental Management

BY Email

The Mine Manager
Dwars Rivier Chrome Mine (Pty) Ltd
P O Box 567
STEELPOORT
2047

Attention: Mr Pieter Schoeman

Email:pieters@dwarsrivier.co.za

ACKNOWLEDGMENT OF FINAL EIR FOR WASTE MANAGEMENT LICENCE LODGED IN TERMS OF NATIONAL ENVIRONMENTAL MANAGEMENT WASTE ACT FOR THE PROPOSED ESTABLISHMENT OR RECLAMATION OF A RESIDUE STOCKPILE OR RESIDUE DEPOSIT RESULTING FROM ACTIVITIES WHICH REQUIRE A MINING RIGHT, EXPLORATION RIGHT OR PRODUCTION RIGHT IN TERMS OF THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT, 2002 (MPRDA) AT DWARS RIVIER MINE, SITUATED WITHIN SEKHUKHUNE DISTRICT MUNICIPALITY: LIMPOPO REGION.

I refer to the above-mentioned matter and confirm that your final EIR submitted on **27 July 2021** is hereby acknowledged.

Please take note that the said EIR is still under review and you will be notified if any additional information is required from you.

Kind Regards

....

REGIONAL MANAGER:

MINERAL REGULATION- LIMPOPO REGION

DATE: 11/08/2021

Annexure 2: EAP CV

Curriculum vitae: Ms Tanja Bekker

Name	:	Bekker, Tanja
Date of Birth	:	23 June 1980
Profession/Specialisation	:	Environmental Project Manager / Cert. Environmental Assessment Practitioner
Nationality	:	South African
Years' Experience	:	18 Years

Key qualifications

Ms Tanja Bekker has more than 18 years' working experience in the Environmental Consultancy Industry. Her key focus is environmental management and compliance with extensive experience in the mining industry. Project Management and Coordination form a critical component of her duties, which include environmental gap analysis, project planning, initiation of projects, client, authority and stakeholder consultation, specialist coordination, budget control, process control, quality control and timeframe management.

Her interest lies in a client advisory capacity, being involved during due diligence investigations, pre-project development and assisting the client and engineering team in adding value to develop a project in and environmental sustainable manner, considering client costs and liabilities, as well as the implication of environmental regulatory requirements and conditions on project deliverables.

Her involvement in projects has spanned over the project life cycle from Due Diligence Investigations, Pre-Feasibility Investigation's, Prospecting Right Applications, Mining Right Applications, Environmental Impact Assessments, Environmental Management Plans and implementation and auditing of Environmental Management Plans and Authorisations.

Ms Bekker has significant experience in integrated environmental management processes, such as Environmental Scoping Assessment, Environmental Impact Assessments (EIAs) and Basic Assessment Reports (BARs), and the development of Environmental Management Plans (EMP). Her experience further spans into the formulation and management of Water Use License Applications and Integrated Water and Waste Management Plans. Her experience and professional registrations have resulted in her capabilities to act as a Project Manager and Peer Reviewer for Environmental Authorisation Projects ensuring the independence of such projects, as well as Project undertaken in terms of IFC/World Bank Requirements.

She has comprehensive experience and thorough understanding of the National Environmental Act, 1998 and subsequent Regulations; National Environmental Management: Waste Act, 2008; National Environmental Management: Air Quality Act, 2004; National Water Act, 1998 and the Mineral and Petroleum Resources Development Act, 2002. She is a certified ISO 14001 Lead Auditor and has been involved in conducting environmental audits and site assessments, implementing of EMPs, as well as assessing environmental compliance. She has acted as the Large Account Manager for various mining companies including Total Coal South Africa (involved for 7 year), as well as for Assmang's Ferrous Division (involved for 12 years).

Ms. Bekker acts as a Guest Lecturer at the University of Johannesburg at the Department of Geography and Environmental Management, where she lectures 3rd and 4th year students on matters regarding Environmental Management and the implementation of knowledge into the Environmental Consulting Field.

Ms Bekker is a registered Professional Natural Scientist with the South African Council of Natural Science Professional Board and is also a Certified Environmental Assessment Practitioner with the Board of Environmental Practitioner Association of South Africa (EPASA) a legal requirement of the National Environmental Management Act, 1998.

PO Box 22014 | Helderkruin | 1733
tanja@envirogistics.co.za
082 412 1799
086 551 5233

Employment Record

02/2015 to current:	EnviroGistics – Owner
01/2007 to 04/2014:	GCS (Pty) Ltd – Project Manager; Environmental Unit Manager
06/2006 to 12/2006:	WSP Environmental (Pty) Ltd – Environmental Scientist
09/2003 to 05/2006:	GCS (Pty) Ltd – Environmental Scientist
08/2002 to 08/2003:	Digby Wells and Associates – Junior Environmental Scientist
04/2001 to 07/2002 (Part time):	UWP Engineers – Part Time Digitizer – GIS (Arc View)

Education

B.Sc. Earth Sciences (Geography & Geology) – RAU (University of Johannesburg)
B.Sc. Geography Honours - RAU (University of Johannesburg)
M.Sc. Environmental Management - RAU (University of Johannesburg)

Career Enhancing Courses

ISO 14000 Lead Auditors Course (WTH Management)
Certificate in Project Management (Pretoria University)
Management Advance Programme (MAP 81) (Wits Business School)
Certificate in Customer Service Excellence (Pretoria University Enterprises)
IWRM, the NWA and Water Use Authorisations (Carin Bosman Sustainable Solutions)

Professional Affiliations

Registered Environmental Assessment Practitioner of South Africa (EAPSA)
Certified ISO 14001 Environmental Management System Auditor
Registered as a Professional Natural Scientist (SACNASP),
Member of the South African affiliate of the International Association for Impact Assessment
Member of the Environmental Law Association of South Africa (ELA).

Languages

	Reading	**Writing**	**Speaking**
English	Excellent	Excellent	Excellent
Afrikaans	Excellent	Excellent	Excellent

Experience Record

1. **National Water Act, 1998**

- Water Use License Application in terms of the National Water Act, 1998 – Compilation of the Water Use License Application for Eden Districts Municipality (2004)
- Senior Review of the Total Coal South Africa, DCM East Water Use License Application (2011)
- Assmang Ltd, Khumani Iron Ore Mine, Senior Project Manager in the application for a holistic Water Use License for the Khumani Iron Ore Mine (2012)
- Assmang Ltd, Beeshoek Iron Ore Mine, Senior Project Management in the application for a holistic Water Use License for the Beeshoek Iron Ore Mine (2013)
- Assmang Ltd, Khumani Iron Ore Mine, Senior Project Manager in the amendment of approved Water Use License with the inclusion of strategic water uses to streamline the application process (2013)
- Senior Consultant in the addressing the appeal of the Total Coal South Africa, DCM East Water Use License Application (2013)
- Water Use License Application for Dwarsrivier Chrome Mine (2016);
- Water Use License Application for Beeshoek Iron Ore Mine (2018);
- Water Use License Application for NWK Liquid Fertiliser (2018);
- Water Use Licence Application for emergency water abstraction for Khumani Iron Ore Mine (2016-current).
- Formulation of Integrated Water and Waste Management Plan for Beeshoek Iron Ore Mine (2016)
- Formulation of Integrated Water and Waste Management Plan for Dwarsrivier Chrome Mine (2016)

- Management of Risk Assessment for a General Authorisation of River Crossings in the Steelpoort area (2017)
- Water Use License Application for Dwarsrivier Chrome Mine (2018 – current)
- Water Use License Application Amendment for DCM Mine, Burgersfort (2018 – current)
- Water Use License Application Amendment for Samancor, TAS Smelter (2018 – current)
- Water Use License Application Amendment for Dwarsrivier Chrome Mine (2019 – current)
- Water Use License Application Amendment for Khumani Iron Ore Mine (2019 – current)
- Integrated Water and Waste Management Plan for Dwarsrivier Chrome Mine (2016)
- Integrated Water and Waste Management Plan for Dwarsrivier Chrome Mine (2017)
- Integrated Water and Waste Management Plan for Beeshoek Iron Ore Mine (2016)
- Integrated Water and Waste Management Plan for Beeshoek Iron Ore Mine (2017)
- Integrated Water and Waste Management Plan for Wonderkop Smelter (2017)
- Integrated Water and Waste Management Plan for DRD Ergo Mine (2018-current)
- Integrated Water and Waste Management Plan for Khumani Iron Ore Mine (2018-current)

2. Mineral and Petroleum Resources Development Act, 2002

- Prospecting Right Application and Environmental Management Plan – Project manager and coordination of the environmental authorisation process on the farm McCarthy for Assmang Ltd for the prospecting of iron ore in the Northern Cape Province. Responsibilities included the overall management of the project with the compilation of the application and subsequent Environmental Management Plan (2004)
- Prospecting Right Application and Environmental Management Plan – Project manager and coordination of the environmental authorisation process on the farm Doornfontein for Assmang Ltd for the prospecting of iron ore in the Northern Cape Province. Responsibilities included the overall management of the project with the compilation of the application and subsequent Environmental Management Plan (2004)
- Prospecting Right Application – Main responsibility involved the compilation and submission of a Prospecting Right Application and associated Environmental Management Plan for Rovic (Pty) Ltd on the farm Rietkuil (2005)
- Prospecting Right Application – Main responsibility involved the compilation and submission of a Prospecting Right Application and associated Environmental Management Plan for Rovic (Pty) Ltd on the farms Ou Damplaats, Mineside, Redhills, Woolcott and Prospect (2005)
- Prospecting Right Application – Project manager for the environmental authorisation process for a Prospecting Right Application for Khusela Womens Investments (Pty) Ltd on the farm Loopspruit in the Mpumalanga Province. Main responsibility involved the coordination of the public participation process and associated Environmental Management Plan (2005)
- Prospecting Right Application – Project manager for the environmental authorisation process for a Prospecting Right Application for Khusela Womens Investments (Pty) Ltd on the farm Van Kolderskop in the Mpumalanga Province. Main responsibility involved the coordination of the public participation process and associated Environmental Management Plan (2005)
- Mining Right Application, Environmental Authorisation and Rehabilitation Fund - Project manager and co-ordination of the environmental authorisation process for the green fields Khumani Iron Ore Mine for Assmang Ltd. Main responsibilities involved the application for the Mining Right Application and subsequent liaison with the relevant authorities; coordination and management of sub consultants; liaison with the relevant stakeholders, which included the consultation in terms of purchasing of land and utilisation of bulk services; coordination and management of the public participation process; overview of the Water Use License Application; Environmental Feasibility Reporting; Site Selection process for the location of a paste disposal facility; Scoping Reporting, interpreting of specialist investigations and results and Environmental Impact Assessment and Management Reporting and the compilation of the rehabilitation fund (2006)
- Environmental Programme Addendum – Project manager and coordination of the addendum of the Harmony Randfontein Operation’s approved Environmental Management Programme to alight the report with the requirements of the Mineral and Petroleum Resources Development Act, 2002, as well as the undertaking of the relevant public participation process
- Environmental Programme Addendum – Project manager and coordination of the addendum of the Harmony Randfontein Operation’s approved Environmental Management Programme to align the report with the requirements of the Mineral and Petroleum Resources Development Act, 2002, as well as the undertaking of the relevant public participation process (2006)

- Environmental Programme Amendment - Project manager and coordination of the Merensky Environmental Management Programme Amendment for Anglo Platinum in Amandelbult. Main responsibilities involved the coordination of sub consultants, interpreting of specialist investigations and results, quality control, coordination of the public participation process and client liaison (2006)
- Environmental Programme Amendment - Project manager and coordination of the UG2 Environmental Management Programme Amendment for Anglo Platinum in Amandelbult. Main responsibilities involved the coordination of sub consultants, interpreting of specialist investigations and results, quality control, coordination of the public participation process and client liaison (2006)
- Environmental Programme Amendment - Project manager and coordination of the Khumani Iron Ore Mine Amendment for the inclusion of the mining of the barrier pillar between the mine and Sishen Iron Ore Mine for Assmang Limited. Main responsibilities involved the coordination and management of the project, interpreting of specialist investigations and results, quality control, coordination of the public participation process and client liaison, as well as the formulation of the financial closure cost (2007)
- Mining Right Application and Environmental Management Programme - Project manager and coordination for a mega tailings dam extension for Mine Waste Solutions, First Uranium South Africa in the Northwest Province. Main responsibilities involved the coordination and management of the project, quality control, coordination of the public participation process and client liaison, as well as the formulation of the financial closure cost (2007)
- Environmental Management Programme - Project manager and coordination of the green fields East Mine Expansion Project for Total Coal South Africa for the establishment of new opencast and underground operations with the associated plant and ancillary infrastructure, including a railway line link to the Richard Bay Coal Terminal. Main responsibilities involved the coordination and management of the project, compilation of the environmental feasibility report, interpreting of specialist investigations and results, site selection for a co-disposal facility and new railway line, quality control, coordination of the public participation process and client liaison, as well as the formulation of the financial closure cost (2008)
- Environmental Programme Amendment – Project manager and coordination of the amendment of the Harmony Kalgold Operation's approved Environmental Management Programme to align the report with the requirements of the Mineral and Petroleum Resources Development Act, 2002. Main responsibilities involved the coordination and management of the project, quality control, coordination of the public participation process and client liaison, as well as the formulation of the financial closure cost, as well as the undertaking of the relevant public participation process (2008)
- Environmental Management Programme Amendment - Project manager and coordination of the East Mine Option 1 Project for Total Coal South Africa for the establishment of conveyor line link to the Richard Bay Coal Terminal. Main responsibilities involved the coordination and management of the project, interpreting of specialist investigations and results, quality control, and client liaison, as well as the formulation of the financial closure cost (2009)
- Environmental Management Programme Amendment - Project manager and coordination of the West Mine Project for Total Coal South Africa for the establishment of new opencast and underground operations with the associated plant and ancillary infrastructure. Main responsibilities involved the coordination and management of the project, interpreting of specialist investigations and results, quality control and client liaison (2009)
- Environmental Management Programme Amendment – Project manager and coordination of the Black Rock Manganese Mines for Assmang Ltd to align the report with the requirements of the Mineral and Petroleum Resources Development Act, 2002 and to include activities such as a new plant, water treatment facility, footprint increases, etc. Main responsibilities involved the coordination and management of the project, quality control, coordination of the public participation process and client liaison, as well as the formulation of the financial closure cost (2009)
- Total Coal Service Level Agreement – Responsible for the coordination of the environmental projects and legal requirements for the Total Coal operations (2010 to current)
- Environmental Management Programme Amendment - Project manager and coordination of the Khumani Iron Ore Amendment project (2012)
- Environmental Management Programme Amendment (Low Grade Stockpile) – Project Management and coordination for the Khumani Iron Ore Mine (2016)

- Environmental Management Programme Amendment – Project Management and coordination for Beeshoek Iron Ore Mine (2018)
- Mukulu PFS Planning Project with Hatch - Project Management and coordination (2013)
- DRA Project Planning and Client Advisory Role – Ad Hoc Appointment (2013)
- Sable Metal and Minerals, Sandbult Prospecting Right Application Environmental Management Plan (2014)
- Sable Metal and Minerals, Bierkraal Prospecting Right Application Environmental Management Plan (2014)
- Sable Metal and Minerals, Doornpoort Prospecting Right Application Environmental Management Plan (2014)
- Assore Wonderstone EMP Amendment Gap Analysis (2017);
- Assore Zeerust EMP Amendment Gap Analysis (2018);
- Assore RDCM EMP Amendment Gap Analysis (2018).

3. Closure Assessments and Financial Provision in terms of the Mineral and Petroleum Resources Development Act, 2002

- Glossam Closure Assessment - Project manager of the historic Glossam Mine operations for Assmang Ltd to obtain closure in terms of the requirements of the Mineral and Petroleum Resources Development Act, 2002 Main responsibilities involve the coordination and management of the project, quality control, client liaison, as well as the formulation of the financial closure cost (2009)
- Japiesrus Closure Assessment - Project manager of the historic Glossam Mine operations for Assmang Ltd to obtain closure in terms of the requirements of the Mineral and Petroleum Resources Development Act, 2002 Main responsibilities involve the coordination and management of the project, quality control, client liaison, as well as the formulation of the financial closure cost (2011)
- Financial Provision Assessment – Responsible for the assessment of and reporting on the financial closure cost for Assmang Ltd for the Beeshoek Iron Ore Mine, Northern Cape (2007)
- Financial Provision Assessment – Responsible for the assessment of and reporting on the financial closure cost for Simmer and Jack Ltd for the Buffelsfontein Gold Mine, Northwest Province (2007)
- Financial Provision Assessment – Responsible for the assessment of and reporting on the financial closure cost for Simmer and Jack Ltd for the Buffelsfontein Gold Mine, Northwest Province (2008)
- Financial Provision Assessment – Responsible for the assessment of and reporting on the financial closure cost for Assmang Ltd for the Beeshoek Iron Ore Mine, Northern Cape (2009)
- Financial Provision Assessment – Responsible for the assessment of and reporting on the financial closure cost for Assmang Ltd for the Khumani Iron Ore Mine, Northern Cape (2009)
- Financial Provision Assessment – Responsible for the assessment of and reporting on the financial closure cost for Assmang Ltd for the Black Rock Manganese Mine, Northern Cape (2009)
- Financial Provision Assessment – Responsible for the assessment of and reporting on the financial closure cost for Simmer and Jack Ltd for the Buffelsfontein Gold Mine, Northwest Province (2009)
- Financial Provision Assessment - Responsible for the assessment of and reporting on the financial closure cost for Total Coal South Africa for the Dorstfontein East Project, Mpumalanga (2009)
- Financial Provision Assessment - Responsible for the assessment of and reporting on the financial closure cost for Total Coal South Africa for the Forzando West Project, Mpumalanga (2011)
- Financial Provision Assessment - Responsible for the assessment of and reporting on the financial closure cost for Khumani Iron Ore Mine (2014)
- Financial Provision Assessment - Responsible for the assessment of and reporting on the financial closure cost for Sable Metals and Minerals, Bierkraal Prospecting Area (2014)
- Financial Provision Assessment - Responsible for the assessment of and reporting on the financial closure cost for Sable Metals and Minerals, Sandbult Prospecting Area (2014)
- Financial Provision Assessment - Responsible for the assessment of and reporting on the financial closure cost for Sable Metals and Minerals, Doornpoort Prospecting Area (2014)
- Financial Provision Assessment for Beeshoek Iron Ore Mine 2015;
- Financial Provision Assessment for Khumani Iron Ore Mine, 2015;
- Financial Provision Assessment for Petra Diamonds Prospecting Right, 2016;
- Financial Provision Assessment for Beeshoek Iron Ore Mine, 2016;
- Financial Provision Assessment for Khumani Iron Ore Mine, 2016;

- Financial Provision Assessment in terms of the NEMA Regulations for the ARM Ferrous Operations, Northern Cape, 2016;
- Financial Provision Assessment in terms of the NEMA Regulations for the ARM Ferrous Operations, Northern Cape, 2017;
- Sebilo Resources Closure Plan Development, 2017
- Financial Provision Assessment for Beeshoek Iron Ore Mine, 2016;
- Financial Provision Assessment for Khumani Iron Ore Mine, 2016;
- Financial Provision Assessment for Beeshoek Iron Ore Mine, 2017;
- Financial Provision Assessment for Khumani Iron Ore Mine, 2017;
- Financial Provision Assessment for Black Rock Manganese Mine, 2017
- Financial Provision Assessment for Beeshoek Iron Ore Mine, 2018;
- Financial Provision Assessment for Khumani Iron Ore Mine, 2018;
- Financial Provision Assessment for Black Rock Manganese Mine, 2018

4. Environmental Conservation Act, 1989

- Environmental Authorisation - Project manager and co-ordination of the environmental authorization process for the green fields Khumani Iron Ore Mine for Assmang Ltd to obtain approval for listed activities (2005)
- Environmental Authorisation – Compilation of the Environmental Impact Assessment Report for the Gerus-Murani Power line in Namibia for NamPower (2006)
- Environmental Authorisation – Project manager and co-ordination of the environmental authorization for Blue Horisons Investments for the Paarl eco-estate development in Lephalale, Limpopo Province. Main responsibilities involved the coordination of sub consultants, quality control, coordination of the public participation process and client liaison (2006)
- Environmental Authorisation – Project manager and co-ordination of the environmental authorization for Blue Horisons Investments for the Madulakgogo eco-estate development in Burgersford, Mpumalanga Province. Main responsibilities involved the coordination of sub consultants, quality control, coordination of the public participation process and client liaison (2006)

5. **National Environmental Management Act, 1998 and National Environment Management: Waste Act, 2008**

- Environmental Authorisation for listed activities - Project manager and coordination for a mega tailings dam extension and associated listed activities (linear, plant, areas greater than 20ha, etc.) for Mine Waste Solutions, First Uranium South Africa in the Northwest Province. Main responsibilities involved the coordination and management of the project, interpreting of specialist investigations and results, quality control, coordination of the public participation process and client liaison, as well as the formulation of the financial closure cost (2007)
- Environmental Authorisation for listed activities - Project manager and coordination of the green fields East Mine Expansion Project for Total Coal South Africa for the authorisation of listed activities that included areas greater than 20ha, railway lines, conveyors, mining within wetland and watercourse areas, etc. Main responsibilities involved the coordination and management of the project, interpreting of specialist investigations and results, site selection for a co-disposal facility and new railway line, quality control, coordination of the public participation process and client liaison, as well as the formulation of the financial closure cost (2008)
- Basic Assessment for listed activities - Project manager and coordination for Assmang Ltd for the Khumani Iron Ore Mine for the temporary storage of diesel along the railway line. Main responsibilities involved the coordination and management of the project, site selection for a co-disposal facility and new railway line, interpreting of specialist investigations and results, quality control, coordination of the public participation process and client liaison, as well as the formulation of the financial closure cost (2008)
- Basic Assessment for listed activities - Project manager and coordination for Harmony Gold Mines Limited for the Evander Operations for the closure of a domestic waste disposal site. Main responsibilities involved the coordination and management of the project, interpreting of specialist investigations and results, coordination of specialists, closure alternatives, quality control, coordination of the public participation process and client liaison (2008)

- Environmental Authorisation for listed activities - Project manager and coordination of the West Mine Expansion Project for Total Coal South Africa for the authorisation of listed activities that included areas greater than 20ha, conveyors, mining within wetland and watercourse areas, etc. Main responsibilities involved the coordination and management of the project, interpreting of specialist investigations and results, quality control, coordination of the public participation process and client liaison (2009)
- Environmental Authorisation for listed activities - Project manager and coordination of the of the East Mine Option 1 Project for Total Coal South Africa for the authorisation of listed activities that involve conveyors, activities within wetland and watercourse areas, etc. Main responsibilities involved the coordination and management of the project, interpreting of specialist investigations and results, quality control, and client liaison, as well as the formulation of the financial closure cost (2009)
- Environmental Authorisation for listed activities - Project manager and coordination of the Black Rock Manganese Mines for Assmang Ltd for the authorisation of listed activities that included diesel storage and generation etc. Main responsibilities involved the coordination and management of the project, quality control, coordination of the public participation process and client liaison (2009)
- Environmental Authorisation for listed activities - Project manager and coordination of the Black Rock Manganese Mines for Assmang Ltd for the authorisation of listed activities, which include a new Eskom power line. Main responsibilities involve the coordination and management of the project, quality control, coordination of the public participation process and client liaison (2009)
- Environmental Management Programme Amendment - Project manager and coordination of the Khumani Iron Ore Amendment project (2011)
- Risk Assessments for current Total Coal Operations
- Khumani Low Grade Stockpile Environmental Authorisation – Peer Review and Overall Advisory Capacity (2014-2015)
- Nederburg (Distell Ltd) Mixed Land Use Environmental Authorisation – Principal Environmental Practitioner (2014 -2015)
- Basic Assessment Application for the upgrade of a Storm Water Dam for Beeshoek Iron Ore Mine, 2016;
- Basic Assessment Application for a Prospecting Right Application for Barkley West, Petra Diamonds, 2015;
- Basic Assessment Application for a Prospecting Right Application for Carter Block, Petra Diamonds, 2015;
- Basic Assessment Application for a Prospecting Right Application for Farm 87&88, Petra Diamonds, 2015;
- Environmental Impact Assessment for the storage of dangerous goods for NWK Liquid Fertiliser, 2016.
- Basic Assessment Application for an upgrade to a Storm Water Dam on an Iron Ore Mine, 2016.
- Basic Assessment Application for the expansion of mining activities and infrastructure at the Khumani Iron Ore Mine, 2017-current.
- Basic Assessment Application for a Prospecting Application near Loeriesfontein, 2017.
- Environmental Gap Analysis for industrial development near Steelpoort, 2017;
- Environmental Gap Analysis and Environmental Management Programme Development for Assore Wonderstone Operations (2017);
- Environmental Gap Analysis and Environmental Management Programme Development for Assore Zeerust Operations (2017);
- Integrated Basic Assessment Application for a Waste Rock Dump Extension, Dwarsrivier Chrome Mine (2017)
- Integrated Environmental Impact Assessment for Dwarsrivier Chrome Mine for new Exploration Activities and the extension of Capital Projects (2018-current);
- Integrated Environmental Impact Assessment for Dwarsrivier Chrome Mine for a new Tailings Storage Facility (2019-current);
- Environmental Impact Assessment for Khumani Iron Ore Mine for a new Return Water Dam, Pipelines and amendments to the Water Use Licence (2018-current);
- Environmental Gap Analysis for expansion projects at Beeshoek Iron Ore Mine (2018-current).
- Environmental Impact Assessment for Assmang Chrome, Machadodorp Smelter (2019-current).

6. Crack Surveys

- Mining Related Crack Survey – Responsible for the establishment of the potential impact on surrounding farm houses for Assmang Ltd for the Khumani Iron Ore Mine with relation to blasting activities. Main responsibility was the establishment of methodology and associated consultation with relevant specialists in the field and the associated reporting (2005)
- Residential Crack Survey – Responsible for determining the current status of houses in an area earmarked for business expansion in Hyde Park For Impafa Technologies (2006)

7. Air Emission Licenses

- Khumani Iron Ore Mine, Diesel Tank Atmospheric Emission License (2014)
- Coordination of LDAR Monitoring at the Khumani Iron Ore Mine (2017)
- Assistance in NAIES Reporting for the Assmang Chrome Machadodorp Operations (2017)
- Assistance in NAIES Reporting for the Assmang Chrome Machadodorp Operations (2018)

8. Audits, Gap Analysis and Due Diligence

- Due Diligence - Formed part of the audit team to assess the environmental liabilities as part of two Phase 1 Environmental Site Assessments for both the manufacturing site, as well as the warehouse. Main responsibility was the assessment of the environmental legal compliance in terms of the national, provincial and municipal legislation (2004)
- Participated as part of the audit team. The audit involved an ISO 14000 assessment in terms of the environmental, health and safety. Main areas of responsibility were to provide guidance in terms of the environmental statues of the South African Legislation (2005)
- Expert Summary on Environmental Legal Issues - The Total vs. Tavistock Arbitration assessment involved the environmental legal assessment of the two companies in question's legal status in terms of environmental compliance with specific reference to legal administration and water management. Main responsibly was the provision of an expert summary regarding the environmental legal compliance in terms of the South African Legislation (2006)
- Environmental Audits as part of the requirements of the Environmental Conservation Act, 1989 and the Mineral and Petroleum Resources Development Act, 2002 - Responsible for the formulation of the audit protocols and feedback procedures for the implementation of the environmental management programme for the Khumani Iron Ore Mine, Northern Cape. The assessment involved six month audit programme during the start of the operational phase of the mine. As part of the assessment the responsibilities involve the provision of action plans to address areas of definite and potential non-compliance. The performance assessments were later extended into the operational phase (2007)
- Environmental, Health and Safety Audit - Participated as the lead auditor for eight mining operations within South Africa for African Rainbow Minerals. The audit addressed all aspects of environmental, safety and financial closure cost within the South African Legislation. The assessment involved the formulation of the audit protocols and audit papers (2007)
- Performance Assessment as part of the requirements of the Mineral and Petroleum Resources Development Act, 2002 - Participated as part of the audit team for Assmang Ltd, the Black Rock Manganese Mine, Northern Cape. Responsible for assessing the compliance to environmental aspects in terms of the broader South African Legislation, as well as the assessment of the financial rehabilitation fund (2007)
- Performance Assessment as part of the requirements of the Mineral and Petroleum Resources Development Act, 2002 - Participated as part of the audit team for Total Coal South Africa for the Forzando North and South Mine Operations. Main responsibility was the assessment of the financial rehabilitation fund (2008).
- Performance Assessment as part of the requirements of the Mineral and Petroleum Resources Development Act, 2002 - Annual environmental audit for Assmang Ltd, the Khumani Iron Ore Mine, Northern Cape. Responsible for assessing the compliance to environmental aspects on site (2008)
- Performance Assessment as part of the requirements of the Environmental Conservation Act, 1989 – Annual environmental audits for Assmang Ltd, the Khumani Iron Ore Mine, Northern Cape. Responsible for assessing the compliance to environmental aspects on site (2008)
- Environmental Implementation for the Assmang Khumani Iron Ore Operations (2010 and contract to 2014)

- Performance Assessments for the Total Coal South Africa Operations (2009 to current – part of Service Level Agreement)
- Mooihoek Due Diligence (2013) for RSV Enco;
- Gap Analysis in terms of IFC and World Bank Operational Policies for Greenfield Madagascar Graphite Mine (2013/2014)
- Khumani Iron Ore Mine Environmental Performance (NEMA, NEM:WA, NWA and MPRDA) Assessments (2014)
- Northam Platinum: Zondereinde Division Environmental Performance (NEMA, MPRDA and NWA) Assessments (2014)
- Northam Platinum: Zondereinde Division Environmental Performance (NEM:WA) Assessments (2014)
- Dwarsrivier Platinum Mine: Water Management Gap Analysis (2014-2016)
- Khumani Iron Ore Mine Dust Monitoring Gap Analysis (2014)
- DRA Global (2014): Molo Greenfields Mine IFC and World Bank Gap Analysis and project scope formalisation;
- GEM Diamonds Botswana: Ghaghoo Diamond Mine (2015): Waste Management Gap Analysis and Action Plan formalisation
- ASA Metals WUL Performance Assessment, 2015;
- Khumani Iron Ore Mine Environmental Performance (NEMA, NEM:WA, NWA and MPRDA) Assessments (2015);
- Beeshoek Iron Ore Mine Environmental Performance (NEMA, NEM:WA, NWA and MPRDA) Assessments (2015)
- GEM Diamonds Botswana: Ghaghoo Diamond Mine (2015): SEIA Performance Assessment;
- Petra Diamonds Prospecting Right Application Annual Performance Assessment, 2016;
- Glencore WUL Audit,2016;
- Beeshoek Iron Ore Mine Environmental Performance (NEMA, NEM:WA, NWA and MPRDA) Assessments (2016);
- Khumani Iron Ore Mine Environmental Performance (NEMA, NWA and MPRDA) Assessments (2016);
- GEM Diamonds Botswana: Ghaghoo Diamond Mine (2017): SEIA Performance Assessment;
- Beeshoek Iron Ore Mine Environmental Performance (NEMA, NWA and MPRDA) Assessments (2016);
- Dwarsrivier Chrome Mine Environmental Performance (NEMA, NWA and MPRDA) Assessments (2016);
- Sable Metals (2016) Waste Management Gap Analysis and project scope formalisation.
- Glencore Magareng, Thorncliffe and Helena Performance Assessments (NEMA, NEM:WA, NWA) (2016);
- Glencore Wonderkop Performance Assessment (NWA) (2016)
- Transvaal Gold Mining Enterprises Performance Assessment (NEMA and NWA) (2017);
- Dwarsrivier Chrome Mine Environmental Performance (NEMA, NWA and MPRDA) Assessments (2017);
- Glencore Magareng, Thorncliffe and Helena Biannual Performance Assessments (NEMA, NEM:WA, 2017);
- Pascua Lama: Argentina Environmental Gap Analysis (2017);
- Yzermyn WUL Audit, 2017;
- Beeshoek Iron Ore Mine Environmental Performance (NEMA, NEM:WA, NWA and MPRDA) Assessments (2017);
- Khumani Iron Ore Mine Environmental Performance (NEMA, NWA and MPRDA) Assessments (2017);
- Yzermyn WUL Audit, 2018.
- Beeshoek Iron Ore Mine Environmental Performance (NEMA, NEM:WA, NWA and MPRDA) Assessments (2018);
- Khumani Iron Ore Mine Environmental Performance (NEMA, NWA and MPRDA) Assessments (2018);
- Dwarsrivier Chrome Mine Environmental Performance (NEMA, NWA and MPRDA) Assessments (2018);
- Glencore Magareng, Thorncliffe and Helena Biannual Performance Assessments (NEMA, NEM:WA, 2018);
- Anglo Mototolo Mine Performance (NEMA, MPRDA, NEM:WA) Assessments (2018)

- Dwarsrivier Chrome Mine Environmental Performance (NEMA, NWA and MPRDA) Assessments (2019 –renewed);
- Anglo Mototolo Mine Performance (NEMA, MPRDA, NEM:WA) Assessments (2019 – renewed)
- Glencore Magareng, Thorncliffe and Helena Biannual Performance Assessments (NEMA, NEM:WA, 201-2021) (three year contract);
- Dwarsrivier Chrome Mine Environmental Performance (NEMA, NWA and MPRDA) Assessments (three year contract 2019-2021);
- Beeshoek Iron Ore Mine Environmental Performance (NEMA, NEM:WA, NWA and MPRDA) Assessments (2019 renewed);
- Assore Wonderstone EMP Compliance Audit (2019).

9. GN704 Applications

- Beeshoek Iron Ore Mine, 2018
- Khumani Iron Ore Mine (2018-current)

10. Guest Lecture

- University of Johannesburg: August 2015 to August 2017: Environmental Impact Assessment Practices and Principles

11. Environmental Coordination and Management

- Environmental Coordination for Assmang Chrome Machadodorp Works Operation to ensure the effective implementation of environmental compliance 2015-2017 & renewed for 2017-2018 & renewed for 2018-2019 & renewed for 2019-2020.

Annexure 3: Soil Assessment

SCIENTIFIC AQUATIC SERVICES

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ALTERNATIVES ANALYSIS AS PART OF THE ENVIRONMENTAL ASSESSMENT AND AUTHORISATION PROCESS FOR THE PROPOSED DEVELOPMENT OF A NEW TAILINGS STORAGE FACILITY AND FUEL STORAGE AREAS AT THE DWARS RIVER CHROME MINE, LIMPOPO PROVINCE

Prepared for

Envirogistics (Pty) Ltd

February 2019
Revised: June 2021

Alternatives Analysis: Soil, Land Use and Land Capability

Prepared by:	**Scientific Aquatic Services**
Report author:	**B. Mzila**
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	S. van Staden (Pr.Sci.Nat)
Report Reference:	**SAS 202175**
Date:	**June 2021**

SAS Environmental Group of Companies

EXECUTIVE SUMMARY

Scientific Aquatic Services (SAS) was appointed to conduct a soil, land use and land capability assessment alternative analysis as part of the Environmental Impact Assessment (EIA) and authorisation process for the proposed five new projects within the existing Dwars River Chrome Mine Mining Rights Area, as specified below:

- Project 1: the proposed development of a new Tailings Storage Facility (TSF);
- Project 2: diesel and emulsion batching;
- Project 3: main parking extension;
- Project 4: widening of access road between South Shaft / Main Offices and Plant; and
- Project 5: Access Crossing between Plant and North Mine.

Specific outcomes required from this report include the following:

- To conduct a high-level ecological scoping assessment of the proposed TSF Options;
- To assess each TSF Options in terms of soil, land use and land capability within the various TSF Options;
- Highlight areas of risk and concern in terms of land capability associated with each TSF Option; and
- Provide high level soil and land capability input for Projects 2, 3, 4 and 5, highlighting the risks and concerns associated with these projects.

Current land use activities associated with the proposed TSF alternatives are largely dominated by wildlife and wilderness, encompassed by some mining operations in the surrounding areas. No current agricultural activities were observed within the proposed TSF alternatives and the surrounding areas. TSF B alternative is however an old agricultural field which has been laid to fallow. All TSF alternatives equally experience a Mean Annual Precipitation (MAP) of less than 600mm per annum, which is not considered adequate to support unirrigated cultivated agriculture on a commercial scale. Furthermore, all proposed TSF alternatives comprise soils not ideal for either cultivated agriculture nor grazing on a commercial scale. Even though TSF alternative D contains patches of arable soils, the viability of agricultural crop cultivation on these soils in this area is low due to the limited extent of arable soils and land fragmentation as a result of mining related activities in the surrounding areas.

The findings of this assessment including soil limiting factors within the TSF alternatives for land capability and land use potential are summarised below:

Table A: Overall Land Capability associated with the TSF Alternatives, and constraints for agriculture.

Alternative	B	C	D	F
Dominant soils	Bonheim	Arcadia/Immerpan/Mispah	Mispah, Glenrosa, Alluvial soils and Plooysburg	Glenrosa and Mispah
Overall Land Capability	Arable (Class II)	Grazing (Class V)	Grazing (Class V)	Grazing (Class VI)
Limiting factors for Agriculture	Minor; these soils have moderate depth 60 cm to support some cultivated crops and good drainage characteristics. These soils are well suited for crop cultivation. The clay content however increases in the subsoil, thus limiting rooting growth for most crops	-Serious management constraints of Arcadia soils attributed to excessive stickiness when wet and	-Shallow effective rooting depth due to shallow indurated bedrock of the Mispah, Glenrosa; -Lack of stability and low nutrient	-Shallow effective rooting depth due to shallow indurated bedrock of the Mispah, Glenrosa.

Alternative	B	C	D	F
		hardening when dry due to high smectitic (expandable) clay minerals and high plasticity index values -Shallow effective rooting depth due to shallow indurated bedrock of the Mispah, Glenrosa.	holding capacity of alluvial soil forms associated with the freshwater features.	
Business Case	These soils are regarded well suited for cultivated agriculture of selective crops, however the viability of agricultural crop cultivation of these soils in area is low due to land fragmentation by current mining and associated activities in the surrounding areas. In addition, these soils also cover a small area which is not sufficient for commercial agricultural production However, mitigation measures with specific mention of removal of the soil for reuse in rehabilitation should be implemented to conserve soil resources. The impact of the proposed TSF development on the land capability of these soils is anticipated to be within acceptable levels, given the lack of high potential agricultural soils as well as the limiting climatic conditions (MAP less than 600 mm).	Overall, from a soils point of view this site is not ideal for placement of infrastructure due to the occurrence of expansive clay and dispersive soils, as infrastructure may be damaged or displaced when soils come into contact with water.	This site, in comparison to the other two (2) TSF alternatives may be ideal for the development of a tailings facility given the proximity to existing mining infrastructure, thus eliminating the need for significant disturbance of undisturbed soils in other areas within the MRA.	From a soil and land capability perspective, this site may be an ideal option for the development of the new TSF facility. However this would require extensive construction of new infrastructure such as pipelines, leading to the destruction of undisturbed natural soil resources. A greater degree of mitigation may therefore be required (in comparison to alternative D) should this site be utilised.

The proposed Project 2 will most likely result in the clearance of vegetation as part of the construction phase which will lead to loss of soil through erosion and subsequent loss of land capability. Given the small footprint of this project, the loss of land capability is not anticipated to be significant, provided that the project occurs within the demarcated areas and mitigation measures are implemented during all phases of development. The extent of the access road required for this project will be limited since this project is located adjacent the current TRP mines new TSF pipeline and service road. The TSF maintenance road will serve as the main access road and as such the impact of the access road will be negligibly low.

The proposed projects (3,4 & 5) are located within the existing mine operational footprint where soils have already been subjected to significant disturbance associated with mining and related infrastructure. The extension of the existing infrastructure will not lead to a significant losses of land capability given the disturbance that has occurred on the surrounding soils. Impact such as soil erosion, compaction and soil contamination will likely occur during the construction phase which will lead to further degradation of the surrounding soils and the subsequent loss of land capability. However, the overall impact significance of the proposed project will be negligibly low, after mitigation measures have been put in place during all phases of development.

This study aims to provide the proponent with relevant information required in order to inform the decision-making process. Taking the above into consideration, it is the opinion of the specialist that, from a soil and land capability perspective, TSF Alternative D is recommended as the suitable site for TSF development, in comparison to the other three (3) TSF alternatives given the proximity to existing mining infrastructure, thus eliminating the need for significant disturbance of undisturbed soils in other areas within the MRA.

DOCUMENT GUIDE

Table a: Document guide according to the amended 2017 EIA Regulations (No. R. 326)

NEMA Regulations (2017) - Appendix 6	Relevant section in report
(1) A specialist report prepared in terms of these Regulations must contain -	
(a) details of -	
(i) the specialist who prepared the report; and	Appendix A
(ii) the expertise of that specialist to compile a specialist report, including a curriculum vitae;	Appendix A
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix A
(c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1.1
(cA) an indication of the quality and age of base data used for the specialist report;	Section 2
(cB) a description of existing impacts on site, cumulative impacts of the proposed development and levels of acceptable change;	Section 4
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 1
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 2
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying alternatives;	Section 4
(g) an identification of any areas to be avoided, including buffers;	Section 4
(h) a map superimposing the activity, including the associated structures and infrastructure on the environmental sensitivities of the site, including areas to be avoided, including buffers;	none
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.2
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment or activities;	Section 4
(k) any mitigation measures for inclusion in the EMPr;	Section 4
(l) any conditions for inclusion in the environmental authorisation;	Section 5
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	none
(n) a reasoned opinion -	
(i) as to whether the proposed activity, activities or portions thereof should be authorised;	Section 5
(iA) regarding the acceptability of the proposed activity or activities; and	Section 5
(ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 5
(o) a description of any consultation process that was undertaken during the course of preparing the specialist report	none
(p) a summary and copies, if any, comments received during any consultation process and, where applicable all responses thereto; and	none
(q) any other information requested by the competent authority.	None during the scoping phase

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GLOSSARY OF TERMS

AGIS	Agricultural Geo-Referenced Information Systems
Alluvial soil:	A deposit of sand, mud, etc. formed by flowing water, or the sedimentary matter deposited thus within recent times, especially in the valleys of large rivers.
Chromic:	Having within ≤150 cm of the soil surface, a subsurface layer ≥30 cm thick, that has a Munsell colour hue redder than 7.5YR, moist.
Catena	A sequence of soils of similar age, derived from similar parent material, and occurring under similar macroclimatic condition, but having different characteristics due to variation in relief and drainage.
Catchment	The area where water is collected by the natural landscape, where all rain and run-off water ultimately flows into a river, wetland, lake, and ocean or contributes to the groundwater system.
Chroma	The relative purity of the spectral colour which decreases with increasing greyness.
Evapotranspiration	The process by which water is transferred from the land to the atmosphere by evaporation from the soil and other surfaces and by transpiration from plants
Ferralic horizon	A subsurface horizon resulting from long and intense weathering, with a clay fraction that is dominated by low-activity clays and contains various amounts of resistant minerals such as Fe, Al, and/or Mn hydroxides.
Ferralic	Having a ferralic horizon starting ≤150 cm of the soil surface.
IEM	Integrated Environmental Management
IUSS	International Union of Soil Sciences
Lithic	Having continuous rock or technic hard material starting ≤10 cm from the soil surface.
MRA	Mining Right Application
SACNASP	South African Council for Natural Scientific Professions
Salinity	High Sodium Adsorption Ratio (SAR) above 15% are indicative of saline soils. The dominance of Sodium (Na) cations in relation to other cations tends to cause soil dispersion (deflocculation), which increases susceptibility to erosion under intense rainfall events.
SAS	Scientific Aquatic Services
Sodicity	High exchangeable sodium Percentage (ESP) values above 15% are indicative of sodic soils. Similarly, the soil dispersion.
SOTER	Soil and Terrain
Watercourse	In terms of the definition contained within the National Water Act, a watercourse means: • A river or spring; • A natural channel which water flows regularly or intermittently; • A wetland, dam or lake into which, or from which, water flows; and • Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse; • and a reference to a watercourse includes, where relevant, its bed and banks

ACRONYMS

°C	Degrees Celsius.
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
ET	Evapotranspiration
FAO	Food and Agriculture Organization
GIS	Geographic Information System
GPS	Global Positioning System
m	Meter
MAP	Mean Annual Precipitation
MPRDA	Minerals and Petroleum Resources Development Act, Act 28 of 2002
NEMA	National Environmental Management Act
NWA	National Water Act
PSD	Particle Size Distribution
SACNASP	South African Council for Natural Scientific Professions
SAS	Scientific Aquatic Services
subWMA	Sub-Water Management Area
WMA	Water Management Areas
WULA	Water Use Licence Application

1. INTRODUCTION

Scientific Aquatic Services (SAS) was appointed to conduct a soil, land use and land capability assessment alternative analysis as part of the Environmental Impact Assessment (EIA) and authorisation process for the proposed development of a new Tailings Storage Facility (TSF), at Dwars River Chrome Mine near Steelpoort, Limpopo Province. Three (3) areas have been identified by the mine as potential options for the TSF development, namely sites C, D and F, and will henceforth be referred to as TSF alternatives. All three (3) proposed TSF alternatives are located within the Dwars River Mining Right Area (MRA).

The town of Steelpoort is located approximately 13km northeast of the MRA, with the R555 located approximately 7.5 km east of the MRA. The MRA is further situated approximately 5.5km west of the Mpumalanga/Limpopo border, within the Greater Tubatse Local Municipality, and the Greater Sekhukhune District Municipality, within the Limpopo Province. Figure 1 and 2 depict the locality of the MRA as well as the TSF alternatives in relation to the surrounding areas.

High potential agricultural land is a scarce non-renewable resource, which necessitates an Agricultural Potential Assessment prior to land development, particularly for purposes other than agricultural land use which will affect extensive tracts of lands, as per the Conservation of Agricultural Resources Act (CARA), 1983 (Act No. 43 of 1983). Therefore, it is the objective of this study to investigate the soil types within the proposed TSF alternatives and classify them according to their capability to support cultivated agriculture. It was also the objective of this study, from a soil and land capability perspective, to recommend the most suitable site for TSF development by selecting the least suitable site for cultivation by defining its limitations for agriculture.

The purpose of this report is to define each of the proposed projects and their alternatives where relevant in terms of soil and land capability at a high level, by means of analysis of relevant datasets.

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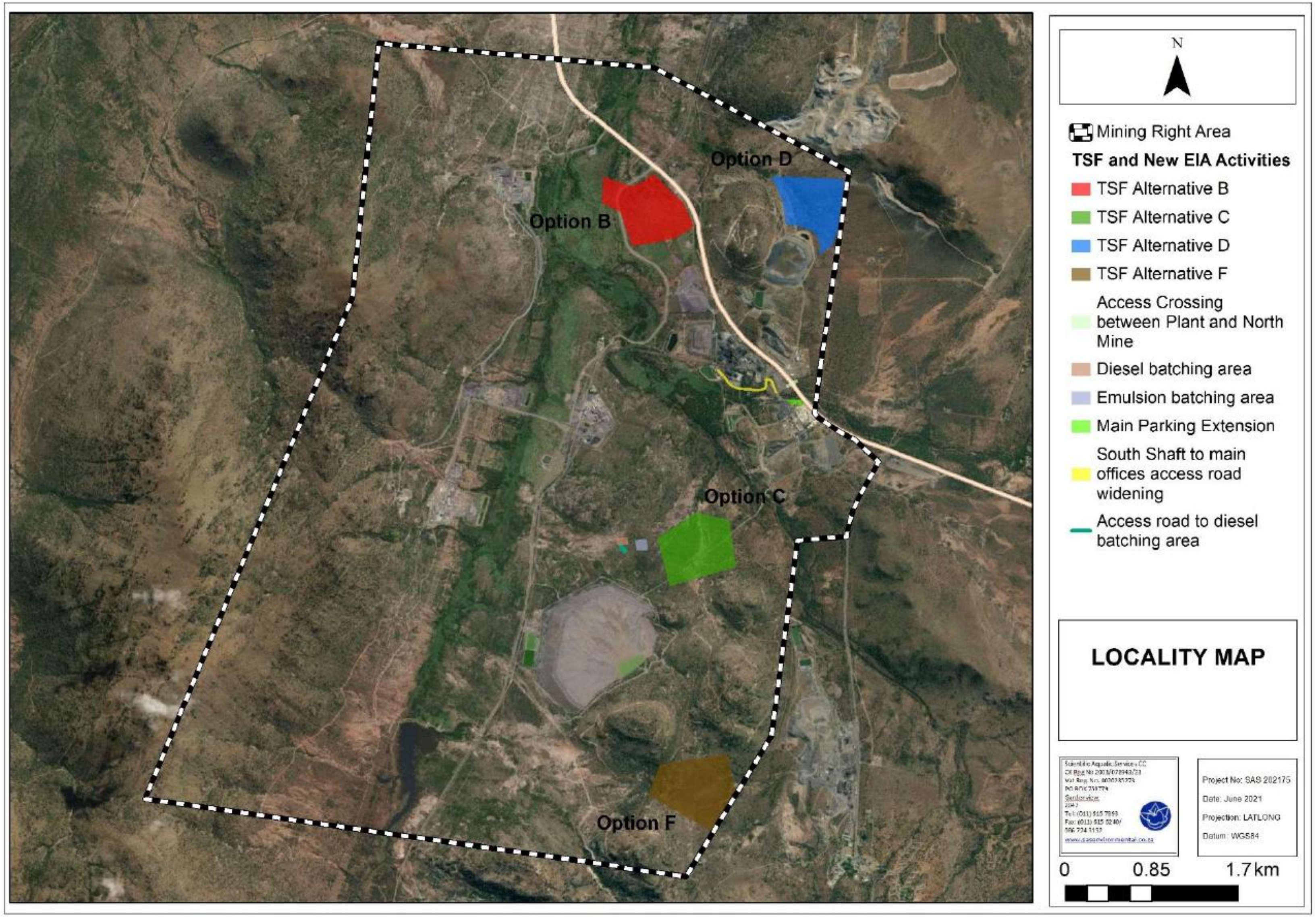


Figure 1: Digital satellite imagery depicting the MRA and TSF alternatives in relation to the surrounding areas.

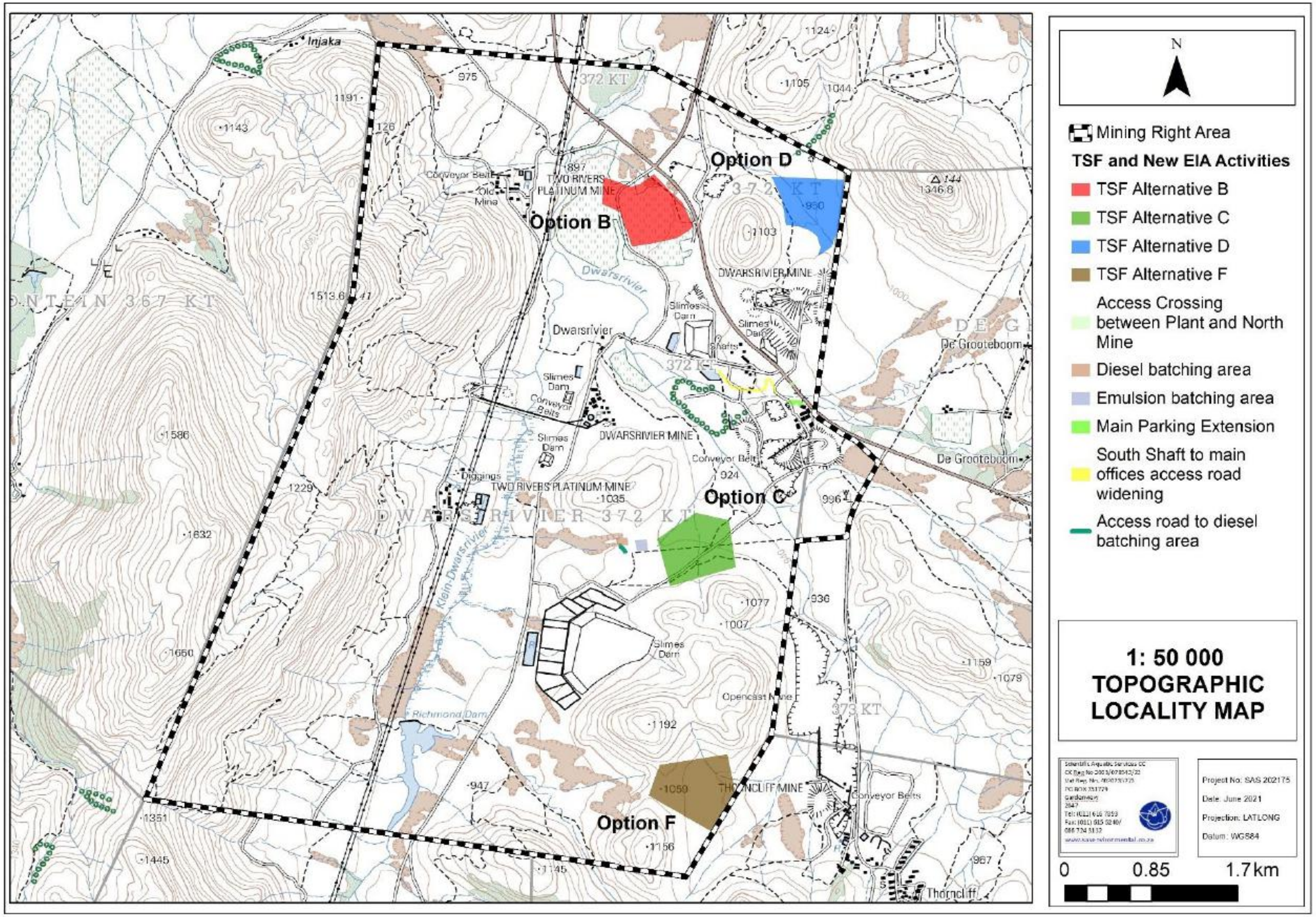


Figure 2: Location of the MRA depicted on a 1:50 000 topographical map in relation to surrounding area

1.1 *Project description*

A brief description of each of the five proposed projects is provided below. It must be noted that the project description was obtained from the report "Dwarsrivier Chrome Mine (Pty) Ltd Environmental Authorisation Application Form for new Capital Projects and the proposed new Khulu Tailings Storage Facility and associated infrastructure (4th Draft) prepared by Envirogistics (Pty) Ltd, as received by the specialist on 2nd June 2021. SAS therefore takes no responsibility for the accuracy of the information presented in this section. The localities of the five proposed projects are presented in Figures 1 and 2 following the project descriptions.

Project 1: Tailings Storage Facility

Dwarsrivier is currently depositing at the existing North Tailings Storage Facility (NTSF) at the eastern side of their process plant on the remaining portion of the Farm Dwarsrivier 372. It is anticipated that the existing active NTSF will reach its full capacity relatively sooner than anticipated due to tonnage ramp ups and additional tonnages from other sites.

The mine identified seven (7) potential TSF options initially, which have subsequently been reduced to four (4) (Option B, C, D and F). During the 2019 Site Selection Process, Option D was the preferred site for the mine. Based on the initial view by the Environmental Assessment Practitioner, Option B was fatally flawed due to the potential future Eskom substation, for which an EIA has been approved and negotiations in terms of land use between the mine and Eskom have commenced. However, subsequent to the 2019 Site Selection Process, further geotechnical studies were undertaken, which identified potential concerns for Option D, which also included the proximity of the non-perennial tributary of the Dwarsrivier River. In addition to this, the Eskom substation is no longer planned, which has reintroduced Option B into the overall assessment.

The areas are as follows:

- B: 24ha;
- C:21ha;
- D:19ha; and
- F:17ha

The heights currently anticipated of each of the facilities will be 37m, 29m, 49m and 50m respectively. The project will not involve typical tailings deposition techniques, but will involve the piping of tailings to a filter press facility from where the filter cake will be trucked to the new TSF. A life of mine of about 20 years are currently considered as part of the design.

Options C, D and F are located on the eastern boundary of the MRA, with Option D situated at the most northern point of the eastern boundary, Option C located centrally within the MRA and Option F situated towards the southern end of the eastern boundary of the MRA. Option B is located in the north, approximately 895 m west of Option D. These sites are henceforth referred to individually as Options B, Project 2:C, D and F and collectively as the "TSF alternatives".

Project 2: Diesel and Emulsion Batching

The mine plans to erect two (2) respective diesel and emulsion batching areas, to supply diesel and emulsion to the underground mining operations. The location of this area is to the north-east of the old Two Rivers Platinum Mine (TRP), just north of the new TRP TSF Pipeline.
The project will include:

- Construction of an approximate 80 m access road to the diesel batching area;
- Parking Area, with security office at both areas (no dangerous good storage planned at any time);
- At the Diesel Batching area the following tanks will be present: 23 m^3 Diesel + 23 m^3 Engine Oil + 23 m^3 Hydraulic Oil;
- At the Emulsion Batching area a 60 m^3 emulsion tank will be placed; and
- Feed into pipeline for underground used at both areas.

Clearance of indigenous vegetation will be required in the order of approximately 1.3ha.

Project 3: Main Parking Extension

The Mine requires the expansion of the existing parking area at the Main Offices. The current parking area is about 0.8 ha with the parking bays not sufficient to cater for the number of vehicles. The current parking bay comprises a tarred surface area and steel roof parking bays. The same principle will be applied at the expanded area. No new entrances will be required. The planned parking bay expansion will be located about 20 m from the Springkaanspruit.

Clearance of indigenous vegetation will be required in the order of approximately 4 900 m^2.

Project 4: Widening of Access Road between South Shaft/Main Offices and Plant

An existing road provides access between the Main Office Buildings and the Plant. The current width of the road ranges between 5-6 m. To accommodate for larger vehicles such as Trucks, the mine is planning on increasing a section of 700m of this road to a width of 16 m (two way traffic).

Clearance of indigenous vegetation will be required in the order of approximately 3 311 m^2.

Project 5: Access Crossing between Plant and North Mine

To ensure more optimal logistical management of traffic between the South Mine and the North Mine, and to reduce the number of vehicles on the regional road, the mine is planning on constructing a road under the regional road bridge to allow for access between the two areas.

Clearance of indigenous vegetation will be required in the order of approximately 1 700 m^2.

1.2 *Scope*

The primary objective of this report is to:

- Conduct a desktop review of existing land type maps, to establish broad baseline conditions and areas of environmental sensitivity and sensitive agricultural areas;
- Classify the soil types within the TSF alternatives according to the new Soil Classification System: A Natural and Anthropogenic System for South Africa (2018);
- Group the identified soil types according to their capability to support cultivated agriculture;
- Outline the current land use within, and in close proximity to the TSF alternatives;
- Recommend the most suitable site for TSF development by defining its limitations for agriculture; and
- Compile a report presenting the results of the desktop study and a description of the findings during the field assessment.

1.3 *Assumptions and Limitations*

For the purpose of this assessment, the following assumptions and limitations are applicable:

- The soil and land capability assessment was confined within the TSF alternative areas and fuel storage areas, which is considered adequate for the purpose of this investigation. Areas in the immediate vicinity were however considered as part of the desktop assessment where existing soil studies were consulted;
- Sampling by definition means that not all areas are assessed, and therefore some aspects of soil and land capability may have been overlooked in this assessment. However, it is the opinion of the specialist that this assessment was carried out with sufficient sampling and in sufficient detail to enable the proponent, the Environmental Assessment Practitioner (EAP) and the regulating authorities to make an informed decision regarding the proposed TSF development;
- Land Capability was classified according to current soil restrictions, with respect to prevailing climatic conditions on site; however, it is virtually impossible to achieve 100%

purity in soil mapping. Therefore the delineated soil map units could include other soil type(s) as the boundaries between the mapped soils are not absolute but rather form a continuum and gradually change from one type to another. Soil mapping and the findings of this assessment were therefore inferred from extrapolations from individual observation points;

- Since soils occur in a continuum with infinite variances, it is often problematic to classify any given soils as one form, or another. For this reason, the classifications presented in this report are based on the "best fit" approach to the soil classification system of South Africa; and
- Soil fertility status was not considered a limitation, as inherent nutrient deficiencies and/or toxicities could be rectified by appropriate liming and/or fertilisation prior to cultivation.

1.4 *Legislative Requirements*

The following legislative requirements were considered during the assessment:

- National Environmental Management Act 1998 (Act 107 of 1998) (NEMA);
- Conservation of Agricultural Resources Act 1983 (CARA, Act 43 of 1983);
- Minerals and Petroleum Resource Development Act 2002 (Act 28 of 2002) (MPRDA); and
- Limpopo Environmental Management Act 2003 (Act 7 of 2003) (LEMA).

2. METHOD OF ASSESSMENT

2.1 *Literature and Database Review*

A desktop study was compiled from various data sources including but not limited to the Agricultural Geo-Referenced Information System (AGIS) and other sources as listed in this report under References.

2.2 *Desktop Screening*

A background study including a literature review was conducted prior to commencement of the field assessment. This was done in order to gather the pre-determined soil and land capability data within the MRA, TSF alternatives and fuel storage areas. The different data sources that are listed under References were used for the assessment, including but not limited to the Agricultural Geo-Referenced Information System (AGIS) and other sources. Furthermore, existing soil studies conducted by SAS (2018) as part of the Dwars River Expansion and Exploration project were consulted to understand the soils and land capability within the MRA.

2.3 *Soil Classification and Sampling*

- A soil survey was conducted by a qualified soil specialist at which time the identified soils within the proposed TSF alternatives areas were classified into soil forms;
- Subsurface soil observations were made using a manual hand auger in order to assess individual soil profiles, which entailed evaluating physical soil properties and prevailing limitations to various land uses;
- Dominant soil types were classified according to the new Soil Classification System: A Natural and Anthropogenic System for South Africa (2018); and
- A Global Positioning System (GPS) was used to record assessed survey and sampling points.

2.4 *Land Capability Classification*

Agricultural potential is directly related to Land Capability, as measured on a scale of I to VIII as presented in Table 1; with Classes I to III classified as high potential agricultural land that is well suited to cultivation of annual crops. Class IV soils may be cultivated under certain circumstances and management practices, whereas Land Classes V to VIII are not suitable for cultivation. Furthermore, the climate capability is measured on a scale of 1 to 8, as illustrated in Table 2. The land capability rating is therefore adjusted accordingly, depending on the prevailing climatic conditions as indicated by the respective climate capability rating.

Table 1: Land Capability Classification (Scotney et al., 1987)

Land Capability Group	Land Capability Class	Increased intensity of use									Limitations
Arable	I	W	F	LG	MG	IG	LC	MC	IC	VIC	No or few limitations. Very high arable potential. Very low erosion hazard
	II	W	F	LG	MG	IG	LC	MC	IC	-	Slight limitations. High arable potential. Low erosion hazard
	III	W	F	LG	MG	IG	LC	MC	-	-	Moderate limitations. Some erosion hazards
	IV	W	F	LG	MG	IG	LC	-	-	-	Severe limitations. Low arable potential. High erosion hazard.
Grazing	V	W	-	LG	MG	-	-	-	-	-	Water course and land with wetness limitations
	VI	W	F	LG	MG	-	-	-	-	-	Limitations preclude cultivation. Suitable for perennial vegetation
	VII	W	F	LG	-	-	-	-	-	-	Very severe limitations. Suitable only for natural vegetation
Wildlife	VIII	W	-	-	-	-	-	-	-	-	Extremely severe limitations. Not suitable for grazing or afforestation.

W - Wildlife F - Forestry LG - Light grazing
MG – Moderate grazing IG - Intensive grazing LC - Light cultivation
MC - Moderate cultivation IC - Intensive cultivation. VIC – Very intensive cultivation

Table 2: Climate Capability Classification (Scotney et al., 1987)

Climate Capability Class	Limitation Rating	Description
C1	None to slight	Local climate is favourable for good yield for a wide range of adapted crops throughout the year.
C2	Slight	Local climate is favourable for good yield for a wide range of adapted crops and a year-round growing season. Moisture stress and lower temperatures increase risk and decrease yields relative to C1.
C3	Slight to moderate	Slightly restricted growing season due to the occurrence of low temperatures and frost. Good yield potential for a moderate range of adapted crops.
C4	Moderate	Moderately restricted growing season due to low temperatures and severe frost. Good yield potential for a moderate range of adapted crops but planting date options more limited than C3.
C5	Moderate to severe	Moderately restricted growing season due to low temperatures, frost and/or moisture stress. Suitable crops may be grown at risk of some yield loss.
C6	Severe	Moderately restricted growing season due to low temperatures, frost and/or moisture stress. Limited suitable crops for which frequently experience yield loss.
C7	Severe to very severe	Severely restricted choice of crops due to heat, cold and/or moisture stress.
C8	Very severe	Very severely restricted choice of crops due to heat and moisture stress. Suitable crops at high risk of yield loss.

3. DESKTOP ASSESSMENT RESULTS

**The background data was accessed for the entire MRA, and where necessary, specifics pertaining to the specific proposed projects are emboldened where considered relevant.*

The following data is applicable to the MR, according to various data sources including but not limited to the Agricultural Geo-Referenced Information System (AGIS):

- The Mean Annual Precipitation (MAP) within the MRA is estimated to range between 401 and 600mm per annum; while the southern portion of the MRA ranges from 601 to 800mm. Refer to Figure 3;
- According to the Soils 2001 Dataset, the larger portion of the MRA is situated within an area where the soils are classified as prismacutanic and pedocutanic diagnostic horizons dominant. In addition, one or more of Vertic, melanic, red structured diagnostic horizons occur within this area. The remaining portion of the MRA is situated within "miscellaneous" land classes, rocky areas with miscellaneous soils, as depicted in Figure 4;
- The natural soil pH within the MRA and TSF alternatives is estimated to range between 6.5 and 7.4, indicating that the soils are anticipated to be slightly acidic to neutral, as interpolated from topsoil pH values obtained from the National Soil Profile Database (AGIS database);

- According to the Soil-Terrain (SOTER) database and the 1:250 000 geological map of South Africa, the majority of the MRA as well as the TSF alternatives are underlain by Pyroxenite rock formations while the remaining portion of the MRA located to the west and the southern portion of TSF alternative F are underlain by Gabbro. Refer to Figure 5;
- According to the Geology (2001) Dataset the majority of the MRA is underlain by Norite, while the remaining portion underlain by Gabbro. All TSF alternatives are underlain by norite, as depicted in Figure 6;
- The desktop assessment indicates that the majority of the TSF alternatives have a moderate potential arable land capability (class III), whereas small portions of TSF alternatives D and F located to the west are characterised by a land capability classified as best suited for Wilderness land use (class VIII), as illustrated in Figure 7 below; and
- According to the AGIS database, the livestock grazing capacity potential of the entire MRA and the three TSF alternatives is estimated to be approximately 6 hectares per large animal unit (Morgenthal *et al.*, 2005);

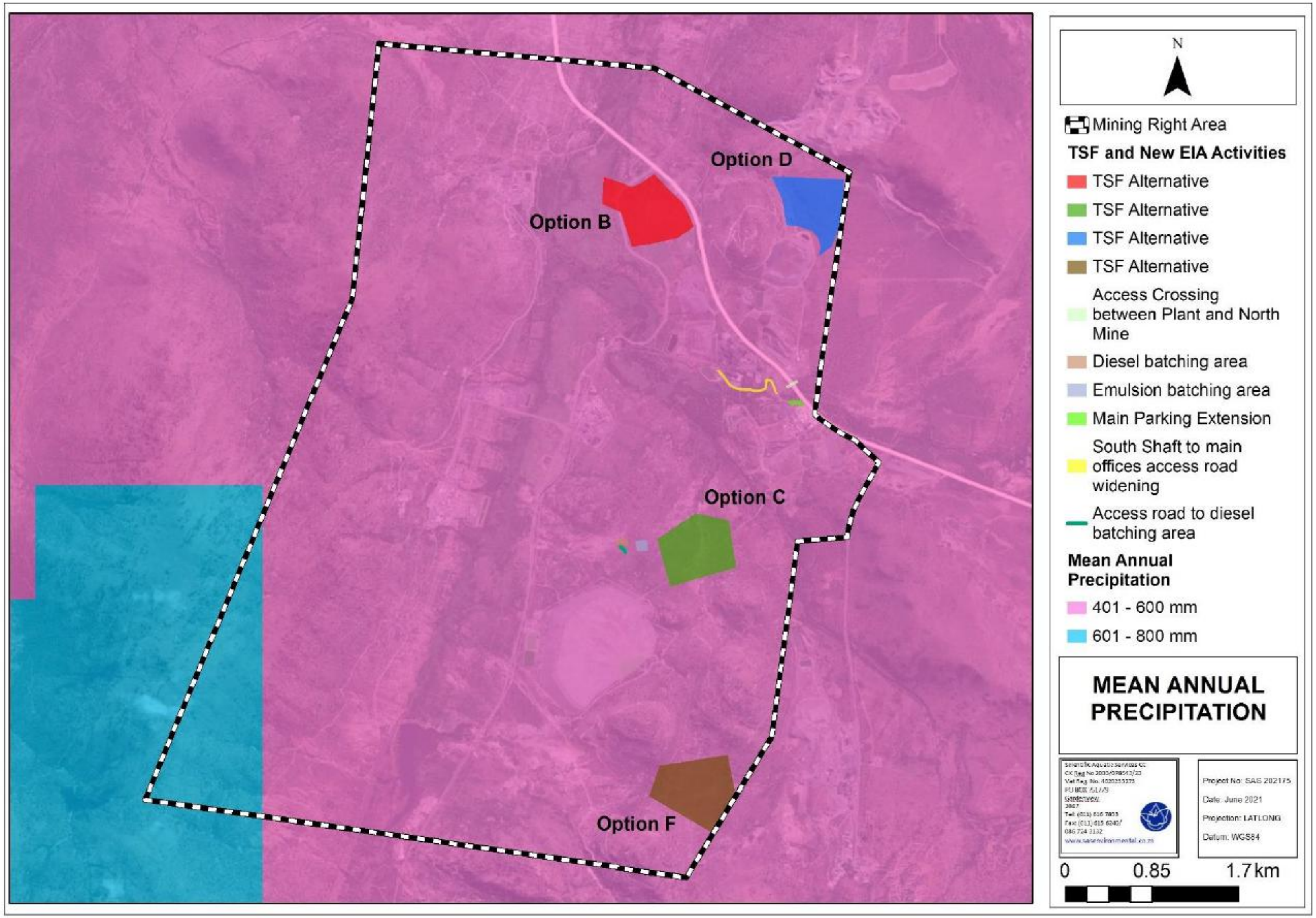


Figure 3: Mean Annual Precipitation associated with the MRA and TSF Alternatives.

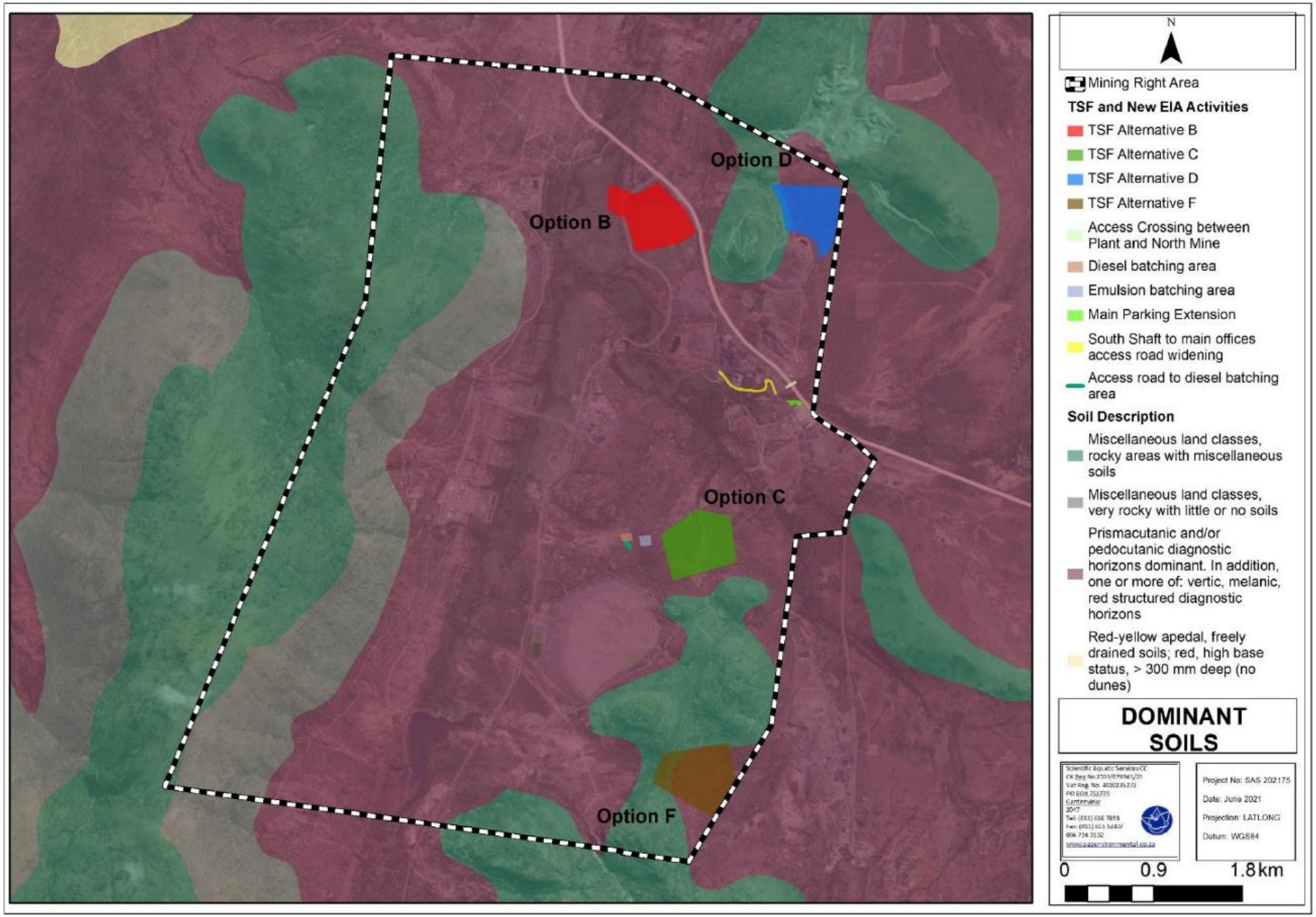


Figure 4: Soils (2001) associated with the MRA and TSF alternatives

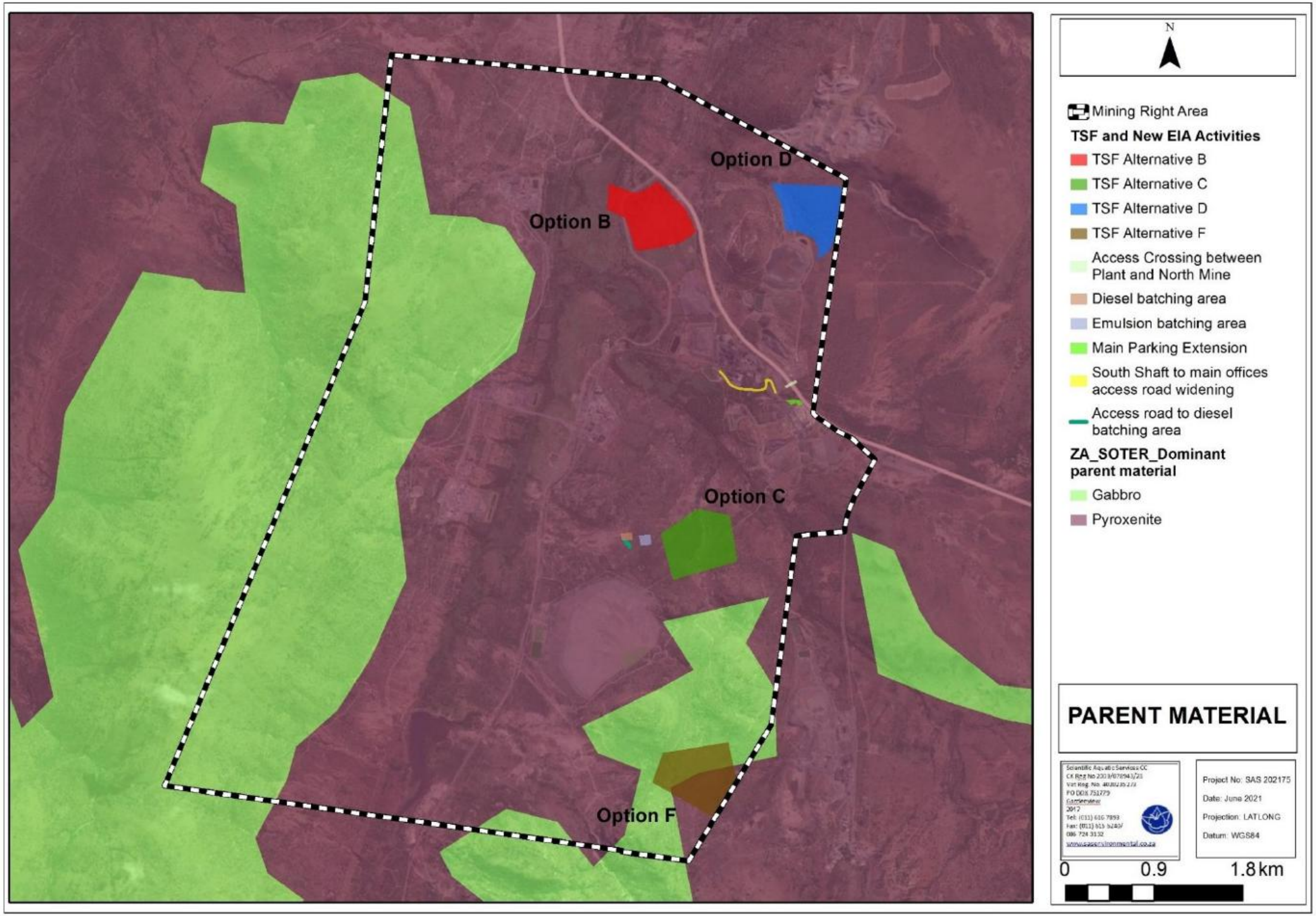


Figure 5: Dominant parent material associated with the MRA and TSF Alternatives.

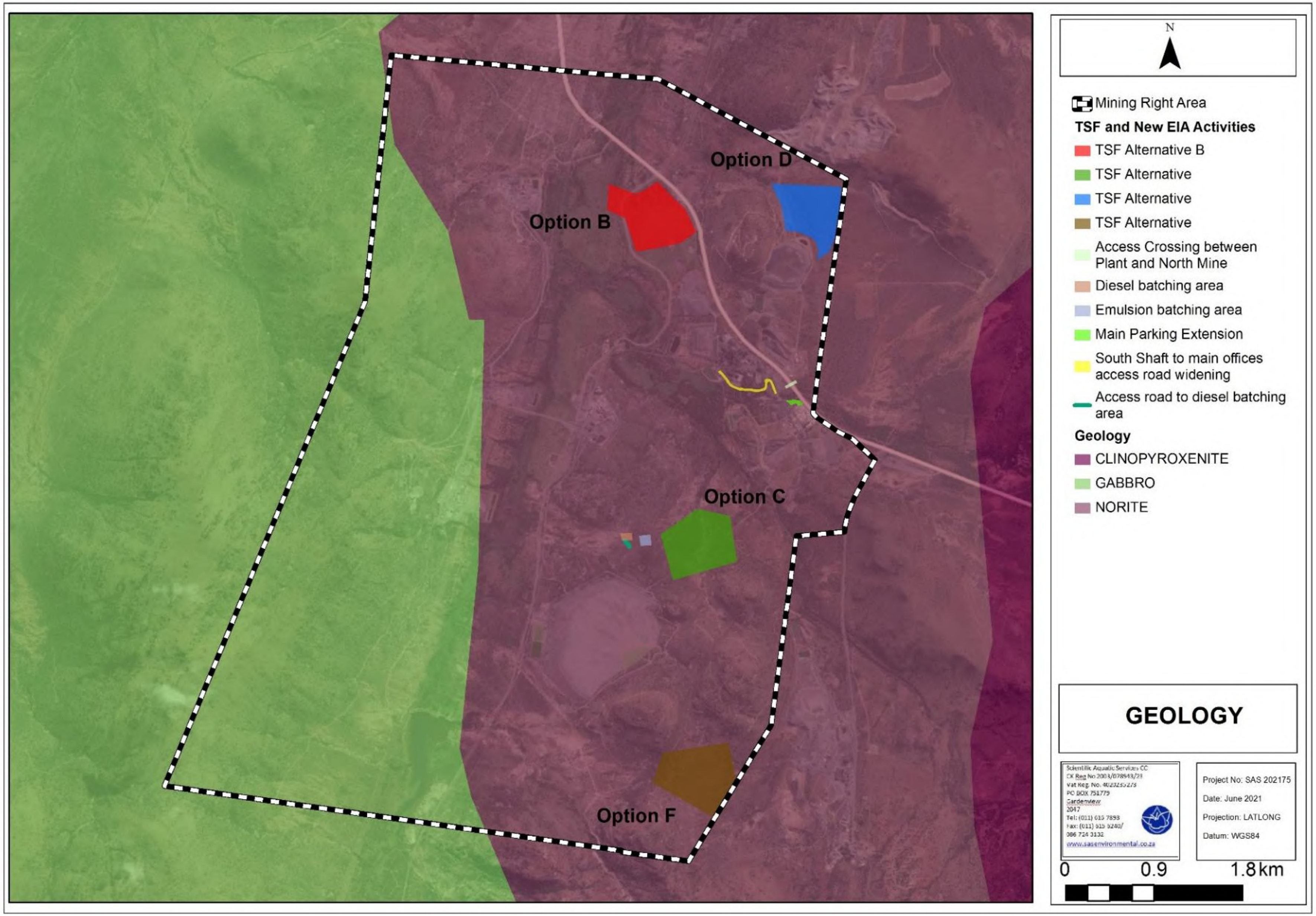


Figure 6: Geology associated with the MRA

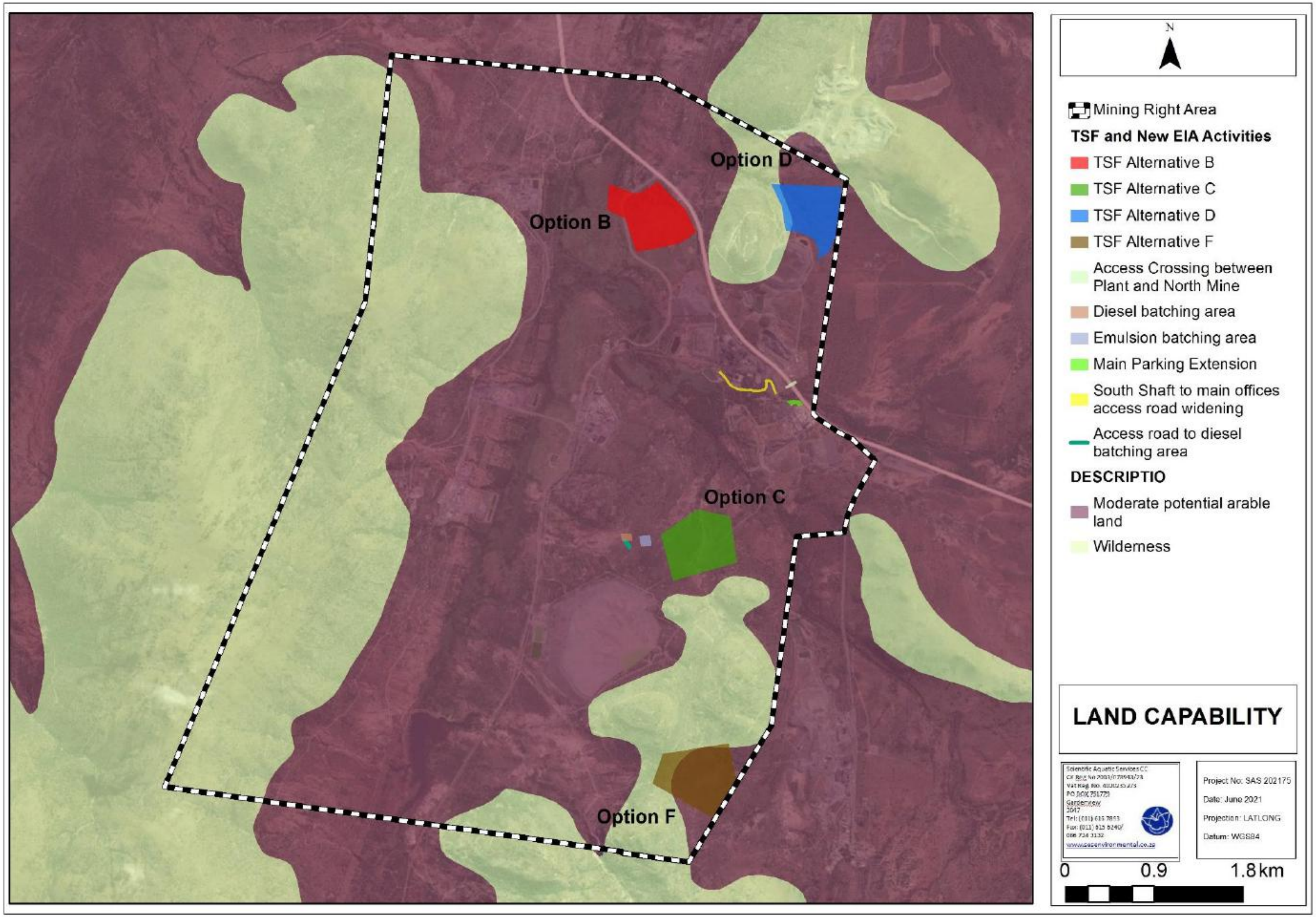
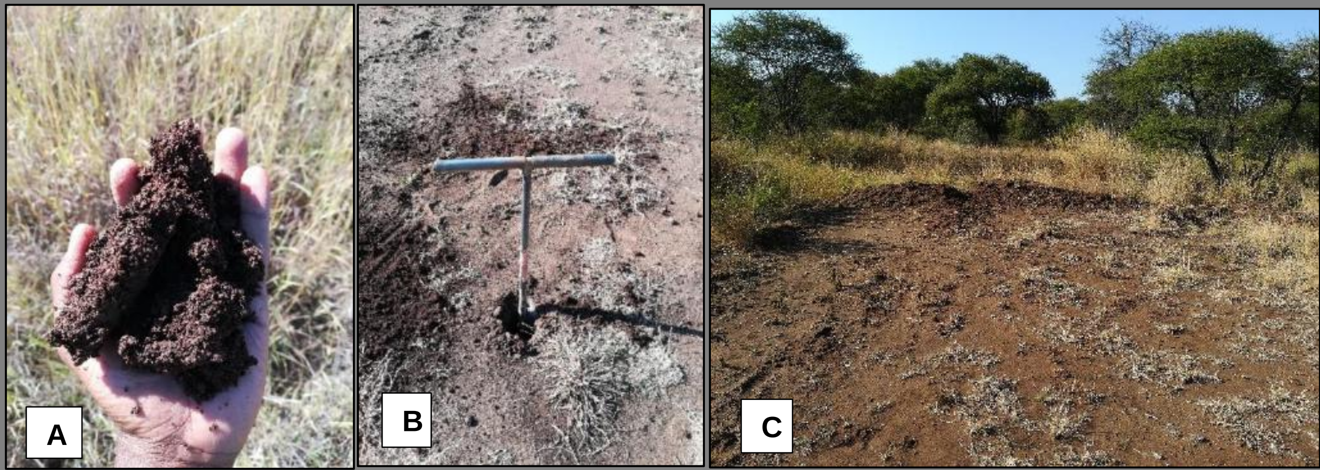


Figure 7: Land capability associated with the MRA

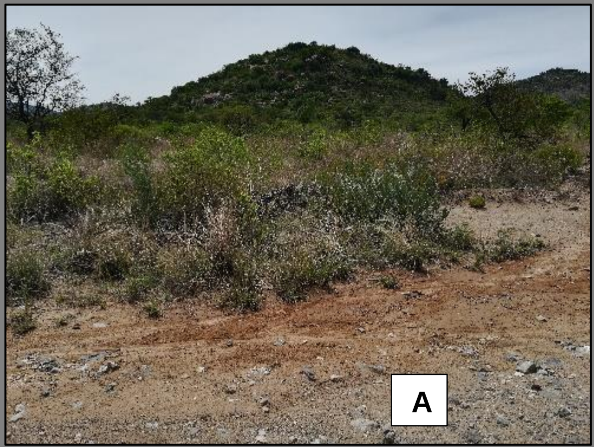
4. ALTERNATIVE ANALYSIS RESULTS

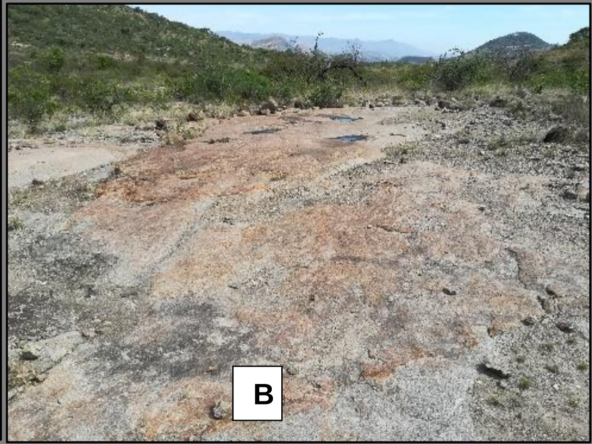
Table 3: Summary discussion of the TSF Alternative B

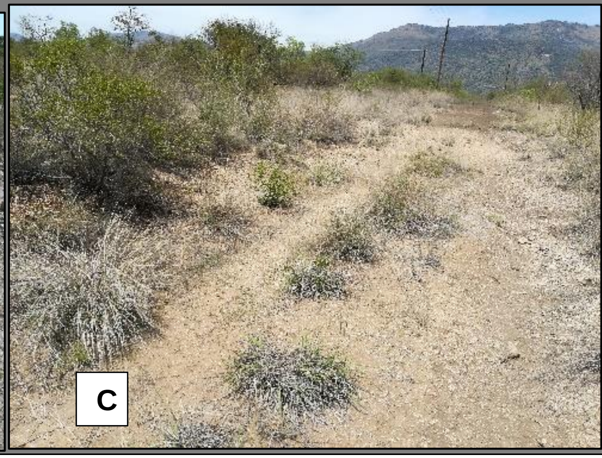


Soil Form(s)	Bonheim	**Photograph notes**	Various representative views of the proposed TSF Alternative B
General Discussion and Site Analysis Results		**Business case, Conclusion and Alternative analysis:**	
The identified Bonheim soil forms are considered somewhat suitable for cultivation (class III). Therefore, these soils are considered to contribute to reginal and provincial agricultural production grid if managed properly, and are essentially also well-suited for other less intensive land uses such as grazing, forestry, etc. However, emphasis is directed to their agricultural crop productivity due to the scarcity of such soil resources on a national scale and food security concerns. Although no agricultural activities were identified with this TSF alternative area, this area has been historically used for cultivation, thus indicating its suitability for cultivation. This can be attributed to the soil effective rooting depth which was found to be somewhat deep. The clay content however increases in the subsoil, thus limiting rooting growth for most crops.		These soils are regarded ideal for cultivated agriculture of selective crops, however the viability of agricultural crop cultivation of these soils in area is low due to land fragmentation by current mining and associated activities in the surrounding areas. In addition, these soils also cover a small area which is not sufficient for commercial agricultural production However, mitigation measures should be implemented accordingly. The impact of the proposed TSF development on the land capability of these soils is anticipated to be within acceptable levels, given the lack of high potential agricultural soils as well as the limiting climatic conditions (MAP less than 600 mm). Although the identified soils are not considered as prime agricultural soils, these soils may be important for potential small-scale grazing opportunities.	

Table 4: Summary discussion of the TSF Alternative C







<table>
<tr><td>Soil Form(s)</td><td>Arcadia/Immerpan/Mispah</td><td>Photograph notes</td><td>Various representative views of the proposed TSF Alternative C</td></tr>
<tr><td colspan="2">General Discussion and Site Analysis Results</td><td colspan="2">Business case, Conclusion and Alternative analysis:</td></tr>
<tr><td colspan="2">The dominant land use associated with TSF alternative C is wildlife and wilderness, with a freshwater feature traversing the central portion, connecting the upgradient catchment areas to the downstream receiving environment. Mining facilities are located within a 500m radius of this site, and no ongoing agricultural activities were observed within this area and immediate vicinity. This proposed TSF alternative also falls within Climate Capability Class 5, which is characterised by a moderately restricted growing season due to low temperatures, frost and/or moisture stress. Suitable crops may be grown at risk of some yield loss.

No high agricultural potential soils were identified with this TSF alternative area. The area is characterised by shallow Mispah and highly clayey Arcadia as well as dispersive Immerpan soils, all not considered ideal for cultivation due to limiting factors such as shallow depth, high clay content and erosion hazard.

Effective rooting depth is the primary limitation of the land capability of the Mispah soil forms, due to the occurrence of a rocky layer at relatively shallow depth. Arcadia soils inherently have serious management constraints attributed to excessive stickiness when wet and hardening when dry due to high smectitic (expandable) clay minerals and high plasticity index values. Immerpan soils were found to be highly weathered and have a high erosion hazard, particularly the topsoil layer. All identified soil forms are, at best, suited for grazing and/or wilderness practices.</td><td colspan="2">The impact of the proposed TSF development on the land capability of these soils is anticipated to be within acceptable levels, given the lack of high potential agricultural soils as well as the limiting climatic conditions (MAP less than 600 mm). Although the identified soils are not considered as prime agricultural soils, these soils may be important for potential small-scale grazing opportunities.

The susceptibility of Arcadia soils to shrink under dry conditions and expand under moist conditions should be considered and avoided where possible as this may cause undesired damage on the structural integrity of the surface infrastructure.

Immerpan soils require strict erosion control measures due to their susceptibility to erosion. These soils collapse or disperse to form dissolved slurry when in contact with water. Furthermore, Immerpan soils are highly prone to erosion often leading to tunnel and gully erosion, thus the recommended best management approach to these soils is to avoid their disturbance. Maintaining vegetation cover of the soil is also important to minimise soil dispersion.

Overall, from a soils point of view this site is not ideal for placement of infrastructure due to the occurrence of expansive clay and dispersive soils, as infrastructure may be damaged or displaced when soils come into contact with water.</td></tr>
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Table 5: Summary discussion of the TSF Alternative D

Dominant Soil Form(s)	Mispah, Glenrosa, Alluvial soils and Plooysburg	**Photograph notes**	Various representative views of the TSF Alternative D

General Discussion and Site Analysis Results	**Business case, Conclusion and Alternative analysis:**
The current land use associated with TSF alternative D is mainly wildlife and wilderness, whilst the surrounding areas are surrounded by mining operations to the north, east and south of the TSF alternative area. The central portion of alternative D is characterised by a freshwater feature which conveys water from the upper catchment areas to the downstream receiving environment. No current agricultural activities were observed within TSF alternative D and surrounding areas. The MRA as well as TSF alternative D fall within Climate Capability Class 5, which is characterised by moderately restricted growing season due to low temperatures, frost and/or moisture stress. Suitable crops may be grown at risk of some yield loss. The dominant soils within this TFS area are Mispah and Glenrosa as well as small patches of Plooysburg soils dispersed within various portions of the TSF area. Alluvial soils were also identified within the TSF area and are associated with the freshwater feature traversing the central portion. Plooysburg soils are characterised by good aeration and drainage, capable of supporting a large variety of cultivated crops with an average effective rooting depth of 60 cm before layer of refusal. Although Plooysburg soil may potentially be utilised for cultivation, the extent of these soils within the TSF is not considered sufficient for viable commercial cultivation. The shallow nature of the dominant soils of Mispah and Glenrosa can largely be attributed to limited rock weathering or rejuvenation through natural erosion on steeper, convex slopes. Alluvial soils associated with the watercourses are not ideal for cultivation due to lack of soil stability, poor nutrient holding capacity and susceptibility to erosion of alluvial soil forms.	Although small patches of Plooysburg soil may potentially be considered suitable for cultivated agriculture, the viability of agricultural crop cultivation of these soils in this area is low due to land fragmentation resulting from mining related activities in the surrounding areas. These soils also cover a small area which is not sufficient for commercial agricultural production. The southern and western portions of this TSF alternative are already degraded due to the ongoing mining activities in the immediate vicinity, with an access road traversing the western portion, causing land withdrawal for potential grazing. In addition, the ongoing mining activities to north and east of the TSF area further disqualify this area for cultivation and potential grazing due to the prospect of future mine expansion into the immediate vicinity. While there are small patches of arable soils, given the climatic constraints of the area (rainfall less than 600 mm per annum) and lack of irrigation options, the soils within this TSF option are not likely to contribute to national food production. This site, in comparison to the other three (3) TSF alternatives may be ideal for the development of a tailings facility given the proximity to existing mining infrastructure, thus eliminating the need for significant disturbance of undisturbed soils in other areas within the MRA.

Table 6: Summary discussion of the TSF Alternative F

Soil Form(s)	Glenrosa and Mispah	Photograph notes	Various representative views of the TSF Alternative F

General Discussion and Site Analysis Results	Business case, Conclusion and Alternative analysis:
The dominant land use associated with the TSF alternative F is wildlife and wilderness. The surrounding areas are characterised by wildlife/wilderness as well as mining operations to the northeast. No existing agricultural activities were observed within TSF alternative F and surrounding areas. This TSF alternative also falls within Climate Capability Class 5, which is characterised by moderately restricted growing season due to low temperatures, frost and/or moisture stress. Suitable crops may be grown at risk of some yield loss. No high potential agricultural soils were identified within this proposed TSF area. Shallow Glenrosa and Mispah soils are the dominant soil forms within this area, which are characterised by the occurrence of a rocky layer at relatively shallow depth. As mentioned above, these soils are not ideal for cultivation, however they may be used for grazing on a subsistence level even though the grazing capacity for this area is low (6 ha per Large Animal Unit). Overall the impact of the proposed TSF development on the land capability of these soils is anticipated to be within acceptable levels due to limited soil rooting depth for cultivation and limited potential grazing opportunities.	The identified Glenrosa/Mispah soil forms are, at best suited for grazing and not for arable agricultural land use. Theses soils are, at best, suitable for natural pastures for light grazing and/or wildlife practices. This is due to the relatively shallow parent rock and lithocutanic material. Therefore, although not considered prime agricultural soils, these soils are considered to make an important and substantial contribution to extensive subsistence farming on a local scale. The impact of the proposed TSF on the land capability of these soils is anticipated to be within acceptable levels, should this site be selected as the preferred TSF option, given its constraints for cultivated agriculture. From a soil and land capability perspective, this site may be an ideal option for the development of the new TSF facility. However this would require extensive construction of new infrastructure such as pipelines, leading to the destruction of undisturbed natural soil resources. A greater degree of mitigation may therefore be required (in comparison to alternative D) should this site be utilised.

4.1 *Project 2: Diesel Storage and Emulsion Batching Site*

The diesel storage and emulsion batching sites are located within shallow soils which were classified as Glenrosa/Mispah soil forms. These soils are of poor (class VII) land capability and are not suitable for arable agricultural land use. At best, these soils are suitable for natural pastures for light grazing.

The proposed Project 2 will most likely result in the clearance of vegetation as part of the construction phase which will lead to loss of soil through erosion and subsequent loss of land capability. Given the small footprint of this project, the loss of land capability is not anticipated to be significant, provided that the project occurs within the demarcated areas and mitigation measures are implemented during all phases of development. The extent of the access road required for this project will be limited since this project is located adjacent the current TRP mines new TSF pipeline and service road. The TSF maintenance road will serve as the main access road and as such the impact of the access road will be negligibly low.

4.2 *Projects 3, 4 and 5: Main Parking Extension, Widening of Access Road between South Shaft/Main Offices and Plant, and Access Crossing between Plant and North Mine respectively*

The proposed projects are located within the existing mine operational footprint where soils have already been subjected to significant disturbance associated with mining and related infrastructure. The extension of the existing infrastructure will not lead to a significant losses of land capability given the disturbance that has occurred on the surrounding soils. Impact such as soil erosion, compaction and soil contamination will likely occur during the construction phase which will lead to further degradation of the surrounding soils and the subsequent loss of land capability. However, the overall impact significance of the proposed project will be negligibly low, after mitigation measures have been put in place during all phases of development.

5. POTENTIAL IMPACTS AND PROPOSED MANAGEMENT MEASURES

5.1 *Description of Potential Impacts Associated with the Proposed TSF Areas*

Several potential risks to the receiving environment by the proposed expansion of the TSF have been identified and are presented in the bullets below:

- Vegetation clearing within the proposed TSF areas as part of site preparation prior to commencement mining and related of activities, leading to soil disturbances and risk of erosion of exposed soils;
- Potential risk of soil erosion and disposal of waste on soil resources, leading to altered soil chemistry and quality;
- Contamination resulting from spillages of hydrocarbons and heavy metals;
- Movement of heavy machinery / construction vehicles off existing/demarcated roads, leading to soil compaction;

6. PRELIMINARY MITIGATION MEASURES

Soil Erosion and Dust Emission Management

- The footprint of the proposed TSF area should be clearly demarcated to restrict vegetation clearing activities within the infrastructure footprint as far as practically possible;
- Bare soils can be regularly dampened with water to suppress dust, especially when strong wind conditions are predicted according to the local weather forecast; and
- All disturbed areas adjacent to the TSF area can be re-vegetated with an indigenous grass mix, if necessary, to re-establish a protective cover, to minimise soil erosion and dust emission

Sedimentation and Soil Compaction management

- All vehicular traffic should be restricted to the existing service roads and the selected road servitude as far as practically possible; and
- Compacted soils adjacent to the mining blocks and associated infrastructure footprint can be lightly ripped to at least 25 cm below ground surface to alleviate compaction prior to re-vegetation.

Soil Contamination Management

- Contamination prevention measures should be addressed in the Environmental Management Programme (EMP) for the proposed development, and this should be implemented and made available and accessible at all times to the contractors and construction crew conducting the works on site for reference;
- A spill prevention and emergency spill response plan, as well as dust suppression, and fire prevention plans should also be compiled to guide the construction works;

- An emergency response contingency plan should be put in place to address clean-up measures should a spill and/or a leak occur, as well as preventative measures to prevent ingress; and
- Burying of any waste including rubble, domestic waste, empty containers on the site should be strictly prohibited and all construction rubble waste must be removed to an approved disposal site.

Loss of Natural Topography and Drainage Pattern Management

- TSF area should be accessed through existing road network, where feasible to avoid unnecessary excavation;
- Excavation and long-term stockpiling of soil should be limited within the demarcated areas as far as practically possible;
- Stockpile should not exceed three (3) meters in height and should be treated with temporary soil stabilization and erosion control measures;
- Stockpiles should be revegetated to establish a vegetation cover as an erosion control measure. These stockpiles should also be kept alien vegetation free at all times to prevent loss of soil quality;
- Temporary berms can be installed, if necessary, around stockpile areas whilst vegetation cover has not established to avoid soil loss through erosion; and

Loss of Land Capability Management

- Direct surface disturbance of soils should be avoided where possible;
- The footprint as well as areas affected by edge effect should be ripped to alleviate compaction;
- Stored topsoil should be replaced (if any) and ameliorated according to soil chemical analysis;
- The recovered soils should be re-used to rehabilitate the mine footprint following mine closure.

7. EIA PHASE – PLAN OF STUDY

The scope of work and specific outcomes in terms of the EIA Phase specialist soil and land capability report are presented in the points below:

- Classify the dominant soil types within the preferred TSF alternative according to the Natural and Anthropogenic System for South Africa (2018).
- Group uniform soil patterns into map units, according to observed limitations; and

- Provide recommended mitigation measures and management practices to implement in order to comply with applicable legislations.

8. CONCLUSION

Scientific Aquatic Services (SAS) was appointed to conduct a soil, land use and land capability assessment alternative analysis as part of the Environmental Impact Assessment (EIA) and authorisation process for the proposed five new projects within the existing Dwars River Chrome Mine Mining Rights Area, as specified below:

- Project 1: the proposed development of a new Tailings Storage Facility (TSF);
- Project 2: diesel and emulsion batching;
- Project 3: main parking extension;
- Project 4: widening of access road between South Shaft / Main Offices and Plant; and
- Project 5: Access Crossing between Plant and North Mine.

Current land use activities associated with the proposed TSF alternatives are largely dominated by wildlife and wilderness, encompassed by some mining operations in the surrounding areas. No current agricultural activities were observed within the proposed TSF alternatives and the surrounding areas. TSF B alternative is however an old agricultural field which has been laid to fallow. All TSF alternatives equally experience a Mean Annual Precipitation (MAP) of less than 600mm per annum, which is not considered adequate to support unirrigated cultivated agriculture on a commercial scale. Furthermore, all proposed TSF alternatives comprise soils not ideal for either cultivated agriculture nor grazing on a commercial scale. Even though TSF alternative D contains patches of arable soils, the viability of agricultural crop cultivation on these soils in this area is low due to the limited extent of arable soils and land fragmentation as a result of mining related activities in the surrounding areas.

The findings of this assessment including soil limiting factors within the TSF alternatives for land capability and land use potential are summarised below:

Table A: Overall Land Capability associated with the TSF Alternatives, and constraints for agriculture.

Alternative	B	C	D	F
Dominant soils	Bonheim	Arcadia/Immerpan/Mispah	Mispah, Glenrosa, Alluvial soils and Plooysburg	Glenrosa and Mispah
Overall Land Capability	Arable (Class II)	Grazing (Class V)	Grazing (Class V)	Grazing (Class VI)

Alternative	B	C	D	F
Limiting factors for Agriculture	Minor; these soils have moderate depth 60 cm to support some cultivated crops and good drainage characteristics. These soils are well suited for crop cultivation. The clay content however increases in the subsoil, thus limiting rooting growth for most crops	-Serious management constraints of Arcadia soils attributed to excessive stickiness when wet and hardening when dry due to high smectitic (expandable) clay minerals and high plasticity index values -Shallow effective rooting depth due to shallow indurated bedrock of the Mispah, Glenrosa.	-Shallow effective rooting depth due to shallow indurated bedrock of the Mispah, Glenrosa; -Lack of stability and low nutrient holding capacity of alluvial soil forms associated with the freshwater features.	-Shallow effective rooting depth due to shallow indurated bedrock of the Mispah, Glenrosa.
Business Case	These soils are regarded well suited for cultivated agriculture of selective crops, however the viability of agricultural crop cultivation of these soils in area is low due to land fragmentation by current mining and associated activities in the surrounding areas. In addition, these soils also cover a small area which is not sufficient for commercial agricultural production However, mitigation measures with specific mention of removal of the soil for reuse in rehabilitation should be implemented to conserve soil resources. The impact of the proposed TSF development on the land capability of these soils is anticipated to be within acceptable levels, given the lack of high potential agricultural soils as well as the limiting climatic conditions (MAP less than 600 mm).	Overall, from a soils point of view this site is not ideal for placement of infrastructure due to the occurrence of expansive clay and dispersive soils, as infrastructure may be damaged or displaced when soils come into contact with water.	This site, in comparison to the other two (2) TSF alternatives may be ideal for the development of a tailings facility given the proximity to existing mining infrastructure, thus eliminating the need for significant disturbance of undisturbed soils in other areas within the MRA.	From a soil and land capability perspective, this site may be an ideal option for the development of the new TSF facility. However this would require extensive construction of new infrastructure such as pipelines, leading to the destruction of undisturbed natural soil resources. A greater degree of mitigation may therefore be required (in comparison to alternative D) should this site be utilised.

The proposed Project 2 will most likely result in the clearance of vegetation as part of the construction phase which will lead to loss of soil through erosion and subsequent loss of land capability. Given the small footprint of this project, the loss of land capability is not anticipated to be significant, provided that the project occurs within the demarcated areas and mitigation measures are implemented during all phases of development. The extent of the access road required for this project will be limited since this project is located adjacent the current TRP mines new TSF pipeline and service road. The TSF maintenance road will serve as the main access road and as such the impact of the access road will be negligibly low.

The proposed projects (3,4 & 5) are located within the existing mine operational footprint where soils have already been subjected to significant disturbance associated with mining and related infrastructure. The extension of the existing infrastructure will not lead to a significant losses of land capability given the disturbance that has occurred on the surrounding soils. Impact such as soil erosion, compaction and soil contamination will likely occur during the construction phase which will lead to further degradation of the surrounding soils and the subsequent loss of land capability. However, the overall impact significance of the proposed project will be negligibly low, after mitigation measures have been put in place during all phases of development.

This study aims to provide the proponent with relevant information required in order to inform the decision-making process. Taking the above into consideration, it is the opinion of the specialist that, from a soil and land capability perspective, TSF Alternative D is recommended as the suitable site for TSF development, in comparison to the other three (3) TSF alternatives given the proximity to existing mining infrastructure, thus eliminating the need for significant disturbance of undisturbed soils in other areas within the MRA.

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APPENDIX A: DETAILS, EXPERTISE AND CURRICULUM VITAE OF SPECIALISTS

1. (a) (i) Details of the specialist who prepared the report

Braveman Mzila BSc (Hons) Environmental Hydrology (University of KwaZulu-Natal)

Stephen van Staden MSc (Environmental Management) (University of Johannesburg)

1. (a). (ii) The expertise of that specialist to compile a specialist report including a curriculum vitae

Company of Specialist:	Scientific Aquatic Services		
Name / Contact person:	Stephen van Staden		
Postal address:	29 Arterial Road West, Oriel, Bedfordview		
Postal code:	2007	Cell:	083 415 2356
Telephone:	011 616 7893	Fax:	011 615 6240/ 086 724 3132
E-mail:	stephen@sasenvgroup.co.za		
Qualifications	MSc (Environmental Management) (University of Johannesburg) BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg) BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)		
Registration / Associations	Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP) Accredited River Health practitioner by the South African River Health Program (RHP) Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum		

1. (b) A declaration that the specialist is independent in a form as may be specified by the competent authority

I, Stephen van Staden, declare that -

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

----

Signature of the Project Manager

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

Position in Company	Managing member, Ecologist with focus on Freshwater Ecology
Date of Birth	13 July 1979
Nationality	South African
Languages	English, Afrikaans
Joined SAS	2003 (year of establishment)
Other Business	Trustee of the Serenity Property Trust and emerald Management Trust

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP);
Accredited River Health practitioner by the South African River Health Program (RHP);
Member of the South African Soil Surveyors Association (SASSO);
Member of the Gauteng Wetland Forum;
Member of International Association of Impact Assessors (IAIA) South Africa;
Member of the Land Rehabilitation Society of South Africa (LaRSSA)

EDUCATION

Qualifications

MSc (Environmental Management) (University of Johannesburg)	2003
BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg)	2001
BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)	2000
Tools for Wetland Assessment short course Rhodes University	2016

COUNTRIES OF WORK EXPERIENCE

South Africa – All Provinces
Southern Africa – Lesotho, Botswana, Mozambique, Zimbabwe Zambia
Eastern Africa – Tanzania Mauritius
West Africa – Ghana, Liberia, Angola, Guinea Bissau, Nigeria, Sierra Leone
Central Africa – Democratic Republic of the Congo

PROJECT EXPERIENCE (Over 2500 projects executed with varying degrees of involvement)

1 Mining: Coal, Chrome, PGM's, Mineral Sands, Gold, Phosphate, river sand, clay, fluorspar
2 Linear developments
3 Energy Transmission, telecommunication, pipelines, roads
4 Minerals beneficiation
5 Renewable energy (wind and solar)
6 Commercial development
7 Residential development
8 Agriculture
9 Industrial/chemical

REFERENCES

- Terry Calmeyer (Former Chairperson of IAIA SA)
  Director: ILISO Consulting Environmental Management (Pty) Ltd
  Tel: +27 (0) 11 465 2163
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  Managing Director: Jacana Environmental
  Tel: 015 291 4015

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF AMANDA MILESON

PERSONAL DETAILS

Position in Company	Ecologist
Date of Birth	15 February 1978
Nationality	Zimbabwean
Languages	English
Joined SAS	2013

MEMBERSHIP IN PROFESSIONAL SOCIETIES

South African Wetland Society

Gauteng Wetland Forum

Society of Wetland Scientists

EDUCATION

Qualifications	
N.Dip Nature Conservation (UNISA)	2017
Tools for Wetland Assessment (Rhodes University)	2017
Wetland Rehabilitation (University of the Free State)	2015

COUNTRIES OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, Free State, North West, Limpopo, Northern Cape, Eastern Cape

Zimbabwe

SELECTED PROJECT EXAMPLES

Wetland Assessments

- Baseline Aquatic and Freshwater Assessment as part of the Environmental Assessment and Authorisation Process for the N11 Ring Road, Mokopane, Limpopo Province.
- Freshwater Resource Ecological Assessment as part of the Water Use License Application Requirements for the Proposed Upgrades to the Klippan Pump Station Near Welkom, Free State Province.
- Freshwater Resource Ecological Assessment as part of the Water Use License Application Requirements for the Proposed Urania-Bronville 11kv and 132kv Powerline Corridor Near Welkom, Free State Province.

- Freshwater Assessment for the Proposed Rietrug, Distribution Line: Basic Assessment for the proposed Construction of Electrical Grid Infrastructure to support the proposed (split) Rietrug Wind Energy Facility, near Sutherland, in the Northern Cape and Western Cape Provinces.
- Freshwater Assessment for the Proposed Sutherland 2 Distribution Line: Basic Assessment for the proposed Construction of Electrical Grid Infrastructure to support the proposed (split) Sutherland 2 Wind Energy Facility, near Sutherland, in the Northern Cape and Western Cape Provinces.
- Freshwater Assessment for the Proposed Sutherland Distribution Line: Basic Assessment for the proposed Construction of Electrical Grid Infrastructure to support the proposed (split) Sutherland Wind Energy Facility, near Sutherland, in the Northern Cape and Western Cape Provinces.
- Freshwater resource delineation and ecological assessment as part of the proposed expansion of the Kudumane Mining Project, Northern Cape Province.
- Freshwater assessment as part of the environmental assessment and authorisation process for associate electrical infrastructure and a proposed pipeline for the Rooipunt Solar Thermal Power Park Project near Upington, Northern Cape.
- Present Ecological State of the Wetlands Report: Jukskei and Klip River Catchments: Monitoring and Managing the Ecological State of the Wetlands in the City of Johannesburg Metropolitan Area.
- Wetland assessment as part of the environmental assessment and authorisation process for the proposed Leandra underground coal mine.
- Freshwater ecological assessment as part of the water use licence application process for the proposed waste rock dump expansion for Impala Platinum Mine in Rustenburg, North-West Province.
- Wetland assessment as part of the water use licence application process for the Marula Platinum Mine, Limpopo Province.
- Wetland assessment as part of the environmental authorisation process for the Anglo Platinum Der Brochen Project, Limpopo Province.
- Wetland assessment as part of the environmental authorisation process for the proposed Yzermyn Coal Mining Project near Dirkiesdorp, Mpumalanga.
- Wetland assessment as part of the environmental authorisation process for the Mzimvubu Water Project, Eastern Cape.
- Wetland assessment as part of the proposed water management process at the Assmang Chrome Machadodorp Works, Mpumalanga.
- Wetland ecological assessment as part of the Section 24G application process for the Temba Water Purification Plant.

Terrestrial Assessments

- Investigation of specialist biodiversity aspects required by GDARD in the vicinity of the Apies River, downstream of the proposed construction of new outlet works at the Kudube (Leeuwkraal) Dam in Temba, Gauteng
- Terrestrial Ecological Scan as part of the environmental authorisation process for three proposed bridge upgrades near Edenvale, Gauteng
- Terrestrial Ecological Scan as part of the environmental authorisation process for the proposed Dalpark Ext 3 filling station development, Gauteng

Rehabilitation Projects

- Freshwater Resource Rehabilitation and Management Plan as part of the Environmental Authorisation Process for the Proposed Urania-Bronville 11kv and 132kv Powerline Corridor Near Welkom, Free State Province.
- Rehabilitation Plan as part of the Water Use License Application Requirements for the Proposed Upgrade of the Thabazimbi Wastewater Treatment Works (WWTW) Sewer Line, Limpopo Province.
- Wetland rehabilitation and management plan for The Hills EcoEstate, Midrand, Gauteng.
- Riparian rehabilitation and management plan for The Diepsloot River, Riversands, Gauteng.
- Riparian rehabilitation and management plan for the Apies River in the vicinity of the proposed construction of new outlet works at the Kudube (Leeuwkraal) Dam in Temba, Gauteng.

Environmental Control Officer

- Monthly specialist Environmental Control Officer (ECO) function for the monitoring of riparian crossings at Riversands Country Estate Development, Gauteng province.
- Weekly specialist Environmental Control Officer (ECO) function for the monitoring of emergency desilting and rehabilitation of existing stormwater retention dams on ERF 836 Kosmosdal ext 1, and portion 5 of ERF 115 Kosmosdal ext 4, near Centurion, Gauteng Province.

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION
CURRICULUM VITAE OF BRAVEMAN MZILA

PERSONAL DETAILS

Position in Company	Wetland Ecologist and Soil Scientist
Date of Birth	03 January 1991
Nationality	South African
Languages	IsiZulu, English
Joined SAS	2017

EDUCATION

Qualifications

BSc (Hons) Environmental Hydrology (University of Kwazulu-Natal)	2013
BSc Hydrology and Soil Science (University of Kwazulu-Natal)	2012

COUNTRIES OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, Kwa-Zulu Natal, Eastern Cape

SELECTED PROJECT EXAMPLES

Freshwater Resource Assessment

Freshwater Ecological Assessments

- Freshwater ecological assessment as part of the water use authorisation relating to stormwater damage of a tributary of the Sandspruit, Norwood, Gauteng province.
- Wetland verification as part of the environmental assessment and authorization process for the proposed development in Crowthorne extension 67, Gauteng province.
- Freshwater assessment as part of the section 24g rectification process for unauthorised construction related activities that took place on erf 411, Ruimsig extension 9, Gauteng province
- Baseline aquatic and freshwater assessment as part of the environmental assessment and authorisation process for the N11 Ring Road, Mokopane, Limpopo Province
- Wetland Resource Scoping Assessment as Part of the Environmental Assessment and Authorisation Process for the Kitwe TSF Reclamation Project, Kitwe, Zambia
- Wetland delineation as part of the environmental assessment and authorization process for the proposed development in Boden Road, Benoni, Ekurhuleni Metropolitan Municipality, Gauteng Province.

Soil, Land Use and Land Capability Assessments

- Soil, Land Use and Land Capability Assessment as part of the environmental assessment and authorisation process for the proposed Witfontein Railway Siding Project Near Bethal, Mpumalanga Province
- Soil, Land Use and Land Capability Assessment as part of the environmental assessment and authorisation process for the proposed Heuningkranz Mine, Postmasburg, Northern Cape Province
- Soil, Land Use and Land Capability Assessment as Part of The Environmental Assessment and Authorisation Process for The Proposed Kanakies Mining Project, Near Loeriesfontein, Northern Cape

Hydropedological Wetland Impact Assessments

- Hydropedological Assessment as Part of the Environmental Assessment and Authorisation Process for the proposed Vandyksdrift Central Dewatering Project

- Hydropedological Assessment for the Proposed Evander Gold Elikhulu Tailings Storage Facility (TSF) Expansion, Mpumalanga Province
- Hydropedological Assessment as part of the environmental assessment and authorisation process for the proposed Palmietkuilen Mine, Springs, Gauteng Province
- Hydropedological Assessment as part of the environmental assessment and authorisation process for the proposed Uitkomst Colliery Mine expansion, Newcastle, KwaZulu-Natal Province
- Hydropedological Assessment for The Proposed Khutala Water Treatment Plant and Kendal 5 Seam Underground Mine Dewatering at Khutala Colliery, Near Ogies, Mpumalanga Province

Soil Rehabilitation Assessments

Soil rehabilitation plan, a water resource assessment and develop a management plan in support of the water use license for the Driefontein operations, Carletonville, Gauteng

Annexure 4: Ecological Assessment

SCIENTIFIC AQUATIC SERVICES

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SCOPING REPORT FOR THE ALTERNATIVES ANALYSIS AS PART OF THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS FOR THE PROPOSED DEVELOPMENT OF A NEW TAILINGS STORAGE FACILITY AT THE DWARSRIVIER CHROME MINE, LIMPOPO PROVINCE

Prepared for

Envirogistics (Pty) Ltd

June 2021

Alternatives Analysis Scoping Report: Terrestrial Ecology

Prepared by:	**Scientific Aquatic Services**
Report author	**C. Hooton**
	S. Erwee
	C. van Schalkwyk
Report reviewer	**S. van Staden (Pr.Sci.Nat)**
Report Reference:	**SAS 218221**

SAS Environmental Group of Companies

EXECUTIVE SUMMARY

Scientific Aquatic Services (SAS) was appointed to conduct a terrestrial ecological alternatives analysis as part of the Environmental Impact Assessment (EIA) and authorisation process for five projects Dwarsrivier Chrome Mine (DCM), near Steelpoort, Limpopo, within the mine's existing Mining Rights Area (MRA), specifically:

- Project 1: the proposed development of a new Tailings Storage Facility (TSF);
- Project 2: diesel and emulsion batching;
- Project 3: main parking extension;
- Project 4: widening of access road between South Shaft / Main Offices and Plant; and
- Project 5: Access Crossing between Plant and North Mine.

Specific outcomes required from this report include the following:

- To conduct a high-level ecological scoping assessment of the proposed TSF Options;
- To assess each TSF Options in terms of faunal and floral Species of Conservation Concern including the potential for such species to occur within the various TSF Options;
- Highlight areas of risk and concern regarding sensitive habitat and SCC associated with each TSF Option; and
- Provide high level ecological scoping input for Projects 2, 3, 4 and 5, highlighting the risks and concerns associated with these projects.

The proposed TSF Options are all located within a Critical Biodiversity Area (CBA) 1 as well as an area of highest biodiversity importance according to the mining and biodiversity guidelines. Overall the habitat within TSF Option C, D and F is largely representative of the Sekhukhune Bushveld, whilst Option B is not considered to be representative of the vegetation type. Several floral and faunal SCC were observed within TSF Option C, D and F but not B. The below table summarises the results obtained from the sight assessment and alternatives analysis for each proposed TSF. For detailed results please see Section 4.

Table A: Terrestrial results and constraints associated with the TSF Options.

	Ecological Results	Business Case
Option B	Option B is located in an area which was historically cleared and used for agricultural purposes. The footprint area at present is dominated by pioneer and sub-climax plant species indicative of disturbed areas. Option B is located in the western corner of the mine property and surrounded by high electrified fences, limiting faunal, notably mammal, species movement. The proposed footprint will not result in a loss of habitat connectivity or species movement. Further, no loss of important intact habitat or faunal / floral SCC will occur should this footprint be utilised for the proposed TSF.	The construction of this TSF Option will result in the loss of approximately 24ha of vegetation. Option B is located nearby (approx. 360m) from the Groot Dwars River. Should the TSF fail, or any spills/leaching occur, it will have a significant impact on the freshwater system not just at the point of contact but also further downstream. The footprint area is not considered to be ecologically intact and as such, from an ecological integrity point of view, is considered the favourable option, provided risks to the freshwater system can be mitigated.
Option C	Largely undisturbed and intact floral and faunal habitat representative of the Sekhukhune Bushveld with several faunal and floral SCC observed/known to occur within the TSF Option Located 300m upslope of the Groot Dwars River, an essential ecological servitude, providing habitat and water resources to faunal species. The TSF Option was noted to have a high floral and faunal diversity and formed part of a larger open space system that has been subjected to limited impacts from mining. Additionally, the endemic and understudied Cicada species *Pycna sylvia* (Cicada) was observed within the Option C.	The construction of this TSF Option will result in the loss of approximately 21ha of terrestrial habitat and SCC whilst impacting habitat connectivity. Option C is the closest in close proximity to the Groot Dwars River. Should the TSF fail, or any spills/leaching occur, it will have a significant impact on the freshwater system not just at the point of contact but also further downstream. Additional pipelines and roads will likely need to be constructed in order to facilitate Option C, leading to habitat and species loss/impacts over and above that associated with the TSF. As such, from an ecological and risk management perspective TSF Option C is deemed unsuitable.

	Ecological Results	Business Case
Option D	Located in an area that is surrounding by opencast mining activities as well as the current DCM TSF, the terrestrial habitat is considered to representative of the Sekhukhune Bushveld. Edge effects from the surrounding mining activities were evident. However, these were still limited in extent and had not led to large scale habitat loss or degradation. A number of floral SCC were observed in, and the habitat may further support several faunal SCC. Habitat connectivity has been compromised to a degree as a result of the surrounding mining activities, roads, fences and mining-related infrastructure.	The construction of this TSF Option will result in the loss of approximately 19ha of terrestrial habitat and SCC whilst impacting habitat connectivity. Option D is located in an area of extensive mining activities with the current DCM TSF in close proximity, leading to minimal additional roads and pipelines being needed. The construction of the Two Rivers Platinum (TRP) TSF to the east of Option D has impacted on habitat connectivity, significantly limiting faunal species movement. Taking into consideration the continued mining activities and future construction plans of this area, TSF Option D is deemed to be a potential option.
Option F	The habitat has not been subjected to intensive mining activities and edge effects. Exploration roads and drill pads are notable in the area; however, these disturbed areas are relatively small and spread out. The diverse habitat along the topographical scale, numerous rocky outcrops, sheetrock and drainage line provide numerous areas of niche habitat for faunal and floral species. Several faunal and floral SCC are known to occur within and utilise the habitat associated with Option F. Additionally, the endemic and understudied Cicada species *Pycna sylvia* (Cicada) was observed within the Option F.	Construction of Option F will result in the loss of faunal and floral species, habitat and habitat connectivity. Option F is the furthest located from current mining activities and as such will require extensive roads and pipeline construction, leading to further habitat and species loss. Due to the relatively isolated nature of the area in which Option F is located, the habitat has remained largely intact while faunal and floral species have been subjected to low-level impacts and edge effects. As such, from an ecological perspective, TSF Option F is deemed unsuitable.

TSF Options C, D and F are located within areas which are considered relatively intact, and representative of the Sekhukhune vegetation type and as such differentiation between options cannot be made simply on habitat quality.

TSF Option B is located within an area that has been historically disturbed, lacking ecologically intact habitat. Development herein will lead to no loss of intact habitat or faunal and floral SCC. The footprint I dominated by plant species indicative of disturbed areas as well as several alien plant species. TSF Options C and F are located to the south of the Groot Dwars River and are the furthest removed from the current DCM mining activities and edge effects. As such, the habitat herein is still largely intact and provides habitat to numerous faunal and floral species, both common and SCC. Additionally, construction of these options will require additional pipelines and road networks to be constructed, resulting in further habitat loss and degradation. Whilst the habitat and importance of TSF Option D is similar in most respects to Options C and F, it must be noted that the proposed locality of Option D is in close proximity to the current DCM TSF, requiring less supporting infrastructure. In addition to this, Two Rivers Platinum (TRP) Mine has also recently developed their new TSF to the east of Option D. Edge effects from this combined with the ever-expanding open cast mining operations to the east and north of Option D are further adding to the cumulative impacts in that immediate area. Habitat connectivity has been lost due to TRPs new TSF, and as such, should Option D be selected, it will have minimal impact on species movement, as this has already been largely compromised.

Taking the above into consideration, from a long-term ecological maintenance perspective Option B is deemed to be the preferred option, as this site is already disturbed, is located adjacent the current mine operations and will not lead to the loss of habitat connectivity. This option does however pose a potential risk to the Groot Dwars River, which needs to be investigated in terms of mitigatory and management requirements.

Project 2 is located in an intact section of the Sekhukhune Bushveld habitat, and as such, will result in the loss of indigenous vegetation and potentially floral SCC, for which permits will be required. Faunal SCC, should they be present, will likely self-relocate.

Projects 3, 4 and 5 are located within the current mining footprint and as such, the habitat therein has been impacted upon through edge effects and AIP proliferation. Some floral SCC are still however expected and will require permits prior to construction. No faunal SCC are likely to inhabit these footprint areas, nor will the development result in the loss of habitat connectivity.

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ACRONYMS

BGIS	Biodiversity Geographic Information Systems
CARA	Conservation of Agricultural Resources Act
CBA	Critical Biodiversity Area
DFFE	Department of Forestry, Fisheries and the Environment
EIA	Environmental Impact Assessment
IBA	Important Bird Area
IUCN	International Union for the Conservation of Nature
MAP	Mean Annual Precipitation
MAPE	Mean Annual Potential Evaporation
MASMS	Mean Annual Soil Moisture Stress
MAT	Mean Annual Temperature
MFD	Mean Frost Days
MRA	Mining Right Area
NBA	National Biodiversity Assessment
NEMA	National Environmental Management Act
NEMBA	National Environmental Management Biodiversity Act
NPAES	National Protected Areas Expansion Strategy
PES	Present Ecological State
PRECIS	Pretoria Computer Information System
SABAP2	South African Bird Atlas Project 2
SACAD	South African Conservation Areas Database
SANBI	South African National Biodiversity Institute
SAPAD	South African Protected Area Database
SAS	Scientific Aquatic Services
TSP	Threatened Species Programme
TSF	Tailings Storage facility

1 INTRODUCTION

Scientific Aquatic Services (SAS) was appointed to conduct a terrestrial ecological alternatives analysis as part of the Environmental Impact Assessment (EIA) and authorisation process for five projects Dwarsrivier Chrome Mine (DCM), near Steelpoort, Limpopo, within the mine's existing Mining Rights Area (MRA), specifically:

- Project 1: the proposed development of a new Tailings Storage Facility (TSF);
- Project 2: diesel and emulsion batching;
- Project 3: main parking extension;
- Project 4: widening of access road between South Shaft / Main Offices and Plant; and
- Project 5: Access Crossing between Plant and North Mine.

Further detail regarding the above projects is provided in Section 1.1 of this report.

The DCM MRA is located in the Dwars River Valley, approximately 13 km south of the town of Steelpoort and approximately 5.5 km west of the Mpumalanga/Limpopo border within the Greater Tubatse Local Municipality, and the Greater Sekhukhune District Municipality, Limpopo Province. The R555 is situated approximately 10 km northwest of the MRA, with the R37 situated approximately 19 km east of the MRA.

A site selection study was carried out by Fraser Alexander on behalf of Dwarsrivier Chrome Mine in August 2018 to provide guidance in terms of the technical feasibility and suitability of each of four proposed TSF location options. According to the Environmental Assessment Practitioner (EAP), one site (Site B) has been deemed 'fatally flawed' due to the proposed construction of an Eskom substation within Site B. Following on from the technical study (Fraser Alexander, 2018), three (3) alternative sites were provided to the specialist for assessment from a terrestrial perspective.

The purpose of this report is to define each of the proposed projects and their alternatives where relevant in terms of faunal and floral ecology at a high level, by means of analysis of relevant datasets, prior studies conducted by SAS for DCM, and a brief site assessment of each proposed alternative (where applicable). It is a further aim of this study to provide adequate relevant information to the EAP, the proponent and the relevant authorities to allow for informed decision-making in consideration of the principles of Integrated Environmental Management (IEM) and sustainable development as enshrined in Section 24 of the Constitution of South Africa.

1.1 Project description

A brief description of each of the five proposed projects is provided below. It must be noted that the project description was obtained from the report "Dwarsrivier Chrome Mine (Pty) Ltd Environmental Authorisation Application Form for new Capital Projects and the proposed new Khulu Tailings Storage Facility and associated infrastructure (4th Draft) prepared by Envirogistics (Pty) Ltd, as received by the specialist on 2nd June 2021. SAS therefore takes no responsibility for the accuracy of the information presented in this section. The localities of the five proposed projects are presented in Figures 1 and 2 following the project descriptions.

Project 1: Tailings Storage Facility

Dwarsrivier is currently depositing at the existing North Tailings Storage Facility (NTSF) at the eastern side of their process plant on the remaining portion of the Farm Dwarsrivier 372. It is anticipated that the existing active NTSF will reach its full capacity relatively sooner than anticipated due to tonnage ramp ups and additional tonnages from other sites.

The mine identified seven (7) potential TSF options initially, which have subsequently been reduced to four (4) (Option B, C, D and F). During the 2019 Site Selection Process, Option D was the preferred site for the mine. Based on the initial view by the Environmental Assessment Practitioner, Option B was fatally flawed due to the potential future Eskom substation, for which an EIA has been approved and negotiations in terms of land use between the mine and Eskom have commenced. However, subsequent to the 2019 Site Selection Process, further geotechnical studies were undertaken, which identified potential concerns for Option D, which also included the proximity of the non-perennial tributary of the Dwarsrivier River. In addition to this, the Eskom substation is no longer planned, which has reintroduced Option B into the overall assessment.

The areas are as follows:

- B: 24ha;
- C:21ha;
- D:19ha; and
- F:17ha.

The heights currently anticipated of each of the facilities will be 37m, 29m, 49m and 50m respectively. The project will not involve typical tailings deposition techniques, but will involve the piping of tailings to a filter press facility from where the filter cake will be trucked to the new TSF. A life of mine of about 20 years are currently considered as part of the design.

Options C, D and F are located on the eastern boundary and Option B along the western boundary, with Option B and D situated at the most northern points, Option C located centrally within the MRA and Option F situated the furthest south. These sites are henceforth referred to individually as Options B, C, D and F and collectively as the “TSF options”.

Project 2: Diesel and Emulsion Batching

The mine plans to erect two (2) respective diesel and emulsion batching areas, to supply diesel and emulsion to the underground mining operations. The location of this area is to the north-east of the old Two Rivers Platinum Mine (TRP), just north of the new TRP TSF Pipeline.
The project will include:

- Construction of an approximate 80 m access road to the diesel batching area;
- Parking Area, with security office at both areas (no dangerous good storage planned at any time);
- At the Diesel Batching area the following tanks will be present: 23 m^3 Diesel + 23 m^3 Engine Oil + 23 m^3 Hydraulic Oil;
- At the Emulsion Batching area a 60 m^3 emulsion tank will be placed; and
- Feed into pipeline for underground used at both areas.

Clearance of indigenous vegetation will be required in the order of approximately 1.3ha.

Project 3: Main Parking Extension

The Mine requires the expansion of the existing parking area at the Main Offices. The current parking area is about 0.8 ha with the parking bays not sufficient to cater for the number of vehicles. The current parking bay comprises a tarred surface area and steel roof parking bays. The same principle will be applied at the expanded area. No new entrances will be required. The planned parking bay expansion will be located about 20 m from the Springkaanspruit.

Clearance of indigenous vegetation will be required in the order of approximately 4900 m^2.

Project 4: Widening of Access Road between South Shaft/Main Offices and Plant

An existing road provides access between the Main Office Buildings and the Plant. The current width of the road ranges between 5-6 m. To accommodate for larger vehicles such as Trucks, the mine is planning on increasing a section of 700m of this road to a width of 16 m (two way traffic).

Clearance of indigenous vegetation will be required in the order of approximately 3 311 m^2.

Project 5: Access Crossing between Plant and North Mine

To ensure more optimal logistical management of traffic between the South Mine and the North Mine, and to reduce the number of vehicles on the regional road, the mine is planning on constructing a road under the regional road bridge to allow for access between the two areas.

Clearance of indigenous vegetation will be required in the order of approximately 1 700 m^2.

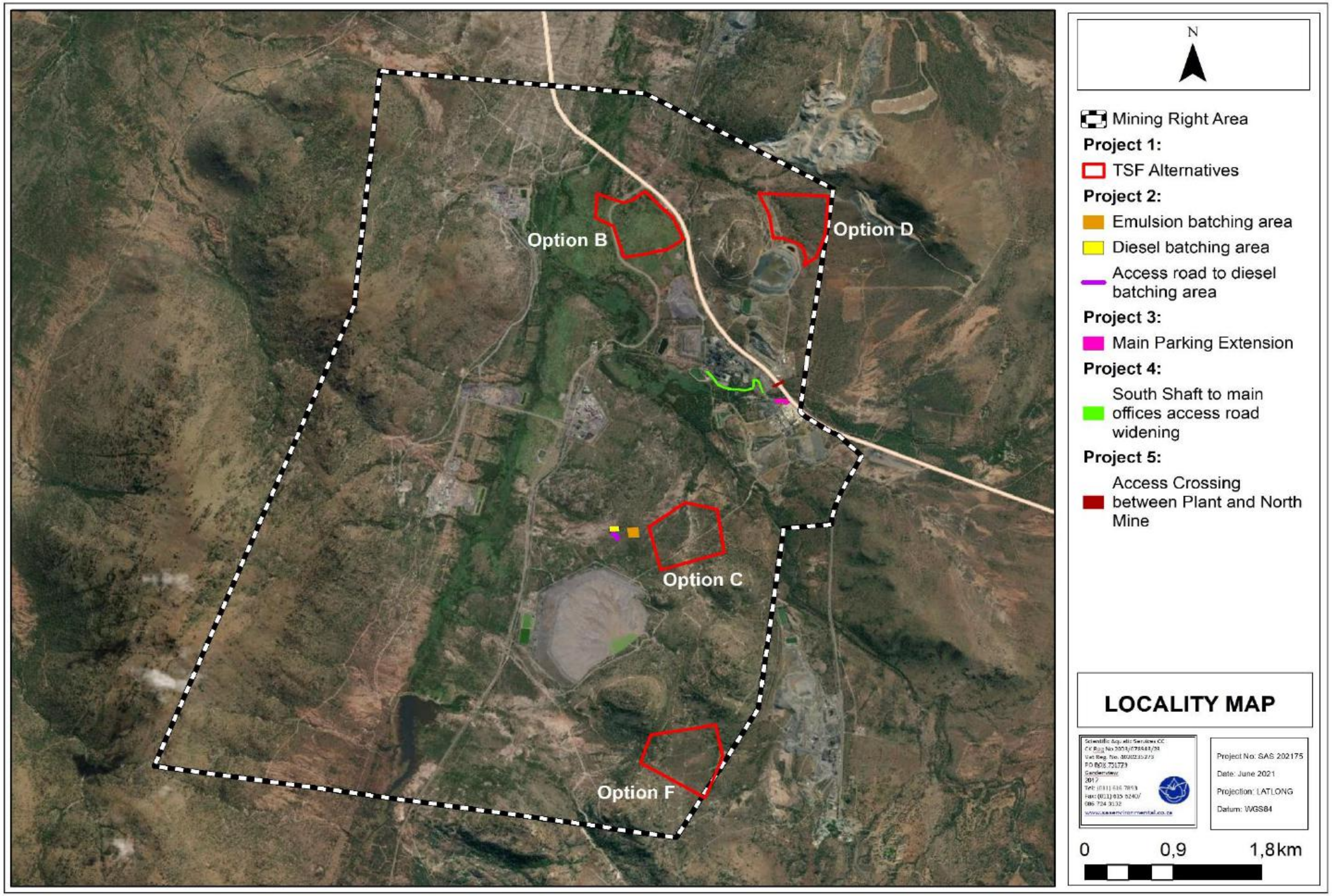


Figure 1: Digital satellite image depicting the MRA and the five proposed projects (including alternatives where applicable).

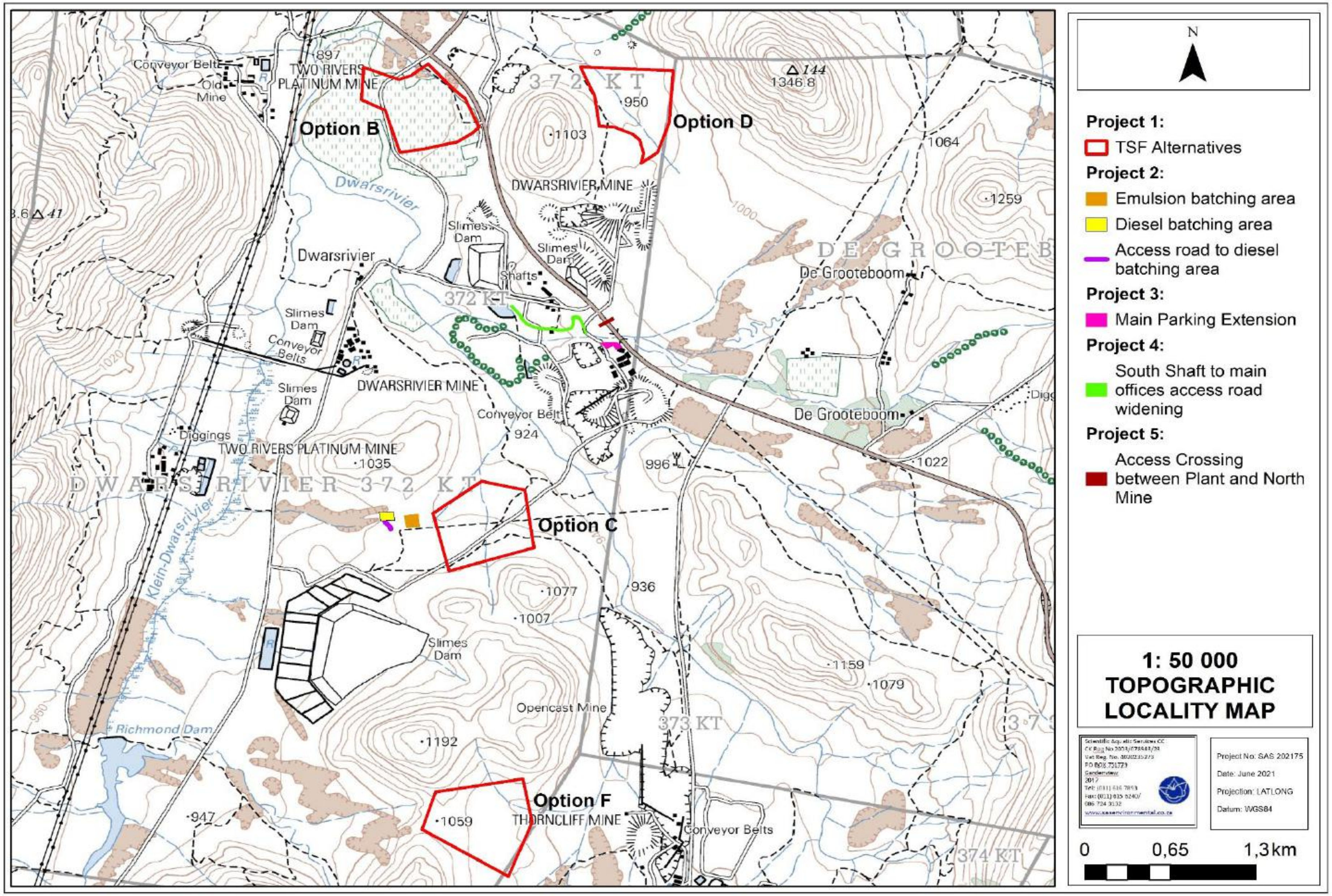


Figure 2: The location of the five proposed projects depicted on a 1:50 000 topographical map in relation to the surrounding area.

1.2 Project Scope

Specific outcomes in terms of the report are as follows:

- Compile a desktop study with all relevant information as presented by SANBI's Biodiversity Geographic Information Systems (BGIS) website (http://bgis.sanbi.org), including the Limpopo Conservation Plan Version 2 (2013), to gain background information on the physical habitat and potential floral and faunal biodiversity associated with the five proposed projects;
- To conduct a high-level ecological scoping assessment of the proposed TSF Options;
- To assess each TSF Options in terms of faunal and floral Species of Conservation Concern including the potential for such species to occur within the various TSF Options;
- Highlight areas of risk and concern regarding sensitive habitat and SCC associated with each TSF Option; and
- Provide high level ecological scoping input for Projects 2, 3, 4 and 5, highlighting the risks and concerns associated with these projects.

1.3 Assumptions and Limitations

The following assumptions and limitations are applicable to this report:

- It is important to note that although all data sources used provide useful and often verifiable, high-quality data, the various databases used do not always provide an entirely accurate indication of the actual site characteristics at a fine scale. However, this information is considered to be useful as background information to the study, and sufficient decision making can take place with regards to the development activities based on the desktop results;
- With ecology being dynamic and complex, some aspects (some of which may be important) may have been overlooked. It is, however, expected that the terrestrial ecology had been accurately assessed and considered and the information provided is considered sufficient to allow informed decision making to take place and facilitate integrated environmental management;
- Assessments were carried out using a habitat focused approach to assess the habitat sensitivity associated with the TSF Options;
- Sampling by its nature means that not all individuals are assessed and identified. Some species and taxa within the TSF Options may, therefore, have been missed during the assessment; and

- The data presented in this report are based on the site visit, undertaken on the 4th and 5th of December 2018. On-site data was further augmented with all available desktop data, historical studies and specialist experience in the area, and the findings of this assessment are considered to be an accurate reflection of the ecological characteristics of the areas assessed. The assessment and information was deemed sufficient based on the scope of work. Once an alternative has been selected, in depth assessment will follow pertaining to the specific site selected.

1.4 Legislative Requirements

The following legislative requirements were considered during the assessment:

- National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA);
- National Environmental Management: Biodiversity Act ,2004 (Act 10 of 2004) (NEMBA);
- Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983) (CARA);
- Minerals and Petroleum Resource Development Act, 2002 (Act 28 of 2002) (MPRDA); and
- Limpopo Environmental Management Act, 2003 (Act 7 of 2003) (LEMA);

The details of each of the above, as they pertain to this study, are provided in Appendix B of this report.

2 ASSESSMENT APPROACH

2.1 General Approach

To accurately determine the Present Ecological State (PES) of the TSF Options and capture comprehensive data with respect to faunal and floral taxa, the following methodology was used:

- Maps and digital satellite images were consulted prior to the field assessment in order to determine broad habitats, vegetation types and potentially sensitive sites. A visual on-site assessment of the TSF Options was made in order to confirm the assumptions made during consultation of the maps;
- Relevant databases considered during the assessment of the TSF Options included the South African National Biodiversity Institute (SANBI) Threatened Species Programme (TSP), the Limpopo Conservation Plan Version 2 (2013), Mucina and

Rutherford (2012), National Biodiversity Assessment (2011), Important Bird Areas in conjunction with the South African Bird Atlas Project (SABAP 2) (2015), International Union for Conservation of Nature (IUCN), and Pretoria National Herbarium Computer Information Systems (PRECIS);

- A site visit was undertaken on the 4th and 5th of December 2018 (summer season), 11th March 2020 (Autumn) and 20th May 2021 (Winter) to determine the ecological status of the TSF Options and the Fuel Storage Areas. Each alternative was assessed in terms of the available habitat, with special emphasis being placed on areas that may potentially support faunal and floral SCC and the threat posed to the surrounding environment associated with each locality of the proposed projects.

3 RESULTS OF THE DESKTOP ANALYSIS

3.1 Conservation Characteristics of the TSF Options based on National and Provincial Datasets

The following section contains data accessed as part of the desktop assessment and are presented as a “dashboard” report below (Table 1). The dashboard report aims to present concise summaries of the data on as few pages as possible in order to allow for improved assimilation of results by the reader to take place. Where required, further discussion and interpretation is provided.

Table 1: Summary of the conservation characteristics for the five proposed projects.

Details of the five proposed projects in terms of Mucina & Rutherford (2012)	
Biome	The five proposed projects are situated within the **Savanna Biome**.
Bioregion	The five proposed projects is located within the **Central Bushveld Bioregion**
Vegetation Type	The five proposed projects is situated within the **Sekhukhune Mountain Bushveld (SVcb28).**
Conservation details pertaining to the five proposed projects (Various databases)	
NBA (2018) (Figure 3)	The majority of the of the portions of the five proposed projects currently fall within the remaining extent of the **least concerned Sekhukhune Mountain Bushveld,** that is currently **poorly protected.** Ecosystem types are categorised[1] as "not protected", "poorly protected", "moderately protected" and "well protected" based on the proportion of each ecosystem type that occurs within a protected area recognised in the Protected Areas Act, 2003 (Act No. 57 of 2003), and compared with the biodiversity target for that ecosystem type.
National Threatened Ecosystems (2011)	The entire TSF Alternative Options C, D and F, Project 2 and portions of TSF Alternative Option B and Projects 3 to 5 falls within an area considered to form part of the remaining extent of the **Endangered Sekhukhune Mountainlands** (Figure 4). According to the description in GN 1002, the **Sekhukhune Mountainlands** falls under **Criterion F**, which are priority areas for meeting explicit biodiversity targets as defined in a systemic biodiversity plan. These areas have a very high irreplaceability and are of medium threat. Endangered ecosystems have undergone degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems. For this purpose, habitat is considered severely degraded if it would be unable to recover to a natural or near-natural state following the removal of the cause of the degradation (e.g., invasive aliens, over-grazing), even after very long time periods. __Note__: *For Environmental Impact Assessments (EIAs), the 2011 National list of Threatened Ecosystems remains the trigger for a Basic Assessment in terms of Listing Notice 3 of the EIA Regulations*

Description of the vegetation type(s) relevant to the five proposed projects (Mucina & Rutherford 2012)	
Vegetation Type	Sekhukhune Mountain Bushveld
Climate	Summer rainfall with very dry winters
Altitude (m)	900–1 600 m
MAP* (mm)	609 mm
MAT* (°C)	17.5 °C
MFD* (Days)	5
MAPE* (mm)	2043 mm
MASMS* (%)	77 %
Distribution	Limpopo and Mpumalanga Provinces
Geology & Soils	Rocks mainly ultramafic intrusives of the lower, critical and main zones of the eastern Rustenburg Layered Suite of the Bushveld Igneous Complex (Vaalian). Three subsuites (zones), namely Croydon, Dwars River and Dsjate consist mainly of norite, pyroxenite, anorthosite and gabbro, and are characterised by localised intrusions of magnetite, diorite, dunite, bronzitite and harzburgite. Soils are predominantly shallow, rocky and clayey. Glenrosa and Mispah soil forms are common, with lime present in low-lying areas. Rocky areas without soil are common on steep slopes. The Dwars River Valley is characterised by prismacutanic horizons with melanic structured diagnostic horizons. Around Steelpoort red apedal, freely drained soils occur, and these deeper soils include Hutton, Bonheim and Steendal soil forms
Conservation	Least threatened. Target 24%. None conserved in statutory conservation areas
Vegetation & landscape features (Dominant Floral Taxa in Appendix C)	Dry, open to closed microphyllous and broad-leaved savanna on hills and mountain slopes that form concentric belts parallel to the north-eastern escarpment. Open bushveld often associated with ultramafic soils on southern aspects. Bushveld on ultramafic soils contain a high diversity of edaphic specialists. Bushveld of mountain slopes generally taller than in the valleys, with a well-developed herb layer. Bushveld of valleys and dry northern aspects usually dense, like thicket, with a herb layer comprising many short-lived perennials. Dry habitats contain a number of species with xerophytic adaptations, such as succulence and underground storage organs. Both man-made and natural erosion dongas occur on foot slopes of clays rich in heavy metals.
National Web-based Screening Tool (2020)	
The screening tool is intended to allow for pre-screening of sensitivities in the landscape to be assessed within the EA process. this assists with implementing the mitigation hierarchy by allowing developers to adjust their proposed development footprint to avoid sensitive areas. The different sensitivity ratings pertaining to the Plant [and Animal] Protocols are described below:	

[1] The ecosystem protection level status is assigned using the following criteria:

i. If an ecosystem type has more than 100% of its biodiversity target protected in a formal protected area either A or B, it is classified as Well Protected;
ii. When less than 100% of the biodiversity target is met in formal A or B protected areas it is classified it as Moderately Protected;
iii. If less than 50% of the biodiversity target is met, it is classified it as Poorly Protected; and
iv. If less than 5% it is Hardly Protected.

	published under the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA).
SAPAD (2020) [2]**; SACAD (2020)** [3]**; & NPAES (2009)**	According to the SAPAD (2018), the TSF Alternative Option B is located approximately 6 km south east of the De Hoop Dam Protected Environment. The NPAES (2009) and SACAD (2020) databases does not indicate any formally or informally protected areas or conservation areas to be situated within 10 km of the five proposed project. The NPAES database does however indicate that the TSF Alternative Option F is situated within the **Mpumalanga Mesic Grasslands Focus Area** (Figure 5). The Mpumalanga Mesic Grasslands focus area represents opportunities to conserve poorly protected grassland and bushveld vegetation types as well as whole river reaches and threatened river types. It was also identified as a national priority in the Grasslands systematic biodiversity plan.
IBA (2015)	The five proposed projects are not situated within 10 km of an Important Bird and Biodiversity Area (IBA).
Mining and Biodiversity Guidelines (2013)	
Highest Biodiversity Importance	The five proposed projects fall within an area considered to be of Highest Biodiversity Importance. Highest Biodiversity Importance areas include areas where mining is not legally prohibited, but where there is a very high risk that due to their potential biodiversity significance and importance to ecosystem services (e.g. water flow regulation and water provisioning) that mining projects will be significantly constrained or may not receive the necessary authorisations.

- **Very High:** Habitat for species that are endemic to South Africa, where all the known occurrences of that species are within an area of 10 km^2 are considered Critical Habitat, as all remaining habitat is irreplaceable. Typically, these include species that qualify under Critically Endangered (CR), Endangered (EN), or Vulnerable (VU) D criteria of the IUCN or species listed as Critically/ Extremely Rare under South Africa's National Red List Criteria. For each species reliant on a Critical Habitat, all remaining suitable habitat has been manually mapped at a fine scale.
- **High:** Recent occurrence records for all threatened (CR, EN, VU) and/or rare endemic species are included in the high sensitivity level.
- **Medium:** Model-derived suitable habitat areas for threatened and/or rare species are included in the medium sensitivity level.
- **Low:** Areas where no SCC are known or expected to occur.

Terrestrial Biodiversity Theme	For the terrestrial biodiversity theme, the five proposed projects are considered to have an overall **sensitivity of very high**. The triggered sensitivity features include CBA Category 1 and ESA Category 2, FEPA catchment, an endangered ecosystem and focus areas for land based protected area environment. Therse correspond with the various databases as presented in this dashboard.
Animal Species Theme	For the animal species theme, the five proposed projects are considered to have an overall **sensitivity of medium**. Species identified by the EIA Screening tool include: *Chrysospalax villous* (Rough-haired golden mole, VU), *Crocidura maquassiensis* (Makwassie Musk Shrew, LC), *Dasymys robertsii* (Robert's shaggy rat, DD) and *Sagittarius serpentarius* (Secretary bird, EN). Figure 8.
Plant Species Theme	For the plant species theme, the five proposed projects are considered to have a **medium sensitivity**. Species identified by the EIA Screening tool include: *Asparagus fourei* (VU), *Polygala sekhukhuniensis* (VU), *Searsia batophylla* (VU), *S. sekhukhuniensis* (Rare) and *Combretum petrophilum* (Rare).

Limpopo Conservation Plan Version 2 (2013) (Figure 6)			
Critical Biodiversity Area (CBA) 1	The Projects 1, 2 3 and 5 and the majority of Project 4 falls within areas is defined as a **Category 1 CBA.** These are "Irreplaceable" areas, which are required to meet biodiversity pattern and/or ecological processes targets; and with no alternative sites available to meet targets.	**Ecological Support Area (ESA) 2**	A small portion of Project 4 falls within an area defined as a **Category 2 ESA**. These are areas where no natural habitat remains, but that are still important for meeting ecological processes.

Strategic Water Source Areas (SWSA)

[2] **SACAD (2020):** The types of conservation areas that are currently included in the database are the following: 1. Biosphere reserves, 2. Ramsar sites, 3. Stewardship agreements (other than nature reserves and protected environments), 4. Botanical gardens, 5. Transfrontier conservation areas, 6. Transfrontier parks, 7. Military conservation areas and 8. Conservancies.

[3] **SAPAD (2020):** The definition of protected areas follows the definition of a protected area as defined in the National Environmental Management: Protected Areas Act, (Act 57 of 2003). Chapter 2 of the National Environmental Management: Protected Areas Act, 2003 sets out the "System of Protected Areas", which consists of the following kinds of protected areas - 1. Special nature reserves; 2. National parks; 3. Nature reserves; 4. Protected environments (1-4 declared in terms of the National Environmental Management: Protected Areas Act, 2003); 5. World heritage sites declared in terms of the World Heritage Convention Act; 6. Marine protected areas declared in terms of the Marine Living Resources Act; 7. Specially protected forest areas, forest nature reserves, and forest wilderness areas declared in terms of the National Forests Act, 1998 (Act No. 84 of 1998); and 8. Mountain catchment areas declared in terms of the Mountain Catchment Areas Act, 1970 (Act No. 63 of 1970).

Surface water SWSAs are defined as areas of land that supply a disproportionate (i.e., relatively large) quantity of mean annual surface water runoff in relation to their size. They include transboundary areas that extend into Lesotho and Swaziland. The sub-national Water Source Areas (WSAs) are not nationally strategic as defined in the report but were included to provide a complete coverage.	
Name and Criteria	The five proposed projects area are not within 10 km of a Strategic Water Source Area.

NBA = National Biodiversity Assessment; SAPAD = South African Protected Areas Database; NPAES = National Protected Areas Expansion Strategy; IBA = Important Bird Area; MAP = Mean annual precipitation; MAT = Mean annual temperature; MAPE = Mean annual potential evaporation; MFD = Mean Frost Days; MASMS = Mean annual soil moisture stress (% of days when evaporative demand was more than double the soil moisture supply).

Figure 3: The remaining extent of the Sekhukhune Mountain Bushveld associated with the five proposed projects according to the National Biodiversity Assessment (NBA, 2018).

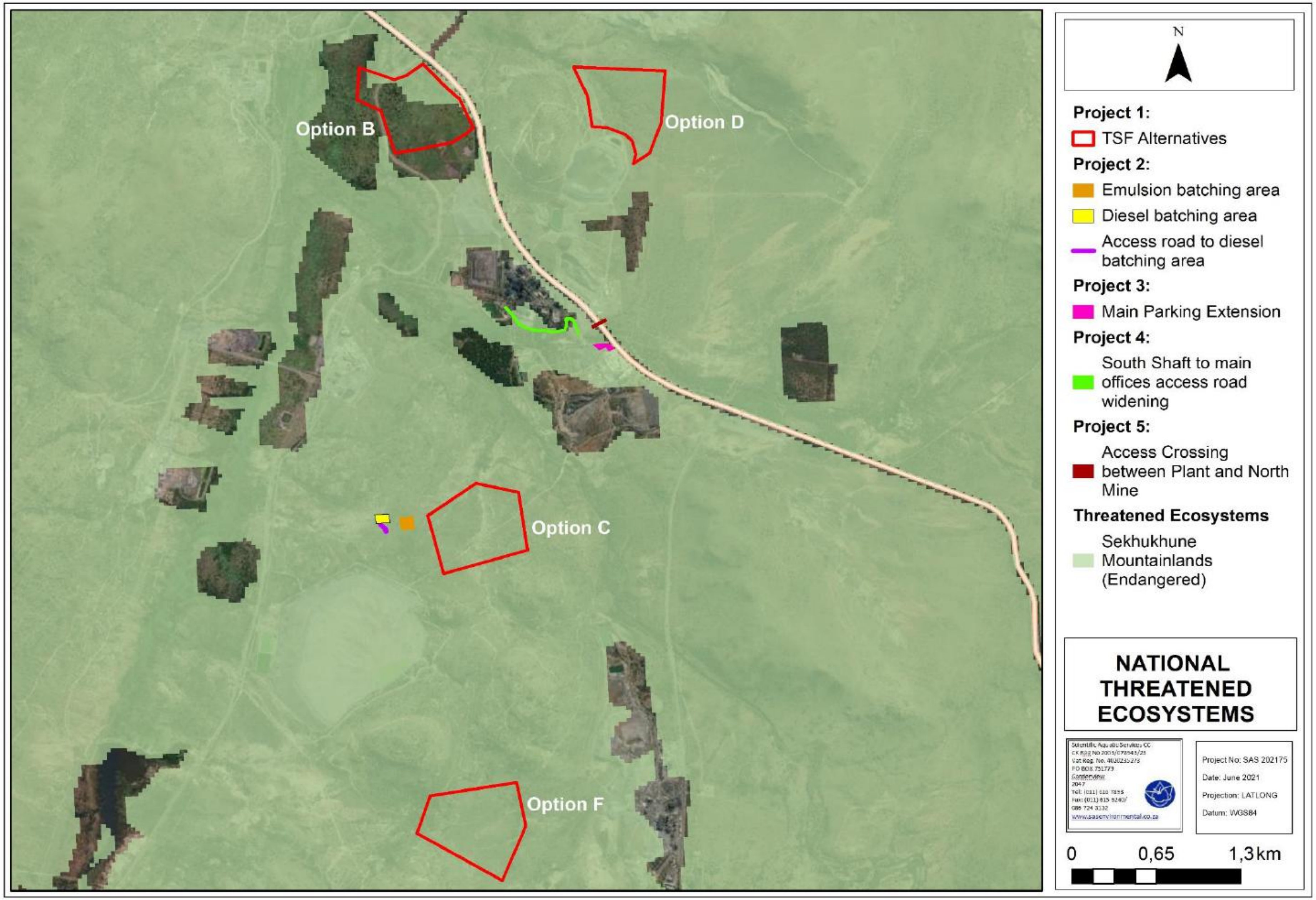


Figure 4: Endangered Sekhukhune Mountainlands associated with the five proposed projects (National Threatened Ecosystems, 2011).

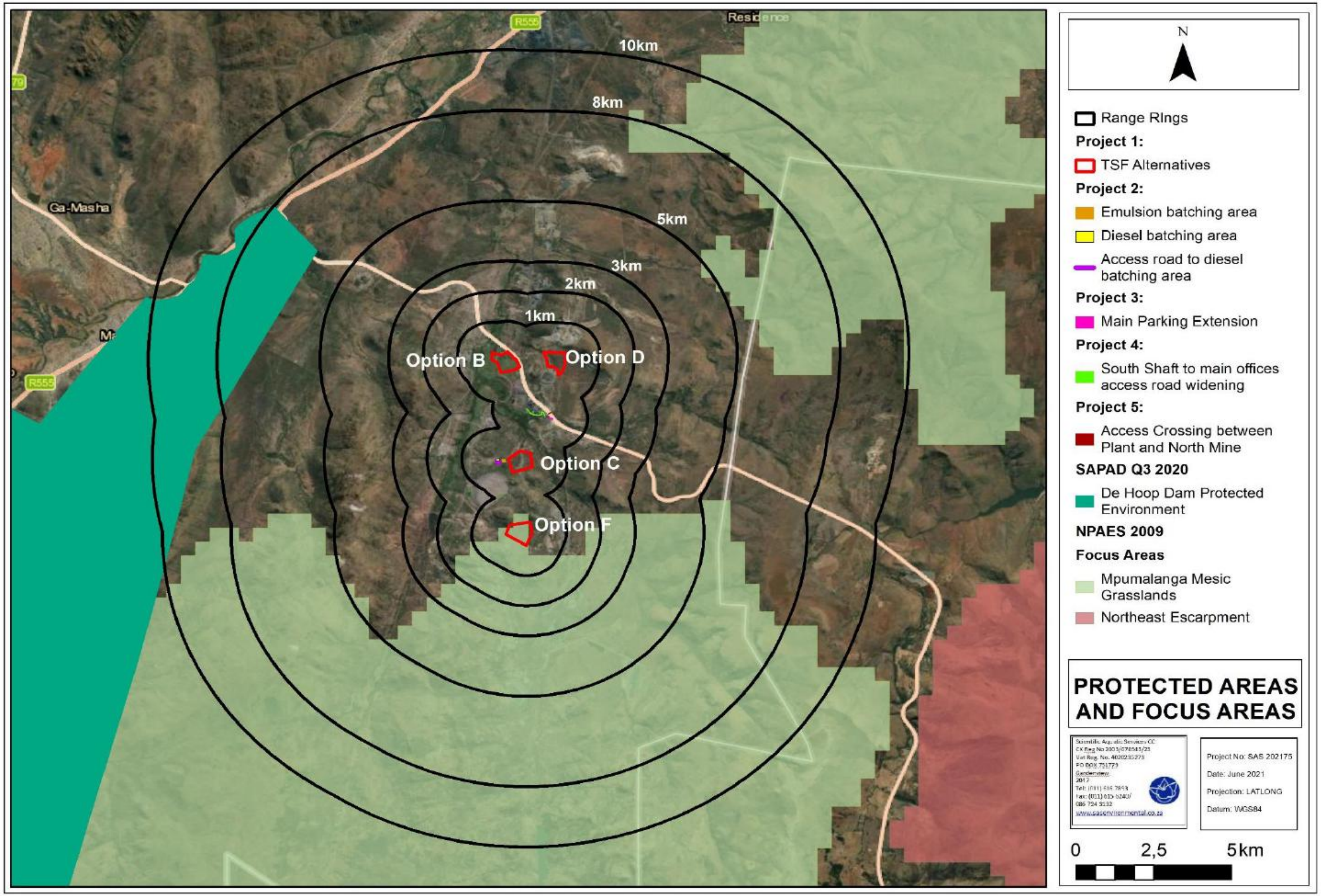


Figure 5: The protected area and focus area associated with the five proposed projects (SAPAD, 2020 and NPAES, 2009).

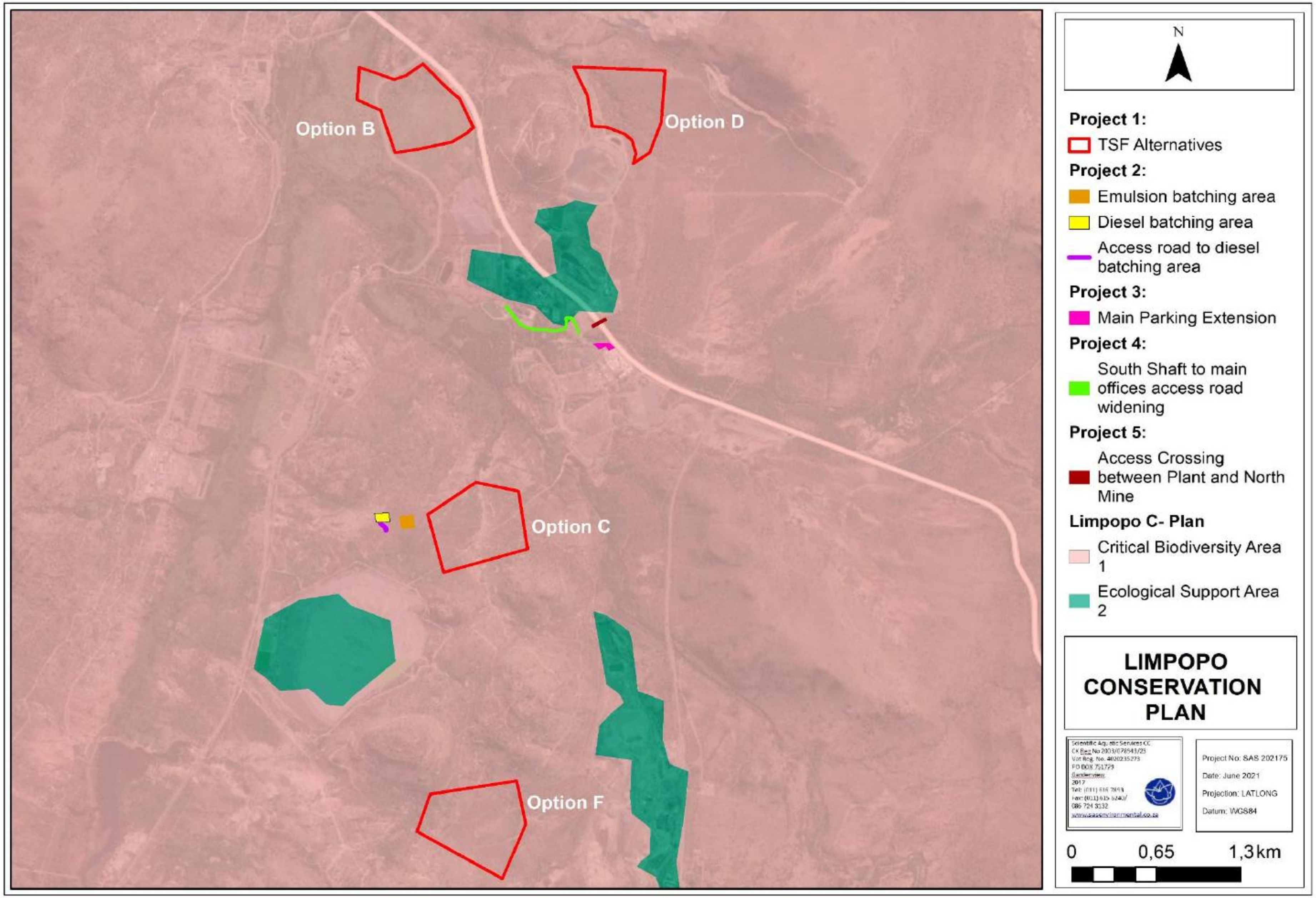


Figure 6: CBA 1 and ESA 2 associated with the five proposed projects according to the Limpopo Conservation Plan V2 (2013).

4 PROPOSED PROJECTS ANALYSIS RESULTS

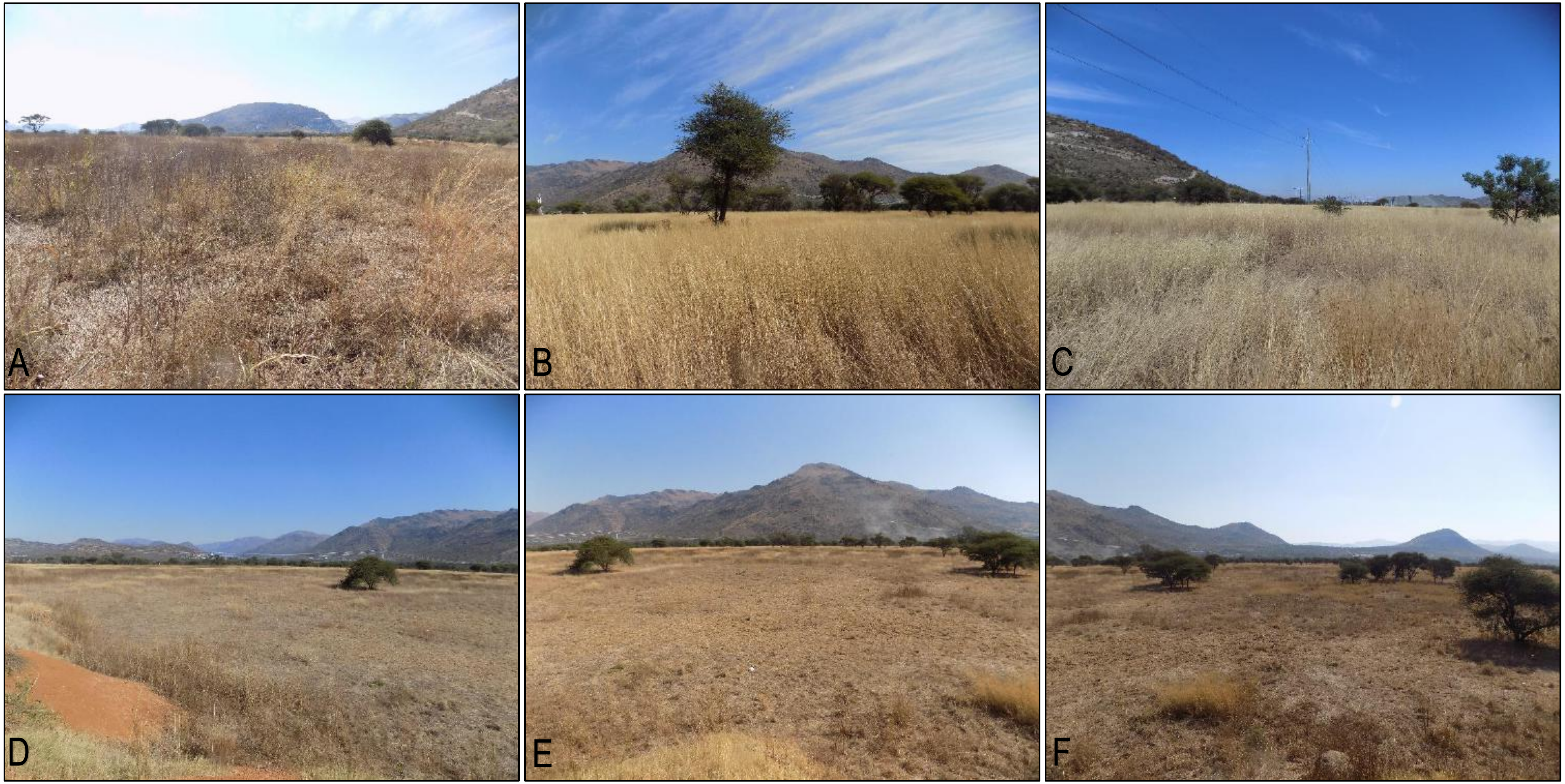
4.1 Project 1: TSF OPTION ANALYSIS RESULTS

During the field assessments undertaken in December 2018 and May 2021, each TSF Option (B, C, D and F) was assessed in terms of location, habitat and species diversity, ecological importance and sensitivity and potential impacts relating to terrestrial biodiversity within each site which may occur as a result of the proposed activity. Previous studies conducted by SAS (2018) in the area as well as the relevant desktop data was used to provide input into the suitability and constraints of each option.

The dashboards below briefly discuss each TSF Options, and the opportunities and constraints associated therein.

4.1.1 TSF Option B

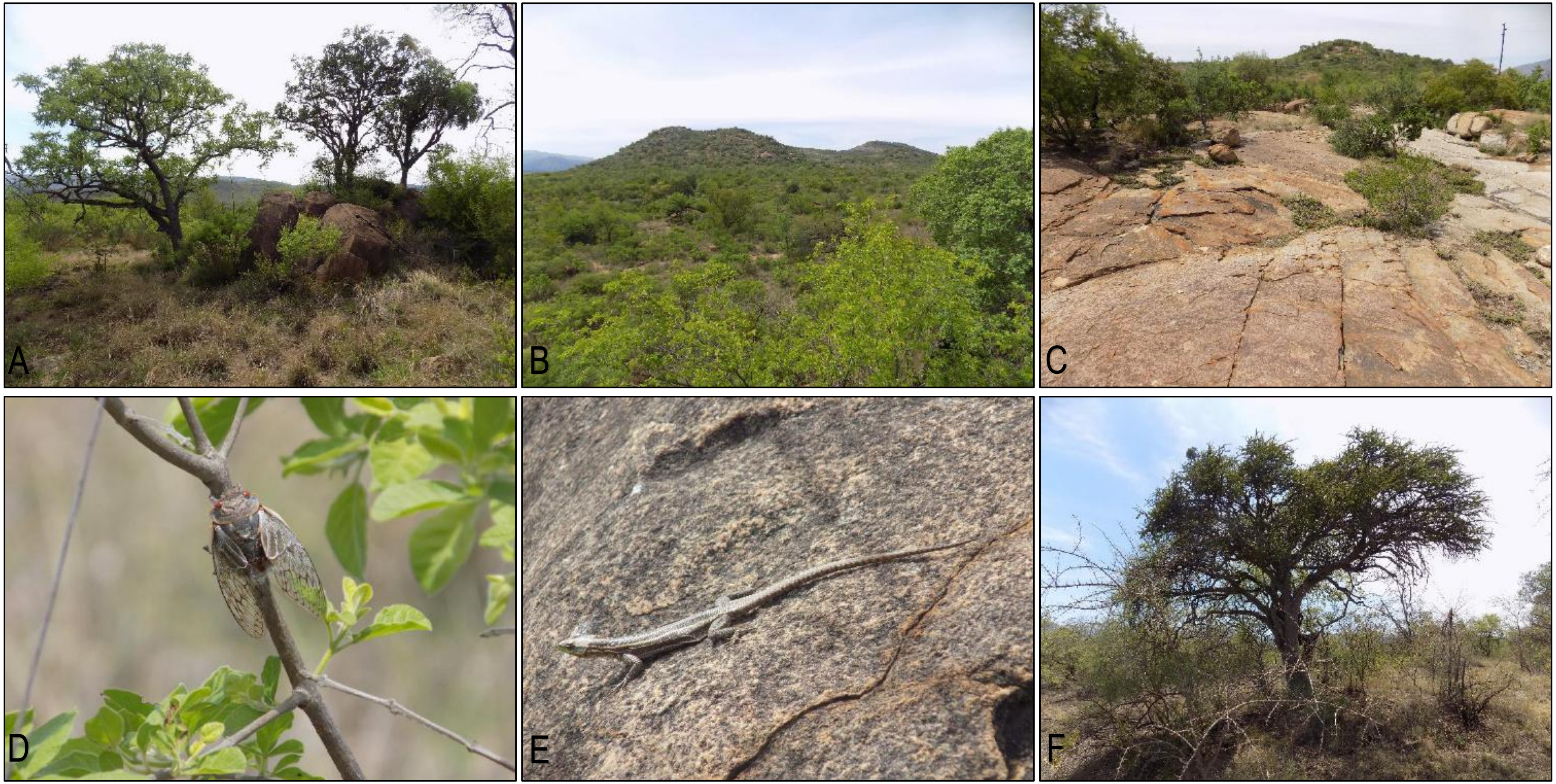
Table 2: High-level field assessment results pertaining to the terrestrial ecology of TSF Option B.

TSF Option B


General Discussion and Site Analysis Results	Business Case, Conclusion and Alternatives Analysis:
TSF Option B is located in a histrocially disturbed area, notably, an area that was used for agriculture. With the advent of mining, the old agricultrual lands lay fallow and have subsequently been recolonised with a combination of indigenouse vegetation and alien and invasive plants (AIP). As no structured rehabilitation has occurred and due to the exclusion of important ecological processes (herbivory and fire), the footprint area appears to remain in a sub-climax, bordering pioneer in some instances, stage of vegetative succession. The herbaceous layer comprises of only a handful of grass species, often present within large, homogenous swards that shift between these species in terms of dominance/abundance. The dominant grass species include *Aristidea adscensionis, Heteropogon contortus, Enneapogon cenchroides*, *Cymbopogon excavatus* and *Eragrsotis* spp. No floral or faunal SCC were observed within the footprint area, further, given the current ecological condition of the footprint it is unlikely that any such species will occur herein. Over all the terrestrial habitat within the proposed TSF is in a degraded, dominated by plant species associated with disturbed habitat and is not considered representative of the vegetation type (Sekhukhune Mountain Bushveld).	The proposed TSF Option is located within a CBA 1 as well as an area of highest biodiversity importance according to the mining and biodiversity guidelines. Option B is however the only option that is not located within an area listed on the NBA (2018) or the National Threatened Ecosystems (2011). The site assessment and previous studies indicated that the habitat within the footprint is not representative of the vegetation type, notably due to the area being historically cleared for agriculture. Post agricultural land use did not include formal rehabilitation or revegetation, rather allowing for natural recolonisation of plant species to occur. Currently, the footprint is dominated by pioneer and sub-climax grass species indicative of disturbed lands. The construction of the TSF in this locality will not impact on any floral or faunal SCC. Further the development herein will not impact on faunal species movement or habitat connectivity, as the site is located in an already disturbed and fenced off area. There is however the risk that the proposed TSF poses to the Groot Dwars River. Should the TSF fail, or any spills/leaching occur, it will have a significant impact on the freshwater system not just at the point of contact but also further downstream. Provided the risk of leaching of tailings or contaminated water from the associated PCD's can be suitably managed so as to not impact the Groot Dwars River, this proposed footprint is considered suitably from a terrestrial ecological point, as no ecologically intact and important vegetation will be cleared. The risk of failure from the TSF however needs to be considered from a freshwater ecological standpoint.

4.1.2 TSF Option C

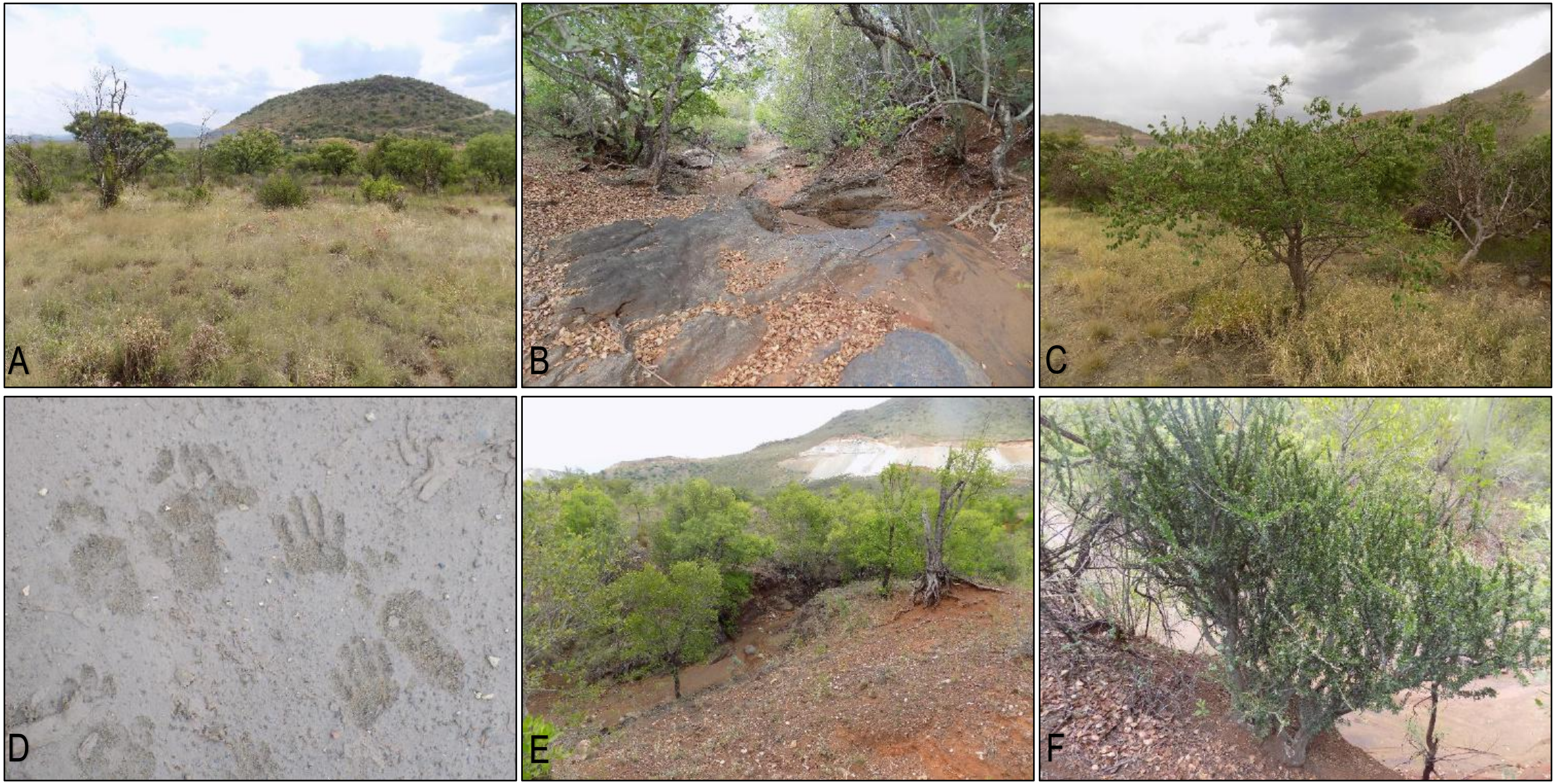
Table 3: High-level field assessment results pertaining to the terrestrial ecology of TSF Option C.

TSF Option C


General Discussion and Site Analysis Results	Business Case, Conclusion and Alternatives Analysis:
A number of floral SCC were observed within TSF Option C including *Sclerocarya birrea* subsp *caffra* (NFA, Act 84 of 1998) (Figure A), *Lydenburgia cassinoides* (NFA, Act 84 of 1998) and *Boscia albitrunca* (NFA, Act 84 of 1998) (Figure F). One faunal SCC was observed within the proposed TSF area, namely *Pycna sylvia* (Cicada) (Figure D) with *Python natalensis* (African Python, VU) being previously recorded. Of importance is that *Pycna* sylvia appears to be largely endemic to the Dwars River Valley and is most commonly associated with the tree species *Vitex obovata* subsp *wilmsii* and as such loss of habitat and individuals in the area will have a significant knock-on effect on the overall population of this species in the valley. Of additional importance is the increased probability that species such as *Panthera pardus* (Leopard, Vulnerable, TOPS Listed), *Parahyaena brunnea* (Brown hyaena, NT, TOPS Listed), *Sagittarius serpentarius* (Secretary bird, VU), *Polemaetus bellicosus* (Martial Eagle, VU) and *Neotis denhami* (Denham's Bustard, NT) will occur within and utilise the area associated with the proposed TSF. The Groot Dwars River, located to the north of the proposed TSF, forms a natural buffer and boundary between the proposed site and then mine itself. This, combined with no additional mining developments/activities in this locality has ensured that the overall ecology of the area remains relatively intact and less disturbed in comparison to areas north of the Dwars River, where mining activities and edge effects have led to habitat degradation. The varying landscape with rocky kopies and areas of sheetrock further provide important areas of niche habitat for numerous faunal and floral species including *Platysaurus orientalis orientalis* (Sekhukhune Flat Lizard) (Figure E). Additionally, these areas of sheetrock and rocky outcrops provide habitat for endemic species such as *Platysaurus orientalis fitzsimonsi* (Fitzsimon's Flat Lizard) and *Hadogenes polytrichobothrius* (Burrowing Scorpion). Overall the terrestrial habitat within the proposed TSF is considered intact and of high habitat integrity, with many of the floral species observed considered representative of the Sekhukhune Bushveld. Small scale edge effects were evident as a result of the construction of access roads and old drill pads; however, these have not led to significant habitat degradation.	The proposed TSF Option is located within a CBA 1 as well as an area of highest biodiversity importance according to the mining and biodiversity guidelines. The site assessment and previous studies indicated that the habitat is still largely intact and comprises numerous floral species indicative of the Sekhukhune Bushveld areas. Several floral SCC were observed within the proposed TSF, while it is likely that several faunal SCC will utilise the proposed TSF foraging, as a movement corridor and for permanent habitat. The construction of TSF Option C will result in the loss of floral and faunal species and SCC while leading to the loss of a significant portion of intact habitat. Additionally, the location of the TSF will lead to loss of habitat connectivity for faunal species and also further limit access to and from the important areas of habitat and water resource provided by the Groot Dwars River. Additionally, the location of the TSF will necessitate the upgrading and widening of the access road and the laying of additional TSF related infrastructure such as pipelines, which will result in further vegetation clearing and loss of habitat connectivity. The additional risk posed by Option C is the relative proximity (300m) of the TSF to the Groot Dwars River. Should the TSF fail, or any spills/leaching occur, it will have a significant impact on the freshwater system not just at the point of contact but also further downstream. Additionally, TRP mine have now placed a pipeline to their new TSF which traverses the footprint of this option. As such, from an ecological and risk management perspective TSF Option C is deemed unsuitable.

4.1.3 TSF Option D

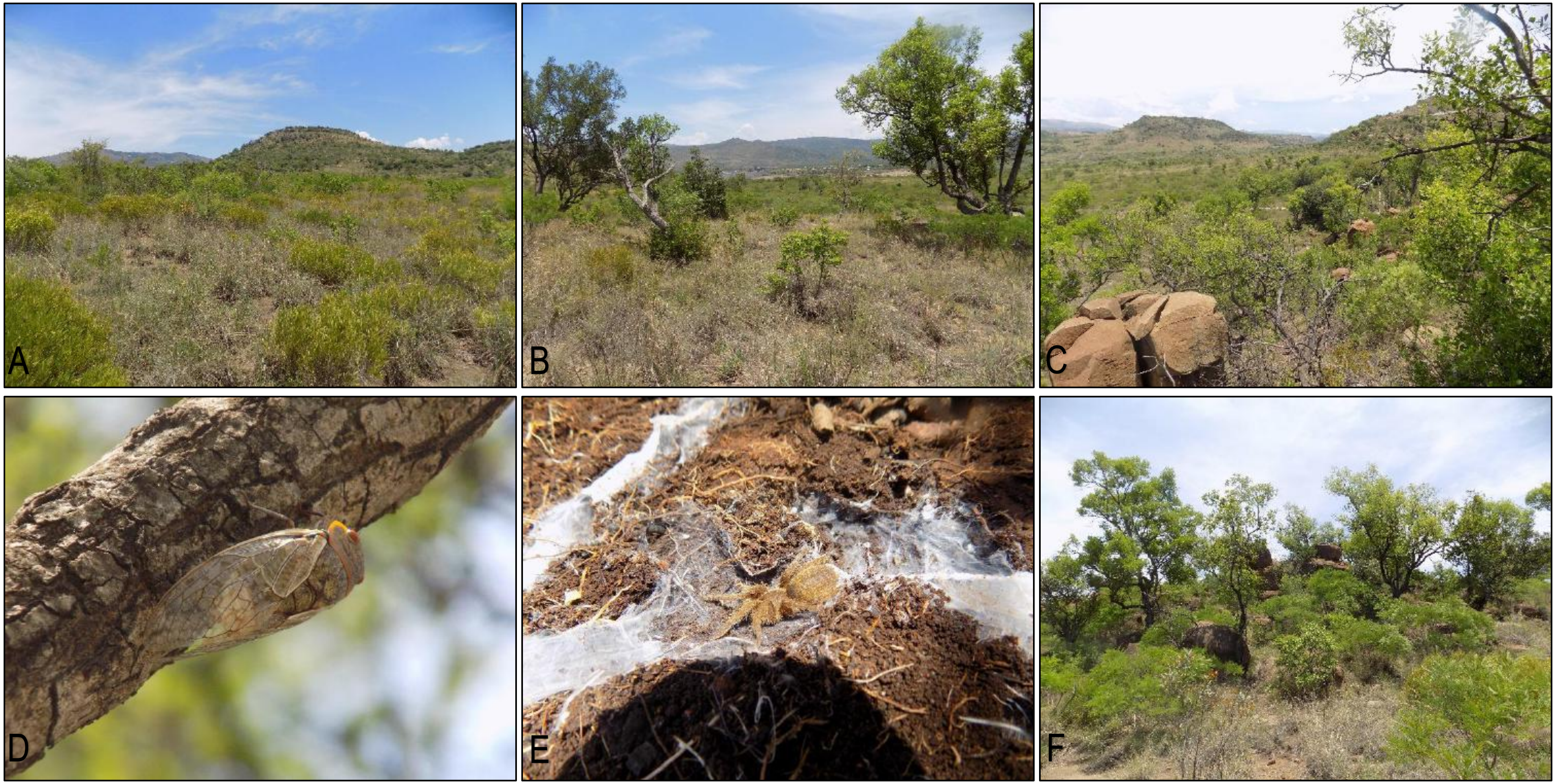
Table 4: High-level field assessment results pertaining to the terrestrial ecology of TSF Option D.

TSF Option D


General Discussion and Site Analysis Results	Business Case, Conclusion and Alternatives Analysis:
A small number of individuals of the floral SCC *Sclerocarya birrea* subsp *caffra* (Figure C) were observed, while the floral SCC *Lydenburgia cassinoides* (Figure E) which are protected under the National Forest Act (Act 84 of 1998) were observed in far greater abundance, primarily associated with the drainage line. Additionally, several individuals of *Boscia albitrunca* (NFA, Act 84 of 1998) (Figure F) were also observed within the TSF area. No faunal SCC or signs thereof were observed within the proposed TSF area; however, it is likely that species such as *Panthera pardus* (Leopard, Vulnerable, TOPS 2015) and *Parahyaena brunnea* (Brown hyaena, NT, TOPS Listed) may move through the area from time to time while foraging. Additionally, species such as *Sagittarius serpentarius* (Secretary bird, VU), *Polemaetus bellicosus* (Martial Eagle, VU), *Neotis denhami* (Denham's Bustard, NT) and *Python natalensis* (African Python, VU) may occur within the proposed TSF, however it is likely that this will only be for short periods or when moving through the area due to the low levels of available food resources for these species. The tree species *Vitex obovata* subsp *wilmsii* was observed within the proposed TSF, however in low densities. This tree species has been generally associated with the endemic Cicada species *Pycna sylvia*, with this Cicada predominantly calling from this tree species. No Cicadas were heard calling during the assessment, nor have they been heard during previous assessments in the area. This may be due to the low density of *Vitex* trees or unsuitable soils in which to lay its eggs; alternatively due to the lifecycles of this species, no Cicadas may have emerged in the area at the time of assessment. Habitat connectivity has been compromised to a degree as a result of the surrounding mining activities, roads, fences and mining-related infrastructure. As such, it is unlikely that the habitat within the proposed TSF will provide long term permanent habitat for large mammal species, with the proposed TSF area acting more as a conduit of movement. Overall the terrestrial habitat within the proposed TSF is considered to be in good condition, with many of the floral species observed considered representative of the Sekhukhune Bushveld. Edge effects from the surrounding mining activities were evident. However these were still limited in extent and had not led to large scale habitat loss or degradation. Overall the vegetation structure is indicative of a mature system, dominated by large trees with a well-developed herbaceous layer and understory.	The proposed TSF Option is located within a CBA 1 as well as an area of highest biodiversity importance. The site assessment and previous studies indicated that the habitat is still largely intact and comprises numerous floral species indicative of the Sekhukhune Bushveld areas. Several floral SCC were observed within the proposed TSF, while it is likely that several faunal SCC will utilise the proposed TSF for foraging and as a movement corridor. The development of this TSF will result in the loss of the aforementioned floral species located within the project footprint and will also impact the movement and habitat connectivity of faunal species. However, cognisance of the surrounding activates must be taken, and it is evident that this proposed option is already located in an area of extensive mining activities, including ongoing open cast mining and an already existing TSF belong to Dwars River Mine. Due to the location of the existing Dwars River Mine TSF, minimal additional TSF related infrastructure (roads, pipelines and so forth) will need to be constructed and laid, reducing the overall impact of the proposed project. Additionally, Two Rivers Platinum (TRP) is planning on constructing a second TSF to the east of the proposed Option D TSF of Dwars River Mine. The construction of this TSF will result in the loss of habitat connectivity and significantly impact on faunal species movement. As such, should Dwars River Mine opt to select an alternative site, it is likely that the receiving environment will be impacted upon nonetheless as a result of the construction of the TRP TSF. Although the TSF Option D will result in the loss of habitat, impact on species and decrease habitat connectivity, taking into consideration the continued mining activities and future construction plans of the area, Option D should be considered over Option C and F.

4.1.4 TSF Option F

Table 5: High-level field assessment results pertaining to the terrestrial ecology of TSF Option F.

TSF Option D


General Discussion and Site Analysis Results	Business Case, Conclusion and Alternatives Analysis:
TSF Option F provides habitat to floral SCC such as *Lydenburgia cassinoides* (NFA, Act 84 of 1998). The faunal SCC *Pycna sylvia* (Cicada) (Figure D) was observed during the assessment of TSF Option F while previous assessments of the area resulted in the observation of *Panthera pardus* (Leopard, Vulnerable, TOPS 2015) spoor. Of additional importance is the increased probability that species such as *Parahyaena brunnea* (Brown hyaena, NT), *Sagittarius serpentarius* (Secretary bird, VU), *Polemaetus bellicosus* (Martial Eagle, VU) and *Neotis denhami* (Denham's Bustard, NT) will occur within and utilise the area associated with the proposed TSF. Option F is located in the south-east of the mining property, is surrounded by hills to the west, south and north while being open to the east to which the property borders onto a neighbouring mine. Due to the location and distance from the DCM itself, this area has not been subjected to intensive mining activities and edge effects. The results of exploration drilling are notable in the area; however, these disturbed areas are relatively small and spread out. The varying habitat along the topographical scale, numerous rocky outcrops, sheetrock and drainage line provide numerous areas of niche habitat for species. Additionally, the isolated nature of Option F in terms of mining impacts has ensured that the habitat has largely remained intact and capable of supporting numerous floral and faunal species, notably endemic species such as *Platysaurus orientalis fitzsimonsi* (Fitzsimon's Flat Lizard), *Pycna sylvia* (Cicada) and *Hadogenes polytrichobothrius* (Burrowing Scorpion). Additionally, species such as *Harpactirella overdijki* (Baboon spider) (Figure E) was observed in the rocky areas adjacent to the drainage line. Overall the terrestrial habitat within the proposed TSF is considered intact and of high habitat integrity, with many of the floral species observed considered representative of the Sekhukhune Bushveld. Small scale edge effects associated with the construction of access roads and old drill pads were evident, however, have not led to significant habitat degradation.	The proposed TSF falls within a CBA 1 as well as an area of highest biodiversity importance. The site assessment and previous studies indicated that the habitat is still largely intact and comprises numerous floral species indicative of the Sekhukhune Bushveld areas. Several floral SCC were observed within the proposed TSF, while it is likely that several faunal SCC will utilise the proposed TSF foraging, as a movement corridor and for permanent habitat. The construction of TSF Option F will result in the loss of both common, endemic and SCC fauna and flora while contributing to the further loss of intact habitat in the region. Additionally, the location of the TSF will lead to loss of habitat connectivity and numerous areas of important niche habitat. Due to the location of the TSF, it will be necessary to upgrade and widen access roads as well as clear additional areas of vegetation for the installation of pipelines and power lines, leading to further habitat loss and increased edge effects. Due to the relatively isolated nature of the area in which Option F is located, the habitat has remained largely intact while faunal and floral species have been subjected to low-level impacts and edge effects. As such, from an ecological perspective, TSF Option C is deemed unsuitable.

4.2 Project 2: Diesel Storage and Emulsion Batching Site

The diesel storage and emulsion batching sites are located in a CBA 1 as well as the Sekhukhune Bushveld habitat. The habitat herein is considered to be intact, providing habitat to an array of indigenous and endemic plant and animal species. A number of floral SCC are noted to occur within the habitat including *Sclerocarya birrea* subsp *caffra* (NFA, Act 84 of 1998), *Lydenburgia cassinoides* (NFA, Act 84 of 1998) and *Boscia albitrunca* (NFA, Act 84 of 1998). One faunal SCC has been observed within area, namely *Pycna sylvia* (Cicada) whilst *Python natalensis* (African Python, VU) has been previously recorded. *Pycna sylvia* appears to be largely endemic to the Dwars River Valley and is most commonly associated with the tree species *Vitex obovata* subsp *wilmsii*. Additional faunal SCC that present an increased probability of occurring within or near the footprint include *Panthera pardus* (Leopard, Vulnerable, TOPS Listed), *Parahyaena brunnea* (Brown hyaena, NT), *Sagittarius serpentarius* (Secretary bird, VU), *Polemaetus bellicosus* (Martial Eagle, VU) and *Neotis denhami* (Denham's Bustard, NT). These species may utilise the area associated with the diesel storage and emulsion batching for foraging or as a thorough fare.

Development of Project 2 will result in the clearance of vegetation and the loss of habitat; however, the planned footprint is small and as such, this loss is likely to not be significant nor lead to a decline in species diversity or abundance, provided edge effects are managed. In addition, the footprint is located adjacent the current TRP mines new TSF pipeline and service road. As such, only a small access road is required for project 2 as the TSF maintenance road will serve as the main access road.

Figure 7: Representative images of the habitat associated with Project 2.

4.3 Projects 3, 4 and 5: Main Parking Extension, Widening of Access Road between South Shaft/Main Offices and Plant, and Access Crossing between Plant and North Mine respectively

These projects are predominantly located in a CBA 1 as well as the Sekhukhune Bushveld habitat. All these projects are located within the existing mine operational footprint, and in the case of the access road between the main offices and plant, is an already existing road that needs upgrading. Due to the location of the various projects, the habitats have been subjected to edge effects, notably AIP proliferation, which has already impacted on habitat integrity. Habitat connectivity has been impacted upon as the projects are all located within the fenced off sections of the mine, and to a large degree are surrounded by buildings and other mining related infrastructure. Although habitat integrity has been impacted upon, the projects are still associated with areas of indigenous vegetation which likely provide habitat to numerous small mammals (rodents), avifauna and invertebrates. Although no faunal SCC are expected to inhabit the areas associated with Projects 3, 4 and 5, it is likely that floral SCC may be located in these footprints, notably *Sclerocarya birrea* subsp *caffra* (NFA, Act 84 of 1998) and potentially *Lydenburgia cassinoides* (NFA, Act 84 of 1998). Clearance of vegetation in the footprint areas will result in the loss of available floral and faunal habitat, however, given the localities of the footprints, such habitat loss is not expected to be detrimental to the floral and faunal communities in the region. The proposed projects are additionally associated with, and may impact upon, the Springkaanspruit freshwater system. Impacts to this freshwater system may additionally impact upon the Groot Dwars River, as the Springkaanspruit is a tributary of the Groot Dwars, and may carry sediment and pollutants into the Dwars that stem from the construction and operational activities associated with Projects 3, 4 and 5.

5 POTENTIAL IMPACTS AND PROPOSED MANAGEMENT MEASURES

5.1 Description of Potential Impacts Associated with the Proposed Construction of the TSF

Several potential risks to the receiving environment relating to proposed Projects 1 - 5 have been identified and are presented in the bullets below:

- Site clearing and construction activities will lead to habitat destruction within the footprint areas and will likely lead to the loss of floral and faunal species in the footprint areas, consequently impacting on the terrestrial biodiversity in the adjacent habitats;

- Vegetation clearance and constructions activities may result in the loss of faunal and floral SCC within the impacted areas;
- Potential indiscriminate fires by construction personnel may lead to uncontrolled / run-away fires, impacting on floral and faunal communities;
- Construction and introduction of foreign material (e.g. soil) may lead to the further introduction of alien invader species, impacting on the floral characteristics of the mining right area;
- Vehicles may impact upon the sensitive habitat during construction and operation, resulting in a loss of habitat. Vehicular movement, and construction activities, could additionally cause increased erosion, leading to poor vegetation growth, consequently providing sub-optimal living conditions for faunal species;
- Dumping of construction and operational waste materials in the surrounding habitat will result in floral and faunal habitat changes, which is likely to push faunal species out of their current home ranges, resulting in an increased competition for space and resources in the areas surrounding the footprints;
- Earthworks may lead to increased runoff and erosion resulting in a further loss of faunal and floral habitat. This is particularly relevant to Projects 3, 4 and 5 which are located in close proximity to the Springkaanspruit;
- Risk of discharge from the TSF facilities may pollute the receiving environment leading to altered floral and faunal habitat;
- Increased personnel on site may result in an increased risk of harvesting / overutilisation of medicinal and endangered floral species. Moreover, increased personnel inherently bring a higher risk of poaching activities, threatening the current faunal populations;
- Failure to update the biodiversity action plan and implement a rehabilitation and alien floral control plan:
  - Failure to update the biodiversity action plan and control measures may lead to an increased loss of biodiversity within the MRA and high rehabilitation cost at a later stage in the life cycle of the project;
  - Ineffective rehabilitation and monitoring of disturbed areas could lead to loss of species diversity;
  - Dust generated by ineffective rehabilitation of exposed areas may impact on the floral characteristics of the habitat surrounding the TSF; and
  - Ineffective removal of alien invader species, control of bush encroachers and rehabilitation of exposed areas could lead to re-establishment of invasive species, impacting on floral community rehabilitation efforts.

Please note that the above list is not exhaustive, and during the detailed impact assessment phase additional impacts may be identified.

5.2 Preliminary Management Measures

The implementation of mitigation measures is important to manage the overall risk to floral and faunal diversity, habitat and SCC. The list below highlights the key integrated mitigation measures that are applicable in order to suitably manage and mitigate the ecological impacts, both faunal and floral, that are associated with the proposed activities.

Mitigation Measures

- The various projects are located in areas known to harbour tree species that are protected under the National Forest Act (NFA) (1998), i.e. *Boscia albitrunca, Lydenburgia cassinoides* and *Sclerocarya birrea* subsp *caffra*. In terms of this act, protected tree species may not be cut, disturbed, damaged or destroyed and their products may not be possessed, collected, removed, transported, exported, donated, purchased or sold - except under licence granted by the Department of Forestry, Fisheries and the Environment (DFFE), or a delegated authority;
- The Limpopo Environmental Management Act (LEMA) (Act 7 of 2003) as well as the Screening Tool output lists several floral and faunal SCC. If individuals or communities of these species will be disturbed by construction/operational activities, they must be relocated to suitable, similar habitat in close proximity to where they were removed from, but outside the disturbance footprint after obtaining the relevant permits from the Limpopo Department of Economic Development, Environment and Tourism (LEDET) or the DFFE;
- The construction and operational footprints must be kept as small as possible in order to minimise impact on the surrounding environment;
- Where site clearing takes place, it should be in a phased manner to allow for faunal species present to move out of the footprint area;
- Prior to any vegetation clearing activities taking place, an extensive assessment for floral and faunal SCC is to be undertaken within the proposed footprint areas. Where such species are located, notably floral SCC, the appropriate permits are to be obtained from the relevant authorities before any further work can be conducted;
- No trapping or hunting of any faunal species is to take place;
- No collection/ harvesting of floral medicinal plants or SCC is to take place;
- Informal fires by construction personnel should be prohibited, and no uncontrolled fires whatsoever should be allowed;

- Appropriate sanitary facilities must be provided during the construction phase and all waste must be removed to an appropriate waste facility;
- All soils compacted as a result of construction activities should be ripped and reprofiled to natural levels and revegetated with indigenous vegetation. Special attention should be paid to alien and invasive plant control within these areas;
- No dumping of waste should take place. If any spills occur, they should be immediately cleaned up, and be disposed of at a registered waste facility;
- Upon completion of construction activities, it must be ensured that no bare areas remain, and that indigenous floral species are reintroduced; and
- Establishment of reintroduced vegetation must be monitored during the rehabilitation phase.

Vehicle access

- Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the proposed development activities; and
- In the event of a breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practiced near the surface area to prevent ingress of hydrocarbons into topsoil.

Soils

- Limit the footprint area of the construction activity to what is absolutely essential in order to minimise environmental damage;
- Edge effects of activities including erosion and alien and invasive plant control needs to be strictly managed in these areas;
- It must be ensured that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage. All vehicles must be regularly inspected for leaks. Re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into topsoil; and
- To prevent the erosion of top soils, management measures may include berms, soil traps, hessian curtains and storm water diversion away from areas susceptible to erosion. It must be ensured that topsoil stockpiles are located outside of any watercourses and areas susceptible to erosion. Stockpiles should be placed away from areas known to contain hazardous substances such as fuel and if any soils are contaminated, it should be stripped and disposed of at a registered hazardous waste disposal site.

Rehabilitation

- As much vegetation growth as possible should be promoted within the proposed development areas following construction activities in order to protect the soils. In this regard, special mention is made of the need to use indigenous vegetation species as the first choice during landscaping;
- All areas of disturbed and compacted soils need to be ripped and reprofiled; and
- All areas affected by mining activities should be rehabilitated upon closure of the mining and associated infrastructure areas. Areas should be reseeded with indigenous grasses as required. All rehabilitated areas should be rehabilitated to a point where natural processes will allow the pre-development ecological functioning and biodiversity of the area to be re-instated.

5 PLAN OF STUDY FOR EIA PHASE

Specific outcomes in terms of the EIA phase report are presented in the points below:

- To conduct a Species of Conservational Concern (SCC) assessment, including potential for species to occur within the selected project areas;
- To provide faunal and floral inventories of species as encountered on site;
- To determine and describe faunal and floral habitats, communities and ecological state within the areas of the proposed expansion;
- To describe the spatial significance of the expansion areas with regards to surrounding natural areas;
- To identify and consider all sensitive landscapes including rocky ridges, wetlands and/or any other special features; and
- To identify anticipated environmental impacts of the proposed mine expansion activities on the terrestrial ecology.

6 CONCLUSION

Scientific Aquatic Services (SAS) was appointed to conduct a terrestrial ecological alternatives analysis as part of the Environmental Impact Assessment (EIA) and authorisation process for five projects Dwarsrivier Chrome Mine (DCM), specifically:

- Project 1: the proposed development of a new Tailings Storage Facility (TSF);
- Project 2: diesel and emulsion batching;
- Project 3: main parking extension;
- Project 4: widening of access road between South Shaft / Main Offices and Plant; and
- Project 5: Access Crossing between Plant and North Mine.

TSF Option B is located in an area that has been historically disturbed through agriculture and as such, the vegetation present is not considered representative of the vegetation type. The floral and faunal diversity in the footprint area is significantly lower than that of the surrounding intact habitats, additionally, no floral or faunal SCC are expected to inhabit this area. TSF Options C and F are located to the south of the Groot Dwars River and are the furthest removed from the current DCM mining activities and edge effects. As such, the habitat herein is still largely intact and provides habitat to numerous faunal and floral species, both common and SCC. Additionally, construction of these options will require additional pipelines and road networks to be constructed, resulting in further habitat loss and degradation. Option D is located in an area of extensive mining activities with the current DCM TSF in close proximity, leading to minimal additional roads and pipelines being needed. The construction of the new TRP TSF to the east of Option D has impacted on habitat connectivity, significantly limiting faunal species movement. Taking the above into consideration Option B is deemed to be the preferred option, as this site is already disturbed and will not lead to the loss of habitat connectivity. This option does however pose a potential risk to the Groot Dwars River, which needs to be investigated in terms of mitigatory and management requirements.

Project 2 is located in an intact section of the Sekhukhune Bushveld habitat, and as such, will result in the loss of indigenous vegetation and potentially floral SCC, for which permits will be required. Faunal SCC, should they be present, will likely self-relocate.

Projects 3, 4 and 5 are located within the current mining footprint and as such, the habitat therein has been impacted upon through edge effects and AIP proliferation. Some floral SCC are still however expected and will require permits prior to construction. No faunal SCC are likely to inhabit these footprint areas, nor will the development result in the loss of habitat connectivity.

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APPENDIX A: INDEMNITY AND TERMS OF USE OF THIS REPORT

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

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This report must not be altered or added to without the prior written consent of the author. This also refers to electronic copies of this report which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements or conclusions drawn from or based on this report must make reference to this report. If these form part of the main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

APPENDIX B: LEGISLATIVE REQUIREMENTS

National Environmental Management Act, 1998

The National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA) and the associated Environmental Impact Assessment (EIA) Regulations (GN R326 as amended in 2017 and well as listing notices 1, 2 and 3 (GN R327, R325 and R324 of 2017), state that prior to any development taking place which triggers any activity as listed within the abovementioned regulations, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment process or the Environmental Impact Assessment process depending on the nature of the activity and scale of the impact.

National Environmental Management Biodiversity Act, 2004 (Act 10 of 2004) (NEMBA)

The objectives of this act are (within the framework of NEMA) to provide for:

- The management and conservation of biological diversity within the Republic of South Africa and the components of such diversity;
- The use of indigenous biological resources in a sustainable manner;
- The fair and equitable sharing among stakeholders of the benefits arising from bio prospecting involving indigenous biological resources;
- To give effect to ratify international agreements relating to biodiversity which are binding to the Republic;
- To provide for cooperative governance in biodiversity management and conservation; and
- To provide for a South African National Biodiversity Institute to assist in achieving the objectives of this Act.

This act alludes to the fact that management of biodiversity must take place to ensure that the biodiversity of the surrounding areas is not negatively impacted upon, by any activity being undertaken, in order to ensure the fair and equitable sharing among stakeholders of the benefits arising from indigenous biological resources.

Furthermore, a person may not carry out a restricted activity involving either:

a) A specimen of a listed threatened or protected species;
b) Specimens of an alien species; or
c) A specimen of a listed invasive species without a permit.

Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983) (CARA)

Removal of the alien and weed species encountered in the application area must take place in order to comply with existing legislation (amendments to the regulations under the CARA, 1983 and Section 28 of the NEMA, 1998). Removal of species should take place throughout the construction and operation, phases.

Minerals and Petroleum Resource Development Act, 2002 (Act 28 of 2002) (MPRDA)

The obtaining of a New Order Mining Right (NOMR) is governed by the MPRDA. The MPRDA requires the applicant to apply to the Department of Mineral Resources (DMR) for a NOMR which triggers a process of compliance with the various applicable sections of the MPRDA. The NOMR process requires environmental authorisation in terms of the MPRDA Regulations and specifically requires the preparation of a Scoping Report, an Environmental Impact Assessment (EIA) and Environmental Management Programme (EMP), and a Public Participation Process (PPP).

Limpopo Environmental Management Act, 2003 (Act 7 of 2003) (LEMA)

The objectives of this Act are:

- to manage and protect the environment in the Province;
- to secure ecologically sustainable development and responsible use of natural resources in the Province;
- generally, to contribute to the progressive realisation of the fundamental rights contained in section 24 of the Constitution of the Republic of South Africa Act, 1996 (Act No. 108 of 1996), and
- to give effect to international agreements affecting environmental management which are binding on the Province.

This Act must be interpreted and applied in accordance with the national environmental management principles set out in Section 2 of the National Environmental Management Act, 1998 (Act 107 of 1998).

APPENDIX C: VEGETATION TYPES

Sekhukhune Mountain Bushveld

Table C1: Dominant & typical floristic species of Sekhukhune Mountain Bushveld (Mucina & Rutherford, 2012).

Floral Community	Species
Tall Tree	*Senegalia nigrescens*
Small Trees	*Senegalia senegal* var. *leiorhachis* (d), *Combretum apiculatum* (d), *Kirkia wilmsii* (d), *Terminalia prunioides* (d), *Vitex obovata* subsp. *wilmsii* (d), *Ziziphus mucronata* (d), *Bolusanthus speciosus*, *Boscia albitrunca*, *Brachylaena ilicifolia*, *Combretum molle*, *Commiphora mollis*, *Croton gratissimus*, *Cussonia transvaalensis*, *Hippobromus pauciflorus*, *Ozoroa sphaerocarpa*, *Pappea capensis*, *Schotia latifolia*, *Sterculia rogersii*. Succulent Tree: *Aloe marlothii* subsp. *marlothii*.
Tall Shrubs	*Dichrostachys cinerea* (d), *Euclea crispa* subsp. *crispa* (d), *Combretum hereroense*, *Euclea linearis*, *Pavetta zeyheri*, *Tinnea rhodesiana*, *Triaspis glaucophylla*
Low Shrubs	*Elephantorrhiza praetermissa* (d), *Grewia vernicosa* (d), *Asparagus intricatus*, *Barleria saxatilis*, *B. senensis*, *Clerodendrum ternatum*, *Commiphora africana*, *Hermannia glanduligera*, *Indigofera lydenburgensis*, *Jatropha latifolia* var. *angustata*, *Melhania prostrata*, *Phyllanthus glaucophyllus*, *Psiadia punctulata*, *Rhus keetii*, *Rhynchosia komatiensis*. Succulent Shrubs: *Aloe castanea* (d), *A. cryptopoda* (d).
Woody Climbers	*Clematis brachiata* (d), *Rhoicissus tridentata* (d), *Acacia ataxacantha*
Woody Succulent Climber	*Sarcostemma viminale*
Graminoids	*Aristida canescens* (d), *Heteropogon contortus* (d), *Panicum maximum* (d), *Setaria lindenbergiana* (d), *Themeda triandra* (d), *Aristida transvaalensis*, *Cymbopogon pospischilii*, *Diheteropogon amplectens*, *Enneapogon scoparius*, *Loudetia simplex*, *Panicum deustum*, *Setaria sphacelata*.
Herbs	*Berkheya insignis* (d), *Commelina africana* (d), *Cyphostemma woodii*, *Kyphocarpa angustifolia*, *Senecio latifolius*. Geophytic Herbs: *Hypoxis rigidula*, *Sansevieria hyacinthoides*
Succulent Herb	*Huernia stapelioides*

***(d) – Dominant species for the vegetation type**
(The genus for all *Senegalia* spp. were formerly *Acacia*)

APPENDIX D: DETAILS, EXPERTISE AND CURRICULUM VITAE OF SPECIALISTS

1. (a) (i) Details of the specialist who prepared the report

Stephen van Staden MSc (Environmental Management) (University of Johannesburg)
Chris Hooton BTech Nature Conservation (Tshwane University of Technology)

1. (A). (ii) The expertise of that specialist to compile a specialist report including a curriculum vitae

Company of Specialist:	Scientific Aquatic Services		
Name / Contact person:	Stephen van Staden		
Postal address:	29 Arterial Road West, Oriel		
Postal code:	2007	Cell:	083 415 2356
Telephone:	011 616 7893	Fax:	086 724 3132 / 011 615 6240
E-mail:	stephen@sasenvgroup.co.za		
Qualifications	MSc (Environmental Management) (University of Johannesburg) BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg) BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)		
Registration / Associations	Registered Professional Natural Scientist at South African Council for Natural Scientific Professions (SACNASP) Accredited River Health Practitioner by the South African River Health Program (RHP) Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum		

1. (b) a declaration that the specialist is independent in a form as may be specified by the competent authority

I, Stephen van Staden, declare that -

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

Signature of the Specialist

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

Position in Company	Managing member, Ecologist, Aquatic Ecologist
Date of Birth	13 July 1979
Nationality	South African
Languages	English, Afrikaans
Joined SAS	2003 (year of establishment)
Other Business	Trustee of the Serenity Property Trust

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP)
Accredited River Health practitioner by the South African River Health Program (RHP)
Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum
Member of IAIA South Africa

EDUCATION

Qualifications

MSc (Environmental Management) (University of Johannesburg)	2003
BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg)	2001
BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)	2000
Tools for wetland Assessment short course Rhodes University	2016

COUNTRIES OF WORK EXPERIENCE

South Africa – All Provinces
Southern Africa – Lesotho, Botswana, Mozambique, Zimbabwe, Zambia
Eastern Africa – Tanzania, Mauritius
West Africa – Ghana, Liberia, Angola, Guinea Bissau, Nigeria, Sierra Leona
Central Africa – the Democratic Republic of the Congo

PROJECT EXPERIENCE (Over 2500 projects executed with varying degrees of involvement)

1 Mining: Coal, Chrome, PGM's, Mineral Sands, Gold, Phosphate, river sand, clay, fluorspar
2 Linear developments
3 Energy Transmission, telecommunication, pipelines, roads
4 Minerals beneficiation
5 Renewable energy (wind and solar)
6 Commercial development
7 Residential development
8 Agriculture
9 Industrial/chemical

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION
CURRICULUM VITAE OF CHRISTOPHER HOOTON

PERSONAL DETAILS

Position in Company	Ecologist
Date of Birth	24 June 1986
Nationality	South African
Languages	English, Afrikaans
Joined SAS Group of Companies	2013

EDUCATION

Qualifications

BTech Nature Conservation (Tshwane University of Technology)	2013
National Diploma Nature Conservation (Tshwane University of Technology)	2008

COUNTRIES OF WORK EXPERIENCE

South Africa
Zimbabwe
Sierra Leone
Zambia

SELECTED PROJECT EXAMPLES

Terrestrial Assessments

- Faunal assessment as part of the environmental assessment and authorisation process for the proposed Mzimvubu Water Project, Eastern Cape.
- Terrestrial assessment as part of the expansion activities of the SRL mine in Sierra Leon;
- Terrestrial assessment as part of the proposed Rietkol mine in Mpumalanga;
- Terrestrial assessment as part of the proposed expansion of Lonmin mine, North West province;
- Terrestrial assessment as part of the expansion of the Tshipi mine, Northern Cape;
- Faunal assessment as part of the environmental assessment and authorisation process for the proposed Setlagole Mall Development, North West.
- Faunal assessment as part of the environmental assessment and authorisation process for the proposed Expansion and Upgrade of the Springlake Railway Siding, Hattingspruit, Kwa-Zulu Natal.
- Faunal assessment as part of the environmental assessment and authorisation process for the proposed Styldrift tailings storage facility, return water dams, topsoil stockpile and other associated infrastructure, North West.
- Faunal assessment as part of the environmental assessment and authorisation process for the development of a proposed abalone farm, Brand se Baai, Western Cape.
- Faunal assessment as part of the environmental assessment and authorisation process for the development of a proposed abalone farm, Doringbaai, Western Cape.
- Vegetation composition and subsequent loss of carrying capacity for the Rand Water B19 and VG Residue Pipeline Project, Free State.
- Faunal assessment as part of the environmental assessment and authorisation process for the Evander Shaft 6 Plant Upgrade, New Tailings Dam Area and Associated Tailings Delivery and Return Water Pipeline, Evander, Mpumalanga.

Previous Work Experience

- Spotted Hyaena Research Project, Phinda Private Game Reserve, KwaZulu Natal.
- Camera Trap Survey as part of the Munyawana Leopard Project, Mkuze Game Reserve, KwaZulu Natal.
- Lowveld Wild Dog Project, Savé Valley Conservancy, Zimbabwe.
- Lion collaring and Tracking as part lion management program, Savé Valley Conservancy, Zimbabwe.
- Junior Nature Conservator, Gauteng Department of Rural Development and Land Reform.

Annexure 5: Hydrological Study

Surface Water Scoping & Site Selection Study for the Proposed Khulu Tailings Storage Facility & Capital Projects at the Dwarsrivier Chrome Mine

Project Number:

ENG010

Prepared for:

EnviroGistics (Pty) Ltd

P.O. Box 22014, Helderkruin, 1733

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Hydrospatial (Pty) Ltd

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June 2021

DOCUMENT CONTROL

Project Name	Surface Water Scoping & Site Selection Study for the Proposed Khulu Tailings Storage Facility & Capital Projects at the Dwarsrivier Chrome Mine
Report Type	Surface Water Study
Client	EnviroGistics (Pty) Ltd
Project Number	ENG010
Report Number	01
Report Status	Draft
Submission Date	23 June 2021
Author	Andy Pirie (*Pr.Sci.Nat.*)
Author Signature	

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1 INTRODUCTION AND BACKGROUND

Hydrospatial (Pty) Ltd was appointed by EnviroGistics (Pty) Ltd to undertake a surface water study for the following proposed projects at the Dwarsrivier Chrome Mine (hereafter referred to as DCM or the Mine):

- Project 1: Site selection for the proposed Khulu Tailings Storage Facility (TSF);
- Project 2: Establishment of a Diesel and Emulsion Batching area;
- Project 3: Main Parking Extension;
- Project 4: Widening of an Access Road between South Shaft/Main Offices and Plant; and
- Project 5: Subway Crossing between the Plant and North Mine

This report constitutes the surface water scoping report for the above-mentioned projects as well as the site selection of the proposed Khulu TSF.

1.1 Project Location

The Mine is situated in the Limpopo Province of South Africa, 23 kilometres (km) south-west of the town of Steelpoort. Figure 1-1 indicates the location of the DCM mining right area and potential TSF sites.

1.2 Project Description

The following provides a description of the proposed projects which are indicated on Figure 1-2.

1.2.1 Project 1: Khulu TSF

DCM is currently depositing at the existing North Tailings Storage Facility (NTSF) at the eastern side of their process plant on the remaining portion of the Farm Dwarsrivier 372. It is anticipated that the existing active NTSF will reach its full capacity relatively sooner than anticipated due to tonnage ramp ups and additional tonnages from other sites.

The Mine identified seven (7) potential TSF sites initially, which have been reduced to four (4) (Site B, C, D and F). During the 2019 Site Selection Process, Site D was the preferred site for the Mine. Based on the initial view by the Environmental Assessment Practitioner, Site B was fatally flawed due to the potential future Eskom substation, for which an EIA has been approved and negotiations in terms of land use between the Mine and Eskom have commenced. However, subsequent to the 2019 Site Selection Process, further geotechnical studies were undertaken, which identified potential concerns for Site D, which also included the proximity of the non-perennial tributary of the Dwarsrivier River. In addition to this, the Eskom substation is no longer planned, which has reintroduced Option B into the overall assessment.

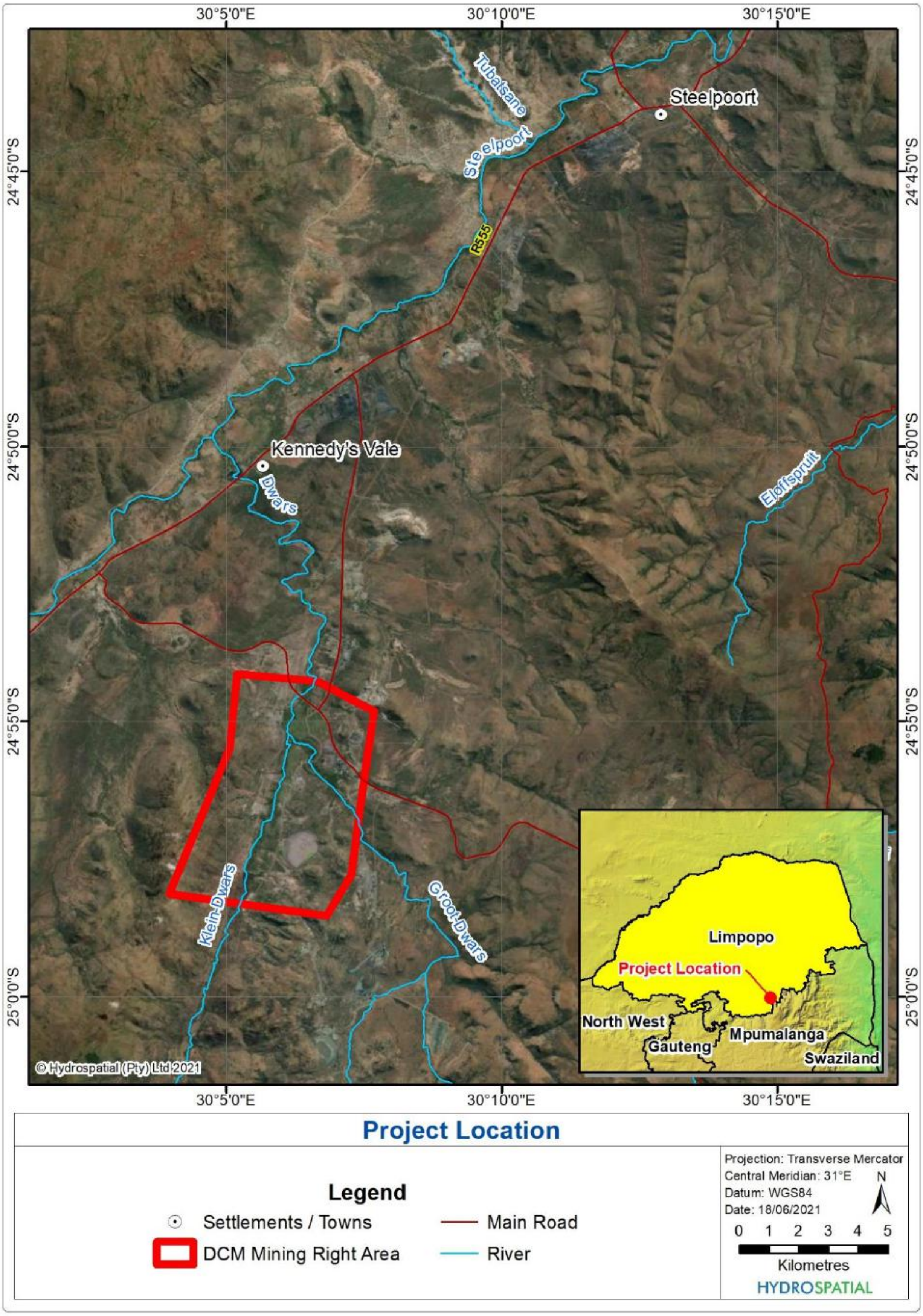

Figure 1-1: Location of the Dwarsrivier Chrome Mine

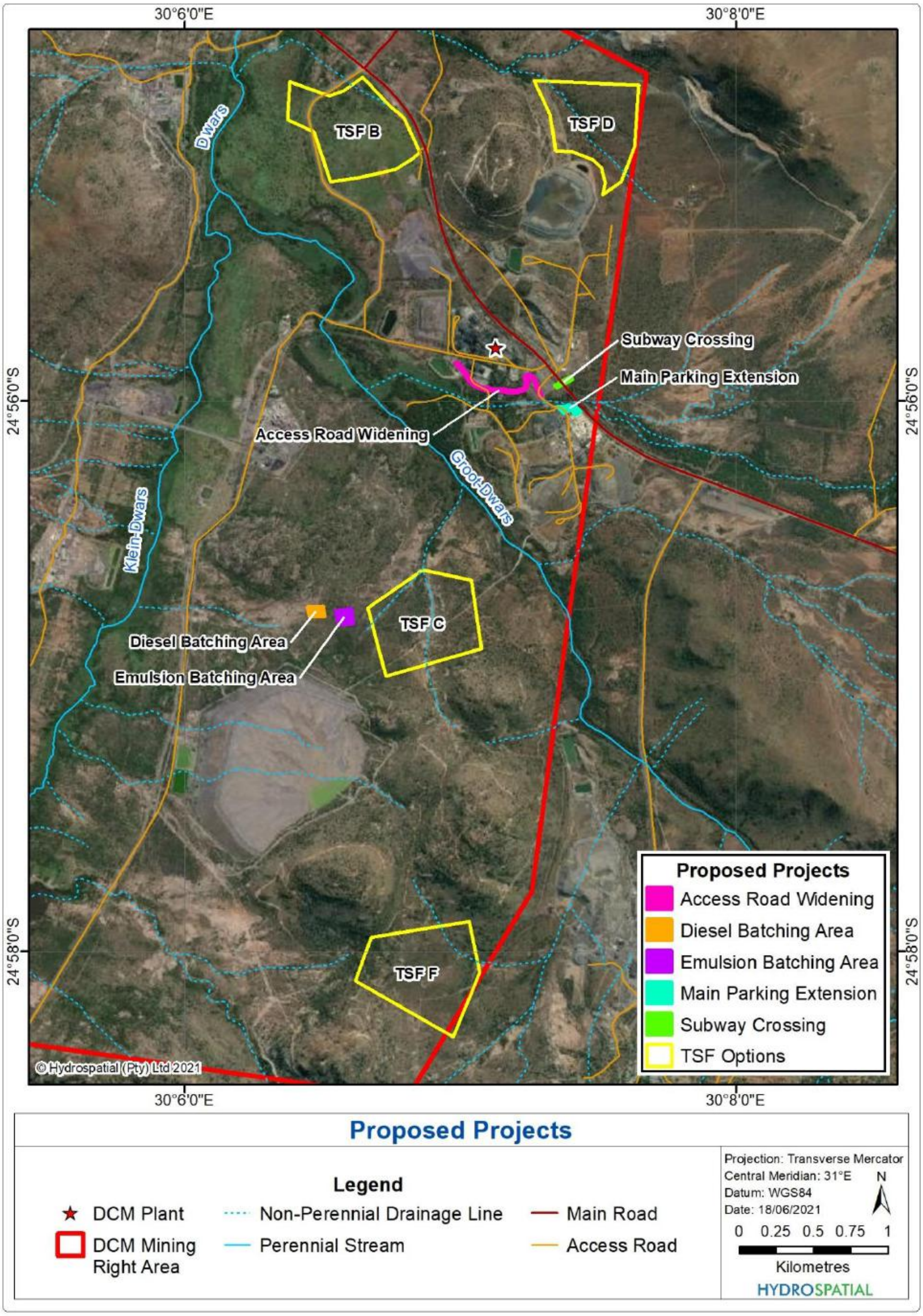

Figure 1-2: Proposed projects

The proposed TSF footprint areas and heights are summarised in Table 1-1.

Table 1-1: Footprint areas and heights of the TSF sites

TSF Option	Footprint Area	Height
Site B	20 ha	37 m
Site C	28 ha	29 m
Site D	21 ha	49 m
Site F	17 ha	50 m

The project will not involve typical tailings deposition techniques, but will involve the piping of tailings to a filter press facility from where the filter cake will be trucked to the new TSF. A life of Mine of about 20 years are currently considered as part of the design.

1.2.2 Project 2: Diesel and Emulsion Batching Areas

The Mine plans to erect two (2) respective diesel and emulsion batching areas, to supply diesel and emulsion to the underground mining operations. The location of this area is to the north-east of the old Two Rivers Platinum Mine (TRP), just north of the new TRP TSP Pipeline. The project will include:

- Construction of an approximate 80 m access road to the diesel batching area;
- Parking Area, with security office at both areas (no dangerous good storage planned at any time);
- At the Diesel Batching area the following tanks will be present: 23 m^3 Diesel + 23 m^3 Engine Oil + 23 m^3 Hydraulic Oil;
- At the Emulsion Batching areas a 60m^3 emulsion tank will be placed; and
- Feed into pipeline for underground used at both areas.

Clearance of indigenous vegetation will be required in the order of approximately 1.3 ha.

1.2.3 Project 3: Main Parking Extension

The Mine requires the expansion of the existing parking area at the Main Offices. The current parking area is about 0.8 ha with the parking bays not sufficient to cater for the number of vehicles. The current parking bay comprises of a tarred surface area and steel roof parking bays. The same principle will be applied at the expanded area. No new entrances will be required. The planned parking bay expansion will be located about 20 m from the Springkaanspruit.

Clearance of indigenous vegetation will be required in the order of approximately 4 900 m^2.

1.2.4 Project 4: Widening of Access Road between South Shaft/Main Offices and Plant

An existing road provides access between the Main Office Buildings and the Plant. To accommodate for larger vehicles such as Trucks. The current width of the road ranges between 5-6 m. The Mine is planning on increasing a section of 700m of this road to a width of 16 m (two-way traffic).

Clearance of indigenous vegetation will be required in the order of approximately 3 311 m^2.

1.2.5 Project 5: Subway Crossing between Plant and North Mine

To ensure more optimal logistical management of traffic between the South Mine and the North Mine, and to reduce the number of vehicles on the regional road, the Mine is planning on construction a road under regional road bridge to allow for access between the two areas.

Clearance of indigenous vegetation will be required in the order of approximately 1 700 m^2.

1.3 Legal Requirements and Guidelines

The following legal requirements and guidelines are applicable to the study:

- National Water Act, 1998 (Act No. 36 of 1998) (NWA);
- Government Notice No. 704 (GN704) of the NWA – Regulations on the Use of Water for Mining and Related Activities Aimed at the Protection of Water Resources;
- National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and associated Environmental Impact Assessment (EIA) 2014 Regulations;
- Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA); and
- Department of Water and Sanitations (DWS) Best Practice Guideline documents.

2 SCOPE OF WORK

The scope of work included the following:

- Provide a baseline (pre-development) description of the surface water environment;
- Undertake a site selection assessment for the proposed Khulu TSF;
- Provide the preliminary anticipated surface water impacts; and
- Provide the terms of reference for the surface water study for the Environmental Impact Assessment (EIA) phase.

3 BASELINE HYDROLOGY

3.1 Hydrological Setting

3.1.1 Climate

3.1.1.1 Rainfall

Majority of the DCM Mining Right Area (MRA) is located in quaternary catchment B41G, and therefore, the monthly rainfall for B41G was adopted to represent the rainfall for the study area, and was obtained from the Water Resources of South Africa Study 2012 (WR2012) (Table 3-1). The Mean Annual Precipitation (MAP) for the study area is 650 mm, with the wettest months occurring from November to January, and the driest months from June to August.

3.1.1.2 Evaporation

Monthly Symon's Pan (S-Pan) evaporation was obtained from the WR2012 database for quaternary catchment B41G. In order to obtain natural open water body evaporation, S-Pan evaporation is multiplied by an evaporation factor. This is due to water temperatures in the S-Pan being higher than that of natural open water, resulting in higher evaporation rates. Table 3-2 provides the monthly evaporation for the Project area. Evaporation is highest over the months of October to March, and lowest over May to August.

Table 3-1: Monthly rainfall for quaternary catchment B41G

Month	Monthly Rainfall (mm)
January	111.5
February	88.3
March	75.5
April	41.8
May	14.8
June	6.2
July	5.2
August	5.8
September	20.6
October	60.0
November	111.7
December	108.7
TOTAL	**650**

Table 3-2: Monthly evaporation for quaternary catchment B41G

Month	Symons Pan Evaporation (mm)	Evaporation Factor	Open Water Evaporation (mm)
January	165.0	0.84	138.6
February	137.6	0.88	121.0
March	135.8	0.88	119.5
April	104.4	0.88	91.9
May	87.9	0.87	76.5
June	71.4	0.85	60.7
July	78.2	0.83	64.9
August	103.5	0.81	83.8
September	134.1	0.81	108.6
October	161.7	0.81	131.0
November	152.6	0.82	125.1
December	168.0	0.83	139.4
TOTAL	**1500**	**N/A**	**1261**

3.1.1.3 Temperature and Wind

Average monthly wind and temperature was obtained from the Loclim programme (FAO, 2005). The method selected to obtain the wind and the temperature data, is based on the nearest neighbour method for the ten closest stations to the Project (

Table 3-3). Temperatures are highest over October to March, with wind generally being highest between September to November.

Table 3-3: Temperature and wind speed for the Projects

Month	Average Temperature (ºC)	Minimum Temperature (ºC)	Maximum Temperature (ºC)	Average Wind Speed (km/hour)
January	20	14.3	26.1	6.48
February	19.7	14.3	23.8	6.48
March	18.7	13.3	24.3	6.12
April	16.7	10	24.3	5.4
May	13.5	5.5	22.2	6.12
June	11	2.2	20	7.2
July	10.8	2.7	20	7.2
August	13.1	4.4	22.2	7.92
September	15.6	7.8	24.3	9.72
October	18	10.6	25.5	9.72
November	18.7	12.8	25.5	9.72
December	19.7	13.8	26.1	7.92

3.1.2 Regional Catchments and Drainage

TSF C and F are located in quaternary catchment B41G, TSF D in quaternary catchment B41H, and TSF B is mostly located in B41G barring a small section of the northern part which is located in B41H (Figure 3-1). The abovementioned quaternary catchments are situated within the Olifants Water Management Area (WMA). A number of non-perennial drainage lines drain the mountain ridges and hills within of the MRA. These non-perennial drainage lines are ephemeral in nature (only flowing for short periods of time in response to high rainfall) and drain into the Klein and Groot Dwars Rivers. The Klein Dwars River flows through the centre of the MRA in a north-easterly direction, whilst the Groot Dwars River flows in a north-westerly direction. These two rivers form a confluence near the north of the MRA, forming the Dwars River, which flows into the Steelpoort River 8.5 km north-west of the MRA. The Steelpoort River flows into the Olifants River, 40 km north-east of the town of Steelpoort. The Olifants River is a tributary of the Limpopo River, which flows into the Indian Ocean near the town of Xai-Xai in Mozambique.

3.1.3 Topography and Site-Specific Drainage

The regional topography can be described as undulating with numerous mountain ridges and valleys (Figure 3-2). A mountain ridge runs along the western boundary of the Mining Right Area (MRA), where a maximum elevation of approximately 1 630 metres above mean sea level (mamsl) is reached. From this ridge, the elevation drops off to approximately 900 mamsl near the confluence of the Klein and Groot Dwars Rivers. A number of hills are located along the eastern portion of the MRA.

The proposed access road widening, subway crossing and main parking extension, are located within a 100 m horizontal distance of the non-perennial Springkaanspruit, which is a tributary of the Klein Dwars River (Figure 3-1). The proposed emulsion batching area is located within 100 m of a non-perennial drainage line, which drains in a north-easterly direction towards the Groot Dwars River. The diesel batching area drains in a westerly direction towards the Klein Dwars River.

TSF B is located on fairly flat topography, dipping gradually in a north-westerly direction towards the Dwars River. According to the 1:50 000 topographical map 2430CC Kennedy's Vale, a non-perennial drainage line occurs along the northern boundary of the TSF site (Figure 1-2). During the site visit, this area was noted to be disturbed by what appeared to be old stockpiles and borrow pits.

TSF site C is proposed to be constructed against two hills. The maximum height of the proposed TSF against the hills is 995 mamsl, whilst the lowest elevation is 950 mamsl. The proposed TSF is drained in a north-easterly direction by two non-perennial drainage lines into the Groot Dwars River.

TSF site D is located in a valley between two hills and immediately north-east of the Mines existing active TSF. The proposed TSF reaches a maximum height of 1 810 mamsl along its western side against a hill, whilst its lowest elevation is 934 mamsl. The proposed TSF is drained in a north-westerly direction by a non-perennial drainage line towards the Dwars River. A number of small drainage lines which drain the hill immediately to the east of the proposed TSF are evident. Open pit mining is taking place along this hill as well as to the north-east of the proposed TSF.

TSF site F is proposed to be constructed against three hills. The proposed TSF will reach a maximum height of 1 064 mamsl along its north-western side, dropping off to 998 mamsl at its lowest point. The proposed TSF is drained firstly in an easterly and then in a north-easterly direction, by a non-perennial drainage line towards the Groot Dwars River. This drainage line appears to be diverted around mining activities, as well as what appears to be an active TSF, located 800 m downstream of the proposed TSF.

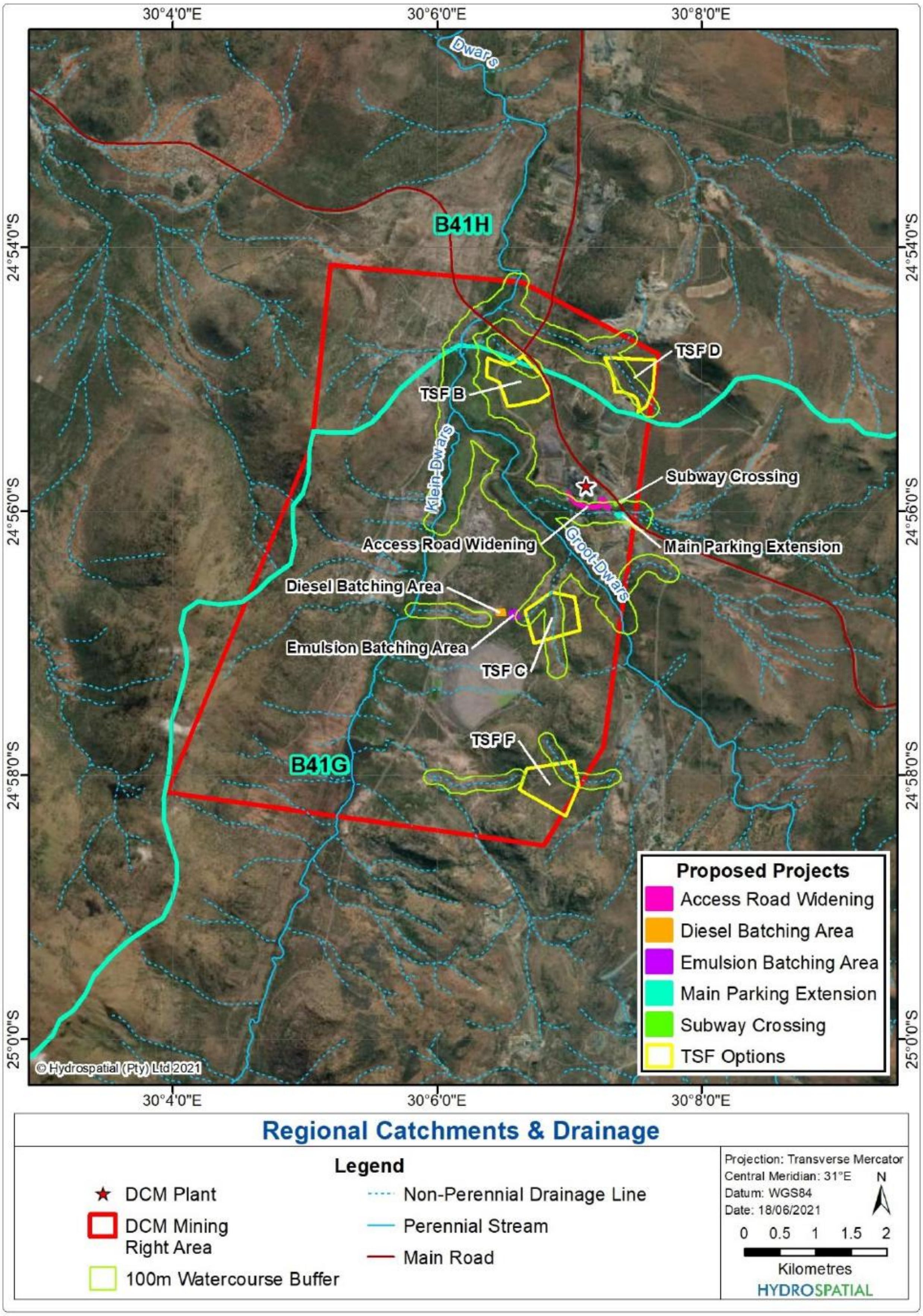

Figure 3-1: Regional catchments and drainage

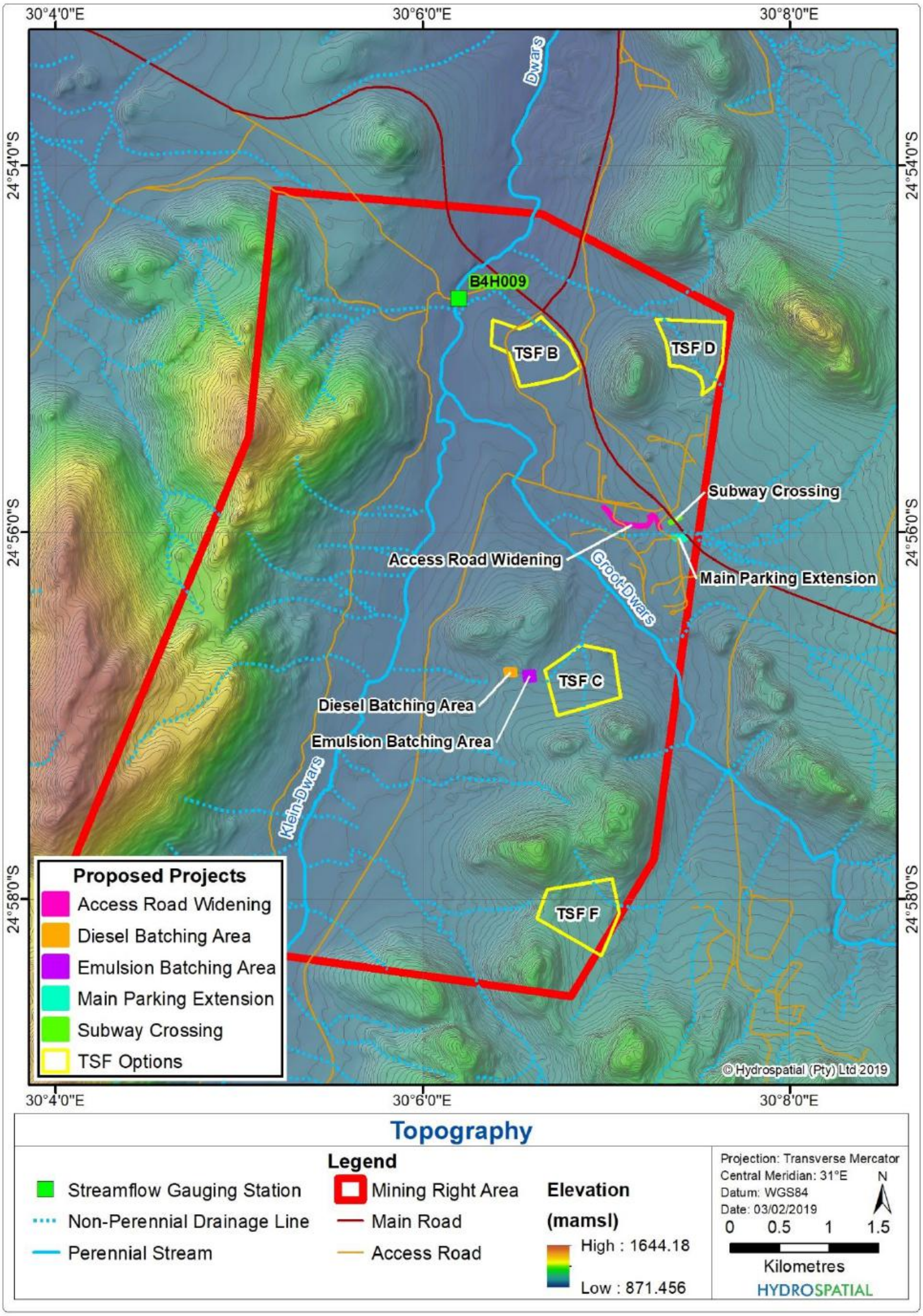

Figure 3-2: Topography

3.1.4 Vegetation and Land Cover

The proposed projects fall within the Sekhukhune Mountain Bushveld vegetation type, with vegetation characterised as open and closed broad leafed savannah on hills and mountain slopes (Mucina & Rutherford, 2006).

The proposed diesel and emulsion batching areas are located within open bushveld and shrubland/grassland areas. The proposed access road widening, subway and parking extension, are located within open woodland areas that are surrounded by mining activities.

TSF B is currently located within an open bush and shrubland/grassland areas (Figure 3-3), but was previously used for crop cultivation.

TSF C is primarily located within an open woodland area, with shrubland and grassland located at the lower elevations. Bare areas occur along the drainage lines. The Two Rivers Platinum Mine TSF is located immediately to the south-west.

TSF D is mostly located within an open woodland area, with the Mines current active TSF located immediately to the south-west. Shrubland and bare areas are located around the drainage line towards the centre of the proposed TSF.

TSF F is mainly located within a grassland area, with sections of shrubland, open woodland and bare areas present.

3.1.5 Soils

The SOTER database indicates that the majority of the MRA comprises of strongly weathered acid soils with low base saturation, classified as Luvisols with the remaining portions classified as Lithic Leptosols. The soils within the MRA are generally shallow.

3.1.6 Surface Water Use

Surface water use within the region is mostly used for mining and agricultural purposes.

3.2 Surface Water Runoff

The non-perennial drainage lines within the MRA are ephemeral, and runoff is only likely to be generated after rainfall events. The Groot Dwars and Klein Dwars are perennial rivers and will flow throughout year, barring dry years, when they may potentially stop flowing.

Monthly flows for river gauging station B4H009 was downloaded from the DWS hydrological services website for the period October 1966 to January 2019. B4H009 is located on the Dwars River below the confluence of the Klein and Groot Dwars Rivers, near the northern boundary of the MRA (Figure 3-2). The mean monthly flows are indicated in Figure 3-4. The highest flows occur over the months of December to March, whilst the low flows occur over the months of June to October.

According to the WR2012 study, quaternary catchment B41G has a Mean Annual Runoff (MAR) of 25.46 million cubic metres (mcm), whilst quaternary catchment B41H has a MAR of 6.7 mcm.

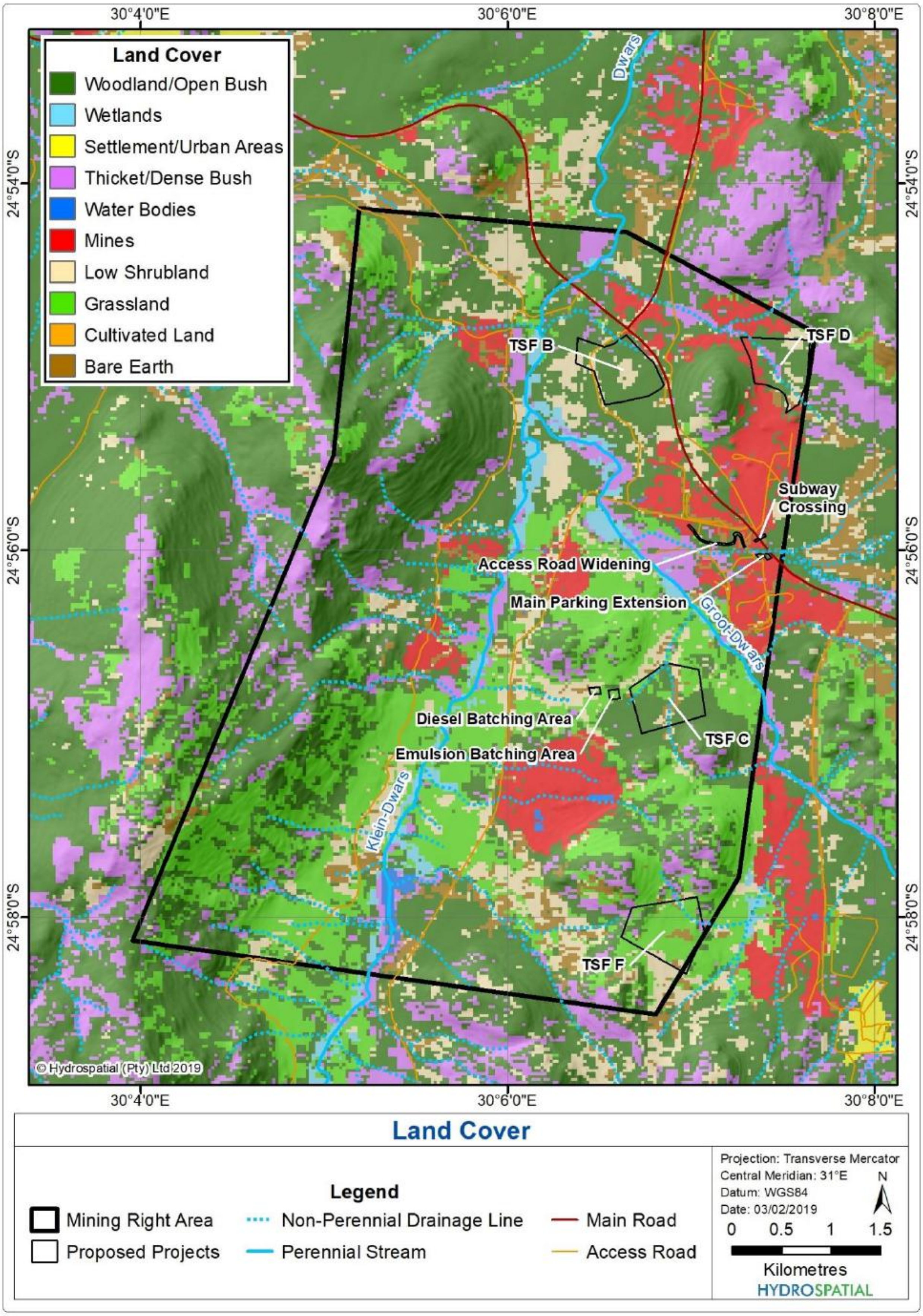

Figure 3-3: Land cover

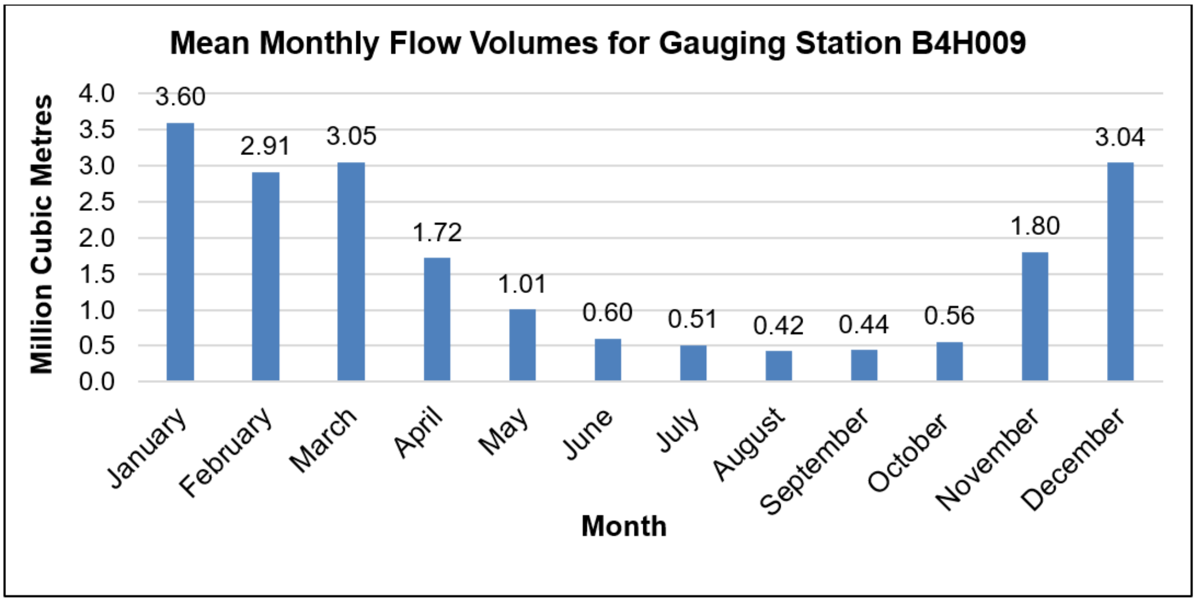

Figure 3-4: Mean monthly flows for river gauging station B4H009

3.3 Surface Water Quality

Surface water quality data was obtained from the Mines monitoring programme. Major water quality parameters such as Total Dissolved Solids (TDS), pH and Nitrate (which have been shown to be elevated at DCM), were assessed at the Mines downstream monitoring points. This was done to obtain an understanding of the water quality status of the receiving streams. The abovementioned parameters were compared to the Mines Water Use Licence (WUL) limits.

The Mines surface water quality monitoring locations in relation to the proposed projects are indicated on Figure 3-5. Monitoring point S3 is located downstream of TSF C, S1 is located downstream of TSF F, and S4 is located on the Dwars River, slightly upstream of the confluence of the non-perennial drainage line draining TSF D (but should provide a good indication of the expected downstream water quality).

The surface water quality is summarised as follows:

- TDS concentrations indicated that there was not much difference between the monitoring points, however, concentrations at S3 and S4 located downstream of the Mine, were generally higher than S1 located upstream (Figure 3-6). The increase in concentrations at S3 and S4 may potentially be as a result of mining activities;
- pH levels were within limits, and there was not much difference in the levels between the monitoring points (Figure 3-7); and
- Nitrate concentrations were high at all of the monitoring points (Figure 3-8). The high nitrate levels may potentially be as a result of explosives used in mining.

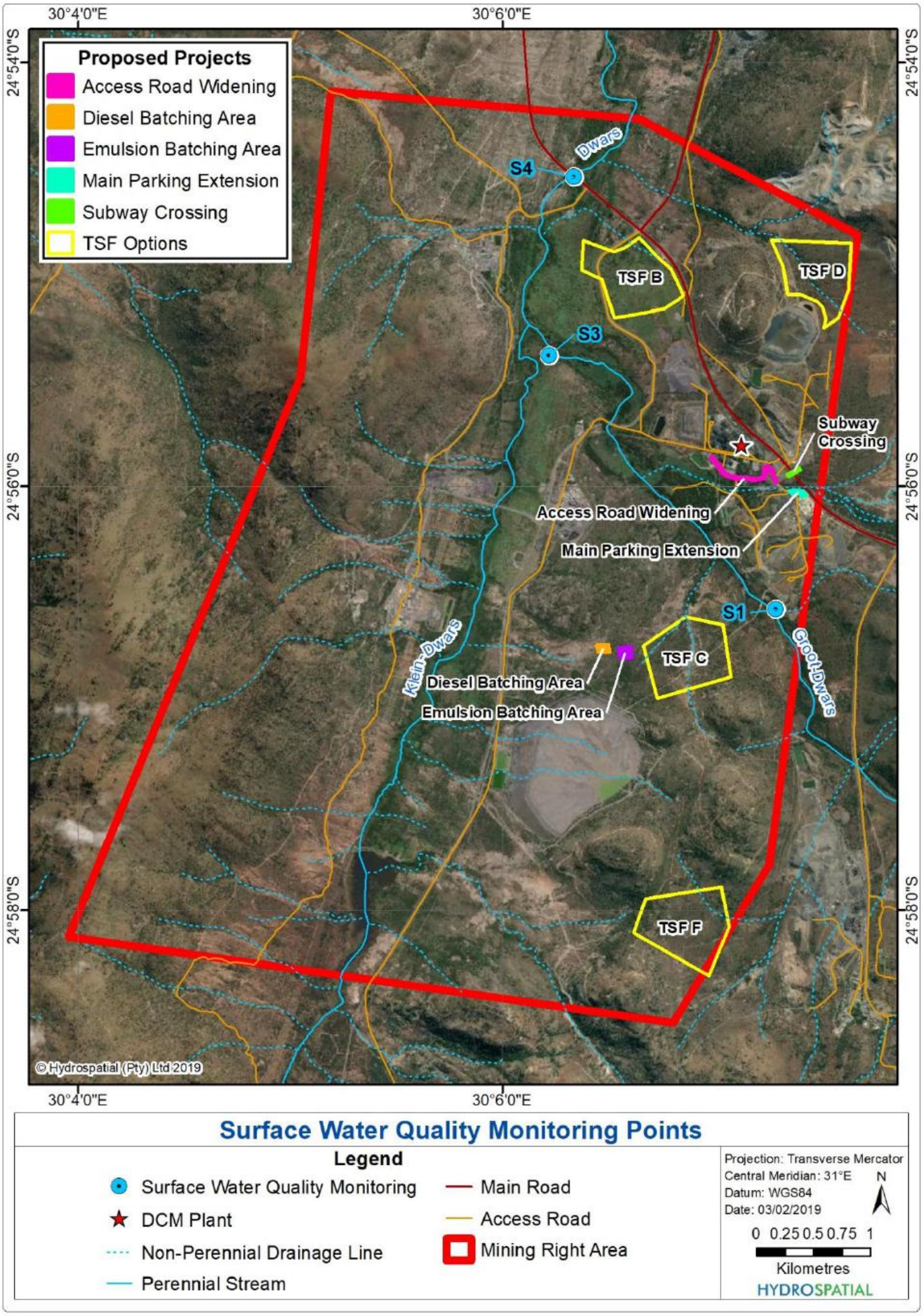

Figure 3-5: Surface water quality monitoring points

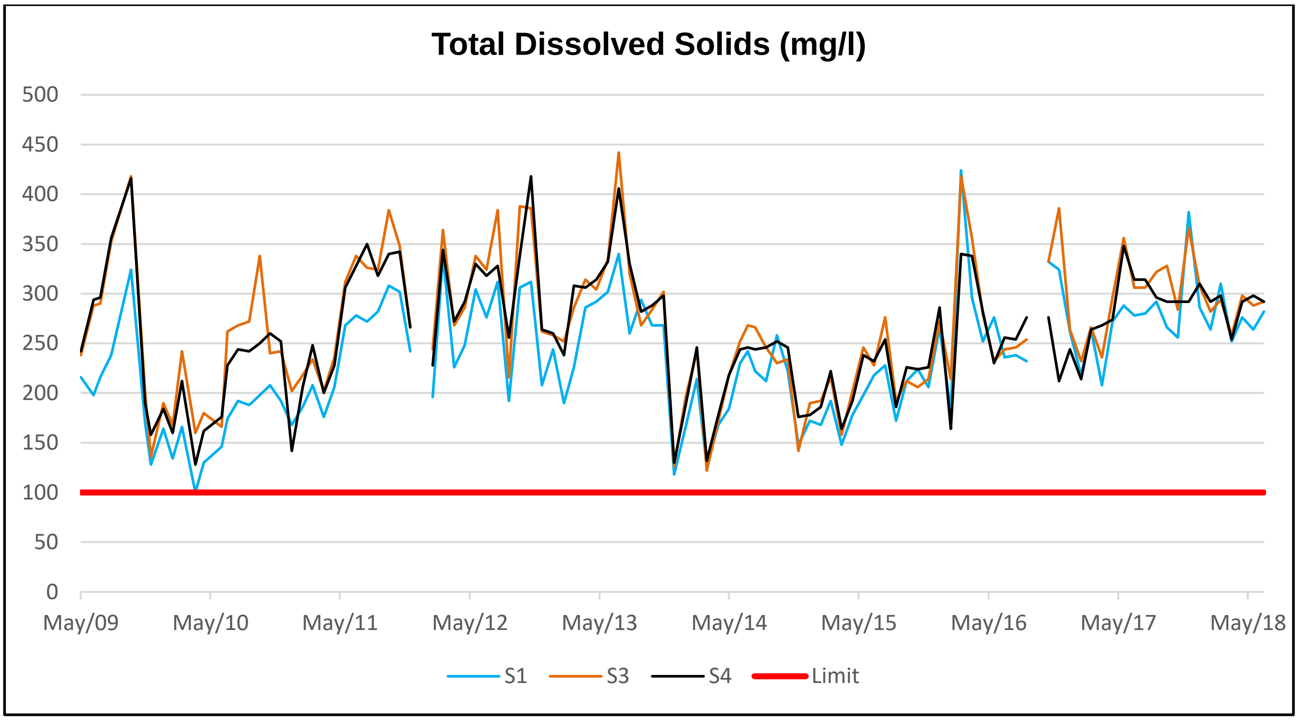

Figure 3-6: Long term trends in TDS concentrations

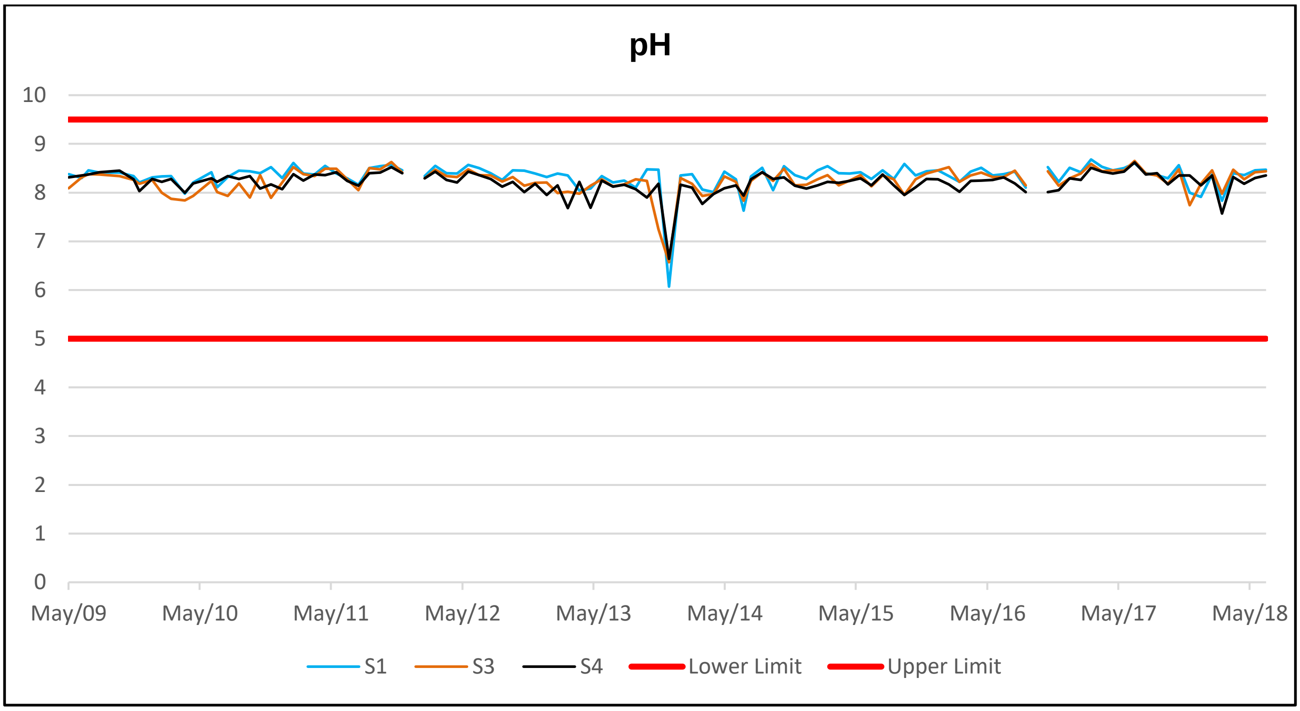

Figure 3-7: Long term trends in pH levels

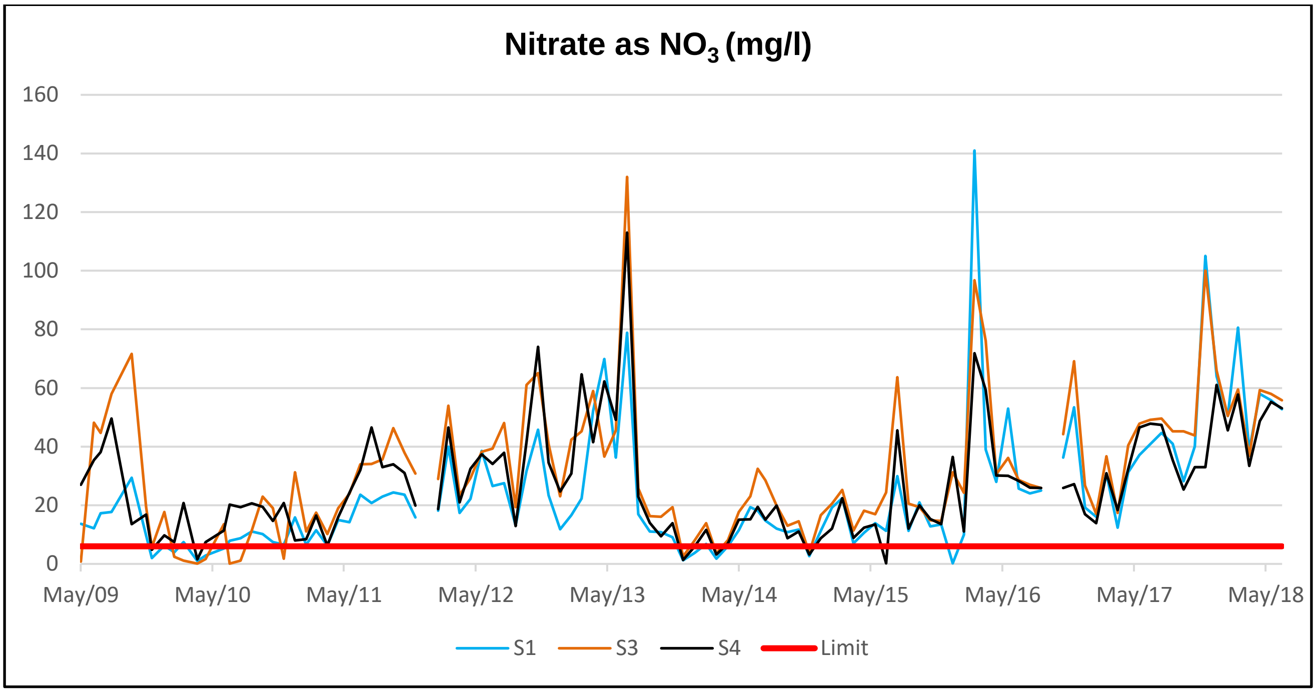

Figure 3-8: Long term trends in nitrate concentrations

4 TSF SITE SELECTION

A site selection is undertaken in this section to assess the 4 potential TSF sites (sites B, C, D and F), to determine the site that is least likely to have a disturbance on the surface water environment, from a water quantity and quality perspective.

4.1 TSF Site Description

TSF site B is located 1.5 km north-west of the plant. The site is drained in a north-westerly direction towards the Dwars River. According to the 1:50 000 topographical map 2430CC Kennedy's Vale, a non-perennial drainage line occurs along the northern boundary of the TSF site (Figure 1-2), however, during the site visit, this area was noted to be disturbed by what appeared to be old stockpiles and borrow pits. Crops were previously planted in the footprint area of TSF B.

TSF site C is located 1.7 km south-west of the DCM plant. The Two Rivers Platinum Mine TSF is located 300 m south-west of the site. The site is drained in a north-easterly direction by two non-perennial drainage lines towards the Groot Dwars River.

TSF site D is located 1.3 km north-east of the DCM plant. The site is drained in a north-westerly direction by a non-perennial drainage line towards the Dwars River. A number of small drainage lines drain the koppie located immediately east of TSF D towards the site. Open pit mining is taking place above these drainage lines along the koppie, as well as to the north of the site. The active DCM NTSF is located immediately south of the site.

TSF site F is located 4 km south-west of the DCM plant. The site is drained in an easterly and north-easterly direction, by a non-perennial drainage line towards the Groot Dwars River. This drainage line appears to be diverted around mining activities, as well as what appears to be an active TSF, located 800 m downstream of the site.

4.2 Methodology

4.2.1 Criteria Assessed

The following criteria was assessed for the site selection.

4.2.1.1 TSF Proximity to Drainage Lines

The rivers and drainage lines indicated on the 1:50 000 topographical map 2430CC Kennedy's Vale, in the vicinity of the TSF sites, were buffered by 100 m. This was done to assess the proximity of the TSF options to drainage lines. It is a GN704 Regulation requirement, that tailings dams and associated infrastructure, are placed beyond a 100 m horizontal distance from a watercourse, unless exemption is obtained from the DWS.

4.2.1.2 Catchment Diversion Area

The topography was assessed to determine the extent of the catchment areas that would need to be diverted around the TSF options. The larger the diversion area, the higher the negative impact expected on the streams and drainage lines.

4.2.1.3 Surface Water Quantity

The selected TSF will be operated as a closed system (as required by GN704) i.e. no discharge of dirty water from the TSF into the environment. Therefore, the larger the TSF area, the more rainwater captured by the TSF, resulting in less runoff and quantity reporting to the downslope streams.

4.2.1.4 Surface Water Quality

The position of the TSF sites, in relation to surrounding mining activities and downslope water quality, was assessed, to determine the option that would result in the least disturbance to surface water quality, from potential seepage and spillages.

4.2.2 Site Selection Ranking

A scoring system was used to rank each of the TSF options from 1 to 3, with 1 being the option with the least negative impact on surface water, and 3 being the option with the highest negative impact. The option with the lowest final score would be the most favourable option from a surface water perspective.

4.3 Results

4.3.1 TSF Proximity to Drainage Lines

The 100 m watercourse buffers for TSF B, C, D and F are indicated on Figure 4-1 to Figure 4-4. Although the 1:50 000 topographical map indicates a drainage line towards the north of TSF B, the topography of this area is disturbed and no drainage line was observed. Table 4-1 indicates the number of drainage lines within 100 m of each of the TSF options, as well as the distance. The ranking is based on the distance of the TSFs to drainage lines.

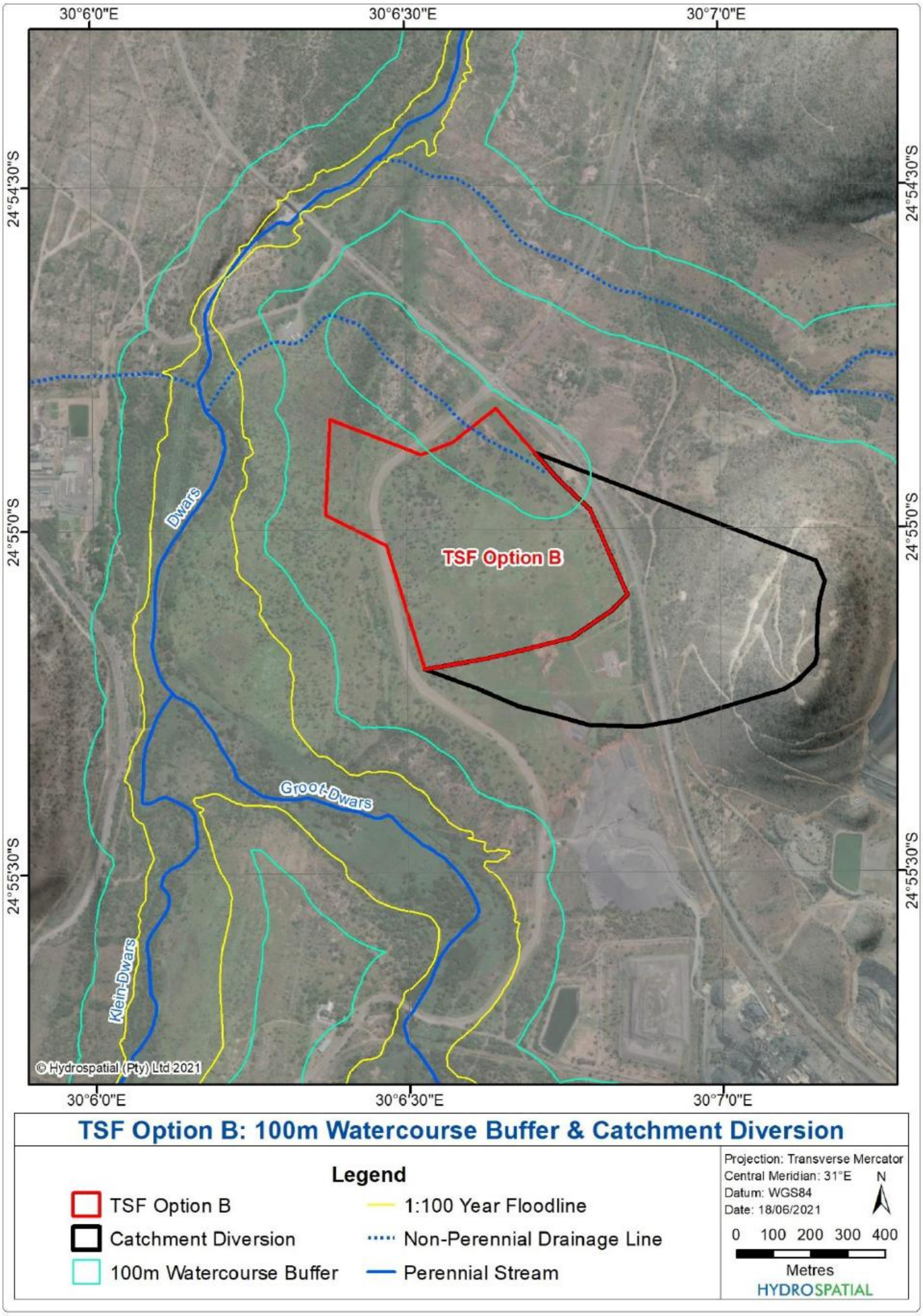

Figure 4-1: TSF Option B 100 m watercourse buffer and catchment diversion

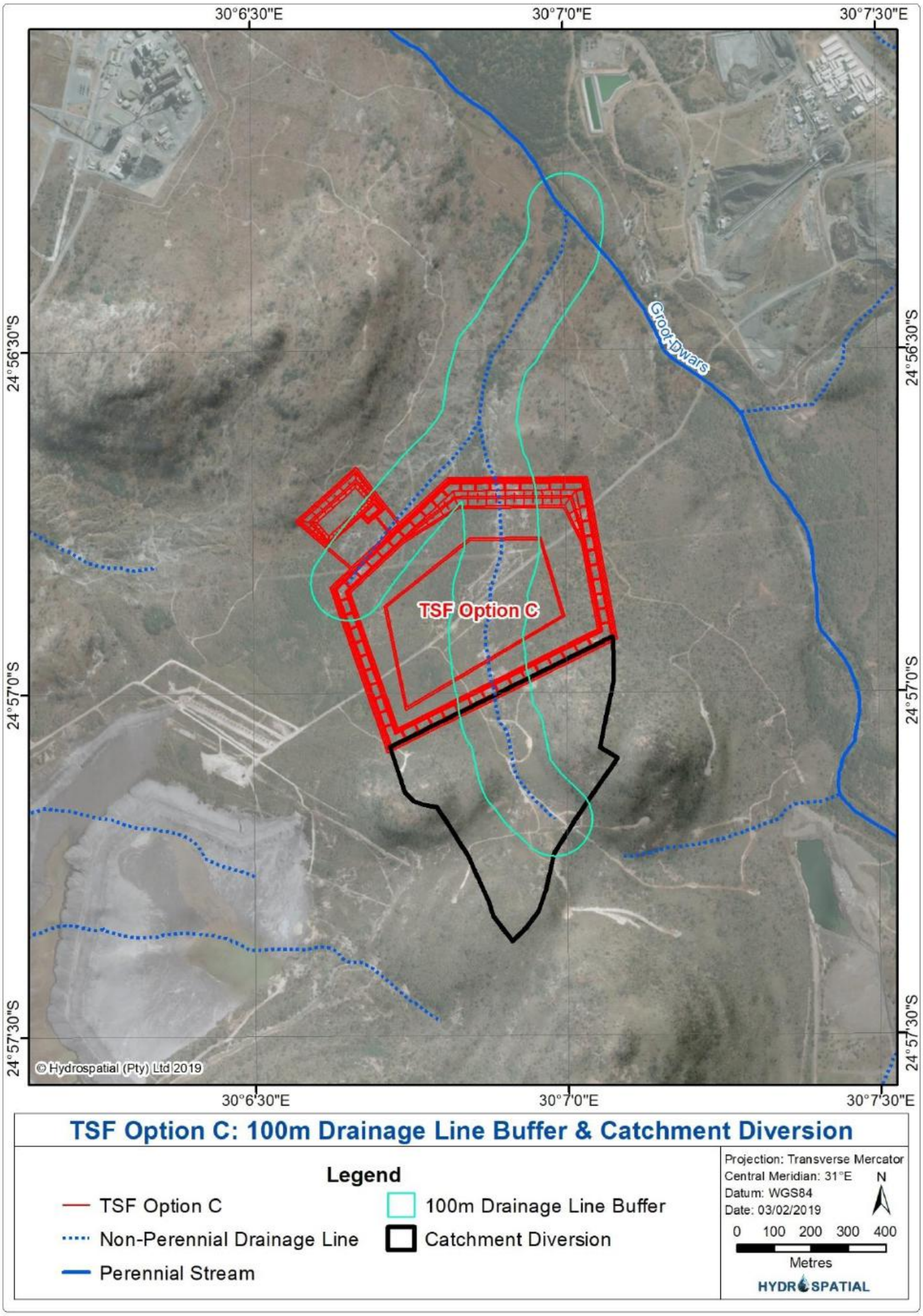

Figure 4-2: TSF Option C 100 m watercourse buffer and catchment diversion

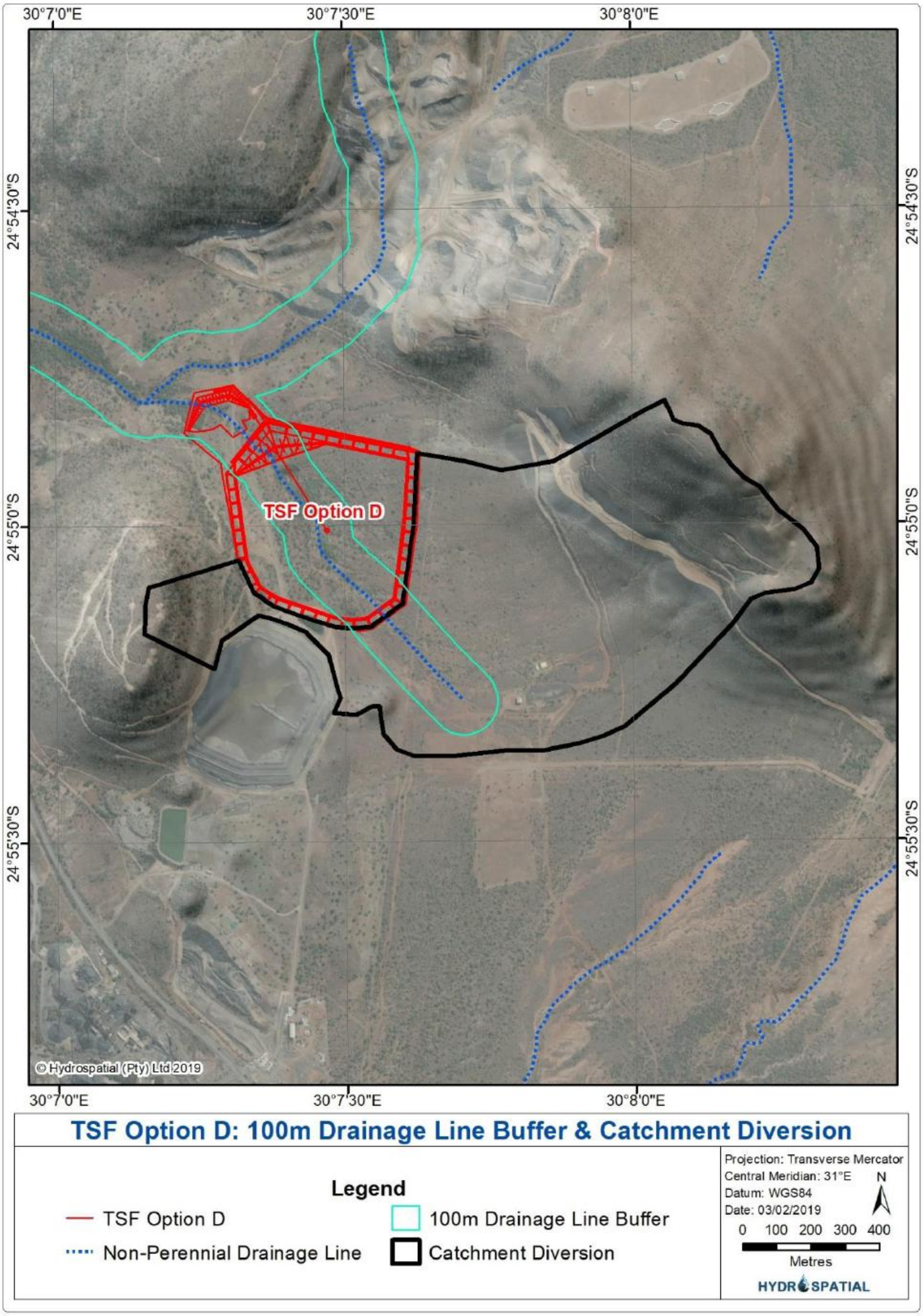

Figure 4-3: TSF Option D 100 m watercourse buffer and catchment diversion

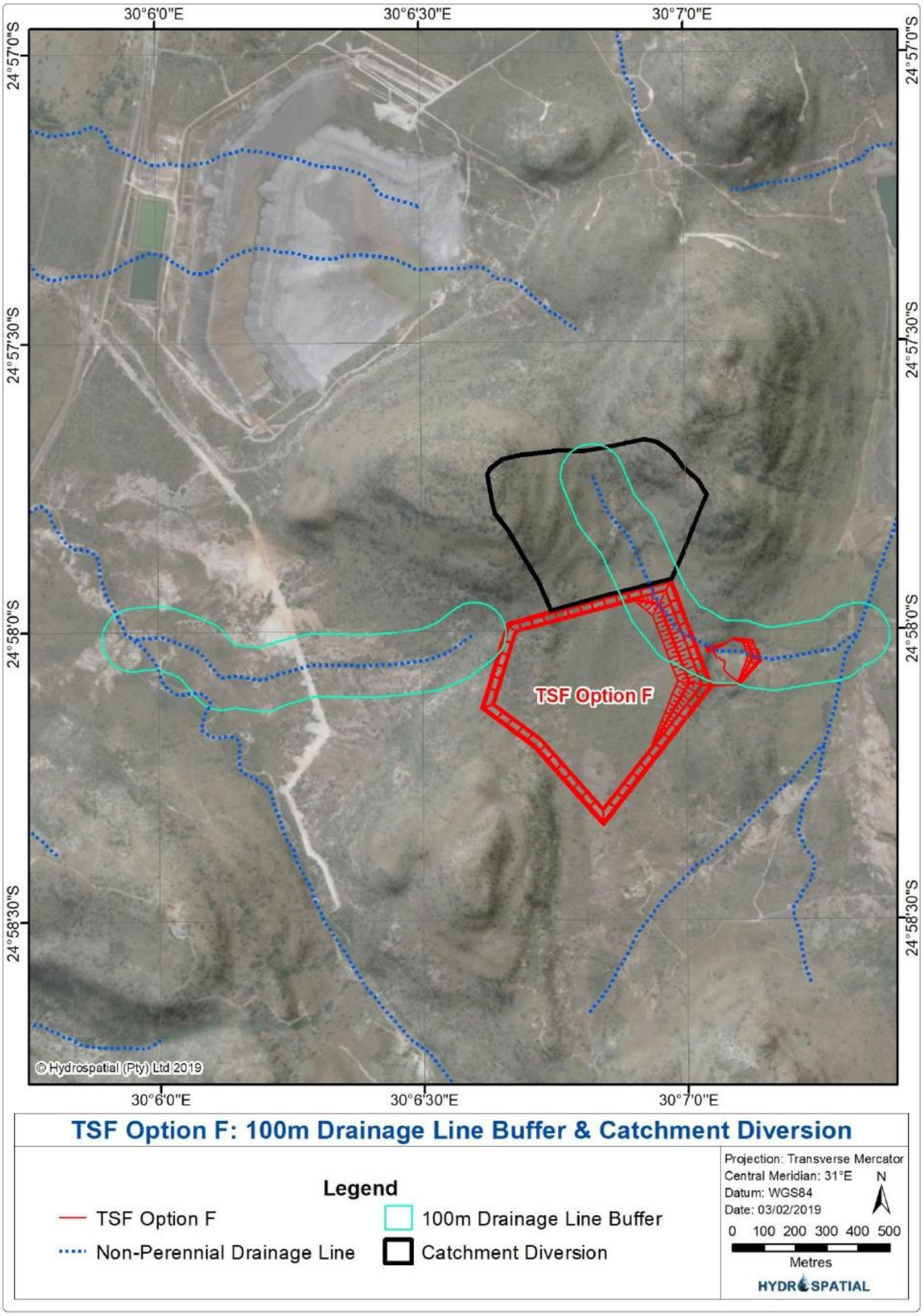

Figure 4-4: TSF Option F 100 m watercourse buffer and catchment diversion

Table 4-1: Number of drainage lines within 100 m and distance to TSF options

TSF Option	No. of Drainage Lines within 100 m of TSF	Distance of Drainage Line to TSF	Rank
TSF B	0	> 100 m	1
TSF C	2	0 m and 0 m	4
TSF D	2	0 m and 63 m	3
TSF F	2	0 m and 90 m	2

4.3.2 Catchment Diversion Area

The catchment areas that would need to be diverted around TSF sites B, C, D and F are indicated on Figure 4-1 to Figure 4-4. As mentioned previously, the larger the catchment area that would need to be diverted, the higher the impact on the drainage line and downslope streams. Table 4-2 indicates the catchment areas that would need to be diverted along with the assigned ranking.

Table 4-2: Catchment diversion areas for the TSF options

TSF Option	Catchment Diversion Area	Rank
TSF B	36.16 ha	3
TSF C	24.7 ha	1
TSF D	97.7 ha	4
TSF F	26.5 ha	2

4.3.3 Surface Water Quantity

The larger the area of the TSF, the more rainwater it will capture, resulting in less runoff reporting to the downslope streams. The TSF areas are indicated in Table 4-3, along with the assigned ranking.

Table 4-3: Areas of the TSF options

TSF Option	Area	Rank
TSF B	20 ha	3
TSF C	28 ha	4
TSF D	21 ha	2
TSF F	17 ha	1

4.3.4 Surface Water Quality

No mining activities are located within the catchment area of the drainage lines at TSF C. Exposed exploration roads are located in the upslope catchment area of TSF B, as well as what appears to be old borrow pit areas along the northern side of the footprint area. Mining activities are located within the catchment area of TSF D, and include the DCM NTSF, as well as upslope open pit mining along the koppies to the east and north. Mining activities are located within the catchment area of TSF F, immediately downstream of the site, where a TSF and other mining activities have been constructed within the drainage line.

In terms of the potential of the TSF options to negatively alter the surface water quality, the drainage lines associated with TSF C have the greatest potential to be altered (as no mining activities are taking place within the catchment), followed by B, D and then F. The assigned rankings are indicated in Table 4-4.

Table 4-4: Potential for surface water quality to be altered for the TSF options

TSF Option	Comment	Rank
TSF B	Some disturbance in upslope catchment in terms of mining roads.	3
TSF C	No mining activities in catchment. Highest potential to alter surface water quality.	4
TSF D	Some mining activities in catchment. Intermediate potential to alter surface water quality.	2
TSF F	Mining activities located in downslope drainage line. Lowest potential to alter surface water quality.	1

4.3.5 Preferred TSF Site

The assigned rankings and totals are indicated in Table 4-5. The site selection assessment indicated that the most preferred option from a surface water perspective is TSF F, followed by B, D and C, respectively.

Table 4-5: Ranking totals

Criteria	TSF Option B Ranking	TSF Option C Ranking	TSF Option D Ranking	TSF Option F Ranking
TSF proximity to drainage lines	1	4	3	2
Catchment diversion area	3	1	4	2
Surface water quantity	3	4	2	1
Surface water quality	3	4	2	1
Total	**10**	**13**	**11**	**6**

5 POTENTIAL SURFACE WATER IMPACTS

The preliminary anticipated surface water impacts for the construction and operational phases of the proposed projects are indicated in Table 5-1. These impacts will be investigated in further detail during the EIA phase of the Project.

Table 5-1: Anticipated surface water impacts

Activity	Impact Description	Significance Pre-Mitigation	Mitigation Measures / Recommendations	Significance Post-Mitigation
Construction Phase				
Removal of vegetation and exposure of soils	Erosion and consequent increase in Total Suspended Solids (TSS) in surrounding watercourses	Medium	• Temporary erosion control measures that reduce flow velocity (e.g. runoff berms) should be implemented around construction areas; • Clean cut-off trenches should be constructed upslope of the TSF to divert clean water around the TSF; • Dirty water trenches and paddocks should be constructed along the sides and downslope perimeter of the proposed TSF; • Clearance of vegetation must be limited as far as possible to only necessary areas; and • Water quality sampling must be implemented near the construction areas to detect negative impacts.	Low

Activity	Impact Description	Significance Pre-Mitigation	Mitigation Measures / Recommendations	Significance Post-Mitigation
Construction of the TSF within drainage lines	The construction and placement of the TSF within drainage lines will result in a loss of natural function and water quantity. It may further result in erosion and flooding if not diverted adequately around the TSF	High	• Diversions around the TSF should ensure that upslope clean water adequately drains around the TSF; and • Erosion and measures must be implemented.	Medium
Alteration to the natural topography	Alteration in surface water drainage patterns leading to erosion and consequent increase in TSS in surrounding watercourses.	Medium	• Temporary erosion control measures that reduce flow velocity (e.g. runoff berms) should be implemented around construction areas; • Clean and dirty water trenches and paddocks must be constructed to divert clean water and to capture and contain dirty water; and • Water quality sampling must be implemented near the construction area. Specific parameters that should be	Low

Activity	Impact Description	Significance Pre-Mitigation	Mitigation Measures / Recommendations	Significance Post-Mitigation
Use of heavy machinery, trucks and vehicles for construction purposes.	Potential hydrocarbon spillages washed into downslope watercourses impacting water quality.	Medium	• Machinery, trucks and vehicles must be well maintained and serviced regularly as per the recommended service guide; • Refuelling must be undertaken over hard park bunded areas that adequately capture and contain spillages; • Drip trays must be used under leaking machinery; and • Spillages should be reported immediately and spill kits should be readily available at all times.	Low
Operational Phase				
Operation of the TSF as a closed dirty area	The proposed TSF will be operated as a closed system to ensure that no dirty water reports to the environment. This will result in a loss of catchment area and water quantity for the Dwars River.	Low	From a water quality perspective, it is of outmost importance that dirty water at the TSF is captured and contained. The loss of water quantity on the Dwars River is likely to be negligible, as the surface area of the proposed TSF in relation to the Dwars River catchment is minimal.	Low

Activity	Impact Description	Significance Pre-Mitigation	Mitigation Measures / Recommendations	Significance Post-Mitigation
Runoff from the TSF into downslope water resources.	Runoff from the TSF is likely to contain high levels of TSS, heavy metals and dissolved salts. If not controlled, this could have a significant impact on the water quality of downslope water resources.	High	A stormwater management plan must be designed and implemented that captures and contains dirty water runoff from the site, in accordance with the requirements stipulated in the GN704 Regulations. Dirty water captured, should be recycled and used at the plant, and should not be allowed to report to the environment. Standard measures should include upslope clean cut-off trenches to divert clean water around the TSF, as well as dirty water trenches and paddocks to capture runoff from the side slopes of the TSF. The walls around the top of the TSF should be of adequate size, and operation of the TSF pool water should be done to ensure that at all times there is sufficient freeboard of 0.8 m, as required by GN704.	Low
Groundwater seepage from the TSF migrating into surface water resources	Seepage water from the TSF has the potential to migrate and daylight in downstream water resources.	High	Lining of the TSF to ensure that seepage of dirty water from the TSF into ground and surface water does not occur.	Low

Activity	Impact Description	Significance Pre-Mitigation	Mitigation Measures / Recommendations	Significance Post-Mitigation
Closure and Post-Closure Phase				
Runoff from the TSF post-closure	Runoff water from the TSF is likely to contain high levels of heavy metals, TSS and dissolved salts which may potentially contaminate downslope water resources in the long term.	High	The stormwater measure should remain in place and should be upgraded to be sustainable in the long term. The clean cut-off trenches and paddocks should be vegetated to prevent erosion.	Low

6 TERMS OF REFERENCE FOR THE EIA PHASE

The following will be undertaken during the EIA phase of the project for the surface water hydrological study:

- Development of a conceptual Stormwater Management Plan (SWMP) in accordance with the DWS Best Practice Guideline G1: Storm Water Management and GN704 Regulations. The primary purpose of the SWMP is to ensure that clean (non-impacted water) and dirty water (mine impacted water) are clearly separated in accordance with the above mentioned Guideline and Regulations;
- Determination of the 1:50 and 1:100 year floodlines for drainage lines in close proximity to the proposed TSF (if necessary);
- An in-depth assessment of the potential surface water impacts and possible mitigation measures for impacts; and
- Development of monitoring plans that can be incorporated into the Mines current monitoring programme.

7 REFERENCES

Food and Agriculture Organisation (FAO) of the United Nations. 2005. New LocClim - Local Climate Estimator.

Smithers J.C. and Schulze R.E. 2002. Design Rainfall and Flood Estimation in South Africa. WRC Project No. K5/1060.

Annexure 6: Hydrogeological Study

Envirogistics

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KHULU TAILINGS STORAGE FACILITY
SITE SELECTION STUDY

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Report No iLEH-EG DCM-W 09-18

July 2021

INDEMNITY AND CONDITIONS RELATING TO THIS REPORT

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on assessment techniques, which are limited by information available, time and budgetary constraints relevant to the type and level of investigation undertaken, and Irene Lea Environmental and Hydrogeology cc reserve the right to modify aspects of the report including the recommendations if and when new information may become available from on-going research, monitoring, further work in this field pertaining to the investigation.

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Irene Lea M.Sc. Pr. Sci. Nat

8 July 2021

EXECUTIVE SUMMARY

A site selection assessment was completed for the proposed Dwarsrivier Chrome Mine Khulu tailings storage facility. The assessment was completed on four candidate sites, following a screening process completed by Fraser Alexander.

Each site was evaluated against the following criteria:

- The current status of aquifer(s) present in the vicinity of the delineated footprints provided.
- The proximity of potential preferential flow paths to groundwater like faults and dykes.
- Existing groundwater use near each footprint.
- The extent of historical, current and planned future undermining.
- The presence of rivers and streams, which may result in shallow groundwater conditions.
- Data availability

The following criteria were identified as potential fatal flaws from a geohydrological perspective:

- The presence of a shallow groundwater table that may rise into the base layer of the liner of the TSF during the wet season.
- The TSF situated near existing groundwater users and therefore potentially impacting on existing use.
- The TSF not lined with a suitable barrier system, including HDPE layer(s).

Based on the outcome of the assessment, Site D was identified as the preferred alternative from a geohydrological perspective for the Khulu TSF.

No fatal flaw conditions were identified, based on the available dataset.

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LIST OF ACRONYMS USED

BH	Borehole
DCM	Dwarsrivier Chrome Mine
FA	Fraser Alexander
HDPE	High Density Polyethylene
iLEH	Irene Lea Environmental and Hydrogeology cc
MRA	Mineral Rights Area
TRP	Two Rivers Platinum Mine
TSF	Tailings Storage Facility
UG	Underground

1 INTRODUCTION

The Northern Tailings Storage Facility (TSF) at Dwarsrivier Chrome Mine (DCM) is estimated to reach its full design capacity in August 2026. If the deposition rates are increased, the design capacity could be reached as soon as August 2023. For this reason, DCM is in the process of completing a study to identify the most suitable site to construct a new tailings storage facility (TSF), referred to as the Khulu TSF, and to obtain the necessary environmental authorisations for the project.

Fraser Alexander (FA) was appointed to identify the most suitable sites for the project (FA, 2018). Initially seven possible sites were identified (Sites A – G). The four most favourable sites were selected for further development. These include Sites B, C, D and F. The locations of each of these four sites are shown on Figures 1, 2 and 3. FA generated models to assess the capacities of and to develop high-level infrastructure design at each site. It is assumed that the Khulu TSF will be lined with a suitable composite liner that will include high-density polyethylene (HDPE) layers. As such, the TSF should not pose a significant risk to groundwater unless the facility overtops or the liner fails.

iLEH was appointed to undertake a geohydrological specialist study for the Khulu TSF project and will complete the work as part of a team managed by Envirogistics. This report represents the geohydrological site selection assessment for the four sites identified by FA.

2 OBJECTIVES OF THE ASSESSMENT

The objective of the study is to assess the four TSF site options from a geohydrological perspective. The preferred alternative will be identified based on the anticipated impacts on groundwater.

3 PROJECT METHODOLOGY

The assessment presented in this report is based on a desktop study of the existing dataset. DCM embarked on a programme to drill and test groundwater monitoring boreholes dedicated to the Khulu TSF project during May 2021. Final results from the drilling and aquifer testing are not yet available and could therefore not be considered in detail as part of the site selection process. The following was considered to complete the site selection for the four preferred sites:

- A site visit and project meeting was attended by iLEH on 5 December 2018. During the site visit, all four sites were visited in order to inspect the terrain and to identify potential impacts on groundwater.
- The existing and updated DCM groundwater monitoring database was consulted to establish groundwater conditions at each site. Information is available for Sites B, C and D, but not for Site F. More detailed aquifer characterisation fieldwork undertaken at Site B was considered in the assessment.
- The regional geological setting was evaluated in order to determine the rock types that underlie each site.
- The results of a high resolution aeromagnetic and radiometric survey were used to delineate the positions of dykes and faults within the study area. This work was completed by GAP (2018). Dykes, especially the host rock contact zones, and faults could potentially act as preferential flow paths to groundwater.
- The historical and existing surface layout and extent of mining were evaluated for each site. The potential future extent of underground mining was also included in the assessment.

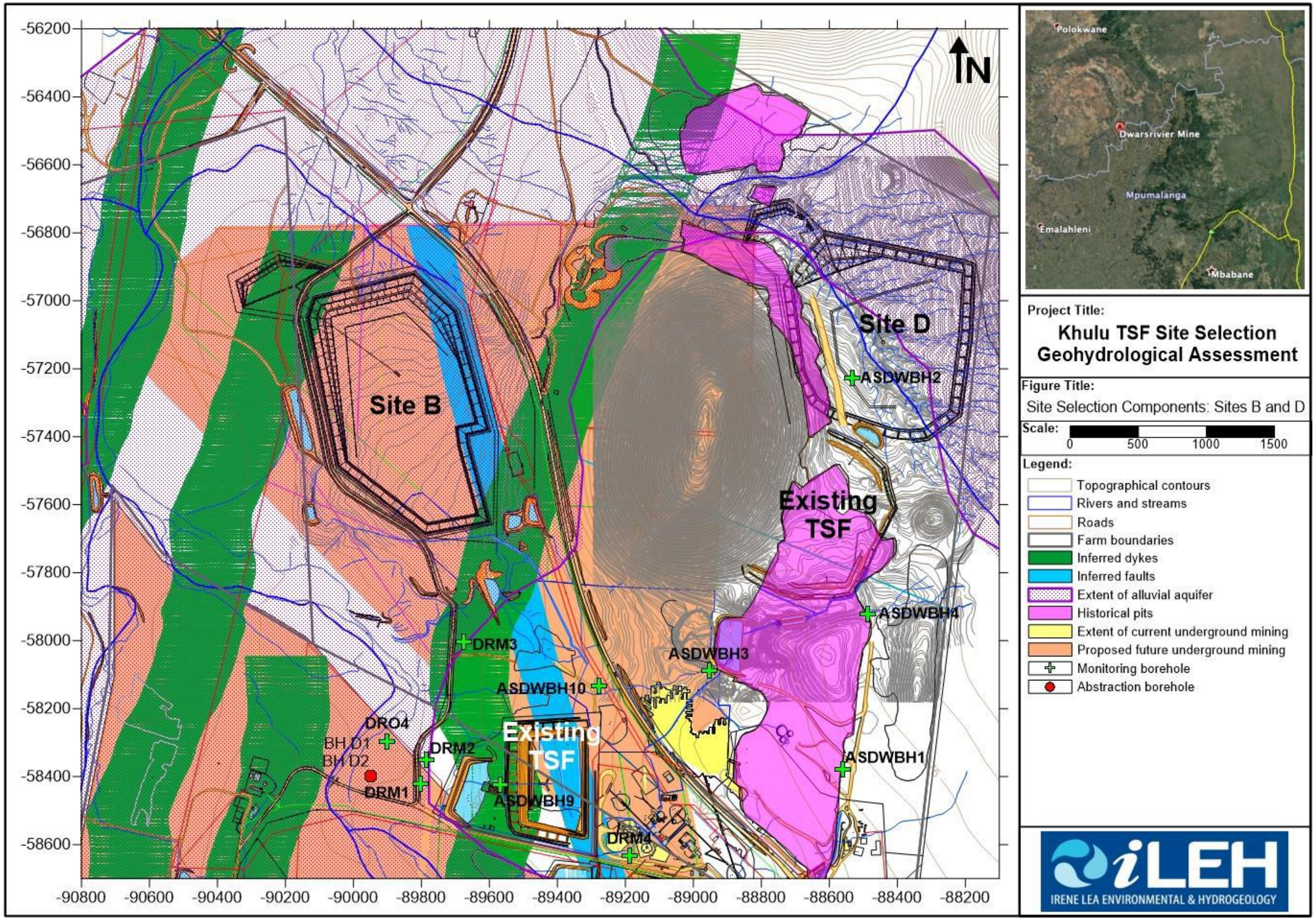

Figure 1 **Geohydrological Site Selection Components: Sites B and D**

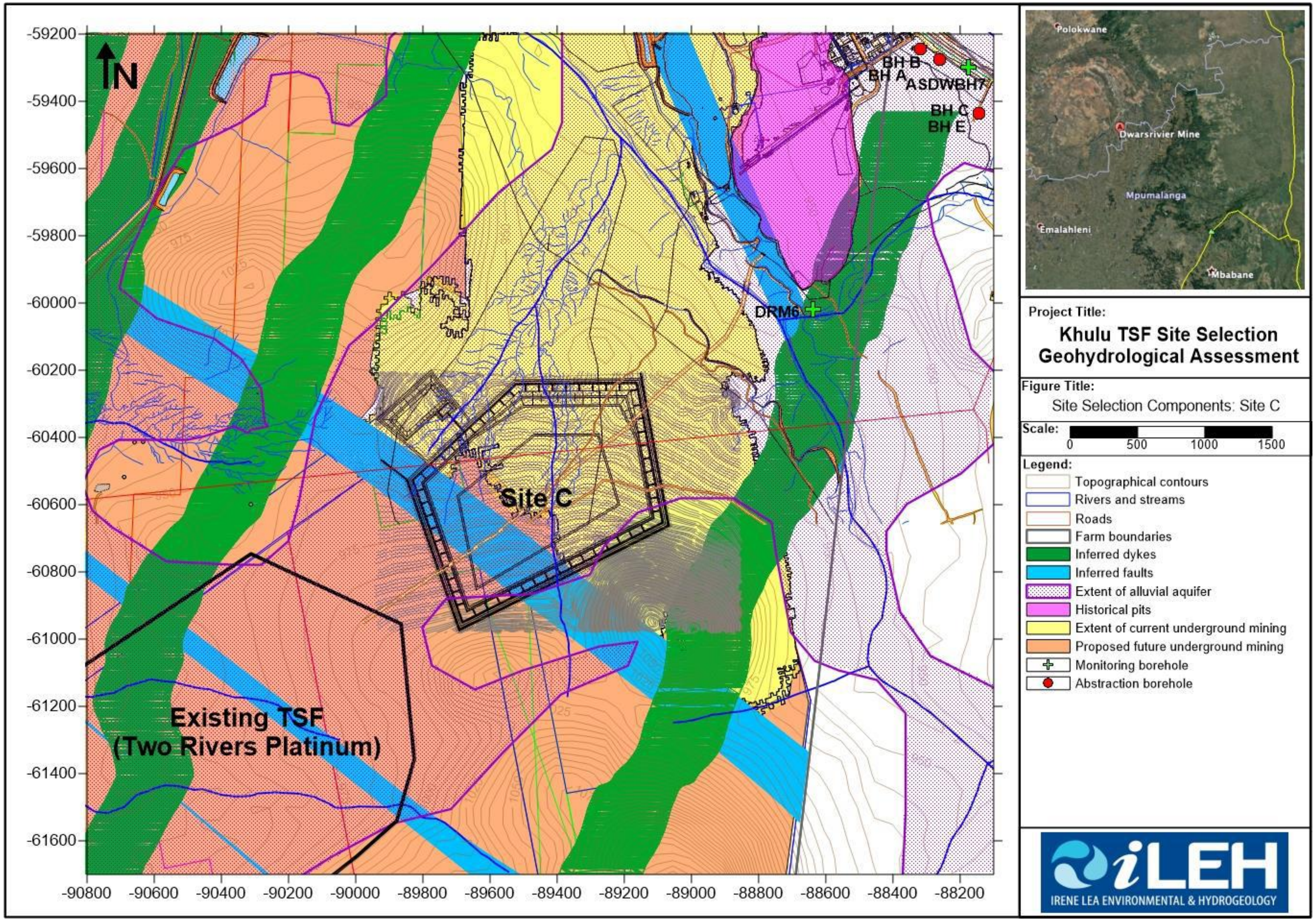

Figure 2 **Geohydrological Site Selection Components: Site C**

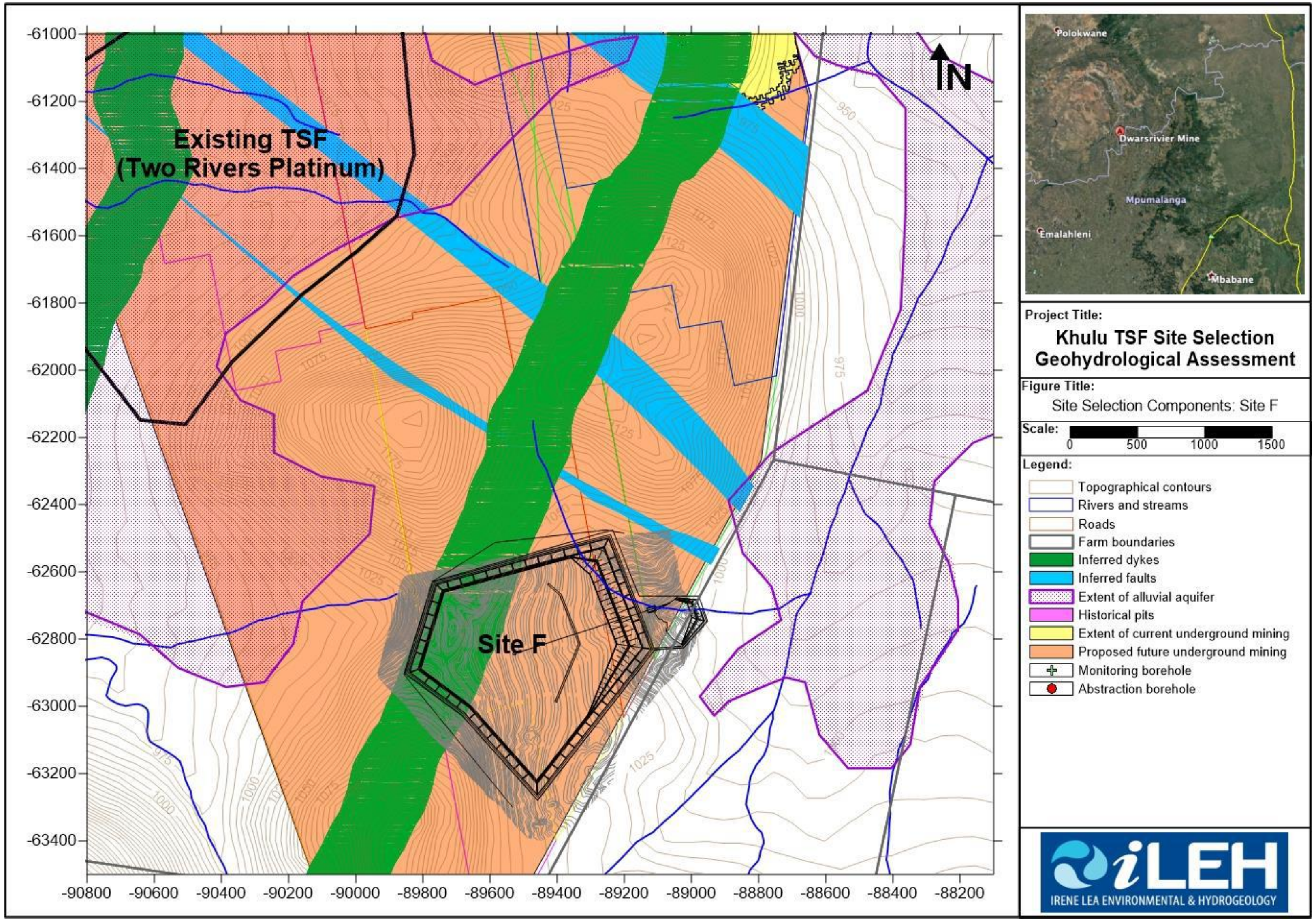

Figure 3 **Geohydrological Site Selection Components: Site F**

4 GEOHYDROLOGICAL SITE SELECTION ASSESSMENT

4.1 Criteria used as part of the assessment

In order to complete the geohydrological site selection assessment, the following criteria were considered.

Table 1 Evaluation criteria

Criteria	Significance	Ranking
Current status of the aquifer(s)	The extent to which groundwater quality is already impacted upon at each site will determine the significance of additional impacts associated with the Khulu TSF. For example, the impact on a pristine aquifer is anticipated to be more significant.	Significantly impacted: 1 Moderately impacted: 2 Pristine aquifer conditions: 3
Proximity to preferential groundwater flow paths	Preferential flow paths to groundwater, which may include faults and dykes, will convey potential contamination from the site faster, thus resulting in adverse impacts on regional aquifers.	No known preferential flow paths: 1 One preferential flow path: 2 More than one preferential flow path: 3
Existing groundwater use	Potential contamination from the TSF may affect existing groundwater use, specifically groundwater abstraction by DCM.	No groundwater use: 1 Limited groundwater use: 2 Significant groundwater use: 3
Extent of undermining	Undermining of the site is expected to affect the stability of the TSF. Potential impacts anticipated with undermining include the risk of subsidence and the creation of additional groundwater preferential flow paths between the TSF and the aquifers.	No undermining: 1 Possible future undermining: 2 Existing/historical undermining: 3
Presence of rivers and streams	Available information suggests that groundwater discharges to watercourses (rivers and streams) as baseflow. The presence of watercourses will therefore result in shallow groundwater level conditions. Potential contamination from the TSF may also have a negative impact on watercourses.	No watercourses present: 1 Non-perennial watercourses present: 2 Perennial watercourses present: 3
Data availability	If no information is available to characterise the aquifers present as part of this site selection assessment, erroneous outcomes may be achieved.	Information is available: 1 Limited information is available: 2 No information is available: 3

4.2 Potential risks and fatal flaws

From a groundwater perspective, the following are considered risks:

- The presence of the alluvial aquifer associated with the Klein and Groot Dwars Rivers relative to the TSF footprint area. This aquifer is formed by unconsolidated alluvium and is unconfined. It is therefore vulnerable to the impact of surface sources of potential contamination, like that associated with the proposed Khulu TSF.
- The presence of a preferential flow path with high permeability near or under the footprint of the proposed TSF. Such flow paths may be associated with faults and dykes, such as those identified by GAP |(2018).
- It is noted that the current monitoring borehole drilling and aquifer testing underway as part of the Khulu TSF project is geared at characterising the perceived preferential flow paths to groundwater. Provisional results obtained for aquifers present underneath the Site B footprint suggest that the faults and dyke that underly this area are potentially strong aquifers with high groundwater yields. This risk is highlighted based on preliminary results from groundwater monitoring borehole drilling and aquifer testing. A more detailed assessment will be provided in the EIA Phase report, once this fieldwork has been completed. However, the presence of potentially strong aquifers underneath the Site B footprint is identified as a potential risk.

It is noted that both risks listed above can be mitigated through selection and implementation of a suitable barrier system (liner) over the TSF footprint. The impact of liner failure, leakage through the liner or poor liner installation will however result in a higher risk to groundwater in the presence of the alluvial aquifer or a preferential flow path with high permeability.

The following groundwater-related fatal flaws were identified:

- The presence of a shallow groundwater table that may rise into the base layer of the liner of the TSF during the wet season.
- The TSF situated near existing groundwater users and therefore potentially impacting on existing use.
- The TSF not lined with a suitable barrier system, including HDPE layer(s).

4.3 Site conditions

A summarised site description for each site is presented in Table 2. The information provided is based on the evaluation of the available information and on the components of significance to groundwater indicated on Figures 1, 2 and 3. Risks and fatal flaws discussed above are considered in Table 2. The following can be concluded from the information presented in the table:

- **Site B**: The underlying lithology at this site is alluvium associated with the Dwars and Groot Dwars Rivers, which creates a major regional aquifer. DCM currently abstracts groundwater from this aquifer from BH D1 and D2, situated 725m southwest from Site B (see Figure 1). Site B is not currently undermined, but future underground mining is planned for this area. Site B is furthermore underlain by both a fault and a dyke. These structures may act as preferential flow paths to groundwater. DCM is in the process of drilling and testing monitoring boreholes that target the dyke and fault present in order to quantify the extent to which these structures could act as preferential flow paths. The provisional results from the drilling and testing programme suggests that strong aquifers are associated with these geological structures with potential high yields. This was identified as a potential risk, as detailed above. The site is situated within an existing watercourse associated with the alluvial aquifers, which suggests that shallow groundwater conditions may occur during the wet season. The site is also situated on or near the alluvial aquifer associated with the Klein and Groot Dwars Rivers. This must be confirmed should this site be developed further. Groundwater in this area has already been impacted by the historical TSF, the Plant and the discard dump. The total dissolved solid (TDS) and nitrate (NO_3) concentrations in the nearest borehole (DRM3) confirm the poorest groundwater quality conditions for the four sites evaluated. The depth to groundwater at this site is the shallowest of all the sites evaluated (4,53m), which means that the barrier between the TSF and the aquifer is the smallest for all four sites. It is not thought that groundwater levels would rise to surface and thus into the liner system. The shallow groundwater is however flagged as a potential risk. Groundwater is not used in the immediate vicinity of Site B other than being monitored.
- **Site C**: This site is underlain by alluvium that forms part of the regional alluvial aquifer associated with the main rivers in the area, as for Site B. Site C is situated south of the DCM mining surface infrastructure, but is underlain by the existing underground workings at South Shaft. South Pit is situated 550m northeast of the site. The existing Two Rivers Platinum (TRP) TSF is situated approximately 150m southwest of this site. The site overlies a fault identified by GAP (2018), but the nearest dyke is 120m to the east (see Figure 2). The footprint is located within an existing watercourse that drains towards the Groot Dwars River. The depth to groundwater in the nearest borehole (DRM6) is 9,03m, which creates a larger barrier between the TSF and the underlying groundwater table compared to Site B. Groundwater quality in this area has also been impacted on, especially in terms of NO_3 concentrations, but not to the same extent as at Site B. Groundwater is not used at this site other than for monitoring and the nearest groundwater abstraction boreholes (BH D1 and D2) are situated 1270m to the

northwest.

- **Site D**: The site is situated immediately north of the existing Northern TSF (see Figure 1). The regional geological map suggests that the footprint is situated partly on alluvium and partly on norite/anorthosite. Groundwater in this area has already been impacted on by historical opencast mining, waste rock dumps and possibly by the northern TSF. It is noted that the latter has an HDPE liner installed. This footprint is partially underlain by an old backfilled and rehabilitated opencast pit. It is however noted that the Northern TSF also overlies an old pit, which suggests that this situation can be overcome through implementation of the appropriate engineering solutions. This site is not underlain by the faults or dykes identified by GAP (2018). The site is situated in an existing watercourse, with surface water draining in a northeasterly direction towards the Dwars River. The depth to groundwater in borehole ASDWBH2, situated within the designated footprint area, is however 16,12m, which is the deepest groundwater table condition for the four sites evaluated. Groundwater quality is already impacted in this area, most notably in terms of NO_3 concentrations. The nearest DCM boreholes used for groundwater abstraction in this area are situated 1690m southwest of the site.
- **Site F**: This site is situated in the southern most corner of the Mineral Rights Area (MRA), as shown on Figure 3. The existing TRP TSF is situated approximately 880m northwest of Site F. DCM is not currently mining in this area, but future underground mining is planned for this site. The footprint area is not underlain by a fault, but a dyke transects the site (see Figure 3). The footprint is situated within and near watercourses. No information is currently available to characterise the aquifers in this area, but it is noted that the footprint is situated on norite/anorthosite and not on alluvium. It is unclear if groundwater is used in this area, but DCM's nearest groundwater abstraction boreholes are situated approximately 3380m northeast of this site.

Table 2 Summary of site description

Component	Site B	Site C	Site D	Site F
Location	North of Discard Dump	Southwest of South Shaft	North of Northern TSF	Southern tip of MRA
Toe area of TSF	24ha	21ha	19ha	17ha
Duration of capacity	2019 – 2044 (25 yrs)	2019 – 2033 (14 yrs)	2019 – 2044 (25 yrs)	2019 – 2044 (25 yrs)
Existing impacts on groundwater	Discard Dump, Plant, Historical TSF	Historical pits, underground mining; TRP TSF	Northern TSF, historical pits, waste rock dumps	TRP TSF
Underlying lithologies	Alluvium (risk)	Alluvium (risk)	Alluvium (risk)/Norite/ Anorthosite	Norite/ Anorthosite
Mining activities	Overlying possible future UG workings	Overlying existing UG workings	Overlying a backfilled and rehabilitated pit	Overlying possible future UG workings
Proximity to known faults	Overlying a fault (risk)	Overlying a fault (risk)	870m	75m
Proximity to known dykes	Overlying 2 dykes (risk)	120m	380m	Overlying a dyke (risk)
Surface drainage	Within an existing watercourse	Within an existing watercourse	Within an existing watercourse	Within an existing watercourse
Depth to groundwater table (Sep ('20_)	DRM3: 4,53m (risk)	DRM6: 9,03m	ASDWBH2: 16,12m	No information available
Groundwater flow direction	Westerly	Westerly	Northwesterly	No information available
Groundwater quality (Sep '20)	DRM3: TDS: 1627mg/l NO_3: 279 mg/l	DRM6: TDS: 592mg/l NO_3: 34,1 mg/l	ASDWBH2: TDS: 556mg/l NO_3: 34,8 mg/l	No information available
Existing groundwater use	Monitoring	Monitoring	Monitoring	No use
Nearest abstraction borehole	725m (BH D1+D2)	1270m ((BH C+E)	1690m (BH D1+D2)	3380m (BH C+E)

Potential data gaps	Characterisation of potential preferential flow paths	Characterisation of potential preferential flow paths	Characterisation of potential preferential flow paths	No monitoring borehole data
Further work required	• Characterisation of aquifers • Groundwater impact assessment	• Characterisation of aquifers • Groundwater impact assessment	• Characterisation of aquifers • Groundwater impact assessment	• Characterisation of aquifers • Groundwater impact assessment

4.4 Identification of the preferred alternative

The assessment presented above was used to determine the preferred alternative for locating the Khulu TSF based on geohydrological considerations. The results are presented in Table 3. It is shown that Site D is the preferred alternative from a groundwater perspective, as it scored the lowest rating based on the available dataset. Risks associated with Site D include the presence of alluvium under or near the TSF footprint.

Site B scored similar to Site D and could therefore also be considered as a preferred alternative, provided that the risks identified are managed to avoid or minimise negative impacts on groundwater. The risks associated with Site B include the presence of the alluvial aquifer under or near the TSF footprint, the presence of potential preferential flow paths to groundwater and shallow groundwater level conditions.

No geohydrological fatal flaw conditions were identified for the sites evaluated.

Table 3 Scoring of sites

Criteria	Scoring			
	Site B	Site C	Site D	Site F
Current status of the aquifer(s)	1	2	1	3
Proximity to preferential groundwater flow paths	3 (risk)	2	1	2
Existing groundwater use	2	2	2	2*
Extent of undermining	2	3 (risk)	3 (risk)	2
Presence of rivers and streams	3 (risk)	2	2	2
Data availability	1	2	1	3 (risk)
Score	**12**	**13**	**10**	**14**

* Assumption as no data is available

5 REFERENCES

FA, 2018. Dwarsrivier Chrome Mine – Tailings Storage Facility Operations Site Selection Report, Report No FA/T/DWARS/2018/08, dated August 2018.

GAP, 2018. Report on Interpretation of High Resolution Aeromagnetic and Radiometric Survey Data over the Farm Dwarsrivier, Steelpoort Locality, Limpopo Province, on behalf of Dwarsrivier Chrome Mine, compiled by GAP Geophysics, dated March 2018.

Annexure 7: Wetland and Freshwater Assessment

SCIENTIFIC AQUATIC SERVICES

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ALTERNATIVES ANALYSIS AS PART OF THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS FOR THE PROPOSED DEVELOPMENT OF A NEW TAILINGS STORAGE FACILITY AND FUEL STORAGE AREAS AT THE DWARS RIVER CHROME MINE, LIMPOPO PROVINCE

Prepared for

Envirogistics (Pty) Ltd

February 2019

Revised: June 2021

Alternatives Analysis: Watercourse Ecology

Prepared by: Scientific Aquatic Services
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Report reference: SAS 218223
Date: February 2019
Revision 1: May 2020
Revision 2: June 2021

EXECUTIVE SUMMARY

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater ecological assessment as part of the Environmental Impact Assessment (EIA) and authorisation process for five new proposed projects within the existing Mining Rights Area, as specified below:

- Project 1: the proposed development of a new Tailings Storage Facility (TSF);
- Project 2: diesel and emulsion batching;
- Project 3: main parking extension;
- Project 4: widening of access road between South Shaft / Main Offices and Plant; and
- Project 5: Access Crossing between Plant and North Mine.

Four alternative sites were proposed for Project 1, and thus an alternatives analysis of these sites formed part of the scope of work of this investigation. The purpose of this report is to define each of the TSF alternatives, and the localities of Projects 2 to 5 in terms of freshwater and aquatic ecology, at a high level, by means of analysis of relevant datasets, prior studies conducted by SAS for DCM, and a brief site assessment of each proposed alternative. It is a further aim of this study to provide adequate relevant information to the EAP and the proponent to allow for informed decision-making in consideration of the principles of Integrated Environmental Management (IEM) and sustainable development as enshrined in Section 24 of the Constitution of South Africa.

The assessment took the following approach:

- A desktop study was conducted, in which possible wetlands/watercourses within each of the four proposed options for the new TSF were identified for on-site investigation. In addition, relevant national and provincial databases were consulted. The results of the desktop study are contained in Section 3 of this report;
- A field assessment of three TSF alternatives (Options C, D, and F) took place in early December 2018, whilst field verification of the Option B was undertaken in May 2021, in order to ground-truth the identified watercourses within each alternative option;
- The identification of watercourses associated with the sites for Projects 2 to 5 were based on data gathered during previous studies conducted by SAS for DCM; and
- Within TSF Options C, D, and F, a single watercourse was identified, mapped and characterised. No watercourses were identified directly within Option B, the proposed batching areas, main parking extension, access road proposed to be widened and the new crossing proposed between North Mine and the Plant, although watercourses were identified within 500 m of each project.

Whilst a detailed assessment of the Present Ecological State (PES), Ecological Importance and Sensitivity (EIS) and ecological and socio-cultural services provision of these watercourses did not form part of the scope of work of this phase of the study, previous studies undertaken by SAS for the DCM were consulted to supplement information obtained during the desktop and site assessments. The watercourses associated with each TSF alternative option and with Projects 2 to 5 are considered moderately modified, of moderate EIS, and likely to provide intermediate levels of ecological and socio-cultural goods and service provision.

Although no watercourses are directly associated with the remaining projects (i.e. not situated directly within the proposed project areas), the proposed batching areas are located upgradient of watercourses, and the proposed extension of the Main Parking area will encroach marginally on the delineated riparian zone of the Springkaanspruit.

The findings of the TSF alternatives analysis are summarised in the table below:

Table A: Summary of the results of the investigation and comparison of TSF options B, C, D and F.

TSF Alternative	Freshwater ecology of site	Business Case	Preferred Site (from a freshwater ecology perspective)
Option B	No watercourses were identified within Option B. The site is located upgradient and approximately 230 m east of the Dwars River. The site is also located approximately 350 m south and downgradient of an ephemeral, unnamed tributary of the Dwars River.	The construction of the proposed TSF in this location does not pose any direct threat to any watercourses. However, indirect impacts could potentially occur during construction such as contaminated stormwater runoff reaching the Dwars River. Similarly, no direct impacts are envisaged during the operational phase should the proposed TSF be placed in this site; however, in the event of failure of the TSF, significant impacts to the Dwars River could occur, particularly without appropriate mitigation.	Preferred, since the placement poses no direct threat to any watercourses. Strict mitigation, including ensuring that the design and operation of the TSF does not lead to failure thereof, will be necessary to prevent any possible indirect impacts on the Dwars River.
Option C	A single freshwater resource, specifically an unnamed tributary of the Groot Dwars River, traverses the central portion of the site. The reach of the watercourse within the site is approximately 1ha in extent. Whilst some impacts were noted (such as bank incision due to the naturally erosive nature of the soils in the vicinity) the resource is considered to be in a moderately modified to largely natural ecological condition.	Construction of the proposed TSF in this location poses a direct threat to the freshwater resource. Anticipated impacts include loss of riparian habitat, increased sedimentation and erosion of the resource, and possible impacts on the downstream system should an extreme event (such as a spill) occur. Furthermore, should the TSF be constructed in this , additional support infrastructure (roads, pipelines, powerlines etc) would be required, which may potentially require watercoursecrossings, thus increasing the risk of cumulative impacts on the freshwater ecology of the surrounding area.	Not preferred.
Option D	An unnamed tributary of the Dwars River was identified within the central portion of this site. SAS (2018) classified this resource as being in a PES Category B/C (largely natural to moderately modified) and of moderate EIS. The extent of this watercourse within the site is approximately 7,3ha.	Construction of the proposed TSF in this location poses a direct threat to the freshwater resource. Anticipated impacts as a result are identical to those identified for Option C. Taking into consideration the surrounding mining activities and anticipated encroachment thereof however, as well as proximity to the existing DCM TSF, utilisation of Option D could potentially reduce the impact on freshwater resources in the two other TSF alternatives and the greater MRA. Consideration must be given to known future activities within the MRA.	Not preferred; however it is acknowledged that utilisation of this site may assist in protection of the freshwater ecology within the greater MRA, provided that future expansion plans are taken into consideration during the site selection process.

Option F	A small ephemeral drainage line with a weakly-formed riparian zone was identified in the north-eastern corner of Option F. This drainage line constitutes the headwaters of a watercourse which may have been significantly impacted by the construction of infrastructure on the neighbouring Thorncliffe Mine; however the upper reach of the resource (i.e. the reach within Option F) remains largely unimpacted. The reach of this watercourse within the site is approximately 0.3ha in extent.	Although a single watercourse was identified during the site assessment, it is the opinion of the ecologist that due to the location thereof, the proposed TSF may be placed and designed in such a way as to avoid the resource. Furthermore, it is likely that the resource is of decreased ecological importance, particularly given possible impacts to the lower reaches of the resource, and that impacts to the upper reaches may therefore be considered of lower significance.	Considered a viable alternative; however, there is a quantum of risk associated with the development of the TSF within this site, due to the extent of pipelines that would be required, thus increasing the potential for spills to occur.

In conclusion, it is apparent that construction of the proposed TSF within Option C or Option D has the potential to have an unacceptably high impact on the watercourse within each respective option. Such impacts may also potentially affect downstream systems. Although no major watercourses were identified within Option F, there is still a quantum of risk associated with utilising Option F due to the extensive network of pipelines that will be required. From a freshwater ecological perspective therefore, Option B is the preferred option, as no direct impacts arising from the construction and operation of the TSF within that location to the receiving freshwater environment are anticipated. Nevertheless, indirect impacts, including potential failure of the TSF, could occur and may potentially be detrimental to the Dwars River specifically, If suitable mitigation measures are not strictly implemented throughout all phases.

Therefore, mitigation measures will need to be strictly implemented during all phases of these proposed projects, throughout the Life of Mine, to minimise the potential risk of indirect impacts occurring on the watercourses.

DOCUMENT GUIDE

No.	Requirement	Section in report
a)	Details of -	
(i)	The specialist who prepared the report	Appendix C
(ii)	The expertise of that specialist to compile a specialist report including a curriculum vitae	Appendix
b)	A declaration that the specialist is independent	Appendix c
c)	An indication of the scope of, and the purpose for which, the report was prepared	Section 1.2
cA)	An indication of the quality and age of base data used for the specialist report	Section 2.1 and 3.1
cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 4
d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 2.1
e)	A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 1
f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives	Section 4
g)	An identification of any areas to be avoided, including buffers	Section 4.3
h)	A map superimposing the activity including the associated structure and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers	Section 5
i)	A description of any assumption made and any uncertainties or gaps in knowledge	Section 1.3
j)	A description the findings and potential implication\s of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities	Section 4
k)	Any mitigation measures for inclusion in the EMPr	Section 6
l)	Any conditions for inclusion in the environmental authorisation	N/A
m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	N/A
n)	A reasoned opinion -	
(i)	As to whether the proposed activity, activities or portions thereof should be authorised	N/A
(iA)	Regarding the acceptability of the proposed activity or activities	N/A
(ii)	If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	N/A
o)	A description of any consultation process that was undertaken during the course of preparing the specialist report	N/A
p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
q)	Any other information requested by the competent authority	N/A

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GLOSSARY OF TERMS

Alien vegetation:	Plants that do not occur naturally within the area but have been introduced either intentionally or unintentionally. Vegetation species that originate from outside of the borders of the biome -usually international in origin.
Alluvial soil:	A deposit of sand, mud, etc. formed by flowing water, or the sedimentary matter deposited thus within recent times, especially in the valleys of large rivers.
Average Score Per Taxon	The average sensitivity of the aquatic community obtained by determining the sum of the sensitivity scores for each aquatic macro-invertebrate family observed and then dividing by the number of families present.
Base flow:	Long-term flow in a river that continues after storm flow has passed.
Biodiversity:	The number and variety of living organisms on earth, the millions of plants, animans and micro-organisms, the genes they contain, the evolutionary history and potential they encompass and the ecosystems, ecological processes and landscape of which they are integral parts.
Buffer:	A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area.
Catchment:	The area where water is collected by the natural landscape, where all rain and run-off water ultimately flows into a river, wetland, lake, and ocean or contributes to the groundwater system.
Chroma:	The relative purity of the spectral colour which decreases with increasing greyness.
Direct Estimation of Ecological Effect Potential	DEEEP proposes a battery of tests to directly assess effluent oxygen demand, lethal (acute) and sublethal (chronic) toxicity, bioaccumulation, mutagenicity and persistence potential of effluents, using test organisms from a range of trophic levels.
Delineation (of a wetland):	To determine the boundary of a wetland based on soil, vegetation and/or hydrological indicators.
Dissolved Oxygen	Dissolved Oxygen is the amount of oxygen that is present in the water. It is measured in milligrams per litre (mg/L).
Dissolved Oxygen Saturation	In aquatic environments, oxygen saturation is a ratio of the concentration of dissolved oxygen in the water to the maximum amount of oxygen that will dissolve in the water at that temperature and pressure under stable equilibrium.
Ecoregion:	An ecoregion is a "recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterise that region".
Electrical Conductivity	Electrical conductivity (EC) is a measure of the ability of water to conduct an electrical current. This ability is a result of the presence in water of ions such as carbonate, bicarbonate, chloride, sulphate, nitrate, sodium, potassium, calcium and magnesium, all of which carry an electrical charge
Ecological Importance and Sensitivity	Ecological importance refers to the diversity, rarity or uniqueness of the habitats and biota. Ecological sensitivity refers to the ability of the ecosystem to tolerate disturbances and to recover from certain impacts.
Environmental Management Plan	An EMP is a site-specific plan developed to ensure that all necessary measures are identified and implemented in order to protect the environment and comply with environmental legislation.
Ecological Water Requirements	The flow patterns (magnitude, timing and duration) and water quality needed to maintain a riverine ecosystem in a particular condition. This term is used to refer to both the quantity and quality components.
Ephemeral stream:	Ephemeral systems flow for less time than they are dry. Flow or flood for short periods of most years in a five-year period, in response to unpredictable high rainfall events. Support a series of pools in parts of the channel.
Episodic stream:	Highly flashy systems that flow or flood only in response to extreme rainfall events, usually high in their catchments. May not flow in a five-year period, or may flow only once in several years.
Facultative species:	Species usually found in wetlands (76%-99% of occurrences) but occasionally found in non-wetland areas
Fluvial:	Resulting from water movement.
Gleying:	A soil process resulting from prolonged soil saturation which is manifested by the presence of neutral grey, bluish or greenish colours in the soil matrix.
Groundwater:	Subsurface water in the saturated zone below the water table.
Hydromorphic soil:	A soil that in its undrained condition is saturated or flooded long enough to develop anaerobic conditions favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic soils).

Hydrology:	The study of the occurrence, distribution and movement of water over, on and under the land surface.
Hydromorphy:	A process of gleying and mottling resulting from the intermittent or permanent presence of excess water in the soil profile.
Hydrophyte:	Any plant that grows in water or on a substratum that is at least periodically deficient of oxygen as a result of soil saturation or flooding; plants typically found in wet habitats.
Intermediate Habitat Integrity Assessment	The habitat integrity assessment is based on two perspectives of the river, the riparian zone and the instream channel. Assessments are made separately for both aspects, but data for the riparian zone are primarily interpreted in terms of the potential impact on the instream component.
Intermittent flow:	Flows only for short periods.
Indigenous vegetation:	As defined within the NEMA EIA Regulations Listing Notice 3 of 2014 (amended 2017) "indigenous vegetation" refers to vegetation consisting of indigenous plant species occurring naturally in an area, regardless of the level of alien infestation and where the topsoil has not been lawfully disturbed during the preceding ten years. Vegetation occurring naturally within a defined area.
Invertebrate Habitat Assessment System	An assessment index to determine the suitability of the habitat at any assessment point for colonisation by aquatic macro-invertebrates.
Macro-Invertebrate Response Assessment Index	MIRAI integrates the ecological requirements of the invertebrate taxa in a community or assemblage to their response to modified habitat conditions.
Mottles:	Soils with variegated colour patterns are described as being mottled, with the "background colour" referred to as the matrix and the spots or blotches of colour referred to as mottles.
Obligate species:	Species almost always found in wetlands (>99% of occurences).
Olifants River Ecological Water Requirement Assessment	A comprehensive determination of the Reserve was conducted with the aim of quantifying the environmental requirements of the resource in order to protect the aquatic ecosystem and secure ecologically sustainable development and use of the resource. The outcome of this determination was recommended flow and water quality objectives that should be achieved in order that the aquatic ecosystem can be afforded the level of protection as required by the Ecological Class.
Perched water table:	The upper limit of a zone of saturation that is perched on an unsaturated zone by an impermeable layer, hence separating it from the main body of groundwater
Perennial:	Flows all year round.
Present Ecological State	The current state or condition of a water resource in terms of its biophysical components (drivers) such as hydrology, geomorphology and water quality and biological responses viz. fish, invertebrates, riparian vegetation). The degree to which ecological conditions of an area have been modified from natural (reference) conditions.
RAMSAR:	The Ramsar Convention (The Convention on Wetlands of International Importance, especially as Waterfowl Habitat) is an international treaty for the conservation and sustainable utilisation of wetlands, i.e., to stem the progressive encroachment on and loss of wetlands now and in the future, recognising the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value. It is named after the city of Ramsar in Iran, where the Convention was signed in 1971.
RDL (Red Data listed) species:	Organisms that fall into the Extinct in the Wild (EW), critically endangered (CR), Endangered (EN), Vulnerable (VU) categories of ecological status
Resource Quality Information Services	RQIS provides national water resource managers with aquatic resource data, technical information, guidelines and procedures that support the strategic and operational requirements for assessment and protection of water resource quality.
Resource Quality Objectives	Classes and resource quality objectives of water resources for the Olifants catchment from Government Gazette number 39943, 22 April 2016, Department of Water and Sanitation (DWS 2016).
Seasonal zone of wetness:	The zone of a wetland that lies between the Temporary and Permanent zones and is characterised by saturation from three to ten months of the year, within 50cm of the surface
South African River Health Programme	The RHP serves as a source of information regarding the overall ecological status of river ecosystems in South Africa. For this reason, the RHP primarily makes use of in-stream and riparian biological communities (e.g. fish, invertebrates, vegetation) to characterise the response of the aquatic environment to multiple disturbances.
South African Scoring System	An index to determine the integrity of the aquatic macro-invertebrate community at any given assessment point.
Sub-quaternary Reach	A finer subdivision of the quaternary catchments (the catchment areas of tributaries of main stem rivers in quaternary catchments).

Target Water Quality Requirement	*Guidelines set by the South African Department of Water and Sanitation (DWS), formerly the Department of Water Affairs and Forestry (DWAF), for various physico-chemical and biological parameters for various uses as well as ecosystem functioning.
Temporary zone of wetness:	the outer zone of a wetland characterised by saturation within 50cm of the surface for less than three months of the year
Watercourse:	In terms of the definition contained within the National Water Act, a watercourse means: • A river or spring; • A natural channel which water flows regularly or intermittently; • A wetland, dam or lake into which, or from which, water flows; and • Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse; • and a reference to a watercourse includes, where relevant, its bed and banks
Whole Effluent Toxicity	Whole Effluent Toxicity refers to the aggregate toxic effect to aquatic organisms from all pollutants contained in a facility's wastewater (effluent).
Wetland Vegetation (WetVeg) type:	Broad groupings of wetland vegetation, reflecting differences in regional context, such as geology, climate, and soils, which may in turn have an influence on the ecological characteristics and functioning of wetlands.
Water Management System	WMS is a suite of computer programmes developed for the Department of Water and Sanitation to provide information for water resource monitoring and management in South Africa.
Water Use License	The National Water Act (Act 36 of 1998) gives the Department of Water and Sanitation the tools to gather the information that we need for the optimal management of our water resources. The registration of water use is one of these tools.

ACRONYMS

% DO sat	Dissolved Oxygen Saturation
°C	Degrees Celsius.
ASPT	Average Score Per Taxon
BAR	Basic Assessment Report
BGIS	Biodiversity Geographic Information Systems
CBA	Critical Biodiversity Area
CSIR	Council of Scientific and Industrial Research
CR	Critically Endangered
DCM	Dwarsrivier Chrome Mine
DEA	Department of Environmental Affairs
DEMC	Desired Ecological Management Class
DO	Dissolved Oxygen
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EC	Ecological Class or Electrical Conductivity (use to be defined in relevant sections)
EI	Ecological Important
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
ES	Ecological Sensitivity
ESA	Ecological Support Area
EWR	Ecological Water Requirements
FEPA	Freshwater Ecosystem Priority Areas
FRAI	Fish Response Assessment Index
GIS	Geographic Information System
GN	General Notice
GPS	Global Positioning System
HGM	Hydrogeomorphic
IHAS	Invertebrate Habitat Assessment System
IEM	Integrated Environmental Management
IHI	Index of Habitat Integrity
LEMA	Limpopo Environmental Management Act
mm	Millimetre
m.a.m.s.l	Metres above Mean Sea Level
MAP	Mean Annual Precipitation
NEMA	National Environmental Management Act
NFEPA	National Freshwater Ecosystem Priority Areas
NWA	National Water Act
OREWRA	Olifants River Ecological Water Requirements Assessment
PEMC	Present Ecological Management Class
PES	Present Ecological State
REC	Recommended Ecological Category
RHP	River Health Program
RQIS	Research Quality Information Services
RWQO	** Resource Water Quality Objectives
SA RHP	South African River Health Programme
SACNASP	South African Council for Natural Scientific Professions
SAIAB	South African Institute of Aquatic Biodiversity
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SAS	Scientific Aquatic Services
SASS5	South African Scoring System
SQR	Sub-Quaternary Reach

subWMA	Sub-Water Management Area
TWQR	* Target Water Quality Requirement
WET	Whole Effluent Toxicity
WetVeg Groups	Wetland Vegetation Groups
WMA	Water Management Areas
WMS	Water Management System
WRC	Water Research Commission
WULA	Water Use License Application

1 INTRODUCTION

1.1 Background

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater and aquatic resource ecological alternatives analysis as part of the Environmental Impact Assessment (EIA) and authorisation process for five projects Dwarsrivier Chrome Mine (DCM), near Steelpoort, Limpopo, within the mine's existing Mining Rights Area (MRA), specifically:

- Project 1: the proposed development of a new Tailings Storage Facility (TSF);
- Project 2: diesel and emulsion batching;
- Project 3: main parking extension;
- Project 4: widening of access road between South Shaft / Main Offices and Plant; and
- Project 5: Access Crossing between Plant and North Mine.

Further detail regarding the above projects is provided in Section 1.2 of this report.

The DCM MRA is located in the Dwars River Valley, approximately 13 km south of the town of Steelpoort and approximately 5.5 km west of the Mpumalanga/Limpopo border within the Greater Tubatse Local Municipality, and the Greater Sekhukhune District Municipality, Limpopo Province. The R555 is situated approximately 10 km northwest of the MRA, with the R37 situated approximately 19 km east of the MRA.

The purpose of this report is to define each of the proposed projects and their alternatives where relevant in terms of freshwater and aquatic ecology at a high level, by means of analysis of relevant datasets, prior studies conducted by SAS for ADCM, and a brief site assessment of each proposed alternative (where applicable). It is a further aim of this study to provide adequate relevant information to the EAP, the proponent and the relevant authorities to allow for informed decision-making in consideration of the principles of Integrated Environmental Management (IEM) and sustainable development as enshrined in Section 24 of the Constitution of South Africa.

1.2 Project description

A brief description of each of the five proposed projects is provided below. It must be noted that the project description was obtained from the report "Dwarsrivier Chrome Mine (Pty) Ltd Environmental Authorisation Application Form for new Capital Projects and the proposed new Khulu Tailings Storage Facility and associated infrastructure (4th Draft) prepared by

Envirogistics (Pty) Ltd, as received by the specialist on 2nd June 2021. SAS therefore takes no responsibility for the accuracy of the information presented in this section. The localities of the five proposed projects are presented in Figures 1 and 2 following the project descriptions.

Project 1: Tailings Storage Facility

Dwarsrivier is currently depositing at the existing North Tailings Storage Facility (NTSF) at the eastern side of their process plant on the remaining portion of the Farm Dwarsrivier 372. It is anticipated that the existing active NTSF will reach its full capacity relatively sooner than anticipated due to tonnage ramp ups and additional tonnages from other sites.

The mine identified seven (7) potential TSF options initially, which have subsequently been reduced to four (4) (Option B, C, D and F). During the 2019 Site Selection Process, Option D was the preferred site for the mine. Based on the initial view by the Environmental Assessment Practitioner, Option B was fatally flawed due to the potential future Eskom substation, for which an EIA has been approved and negotiations in terms of land use between the mine and Eskom have commenced. However, subsequent to the 2019 Site Selection Process, further geotechnical studies were undertaken, which identified potential concerns for Option D, which also included the proximity of the non-perennial tributary of the Dwarsrivier River. In addition to this, the Eskom substation is no longer planned, which has reintroduced Option B into the overall assessment.

The areas are as follows:

- B: 24ha;
- C:21ha;
- D:19ha; and
- F:17ha

The heights currently anticipated of each of the facilities will be 37m, 29m, 49m and 50m respectively. The project will not involve typical tailings deposition techniques, but will involve the piping of tailings to a filter press facility from where the filter cake will be trucked to the new TSF. A life of mine of about 20 years are currently considered as part of the design.

Options C, D and F are located on the eastern boundary of the MRA, with Option D situated at the most northern point of the eastern boundary, Option C located centrally within the MRA and Option F situated towards the southern end of the eastern boundary of the MRA. Option B is located in the north, approximately 895 m west of Option D. These sites are henceforth referred to individually as Options B, Project 2:C, D and F and collectively as the "TSF alternatives".

Project 2: Diesel and Emulsion Batching

The mine plans to erect two (2) respective diesel and emulsion batching areas, to supply diesel and emulsion to the underground mining operations. The location of this area is to the north-east of the old Two Rivers Platinum Mine (TRP), just north of the new TRP TSF Pipeline. The project will include:

- Construction of an approximate 80 m access road to the diesel batching area;
- Parking Area, with security office at both areas (no dangerous good storage planned at any time);
- At the Diesel Batching area the following tanks will be present: 23 m^3 Diesel + 23 m^3 Engine Oil + 23 m^3 Hydraulic Oil;
- At the Emulsion Batching area a 60 m^3 emulsion tank will be placed; and
- Feed into pipeline for underground used at both areas.

Clearance of indigenous vegetation will be required in the order of approximately 1.3ha.

Project 3: Main Parking Extension

The Mine requires the expansion of the existing parking area at the Main Offices. The current parking area is about 0.8 ha with the parking bays not sufficient to cater for the number of vehicles. The current parking bay comprises a tarred surface area and steel roof parking bays. The same principle will be applied at the expanded area. No new entrances will be required. The planned parking bay expansion will be located about 20 m from the Springkaanspruit.

Clearance of indigenous vegetation will be required in the order of approximately 4 900 m^2.

Project 4: Widening of Access Road between South Shaft/Main Offices and Plant

An existing road provides access between the Main Office Buildings and the Plant. The current width of the road ranges between 5-6 m. To accommodate for larger vehicles such as Trucks, the mine is planning on increasing a section of 700m of this road to a width of 16 m (two way traffic).

Clearance of indigenous vegetation will be required in the order of approximately 3 311 m^2.

Project 5: Access Crossing between Plant and North Mine

To ensure more optimal logistical management of traffic between the South Mine and the North Mine, and to reduce the number of vehicles on the regional road, the mine is planning on constructing a road under the regional road bridge to allow for access between the two areas.

Clearance of indigenous vegetation will be required in the order of approximately 1 700 m^2.

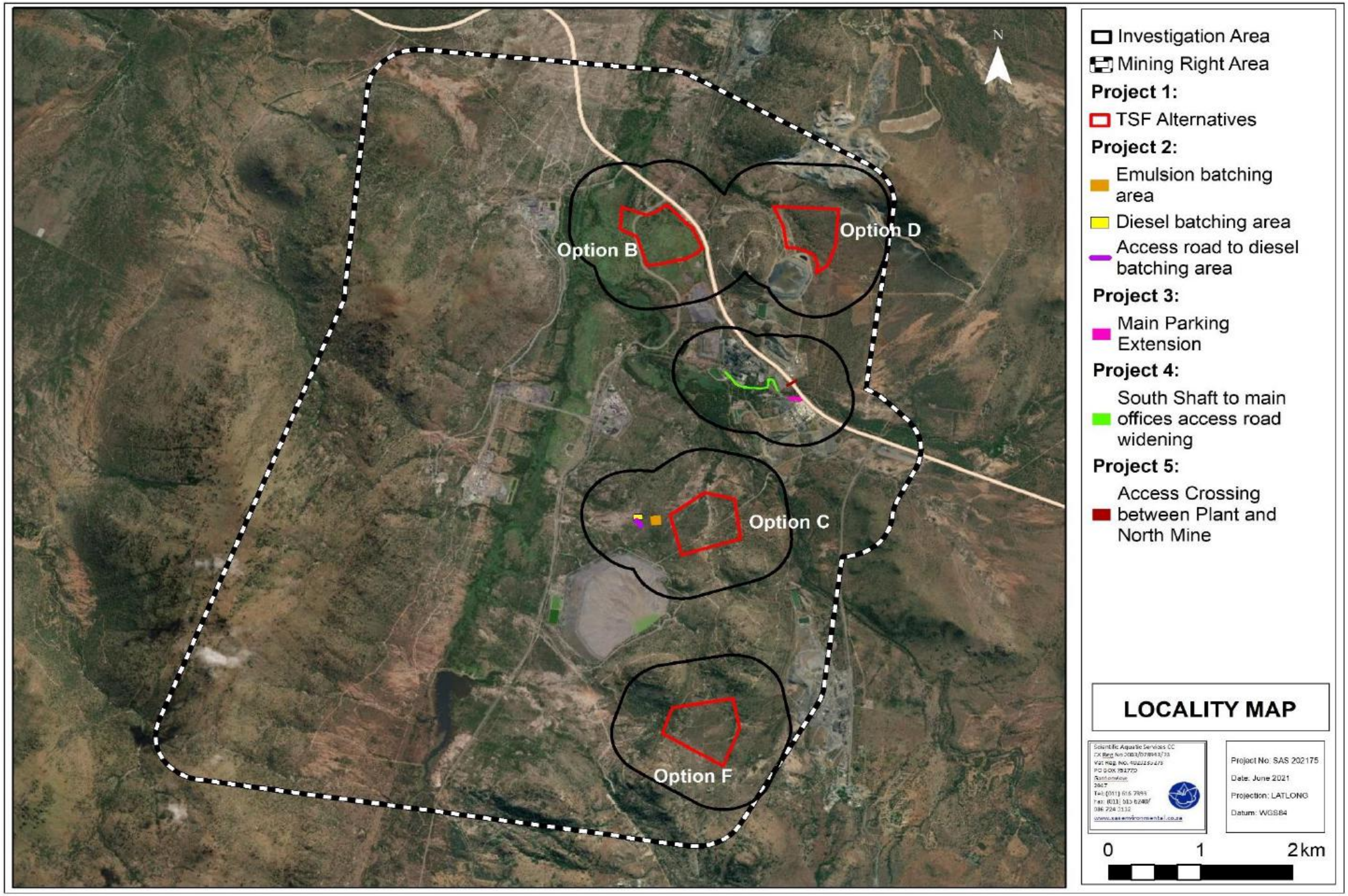

Figure 1: A digital satellite image depicting the location of the MRA and the five proposed projects (including alternatives where applicable).

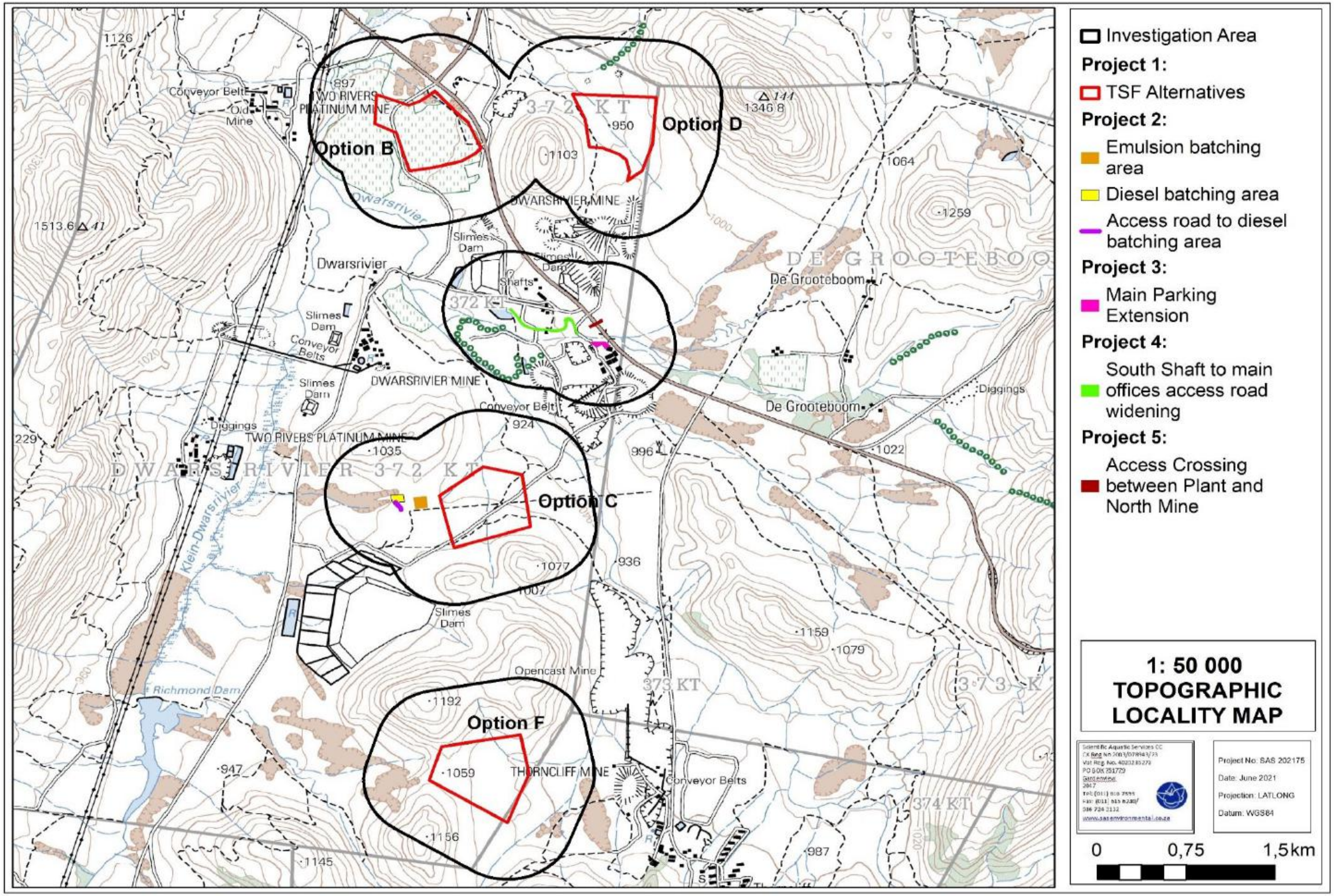

Figure 2: The five proposed projects depicted on a 1:50 000 topographical map, in relation to the surroundings.

1.3 Scope of Work

Specific outcomes in terms of this report are outlined below:

- Compile a background study of relevant national, provincial and municipal datasets (such as the National Freshwater Ecosystem Priority Areas [NFEPA] 2011 database, the National Biodiversity Assessment (2018), the Department of Water and Sanitation Research Quality Information Services [DWS RQIS PES/EIS] 2014 database) and the Limpopo Conservation Plan Version 2 (2013) to aid in defining the PES and EIS of the freshwater and aquatic resources;
- Delineation of watercourses according to "Department of Water Affairs and Forestry (DWAF[1], 2008): A practical Guideline Procedure for the Identification and Delineation of Wetlands and Riparian Zones". Aspects such as soil morphological characteristics, vegetation types and wetness were used to delineate the freshwater resources;
- To define, at a high level, through visual observations and utilisation of existing information, the freshwater and aquatic ecological integrity, importance and sensitivity of each TSF alternative option as well as the localities of proposed Projects 2 to 5; and
- To provide a comparison of each site from a freshwater and aquatic ecological perspective to allow for informed decision-making and application of the principles of Integrated Environmental Management.

1.4 Assumptions and Limitations

The following assumptions and limitations are applicable to this report:

- The determination of the watercourseboundaries and the assessment thereof, is confined to the footprint areas of each of the five proposed projects as provided by the proponent. The general surroundings were, however, considered in the desktop assessment of each area;
- Extensive amounts of information presented in this report are based on results gleaned from databases only. As such, the information gathered must be considered with caution, as inaccuracies and data capturing errors are often present within the national and provincial databases. Since this information forms part of the alternatives analysis and scoping phase, this assessment is considered to provide adequate information for informed decision making to take place and to inform the Plan of Study for the EIA;
- The delineation of watercourses within 500m (in compliance with Regulation GN509 of 2016 as it relates to the National Water Act, 1998 (Act 36 of 1998)) of each of the

[1] The Department of Water Affairs and Forestry (DWAF) was formerly known as the Department of Water Affairs (DWA). At present, the Department is known as the Department of Water and Sanitation (DWS). For the purposes of referencing in this report, the name under which the Department was known during the time of publication of reference material, will be used.

five proposed projects did not form part of the scope of this alternatives and scoping analysis;

- Similarly, the detailed assessment of the Present Ecological State (PES), Ecological Importance and Sensitivity (EIS) and provision of ecological services of any identified freshwater resources did not form part of the scope of this study. Where necessary, previous studies undertaken by SAS for the DCM were utilised to aid in defining the freshwater ecology of the proposed project footprint areas;
- Portions of TSF Option F were inaccessible due to terrain within the site, therefore whilst every effort was made to ensure that all freshwater resources within Option F were identified and delineated, less distinct features within these inaccessible areas may not have been identified;
- The footprint areas of the proposed emulsion batching area (Project 2), main parking extension (Project 3), widening of access road (Project 4) and access crossing between the Plant and North Mine (Project 5) were not ground-truthed specifically as part of this investigation. However, ground-truthing data obtained in these areas by SAS between March 2017 and March 2020 was utilised to inform the watercourse delineations and characterisation of the freshwater ecology of those areas where required;
- The delineations as presented in this report are thus regarded as a best estimate of the temporary wetland zones and riparian zones associated with ephemeral drainage lines and the river systems based on the site conditions present at the time of assessment;
- Global Positioning System (GPS) technology is inherently inaccurate and some inaccuracies due to the use of handheld GPS instrumentation may occur, however, the delineations provided in this report are deemed accurate enough to inform future decision-making and planning processes. If more accurate assessments are required the watercourses will need to be surveyed and pegged according to surveying principles and with survey equipment;
- Wetland, riparian and terrestrial zones create transitional areas where an ecotone is formed as vegetation species change from terrestrial to obligate/facultative species. Within this transition zone, some variation of opinion on the watercourseboundary may occur. However, if the DWAF (2008) method is followed, all assessors should get largely similar results; and
- With ecology being dynamic and complex, certain aspects (some of which may be important) may have been overlooked. However, it is expected that the proposed development activities have been accurately assessed and considered, based on the

field observations and the consideration of existing studies and monitoring data in terms of riparian and wetland ecology.

1.5 Legislative Requirements and Provincial Guidelines

The following legislative requirements and relevant provincial guidelines were taken into consideration during the assessment. A detailed description of these legislative requirements is presented in Appendix B:

- The Constitution of the Republic of South Africa, 1996[2];
- National Environmental Management Act, 1998, (Act No. 107 of 1998) (NEMA);
- National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) (NEMBA)
- National Water Act, 1998, (Act No. 36 of 1998) (NWA);
- General Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the NWA;
- Government Notice 704 Regulations as published in the Government Gazette 20119 of 1999 as it relates to the National Water Act, 1998 (Act 36 of 1998) regarding the use of water for mining and related activities aimed at the protection of water resources;
- Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002) (MPRDA)*;* and
- Limpopo Environmental Management Act, 2003, (Act 7 of 2003) (LEMA).

2 ASSESSMENT APPROACH

2.1 Watercourse Field Verification

For the purposes of this investigation, the definition of watercourses, wetland and riparian systems was taken as per that in the National Water Act, 1998 (Act 36 of 1998). The definitions are as follows:

A **watercourse** means:
(a) a river or spring;
(b) a natural channel in which water flows regularly or intermittently;
(c) a wetland, lake or dam into which, or from which, water flows; and

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[2] Since 1996, the Constitution has been amended by seventeen amendments acts. The Constitution is formally entitled the 'Constitution of the Republic of South Africa, 19996". It was previously also numbered as if it were an Act of Parliament – Act No. 108 of 1996 – but since the passage of the Citation of Constitutional Laws Act, neither it, nor the acts amending it are allocated act numbers.

(d) any collection of water which the Minister may, by notice in the *Gazette,* declare to be a watercourse,

and a reference to a watercourse includes, where relevant, its bed and banks.

Wetland habitat is "land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."

Riparian habitat includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterized by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure **distinct** from those of adjacent areas.

The watercourse delineation took place according to the method presented in the "Updated manual for the identification and delineation of wetland and riparian resources" (DWAF, 2008). The foundation of the method is based on the fact that freshwater resources have several distinguishing factors including the following:

- Landscape position;
- The presence of water at or near the ground surface;
- Distinctive hydromorphic soils;
- Vegetation adapted to saturated soils; and
- The presence of alluvial soils in stream systems.

A field assessment of the proposed TSF alternatives was undertaken in early December 2018 in mid-summer, and of the proposed fuel storage area alternatives in March 2020 in late summer, during which the presence of any riparian or wetland characteristics as defined by DWAF (2008) and by the NWA, were noted within each of the TSF alternative options. In addition, each alternative option was assessed in terms of freshwater and aquatic ecological integrity.

2.2 Sensitivity Mapping

All freshwater resources associated with each of the TSF and alternative options an Projects 2 to 5 were delineated with the use of a GPS. Geographic Information System (GIS) was used to project these features onto digital satellite imagery and topographic maps. The sensitivity map presented in Section 4.3 should guide the design and layout of the development.

3 RESULTS OF THE DESKTOP ANALYSIS

3.1 Conservation Characteristics of the five proposed project areas

The following section contains data accessed as part of the desktop assessment and are presented as a "dashboard" style report below (Table 1). For the purposes of providing context, the background data was accessed for the entire MRA, and where necessary, specifics pertaining to the specific proposed projects are emboldened where considered relevant.

The dashboard report aims to present concise summaries of the data on as few pages as possible to allow for integration of results by the reader to take place. Where required, further discussion and interpretation is provided, and information that was considered of particular importance was emboldened.

It is important to note that although all data sources used provide useful and often verifiable, high quality data, the various databases used do not always provide an entirely accurate indication of the study area's actual site characteristics at the scale required to inform the environmental authorisation and/or water use licencing processes. Given these limitations, this information is considered useful as background information to the study. It must however be noted that site verification of key areas may potentially contradict the information contained in the relevant databases, in which case the site verified information must carry more weight in the decision-making process. Thus, this data was used as a guideline to inform the watercourse scoping assessment and to focus on areas and aspects of increased conservation importance during the site assessment.

Table 1: Desktop data relating to the character of freshwater resources associated with the five proposed projects.

Aquatic ecoregion and sub-regions in which the five proposed projects are located	
Ecoregion	Eastern Bankenveld
Catchment	Olifants North
Quaternary Catchment (Figure 3)	Projects 2 to 5 and TSF Alternatives C and F and the majority of Option B fall within B41G, with the remaining northern portion of Option B and the entire Option D falls within B41H.
WMA	Olifants
subWMA	Steelpoort

Dominant characteristics of the Eastern Bankenveld Ecoregion Level II (9.03) (Kleynhans *et al.*, 2007a)	
Dominant primary terrain morphology	Closed hills, Mountains; Moderate and high relief, low mountains
Dominant primary vegetation types	Mixed Bushveld
Altitude (m a.m.s.l)	500 to 2300
MAP (mm)	400 to 700
Coefficient of Variation (% of MAP)	20 to 34
Rainfall concentration index	55 to 64
Rainfall seasonality	Early summer
Mean annual temp. (°C)	14 to 22
Winter temperature (July)	2 to 20 °C
Summer temperature (Feb)	12 – 30 °C
Median annual simulated runoff (mm)	20 to 150

Ecological Status of the most proximal sub-quaternary reach (DWS, 2014) (Figure 4)		
Sub-quaternary reach	B41G – 00674 (Groot Dwars River)	B41H – 00640 (Dwars River)
Assessed by expert?	Yes	Yes
PES Category Median	**Class D (Largely Modified)**	
Stream Order	2	2
Mean Ecological Importance (EI) Class	**High**	**High**
Mean Ecological Sensitivity (ES) Class	**Very High**	**High**
Default Ecological Class (based on median PES and highest EI or ES mean)	Class A (Very High)	Class B (High)

Importance of the five proposed projects according to the Mining and Biodiversity Guidelines (2013)
The five proposed projects fall within an area considered to be of **Highest Biodiversity Importance**. Highest Biodiversity Importance areas include areas where mining is not legally prohibited, but where there is a very high risk that due to their potential biodiversity significance and importance to ecosystem services (e.g. water flow regulation and water provisioning) that mining projects will be significantly constrained or may not receive the necessary authorisations.

Detail of the five proposed projects in terms of the National Freshwater Ecosystem Priority Area (NFEPA) (2011) database	
FEPACODE (Figure 5)	Projects 2 to 5 and TSF Alternatives Options C and F and the majority of TSF Alternative Option B fall within an area defined as a **FEPA catchment**, with the remaining northern portion of TSF Alternative Option B and the entire Option D located within an area considered a **Fish Support Area (FSA)**. **River Freshwater Ecosystem Priority Areas (FEPA)** achieve biodiversity targets for river ecosystems and threatened fish species and were identified in rivers that are currently in a good condition (A or B ecological category). Although the FEPA status applies to the actual river reach, the surrounding land and smaller stream network needs to be managed in a way that maintains the good condition of the river reach. Remaining fish sanctuaries in lower than an A or B ecological condition were identified as **Fish Support Areas**. Furthermore, the Fish Support Areas include sub-quaternary catchments important for migration of threatened fish species.
NFEPA Wetlands and Rivers (Figure 6 & 7)	• **No wetlands or rivers are indicated by the NFEPA database within any of the five proposed projects.** • The database indicates three small artificial unchannelled valley bottom wetlands located within the investigation area of the proposed project 4. These wetlands are considered to be heavily to critically modified (Class Z3). Analysis of digital satellite imagery indicates that these are various mine process water dams. • The Dwars River is located within the western portion of the TSF Alternative Option B's investigation area. The river is a designated FSA and is currently in a moderately modified ecological condition (Class C). • The Groot-Dwars River traverses the south western portion of the TSF Alternative Option B's investigation area and the north eastern portion of TSF Alternative Option C's investigation area. This river is considered largely natural (Class B) and is a designated FEPA River.
Wetland vegetation Type	The five proposed projects fall within the Central Bushveld Group 1 Wetland Vegetation Type, considered critically endangered (CR) (Mbona *et al*, 2015).

Detail of the five proposed projects in terms of the Limpopo Conservation Plan Version 2 (2013) (Figure 8)	
Critical Biodiversity Area (CBA) 1	The Projects 1, 2 3 and 5 and the majority of Project 4 falls within areas is defined as a **Category 1 CBA.** These are "Irreplaceable" areas, which are required to meet biodiversity pattern and/or ecological processes targets; and with no alternative sites available to meet targets.
Ecological Support Area (ESA) 2	A small portion of Project 4 falls within an area defined as a **Category 2 ESA**. These are areas where no natural habitat remains, but that are still important for meeting ecological processes.

National Biodiversity Assessment (2018): South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (Figure 9)
According to the NBA (2018):SAIIAE the artificial features identified by the NFEPA Database (2011) to be located within the investigation area, are classified as dams. The Dwars and Groot-Dwars Rivers are largely modified according to the NBA 2018 Dataset. The Ecosystem Protection Level (EPL) of the rivers are poorly protected and therefore the rivers are critically endangered (Ecosystem Threat Status (ETS)).

National Web-based Screening Tool (2020)		
The screening tool is intended to allow for pre-screening of sensitivities in the landscape to be assessed within the EA process. this assists with implementing the mitigation hierarchy by allowing developers to adjust their proposed development footprint to avoid sensitive areas.		
For the aquatic biodiversity theme, the five proposed projects, with the exception of a portion of the TSF Alternative Option B and the entire Option D, are considered to have an overall **aquatic sensitivity of very high,** due to the area being classified as a FEPA catchment (NFEPA, 2011). The remaining northern portion of the TSF Alternative Option B and the entire Option D has a **low aquatic sensitivity.**		
Strategic Water Source Areas for Surface Water (2017)		
Surface water SWSAs are defined as areas of land that supply a disproportionate (i.e. relatively large) quantity of mean annual surface water runoff in relation to their size. They include transboundary areas that extend into Lesotho and Swaziland. The sub-national Water Source Areas (WSAs) are not nationally strategic as defined in the report but were included to provide a complete coverage.	Name and Criteria	The five proposed projects do not fall within a SWSA.

CBA = Critical Biodiversity Area; DWS = Department of Water and Sanitation; EI = Ecological Importance; ES = Ecological Sensitivity; ESA = Ecological Support Area; m.a.m.s.l = Metres Above Mean Sea Level; MAP = Mean Annual Precipitation; NBA = National Biodiversity Assessment; NFEPA = National Freshwater Ecosystem Priority Areas; PES = Present Ecological State; SAIIAE = South African Inventory of Inland Aquatic Ecosystems; WMA = Water Management Area.

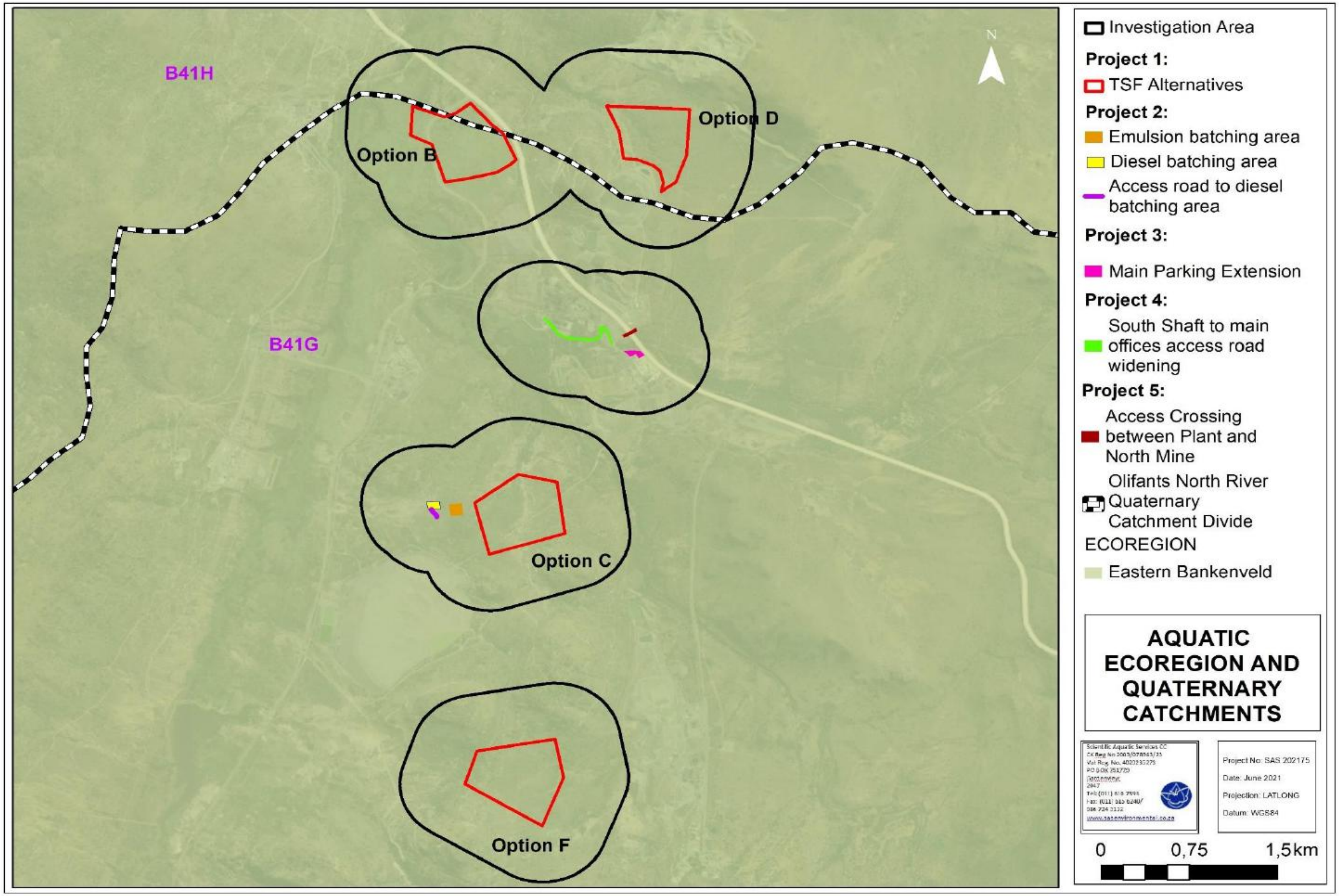

Figure 3: The aquatic ecoregion and quaternary catchments associated with the proposed five projects.

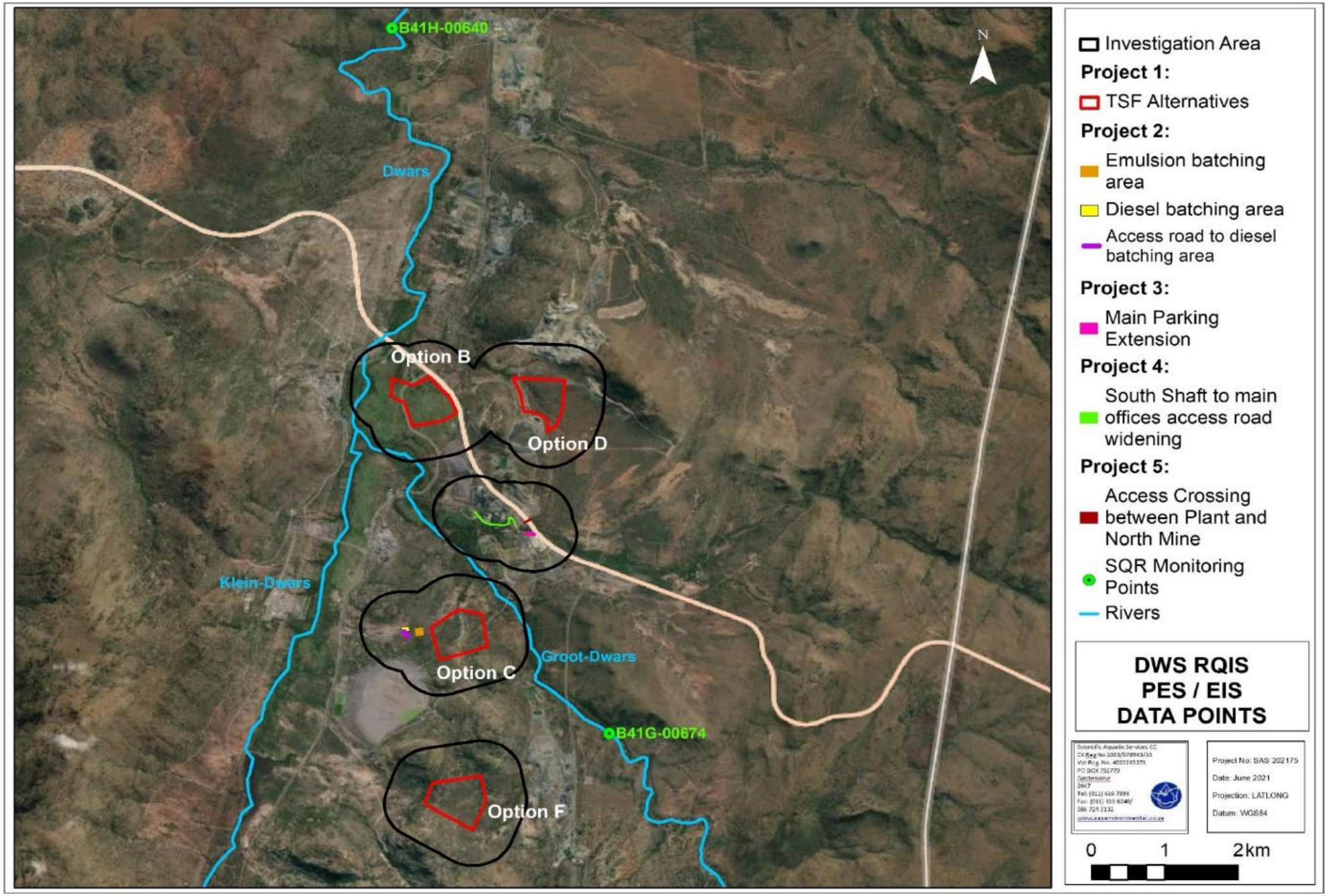

Figure 4: Relevant sub-quaternary catchment reaches (SQR) associated with the five proposed projects.

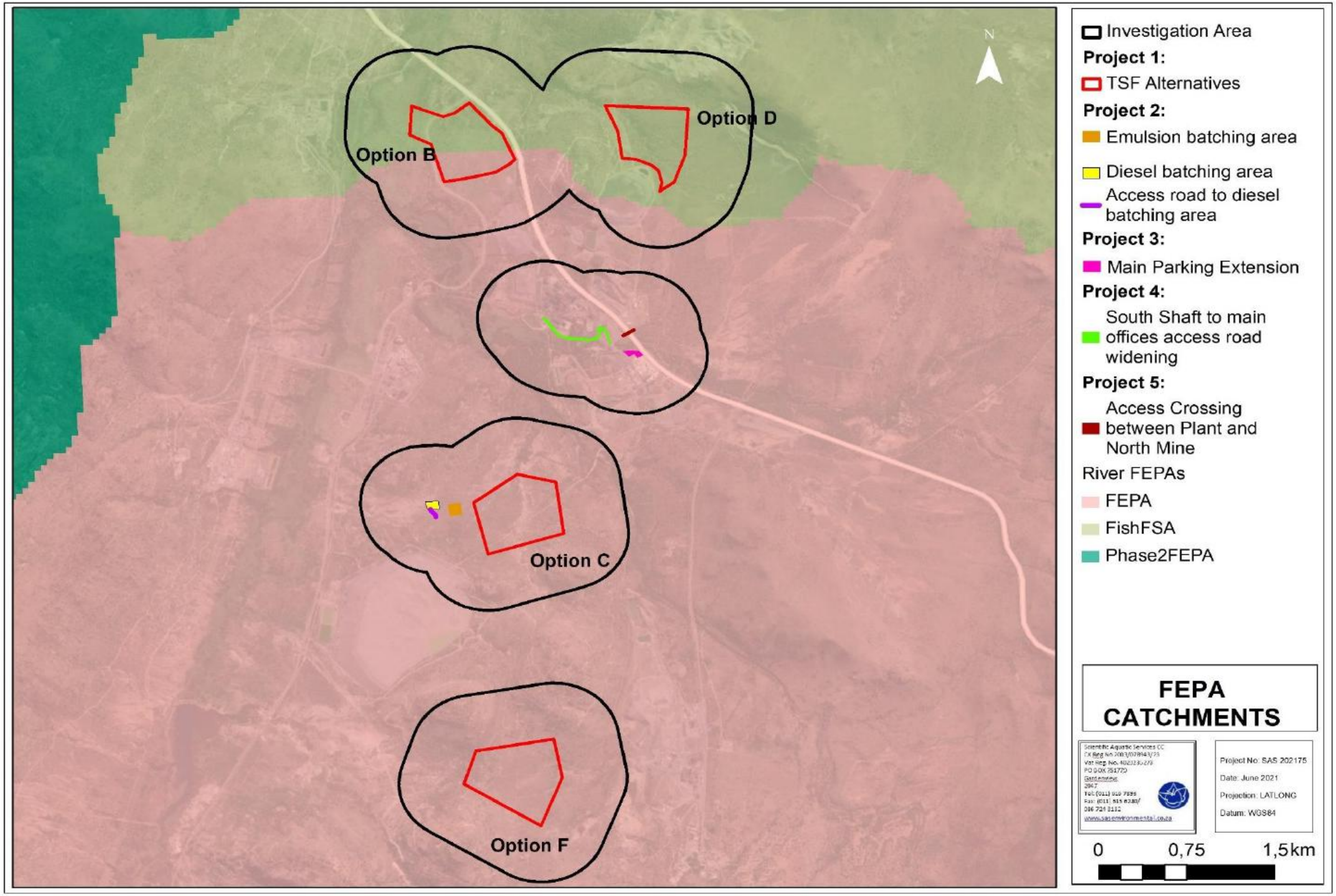

Figure 5: The FEPA catchment status of the five proposed projects according to the NFEPA Database (NFEPA, 2011).

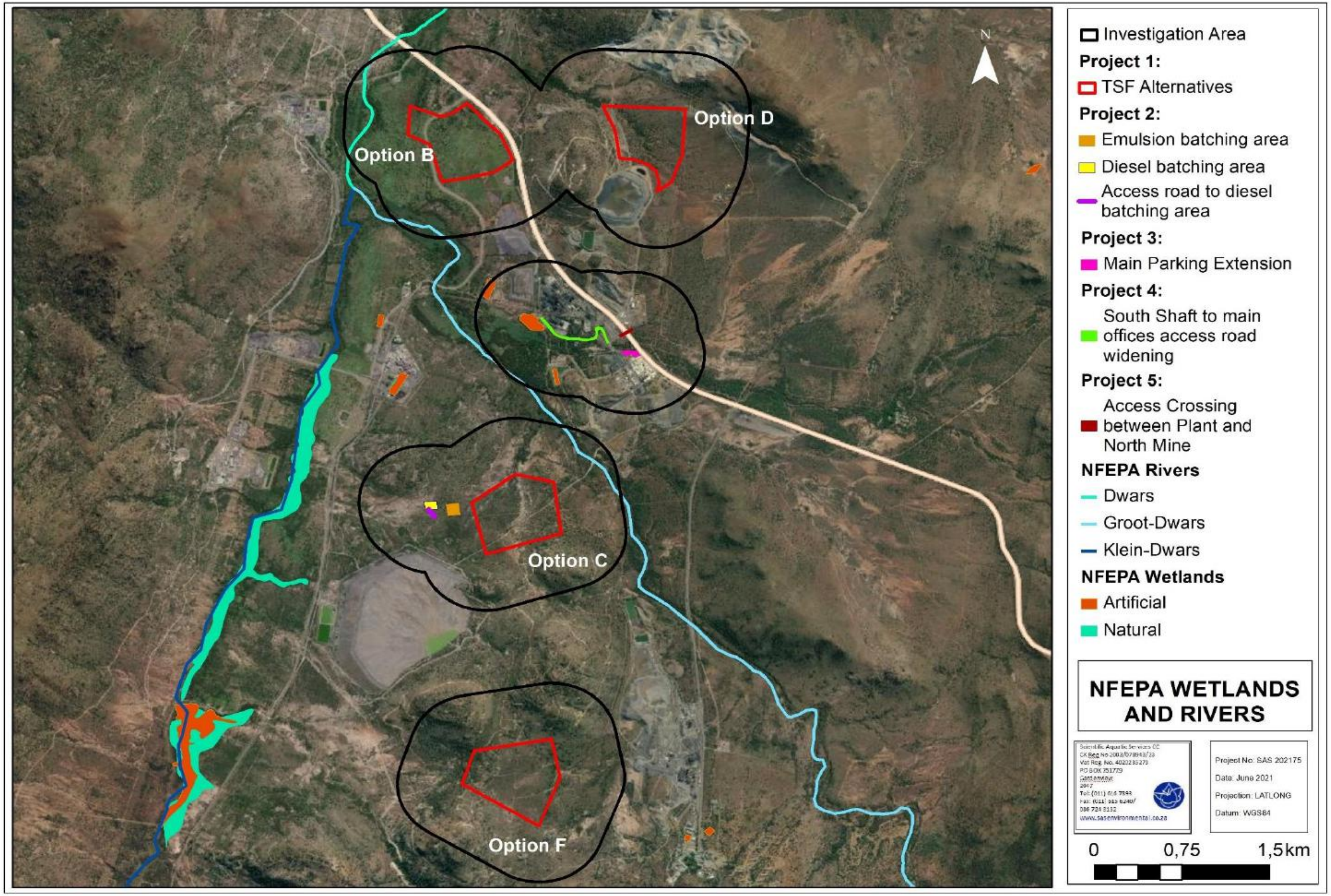

Figure 6: The natural and artificial wetland features, and rivers associated with the five proposed projects according to the NFEPA Database (2011).

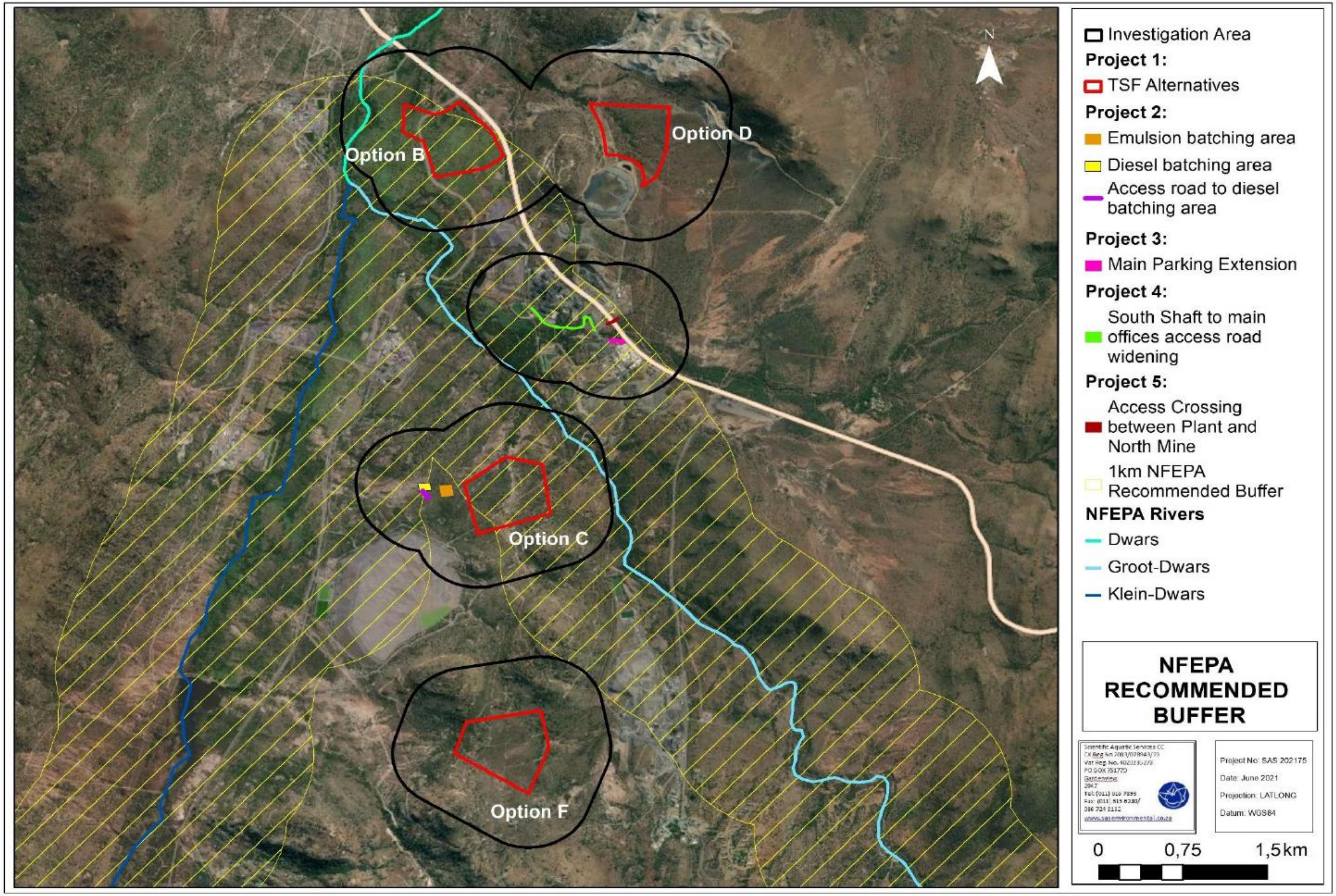

Figure 7: The 1 km recommended buffer around the FEPA Rivers, according to the NFEPA Database (2011).

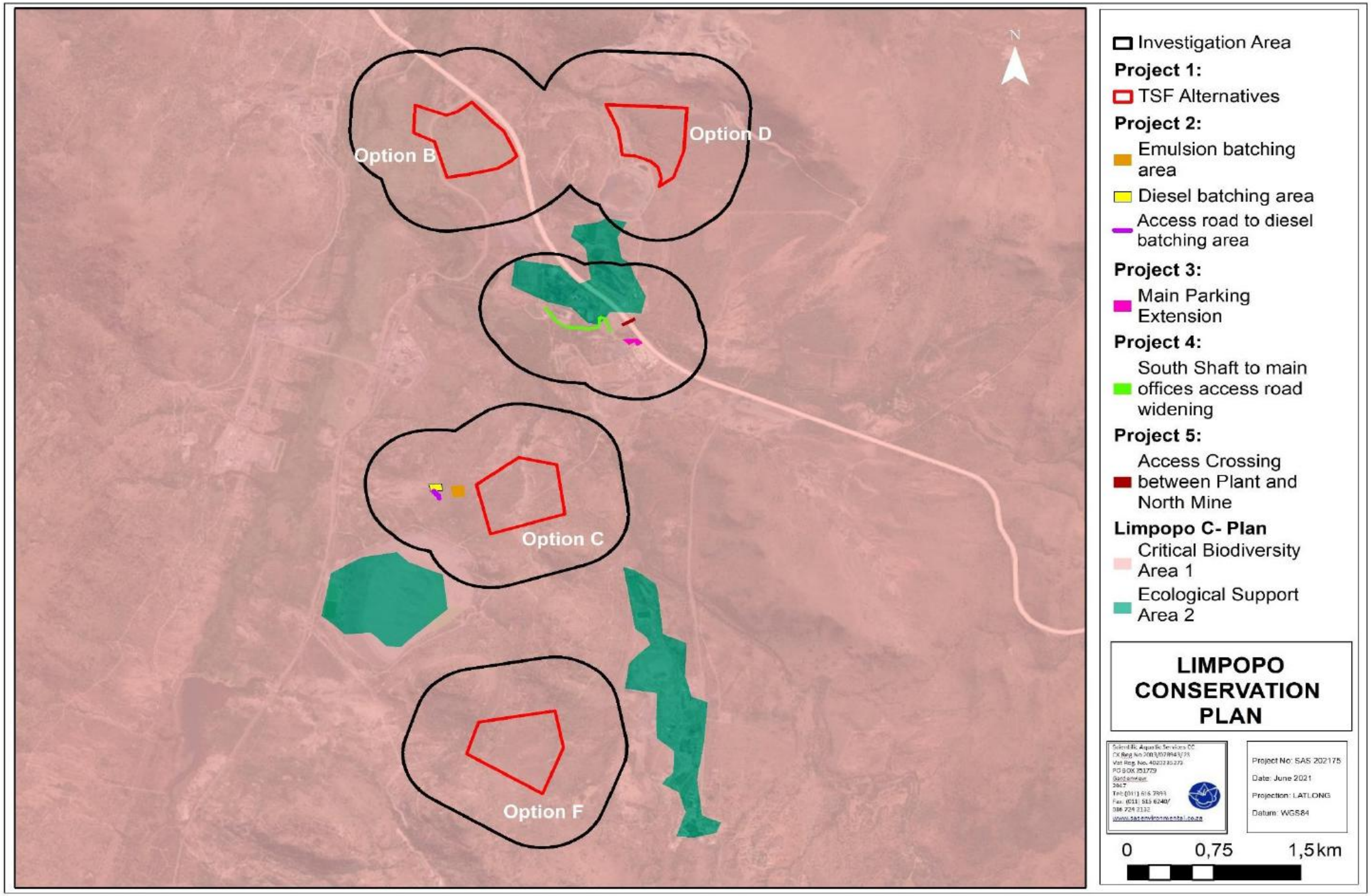

Figure 8: Critical Biodiversity Areas (CBA) and Ecological Support Areas (ESA) associated with the five proposed projects according to the Limpopo Conservation Plan (2013).

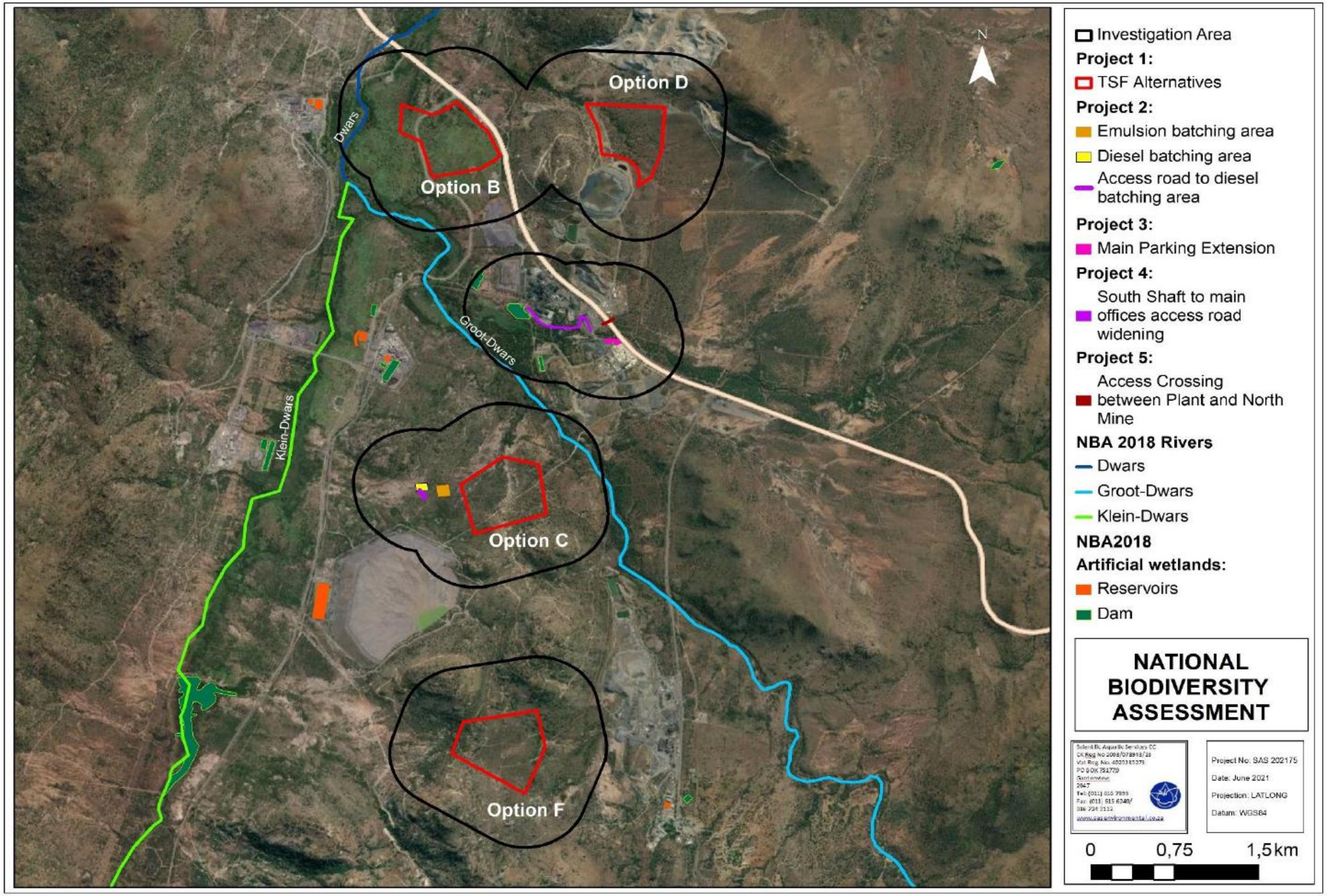

Figure 9: Artificial wetlands associated with the five proposed projects according to the National Biodiversity Assessment (NBA) (2018).

4 DELINEATION AND SENSITIVITY MAPPING

4.1 Delineation

As noted in Section 1.3, the watercourse delineations were limited to each of the proposed project footprint areas only, although these delineations were augmented with data obtained during previous studies undertaken by SAS. The delineations as presented in this report are thus regarded as a best estimate of the riparian zone boundaries based on the site conditions associated with each of the five proposed projects at the time of assessment.

During the field assessments, the following indicators were used to delineate the boundaries of the watercourses:

- Terrain units were used as the primary indicator, as the terrain of all the sites have well-defined low-lying areas where water is likely to collect and/or move through the landscape;
- Vegetation was utilised as a secondary indicator, although floral species composition in the riparian zones did not necessarily differ significantly from that of the surrounding terrestrial areas, particularly in the highly ephemeral systems identified in Sites C and F. However, increased floral density along the watercourses are usually a key indicator of increased soil moisture and this was therefore used to delineate riparian zones;
- Soil morphological characteristics typically associated with wetland conditions, such as gleying or mottling, are generally not present within the MRA due to the characteristics of the dominant soil types, and by association are generally not present within the proposed project footprint areas. Therefore, the soil indicator was not used extensively.

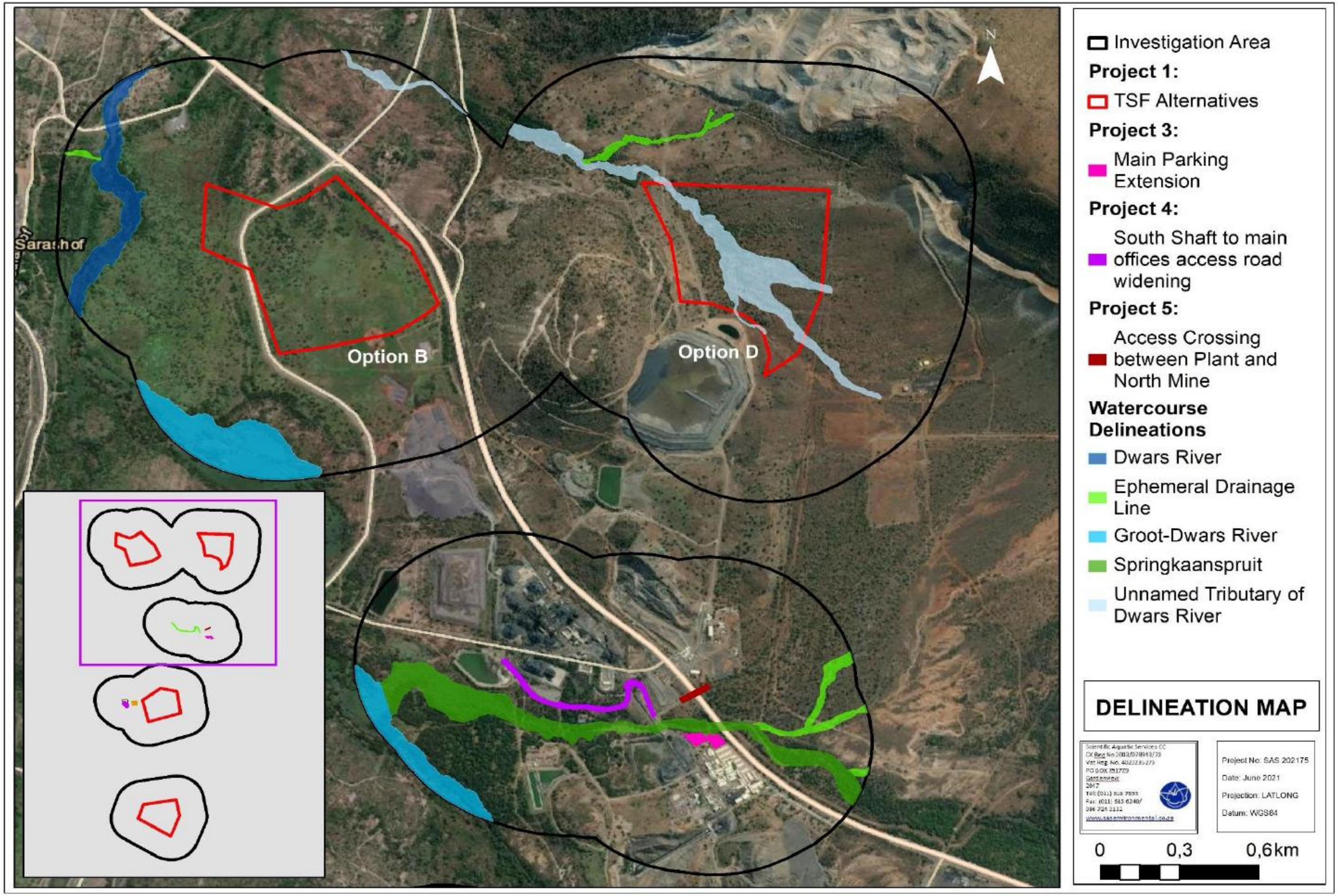

Figure 10: Identified watercourses within the vicinity of Projects 1,3, 4 and 5.

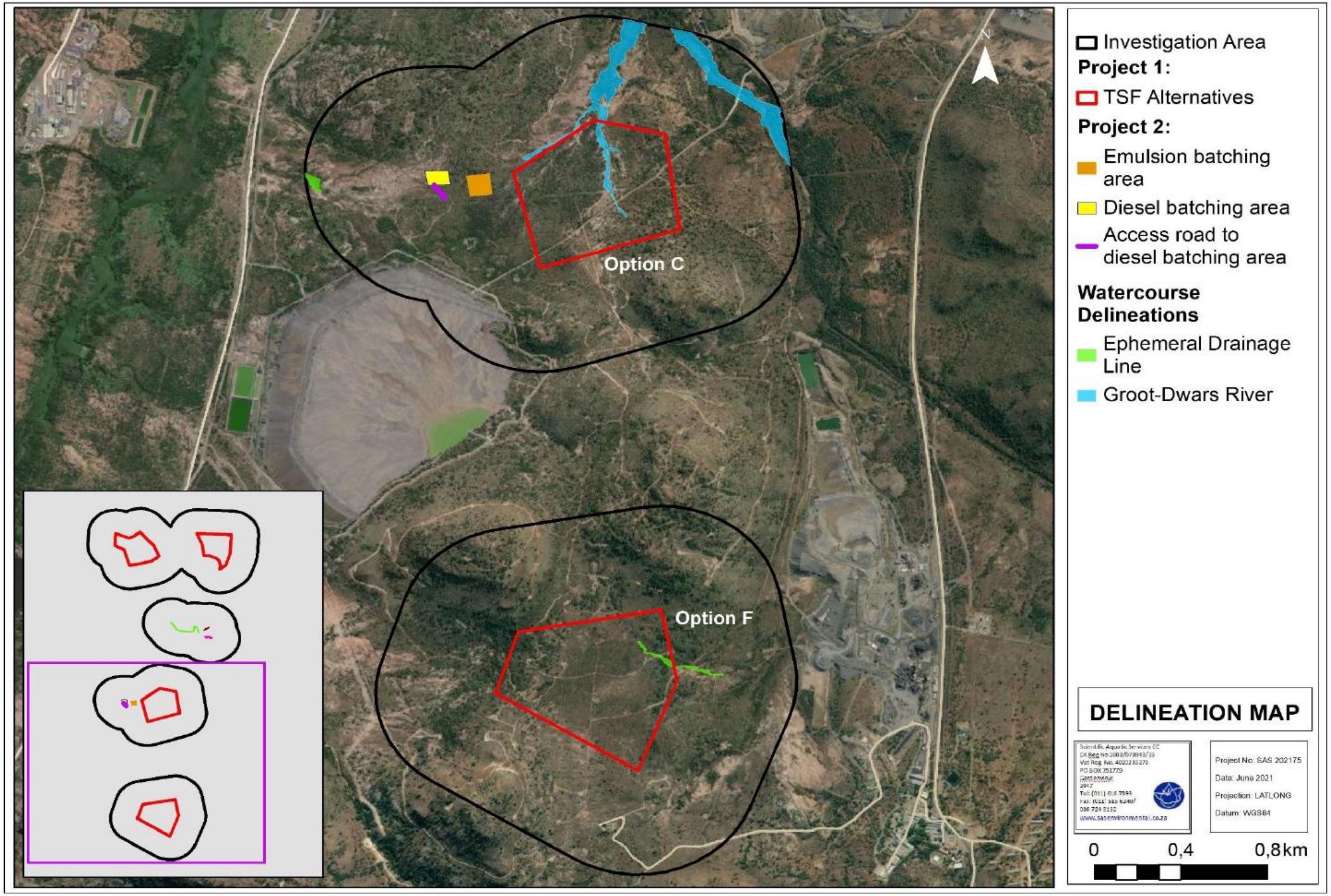

Figure 11: Identified watercourses within the vicinity of Projects 1 and 2.

5 PROPOSED PROJECTS ANALYSIS RESULTS

As noted in Section 1.1 and 1.4, SAS has previously undertaken various freshwater ecological assessments for the DCM, and therefore, where relevant, previous studies were used to inform this investigation. Additional site assessments were undertaken specifically for the proposed TSF alternatives in December 2018 (Alternatives C, D and F) and May 2021 (Alternative B). The proposed diesel and emulsion batching sites were not specifically ground-truthed; however, a site visit was undertaken in March 2020, during which three previously identified potential fuel storage sites were assessed. Those sites were located within 500 m of the proposed diesel and emulsion batching sites and therefore, the data obtained for those sites was utilised for the purposes of assessing the proposed diesel and emulsion batching sites.

5.1 Project 1: TSF Alternatives Analysis Results

During the field assessments undertaken in December 2018 and May 2021, each TSF alternative (B, C, D and F) was assessed in terms of location, freshwater and aquatic habitat availability, ecological importance and sensitivity and any potential impacts on freshwater resources within each site which may occur as a result of the proposed activity. Previous studies conducted by SAS (2018) in the area as well as the relevant desktop data was used to provide input into the suitability and constraints of each alternative.

Figures 10 and 11 above indicate the locality of the identified watercourses within or associated with each of the four TSF alternatives, and the short ‘dashboard style’ reports below discuss the TSF alternatives in terms of freshwater ecology and the opportunities and constraints associated therein are presented.

5.1.1 TSF Alternative Option B

Table 2: Summary of the freshwater and aquatic environment associated with TSF Alternative option B



<table>
<tr><td colspan="2">Photograph notes: Representative photographs of portions of Option B. No obligate, facultative or riparian vegetation was identified within the site, nor did the soil morphological characteristics indicate mottling or gleying, which would potentially indicate a fluctuating water table.</td></tr>
<tr><th>General Discussion and Site Analysis Results</th><th>Business Case, Conclusion and Alternatives Analysis:</th></tr>
<tr><td>Although the topographic map (Figure 2) indicates an ephemeral drainage line within Option B, no watercourses were identified directly therein. The site is however located 230 m east and upgradient of the Dwars River, which flows south to north, confluencing with the Steelpoort River approximately 14.5 km downstream of Option B. Additionally, Option B is located approximately 385 m south, and downgradient of an ephemeral, unnamed tributary of the Dwars River (this unnamed tributary is associated with Option D; please refer to Table 4 for further detail of that watercourse).

According to available databases (refer to Section 3) the Dwars River is deemed an ecologically important and sensitive freshwater ecosystem (DWS, 2014), ‘moderately modified’ (NFEPA, 2011) and ‘moderately modified’ according to the NBA (2018). It is also classified as a Fish Support Area (NFEPA, 2011) SAS (2018) assessed the reach of the Dwars River associated with the DCM MRA and found that the riparian zone was moderately modified, and instream habitat was largely natural, and that the ecological importance and sensitivity correlated with the ‘very high’ category assigned by the various databases.</td><td>Direct impacts to the receiving freshwater environment as a result of placement of the proposed TSF within Option B are not expected; however, the following indirect impacts could occur:
➢ Potential impacts on water quality of the Dwars River in the event of a spill;
➢ Loss of catchment yield and therefore loss of recharge of the downgradient system (i.e. the Dwars River);
➢ Potential for increased sediment volumes to be transported in stormwater runoff to the downgradient reach of the Dwars River; and
➢ Changes to hydraulic patterns, in turn impacting on riparian vegetation.

Whilst impacts to surrounding watercourses may potentially occur due to the necessity for additional infrastructure such as pipelines and access roads, the impacts of such infrastructure crossings can be adequately minimised to reduce the significance thereof. Nevertheless, from a freshwater conservation perspective, Option B is preferred due to the absence of any watercourses directly within the site.</td></tr>
</table>

5.1.2 TSF Alternative Option C

Table 3: Summary of the freshwater and aquatic environment within TSF Alternative Option C



Photograph notes: Representative photographs of various sections of the reach of the unnamed tributary of the Groot Dwars River traversing the central portion of Option C. As illustrated in these photographs, riparian vegetation is sparse due to the ephemeral nature of the system. Erosion and incision is also apparent, due to the erosive and dispersive nature of the soils within the area.

General Discussion and Site Analysis Results	Business Case, Conclusion and Alternatives Analysis:
A single watercourse was identified within the central portion of Option C, forming part of the headwaters of the Groot Dwars River, draining south to north into the Groot Dwars River (as visually represented in Figures 10 and 11 above). This watercourse is ephemeral, thus riparian vegetation is scarce in some reaches of the system, particularly in the upper reaches. Additionally, due to the erosive soils within the area (refer to the specialist soils and land capability report, SAS 2019), bank incision is severe in some sections of the freshwater system, particularly those areas with minimal riparian vegetation. Nevertheless, although a full analysis of the PES, EIS and ecological service provision was not undertaken, the watercourse is considered to be in a largely natural to moderately modified ecological condition, and most likely of moderate EIS. Ecological service provision is likely to be moderately low to intermediate, since the system is ephemeral; however it is likely to be relatively important in terms of biodiversity maintenance and provisioning of a faunal migratory corridor especially given the connectivity to the Groot Dwars River.	Placement of the proposed TSF within Option C could potentially result in the following impacts: ➢ Total loss of watercourse habitat for a portion of the watercourse; ➢ Even if total loss of the headwaters of this system does not occur, some encroachment on riparian habitat is likely; ➢ Increased erosion and sedimentation of the remains of this watercourse as well as of the downstream system; ➢ Potential impacts on water quality of the Groot Dwars River in the event of a spill; ➢ Loss of catchment yield and therefore loss of recharge of downstream systems; and ➢ Changes to hydraulic patterns, in turn impacting on riparian vegetation. In addition to the above, impacts on surrounding watercourses is anticipated, since placing the TSF within Option C would necessitate additional infrastructure such as pipelines and access roads. Therefore, from a freshwater ecological and conservation perspective, Option C is not a preferred option.

5.1.3 TSF Alternative Option D

Table 4: Summary of the freshwater and aquatic environment within TSF Alternative Option D.

Photograph notes: Representative photographs of sections of the reach of the unnamed tributary of the Dwars River which traverses Option D. Proximity of existing mining activities (not related to DCM operations) to the watercourse is apparent (centre) as is stream bank incision in some reaches of the resource (right).

General Discussion and Site Analysis Results	Business Case, Conclusion and Alternatives Analysis:
As in Option C, a single watercourse was identified within Option D (as visually represented in Figures 10 and 11 above). This watercourse was previously identified by SAS (2018) as an unnamed tributary of the Dwars River and was ascertained at the time of that study to be largely natural to moderately modified (PES Category B/C), of moderate EIS, and providing an intermediate level of ecological and socio-cultural services. These results were based on observations made primarily in the lower reaches of the system, and it is the opinion of the ecologist, after observing the upper reaches of the system that the results previously obtained remain valid. However, erosion and bank incision in the upper reaches was noted to be more severe than in the lower reaches, although vegetation cover is greater and fewer disturbances to the riparian zone were observed. Impacts on the watercourse by existing mining activities in the catchment (not related to the operations of DCM) are anticipated and include increased sedimentation (which may exacerbate erosion), impaired surface water quality (when present; this system is ephemeral), and increased wildlife pressure (grazing and trampling) due to loss and fragmentation of habitat in the surrounding areas.	Anticipated impacts arising from placement of the proposed TSF in this site are identical to those expected in Option C and impacts to this watercourse may also have ramifications for the downstream system (i.e. the Dwars River). Therefore, purely from a watercourse conservation perspective, Option D is considered to potentially have an unacceptably high impact on the freshwater resource. However, in consideration of the surrounding mining activities and anticipated encroachment thereof, locality of Option D in relation to the DCM existing TSF, and the reduced requirement for additional infrastructure as a result of this location (since existing infrastructure is within close proximity), makes it the preferred site for the proponent. As such it is the opinion of the freshwater ecologist that Option D may be utilised for the TSF and that the remaining sites not be further impacted upon in order to maintain the present ecological integrity of the freshwater systems therein. However, it is imperative that consideration be given to the potential impacts of known future activities in the remainder of the MRA in order to ensure that further degradation of the freshwater systems within the other sites does not occur and as such the cumulative impacts on freshwater ecology within the greater area can be minimised. Should Option D be selected, very strict mitigation measures will need to be implemented throughout the life of the mine in order to minimise residual and direct impacts on the freshwater ecology of the site. Such mitigation is likely to include a river diversion and potentially a watercourse offset initiative, as well as general best practice measures expected for a project of this nature such as lining the TSF appropriately and spill prevention measures.

5.1.4 TSF Alternative Option F

Table 5: Summary of the freshwater and aquatic environment within TSF Alternative Option F

Photograph notes: Representative photographs of the reach of the ephemeral drainage line associated with Option F. Impacts noted within the site included two road crossings (left) however, aside from these, few impacts were noted.

General Discussion and Site Analysis Results	Business Case, Conclusion and Alternatives Analysis:
Access limitations relating to the terrain of the site were experienced during the site assessment, however, observations during the site assessment combined with analysis of digital satellite imagery indicated that the headwaters of a single watercourse are located close to the eastern border of the site. The upper reach of the watercourse – i.e. the portion within Option F – is limited in extent with a very weakly defined riparian zone. The reach of the system located within Option F has undergone very limited impacts, with only two informal road crossings noted during the assessment. However, based on analysis of digital satellite imagery, it is considered very likely (although unverified during this assessment) that the lower reaches of the watercourse have already been significantly impacted, by the construction of infrastructure belonging to the neighbouring Thorncliffe Mine.	From a freshwater management perspective, Option F is considered the second most suitable site (Option B being the most suitable) for the construction of the proposed TSF, since there are no major freshwater systems traversing or within the site. Whilst the headwaters of a smaller system are located within this site, the lower reaches of that system appear to have been significantly impacted and potentially no longer function optimally (although this cannot be confirmed without assessing the reaches in question). Therefore, purely from the perspective of protection and preservation of watercourses within Option F and reducing the cumulative impact on watercourses within the catchment and greater MRA, this is a potentially viable alternative site as it will have minimal direct impact on freshwater and aquatic ecology. However, it is acknowledged that should the proposed TSF be constructed in Option F, additional infrastructure such as pipelines and access roads will need to be constructed, which will most likely need to traverse several other watercourses. Nevertheless, there remains a quantum of risk to other watercourses, as the potential for spills and construction-related impacts is increased due to the extent of such a network of pipelines, and the distance over which such pipelines would need to traverse. The impact of such activities can only be ascertained once a layout is provided.

5.2 Project 2: Proposed Diesel and Emulsion Batching Sites

Although the sites proposed for the diesel and emulsion batching sites have not been specifically ground-truthed, field-verified data obtained in March 2020 for three sites located between 30 m and 100 m south and south-west of the two proposed batching sites, along with available historical data for watercourses within 50 m thereof and relevant desktop data was used to provide input into the suitability and constraints of each alternative.

It is important to note that no watercourses were identified directly within either the proposed batching areas; however, watercourses were identified within 500 m thereof. Additionally, during the March 2020 site assessment, an area of increased moisture was identified was identified approximately 350 m to the south-west of the proposed diesel batching area. Although graminoid species which are tolerant of increased soil moisture were identified within this area of increased moisture, numerous species which are typically associated with non-wet areas were present. Furthermore, the soil profile was extremely shallow (no more than 10 cm to 15 cm), did not indicate any characteristics associated with a fluctuating water table (such as mottling) and was notably disturbed, containing sediments not found in the immediately adjacent areas (see Figure 12 below). Additionally, surface water which was present appeared to be contaminated, based on a visual assessment. Based on the observations made during the site assessment and the analysis of 5 m contours of the site, historical aerial photographs and digital satellite imagery, it was concluded that this feature has formed as a result of seepage from the existing Two Rivers Platinum TSF and is not a naturally occurring feature.

Figure 12: Soil sample taken within the wet feature (left) and potentially contaminated surface water present in isolated small areas of ponding (right).

Since the scope of work did not include the delineation of watercourses within 500 m of the alternative sites, both proposed batching areas are discussed in a single dashboard-style report below, discussing each area in terms of freshwater ecology, and opportunities and constraints associated therein. The watercourses situated within 500 m of the fuel storage areas are depicted in Figure 11 in Section 4.1.

Table 6: Summary of the freshwater and aquatic environment associated with the proposed diesel and emulsion batching areas.



Photograph notes: (left to right) an erosion gully situated approximately 342 m south-east of the diesel batching area; an erosion gully within the diesel batching area and the wet feature identified approximately 350 m south-west of the emulsion batching area. The Two Rivers Platinum TSF is visible in the background.

General Discussion and Site Analysis Results	Business Case, Conclusion and Alternatives Analysis:
As noted previously, no watercourses were identified within either the proposed diesel or emulsion batching areas, although watercourses were identified within 500 m thereof. Furthermore, both batching areas are situated upgradient of the identified watercourses, therefore although no direct impact is likely, indirect impacts such as possible contamination in the event of a spill may occur. The erosion gullies located to the south-east of the diesel batching area did not display any characteristics consistent with either wetland or riparian ecosystems, however, in both instances these features may act as preferential surface flow paths, conveying water to downgradient watercourses. The wet feature located 350 m south-west of the emulsion batching area was thoroughly investigated. Whilst hydrophytic vegetation was present, the soil profile indicated disturbance (anthrosols), as when compared with soil samples from adjacent dry areas, it was apparent that deposition of foreign material has occurred, most likely transported from the upgradient TSF during rainfall events. Furthermore, although key wetland soil morphological characteristics such as mottling and gleying often do not manifest in the area due to the dominant vertic soils, none were observed in the wet feature. These on-site observations, coupled with analysis of topographic maps, historical aerial photographs and available digital satellite imagery, indicate that the feature is not naturally occurring, and has most likely formed as a result of seepage or runoff from the upgradient TSF.	Since no watercourses were identified within either the diesel or emulsion batching area, no direct impacts to the surrounding watercourses are expected and therefore from that perspective, there are no constraints posed to the proposed development within these areas. However, both sites are situated upgradient and within 500 m of watercourses, thus, indirect and cumulative impacts on downgradient watercourses must be minimised. Both proposed batching areas are located upgradient of an ephemeral drainage line which confluences with the Klein Dwars River. Although the erosion gully associated with the proposed diesel batching area does not display any watercourse characteristics, it may act as a preferential flow path, conveying water to the ephemeral drainage line. Additionally, the proposed emulsion batching area is located upgradient of the ephemeral drainage line associated with TSF Option C. Therefore, both batching areas could potentially indirectly impact on watercourses within 500 m thereof, particularly in the event of spills. Thus, although there are no watercourses directly within either proposed batching area, strict, site specific mitigation measures will be required throughout the life of the development to minimise potential indirect impacts on the regional freshwater ecology with specific mention of the separation of clean and dirty water areas.

5.3 Projects 3, 4 and 5: Main Parking Extension, Widening of Access Road between South Shaft/Main Offices and Plant, and Access Crossing between Plant and North Mine respectively

The extension of the parking facility at the Main Offices (Project 3) encroaches marginally on the delineated riparian zone of the Springkaanspruit, a small tributary of the Groot Dwars River, although the active channel of the Springkaanspruit is approximately 20 m from the proposed extension area. The proposed parking extension is also outside the 1:100 year floodline.

The access road between the South Shaft and the Main Offices which will be widened (Project 4) is currently located approximately 50 m from the Springkaanspruit, and the widening of this road will bring it to within 45 m of the Springkaanspruit.

The proposed access crossing between the Plant and North Mine (Project 5) will be approximately 122 m from the Springkaanspruit and may result in a reduction of traffic over the Springkaanspruit, as some vehicles will no longer need to traverse the Springkaanspruit to access the Plant and North Mine.

The Springkaanspruit was not ground-truthed for the purposes of this investigation; however, the results of the study undertaken by SAS (2018) were utilised. Refer to Table 7 for further details.

Table 7: Summary of the Springkaanspruit, associated with the proposed Main Parking extension (Project 3), widening of the access road between South Shaft and the Main Offices (Project 4) and the proposed access crossing between the Plant and North Mine (Project 5).

Photograph notes: Representative photographs of the Springkaanspruit, taken in 2017, indicating low flow and proliferation of *Phragmite australis* (left), a diverse instream habitat (centre) and a fence crossing (right) against which debris accumulates, and may impede flow.

General Discussion and Site Analysis Results	Business Case, Conclusion and Alternatives Analysis:
The Springkaanspruit is a small tributary of the Klein Dwars River, partially located within the DCM MRA, and is not identified by databases such as NFEPA (2011) or the NBA (2018). When assessed in 2018 by SAS, it was regarded as likely that the upper reaches were relatively unimpacted, as at the time, few mining activities were located within close proximity thereof. Subsequently, Two Rivers Platinum have constructed a new TSF within 220 m of the Springkaanspruit, and it is possible that indirect impacts may have occurred as a result. Additionally, activities associated with the day to day operations of the DCM, including regular use of two road crossings over the Springkaanspruit, are likely to have contributed to increased sedimentation and possible smothering of biota within the river. Based on the assessment undertaken by SAS (2018) and analyses of recent digital satellite imagery, it is considered likely that the Springkaanspruit is in a moderately modified ecological condition, and of moderate ecological importance and sensitivity.	No direct impacts associated with the proposed widening of the access road between South Shaft and the Main Offices or the proposed access crossing between the Plant and North Mine are expected to occur to the Springkaanspruit. Increased dust generation and stormwater runoff associated with the use of both access roads is likely however. The extension of the Main Parking into a portion of the delineated riparian zone may result in the loss of between 300 m^2 to 330 m^2 of already-disturbed riparian habitat. Due to the existing disturbances in the vicinity of the Springkaanspruit, the potential loss of this extent of riparian habitat is unlikely to be significant. However, the proximity of the extended parking area to the active channel could result in the following indirect impacts, some of which may in turn affect the downstream system: ➢ Increased stormwater runoff to the Springkaanspruit, potentially altering flow patterns and flood peaks, and potentially contributing to altered flow patterns in the downstream reach of the Groot Dwars River; ➢ Stormwater runoff from the parking area may transport excess sediment and hydrocarbons to the Springkaanspruit, thus altering water quality and contributing to reduced water quality in the Groot Dwars River; and ➢ If a stormwater management system is implemented to prevent contaminated runoff reaching the Springkaanspruit (recommended) then this could lead to loss of catchment yield. Site specific mitigation measures will need to be implemented throughout all phases of the construction and operation of all three projects to minimise the significance of direct and indirect impacts on the Springkaanspruit arising from the implementation of the projects.

6 LEGISLATIVE REQUIREMENTS, NATIONAL AND PROVINCIAL GUIDELINES PERTAINING TO THE APPLICATION OF BUFFER ZONES

According to Macfarlane *et al.* (2015) the definition of a buffer zone is variable, depending on the purpose of the buffer zone, however in summary, it is considered to be “a strip of land with a use, function or zoning specifically designed to protect one area of land against impacts from another”. Buffer zones are considered important to provide protection of basic ecosystem processes (in this case, the protection of aquatic and wetland ecological services), reduce impacts on water resources arising from upstream activities (e.g. by removing or filtering sediment and pollutants), provision of habitat for aquatic and wetland species as well as for certain terrestrial species, and a range of ancillary societal benefits (Macfarlane *et. al,* 2015). It should be noted however that buffer zones are not considered to be effective mitigation against impacts such as hydrological changes arising from stream flow reduction, impoundments or abstraction, nor are they considered to be effective in the management of point-source discharges or contamination of groundwater, both of which require site-specific mitigation measures (Macfarlane *et. al,* 2015).

The definition and motivation for a regulated zone of activity for the protection of the freshwater resources can be summarised as follows:

Table 8: Articles of Legislation and the relevant zones of regulation applicable to each article.

Regulatory authorisation required	Zone of applicability
Water Use License Application in terms of the National Water Act, 1998 (Act 36 of 1998).	**General Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act 36 of 1998)** In accordance with GN509 of 2016 as it relates to the National Water Act, 1998 (Act 36 of 1998), a regulated area of a watercourse in terms of water uses as listed in Section 21(c) and 21(i) is defined as: • the outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; • in the absence of a determined 1 in 100 year flood line or riparian area the area within **100 m from the edge of a watercourse** where the edge of the watercourse is the first identifiable annual bank fill flood bench; or • a 500m radius from the delineated boundary (extent) of any wetland or pan.
	Government Notice 704 Regulations as published in the Government Gazette 20119 of 1999 as it relates to the National Water Act, 1998 (Act 36 of 1998) regarding the use of water for mining and related activities aimed at the protection of water resources. These Regulations were put in place in order to prevent the pollution of water resources and protect water resources in areas where mining activity is taking place from impacts generally associated with mining. It is recommended that the proposed project complies with GN704 of the

Regulatory authorisation required	Zone of applicability
	National Water Act, 1998 (Act no. 36 of 1998) which contains regulations on use of water for mining and related activities aimed at the protection of water resources. GN704 states that: *No person in control of a mine or activity may:* *(a) locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year floodline or within a horizontal distance of 100 metres from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on waterlogged ground, or on ground likely to become waterlogged, undermined, unstable or cracked;* According to the above, the activity footprint must fall outside of the 1:100 year floodline of the aquatic resource or 100m from the edge of the resource, whichever distance is the greatest.
Listed activities in terms of the National Environmental Management Act, 1998 (Act 107 of 1998) EIA Regulations (2014), as amended must be taken into consideration if any activities (for example, access roads) are to take place within the applicable zone of regulation. This must be determined by the EAP in consultation with the relevant authorities.	**Activity 12** of Listing Notice 1 (GN 327) of the National Environmental Management Act, 1998 (Act 107 of 1998) EIA regulations, 2014 (as amended) states that: *The development of:* *(xii) Infrastructure or structures with a physical footprint of <u>100 square meters</u> or more;* *Where such development occurs—* *a) Within a watercourse;* *b) In front of a development setback; or* *c) If no development setback has been adopted, within **32 meters of a watercourse**, measured from the edge of a watercourse.*

Taking the above into consideration, a 100 m zone of regulation in line with GN704 of the NWA is applicable to each of the watercourses identified within the TSF alternative options, as well as a 32 m zone of regulation in line with National Environmental Management Act, 1998 (Act No. 107 of 1998) for non-mining specific infrastructure (e.g. roads or pipelines). Additionally, in terms of GN509 of the National Water Act, 1998 (Act 36 of 1998), a 100 m zone of regulation is applicable to any riparian area, in the absence of a determined 1:100 year floodline. These zones of regulation must be taken into consideration during the site selection and planning process, in line with the mitigation hierarchy as advocated by the Department of Environmental Affairs (DEA) *et. al*, 2013, and should they be encroached upon then the relevant authorisations will need to be obtained prior to the commencement of any construction activities.

The respective zones of regulation in terms of Regulations GN509 and GN704 of the National Water Act, 1998 (Act No. 36 of 1998), and the National Environmental Management Act, 1998 (Act No. 107 of 1998), are depicted in the figures below.

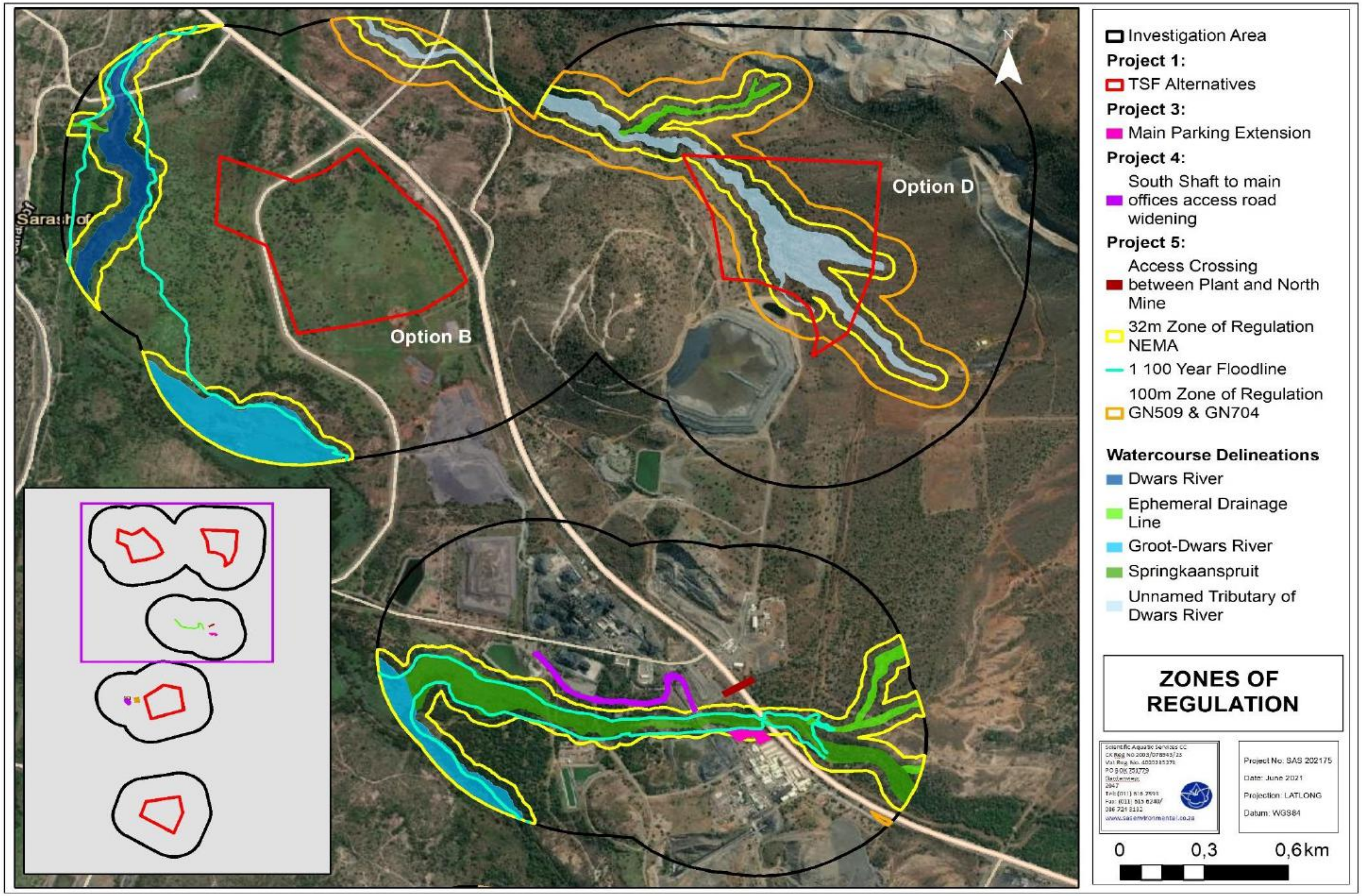

Figure 13: The relevant zones of regulation applicable to the watercourses associated with the various projects, in line with Regulations GN704 and GN509, and NEMA.

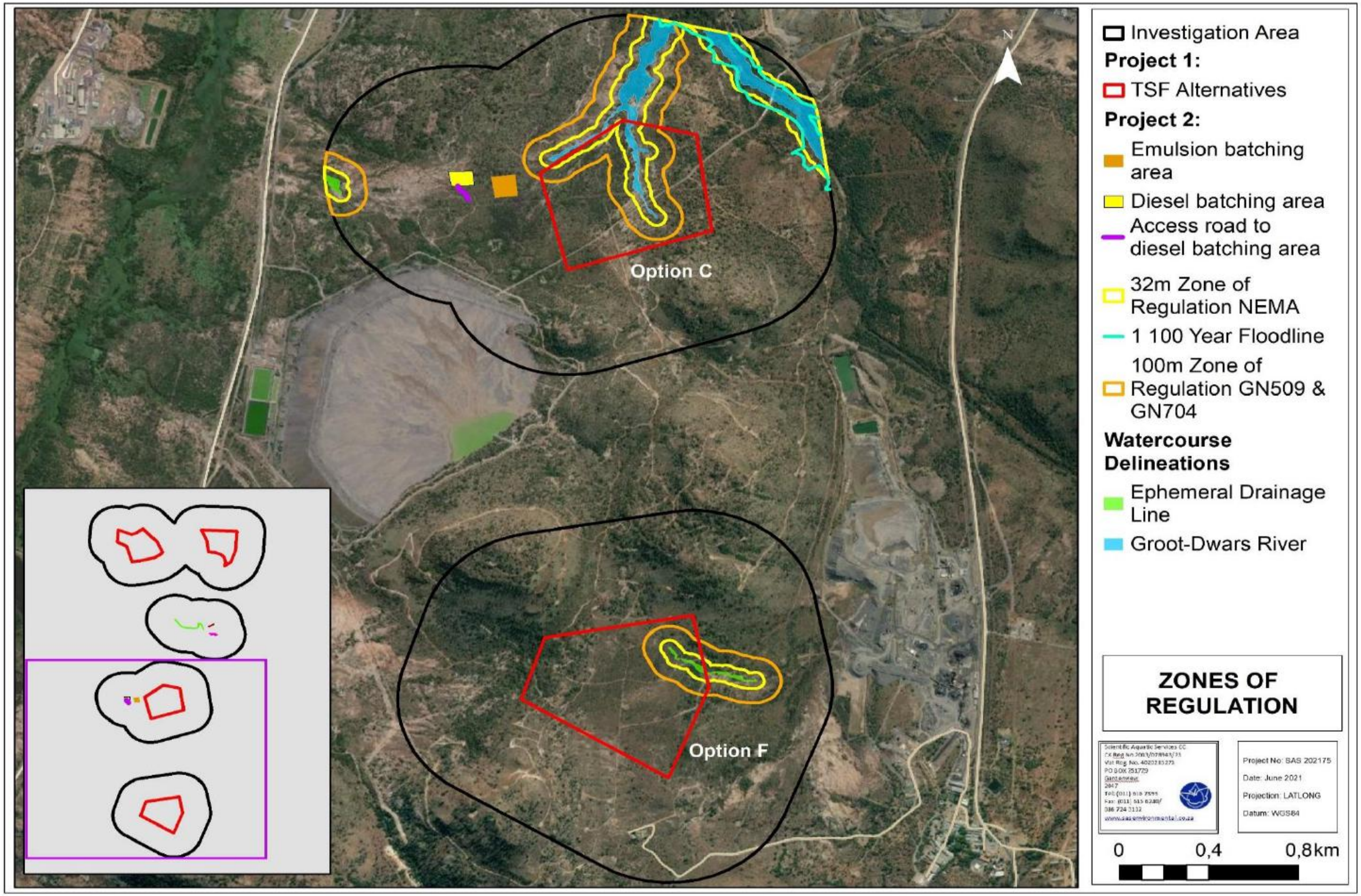

Figure 14: The relevant zones of regulation applicable to the watercourses associated with the fuel storage area alternatives, in line with Regulations GN704 and GN509, and NEMA.

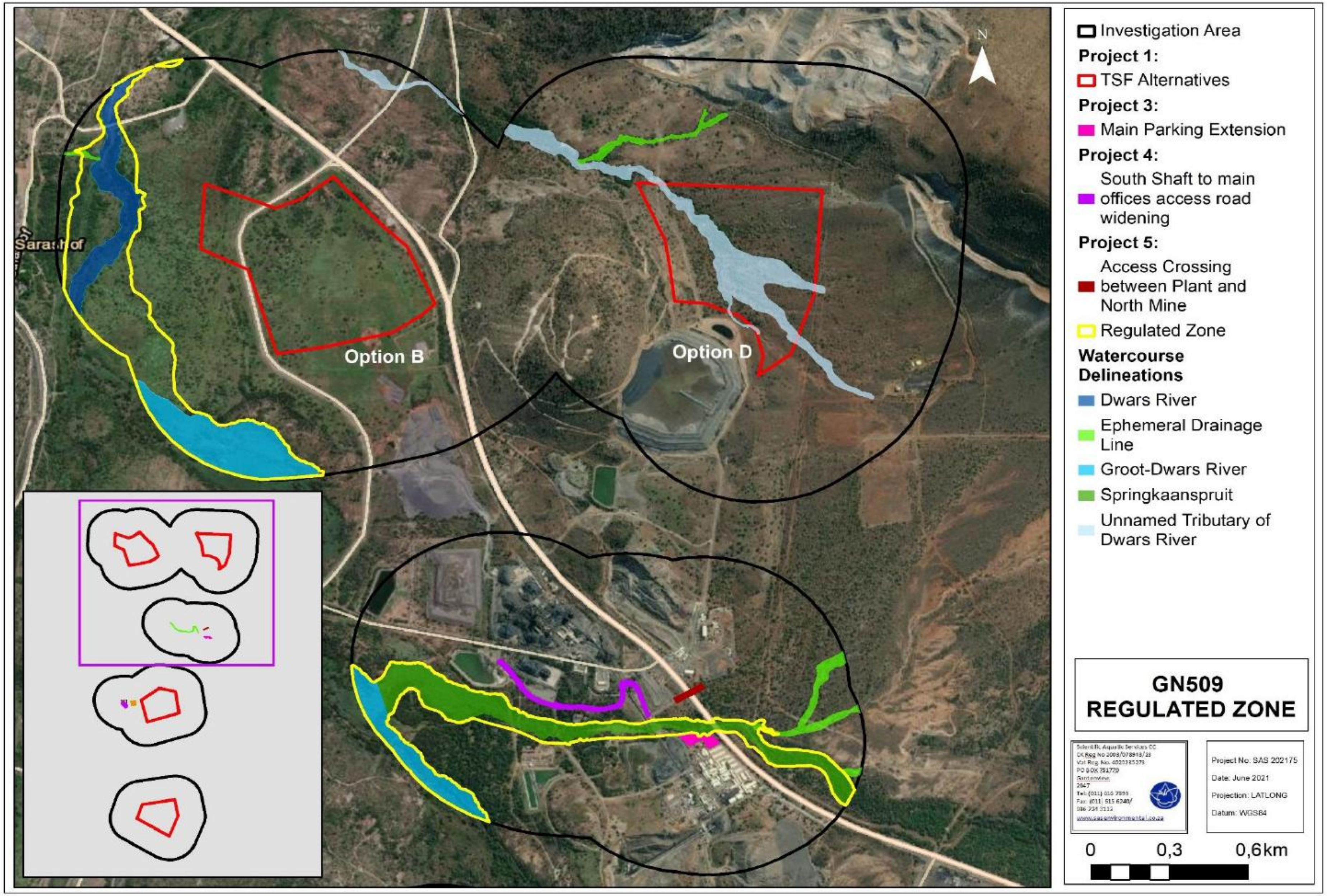

Figure 15: The GN509 regulated zone associated with the watercourses, associated with Projects 1, 3, 4 and 5.

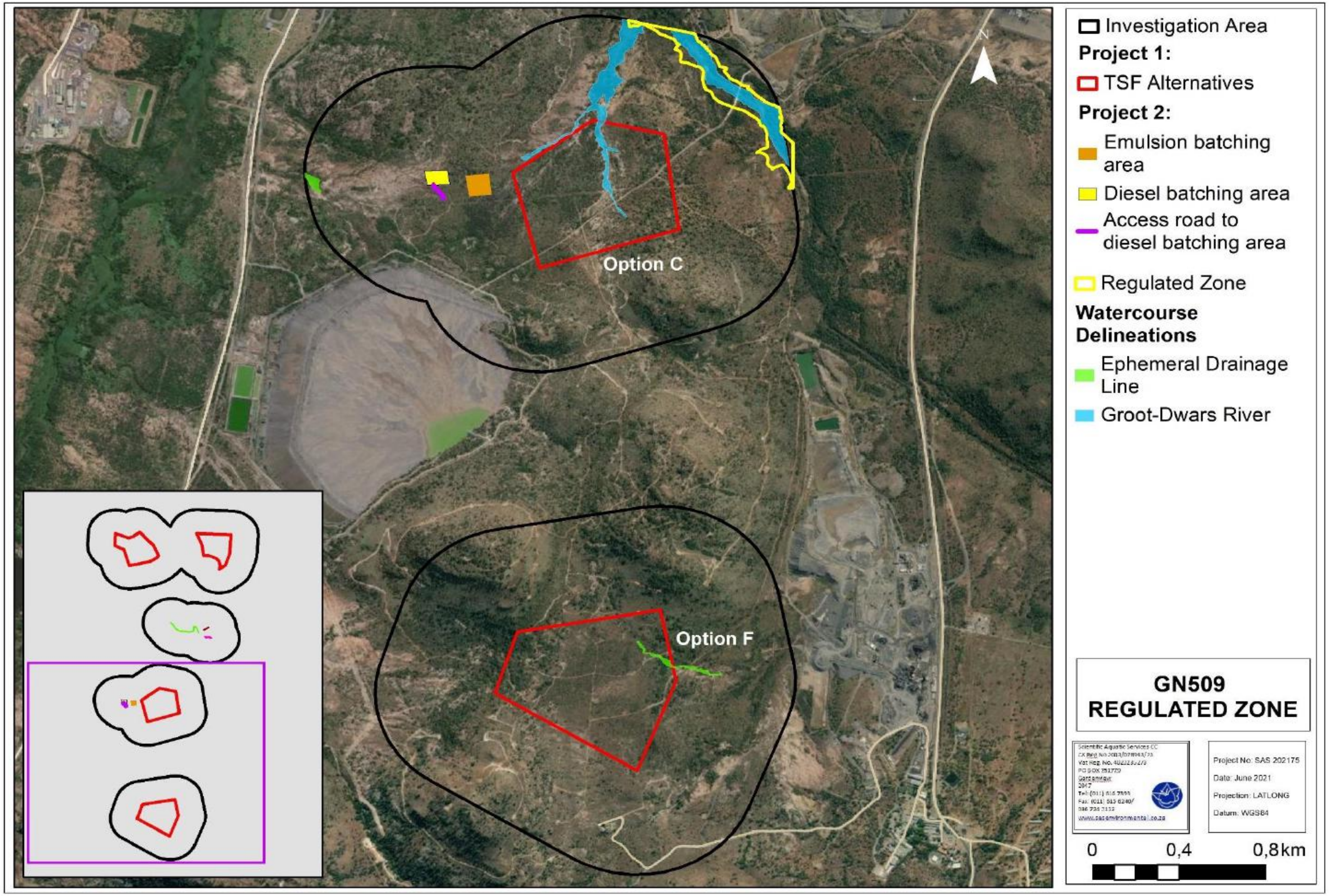

Figure 16: The GN509 regulated zone associated with the watercourses, associated with Projects 1 and 2.

7 POTENTIAL IMPACTS AND PROPOSED MANAGEMENT MEASURES

7.1 Description of Potential Impacts Associated with the Proposed TSF Expansion and Diesel and Emulsion Batching Areas

Several potential risks to the receiving environment by the proposed construction of the TSF and the diesel and emulsion batching areas have been identified and are presented in the bullets below:

- Possible total loss of a portion of important watercourse habitat within TSF Options C and D. This may occur within Option F, but is more easily avoided;
- Increased sedimentation and erosion of remaining portions of watercourses within the TSF options may result from altered run-off patterns. Increased sedimentation and erosion of watercourses situated within 500 m of the proposed fuel storage areas is possible due to the highly erodible and dispersive nature of soils in the region;
- Pollutants from construction activities (chemicals and hydrocarbons), runoff and spills during the operational phase and potential seepage from the TSF post-closure may contaminate nearby water resources and/or groundwater reserves;
- Similarly, pollutants from construction activities and possible fuel spillages during the operational phase of the batching areas may result in contamination of surface and/or groundwater; and
- Disturbances to the hydrological drivers of nearby watercourses may result from disturbances within their catchment areas, with specific mention of the loss of catchment yield due to the separation of clean and dirty water areas.

7.2 Description of Potential Impacts Associated with Projects 3, 4 and 5: Main Parking Extension, Widening of Access Road between South Shaft/Main Offices and Plant, and Access Crossing between Plant and North Mine

The extension of the Main Parking may result in the following impacts to the Springkaanspruit:

- Limited loss of riparian habitat (between 300 m^2 to 330 m^2 of riparian vegetation). The associated disturbance may lead to further proliferation of alien and invasive vegetation along the Springkaanspruit;

- Increased inputs of water to the Springkaanspruit in the form of stormwater runoff, leading to altered flood peaks and flow patterns; and
- Stormwater inputs may transport sediment and hydrocarbons into the Springkaanspruit, leading to altered water quality, which could in turn contribute to altered water quality within the downstream reach of the Groot Dwars River.

No direct impacts arising from proposed projects 4 and 5 (widening of the access road between the south shaft and Main Offices and access crossing between Plant and North Mine) are anticipated. Indirect impacts may include increased dust generation in the vicinity of the Springkaanspruit, leading to increased sedimentation, smothering of biota and altered water quality. However, the construction of an access point between the Plant and North Mine may lead to a reduction in traffic volumes traversing the Springkaanspruit, as vehicles will utilise the more direct route.

7.3 Preliminary Management Measures

The following mitigation measures are applicable to all five proposed projects. Site- and activity-specific mitigation measures will be developed as part of the EIA phase, particularly for the proposed TSF as some mitigation measures will depend on the placement of the TSF.

General Good Housekeeping Mitigation Measures

- The construction and operational footprints must be kept as small as possible to minimise impact on the surrounding environment;
- Appropriate sanitary facilities must be provided during the construction phase and all waste must be removed to an appropriate waste facility;
- All soils compacted as a result of construction activities should be ripped and reprofiled to natural levels and revegetated with indigenous vegetation. Special attention should be paid to alien and invasive plant control within these areas;
- No indiscriminate disposal of waste should take place. If any spills occur, they should be immediately cleaned up, and be disposed of at a registered waste facility; and
- Upon completion of construction activities, it must be ensured that no bare areas remain and that indigenous floral species are reintroduced.

Vehicle access

- Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the proposed development activities; and

- In the event of a breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practiced near the surface area to prevent ingress of hydrocarbons into topsoil.

Soil

- Limit the footprint area of the construction activity to what is essential to minimise environmental damage;
- Edge effects of activities, including erosion and alien and invasive plant control, need to be strictly managed in these areas;
- It must be ensured that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage. All vehicles must be regularly inspected for leaks. Re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into topsoil; and
- To prevent the erosion of topsoil, management measures may include berms, soil traps, hessian curtains and storm water diversion away from areas susceptible to erosion. Stockpiles should be placed away from areas known to contain hazardous substances such as fuel and if any soils are contaminated, they should be stripped and disposed of at a registered hazardous waste disposal site.

Rehabilitation

- As much vegetation growth as possible should be promoted within the proposed development areas following construction activities to protect the soils. In this regard, special mention is made of the need to use indigenous vegetation species as the first choice during landscaping;
- All areas of disturbed and compacted soils need to be ripped and reprofiled; and
- All areas affected by mining activities should be rehabilitated upon closure of the mining and associated infrastructure areas. Areas should be reseeded with indigenous grasses as required. All rehabilitated areas should be rehabilitated to a point where natural processes will allow the pre-development ecological functioning and biodiversity of the area to be re-instated.

8 PLAN OF STUDY FOR THE EIA PHASE

8.1 Impact Assessment Report Scope

The following points highlight the envisaged activities during the impact assessment phase of the project:

- Previous studies undertaken for DCM by SAS will be utilised in conjunction with the desktop data presented in this report, and taking into consideration the prevailing conditions during the site assessments undertaken in December 2018, March 2020 and May 2021, to define the PES and EIS of the watercourses within or associated with the sites selected;
- Watercourses will be mapped according to the ecological sensitivity of each hydrogeomorphic unit in relation to the study area. In addition to the watercourse boundaries, the applicable zones of regulation in terms of relevant environmental legislation will be depicted; and
- The PES, EIS, and ecological service provision of the watercourse within or associated with the selected sites will be highlighted and expected impacts on the system as well as the perceived significance thereof will be assessed according to the DWS Risk Assessment Matrix as published in 2016.

Please refer to Appendices C and D for the method of assessment and DWS risk assessment methodology.

9 CONCLUSION

Scientific Aquatic Services (SAS) was requested to provide specialist input as part of the site selection and alternatives analysis for five proposed new projects, including a proposed new TSF, for the Dwarsrivier Chrome Mine, situated near Steelpoort, Limpopo Province. Four potential sites for the proposed TSF were identified by the proponent, referred to in this report as Options B, C, D and F (or collectively as TSF alternatives).

During a site assessment undertaken in December 2018, a total of three watercourses (one per Option C, D, and F) were identified and mapped. A site assessment undertaken in May 2021 confirmed that no watercourses are present within Option B.

During a site assessment undertaken in March 2020, it was ascertained that no watercourses are present within the two sites proposed for the diesel and emulsion batching areas, although both are located within 500 m of watercourses, and both are located upgradient thereof; therefore, strict mitigation will need to be implemented during the construction and operational phases to ensure that no indirect impacts occur.

The proposed extension of the Main Parking area will encroach marginally on a portion of the riparian zone associated with the Springkaanspruit and will be within the 32 m Zone of Regulation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998). Although no direct impacts are likely, the proximity of the proposed parking extension to the Springkaanspruit will necessitate strict adherence to mitigation measures, especially during construction, to ensure that indirect impacts are minimised as far as possible.

The proposed widening of the access road between the South Shaft and Main Offices, and the proposed crossing between the Plant and North Mine are similarly unlikely to result in direct impacts on the Springkaanspruit; however, increased dust generation due to increased traffic and possible increased stormwater inputs to the river are possible. These can be appropriately managed to mitigate and reduce the impact significance.

Whilst a full ecological assessment of the watercourses associated with the five proposed projects did not form part of the scope of work of this phase of the study, based on visual observations during the site assessment and previous studies conducted within the MRA by SAS (2017, 2018), it is the opinion of the ecologist that most of the affected watercourses are in a largely natural to moderately modified ecological condition, and of moderate EIS. Furthermore, the watercourses located within Options C and D drain into larger systems (the Groot Dwars and Dwars Rivers respectively) and therefore, impacts on the headwaters of these unnamed tributaries may potentially have a significant effect on the ecological integrity and functioning of the respective downstream systems. A summary of the outcome of the TSF Alternatives Analysis is presented in the table overleaf.

Table 9: Summary of the results of the investigation and comparison of TSF options B, C, D and F.

TSF Alternative	Freshwater ecology of site	Business Case	Preferred Site (from a freshwater ecology perspective)
Option B	No watercourses were identified within Option B. The site is located upgradient and approximately 230 m east of the Dwars River. The site is also located approximately 350 m south and downgradient of an ephemeral, unnamed tributary of the Dwars River.	The construction of the proposed TSF in this location does not pose any direct threat to any watercourses. However, indirect impacts could potentially occur during construction such as contaminated stormwater runoff reaching the Dwars River. Similarly, no direct impacts are envisaged during the operational phase should the proposed TSF be placed in this site; however, in the event of failure of the TSF, significant impacts to the Dwars River could occur, particularly without appropriate mitigation.	Preferred, since the placement poses no direct threat to any watercourses. Strict mitigation, including ensuring that the design and operation of the TSF does not lead to failure thereof, will be necessary to prevent any possible indirect impacts on the Dwars River.
Option C	A single freshwater resource, specifically an unnamed tributary of the Groot Dwars River, traverses the central portion of the site. The reach of the watercourse within the site is approximately 1ha in extent. Whilst some impacts were noted (such as bank incision due to the naturally erosive nature of the soils in the vicinity) the resource is considered to be in a moderately modified to largely natural ecological condition.	Construction of the proposed TSF in this location poses a direct threat to the freshwater resource. Anticipated impacts include loss of riparian habitat, increased sedimentation and erosion of the resource, and possible impacts on the downstream system should an extreme event (such as a spill) occur. Furthermore, should the TSF be constructed in this site, additional support infrastructure (roads, pipelines, powerlines etc) would be required, which may potentially require watercourse crossings, thus increasing the risk of cumulative impacts on the freshwater ecology of the surrounding area.	Not preferred.
Option D	An unnamed tributary of the Dwars River was identified within the central portion of this site. SAS (2018) classified this resource as being in a PES Category B/C (largely natural to moderately modified) and of moderate EIS. The extent of this watercourse within the site is approximately 7,3ha.	Construction of the proposed TSF in this location poses a direct threat to the freshwater resource. Anticipated impacts as a result are identical to those identified for Option C. Taking into consideration the surrounding mining activities and anticipated encroachment thereof however, as well as proximity to the existing DCM TSF, utilisation of Option D could potentially reduce the impact on freshwater resources in the two other TSF alternatives and the greater MRA. Consideration must be given to known future activities within the MRA.	Not preferred; however it is acknowledged that utilisation of this site may assist in protection of the freshwater ecology within the greater MRA, provided that future expansion plans are taken into consideration during the site selection process.

Option F	A small ephemeral drainage line with a weakly-formed riparian zone was identified in the north-eastern corner of Option F. This drainage line constitutes the headwaters of a watercourse which may have been significantly impacted by the construction of infrastructure on the neighbouring Thorncliffe Mine; however the upper reach of the resource (i.e. the reach within Option F) remains largely unimpacted. The reach of this watercourse within the site is approximately 0.3ha in extent.	Although a single watercourse was identified during the site assessment, it is the opinion of the ecologist that due to the location thereof, the proposed TSF may be placed and designed in such a way as to avoid the resource. Furthermore, it is likely that the resource is of decreased ecological importance, particularly given possible impacts to the lower reaches of the resource, and that impacts to the upper reaches may therefore be considered of lower significance.	Considered a viable alternative; however, there is a quantum of risk associated with the development of the TSF within this site, due to the extent of pipelines that would be required, thus increasing the potential for spills to occur.

In conclusion, it is apparent that construction of the proposed TSF within Option C or Option D has the potential to have an unacceptably high impact on the watercourse within each respective site. Such impacts may also potentially affect downstream systems. Although no major watercourses were identified within Option F, there is still a quantum of risk associated with utilising Option F due to the extensive network of pipelines that will be required. From a freshwater ecological perspective therefore, Option B is the preferred option, as no direct impacts arising from the construction and operation of the TSF within that location to the receiving freshwater environment are anticipated. Nevertheless, indirect impacts, including potential failure of the TSF, could occur and may potentially be detrimental to the Dwars River specifically, If suitable mitigation measures are not strictly implemented throughout all phases.

Although no watercourses are directly associated with the remaining projects (i.e. not situated directly within the proposed project areas), the proposed batching areas are located upgradient of watercourses, and the proposed extension of the Main Parking area will encroach marginally on the delineated riparian zone of the Springkaanspruit. Therefore, mitigation measures will need to be strictly implemented during all phases of these proposed projects, throughout the Life of Mine, to minimise the potential risk of indirect impacts occurring on the downgradient watercourses.

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APPENDIX A – Terms of Use and Indemnity

INDEMNITY AND TERMS OF USE OF THIS REPORT

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

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APPENDIX B – Legislation

LEGISLATIVE REQUIREMENTS

National Environmental Management Act (1998) (Act No. 107 of 1998) (NEMA)	The National Environmental Management Act 1998 (Act 107 of 1998) (NEMA) and the associated Regulations as amended in 2017, states that prior to any development taking place within a wetland or riparian area, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment Report (BAR) process or the Environmental Impact Assessment (EIA) process depending on the scale of the impact. Provincial regulations must also be considered.
National Environmental Management: Biodiversity Act (2004) (Act 10 of 2004) (NEMBA)	**Ecosystems that are threatened or in need of protection** (1) (a) The Minister may, by notice in the Gazette, publish a national list of ecosystems that are threatened and in need of protection. *(b)* An MEC for environmental affairs in a province may, by notice in *the Gazette,* publish a provincial list of ecosystems in the province that are threatened and in need of protection. (2) The following categories of ecosystems may be listed in terms of subsection (1): *(a)* critically endangered ecosystems, being ecosystems that have undergone severe degradation of ecological structure, function or composition as a result of human intervention and are subject to an extremely high risk of irreversible transformation; *(b)* endangered ecosystems, being ecosystems that have undergone degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems; (c) vulnerable ecosystems, being ecosystems that have a high risk of undergoing significant degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems or endangered ecosystems; and *(d)* protected ecosystems, being ecosystems that are of high conservation value or of high national or provincial importance, although they are not listed in terms of paragraphs *(a), (b)* or (c).
National Water Act (1998) (Act No. 36 of 1998) (NWA)	The National Water Act, 1998 (Act No. 36 of 1998) (NWA) recognises that the entire ecosystem and not just the water itself in any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the Department of Water and Sanitation (DWS). Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DWS in terms of Section 21 (c) & (i).
General Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act 36 of 1998)	In accordance with GN509 of 2016, a regulated area of a watercourse for section 21(c) and 21(i) of the National Water Act, 1998 (Act No. 36 of 1998) is defined as: a) The outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; b) In the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or c) A 500 m radius from the delineated boundary (extent) of any wetland or pan. This notice **replaces GN1199** and may be exercised as follows: i) Exercise the water use activities in terms of Section 21(c) and (i) of the Act as set out in the table below, subject to the conditions of this authorisation; ii) Use water in terms of section 21(c) or (i) of the Act if it has a low risk class as determines through the Risk Matrix; iii) Do maintenance with their existing lawful water use in terms of section 21(c) or (i) of the Act that has a LOW risk class as determined through the Risk Matrix; iv) Conduct river and stormwater management activities as contained in a river management plan; v) Conduct rehabilitation of wetlands or rivers where such rehabilitation activities has a LOW risk class as determined through the Risk Matrix; and vi) Conduct emergency work arising from an emergency situation or incident associated with the persons' existing lawful water use, provided that all work is executed and reported in the manner prescribed in the Emergency protocol. A General Authorisation (GA) issued as per this notice will require the proponent to adhere with specific conditions, rehabilitation criteria and monitoring and reporting programme. Furthermore, the water user must ensure that there is a sufficient budget to complete, rehabilitate and maintain the water use as set out in this GA.

	Upon completion of the registration, the responsible authority will provide a certificate of registration to the water user within 30 working days of the submission. On written receipt of a registration certificate from the Department, the person will be regarded as a registered water user and can commence within the water use as contemplated in the GA.
Government Notice 704 Regulations as published in the Government Gazette 20119 of 1999 as it relates to the National Water Act, 1998 (Act No. 36 of 1998)	These regulations, forming part of the National Water Act, 1998 (Act No. 36 of 1998), were put in place in order to prevent the pollution of water resources and protect water resources in areas where mining activity is taking place from impacts generally associated with mining. It is recommended that the project complies with Regulation GN 704 of the National Water Act (1998) (Act 36 of 1998) which contains regulations on use of water for mining and related activities aimed at the protection of water resources. GN 704 states that: *No person in control of a mine or activity may:* *(b) locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year floodline or within a horizontal distance of 100 metres (m) from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on waterlogged ground, or on ground likely to become waterlogged, undermined, unstable or cracked;* According to the above, the activity footprint must fall outside of the 1:100 year floodline of the drainage feature or 100m from the edge of the feature, whichever distance is the greatest, unless authorised by DWS.
Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA)	The obtaining of a New Order Mining Right (NOMR) is governed by the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA). The MPRDA requires the applicant to apply to the Department of Mineral Rsoures (DMR) for a NOMR which triggers a process of compliance with the various applicable sections of the MPRDA. The NOMR process requires environmental authorisation in terms of the MPRDA Regulations and specifically requires the preparation of a Scoping Report, an Environmental Impact Assessment (EIA) and Environmental Management Programme (EMP), and a Public Participation Process (PPP).
Limpopo Environmental Management Act, 2003 (Act No. 7 of 2003) (LEMA)	The objectives of this Act are: ➢ to manage and protect the environment in the Province; ➢ to secure ecologically sustainable development and responsible use of natural resources in the Province; ➢ generally, to contribute to the progressive realisation of the fundamental rights contained in section 24 of the Constitution of the Republic of South Africa Act, 1996 (Act No. 108 of 1996), and ➢ to give effect to international agreements effecting environmental management which are binding on the Province. This Act must be interpreted and applied in accordance with the national environmental management principles set out in Section 2 of the National Environmental Management Act, 1998 (Act No. 107 of 1998).

APPENDIX C -Method of assessment

1. Desktop Study

Prior to the commencement of the field assessment, a background study, including a literature review, was conducted in order to determine the ecoregion and ecostatus of the larger aquatic system within which the freshwater features present or in close proximity to the study area are located. Aspects considered as part of the literature review are discussed in the sections that follow.

1.1 National Freshwater Ecosystem Priority Areas (NFEPA, 2011)

The NFEPA project is a multi-partner project between the Council of Scientific and Industrial Research (CSIR), Water Research Commission (WRC), South African National Biodiversity Institute (SANBI), Department of Water Affairs (DWA), South African Institute of Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks). The project responds to the reported degradation of freshwater ecosystem condition and associated biodiversity, both globally and in South Africa. It uses systematic conservation planning to provide strategic spatial priorities of conserving South Africa's freshwater biodiversity, within the context of equitable social and economic development.

The NFEPA project aims to identify a national network of freshwater conservation areas and to explore institutional mechanisms for their implementation. Freshwater ecosystems provide a valuable natural resource with economic, aesthetic, spiritual, cultural and recreational value. However, the integrity of freshwater ecosystems in South Africa is declining at an alarming rate, largely as a consequence of a variety of challenges that are practical (managing vast areas of land to maintain connectivity between freshwater ecosystems), socio-economic (competition between stakeholders for utilisation) and institutional (building appropriate governance and co-management mechanisms).

The NFEPA database was searched for information in terms of conservation status of rivers, wetland habitat and wetland features present in the study area or the vicinity thereof.

2. Classification System for Wetlands and other Aquatic Ecosystems in South Africa

The freshwater features encountered within the proposed study area were assessed using the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems (Ollis *et al*., 2013), hereafter referred to as the "Classification System". A summary of Levels 1 to 4 of the classification system are presented in Table C1 and C2, below.

Table C1: Proposed classification structure for Inland Systems, up to Level 3.

WETLAND / AQUATIC ECOSYSTEM CONTEXT		
LEVEL 1: SYSTEM	LEVEL 2: REGIONAL SETTING	LEVEL 3: LANDSCAPE UNIT
Inland Systems	DWA Level 1 Ecoregions OR NFEPA WetVeg Groups OR Other special framework	Valley Floor
		Slope
		Plain
		Bench (Hilltop / Saddle / Shelf)

Table C2: Hydrogeomorphic (HGM) Unit for the Inland System, showing the primary HGM Types at Level 4A and the subcategories at Level 4B to 4C.

FUNCTIONAL UNIT		
LEVEL 4: HYDROGEOMORPHIC (HGM) UNIT		
HGM type	Longitudinal zonation/ Landform / Outflow drainage	Landform / Inflow drainage
A	**B**	**C**
River	Mountain headwater stream	Active channel
		Riparian zone
	Mountain stream	Active channel
		Riparian zone
	Transitional	Active channel
		Riparian zone
	Upper foothills	Active channel
		Riparian zone
	Lower foothills	Active channel
		Riparian zone
	Lowland river	Active channel
		Riparian zone
	Rejuvenated bedrock fall	Active channel
		Riparian zone
	Rejuvenated foothills	Active channel
		Riparian zone
	Upland floodplain	Active channel
		Riparian zone
Channelled valley-bottom wetland	(not applicable)	(not applicable)
Unchannelled valley-bottom wetland	(not applicable)	(not applicable)
Floodplain wetland	Floodplain depression	(not applicable)
	Floodplain flat	(not applicable)
Depression	Exorheic	With channelled inflow
		Without channelled inflow
	Endorheic	With channelled inflow
		Without channelled inflow
	Dammed	With channelled inflow
		Without channelled inflow
Seep	With channelled outflow	(not applicable)
	Without channelled outflow	(not applicable)
Wetland flat	(not applicable)	(not applicable)

Level 1: Inland systems

From the Classification System, Inland Systems are defined as aquatic ecosystems that have no existing connection to the ocean[3](i.e. characterised by the complete absence of marine exchange and/or tidal influence) but which are inundated or saturated with water, either permanently or periodically. It is important to bear in mind, however, that certain Inland Systems may have had a historical connection to the ocean, which in some cases may have been relatively recent.

Level 2: Ecoregions& NFEPA Wetland Vegetation Groups

For Inland Systems, the regional spatial framework that has been included at Level 2 of the classification system is that of DWA's Level 1 Ecoregions for aquatic ecosystems (Kleynhans *et al.,* 2005). There is a total of 31 Ecoregions across South Africa, including Lesotho and Swaziland. DWA Ecoregions have

[3] Most rivers are indirectly connected to the ocean via an estuary at the downstream end, but where marine exchange (i.e. the presence of seawater) or tidal fluctuations are detectable in a river channel that is permanently or periodically connected to the ocean, it is defined as part of the estuary.

most commonly been used to categorise the regional setting for national and regional water resource management applications, especially in relation to rivers.

The Vegetation Map of South Africa, Swaziland and Lesotho (Mucina & Rutherford, 2006) group's vegetation types across the country according to Biomes, which are then divided into Bioregions. To categorise the regional setting for the wetland component of the National Freshwater Ecosystem Priority Areas (NFEPA) project, wetland vegetation groups (referred to as WetVeg Groups) were derived by further splitting bioregions into smaller groups through expert input (Nel *et al*., 2011). There are currently 133 NFEPA WetVeg Groups. It is envisaged that these groups could be used as a special framework for the classification of wetlands in national- and regional-scale conservation planning and wetland management initiatives.

Level 3: Landscape Setting

At Level 3 of the Classification System, for Inland Systems, a distinction is made between four Landscape Units (Table C1) on the basis of the landscape setting (i.e. topographical position) within which an HGM Unit is situated, as follows (Ollis *et al.,* 2013):

- **Slope:** an included stretch of ground that is not part of a valley floor, which is typically located on the side of a mountain, hill or valley;
- **Valley floor:** The base of a valley, situated between two distinct valley side-slopes;
- **Plain:** an extensive area of low relief characterised by relatively level, gently undulating or uniformly sloping land; and
- **Bench (hilltop/saddle/shelf):** an area of mostly level or nearly level high ground (relative to the broad surroundings), including hilltops/crests (areas at the top of a mountain or hill flanked by down-slopes in all directions), saddles (relatively high-lying areas flanked by down-slopes on two sides in one direction and up-slopes on two sides in an approximately perpendicular direction), and shelves/terraces/ledges (relatively high-lying, localised flat areas along a slope, representing a break in slope with an up-slope one side and a down-slope on the other side in the same direction).

Level 4: Hydrogeomorphic Units

Seven primary HGM Types are recognised for Inland Systems at Level 4A of the Classification System (Table C2), on the basis of hydrology and geomorphology (Ollis *et al*., 2013), namely:

- **River:** a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water;
- **Channelled valley-bottom wetland:**a valley-bottom wetland with a river channel running through it;
- **Unchannelled valley-bottom wetland:**a valley-bottom wetland without a river channel running through it;
- **Floodplain wetland:**the mostly flat or gently sloping land adjacent to and formed by an alluvial river channel, under its present climate and sediment load, which is subject to periodic inundation by over-topping of the channel bank;
- **Depression:** a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates.
- **Wetland Flat:** a level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench. Closed elevation contours are not evident around the edge of a wetland flat; and
- **Seep:** a wetland area located on (gently to steeply) sloping land, which is dominated by the colluvial (i.e. gravity-driven), unidirectional movement of material down-slope. Seeps are often located on the side-slopes of a valley but they do not, typically, extend into a valley floor.

The above terms have been used for the primary HGM Units in the classification system to try and ensure consistency with the wetland classification terms currently in common usage in South Africa. Similar terminology (but excluding categories for "channel", "flat" and "valleyhead seep") is used, for example, in the recently developed tools produced as part of the Wetland Management Series including WET-Health (Macfarlane *et al*., 2008), WET-IHI (DWAF, 2007) and WET-EcoServices (Kotze *et al*., 2009).

3. WET-Health

Healthy wetlands are known to provide important habitats for wildlife and to deliver a range of important goods and services to society. Management of these systems is therefore essential if these attributes are to be retained within an ever-changing landscape. The primary purpose of this assessment is to evaluate the eco-physical health of wetlands, and in so doing to promote their conservation and wise management.

Level of Evaluation

Two levels of assessment are provided by WET-Health:

- Level 1: Desktop evaluation, with limited field verification. This is generally applicable to situations where a large number of wetlands need to be assessed at a very low resolution; or
- Level 2: On-site evaluation. This involves structured sampling and data collection in a single wetland and its surrounding catchment.

Framework for the Assessment

A set of three modules has been synthesised from the set of processes, interactions and interventions that take place in wetland systems and their catchments: hydrology (water inputs, distribution and retention, and outputs), geomorphology (sediment inputs, retention and outputs) and vegetation (transformation and presence of introduced alien species).

Units of Assessment

Central to WET-Health is the characterisation of HGM Units, which have been defined based on geomorphic setting (e.g. hillslope or valley-bottom; whether drainage is open or closed), water source (surface water dominated or sub-surface water dominated) and pattern of water flow through the wetland unit (diffusely or channelled) as described under the Classification System for Wetlands and other Aquatic Ecosystems above.

Quantification of Present State of a wetland

The overall approach is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a Present State score. This takes the form of assessing the spatial extent of the impact of individual activities and then separately assessing the intensity of the impact of each activity in the affected area. The extent and intensity are then combined to determine an overall magnitude of impact. The impact scores, and Present State categories are provided in the table below.

Table C3: Impact scores and categories of Present State used by WET-Health for describing the integrity of wetlands.

Impact category	Description	Impact score range	Present State category
None	Unmodified, natural	0-0.9	A
Small	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1-1.9	B
Moderate	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place, but the natural habitat remains predominantly intact.	2-3.9	C
Large	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4-5.9	D
Serious	The change in ecosystem processes and loss of natural habitat and biota is great, but some remaining natural habitat features are still recognisable.	6-7.9	E
Critical	Modifications have reached a critical level and the ecosystem processes have been completely modified with an almost complete loss of natural habitat and biota.	8-10	F

Assessing the Anticipated Trajectory of Change
As is the case with the Present State, future threats to the state of the wetland may arise from activities in the catchment upstream of the unit or within the wetland itself or from processes downstream of the wetland. In each of the individual sections for hydrology, geomorphology and vegetation, five potential situations exist depending upon the direction and likely extent of change (table below).

Table C4: Trajectory of Change classes and scores used to evaluate likely future changes to the present state of the wetland.

Change Class	Description	HGM change score	Symbol
Substantial improvement	State is likely to improve substantially over the next 5 years	2	↑↑
Slight improvement	State is likely to improve slightly over the next 5 years	1	↑
Remain stable	State is likely to remain stable over the next 5 years	0	→
Slight deterioration	State is likely to deteriorate slightly over the next 5 years	-1	↓
Substantial deterioration	State is expected to deteriorate substantially over the next 5 years	-2	↓↓

Overall health of the wetland
Once all HGM Units have been assessed, a summary of health for the wetland as a whole needs to be calculated. This is achieved by calculating a combined score for each component by area-weighting the scores calculated for each HGM Unit. Recording the health assessments for the hydrology, geomorphology and vegetation components provide a summary of impacts, Present State, Trajectory of Change and Health for individual HGM Units and for the entire wetland.

4. Wetland Function Assessment

"The importance of a water resource, in ecological social or economic terms, acts as a modifying or motivating determinant in the selection of the management class".[4] The assessment of the ecosystem

[4] Department of Water Affairs and Forestry, South Africa Version 1.0 of Resource Directed Measures for Protection of Water Resources, 1999

services supplied by the identified freshwater features was conducted according to the guidelines as described by Kotze *et al.* (2009). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the service is provided:

- Flood attenuation;
- Stream flow regulation;
- Sediment trapping;
- Phosphate trapping;
- Nitrate removal;
- Toxicant removal;
- Erosion control;
- Carbon storage;
- Maintenance of biodiversity;
- Water supply for human use;
- Natural resources;
- Cultivated foods;
- Cultural significance;
- Tourism and recreation; and
- Education and research.

The characteristics were used to quantitatively determine the value, and by extension sensitivity, of the freshwater features. Each characteristic was scored to give the likelihood that the service is being provided. The scores for each service were then averaged to give an overall score to the freshwater features.

Table C5: Classes for determining the likely extent to which a benefit is being supplied.

Score	Rating of the likely extent to which the benefit is being supplied
<0.5	Low
0.6-1.2	Moderately low
1.3-2	Intermediate
2.1-3	Moderately high
>3	High

5. Ecological Importance and Sensitivity (EIS) (Rountree & Kotze, 2013)

The purposed of assessing importance and sensitivity of water resources is to be able to identify those systems that provide higher than average ecosystem services, biodiversity support functions or are especially sensitive to impacts. Water resources with higher ecological importance may require managing such water resources in a better condition than the present to ensure the continued provision of ecosystem benefits in the long term (Rountree & Kotze, 2013).

In order to align the outputs of the Ecoservices assessment (i.e. ecological and socio-cultural service provision) with methods used by the DWA (now the DWS) used to assess the EIS of other watercourse types, a tool was developed using criteria from both WET-Ecoservices (Kotze, *et, al,* 2009) and earlier DWA EIA assessment tools. Thus, three proposed suites of important criteria for assessing the Importance and Sensitivity for wetlands were proposed, namely:

- Ecological Importance and Sensitivity, incorporating the traditionally examined criteria used in EIS assessments of other water resources by DWA and thus enabling consistent assessment approaches across water resource types;
- Hydro-functional importance, taking into consideration water quality, flood attenuation and sediment trapping ecosystem services that the wetland may provide; and
- Importance in terms of socio-cultural benefits, including the subsistence and cultural benefits provided by the wetland system.

The highest of these three suites of scores is then used to determine the overall Importance and Sensitivity category (Table C8) of the wetland system being assessed.

Table C6: Ecological Importance and Sensitivity Categories and the interpretation of median scores for biota and habitat determinants (adapted from Kleynhans, 1999).

EIS Category	Range of Mean	Recommended Ecological Management Class
Very high Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications.	>3 and <=4	A
High Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications.	>2 and <=3	B
Moderate Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications.	>1 and <=2	C
Low/marginal Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications.	>0 and <=1	D

6. Recommended Ecological Category (REC)

"A high management class relates to the flow that will ensure a high degree of sustainability and a low risk of ecosystem failure. A low management class will ensure marginal maintenance of sustainability, but carries a higher risk of ecosystem failure."[5]

The REC (Table C9) was determined based on the results obtained from the PES, reference conditions and EIS of the resource (sections above). Followed by realistic recommendations, mitigation, and rehabilitation measures to achieve the desired REC.

A freshwater feature may receive the same class for the PES as the REC if the freshwater feature is deemed in good condition, and therefore must stay in good condition. Otherwise, an appropriate REC should be assigned in order to prevent any further degradation as well as enhance the PES of the freshwater feature.

Table C7: Description of REC classes.

Class	Description
A	Unmodified, natural
B	Largely natural with few modifications
C	Moderately modified
D	Largely modified

7. Wetland and Riparian Delineation

The watercoursedelineation took place according to the method presented in the "Updated manual for the identification and delineation of wetland and riparian resources" published by DWAF in 2008. The foundation of the method is based on the fact that wetlands and riparian zones have several distinguishing factors including the following:

- The presence of water at or near the ground surface;

[5] Department of Water Affairs and Forestry, South Africa Version 1.0 of Resource Directed Measures for Protection of Water Resources 1999

- Distinctive hydromorphic soils;
- Vegetation adapted to saturated soils; and
- The presence of alluvial soils in stream systems.

According to the DWA (2005) like wetlands, riparian areas have their own unique set of indicators. It is possible to delineate riparian areas by checking for the presence of these indicators. Some areas may display both wetland and riparian indicators, and can accordingly be classified as both. If you are adjacent to a watercourse, it is important to check for the presence of the riparian indicators described below, in addition to checking for wetland indicators, to detect riparian areas that do not qualify as wetlands. The delineation process requires that the following be taken into account:

- topography associated with the watercourse;
- vegetation; and
- alluvial soils and deposited material.

By observing the evidence of these features in the form of indicators, wetlands and riparian zones can be delineated and identified. If the use of these indicators and the interpretation of the findings are applied correctly, then the resulting delineation can be considered accurate (DWA, 2005).

APPENDIX D – Risk Assessment Methodology

In order for the EAP to allow for sufficient consideration of all environmental impacts, impacts were assessed using a common, defensible method of assessing significance that will enable comparisons to be made between risks/impacts and will enable authorities, stakeholders and the client to understand the process and rationale upon which risks/impacts have been assessed. The method to be used for assessing risks/impacts is outlined in the sections below.
The first stage of the risk/impact assessment is the identification of environmental activities, aspects and impacts. This is supported by the identification of receptors and resources, which allows for an understanding of the impact pathway and an assessment of the sensitivity to change. The definitions used in the impact assessment are presented below.

- An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that is possessed by an organisation.
- An **environmental aspect** is an 'element of an organizations activities, products and services which can interact with the environment'[6]. The interaction of an aspect with the environment may result in an impact.
- **Environmental risks/impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or wellbeing, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is.
- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as freshwater features, flora and riverine systems.
- **Resources** include components of the biophysical environment.
- **Frequency of activity** refers to how often the proposed activity will take place.
- **Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor.
- **Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.
- **Spatial extent** refers to the geographical scale of the impact.
- **Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.

The significance of the impact is then assessed by rating each variable numerically according to the defined criteria (refer to the table below). The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity, spatial scope and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 15. The frequency of the activity, impact, legal issues and the detection of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 20. The values for likelihood and consequence of the impact are then read off a significance rating matrix and are used to determine whether mitigation is necessary[7].

The model outcome of the impacts was then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in line with South Africa's National Environmental Management Act (No. 108 of 1997) in instances of uncertainty or lack of information, by increasing assigned ratings or adjusting final model outcomes. In certain instances, where a variable or outcome requires rational adjustment due to model limitations, the model outcomes have been adjusted.

"RISK ASSESSMENT KEY" (Based on DWS 2015 publication: Section 21 c and i water use Risk Assessment Protocol)

[6] The definition has been aligned with that used in the ISO 14001 Standard.
[7] Some risks/impacts that have low significance will however still require mitigation

Table D1: Severity (How severe does the aspects impact on the resource quality (flow regime, water quality, geomorphology, biota, habitat)

Insignificant / non-harmful	1
Small / potentially harmful	2
Significant / slightly harmful	3
Great / harmful	4
Disastrous / extremely harmful and/or wetland(s) involved	5
Where "or wetland(s) are involved" it means that the activity is located within the delineated boundary of any wetland. The score of 5 is only compulsory for the significance rating.	

Table D2: Spatial Scale (How big is the area that the aspect is impacting on)

Area specific (at impact site)	1
Whole site (entire surface right)	2
Regional / neighbouring areas (downstream within quaternary catchment)	3
National (impacting beyond secondary catchment or provinces)	4
Global (impacting beyond SA boundary)	5

Table D3: Duration (How long does the aspect impact on the resource quality)

One day to one month, PES, EIS and/or REC not impacted	1
One month to one year, PES, EIS and/or REC impacted but no change in status	2
One year to 10 years, PES, EIS and/or REC impacted to a lower status but can be improved over this period through mitigation	3
Life of the activity, PES, EIS and/or REC permanently lowered	4
More than life of the organisation/facility, PES and EIS scores, a E or F	5
PES and EIS (sensitivity) must be considered.	

Table D4: Frequency of the activity (How often do you do the specific activity)

Annually or less	1
6 monthly	2
Monthly	3
Weekly	4
Daily	5

Table D5: The frequency of the incident or impact (How often does the activity impact on the resource quality)

Almost never / almost impossible / >20%	1
Very seldom / highly unlikely / >40%	2
Infrequent / unlikely / seldom / >60%	3
Often / regularly / likely / possible / >80%	4
Daily / highly likely / definitely / >100%	5

Table D6: Legal issues (How is the activity governed by legislation)

No legislation	1
Fully covered by legislation (wetlands are legally governed)	5
Located within the regulated areas	

Table D7: Detection (How quickly or easily can the impacts/risks of the activity be observed on the resource quality, people and resource)

Immediately	1
Without much effort	2
Need some effort	3
Remote and difficult to observe	4
Covered	5

Table D8: Rating Classes

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

A low risk class must be obtained for all activities to be considered for a GA

Table D9: Calculations

Consequence = Severity + Spatial Scale + Duration
Likelihood = Frequency of Activity + Frequency of Incident + Legal Issues + Detection
Significance\Risk = Consequence X Likelihood

The following points were considered when undertaking the assessment:

- Risks and impacts were analysed in the context of the *project's area of influence* encompassing:
  - Primary project site and related facilities that the client and its contractors develops or controls;
  - Areas potentially impacted by cumulative impacts for further planned development of the project, any existing project or condition and other project-related developments; and
  - Areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location.
- Risks/Impacts were assessed for construction phase and operational phase; and
- Individuals or groups who may be differentially or disproportionately affected by the project because of their disadvantaged or vulnerable status were assessed.

Control Measure Development

The following points presents the key concepts considered in the development of mitigation measures for the proposed construction:

- Mitigation and performance improvement measures and actions that address the risks and impacts[8] are identified and described in as much detail as possible. Mitigating measures are investigated according to the impact minimisation hierarchy as follows:
  - Avoidance or prevention of impact;
  - Minimisation of impact;
  - Rehabilitation; and
  - Offsetting.
- Measures and actions to address negative impacts will favour avoidance and prevention over minimisation, mitigation or compensation; and
- Desired outcomes are defined, and have been developed in such a way as to be measurable events with performance indicators, targets and acceptable criteria that can be tracked over defined periods, wherever possible.

Recommendations

Recommendations were developed to address and mitigate potential impacts on the freshwater ecology of the resources in traversed by or in close proximity of the proposed infrastructure.

[8] Mitigation measures should address both positive and negative impacts

APPENDIX E – Specialist information

DETAILS, EXPERTISE AND CURRICULUM VITAE OF SPECIALISTS

1. (a) (i) Details of the specialist who prepared the report

Stephen van Staden MSc (Environmental Management) (University of Johannesburg)

Amanda Mileson NDip Nature Conservation (UNISA)

1. (a). (ii) The expertise of that specialist to compile a specialist report including a curriculum vitae

Company of Specialist:	Scientific Aquatic Services		
Name / Contact person:	Stephen van Staden		
Postal address:	29 Arterial Road West, Oriel, Bedfordview		
Postal code:	2007	Cell:	083 415 2356
Telephone:	011 616 7893	Fax:	011 615 6240/ 086 724 3132
E-mail:	stephen@sasenvgroup.co.za		
Qualifications	MSc (Environmental Management) (University of Johannesburg) BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg) BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)		
Registration / Associations	Registered Natural Professional Scientist at South African Council for Natural Scientific Professions (SACNASP) Accredited River Health Practitioner by the South African River Health Program (RHP) Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum		

Declaration that the specialist is independent in a form as may be specified by the competent authority

I, Stephen van Staden, declare that -

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

----

Signature of the Specialist

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

Position in Company	Managing member, Ecologist with focus on Freshwater Ecology
Date of Birth	13 July 1979
Nationality	South African
Languages	English, Afrikaans
Joined SAS	2003 (year of establishment)
Other Business	Trustee of the Serenity Property Trust and emerald Management Trust

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP);
Accredited River Health practitioner by the South African River Health Program (RHP);
Member of the South African Soil Surveyors Association (SASSO);
Member of the Gauteng Wetland Forum;
Member of International Association of Impact Assessors (IAIA) South Africa;
Member of the Land Rehabilitation Society of South Africa (LaRSSA)

EDUCATION

Qualifications	
MSc (Environmental Management) (University of Johannesburg)	2003
BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg)	2001
BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)	2000
Tools for Wetland Assessment short course Rhodes University	2016

COUNTRIES OF WORK EXPERIENCE

South Africa – All Provinces
Southern Africa – Lesotho, Botswana, Mozambique, Zimbabwe Zambia
Eastern Africa – Tanzania Mauritius
West Africa – Ghana, Liberia, Angola, Guinea Bissau, Nigeria, Sierra Leone
Central Africa – Democratic Republic of the Congo

PROJECT EXPERIENCE (Over 2500 projects executed with varying degrees of involvement)

1. Mining: Coal, Chrome, PGM's, Mineral Sands, Gold, Phosphate, river sand, clay, fluorspar
2. Linear developments
3. Energy Transmission, telecommunication, pipelines, roads
4. Minerals beneficiation
5. Renewable energy (wind and solar)
6. Commercial development

7 Residential development
8 Agriculture
9 Industrial/chemical

REFERENCES

- Terry Calmeyer (Former Chairperson of IAIA SA)
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- Alex Pheiffer
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  SLR Consulting
  Tel: +27 11 467 0945
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- Marietjie Eksteen
  Managing Director: Jacana Environmental

  Tel: 015 291 4015

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF AMANDA MILESON

PERSONAL DETAILS

Position in Company	Ecologist
Date of Birth	15 February 1978
Nationality	Zimbabwean
Languages	English
Joined SAS	2013

MEMBERSHIP IN PROFESSIONAL SOCIETIES

South African Wetland Society

Gauteng Wetland Forum

EDUCATION

Qualifications

N.Dip Nature Conservation (UNISA)	2017
Wetland Management: Introduction and Delineation (University of the Free State)	2018
Tools for Wetland Assessment (Rhodes University)	2016
Wetland Rehabilitation short learning programme (UFS)	2015

COUNTRIES OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North West, Limpopo, Free State, Northern Cape, Eastern Cape

Zimbabwe, Zambia

SELECTED PROJECT EXAMPLES

Wetland Assessments

- Wetland assessment as part of the environmental authorisation process for the Anglo Platinum Der Brochen Project, Limpopo Province
- Wetland assessment as part of the environmental authorisation process for the proposed Tharisa North eastern waste rock dump, North West Province
- Wetland assessment as part of the environmental authorisation process for the proposed Yzermyn Coal Mining Project near Dirkiesdorp, Mpumalanga
- Wetland assessment as part of the environmental authorisation process for the Mzimvubu Water Project, Eastern Cape
- Wetland assessment as part of the environmental authorisation process for the proposed expansion of mining operations at the Langkloof Colliery, Mpumalanga

- Wetland assessment as part of the proposed water management process at the Assmang Chrome Machadodorp Works, Mpumalanga
- Wetland assessment as part of the water use licencing process for the proposed development in Rooihuiskraal Ext 24, Centurion, Gauteng
- Wetland assessment as part of the environmental authorisation process for the proposed road crossings on The Hills EcoEstate, Midrand, Gauteng
- Wetland ecological assessment as part of the Section 24G application process for the Temba Water Purification Plant
- Wetland assessment and offset studies for the Optimum Colliery Kwagga North Project, Mpumalanga
- Wetland assessment and delineation as part of the environmental authorisation process for the proposed development of a mall adjacent to the M10 Road in Mahube Valley, Mamelodi, Gauteng
- Wetland assessment as part of the environmental authorisation process for the proposed construction of a sewer system in Ekangala Township, Gauteng

Terrestrial Assessments

- Investigation of specialist biodiversity aspects required by GDARD in the vicinity of the Apies River, downstream of the proposed construction of new outlet works at the Kudube (Leeuwkraal) Dam in Temba, Gauteng
- Terrestrial Ecological Scan as part of the environmental authorisation process for three proposed bridge upgrades near Edenvale, Gauteng
- Terrestrial Ecological Scan as part of the environmental authorisation process for the proposed Dalpark Ext 3 filling station development, Gauteng

Rehabilitation Projects

- Wetland rehabilitation and management plan for The Hills EcoEstate, Midrand, Gauteng
- Riparian rehabilitation and management plan for The Diepsloot River, Riversands, Gauteng
- Riparian rehabilitation and management plan for the Apies River in the vicinity of the proposed construction of new outlet works at the Kudube (Leeuwkraal) Dam in Temba, Gauteng

Environmental Control Officer

- Monthly specialist Environmental Control Officer (ECO) function for the monitoring of riparian crossings at Riversands Country Estate Development, Gauteng

Annexure 8: Visual Assessment

Visual Assessment Scoping & Site Selection Study for the Proposed Khulu Tailings Storage Facility at the Dwarsrivier Chrome Mine

Project Number:

ENG011

Prepared for:

EnviroGistics (Pty) Ltd

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June 2021

DOCUMENT CONTROL

Project Name	Visual Assessment Scoping & Site Selection Study for the Proposed Khulu Tailings Storage Facility at the Dwarsrivier Chrome Mine
Report Type	Visual Assessment & Site Selection
Client	EnviroGistics (Pty) Ltd
Project Number	ENG011
Report Number	01
Report Status	Draft
Submission Date	23 June 2021
Author	Andy Pirie
Author Signature	

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1 INTRODUCTION AND BACKGROUND

Hydrospatial (Pty) Ltd was appointed by EnviroGistics (Pty) Ltd to undertake a Visual Impact Assessment (VIA) for the proposed Khulu Tailings Storage Facility (TSF) at the Dwarsrivier Chrome Mine (hereafter referred to as DCM or the Mine). This report constitutes the visual assessment scoping and site selection for the proposed Khulu TSF.

1.1 Project Location

The Mine is situated in the Limpopo Province of South Africa, 23 kilometres (km) south-west of the town of Steelpoort. Figure 1-1 indicates the location of the DCM mining right area.

1.2 Project Description

DCM is currently depositing at the existing North Tailings Storage Facility (NTSF) at the eastern side of their process plant on the remaining portion of the Farm Dwarsrivier 372. It is anticipated that the existing active NTSF will reach its full capacity relatively sooner than anticipated due to tonnage ramp ups and additional tonnages from other sites.

The Mine identified seven (7) potential TSF sites initially, which have been reduced to four (4) (Site B, C, D and F) (Figure 1-2).. During the 2019 Site Selection Process, Site D was the preferred site for the Mine. Based on the initial view by the Environmental Assessment Practitioner, Site B was fatally flawed due to the potential future Eskom substation, for which an EIA has been approved and negotiations in terms of land use between the Mine and Eskom have commenced. However, subsequent to the 2019 Site Selection Process, further geotechnical studies were undertaken, which identified potential concerns for Site D, which also included the proximity of the non-perennial tributary of the Dwarsrivier River. In addition to this, the Eskom substation is no longer planned, which has reintroduced Option B into the overall assessment.

The project will not involve typical tailings deposition techniques, but will involve the piping of tailings to a filter press facility from where the filter cake will be trucked to the new TSF. A life of Mine of about 20 years are currently considered as part of the design.

The proposed TSF footprint areas and heights are summarised in Table 1-1.

Table 1-1: Footprint areas and heights of the TSF sites

TSF Option	Footprint Area	Height
Site B	20 ha	37 m
Site C	28 ha	29 m
Site D	21 ha	49 m
Site F	17 ha	50 m

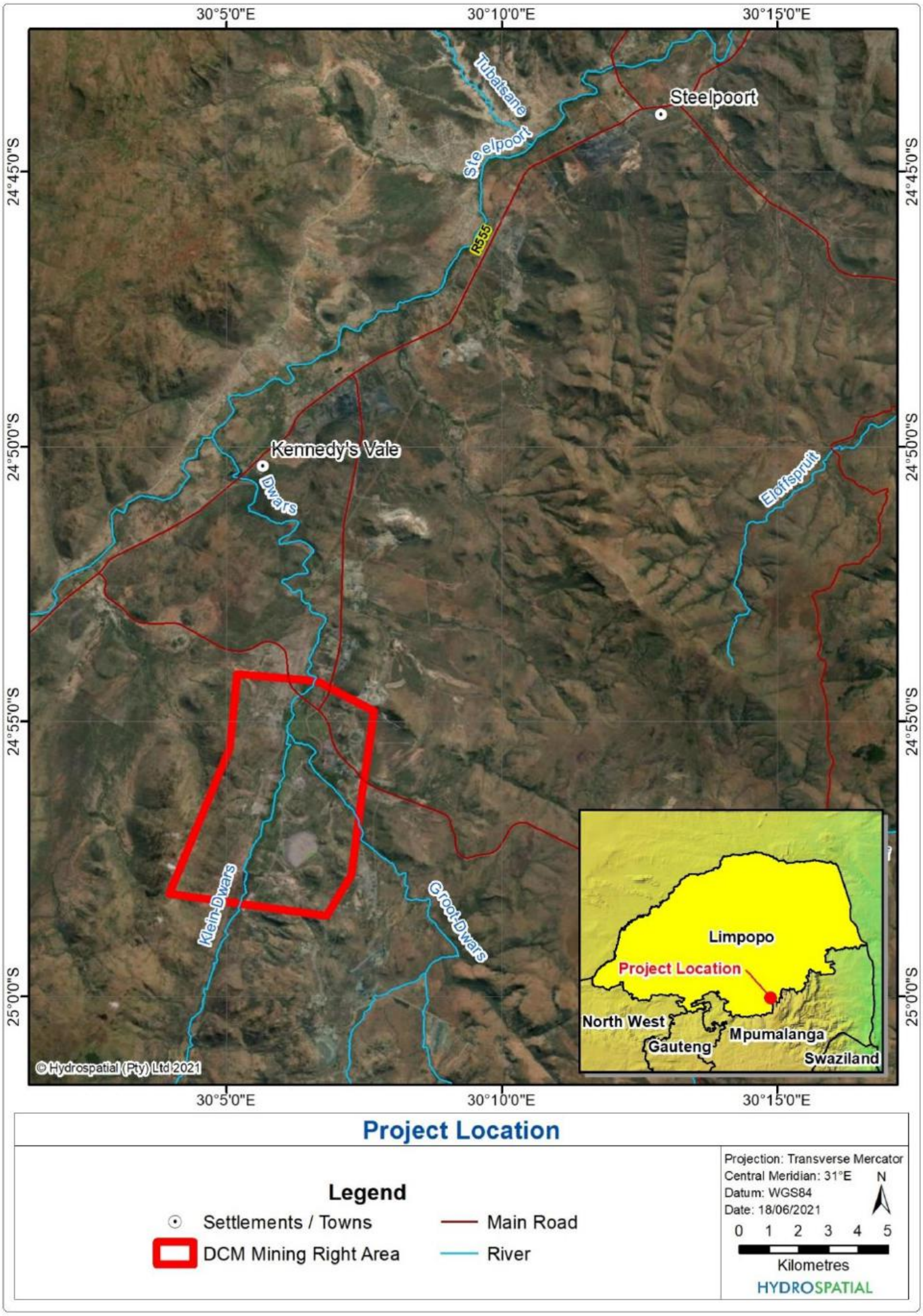

Figure 1-1: Location of the Dwarsrivier Chrome Mine

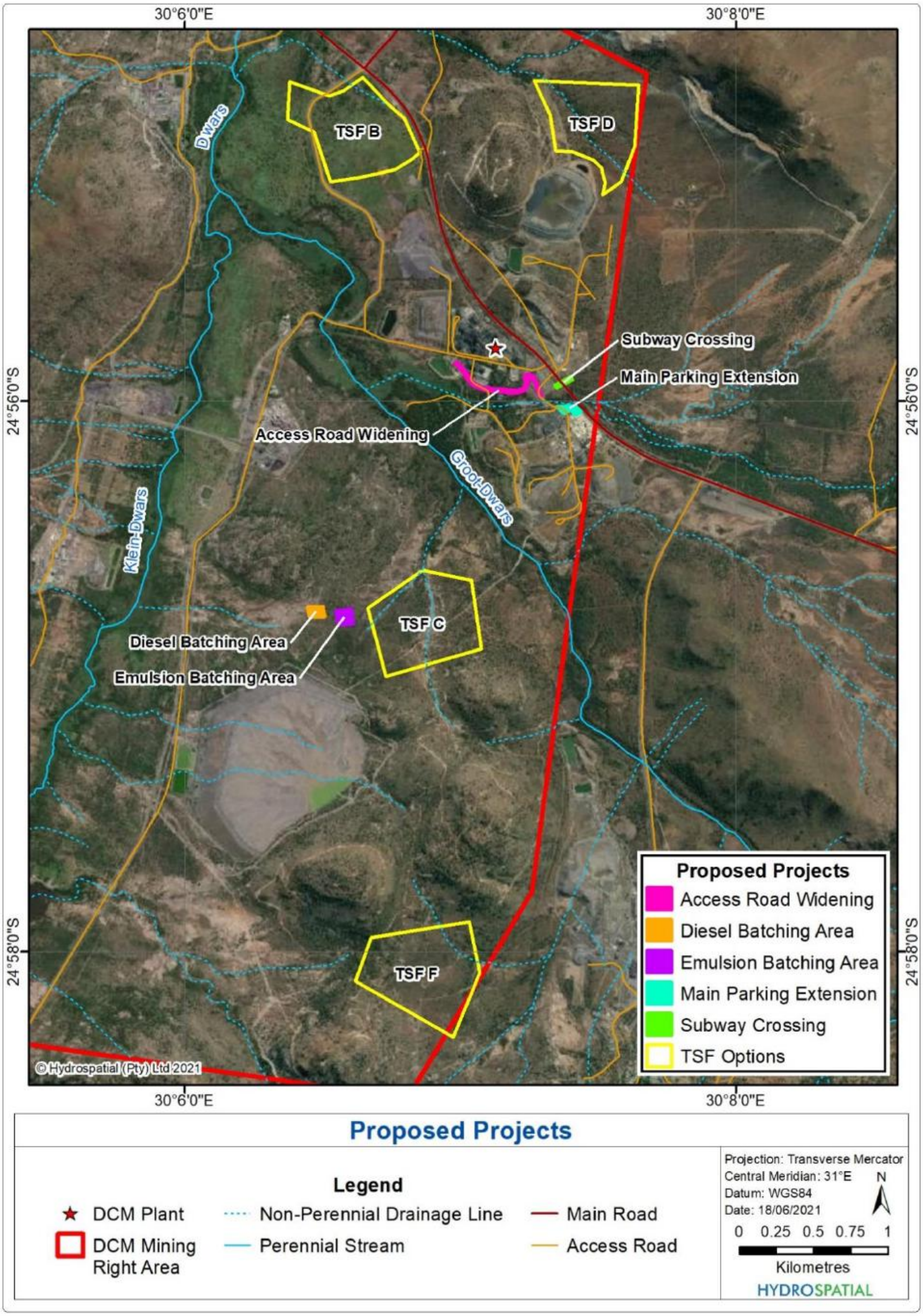

Figure 1-2: Proposed TSF options

1.3 Legislative Requirements and Guidelines

The following international and national legislative requirements and guidelines are relevant to the VIA study:

1.3.1 International

The European Landscape Convention (ELC) created by the Council of Europe, was the first international convention to focus exclusively on landscapes. The purpose of this convention is to promote effective management and planning of landscapes. It was signed by the United Kingdom government in 2006 and became binding from 2007. Public documents that explore the impacts of large scale developments, as defined in the ELC, on any landscape should take into account the effects of these developments. A landscape means "an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors" i.e. the natural, visual and subjectively perceived landscape, (Contesse, 2011; European Landscape Convention, 2007).

There is no regional or local scale legislation pertaining to mining activities and Visual Impact Assessments (VIAs) exclusively but VIAs are relevant to the International Finance Corporation's (IFC) Performance Standards and this will be treated as a best practice guideline.

IFC Performance Standard 3: Resource Efficiency and Pollution Prevention is applicable to the VIA. Performance Standard 3 recognises that increased economic activity and urbanisation often generate increased levels of pollution to air, water and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional and global levels. For the purposes of this Performance Standard, the term 'pollution' is used to refer to both hazardous and non-hazardous chemical pollutants in the solid, liquid, or gaseous phases, and includes other components such as pests, pathogens, thermal discharge to water, GHG emissions, nuisance odours, noise, vibration, radiation, electromagnetic energy and the creation of potential visual impacts including light (IFC, 2012).

The Environmental, Health and Safety Guidelines for Mining therefore need to be considered (World Bank, 2007):

"Mining operations, and in particular surface mining activities, may result in negative visual impacts to resources associated with other landscape uses such as recreation or tourism. Potential contributors to visual impacts include high walls, erosion, discoloured water, haul roads, waste dumps, slurry ponds, abandoned mining equipment and structures, garbage and refuse dumps, open pits, and deforestation. Mining operations should prevent and minimise negative visual impacts through consultation with local communities about potential post-closure land-use, incorporating visual impact assessment into the mine reclamation process. Reclaimed lands should, to the extent feasible, conform to the visual aspects of the surrounding landscape. The reclamation design and procedures should take into consideration the proximity to public viewpoints and the visual impact within the context of the viewing distance. Mitigation measures may include strategic placement of screening materials including trees and use of appropriate plant species in the reclamation phase as well as modification of the placement of ancillary and access roads."

1.3.2 National

At a national level, the following legislative documents potentially apply to the VIA:

- Regulations in Chapter 5 (Integrated Environmental Management) of the NEMA and the Act in its entirety. The Act states that "the State must respect, protect, promote and fulfil the social, economic and environmental right of everyone…" Landscape is both moulded by, and moulds, social and environmental features;
- Section 23(1)(d) of the MPRDA, where it is mentioned that a mining right will be granted if "the mining will not result in unacceptable pollution, ecological degradation or damage to the environment". Visual pollution is a form of environmental pollution and therefore needs to be considered under this section. Holders of rights granted in terms of the MPRDA must at all times give effect to the general objectives of integrated environmental management laid down in Chapter 5 of the NEMA. The Regulations promulgated in terms of the NEMA, with which holders of rights must comply, provide for the assessment and evaluation of potential impacts, and the setting of management plans to mitigate such impacts.
- The National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA) and related provincial regulations – in some instances there are policies or legislative documents that give rise to the protection of listed sites. The NHRA states that it aims to promote "good management of the national estate, and to enable and encourage communities to nurture and conserve their legacy so that it may be bequeathed for future generations". A holistic landscape whose character is a result of the action and interaction and/or human factors has strong cultural associations as societies and the landscape in which they live are affected by one another in many ways; and
- Section 17 of the National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003) (NEM: PAA) sets out the purposes of the declaration of areas as protected areas which includes the protection of natural landscapes. Landscapes are defined by the natural, visual and subjectively perceived landscape; these aspects of a landscape are intertwined to form a holistic landscape context.

2 SCOPE OF WORK

The scope of work for the visual assessment scoping and TSF site selection study included the following:

- Provide a baseline (pre-development) description of the visual and aesthetic landscape;
- Undertake a site selection assessment for the proposed Khulu TSF;
- Provide the preliminary anticipated visual impacts for the project; and
- Provide the terms of reference for the visual assessment study for the Environmental Impact Assessment (EIA) phase.

A study area of 5 km around each of the TSF options was assessed, as beyond this, the visual exposure of the TSFs in the landscape would be negligible.

3 BASELINE VISUAL AND AESTHETIC ENVIRONMENT

The primary purpose of this section is to provide the baseline (pre-mining) visual and aesthetic characteristics of the area in which the TSFs are proposed to be located.

3.1 Topography

The topography of an area in which a project is located, plays an important role in the visibility of a project. For instance, in mountainous areas, a project may be concealed in a valley and not visible to sensitive visual receptors. However, if the project is developed on top of a mountain, or in an open area, it may be visible to many visual receptors. Figure 3-1 demonstrates the role topography in the visibility of a project.

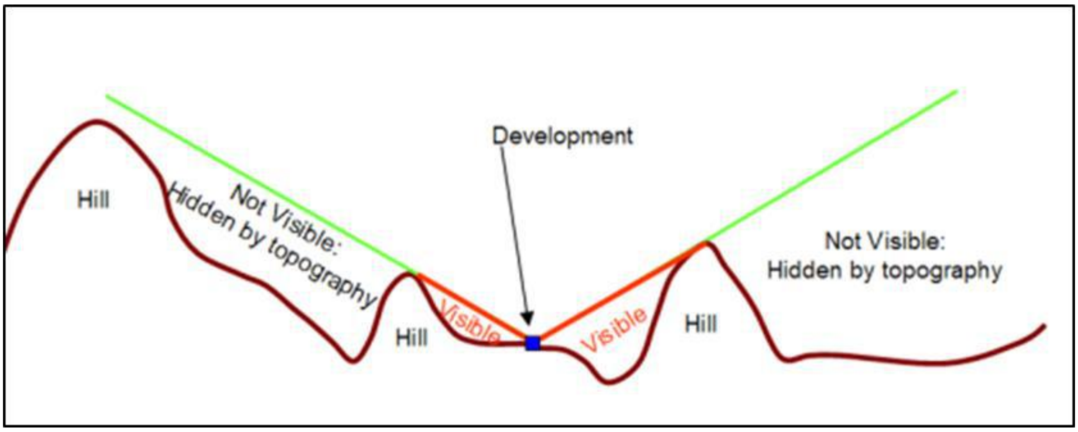

Figure 3-1: The role of topography in the visibility of a project

The regional topography can be described as undulating with numerous mountain ridges and valleys (Figure 3-2). A mountain ridge runs along the western boundary of the Mining Right Area (MRA), where a maximum elevation of approximately 1 630 metres above mean sea level (mamsl) is reached. From this ridge, the elevation drops off to approximately 900 mamsl near the confluence of the Klein and Groot Dwars Rivers. A number of hills are located along the eastern portion of the MRA.

TSF B is located on fairly flat topography, dipping gradually in a north-westerly direction towards the Dwars River. According to the 1:50 000 topographical map 2430CC Kennedy's Vale, a non-perennial drainage line occurs along the northern boundary of the TSF site (Figure 1-2). During the site visit, this area was noted to be disturbed by what appeared to be old stockpiles and borrow pits.

TSF site C is proposed to be constructed against two hills. The maximum height of the proposed TSF against the hills is 995 mamsl, whilst the lowest elevation is 950 mamsl. The proposed TSF is drained in a north-easterly direction by two non-perennial drainage lines into the Groot Dwars River.

TSF site D is located in a valley between two hills and immediately north-east of the Mines existing active TSF. The proposed TSF reaches a maximum height of 1 810 mamsl along its western side against a hill, whilst its lowest elevation is 934 mamsl. The proposed TSF is drained in a north-westerly direction by a non-perennial drainage line towards the Dwars River. A number of small drainage lines which drain the hill immediately to the east of the proposed TSF are evident. Open pit mining is taking place along this hill as well as to the north-east of the proposed TSF.

TSF site F is proposed to be constructed against three hills. The proposed TSF will reach a maximum height of 1 064 mamsl along its north-western side, dropping off to 998 mamsl at its lowest point. The proposed TSF is drained firstly in an easterly and then in a north-easterly direction, by a non-perennial drainage line towards the Groot Dwars River. This drainage line appears to be diverted around mining activities, as well as what appears to be an active TSF, located 800 m downstream of the proposed TSF.

3.2 Vegetation and Land Cover

Similar to topography, the vegetation and land cover of an area plays an important role in the visibility of a project. Tall dense vegetation can conceal a project from visual receptors, while projects located in open areas consisting of grassland vegetation, are likely to be more visible to receptors.

The proposed TSF sites fall within the Sekhukhune Mountain Bushveld with vegetation characterised as open and closed broad leafed savannah on hills and mountain slopes (Mucina & Rutherford, 2006).

TSF B is currently located within an open bushveld and shrubland/grassland areas (Figure 3-3), but was previously used for crop cultivation.

TSF C is primarily located within an open woodland area, with shrubland and grassland located at the lower elevations (Figure 3-3). Bare areas occur along the drainage lines. The Two Rivers Platinum Mine TSF is located immediately to the south-west.

TSF D is mostly located within an open woodland area, with the Mines current active TSF located immediately to the south-west. Shrubland and bare areas are located around the drainage line towards the centre of the proposed TSF.

TSF F is mainly located within a grassland area, with sections of shrubland, open woodland and bare areas present.

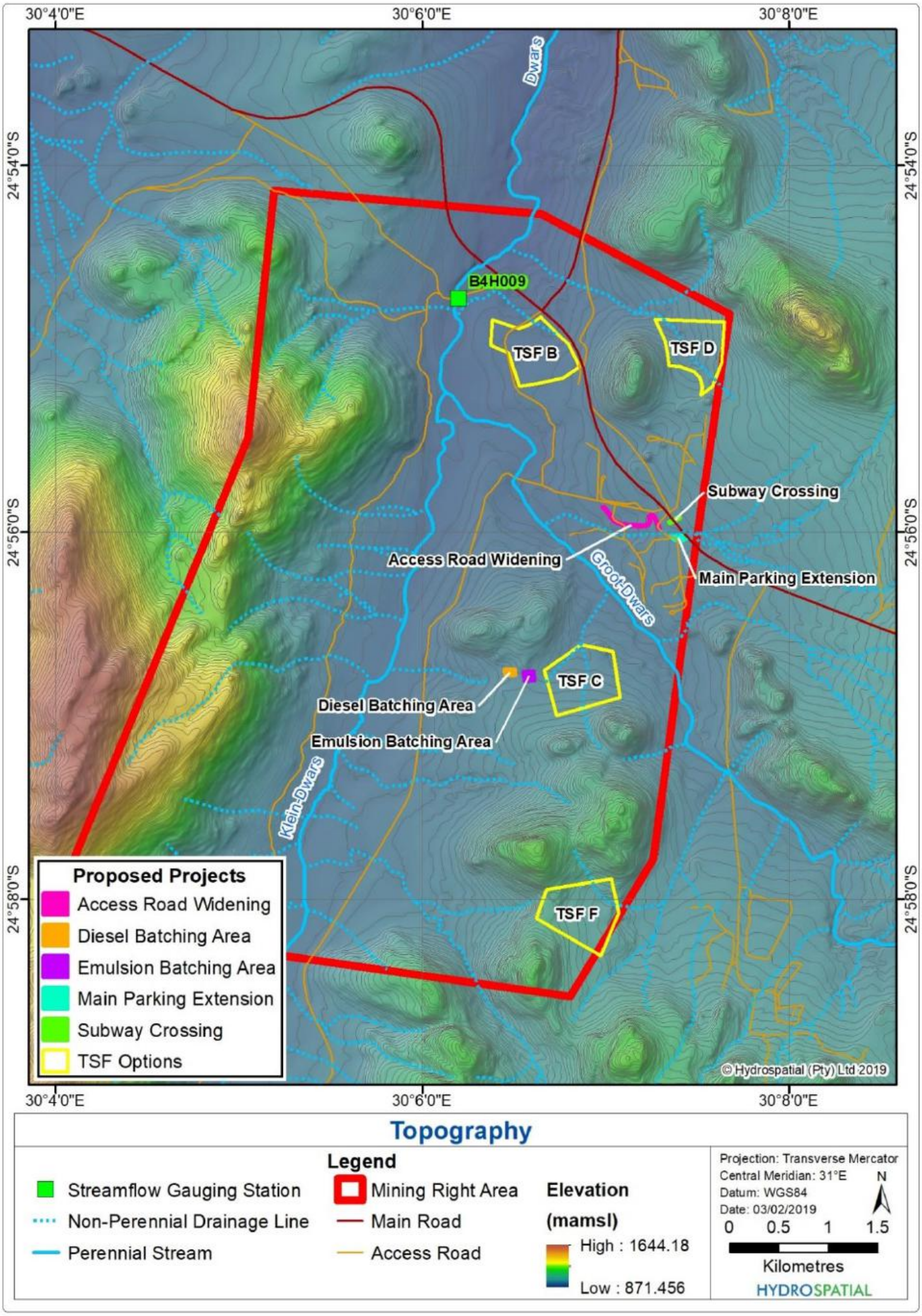

Figure 3-2: Topography

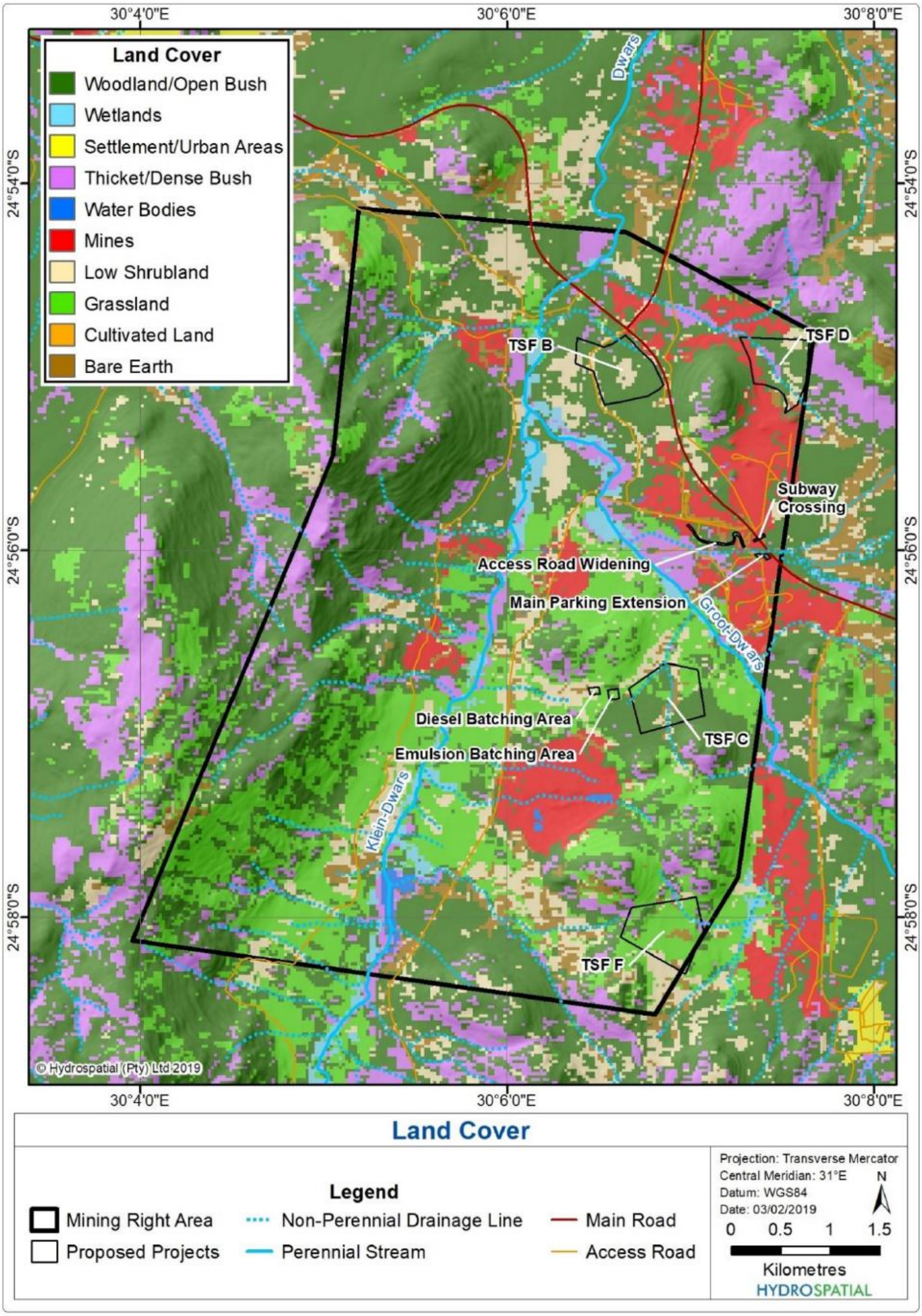

Figure 3-3: Land cover

3.3 Visual/Landscape Characterisation

Within a 5 km radius of the TSF options, the region can be broadly divided into the following categories:

- Mining areas – mining areas occur mostly along the valleys of the Groot and Klein Dwars Rivers; and
- Natural bushveld areas.

3.4 Sense of Place

The sense of place can be defined as the character of the place, whether natural, rural or urban, and is largely dependent on the visual and landscape characterisation of an area.

Mining dominates the landscape, with a number of mines occurring in the region. The natural bushveld sense of place, has largely been converted into a mining landscape.

3.5 Visual Receptors

The following visual receptors have been identified within a 5 km radius of the TSF sites:

- Farmhouses and guesthouses; and
- Regional roads within the area.

4 TSF SITE SELECTION

The purpose of the visual site selection assessment is to assess the potential TSF sites in order to determine the site with the least visual disturbance on surrounding receptors. A study area of 5 km around each of the TSF sites was deemed sufficient, as beyond this, the visual exposure of the TSFs would be negligible.

4.1 Methodology

The following methodology was employed.

4.1.1 Viewshed Analysis

Firstly, viewshed models were generated for a 5 km radius around each of the TSF sites. A viewshed indicates areas in the landscape from where a proposed TSF would or would not be visible from. The 3D Analyst extension within the ArcGIS software programme was used to model the viewsheds. A 5 m spatial resolution Digital Elevation Model (DEM) was generated from the 5 m contour topographical datasets for South Africa. The DEM was used in the viewshed to model the terrain of the landscape. The heights of the TSF options were obtained from the Mine, and were entered in the viewshed setup, along with the average height of the observer (1.7 m)

4.1.2 Visual Receptors

Visual receptors within the visible areas of the viewsheds were identified from aerial imagery. These included farmhouses and roads in the area.

4.1.3 Site Selection and Preferred Site

The TSF option with the smallest visible area effecting the least number of visual receptors, was selected as the most favourable option.

4.2 Results

The viewsheds within a 5 km radius of TSF sites B, C, D and F are indicated on Figure 4-1, Figure 4-2, Figure 4-3 and Figure 4-4 respectively. Visual receptors identified included farmhouses as well as the main roads in the area. Table 4-1 provides a summary of the visible areas, number of visual receptors impacted and site selection rank. As can be observed, TSF F has the smallest visible area and least number of visual receptors impacted, and is therefore ranked 1 (most favourable), followed by C, D and then B. Although TSF F is the most favourable in terms of the criteria used to assess the TSF options, it must be noted that all options fall within an area dominated by mining activities and infrastructure. Due to the visual aesthetics and sense of place of the area being previously altered from rural bushveld to mining, it is unlikely that the implementation of any of the TSF options would result in any significant visual impact.

Table 4-1: Summary of the visible areas, number of visual receptors impacted and site selection rank

TSF Options	Visible Area (km^2)	No. of Visual Receptors Impacted	Rank*
TSF F	21.5	5	1
TSF C	27.4	12	2
TSF D	30.5	13	3
TSF B	40.6	15	4

* Rank 1 indicates the most favourable option with the least favourable option being rank 3

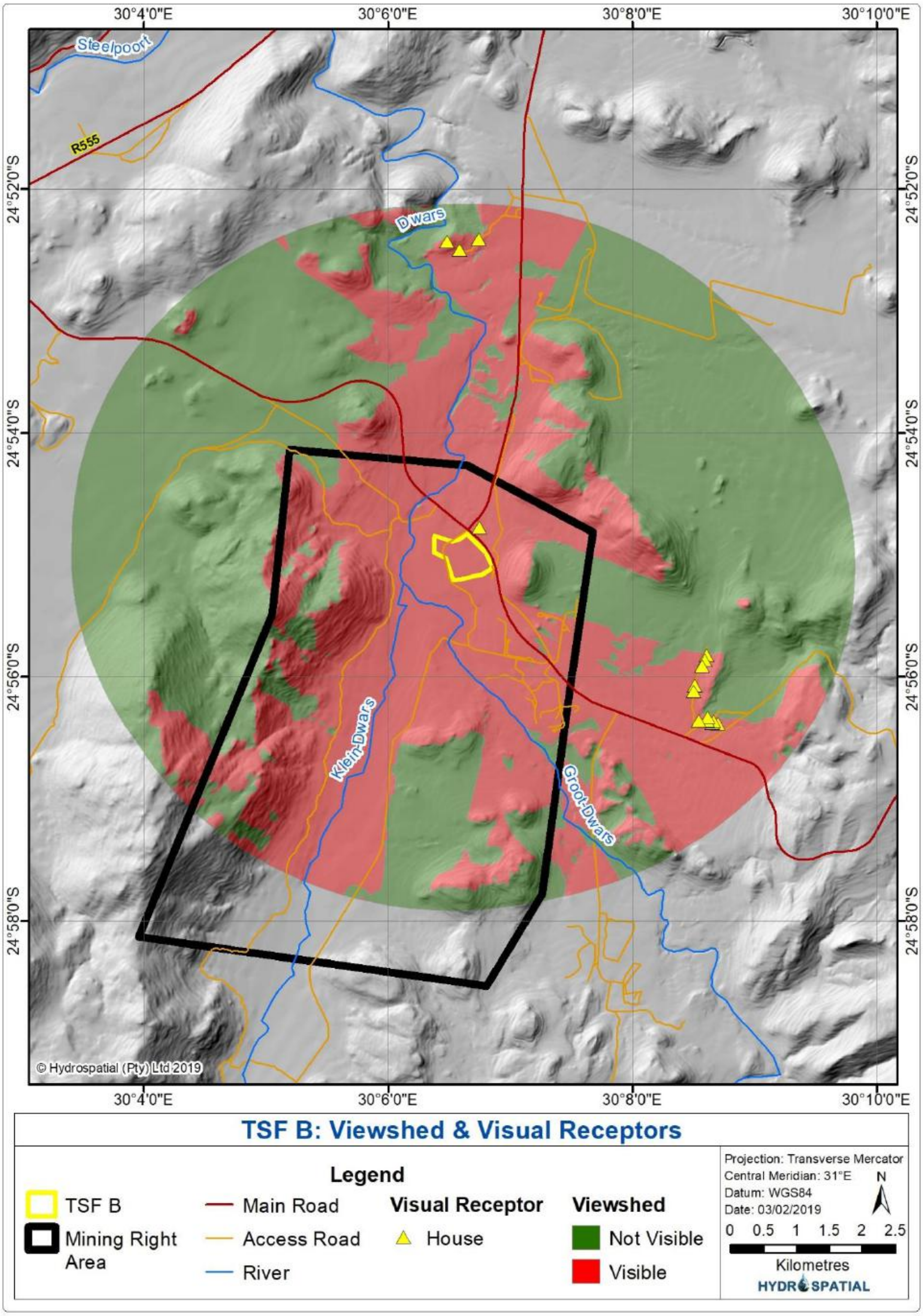

Figure 4-1: Viewshed and visual receptors for TSF B

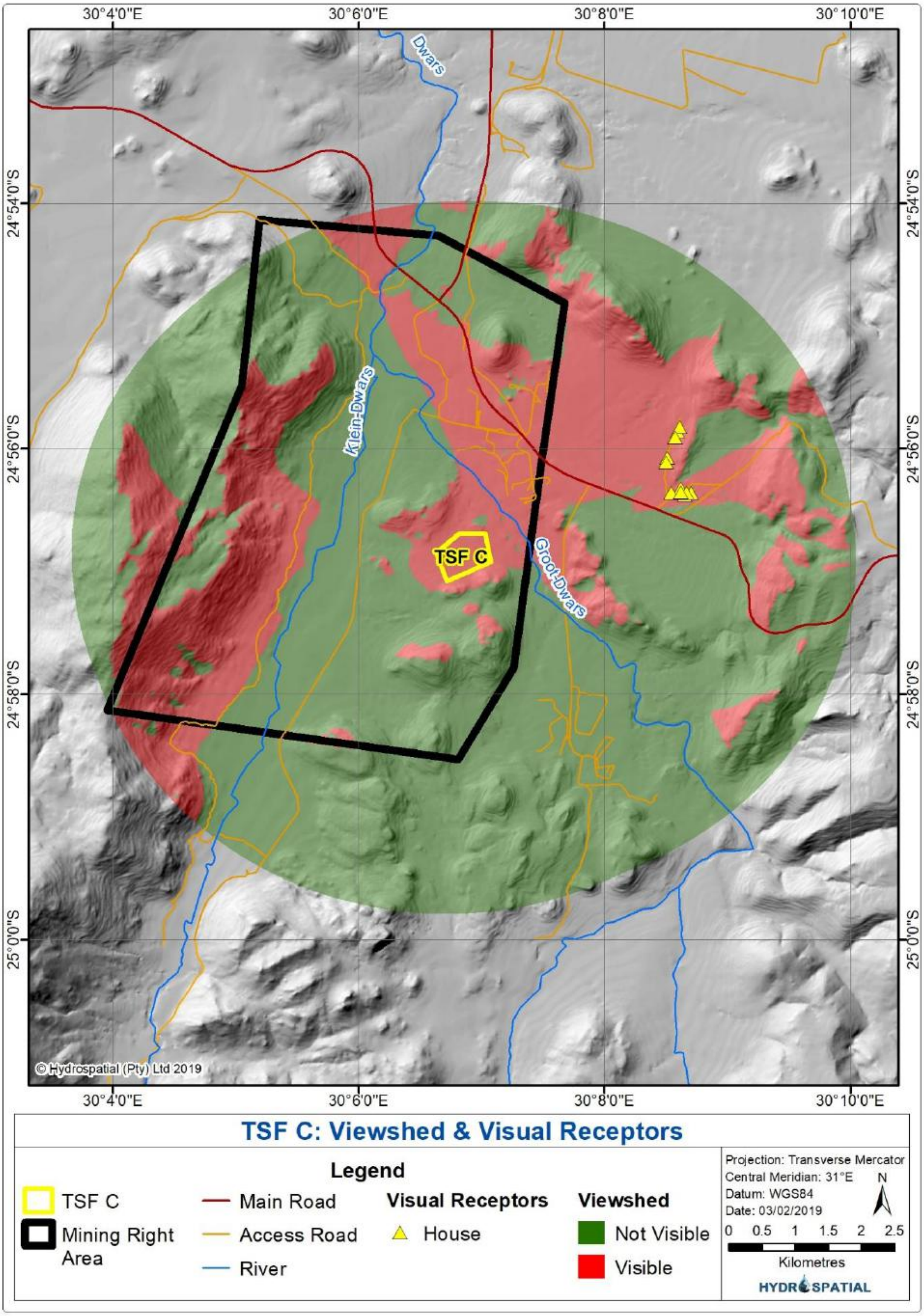

Figure 4-2: Viewshed and visual receptors for TSF C

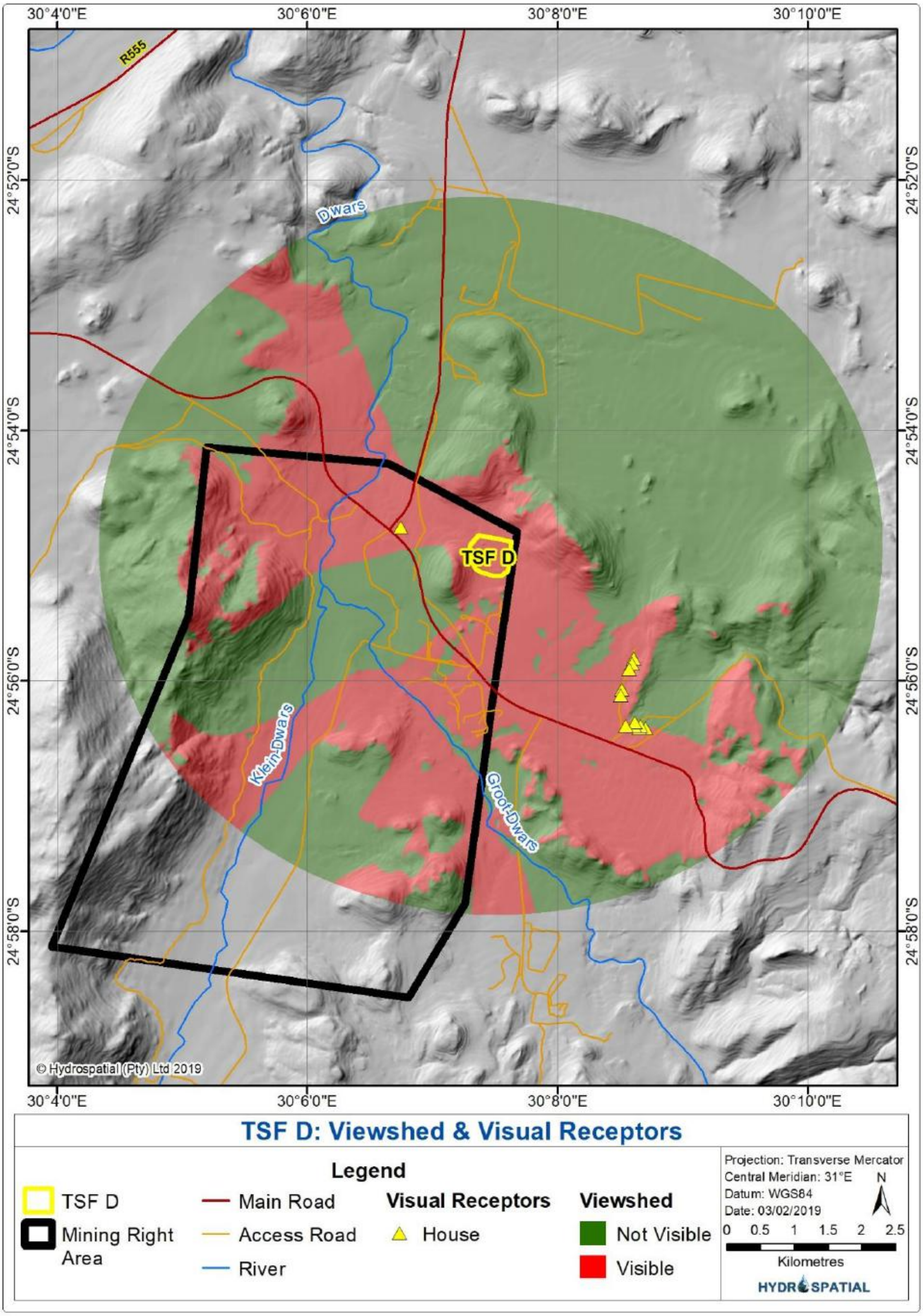

Figure 4-3: Viewshed and visual receptors for TSF D

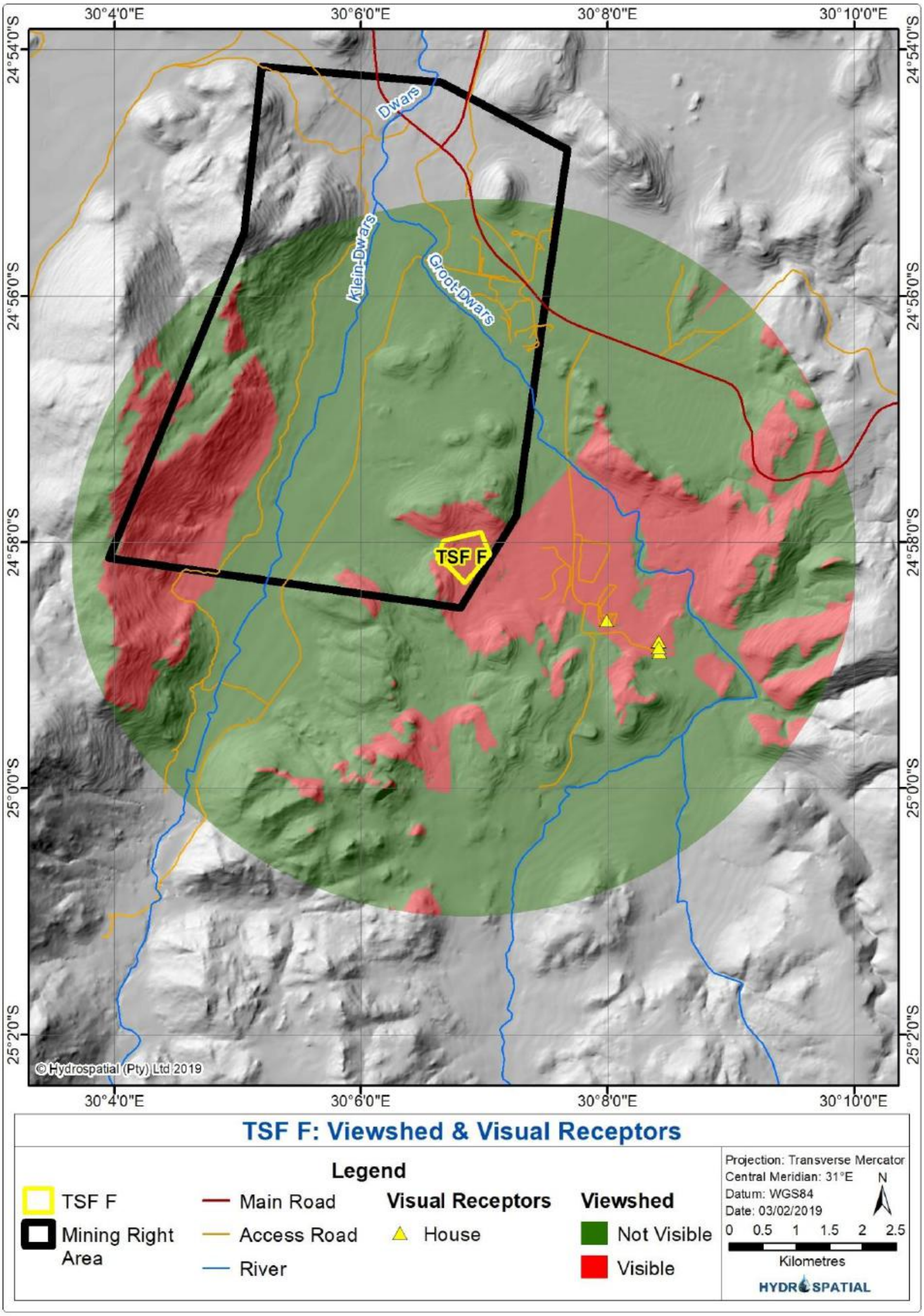

Figure 4-4: Viewshed and visual receptors for TSF F

5 POTENTIAL VISUAL IMPACTS

The preliminary anticipated visual impacts for the construction and operational phases of the Project are indicated in Table 5-1. These impacts will be investigated in further detail during the EIA phase of the Project.

Table 5-1: Anticipated visual impacts

Phase	Activity	Impact Description	Pre-Mitigation					Mitigation/Management Measures & Recommendations	Post-Mitigation				
			Extent	Duration	Probability	Intensity	Significance		Extent	Duration	Probability	Intensity	Significance
Construction Phase	Removal of vegetation for construction of TSF	Creation of a bare areas and the generation of dust.	Local (2)	Short-term (1)	Probable (2)	Minor (-2)	Medium (-6 to -11)	Vegetation clearance should be kept to an absolute minimum. Exposed areas should be vegetated as soon as possible. Dust suppression measures should be implemented to limit the generation of dust.	Site-specific (1)	Short-term (1)	Improbable (1)	Negligible (-1)	Low (-1 to -5)
Construction Phase	The presence and use of heavy machinery, trucks and vehicles for construction purposes.	The movement of vehicles and heavy machinery during the construction phase will create a visual presence and will generate dust.	Local (2)	Short-term (1)	Probable (2)	Minor (-2)	Medium (-6 to -11)	Machinery, trucks and vehicles are already present on the Mine site and are unlikely create any additional significant presence. Dust suppression measures should be implemented to limit the generation of dust.	Site-specific (1)	Short-term (1)	Improbable (1)	Negligible (-1)	Low (-1 to -5)
Operational Phase	The presence of the TSF in the landscape	Impact on the surrounding landscape.	Regional (3)	Long-term (3)	Probable (2)	Minor (-2)	Medium (-6 to -11)	The natural landscape of the area has already been altered by mining. The proposed TSF is in line with the current land use and will add to the already altered landscape. It is not foreseen that the current visual quality of the area will be significantly altered by the proposed TSF.	Local (2)	Medium-term (2)	Improbable (1)	Negligible (-1)	Medium (-6 to -11)

Phase	Activity	Impact Description	Pre-Mitigation					Mitigation/Management Measures & Recommendations	Post-Mitigation				
			Extent	Duration	Probability	Intensity	Significance		Extent	Duration	Probability	Intensity	Significance
Operational Phase	The presence of additional lighting from the TSF at night.	Additional night lighting from the TSF	Regional (3)	Long-term (3)	Probable (2)	Average (-3)	Medium (-6 to -11)	Down lighting and lighting shields should be used as far as possible.	Local (2)	Short-term (1)	Improbable (1)	Negligible (-1)	Low (-1 to -5)
Closure, Decommissioning & Rehabilitation Phase	Rehabilitation of the TSF.	The rehabilitation of the TSF is likely to result in less of a visual impact if it is vegetated.	Regional (3)	Long-term (3)	Probable (2)	Minor (-2)	Medium (-6 to -11)	The TSF should be vegetated at closure.	Site-specific (1)	Medium-term (2)	Improbable (1)	Negligible (-1)	Low (-1 to -5)

6 TERMS OF REFERENCE FOR THE EIA PHASE

The following will be undertaken during the EIA phase of the project for the VIA study:

- Viewshed modelling will be undertaken to determine the visibility of the Project on the surrounding landscape; and
- The visual impacts will be assessed and mitigation measures proposed.

7 REFERENCES

OBERHOLZER, B. 2005. Guideline for involving visual and aesthetic specialists in EIA processes: Edition 1. CSIR Report No ENV-S-C 2005 053 F. Republic of South Africa, Provincial Government of the Western Cape, Department of Environmental Affairs & Development Planning, Cape Town.

Annexure 9: Air Quality Assessment

ENVIROGISTICS (PTY) LTD

DWARSRIVIER TAILINGS STORAGE FACILITY

SITE SELECTION REPORT

22 JUNE 2021

DWARSRIVIER TAILINGS STORAGE FACILITY

SITE SELECTION REPORT

ENVIROGISTICS (PTY) LTD

REPORT (VERSION 01)

PROJECT NO.: 41101333
DATE: JUNE 2021

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QUALITY MANAGEMENT

ISSUE/REVISION	FIRST ISSUE	REVISION 1	REVISION 2	REVISION 3
Remarks	Report	Report		
Date	06 February 2019	22 June 2021		
Prepared by	N. Reddy	N. Singh		
Signature				
Checked by	B. Keiser	K. Collett		
Signature				
Authorised by	B. Keiser	K. Collett		
Signature				
Project number	41101333	41101333		
Report number	1 of 1	1 of 1		
File reference	W:\000 NEW Projects\41101333 - Envirogistics Dwarsrivier TSF AQIA\41 AQ\2-REPORTS\01-Draft\Site Selection Report\Updated - June 2021			

PRODUCTION TEAM

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EXECUTIVE SUMMARY

The Dwarsrivier Chrome Mine is currently depositing at the existing tailings storage facility (TSF) at the eastern side of their process plant. It is anticipated that the existing active TSF will reach its full capacity sooner than anticipated due to tonnage ramp ups and additional tonnages from other sites.

WSP Environmental (Pty) Ltd (WSP) has been requested by Envirogistics (Pty) Ltd (Envirogistics) to undertake a desktop site selection assessment to evaluate if there are potential TSF sites, within the boundaries of the mining concession at Dwarsrivier Chrome Mine, which can be considered to supersede the current active TSF. These sites include Sites B, C, D and F. The mine initially identified seven sites which were reduced to four (Sites B, C, D and F). As such, a screening-level Air Quality Impact Assessment (AQIA) has been undertaken to provide insight into potential air quality impacts associated with the proposed TSF at Sites B, C, D and F.

The study area is situated approximately 60 km northwest of Lydenburg, 25 km south of Steelpoort and 63 km northeast of Roossenekal in the Limpopo Province. The operation is located in the Fetakgomo-Greater Tubatse Local Municipality, within the boundaries of the Sekhukhune District Municipality.

The overall area is characterised by intensive mining development. Several of the neighbouring farms, namely Tweefontein 380JT, Thorncliffe 374KT, De Grootteboom 373KT and Dwarsrivier 372KT are owned by mining houses with existing and operational chrome and platinum mines. On the remainder of the neighbouring farms, agricultural activities take place, in the form of stock grazing and the growing of vegetables, lucerne and cotton. Sensitive receptors within a 10 km radius of the study site have been selected for this impact assessment, namely SR1 and SR2 (i.e. villages).

Emission rates for the proposed activities were calculated using the United States Environmental Protection Agency (USEPA) AP-42 and the Australian Government National Pollutant Inventory (NPI) emission factors. Uncontrolled emission rates were calculated for particulate matter (PM_{10} and $PM_{2.5}$) for Sites B, C, D and F to evaluate the best possible site.

A recommended Level 1 dispersion modelling platform, SCREEN3, was utilised to predict maximum hourly average ground-level downwind concentrations of pollutants emitted from the proposed TSFs. Peak concentrations were predicted to occur at 1,100 m for Site B, 800 m for Site C and 900 m for Site D and F. The closest sensitive receptor assessed in this study from Site C and Site F are villages (SR1), and the closest sensitive receptor to Site B and Site D are villages at SR2. Conversion factors recommended in the *Regulations Regarding Dispersion Modelling* were applied to the 1-hour average output concentrations to allow for comparison with National Ambient Air Quality Standards (NAAQS) applicable to longer averaging periods. Key findings are as follows:

- Predicted ambient PM_{10} and $PM_{2.5}$ concentrations as a result of emissions from all proposed TSF Sites C, D and F are below the PM_{10} and $PM_{2.5}$ NAAQS on a 24-hour and annual averaging period;
- Lowest predicted PM_{10} concentrations are anticipated at Site D with a maximum peak concentration of 10.31 µg/m^3 and 2.06 µg/m^3 on a 24-hour and annual averaging period;
- Lowest predicted $PM_{2.5}$ concentrations are anticipated at Site D with a maximum peak concentration of 1.54 µg/m^3 and 0.31 µg/m^3 on a 24-hour and annual averaging period;
- From the screening assessment Site D was predicted as the most favourable in terms of air quality;
- Site D is located at the northern side of process plant which is adjacent to the existing TSF. Additionally, Site D is obstructed by the mountain 'koppie,' which is likely to reduce dust originating from the Site D; and
- It is noted that Site B is currently the preferred option for the TSF. The predicted PM_{10} concentrations from Site B have a maximum peak concentration of 16.88 µg/m^3 and 3.38 µg/m^3 on a 24-hour and annual averaging period respectively. Site B predicted concentrations were lower than those predicted for Site C. Predicted $PM_{2.5}$ concentrations at Site B have a maximum peak concentration of 2.53 µg/m^3 and 0.51 µg/m^3 on a 24-hour and annual averaging period respectively.

This study comprises an environmentally conservative/'worst-case' air quality impact assessment and did not find predicted pollutant concentrations to exceed regulated ambient air quality standards. Further, impacts predicted at Site D were anticipated to be the lowest and as such, it is recommended that the proposed TSF be located at Site D.

It must be noted that the findings of this assessment have been based on emissions associated with the proposed TSF only and do not incorporate all sources from the Dwarsrivier Mine. Emissions from all sources at Dwarsrivier Mine will be assessed in the full AQIA once the preferred location has been determined.

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FIGURES

1 INTRODUCTION

The Dwarsrivier Chrome Mine is currently depositing at the existing tailings storage facility (TSF) at the eastern side of their process plant. It is anticipated that the existing active TSF will reach its full capacity sooner than anticipated due to tonnage ramp ups and additional tonnages from other sites.

WSP Group Africa (Pty) Ltd has been requested by Envirogistics (Pty) Ltd (Envirogistics) to undertake a desktop site selection assessment to evaluate if there are potential TSF sites, within the boundaries of the mining concession at Dwarsrivier Chrome Mine, which can be considered to supersede the current active TSF. These sites include sites B, C, D and F. The mine initially identified seven sites which were reduced to four (Sites B, C, D and F). A screening-level Air Quality Impact Assessment (AQIA) has been undertaken to provide insight into potential air quality impacts associated with the proposed TSF at sites B, C, D and F.

In addition to the site selection evaluation, the mine plans to erect two respective diesel and emulsion batching areas, to supply diesel and emulsion to the underground mining operations. The mine will require an expansion of the existing parking area to their main offices. The current parking area is about 0.80 ha and insufficient to cater for the number of anticipated vehicles. The area will be expanded and located about 20 m from the Springkaanspruit. Existing roads will be expanded to accommodate for larger vehicles such as trucks. The mine is planning on increasing a section of 700 m of this road to a width of 16 m. To ensure more optimal logistical management of traffic between the South Mine and the North Mine; and to reduce the number of vehicles on the regional road, the mine is planning on constructing a road under the regional road bridge to allow for access between the two areas.

1.1 TERMS OF REFERENCE

The following scope of work is applicable:

- Undertake a baseline assessment of the current meteorological and ambient air quality situation in the area surrounding the proposed project;
- Develop an emissions inventory for the proposed TSF at sites B, C, D and F;
- Conduct a Level 1 (i.e. SCREEN3) dispersion modelling investigation to determine the air quality impacts associated with sites B, C, D and F; and
- Submit an AQIA report, detailing all findings from the baseline assessment, emissions inventory and dispersion modelling simulations and provide recommendations to the Mine.

2 REGULATORY FRAMEWORK

2.1 NATIONAL AMBIENT AIR QUALITY STANDARDS

Ambient air quality standards are defined as "*targets for air quality management which establish the permissible concentration of a particular substance in, or property of, discharges to air, based on what a particular receiving environment can tolerate without significant deterioration*"[1]. The aim of these standards is to provide a benchmark for air quality management and governance. South Africa's National Ambient Air Quality Standards (NAAQS) are based primarily on guidance offered by two standards set by the South African National Standards (SANS):

- SANS 69:2004 Framework for implementing National ambient air quality standards; and
- SANS 1929:2005 Ambient air quality – Limits for common pollutants.

SANS 69:2004 makes provision for the establishment of air quality objectives for the protection of human health and the environment as a whole. Such air quality objectives include limit values, alert thresholds and target values.

SANS1929:2005 uses the provisions in SANS 69:2004 to establish air quality objectives for the protection of human health and the environment and stipulates that limit values are initially set to protect human health. The setting of such limit values represents the first step in a process to manage air quality and initiate a process to ultimately achieve acceptable air quality nationally.

The NAAQS presented in **Table 2-1** became applicable for air quality management from their promulgation in 2009[2] and 2012[3]. The NAAQS generally have specific averaging periods, compliance timeframes, permissible frequencies of exceedance and reference methods.

Table 2-1: South African National Ambient Air Quality Standards

Pollutant	Averaging Period	Concentration		Permissible Frequency of Exceedance
		$\mu g/m^3$	ppb	
Particulate Matter (PM_{10})	24 hours	75	-	4
	1 year	40	-	0
Particulate Matter ($PM_{2.5}$)	24 hour	40	-	4
		25[a]	-	4
	1 year	20	-	0
		15[a]	-	0

a: Effective date is 01 January 2030

2.2 DUST FALLOUT

On 01 November 2013 the legislated standards for dust fallout were promulgated in the form of the NEM:AQA National Dust Control Regulations (GNR 827). These regulations are based on the South African National Standards (SANS) guidelines and present acceptable/allowable dust fallout rates for both residential and non-residential areas. These dust fallout rates, which are used in this study to assess compliance, are presented in **Table 2-2**.

[1] Department of Environmental Affairs (2000): *Integrated Pollution and Waste Management Policy for South Africa.* Government Gazette (No. R 227 of 2000), 17 March 2000 (No. 20978)

[2] Department of Environmental Affairs (2009): National Ambient Air Quality Standards. Government Gazette (No. R 1210 of 2009), 24 December 2009 (No. 32816)

[3] Department of Environmental Affairs (2012): National Ambient Air Quality Standard for Particulate Matter with Aerodynamic Diameter less than 2.5 Micro Metres ($PM_{2.5}$). Government Gazette (No. R 486 of 2012), 29 June 2012 (No. 35463)

Table 2-2: Acceptable Dust Fallout Rates as per the National Dust Control Regulations.

Restriction Areas	Dust Fallout Rate (D) (mg/m^2/day) 30-day average	Permitted frequency of exceeding dust fallout rate	Reference Method
Residential Area	D < 600	Two within a year, not sequential months	ASTM D1739
Non-Residential Area	600 < D < 1,200	Two within a year, not sequential months	ASTM D1739

In 2018, amendments to these Dust Control Regulations are noted in the form of the *Draft National Dust Control Regulations* (GN 517 of May 2018) (Government Gazette 41650), bringing about certain changes in the permitted dust fallout monitoring methodology. Where GNR 827 of November 2013 allowed the use of ASTM D1739:1970 or equivalent methodology, GN 517 of May 2018 specifically states that the *latest* version of the ASTM D1739 method must be utilised. Currently the latest version is the ASTM D1739:1998 methodology. It is important to note that GN 517 has not yet been promulgated, therefore GNR 827 remains in force.

UPDATES TO THE NATIONAL DUST CONTROL REGULATIONS

Key changes, although not limited to these, in the Draft Dust Control Regulations include:

— Permission to exclude exceedances caused by non-anthropogenic sources;

— The reference method is now the latest version of ASTM (D1739:1998), no longer ASTM D1739:1970;

— The latest ASTM requires samplers be installed with a windshield, which has been proven to increase the accuracy of capturing dust fallout;

— All mining operations must implement a DFO program;

— Analysis of both the soluble and insoluble content of samples. As such the dust fallout levels presented in this report are cumulative (representing the sum of the soluble and insoluble fractions) which are assessed cumulatively against the respective standard;

The Draft National Dust Control Regulations (GN 517 of May 2018) stipulate that these changes are effective as of 1 November 2019. These Regulations have, however, not yet been promulgated and formally published.

3 BASELINE ASSESSMENT

3.1 LOCALITY AND STUDY SITE

Dwarsrivier Mine is situated approximately 60 km northwest of Lydenburg, 25 km south of Steelpoort and 63 km northeast of Roossenekal in the Limpopo Province. The mine currently holds the surface rights for Portion 1 (Remaining Extent) and Portion 0 (Remaining Extent) of the farm Dwarsrivier 372KT, as well as Portion 4 (a portion of Portion 3) of the farm De Grootteboom 373KT. The operation is located in the Fetakgomo-Greater Tubatse Local Municipality, within the boundaries of the Sekhukhune District Municipality.

The R577 roadway that connects to the R555 (Lydenburg-Roossenekal road), is situated to the north of the plant and mine offices. The overall area is characterised by intensive mining development. Various servitudes traversing the site are present, which include gravel roads, telephone lines and electricity lines.

Several neighbouring farms, namely Tweefontein 380JT, Thorncliffe 374KT, De Grootteboom 373KT and Dwarsrivier 372KT are owned by mining houses with existing and operational chrome and platinum mines. On the remainder of the neighbouring farms, agricultural activities take place, in the form of stock grazing and the growing of vegetables, lucerne and cotton.

The potential TSF sites, within the boundaries of the mining concession at Dwarsrivier Chrome Mine which can be considered to supersede the current active TSF include sites B, C, D and F. Site B was initially fatally flawed due to the potential future Eskom substation, for which an EIA has been approved and negotiations in terms of land use between the mine and Eskom have commenced. Site C is located at the southern side of the process plant. The site has sloping ground towards the north. The site is readily accessible from the west. Site D is located at the northern side of the process plant. The site is adjacent to the existing TSF. Additionally, Site D is obstructed by the mountain 'koppie,' which is likely to reduce dust originating from the Site D. Site F is located approximately 5,500 m to the south side of the process plant. The site is on top of the mountain at the upstream of a reservoir towards the west and downstream of the potential TSF site (**Figure 3-1**).

Sensitive receptors (i.e. places where sensitive individuals may be impacted, such as residences, schools and medical facilities) within a 10 km radius of the study site that have been selected for evaluation in this impact assessment are listed in **Table 3-1**.

Table 3-1: Sensitive receptors

ID	Receptor Name	Distance from site B (km)	Distance from site C (km)	Distance from site D (km)	Distance from site F (km)	Longitude (°S)	Latitude (°E)
1	SR1 (Villages)	6.01	3.05	5.91	1.12	30.127585	24.973693
2	SR2 (Villages)	5.06	8.17	5.10	10.09	30.119396	24.869117

3.2 PROJECT DESCRIPTION

The Dwarsrivier Chrome Mine is currently depositing at the existing TSF at the eastern side of their process plant. The existing TSF was designed to contain production tonnages for 23 years, with 29,000 tons per month for the first two years of operation and the remaining 21 years at a deposition rate of 17,280 tons per month. The deposited tonnage rate was later revised to contain 33,500 tons per month for the first two years, which is higher than the originally designed amount and is anticipated to reduce the anticipated life of 23 years. However, it is anticipated that the existing active TSF will reach its full capacity sooner than anticipated due to tonnage ramp ups and additional tonnages from other sites. As such, four possible TSF sites are to be considered to supersede the current active TSF, namely B, C, D and F.

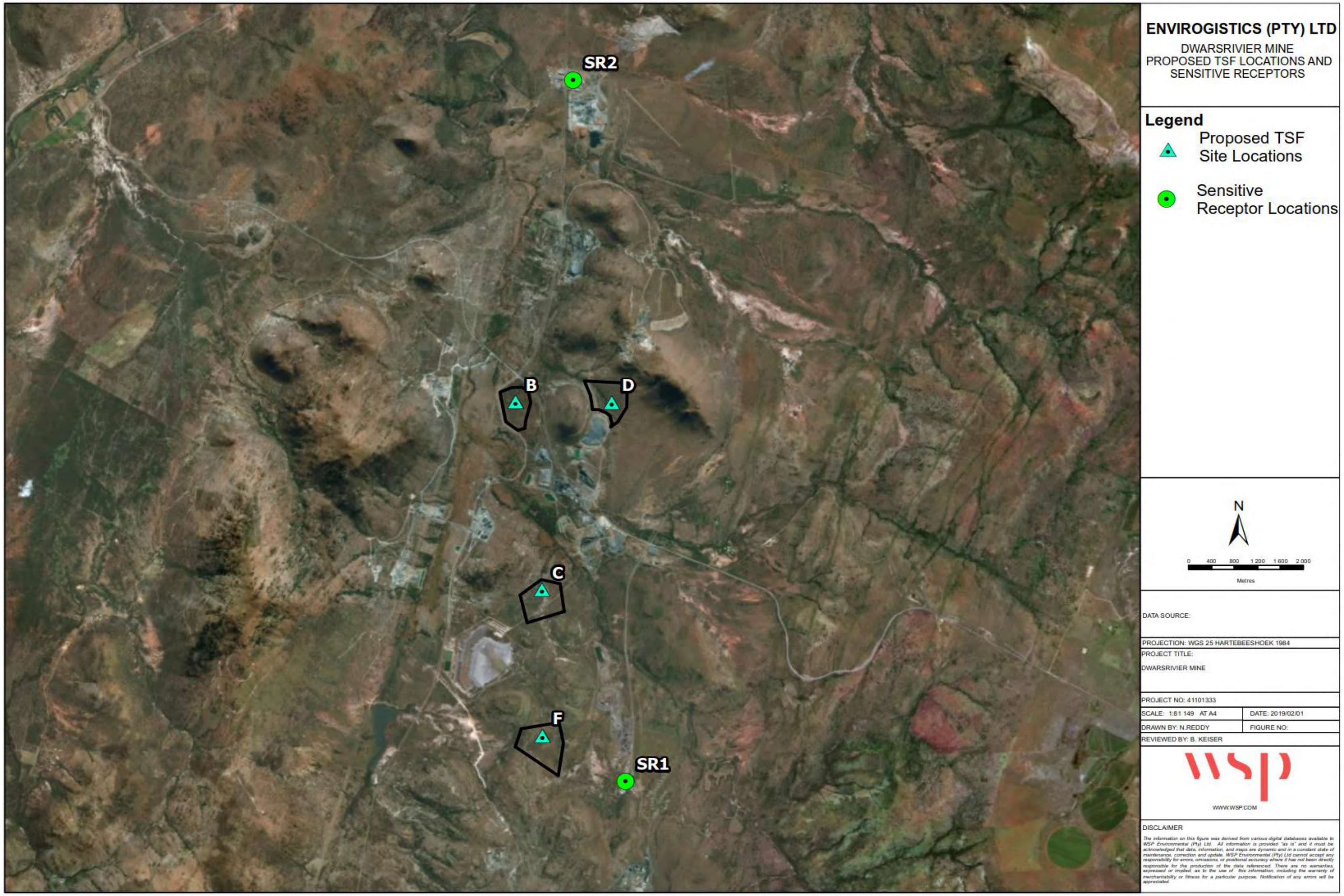

Figure 3-1: Proposed TSF site locations and sensitive receptors within a 10 km radius

3.3 METEOROLOGICAL CONTEXT

Seasonal and diurnal pollutant concentration levels fluctuate in response to the changing state of atmospheric stability, to concurrent variations in mixing depth and to the influence of mesoscale and macroscale wind systems on the transport of atmospheric contaminants. This section provides an overview of the atmospheric circulations influencing airflow and the subsequent dispersion and dilution of pollutant concentrations in the study area.

Site-specific modelled MM5 (5th-generation Penn State/NCAR Mesoscale Model) prognostic meteorological data, including hourly temperature, rainfall, wind speed and wind direction, was obtained from Lakes Environmental for the surrounding project area and analysed for the period January 2015 - December 2017 (i.e. three calendar years as required by the *Regulations Regarding Dispersion Modelling*[4], hereafter referred to as the *Modelling Regulations*). The United States Environmental Protection Agency (USEPA) AERMET is a meteorological model that generates diagnostic wind field and boundary layer data using MM5 wind fields as part of an objective analysis procedure. The data coverage is centred over the project area (anemometer height of 14 m) with a grid cell dimension of 12 km x 12 km over a 50 km x 50 km domain. Data recovery information is given in **Table 3-2** and an analysis of this dataset is presented in the sections below (**Figure 3-2** to **Figure 3-4**).

Note: *This section will be updated with 2018-2020 MM5 data in the full AQIA phase of the project.*

Table 3-2: Details of the Lakes Environmental Data

Latitude (ºS)	Longitude (ºE)	Altitude (m)	Data Recovery			
			Wind Direction	Wind Speed	Temp	Rainfall
24.9171	30.1254	1,227	100%	100%	100%	100%

3.3.1 TEMPERATURE AND RAINFALL

Ambient air temperature influences plume buoyancy as the higher the plume temperature is above the ambient air temperature, the higher the plume will rise. Further, the rate of change of atmospheric temperature with height influences vertical stability (i.e. formation of mixing or inversion layers). Rainfall is an effective removal mechanism of atmospheric pollutants and thus also relevant in the assessment of pollution potential.

Figure 3-2 presents the average, minimum and maximum temperatures, while **Figure 3-3** presents the total monthly rainfall and average humidity, using the modelled MM5 data.

With the use of the modelled MM5 data, the highest monthly average temperature for 2015, 2016 and 2017 was 22.46, 21.84 and 21.65°C, respectively, recorded during summer. The lowest monthly average temperature for 2015, 2016 and 2017 was 12.36, 12.77 and 13.09°C, respectively, recorded during winter.

The Dwarsrivier project area receives most of its rainfall during the summer months. The total rainfall for 2015, 2016 and 2017 was 697.23, 709.68 and 497.84 mm, respectively.

The modelled MM5 data shows that the humidity in the region is moderate to high, with the annual average for 2015, 2016 and 2017 being 65.13, 66.94 and 63.13 %, respectively.

[4] Department of Environmental Affairs (2014): Regulations regarding dispersion modelling (GN.R. 533) Government Gazette - 11 July 2014 (No. 37804)

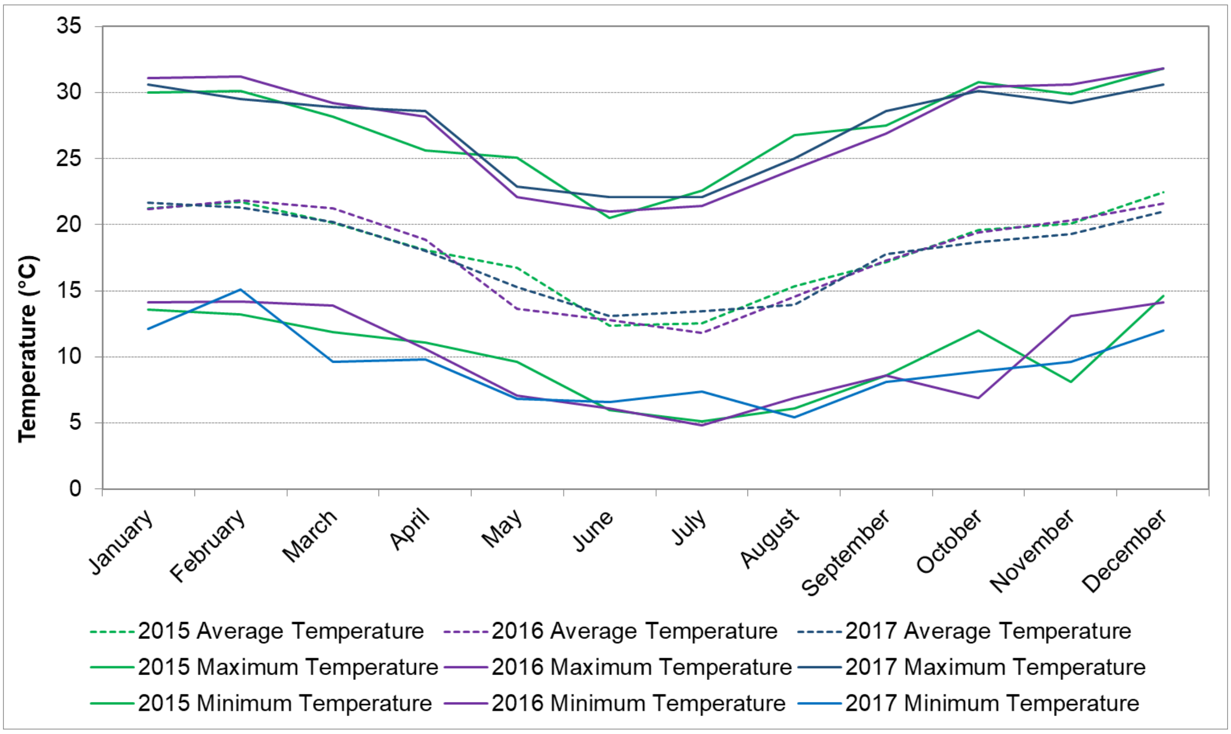

Figure 3-2: Maximum, average and minimum temperatures using modelled MM5 data (January 2015 - December 2017)

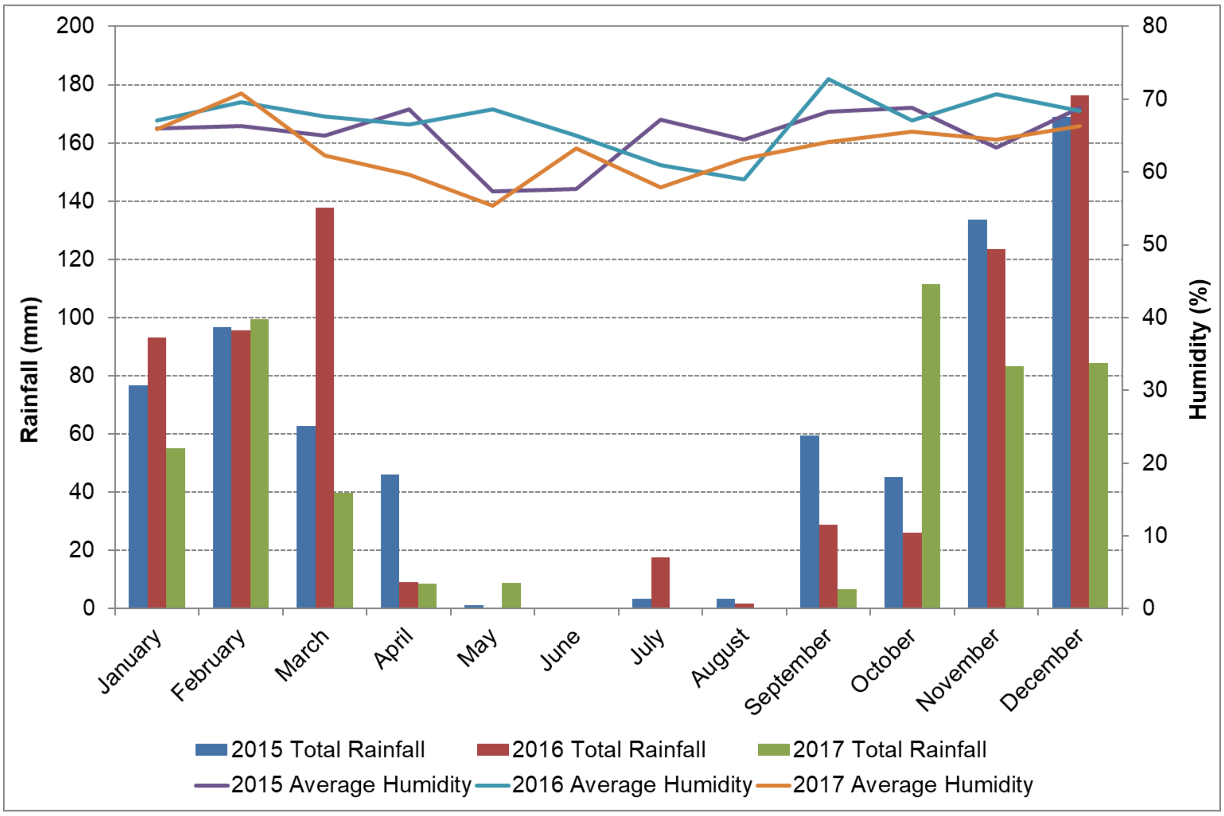

Figure 3-3: Total rainfall and average humidity using modelled MM5 data (January 2015 - December 2017)

3.3.2 WIND FIELD

Wind roses (**Figure 3-4**) summarize wind speed and directional frequency at a location. Each directional branch on a wind rose represents wind originating from that direction. Each directional branch is divided into segments of colour, representative of different wind speeds.

Typical wind fields are analysed for the full period (January 2015 – December 2017); diurnally for day (06h00–18h00) and night (18h00–06h00); and seasonally for summer (December, January and February), autumn (March, April and May), winter (June, July and August) and spring (September, October and November).

- Calm conditions occurred 3.81% of the time;
- Moderate winds from the east-southeast prevailed in the region with notable north-north-easterly, easterly and south-easterly components;
- Highest average wind speeds occurred from the southeast;
- North-north-easterly trajectories prevailed during the day while east-south-easterly trajectories prevailed at night;
- East-south-easterly winds prevailed during spring and summer, while south-easterly winds prevailed in winter and autumn; and
- Highest average wind speeds occurred in spring.

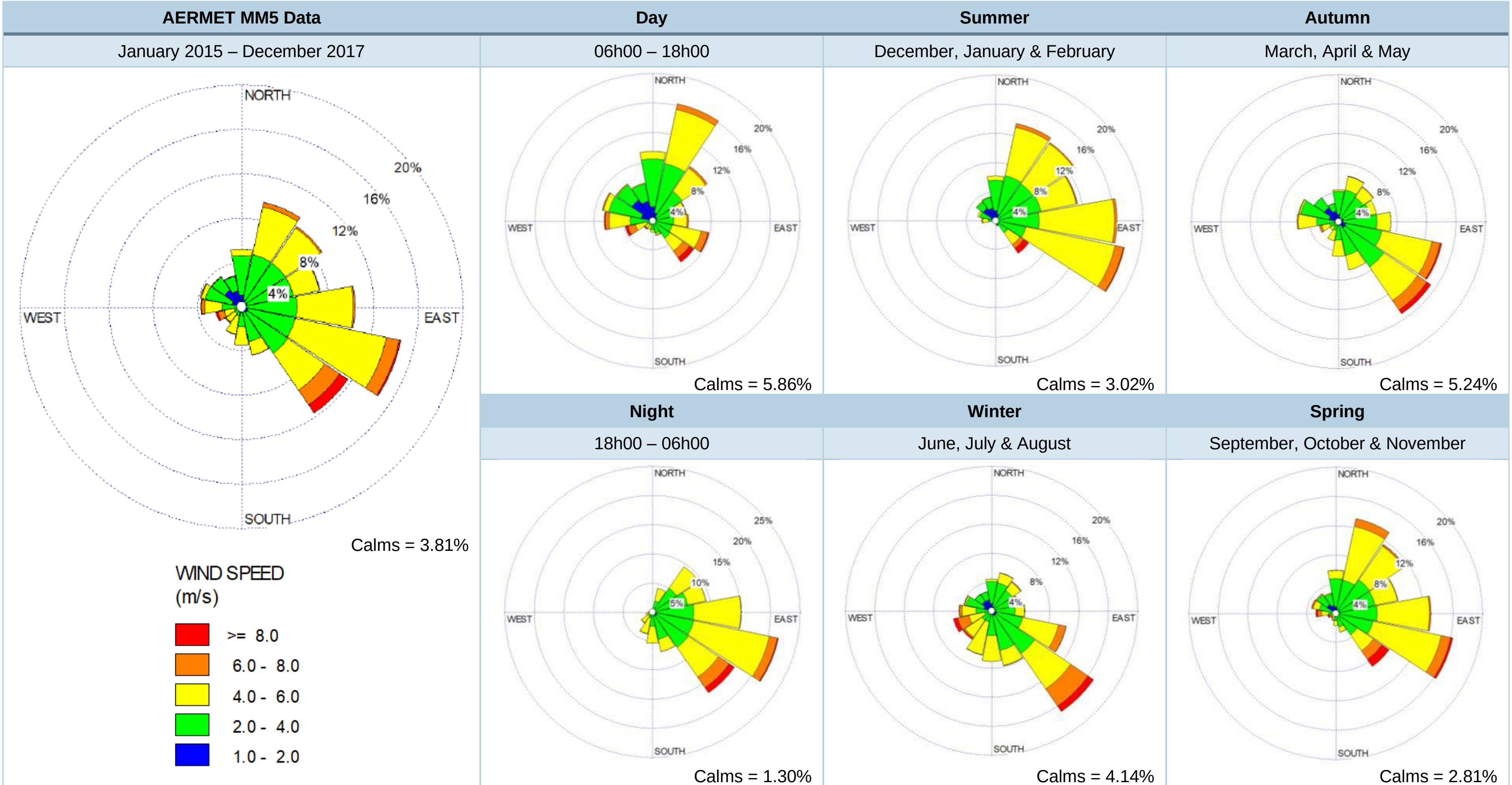

Figure 3-4: Local wind conditions using modelled MM5 data

3.4 AMBIENT AIR QUALITY

3.4.1 LOCAL AIR QUALITY MONITORING

Dust fallout monitoring at Dwarsrivier Chrome Mine has historically been undertaken at five monitoring locations through the use of multi-directional dust fallout buckets. The dust watch directional gauge system can be defined as a measurement of dust deposition in addition to providing the dust source direction, however, these monitoring results should not be used to assess compliance against relevant guidelines and standards. The monitoring results in the graphs below are presented as the sum of the multidirectional dust buckets for each site and assessed against the respective standards solely for statistical/comparative purposes. **Table 3-3** lists the coordinates and classifications for each monitoring location.

Table 3-3: Dwarsrivier Chrome Mine dust fallout monitoring location

Locality	Description	Latitude (°S)	Longitude (°E)	Classification
DW001	School monitoring station	24.89157	30.06744	Residential
DW002	Far North Point	24.91622	30.12237	Non-residential
DW003	Parking Lot South Shaft	24.93611	30.12501	Non-residential
DW004	Discard Dump South Shaft	24.93806	30.12517	Non-residential
DW005	North Shaft	24.93193	30.12503	Non-residential

Dust fallout results for the 2019 to 2021 monitoring period are presented below. For comparative purposes only; the dust fallout rates will be compared to the National Dust Control Regulations. **Figure 3-5** shows dust fallout rates during the 2019 monitoring period. No data was available during September – November 2019.

DW001 exceeded the residential standard four times during 2019 (February, March, April and December), resulting in non-compliance with the Dust Control Regulations. Such regulations allow for two non-sequential exceedances over a twelve-month period. Exceedances of the non-residential standard were recorded at DW003 (January and April) and DW004 (April). These monitoring locations, however, remained compliant with the Dust Control Regulations.

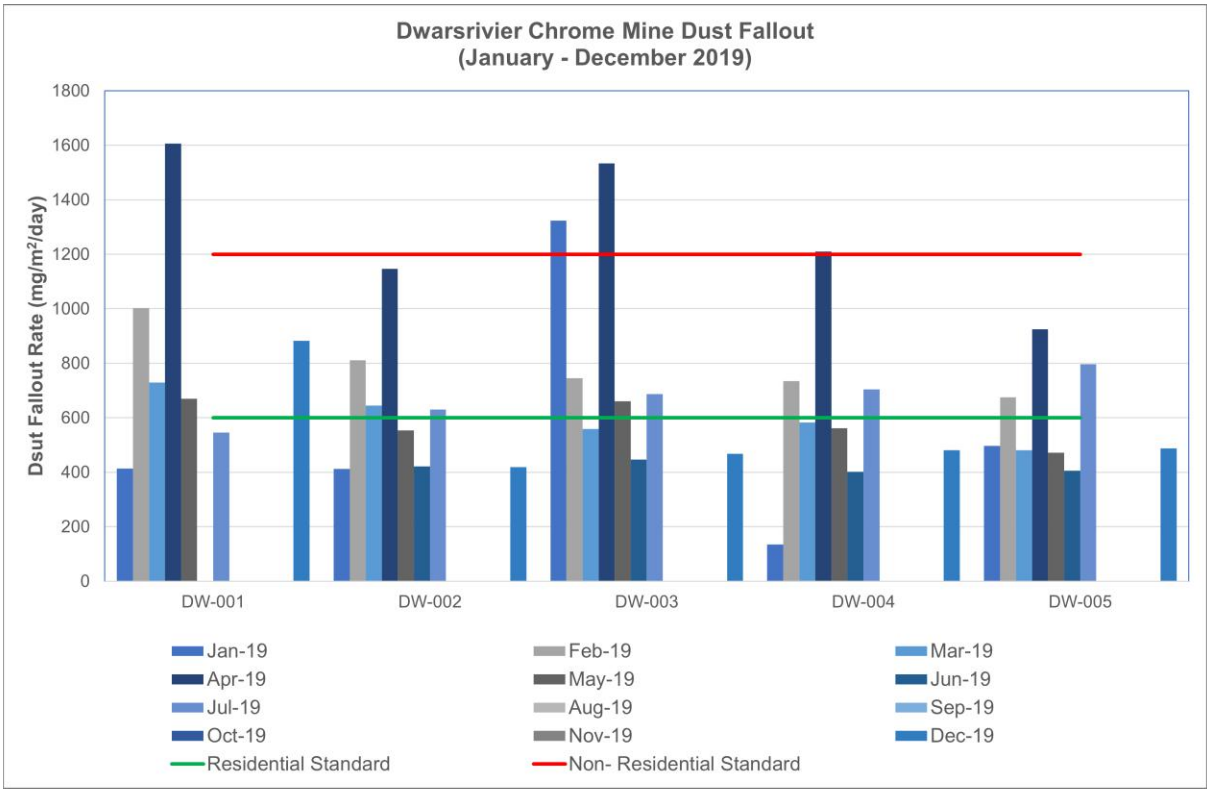

Figure 3-5: Onsite dust fallout results for 2019

Figure 3-6 illustrates the dust fallout monitoring results for 2020. There are no monitoring results for the months of March and April 2020, due to COVID-19 lockdown restrictions. As such, the May results represent exposure over the March to May period. Six exceedances of the residential standard were recorded at DW001 in 2020 (July, August, September, October, November and December), resulting in non-compliance with the Dust Control Regulations. The non-residential standard was exceeded once at DW004 during January, however, remaining complaint with the National Dust Control Regulations.

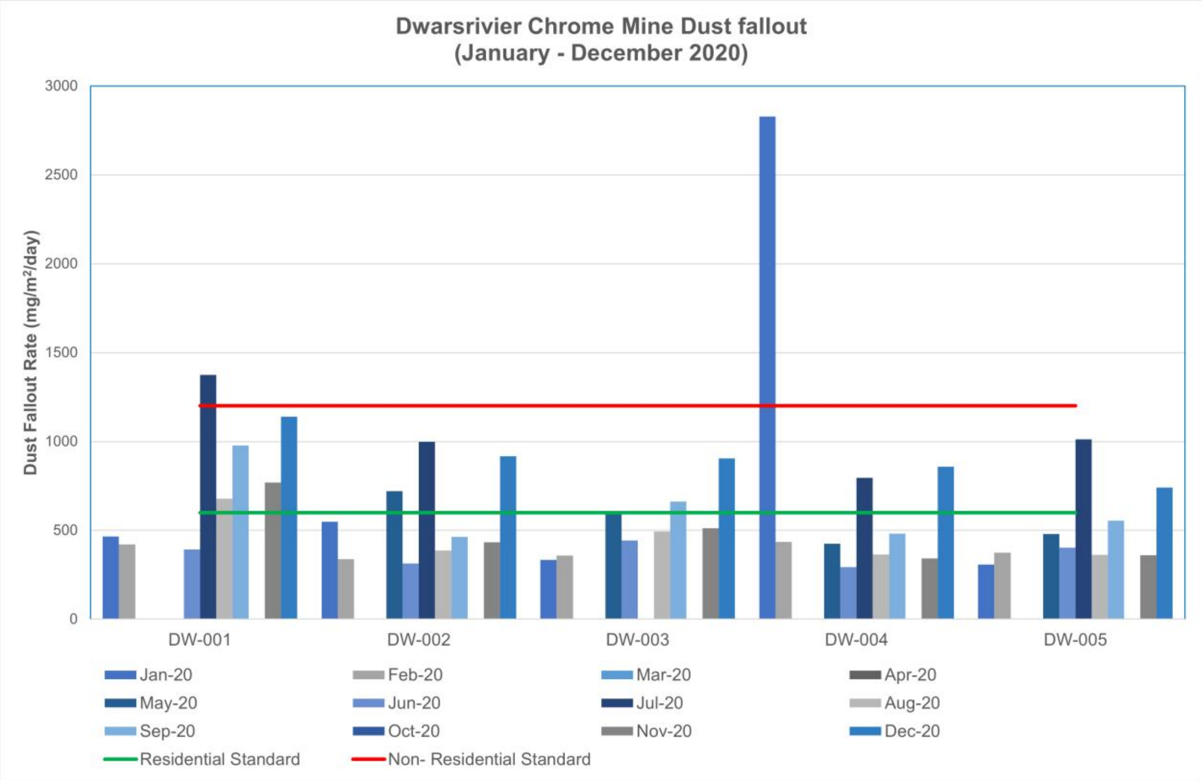

Figure 3-6: Onsite dust fallout rates for 2020.

Figure 3-7 illustrates the monitoring results for 2021. Monitoring data from January to April 2021 was provided for assessment. In comparison to the National Dust Control Regulation residential standard, DW001 was non-compliant as it recorded three exceedances (January, March and April). All other monitoring sites were compliant.

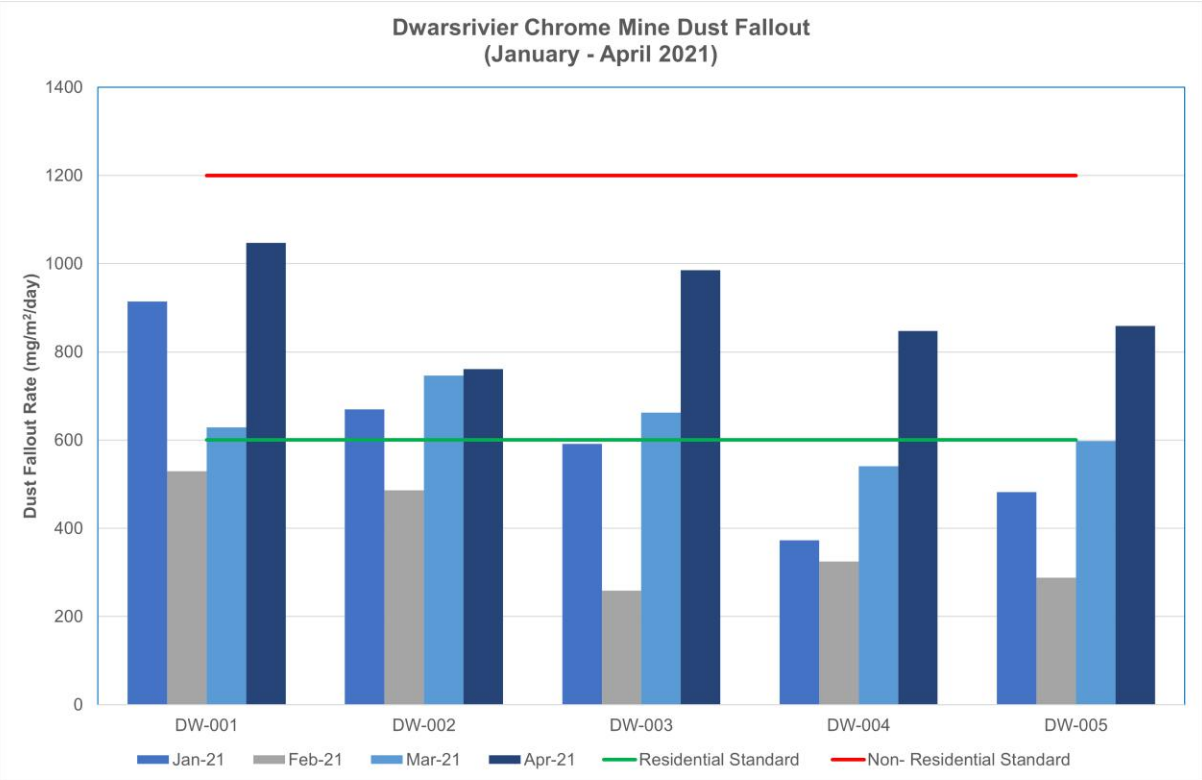

Figure 3-7: Onsite Dust fallout rates for 2021

3.4.2 EXISTING SOURCE OF EMISSIONS

Possible emissions sources identified in the Dwarsrivier area that contribute towards the air quality status quo include mining, agriculture and vehicle tailpipe emissions along nearby roads.

MINING AND AGRICULTURAL ACTIVITIES

Mining is the predominant land use within the surrounding area, with existing and operational chrome and platinum mines in the surrounding area. Expected fugitive emissions from mining include wind erosion and material handling.

Additionally, agriculture is also one of the dominant land uses within the surrounding area, comprising mostly in the form of stock grazing and the production of vegetables, lucerne and cotton.

Emissions from agricultural activities are difficult to control due to the seasonality of emissions and the large surface area producing emissions (USEPA, 1995). Expected emissions resulting from agricultural activities include particulates associated with wind erosion, ploughing and burning of crop residue, chemicals associated with crop spraying and odiferous emissions resulting from manure, fertilizer and crop residue.

Dust associated with agricultural practices may contain seeds, pollen and plant tissue, as well as agrochemicals, such as pesticides. The application of pesticides during temperature inversions increases the drift of the spray and the area of impact. Dust entrainment from vehicles travelling on gravel roads may also cause increased particulates in an area. Dust from traffic on gravel roads increases with higher vehicle speeds, more vehicles and lower moisture conditions.

These are the most likely contributors of fugitive emissions from agricultural activities. However, it is noted that fugitive emissions from agricultural activities generally have confined impacts near to the source, limiting the regional impacts.

VEHICLE TAILPIPE EMISSIONS

Atmospheric pollutants emitted from vehicles include hydrocarbons, CO, CO_2, NO_x, SO_2 and particulates. These pollutants are emitted from the tailpipe, from the engine and fuel supply system, and from brake linings, clutch plates and tyres. Hydrocarbon emissions, such as benzene, result from the incomplete combustion of fuel molecules in the engine. Carbon monoxide is a product of incomplete combustion and occurs when carbon in the fuel is only partially oxidized to carbon dioxide. Nitrogen oxides are formed by the reaction of nitrogen and oxygen under high pressure and temperature conditions in the engine. Sulphur dioxide is emitted due to the high sulphur content of the fuel. Particulates, such as lead, originate from the combustion process as well as from brake and clutch linings wear (Samaras and Sorensen, 1999).

Possible contributors to mobile combustion emissions include access roads surrounding the site. Neighbouring communities are likely to use these routes on a daily basis to access the mine.

4 IMPACT ASSESSMENT

4.1 EMISSIONS INVENTORY

Emission rates for the proposed activities are calculated using the United States Environmental Protection Agency (USEPA) AP-42 and the Australian Government National Pollutant Inventory (NPI) emission factors. An emission factor is a value representing the relationship between an activity and the rate of emissions of a specified pollutant. AP-42 emission factors have been compiled since 1972 and contain emission factors and process information for over 200 air pollution source categories. These emission factors have been developed based on test data, material mass balance studies and engineering estimates.

Emission factors are always expressed as a function of the weight, volume, distance or duration of the activity emitting the pollutant. The general equation used for the estimation of emissions is:

$$E = A \times EF \times \left(1 - \frac{ER}{100}\right)$$

Where:

E = emission rate

A = activity rate

EF = emission factor

ER = overall emission reduction efficiency (%)

4.1.1 PROPOSED TAILINGS STORAGE FACILITY

In the absence of available data regarding the fine material and moisture content of the stockpiles, the default wind erosion emission factor for TSP and PM_{10} have been applied in accordance with the Australian Government NPI (NPI, 2012). In order to determine the $PM_{2.5}$ emission rate, a factor of 15% was applied to the PM_{10} equation (USEPA, 1995). The emission factor and uncontrolled emission rates for wind erosion are presented in **Table 4-1** and **Table 4-2**.

Table 4-1: Emission factor for TSP Site B, C, D and F

Source	Unit	Emission Factor	
		TSP	PM_{10}
Wind Erosion	kg/ha/hr	0.40	0.20

Table 4-2: Calculated emission rates for TSP Site B, C, D and F

Source	Emission Rate (g/s/m^2)		
	TSP	PM_{10}	$PM_{2.5}$
Site B/ Site C / Site D / Site F	1.11E-05	5.56E-06	8.33E-07

4.2 DISPERSION MODELLING

Atmospheric dispersion modelling mathematically simulates the transport and fate of pollutants emitted from a source into the atmosphere. In line with the *Modelling Regulations*, the level of dispersion assessment is dependent on technical factors such as geophysical, emissions and meteorological conditions. The assessment also depends on the level of risk associated with the emissions and hence the level of detail and accuracy required from a model.

A recommended Level 1 dispersion model platform, SCREEN3, was utilised to predict maximum hourly average ground-level downwind concentrations of pollutants emitted from the proposed TSFs. SCREEN3 is a single source Gaussian plume model that provides maximum ground-level concentrations for point, area, flare, and volume sources. The SCREEN3 model results can be summed to conservatively estimate the impact from several sources. SCREEN3 examines a full range of meteorological conditions, including standard stability classes and wind speeds, to determine maximum ambient impacts. The SCREEN3 model calculates hourly concentrations at downwind distances from the source based on the following input parameters:

— Source type (point, area, flare or volume);
— Dispersion co-efficient (urban or rural);
— Receptor height;
— Emission rate;
— Terrain (simple or complex);
— Meteorology (stability classes and wind speed); and
— Distance of receptors from the source.

Table 4-3 presents the input parameters used in the screening model to generate downwind concentrations of pollutants from the selected sites under a combination of stability classes (ALL). Under the ALL scenario, the model runs all stability and wind speed options and provides the maximum ambient output calculated for each distance from source. Since model outputs are for 1-hour averaging periods, the conversion factors provided in the *Modelling Regulations* have been applied to determine concentrations for longer averaging periods (i.e. 24-hour and annual).

Table 4-3: SCREEN3 input parameters for Site C, D and F

Parameter	Site B	Site C	Site D	Site F
Location (latitude, longitude)	-24.917086° 30.110353°	-24.945080° 30.114514°	-24.917163° 30.125446°	-24.966851° 30.114593°
Source type	Area	Area	Area	Area
TSF height (m)	37	29	49	50
TSF area (m^2)	240,000	210,000	190,000	170,000
Dispersion coefficient	Rural	Rural	Rural	Rural
Terrain	Simple	Simple	Simple	Simple
Simple terrain	Flat	Flat	Flat	Flat
Automated distance (m)	100	100	100	100
Receptor height (m)[5]	1.5	1.5	1.5	1.5

4.2.1 RESULTS

Ambient pollutant concentrations from the proposed sites (Site B, Site C, Site D and Site F) are presented in **Table 4-4** and **Table 4-5** and **Figure 4-1** to **Figure 4-4**. These results are representative of emissions from the proposed TSFs only.

Peak concentrations occur at approximately 1,100 m for Site B, 800 m for Site C and 900 m for Site D and Site F. The closest sensitive receptor assessed in this study from Site C and Site F are villages (SR1), and the closest sensitive receptor to Site B and Site D are villages at SR2. Predicted concentrations have been evaluated against their respective short-term (24-hour average) and long-term (annual average) NAAQS. Key findings are as follows:

- Predicted ambient PM_{10} and $PM_{2.5}$ concentrations as a result of emissions from all proposed TSF Sites B, C, D and F are below the PM_{10} and $PM_{2.5}$ NAAQS on a 24-hour and annual averaging period;
- Lowest predicted PM_{10} concentrations are anticipated at Site D with a maximum peak concentration of 10.31 µg/m^3 and 2.06 µg/m^3 on a 24-hour and annual averaging period;
- Lowest predicted $PM_{2.5}$ concentrations are anticipated at Site D with a maximum peak concentration of 1.54 µg/m^3 and 0.31 µg/m^3 on a 24-hour and annual averaging period;
- From the screening assessment Site D was predicted as the most favourable in terms of air quality; and
- Site D is located at the northern side of the process plant which is adjacent to the existing TSF. Additionally, Site D is obstructed by the mountain 'koppie,' which is likely to reduce dust originating from Site D.

Table 4-4: PM10 Predicted ground level concentrations at increasing distance from source

Distance from source (m)	Affiliated sensitive receptor	24-hour average PM_{10} (µg/m³)				Annual average PM_{10} (µg/m³)			
		Site B	Site C	Site D	Site F	Site B	Site C	Site D	Site F
100		6.84	8.58	3.65	4.12	1.37	1.72	0.73	0.82
200		8.67	11.32	5.31	5.71	1.73	2.26	1.06	1.14
300		10.96	13.93	6.72	6.82	2.19	2.79	1.34	1.36
400		12.87	16.20	8.01	7.99	2.57	3.24	1.60	1.60
500		14.35	18.68	9.40	9.47	2.87	3.74	1.88	1.89
600		16.05	18.82	9.42	9.72	3.21	3.76	1.88	1.94
700		16.29	19.04	10.16	10.56	3.26	3.81	2.03	2.11
800		15.62	20.01	10.31	10.84	3.12	4.00	2.06	2.17
900		15.91	20.20	10.02	10.59	3.18	4.04	2.00	2.12
1,000		16.60	19.93	9.52	10.08	3.32	3.99	1.90	2.02
1,100	SR1 – Site F	16.88	19.40	8.97	9.43	3.38	3.88	1.79	1.89
1,200		16.87	19.71	9.39	9.83	3.37	3.94	1.88	1.97
1,300		16.67	19.91	9.61	10.11	3.33	3.98	1.92	2.02
1,400		16.37	19.92	9.72	10.24	3.27	3.98	1.94	2.05
1,500		16.01	19.81	9.73	10.25	3.20	3.96	1.95	2.05
1,600		15.86	19.61	9.68	10.18	3.17	3.92	1.94	2.04
1,700		16.06	19.34	9.58	10.04	3.21	3.87	1.92	2.01
1,800		16.16	19.02	9.43	9.86	3.23	3.80	1.89	1.97
1,900		16.18	18.67	9.26	9.64	3.24	3.73	1.85	1.93
2,000		16.14	18.34	9.07	9.40	3.23	3.67	1.81	1.88
3,000	SR1 – Site C	14.57	18.74	8.52	8.68	2.91	3.75	1.70	1.74
4,000		14.77	17.22	7.52	7.46	2.95	3.44	1.50	1.49
5,000	SR2 – Site B, D	14.05	15.41	7.20	7.18	2.81	3.08	1.44	1.44
6,000	SR1 – Site B, D	12.95	13.70	7.06	6.92	2.59	2.74	1.41	1.38
7,000		11.80	12.16	6.73	6.52	2.36	2.43	1.35	1.30
8,000	SR2 – Site C	10.73	10.87	6.32	6.07	2.15	2.17	1.26	1.21
9,000		9.77	9.76	5.92	5.63	1.95	1.95	1.18	1.13
10,000	SR2 – Site F	8.94	8.83	5.52	5.23	1.79	1.77	1.10	1.05
Peak concentration									

Table 4-5: $PM_{2.5}$ Predicted ground level concentrations at increasing distance from source

Distance from source (m)	Affiliated sensitive receptor	24-hour average $PM_{2.5}$ (µg/m³)				Annual average $PM_{2.5}$ (µg/m³)			
		Site B	Site C	Site D	Site F	Site B	Site C	Site D	Site F
100		1.02	1.29	0.55	0.62	0.20	0.26	0.11	0.12
200		1.30	1.70	0.80	0.86	0.26	0.34	0.16	0.17
300		1.64	2.09	1.01	1.02	0.33	0.42	0.20	0.20
400		1.93	2.43	1.20	1.20	0.39	0.49	0.24	0.24
500		2.15	2.80	1.41	1.42	0.43	0.56	0.28	0.28
600		2.40	2.82	1.41	1.46	0.48	0.56	0.28	0.29
700		2.44	2.85	1.52	1.58	0.49	0.57	0.30	0.32
800		2.34	3.00	1.54	1.62	0.47	0.60	0.31	0.33
900		2.38	3.03	1.50	1.59	0.48	0.61	0.30	0.32
1,000		2.49	2.99	1.43	1.51	0.50	0.60	0.29	0.30
1,100	SR1 – Site F	2.53	2.91	1.34	1.41	0.51	0.58	0.27	0.28
1,200		2.53	2.95	1.41	1.47	0.51	0.59	0.28	0.29
1,300		2.50	2.98	1.44	1.51	0.50	0.60	0.29	0.30
1,400		2.45	2.98	1.46	1.53	0.49	0.60	0.29	0.31
1,500		2.40	2.97	1.46	1.54	0.48	0.59	0.29	0.31
1,600		2.38	2.94	1.45	1.52	0.48	0.59	0.29	0.30
1,700		2.41	2.90	1.43	1.50	0.48	0.58	0.29	0.30
1,800		2.42	2.85	1.41	1.48	0.48	0.57	0.28	0.30
1,900		2.42	2.80	1.39	1.44	0.48	0.56	0.28	0.29
2,000		2.42	2.75	1.36	1.41	0.48	0.55	0.27	0.28
3,000	SR1 – Site C	2.18	2.81	1.28	1.30	0.44	0.56	0.26	0.26
4,000		2.21	2.58	1.13	1.12	0.44	0.52	0.23	0.22
5,000	SR2 – Site B, D	2.11	2.31	1.08	1.08	0.42	0.46	0.22	0.22
6,000	SR1 – Site B, D	1.94	2.05	1.06	1.04	0.39	0.41	0.21	0.21
7,000		1.77	1.82	1.01	0.98	0.35	0.36	0.20	0.20
8,000	SR2 – Site C	1.61	1.63	0.95	0.91	0.32	0.33	0.19	0.18
9,000		1.46	1.46	0.89	0.84	0.29	0.29	0.18	0.17
10,000	SR2 – Site F	1.34	1.32	0.83	0.78	0.27	0.26	0.17	0.16
Peak concentration									

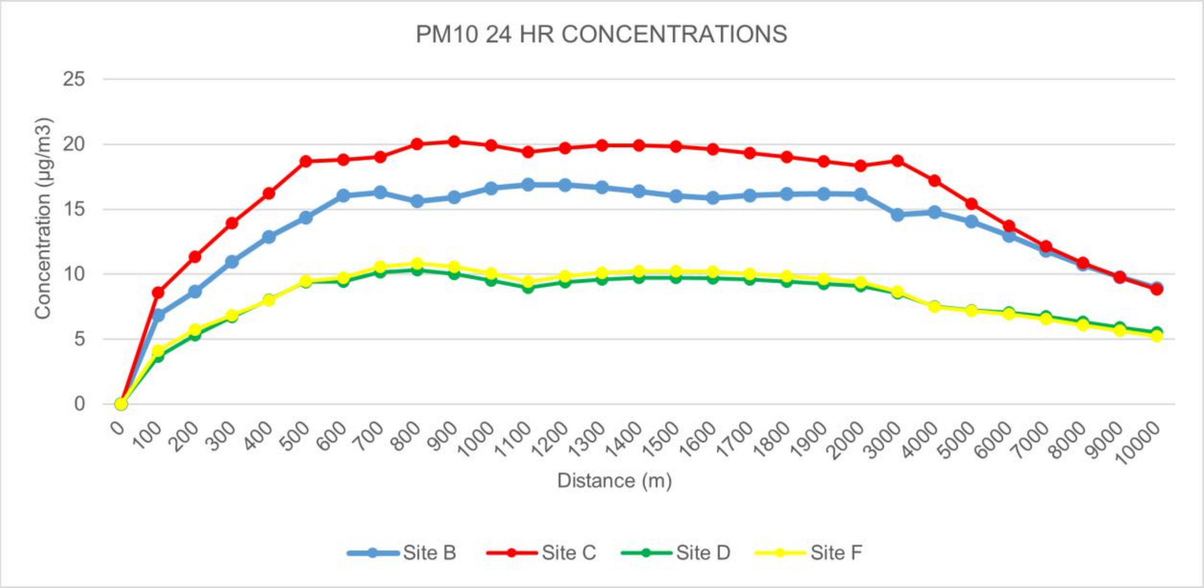

Figure 4-1: PM$_{10}$ 24-hour emissions profile

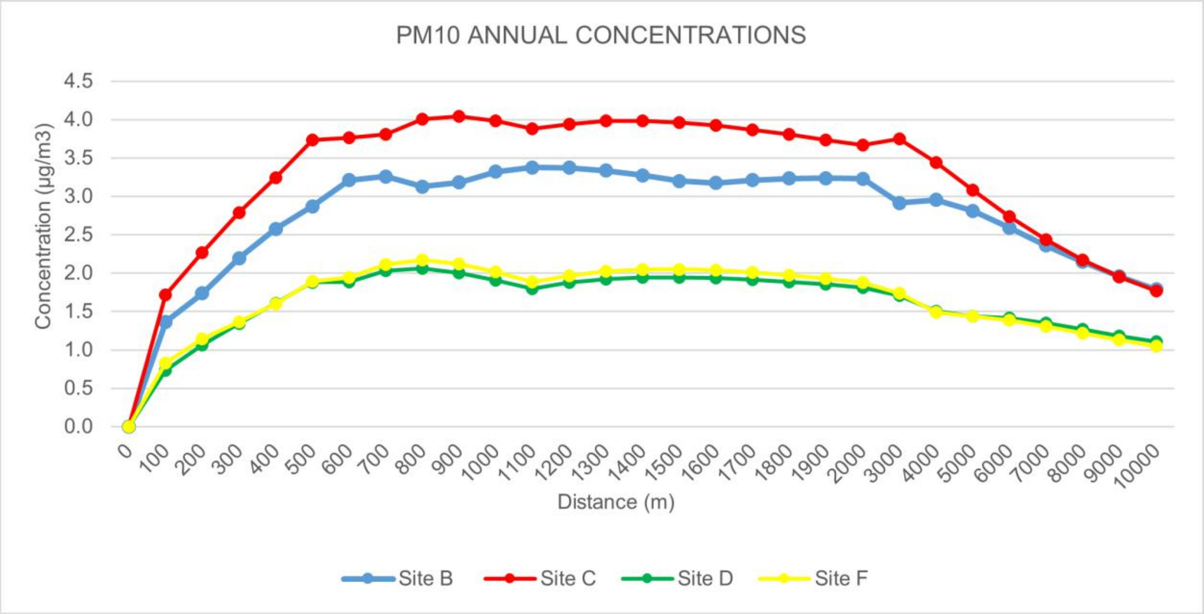

Figure 4-2: PM$_{10}$ annual emissions profile

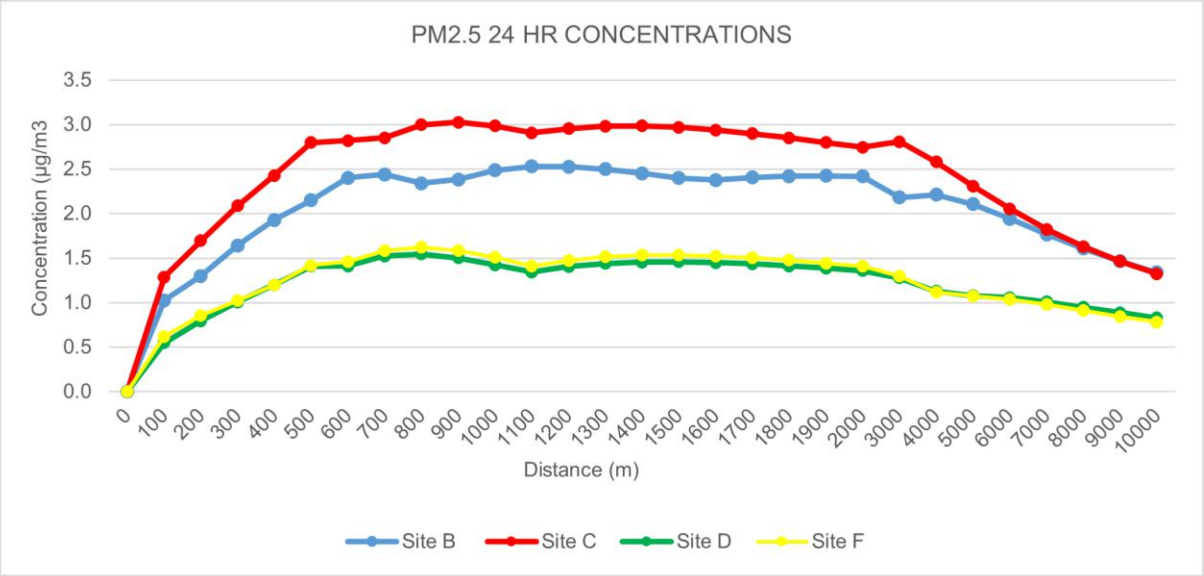

Figure 4-3: PM$_{2.5}$ 24-hour emissions profile

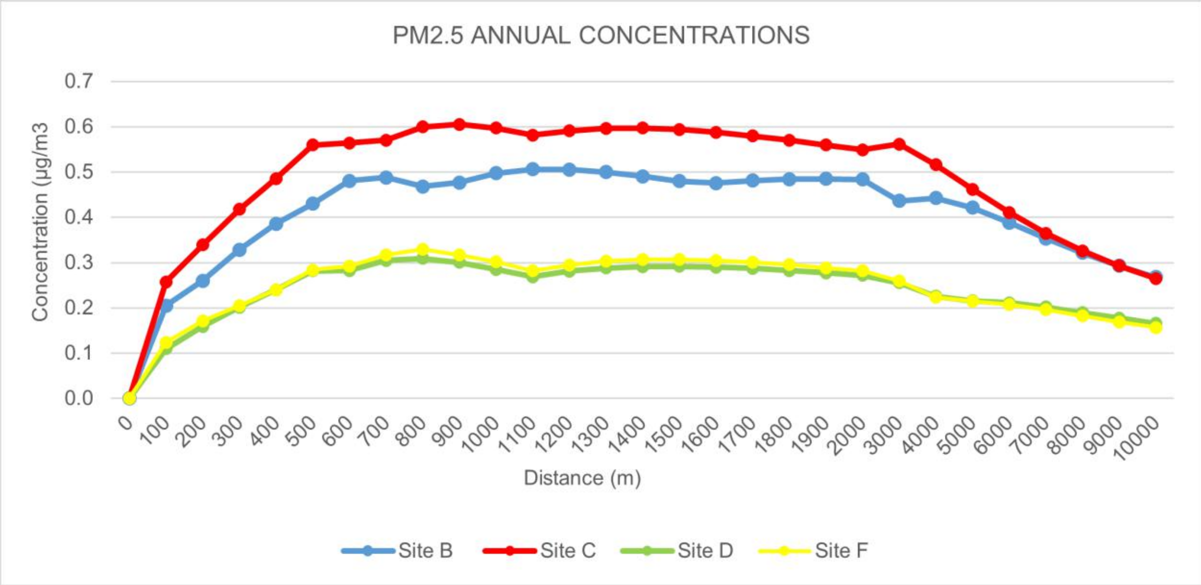

Figure 4-4: **$PM_{2.5}$ annual emissions profile**

5 ASSUMPTIONS

Various assumptions were made in the compilation of this AQIA. Where possible, the more environmentally conservative approach was taken to ensure emission calculations and dispersion simulations represent the worst-case scenario. The assumptions and limitations underlying the study methodology include:

- Emission source parameters for the proposed sites were provided by the client and assumed to be correct;
- It must be noted that TSP (in the form of dust fallout) has not been considered for this assessment as SCREEN3, which is a Level 1 modelling platform, is incapable of assessing TSP accurately;
- Dispersion simulations were run under all stability and wind speed options to determine the maximum possible ambient concentration for each pollutant; and
- Conversion factors provided in the *Modelling Regulations* were applied to hourly average outputs to determine concentrations for longer averaging periods.

6 CONCLUSION

WSP has been requested by Envirogistics to undertake a desktop site selection assessment to evaluate if there are potential TSF sites, within the boundaries of the mining concession at Dwarsrivier Chrome Mine, which can be considered to supersede the current active TSF. These sites include Sites B, C, D and F. The mine initially identified seven sites which were reduced to four (Sites B, C, D and F). As such, a screening level AQIA has been undertaken to provide insight into potential air quality impacts associated with the proposed TSF at Sites B, C, D and F.

The study area is situated approximately 60 km northwest of Lydenburg, 25 km south of Steelpoort and 63 km northeast of Roossenekal in the Limpopo Province. The operation is located in the Fetakgomo-Greater Tubatse Local Municipality, within the boundaries of the Sekhukhune District Municipality.

The overall area is characterised by intensive mining development. Several of the neighbouring farms, namely Tweefontein 380JT, Thorncliffe 374KT, De Grootteboom 373KT and Dwarsrivier 372KT are owned by mining houses with existing and operational chrome and platinum mines. On the remainder of the neighbouring farms, agricultural activities take place, in the form of stock grazing and the growing of vegetables, lucerne and cotton. Sensitive receptors within a 10 km radius of the study site have been selected for this impact assessment, namely SR1 and SR2 (i.e. villages).

Emission rates for the proposed activities were calculated using the USEPA AP-42 and the Australian Government NPI emission factors. Uncontrolled emission rates were calculated for particulate matter (PM_{10} and $PM_{2.5}$) for Sites B, C, D and F to evaluate the best possible site.

A recommended Level 1 dispersion modelling platform, SCREEN3, was utilised to predict maximum hourly average ground-level downwind concentrations of pollutants emitted from the proposed TSFs. Peak concentrations were predicted to occur at 1,100 m for Site B, 800 m for Site C and 900 m for Site D and F. The closest sensitive receptor assessed in this study from Site C and Site F are villages (SR1), and the closest sensitive receptor to Site B and Site D are villages at SR2. Conversion factors recommended in the *Regulations Regarding Dispersion Modelling* were applied to the 1-hour average output concentrations to allow for comparison with NAAQS applicable to longer averaging periods. Key findings are as follows:

- Predicted ambient PM_{10} and $PM_{2.5}$ concentrations as a result of emissions from all proposed TSF Sites B, C, D and F are below the PM_{10} and $PM_{2.5}$ NAAQS on a 24-hour and annual averaging period;
- Lowest predicted PM_{10} concentrations are anticipated at Site D with a maximum peak concentration of 10.31 $\mu g/m^3$ and 2.06 $\mu g/m^3$ on a 24-hour and annual averaging period;
- Lowest predicted $PM_{2.5}$ concentrations are anticipated at Site D with a maximum peak concentration of 1.54 $\mu g/m^3$ and 0.31 $\mu g/m^3$ on a 24-hour and annual averaging period;
- From the screening assessment Site D was predicted as the most favourable in terms of air quality;
- Site D is located at the northern side of process plant which is adjacent to the existing TSF. Additionally, Site D is obstructed by the mountain 'koppie,' which is likely to reduce dust originating from the Site D; and
- It is noted that Site B is currently the preferred option for the TSF. The predicted PM_{10} concentrations from Site B have a maximum peak concentration of 16.88 $\mu g/m^3$ and 3.38 $\mu g/m^3$ on a 24-hour and annual averaging period respectively. Site B predicted concentrations are lower than those predicted for Site C. Predicted $PM_{2.5}$ concentrations at Site B have a maximum peak concentration of 2.53 $\mu g/m^3$ and 0.51 $\mu g/m^3$ on a 24-hour and annual averaging period respectively.

This study comprises an environmentally conservative/'worst-case' air quality impact assessment and did not find predicted pollutant concentrations to exceed regulated ambient air quality standards. Further, impacts predicted at Site D were anticipated to be the lowest and as such, it is recommended that the proposed TSF be located at Site D.

It must be noted that the findings of this assessment have been based on emissions associated with the proposed TSF only and do not incorporate all sources from the Dwarsrivier Mine. Emissions from all sources at Dwarsrivier Mine will be assessed in the full AQIA once the preferred location has been determined.

Annexure 10: Heritage Assessment

ARCHAEOLOGICAL SITE SELECTION REPORT

FOR THE PROPOSED KHULU TSF PROJECT, LIMPOPO PROVINCE

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Report Author:

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Project Reference:

21907

Report date:

February 2019

Revised June 2021

DOCUMENT PROGRESS
Heritage Site Screening Report

Document status

Document Version	**v1.0**		
Report Purpose	**Draft for review Envirogistics (Pty) Ltd**		
Report Ref. No.	**21907**		
	Name	**Signature**	**Date**
Document Compilation	**Mr. J. van der Walt**		**February 2019** **June 2021**

Distribution List

Date	Report Reference number	Document Distribution	Number of Copies
2019/02/08 2021/06/18	21907	Envirogistics (Pty) Ltd	Electronic copy

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EXECUTIVE SUMMARY

Site name and location: Khulu TSF located at the Dwarsrivier Mine, Steelpoort, Limpopo Province

1: 50 000 Topographic Map: 2430 CC

EIA Consultant: Envirogistics (Pty) Ltd .

Developer: Dwarsrivier Chrome Mine

Heritage Consultant: HCAC (Heritage Contracts and Archaeological Consulting).
Contact person: Jaco van der Walt, Tel: +27 82 373 8491, Email: jaco@heritageconsultants.co.za

Date of Report: 8 February 2019. Revised with additional option – TSF option B.

Findings of the Assessment:

The scope of work comprises a preferred site selection process for the Khulu TSF Project. Dwarsrivier Chrome Mine identified 7 sites but due to Environmental constrains four potential sites (Site B, C, D and F) were selected and assessed in this report. This screening report was conducted based on a desktop study of available data regarding cultural heritage resources of the area as well as a walkdown of the proposed impact areas

Based on the findings of this screening report Site D is from a heritage point of view the preferred site. Site D has previously been disturbed and no heritage resources were identified inside the footprint area of the proposed TSF. It should be noted that a cemetery occurs on the periphery of the site, and this area should be demarcated and avoided.

Site F is also considered to be acceptable if the correct management and mitigation measures are implemented. Site F is however located in a pristine Greenfields area and therefore less suitable than Site D.

The stone wall foundations of a ruin and a possible Early Iron Age site was recorded within Site B. The study area is how ever disturbed, possibly by previous cultivation reducing the significance of the recorded finds. The recorded sites will require limited mitigation and Site B are therefore the third option from a heritage point of view

From a heritage point of view the heritage sensitivity associated with Site C are considered to be high due to the high number of Iron Age sites in the impact area and this option is not recommended for the proposed development.

Contents

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ABBREVIATIONS

AIA: Archaeological Impact Assessment
ASAPA: Association of South African Professional Archaeologists
BIA: Basic Impact Assessment
CRM: Cultural Resource Management
EAP: Environmental Assessment Practitioner
ECO: Environmental Control Officer
EIA: Environmental Impact Assessment*
EIA: Early Iron Age*
EMP: Environmental Management Plan
ESA: Early Stone Age
GPS: Global Positioning System
HIA: Heritage Impact Assessment
LIA: Late Iron Age
LSA: Late Stone Age
MEC: Member of the Executive Council
MIA: Middle Iron Age
MPRDA: Mineral and Petroleum Resources Development Act
MSA: Middle Stone Age
NEMA: National Environmental Management Act
PRHA: Provincial Heritage Resource Agency
SADC: Southern African Development Community
SAHRA: South African Heritage Resources Agency
SAHRIS: South African Heritage Resources Information System

**Although EIA refers to both Environmental Impact Assessment and the Early Iron Age both are internationally accepted abbreviations and must be read and interpreted in the context it is used.*

GLOSSARY

Archaeological site (remains of human activity over 100 years old)

Early Stone Age (2 million to 300 000 years ago)

Middle Stone Age (300 000 to 30 000 years ago)

Late Stone Age (30 000 years ago until recent)

Historic (approximately AD 1840 to 1950)

Historic building (over 60 years old)

Lithics: Stone Age artefacts

1. INTRODUCTION

HCAC was contracted by Envirogistics (Pty) Ltd to conduct a heritage screening study for the proposed Khulu TSF. The Project is located close to Steelpoort and currently four sites (TSF Option B, C, D & F) are considered. Heritage resources were recorded in all of the sites apart from Option D and F (Figure 1).The heritage screening report forms part of the Environmental Impact Assessment (EIA) process for the project and will be followed by a Heritage Impact Assessment conducted on the preferred site.

The aim of the screening report is to conduct a desktop study to identify possible heritage resources within the potential project sites in order to select a preferred project site. The study furthermore aims to assess the impact of the proposed project on non - renewable heritage resources and to submit appropriate recommendations with regards to the responsible cultural resources management measures that might be required to assist the developer in choosing the best possible development site with the lowest impact on heritage resources.

This report outlines the approach and methodology utilised for the screening phase of the project. The report includes information collected from various sources and consultations. Possible impacts are identified and mitigation measures are proposed in the following report.

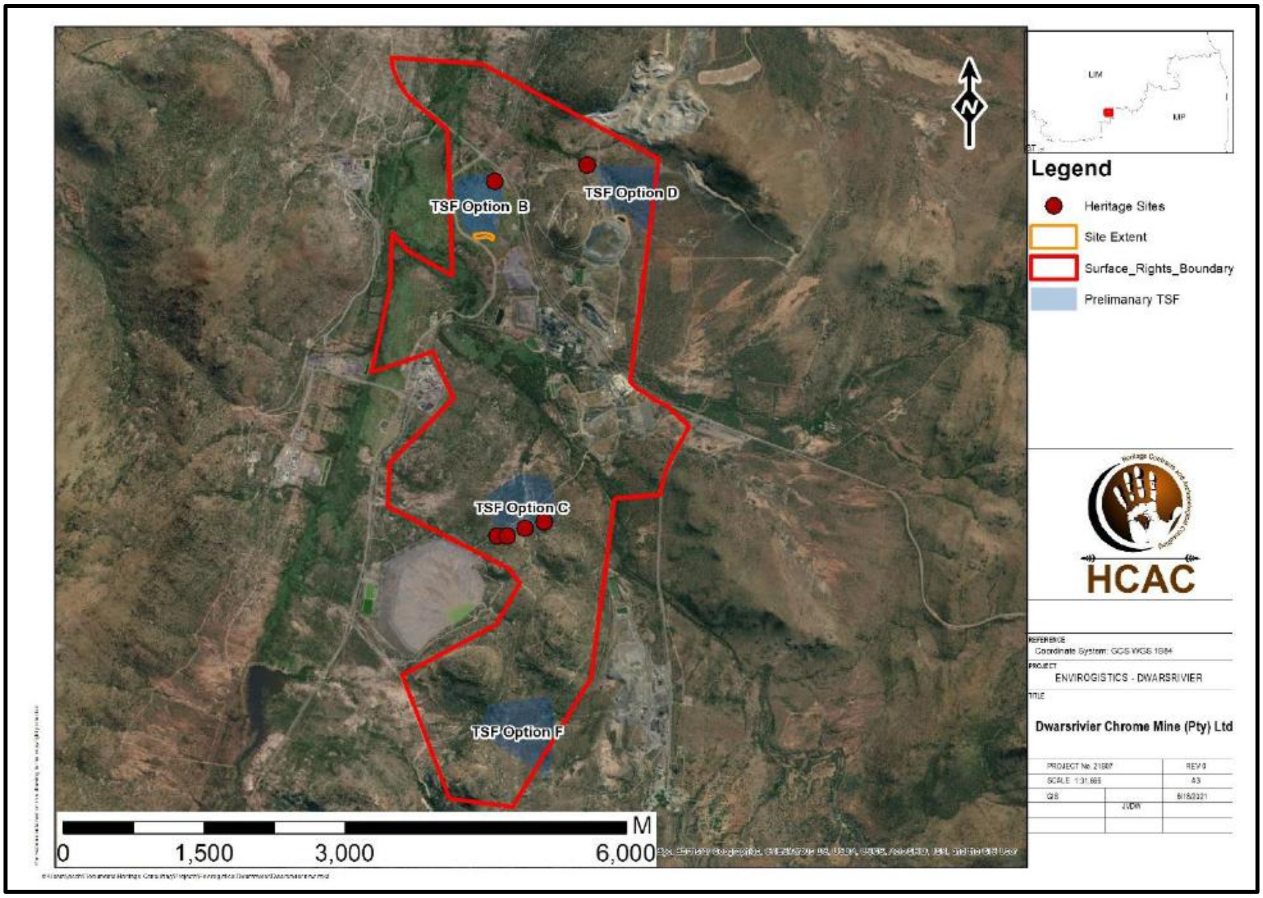


Figure 1. Locality map of the sites under investigation also indicating the heritage resources identified in each area.

1.1 Terms of Reference

The main aim of this screening report is to determine if any known heritage resources occur within the potential project sites and to determine which site would be most suitable from a heritage point of view. The objectives of the screening report were to:

- » Conduct a desktop study:
  - ∗ Review available literature, previous heritage studies and other relevant information sources to obtain a thorough understanding of the archaeological and cultural heritage conditions of the area;
  - ∗ Identify known and recorded archaeological and cultural sites; and
  - ∗ Determine whether the area is renowned for any cultural and heritage resources, such as Stone Age sites, Iron Age sites, informal graveyards or historical homesteads.
  - » Conduct a walkdown of the proposed areas.

- » Compile a specialist Heritage Screening Report in line with the requirements of the EIA Regulations, 2014.

The reporting of the screening component is based on the results and findings of the desktop study and a site visit, wherein potential issues associated with the proposed project will be identified, and those issues requiring further investigation through the subsequent impact assessment Phase's highlighted.

1.2 The receiving environment

The study area is situated approximately 60km northwest of Lydenburg, 25km south of Steelpoort and 63km northeast of Roossenekal in the Limpopo Province. The study area forms part of the Dwarsrivier Valley part of the Bushveld Igneous Complex. The greater area has been transformed over the years firstly by agricultural fields and more recently by mining related activities including infrastructure like roads, water pipelines and power lines.

2. APPROACH AND METHODOLOGY

The scope of work comprises a preferred site selection process based on experience working in the area as well as available data regarding archaeological and cultural heritage resources in order to identify a preferred site in terms of potential impacts to known heritage resources.

This was accomplished by means of the following phases (the results are represented in section 4 and 6 of this report):

2.1 Literature review

A review was conducted utilising data for information gathering from published articles on the archaeology and history of the area. The aim of this is to extract data and information on the area in question, looking at archaeological sites, historical sites and graves of the area.

2.2 Information collection

Data from the South African Heritage Resources Information System (SAHRIS) was consulted to further collect data from Cultural Resource Management (CRM) practitioners who undertook work in the area to provide the most comprehensive account of known sites where possible.

2.3 Public consultation

No public consultation was conducted during this phase.

2.4 Google Earth and mapping survey

Google Earth and 1:50 000 maps of the area were utilised to identify possible places where archaeological sites might be located.

2.5 Genealogical Society of South Africa

The database of the genealogical society was consulted to collect data on any known graves in the area.

2.6. Heritage Walk Down

The identified areas were subjected to a heritage walkdown to identify heritage sites in the impact areas.

3. LEGISLATION

For this project the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA) is of importance and the following sites and features are protected:

a. Archaeological artefacts, structures and sites older than 100 years
b. Ethnographic art objects (e.g. prehistoric rock art) and ethnography
c. Objects of decorative and visual arts
d. Military objects, structures and sites older than 75 years
e. Historical objects, structures and sites older than 60 years
f. Proclaimed heritage sites
g. Grave yards and graves older than 60 years
h. Meteorites and fossils
i. Objects, structures and sites or scientific or technological value.

The national estate includes the following:

a. Places, buildings, structures and equipment of cultural significance
b. Places to which oral traditions are attached or which are associated with living heritage
c. Historical settlements and townscapes
d. Landscapes and features of cultural significance
e. Geological sites of scientific or cultural importance
f. Archaeological and palaeontological importance
g. Graves and burial grounds
h. Sites of significance relating to the history of slavery
i. Movable objects (e.g. archaeological, palaeontological, meteorites, geological specimens, military, ethnographic, books etc.)

Section 34 (1) of the Act deals with structures that are older than 60 years. Section 35(4) of this Act deals with archaeology, palaeontology and meteorites. Section 36(3) of the Act, deals with human remains older than 60 years. Unidentified/unknown graves are also handled as older than 60 years until proven otherwise.

3.1 Heritage Site Significance and Mitigation Measures

The presence and distribution of heritage resources define a Heritage Landscape. In this landscape, every site is relevant. In addition, because heritage resources are non-renewable, heritage surveys need to investigate an entire project area. In all initial investigations, however, the specialists are responsible only for the identification of resources visible on the surface.

This section describes the evaluation criteria used for determining the significance of archaeological and heritage sites. National and Provincial Monuments are recognised for conservation purposes. The following interrelated criteria were used to establish site significance:

- The unique nature of a site;
- The integrity of the archaeological/cultural heritage deposit;
- The wider historic, archaeological and geographic context of the site;
- The location of the site in relation to other similar sites or features;
- The depth of the archaeological deposit (when it can be determined or is known);
- The preservation condition of the site; and
- Potential to answer present research questions.

The criteria above will be used to place identified sites within the South African Heritage Resources Agency's (SAHRA's) (2006) system of grading of places and objects that form part of the national estate. This system is approved by the Association of South African Professional Archaeologists (ASAPA) for the Southern African Development Community (SADC) region.

FIELD RATING	***GRADE***	***SIGNIFICANCE***	***RECOMMENDED MITIGATION***
National Significance (NS)	Grade 1	-	Conservation; national site nomination
Provincial Significance (PS)	Grade 2	-	Conservation; provincial site nomination
Local Significance (LS)	Grade 3A	High significance	Conservation; mitigation not advised
Local Significance (LS)	Grade 3B	High significance	Mitigation (part of site should be retained)
Generally Protected A (GP. A)	-	High/medium significance	Mitigation before destruction
Generally Protected B (GP. B)	-	Medium significance	Recording before destruction
Generally Protected C (GP.C)	-	Low significance	Destruction

4. REGIONAL OVERVIEW

4.1 General Information

4.1.1. Known Sites

Based on the desktop study a number of known sites were identified and mapped in relation to the proposed sites. None of the previously known sites occur within the proposed site alternatives (Figure 2).

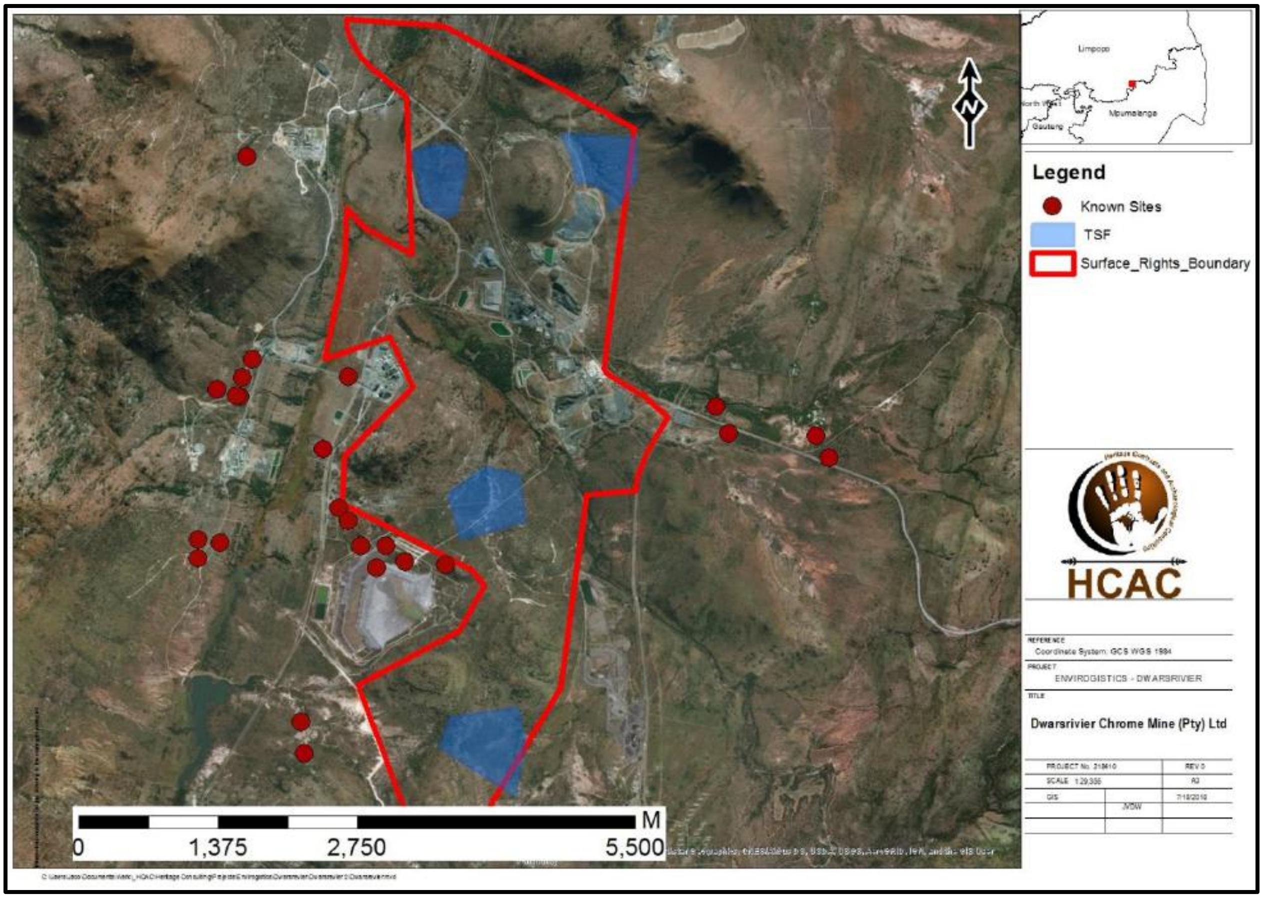
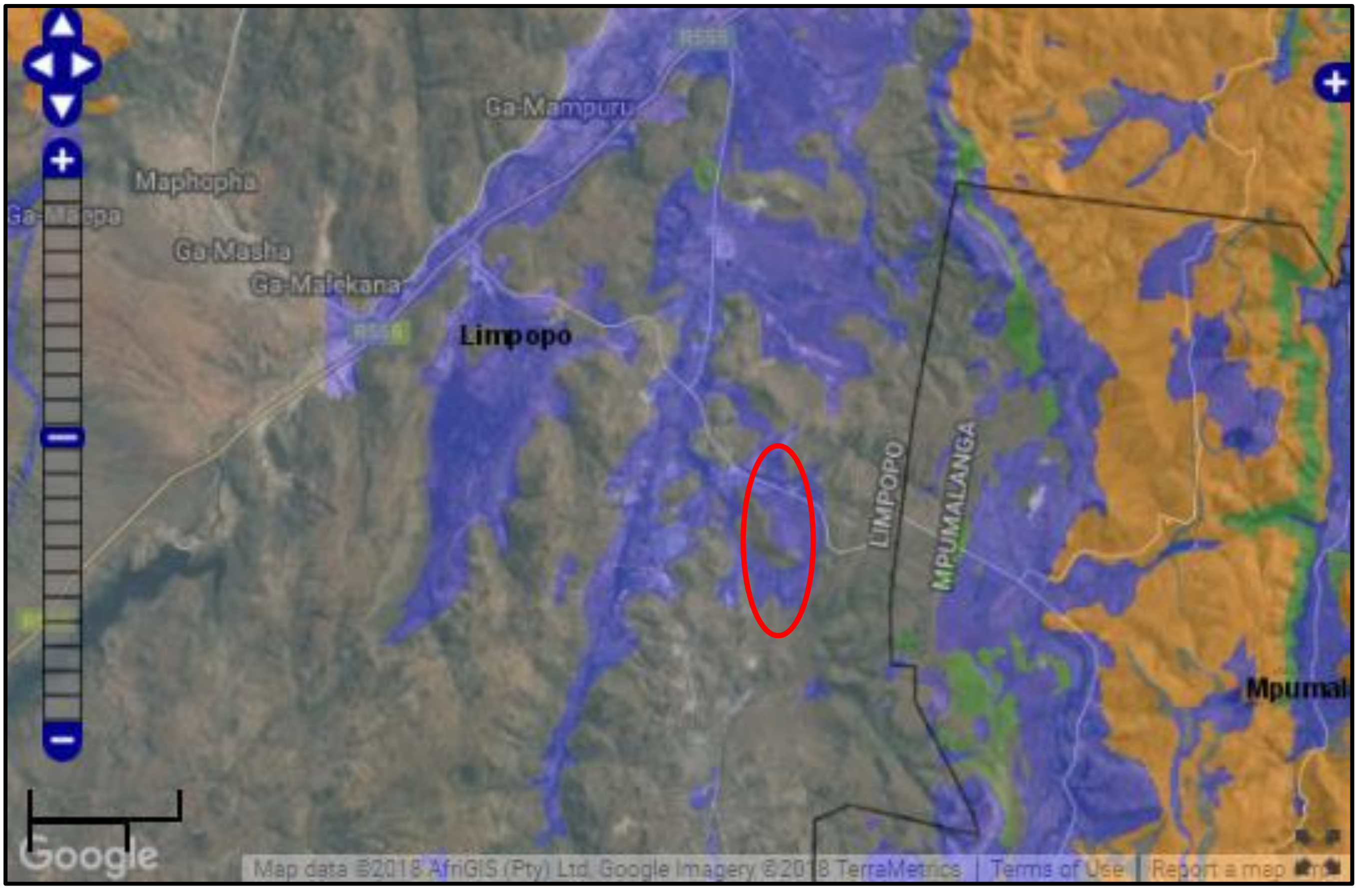


Figure 2. Known sites in relation to the study area.

4.1.2. Paleontological Sensitivities

The area is indicated as of insignificant and low paleontological sensitivity on the SAHRA paleontological sensitivity map (Figure 3).



Colour	Sensitivity	Required Action
RED	VERY HIGH	Field assessment and protocol for finds is required
ORANGE/YELLOW	HIGH	Desktop study is required and based on the outcome of the desktop study, a field assessment is likely
GREEN	MODERATE	Desktop study is required
BLUE	LOW	No paleontological studies are required however a protocol for finds is required
GREY	INSIGNIFICANT/ZERO	No palaeontological studies are required
WHITE/CLEAR	UNKNOWN	These areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

Figure 3. Paleontological Sensitivity of the approximate study area (red polygon) is indicated as insignificant and low.

4.1 3. Public consultation

No public consultation was conducted by the heritage consultant during the screening phase.

4.1.4. Google Earth and mapping survey

Google Earth and 1:50 000 maps of the area was utilised to identify possible places where archaeological sites might be located.

4.1.5. Genealogical Society of South Africa

No grave sites are indicated within the study area.

5. ASSUMPTIONS AND LIMITATIONS

This study did not assess the impact on intangible resources of the project. Additional information could become available in future that could change the results of this report.

6. FINDINGS

The mine identified seven (7) sites initially, which have been reduced to four (4) (Site B, C, D and F), with site D being the most favourable for the mine. Based on the initial review by the Environmental Assessment Practitioner, Site B was found to be fatally flawed due to the potential future Eskom substation but has now been included.

The potential heritage constraints relating to each site were evaluated to determine the best suited site for the proposed development from a heritage perspective as outlined below:

TSF Option	Approximate size of area	Heritage constraints and numerical rating based on preference
Site B	25.8 ha	The stone wall foundations of a ruin and a possible Early Iron Age site was recorded within Site B. The study area is however disturbed, possibly by previous cultivation reducing the significance of the recorded finds. The recorded sites will require limited mitigation and Site B is therefore the third option from a heritage point of view (3).
Site C	21 ha	From a heritage point of view the heritage sensitivity associated with Site C is high due to the Iron Age sites recorded in the impact area and this option is therefore the least suitable for the proposed development (4).
Site D	19 ha	Site D is from a heritage point of view the preferred site (1). Site D has previously been disturbed and no heritage resources were identified inside the footprint area of the proposed TSF. It should be noted that a cemetery occurs on the periphery of the site, and this area should be demarcated and avoided.
Site F	17 ha	Site F is also considered to be acceptable if the correct management and mitigation measures are implemented (2). Site F is however located in a pristine Greenfields area and therefore less suitable than Site D.

7 OCCURRENCES OF SITES

Form a heritage point of view a number of factors were considered including the occurrence of heritage sites and whether the site has been previously disturbed (Table 1)

Table 1. Limitations considered in the site selection process

	Site B	Site C	Site D	Site F
Heritage Sites within Footprint	X	X		
Graves/ Cemeteries within footprint				
Paleontological Sensitivity				
Pristine Area				X
Rating	3	4	1	2

8. CONCLUSIONS AND RECOMMENDATIONS

The scope of work comprises a preferred site selection process for the Khulu TSF Project. Dwarsrivier Chrome Mine identified 7 sites but due to Environmental constrains four potential sites (Site B, C, D and F) were selected and assessed in this report. This screening report was conducted based on a desktop study of available data regarding cultural heritage resources of the area as well as a walkdown of the proposed impact areas.

Based on the findings of this screening report Site D is from a heritage point of view the preferred site. Site D has previously been disturbed and no heritage resources were identified inside the footprint area of the proposed TSF. It should be noted that a cemetery occurs on the periphery of the site, and this area should be demarcated and avoided.

Site F is also considered to be acceptable if the correct management and mitigation measures are implemented. Site F is however located in a pristine Greenfields area and therefore less suitable than Site D.

The stone wall foundations of a ruin and a possible Early Iron Age site was recorded within Site B. The study area is how ever disturbed, possibly by previous cultivation reducing the significance of the recorded finds. The recorded sites will require limited mitigation and Site B are therefore the third option from a heritage point of view

From a heritage point of view the heritage sensitivity associated with Site C are considered to be high due to the high number of Iron Age sites in the impact area and this option is not recommended for the proposed development.

It is recommended that the preferred site should be subjected to a Heritage Impact Assessment.

9. PLAN OF STUDY

With cognisance of the recorded archaeological sites in the wider area and in order to comply with the National Heritage Resources Act (Act 25 of 1999) it is recommended that a Phase 1 heritage impact assessment must be undertaken for the preferred site. During the study sites of archaeological, historical or places of cultural interest must be located, identified, recorded, photographed and described. During this study the levels of significance of recorded heritage resources must be determined and mitigation proposed should any significant sites be impacted upon, ensuring that all the requirements of SAHRA are met.

10. LIST OF PREPARERS

Jaco van der Walt (Archaeologist and project manager)

11. STATEMENT OF COMPETENCY

The author of the report is a member of the Association of Southern African Professional Archaeologists and is also accredited in the following fields of the Cultural Resource Management (CRM) Section, member number 159: Iron Age Archaeology, Colonial Period Archaeology, Stone Age Archaeology and Grave Relocation. Jaco is also an accredited CRM Archaeologist with SAHRA and AMAFA.

Jaco has been involved in research and contract work in South Africa, Botswana, Mozambique, Zimbabwe, Tanzania and the DRC and conducted well over 300 AIAs since he started his career in CRM in 2000. This involved several mining operations, Eskom transmission and distribution projects and infrastructure developments. The results of several of these projects were presented at international and local conferences.

12. STATEMENT OF INDEPENDENCE

I, Jaco van der Walt as duly authorised representative of Heritage Contracts and Archaeological Consulting CC, hereby confirm my independence as a specialist and declare that neither I nor the Heritage Contracts and Archaeological Consulting CC have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which the client was appointed as Environmental Assessment practitioner, other than fair remuneration for work performed on this project.

SIGNATURE: ____________________

13. REFERENCES

Archaeological Database Wits University Referenced 2009

National Heritage Resources Act NHRA of 1999 (Act 25 of 1999)

SAHRA Report Mapping Project Version 1.0, 2009

SAHRIS (Cited 2019)

Annexure 11: Socio-Economic

ENVIRONMENTAL AUTHORISATION APPLICATION FOR NEW CAPITAL PROJECTS AND THE PROPOSED NEW KHULU TAILINGS STORAGE FACILITY AND ASSOCIATED INFRASTRUCTURE

DWARSRIVIER CHROME MINE, STEELPOORT AREA, MPUMALANGA

SOCIO-ECONOMIC IMPACT ASSESSMENT

SCOPING AND SITE SELECTION REPORT

Submitted to:

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June 2020

DOCUMENT STATUS

SOCIAL IMPACT ASSESSMENT: Site Selection and Scoping Report: Draft

Date: 20 June 2021

Authors: Ms. Ingrid Snyman: Batho Earth

Signature:

GLOSSARY OF ABBREVIATIONS

DCM:	Dwarsrivier Chrome Mine (Pty) Ltd.
DMRE:	Department of Mineral Resources
EAP:	Environmental Assessment Practitioner
EIA:	Environmental Impact Assessment
EMPr:	Environmental Management Programme
EMPR:	Environmental Management Programme Report
FTLM:	Fetakgomo Tubatse Local Municipality
IDP:	Integrated Development Plan
MPRDA:	Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002)
NEMA:	National Environmental Management Act, 1998 (NEMA) (Act 107 of 1998)
NWA:	National Water Act, 1998 (NWA) (Act 36 of 1998).
RE:	Remaining Extent
SDF:	Strategic Development Framework
SIA:	Social Impact Assessment
SLP:	Social and Labour Plan
StatsSA:	Statistics South Africa
TSF:	Tailings Storage Facility
TRP:	Two Rivers Platinum Mine

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1. INTRODUCTION AND BACKGROUND TO THE PROPOSED PROJECTS

Dwarsrivier Chrome Mine (Pty) Ltd. (DCM) is located 25 km south of Steelpoort in the Limpopo Province. The mine currently holds the mining rights for Portion 1 (Remaining Extent (RE)) and Portion 0 (RE) of the farm Dwarsrivier 372KT and surface rights for the said portions. The surface rights also extent onto Portion 4 (a portion of Portion 3) of the farm de Grootteboom 373KT. In addition to the above, DCM also owns mining rights on Portions 6 and 7 of the farm Dwarsrivier 372KT, of which the surface rights are owned by Two Rivers Platinum Mine (TRP).

Dwarsrivier has been mining chromite ore from the LG6 seam since 1999. Between 1999 and 2005, ore was mined using opencast methods. The six (6) pits have subsequently been mined out and backfilled, with the exception of the South and North Pit portals from which access is gained to the underground workings. The current mine plan extends the life of the operations to the year 2042.

DCM is proposing new capital projects and the new Khulu Tailings Storage Facility (TSF) and associated infrastructure. The projects can be summarised as follows:

- Project 1: Khulu TSF, where four alternative sites will be investigated. A Return Water Dam is also proposed.
- Project 2: Diesel and Emulsion Batching.
- Project 3: Extension of Main Parking Area.
- Project 4: Widening of Access Road between South Shaft/Main Offices and Plant.
- Project 5: Access Crossing between Plant and North Mine.

Envirogistics (Pty) Ltd. was appointed by DCM as Environmental Assessment Practitioner (EAP) to undertake the necessary Environmental Authorisations for the proposed projects. A Social Impact Assessment (SIA) will be conducted as part of the Environmental Authorisation Process.

1.1 Project 1: Khulu TSF and associated infrastructure

DCM is currently depositing at the existing North Tailings Storage Facility (NTSF) at the eastern side of the process plant on the remaining portion of the Farm Dwarsrivier 372KT. It is anticipated that the existing active NTSF will soon reach its full capacity and therefore seven (7) potential TSF sites were identified in 2019. During the initial assessment the number of sites were reduced to four (4) sites, namely Sites B, C, D and F.

A future Eskom substation, however, was planned on Site B, which was the preferred site. Site B was then disregarded and during the 2019 Site Selection Process, Site D was selected as the preferred site for the mine.

Subsequent to the 2019 Site Selection Process, further geotechnical studies were undertaken, which identified potential concerns for Site D, which also included the proximity of the non-perennial tributary of the Dwarsrivier River. In addition to this, the Eskom substation is no longer planned, which has reintroduced Option B into the overall assessment.

Four sites will now again be assessed. These are:

- TSF Option B (24ha and 37 m in height) located on the farm Dwarsrivier 372KT RE;
- TSF Option D (19ha and 29 m in height) located on the farm Dwarsrivier 372KT RE;
- TSF Option C (21ha and 49 m in height) located on the farm Dwarsrivier 372KT Remainder of Portion 1; and
- TSF Option F (17ha and 50 m in height) located on the farm Dwarsrivier 372KT Remainder of Portion 1.

TSF Option B is the preferred site for DCM. The ancillary infrastructure is also proposed on the farm Dwarsrivier 372KT RE. The Return Water Dam for Option B (1.7ha) is proposed on the farm Dwarsrivier 372KT Remainder of Portion 6, but the location can still change to Dwarsrivier 372KT RE. The location of the facility will be finalised once the preferred site has been decided.

The project will not involve typical tailings deposition techniques, but will involve the piping of tailings to a filter press facility from where the filter cake will be trucked to the new TSF. A life of mine of about 20 years are currently considered as part of the design.

Herewith the location of the sites:

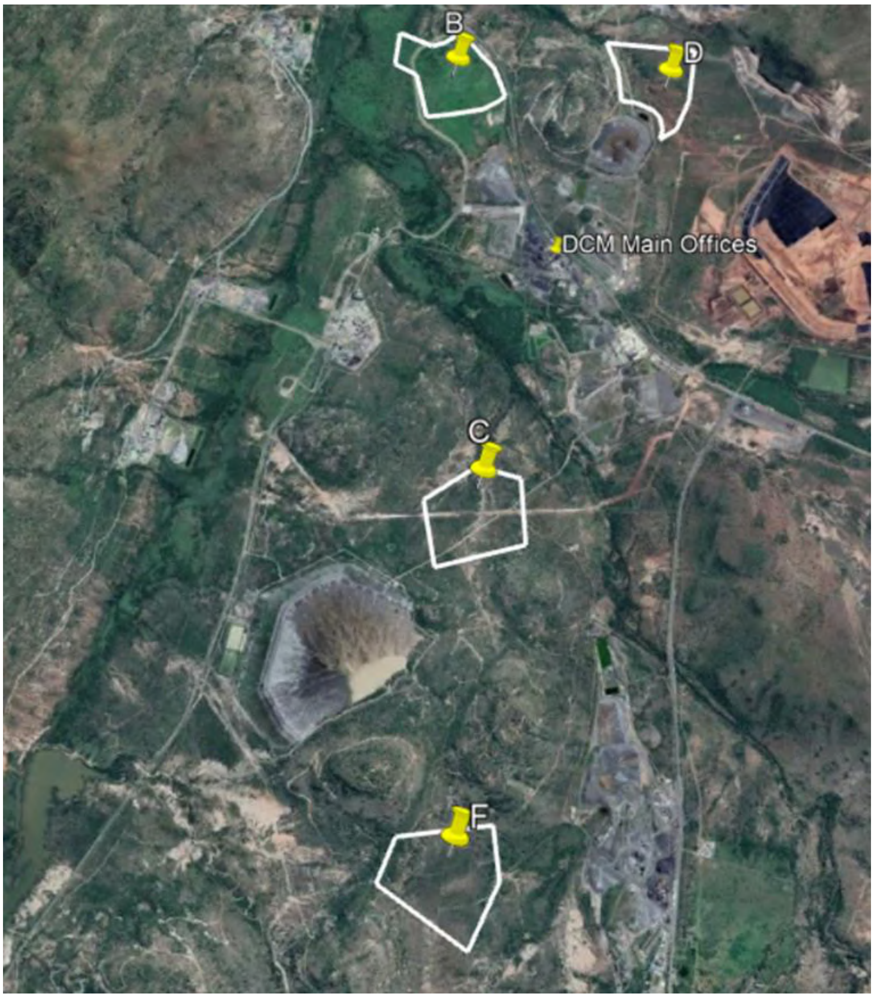

Figure 1: Proposed TSF site alternatives

1.2 Project 2: Diesel and Emulsion Batching

DCM plans to erect two (2) diesel and emulsion batching areas, to supply diesel and emulsion to the underground mining operations. The location of this area is to the north-east of the old Two Rivers Platinum Mine (TRP), just north of the new TRP TSP Pipeline. The project (1.6ha) is proposed on the farm Dwarsrivier 372KT Remainder of Portion 1 and will include:

- Construction of an approximate 80m access road to the diesel batching area;
- Parking area, with security office at both areas (no dangerous good storage planned at any time);
- The following tanks will be located at the Diesel Batching area: 23m^3 Diesel; 23m^3 Engine Oil and 23m^3 Hydraulic Oil.
- A 60m^3 emulsion tank will be placed at the Emulsion Batching areas.
- The tanks will feed into a pipeline for underground use at both areas.

Clearance of indigenous vegetation of approximately 1.3ha will be required.

The following figure indicates the location of the diesel and emulsion batching areas:

Figure 2: Diesel and emulsion batching areas

1.3 Project 3: Main Parking Extension

The Mine requires the expansion of the existing parking area at the Main Offices. The current parking area is about 0.8ha with the parking bays not sufficient to cater for the number of vehicles. The current parking bay comprises of a tarred surface area and steel roof parking bays. The same principle will be applied at the expanded area. No new entrances will be required. The planned parking bay expansion will be located about 20m from the Springkaanspruit on the farm Dwarsrivier 372KT Remainder of Portion 1 and will be approximately 0.5ha.

Clearance of indigenous vegetation will be required in the order of approximately 4 900m^2.

The location of the planned extension is indicated in the figure below.

Figure 3: Proposed Parking area extension

1.4 Project 4: Widening of Access Road between South Shaft/Main Offices and Plant

An existing road provides access between the Main Office Buildings and the Plant. The current width of the road ranges between 5-6m. To accommodate larger vehicles such as Trucks, DCM is planning on increasing a section of 700m of this road to a width of 16m (to accommodate two-way traffic). This will mainly be located on the farm Dwarsrivier 372KT Remainder of Portion 1 (0.3ha).

Clearance of indigenous vegetation will be required in the order of approximately 3 311m^2.

The figure below indicates the location where widening of the road would be required.

Figure 4: Widening of access road

1.5 Project 5: Access Crossing between Plant and North Mine

To ensure more optimal logistical management of traffic between the South Mine and the North Mine, and to reduce the number of vehicles on the regional road, the mine is planning the construction of a new road under regional road bridge to allow for access between the two areas. Project 5 will be located on the farm Dwarsrivier 372KT RE and will be approximately 0.2ha.

Clearance of indigenous vegetation will be required in the order of approximately 1 700m^2.

Figure 5: Location of new road under road crossing

2. PURPOSE OF THE REPORT

The purpose of the Scoping and Site Selection Report is to provide the outcome of a desktop study and preliminary considerations that need to be further investigated during the EIA phase of the project. This investigation from a socio-economic perspective focuses on Sites B, C, D and F. The aim is to determine which of these sites would be most suitable for further studies.

The purpose of the report is thus to:

- Provide a brief overview of the current socio-economic status of the area and the social characteristics of the receiving environment;
- Indicate the anticipated core impact categories and impact areas (possible hot spots);
- Identify anticipated positive and negative socio-economic impacts of the proposed project;
- Identify gaps and no-go options;
- Assess the suitability of the different sites based on the socio-economic environment and possible impacts in this regard;
- Recommend a preferred site from a socio-economic perspective;

- Present the findings, recommendations and conclusions of the social scoping study;
- Indicate issues that should be considered during the EIA phase of the project; and
- Describe the approach and determine the need and content of future social studies to be undertaken as part of the detailed SEIA.

The site ranking exercise is thus aimed at providing planners, as well as Interested and Affected Parties (I&APs), with a comparison of the site suitability, for the short listing of sites for further, more detailed site investigation.

3. DEFINITION OF A SOCIO-ECONOMIC IMPACT ASSESSMENT

Burdge (1995) describes a Social Impact Assessment as the "…systematic analysis in advance of the likely impacts a development event (or project) will have on the day-to-day life (environmental) of persons and communities." A SEIA therefore attempts to predict the probable impact of a development (before the development actually takes place) on people's way of life (how they live, work, play and interact with one another on a daily basis), their culture (their shared beliefs, customs and values) and their community (its cohesion, stability, character, services and facilities), by:

- Appraising the social impacts resulting from the proposed project;
- Relating the assessed social impacts of the project to future changes in the socio-economic environments that are not associated with it. This would serve to place the impacts of the project into context;
- Using the measurements (rating) to determine whether the impacts would be negative, neutral or positive;
- Determining the significance of the impacts; and
- Proposing mitigation measurements.

A SEIA is thus concerned with the human dimensions of the environment, as it aims to balance social, economic and environmental objectives and seeks to predict, anticipate and understand the potential impacts of development.

The usefulness of a SEIA as a planning tool is immediately clear, in that it can assist the project proponent to conceptualise and implement a project in a manner which would see the identified negative socio-economic impacts addressed through avoidance or mitigation and the positive impacts realised and optimised. It would also allow the community to anticipate, plan for and deal with the social changes once they come into effect. In this sense then, the SEIA is an indispensable part of the EIA, the Environmental Management Plan (EMP) and any participative activity (e.g. community involvement in mitigation and monitoring during planning and implementation).

4. LEGAL REQUIREMENTS AND GUIDELINES

4.1. General

In South Africa, the National Environmental Management Act, 1998 (NEMA), provides the legal framework for the correct use and management of the environment. Many developments undertaken by both public and private sector organisations require, by legislation, an Environmental Impact Assessment (EIA). In specific, Section 24 of NEMA provides for both the Minister and MEC to identify activities or areas in which certain activities may not be undertaken in absence of an environmental authorization.

An EIA is depended on the type, scale and size of the specific development. The National Environmental Management Act, Environmental Impact Assessment Regulations, GN R543 ("NEMA EIA Regulations") were published on 18 June 2010 and came into operation on 2 August 2010. These Regulations has been superseded with the 2014 EIA Regulations, GNR 982 published on 4 December 2014 and came into operation on 8 December 2014.

Together with the NEMA EIA Regulations, the assessment of the social environment came into place and thus the origin for undertaking a Social Impact Assessment (SIA). The guidelines from NEMA thus also apply to an SIA.

Other applicable legislation (Acts and Guidelines) include:

- Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA);
- National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and associated Environmental Impact Assessment Regulations, 2014, as amended in 2017 (EIA Regulations);
- The Social and Labour Plan required by MPRDA and MPRDA Regulations GN R527 (Part II Regulations 40 to 46); and
- Guidelines and Principles for Social Impact Assessment published by the International Association of Impact Assessment (2003).

4.2. EIA Regulations Checklist

Herewith the checklist and requirements for Specialist Reports, as Contained in the 2014 EIA Regulations, as amended:

Table 1: Requirements for specialist reports, as contained in the 2014 EIA Regulations, as amended

EIA REGULATIONS 2014 GNR 982 Appendix 6 CONTENT OF THE SPECIALIST REPORTS	**Status / Cross-reference in this Report**
a) details of the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a curriculum vitae;	Section 14 **Error! Reference source not found.**
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Section 15
c) an indication of the scope of, and the purpose for which, the report was prepared	Section 2

EIA REGULATIONS 2014 GNR 982 Appendix 6 CONTENT OF THE SPECIALIST REPORTS	Status / Cross-reference in this Report
cA) an indication of the quality and age of base data used for the specialist report	Statistics from Census 2011 were used. Where available statistics from Household Survey of 2016 (StatsSA) were used.
cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 7**Error! Reference source not found.**
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 6
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 6
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Sections 7, 8 and 9
g) an identification of any areas to be avoided, including buffers;	Section 11
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers	Section 1
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 5
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Sections 7, 8 and 9
k) any mitigation measures for inclusion in the EMPr	Section 11
l) any conditions for inclusion in the environmental authorisation;	Section 11: To be updated: EIA Phase
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	To be included in detailed report: EIA Phase
n) a reasoned opinion • whether the proposed activity, activities or portions thereof should be authorised; • regarding the acceptability of the proposed activity or activities; and • if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	To be included in detailed report: EIA Phase
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	To be included in detailed report: EIA Phase
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	To be included in detailed report: EIA Phase
q) any other information requested by the competent authority	N/A
2) Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be	N/A

EIA REGULATIONS 2014 GNR 982 Appendix 6 CONTENT OF THE SPECIALIST REPORTS	Status / Cross-reference in this Report
applied to a specialist report, the requirements as indicated in such notice will apply.	

5. GAPS, LIMITATIONS AND ASSUMPTIONS

With regards to the study undertaken, the following should be noted:

- A SIA aims to identify possible socio-economic impacts that could occur in future. These impacts are based on existing baseline information. There is thus always an uncertainty with regards to the anticipated impact actually occurring, as well as the intensity thereof. Impact predictions have been made as accurately as possible based on the information available at the time of the Scoping Study.
- Sources consulted are not exhaustive and additional information can still come to the fore to influence the contents, findings, ratings and conclusions made.
- Additional information may become known or available during a later stage, which could not have been allowed for at the time of the study.
- Technical and other information provided by the client is assumed to be correct.

6. METHODOLOGY

The broad steps followed as part of the site selection assessment are discussed below.

6.1 Scope of the Assessment

Based on information received from Dwarsrivier Chrome Mine and Envirogistics (Pty) Ltd., the scope of the assessment was determined.

6.2 Site Visit

The social consultant undertook a site visit to the different sites on 4 December 2018 to undertake a preliminary inspection of the potential candidate sites to obtain site specific data prior to the ranking of these sites, and to familiarise themselves with the location of the different sites.

No site visit was required for the 2021 assessment.

6.3 Literature Review, Analysis and Desktop Studies

The literature review and desktop studies assisted the consultant in confirming the social setting and characteristics of the study area, as well as the key economic activities. The initial phase of the investigation thus consisted of relevant data collection and an evaluation aimed at the identification of the broader socio-economic environment, which would be expanded during the more detailed studies that will be carried out in subsequent phases of the project.

Secondary data, which was not originally generated for the specific purpose of the study, were gathered and analysed for the purposes of the study. Such data included the census data, project maps, and planning documentation such as the draft Integrated Development Plans (IDP) of the Fetakgomo Tubatse Local Municipality.

6.4 Criteria Used

The following criteria were used to assess the suitability of each site for the proposed Khulu TSF:

- Location and socio-economic characteristics of the site;
- Land-use and surrounding land-use that could be incompatible or compatible with the proposed development;
- Residential proximity to the site;
- Visibility of the site to surrounding land-users;
- Location suitability that could influence the cost of the development;
- Distance from existing mining infrastructure to the sites;
- Movement of workers to and from the site;
- Safety and Security Issues;
- Existing access roads; and
- Areas where servitudes are held.

7. BASELINE DESCRIPTION OF THE RECEIVING ENVIRONMENT

7.1 Sekhukhune District

The Sekhukhune District Municipality (SDM) was established in December 2000. It consists of five Local Municipalities, namely Elias Motsoaledi, Ephraim Mogale, Greater Tubatse, Fetakgomo, and Makhuduthamaga Local Municipalities. The district is situated in the Limpopo province, to the northwest of Mpumalanga and within the southern section of the Limpopo Province. The SDM covers an area of approximately 13 264 m^2. Most of the area is typical rural as only 5% of Sekhukhune population lives in urban areas.

The main urban centres are Groblersdal, Marble Hall, Burgersfort, Jane Furse, Ohrigstad, Steelpoort and Driekop. Outside these major towns, one finds almost 605 villages which are generally sparsely populated and dispersed throughout the district[1].

7.2 Study area

The Dwarsrivier Chrome Mine (DCM) is situated on Portion 1 (Remaining Extent) and Portion 0 (Remaining Extent) of the farm Dwarsrivier 372 KT and Portion 4 (a Portion of Portion 3) of the Farm De Grootteboom 373 KT, approximately 25 km south of the town of Steelpoort in the Limpopo Province. DM is 60km northwest of Lydenburg, and 63km northeast of Roossenekal.

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[1] www.sekhukhunedistrict.gov.za

The DCM is accessed from the R577. The area falls under the jurisdiction of the Sekhukhune District and the Fetakgomo Tubatse Local Municipality (FTLM).

According to the recent official demographic survey results (2016), the FTLM has a total population of 490 381 people (Statistics South Africa Community Survey, 2016).

There is overwhelming strong statistical evidence that the population is growing at an exponential rate. There are more females 251 923 (51%) than males 238 458 (49%) in the population pyramid. Of the total population within the FTLM, 223 214 are young people. The youth thus represents 46% of the total population figure[2].

The DCM falls within Ward 27 of the FTLM and has a population of 12 527 (Statistics from 2011)[3]. Ward 27 has the following villages: Moshate, Tsakane, Kalkontein, Mabelane, Makakatela, Kutullo A&B, Shushumela & Matepe, Kutullo C&D, Dithamaga and Madibeng[4].

The main economic sectors within FTLM include agriculture, mining and quarrying, trade, tourism, manufacturing, general government, community, social and personal services, catering and accommodation[5].

7.3 Social Profile

7.3.1 *Population Figures*

The following table provides an outline of the population figures in the affected ward and how it compares to those of the municipality, district and province.

Table 2: Population figures[6]

POPULATION FIGURES				
Ward	**Population**	**People per km^2**	**Number of Households**	**% Under 20 Years Age Group**
Ward 27	12 527	18.9 km^2	2 727	48%
FTLM	489 902	85.9 km^2	125 363	42%
Sekhukhune District	1 169 762	85.7 km^2	290 526	45%
Limpopo	5 799 990	46.1 km^2	1 601 083	44%

The population figures indicate a study area which is not densely populated compared to the rest of the Fetakgomo Tubatse Local Municipality. The percentage of youth under the age of 20 years comprises approximately half of the population sector within Ward 27. The FTLM has

[2] www.fgtm.gov.za

[3] www.wazimap.co.za

[4] Draft 2018/19 IDP/Budget for Fetakgomo Tubatse Local Municipality

[5] Fetakgomo Tubatse Local Municipality: Draft 2018/19 IDP/Budget for Fetakgomo Tubatse Local Municipality

[6] www.wazimap.co.za (Census 2011)

a lower percentage of people within the under 20 years age category, but this figure still remains high. Employment creation within the municipality and especially within the ward, over the long term, is thus critical.

Ward 27 constitutes 1% of the total FTLM population[7].

7.3.2 *Education Levels*

Based on information received, the percentage within Ward 27 that achieved Grade 12 compares much lower to the levels of the FTLM. The levels of higher education achieved in the study area are also lower than those of the FTLM, the district and province.

Table 3: Education Levels[8]

MUNICIPALITY / WARD	NO SCHOOLING	GRADE 12	HIGHER EDUCATION
Ward 27	16%	19%	1%
FTLM	16%	26%	4%
Sekhukhune District	16%	26%	4%
Limpopo	14%	28%	6%

7.3.3 *Employment and Income Levels*

The table below shows relatively higher average income levels in the Ward and FTLM compared to the Sekhukhune District. This could be due to the various mining activities in the area responsible for various employment opportunities.

Table 4: Employment and Income Levels

EMPLOYMENT AND INCOME LEVELS			
WARD	**Employed**	**Other not economically active**	**Average Annual household income**
Ward 27	22.1%	43%	R29 400
FTLM	23%	47%	R57 500
Sekhukhune District	20.9%	50%	R14 600
Limpopo	27.4%	49%	R30 000

[7] Draft IDP/Budget 2021/22-2023/26 for Fetakgomo Tubatse Local Municipality

[8] www.wazimap.co.za (Community Survey 2016)

7.3.4 *Skill levels of the labour force*

According to the FTLM IDP, there is a shortage of relevant skills among locals which results in a situation where skills for the mining industry are sourced from outside the province. This hampers the municipality's job creation efforts[9]. Skills shortages are thus a challenge that needs to be overcome.

7.3.5 *Infrastructure*

The majority of residents within the FTLM live in formal dwellings (76%), which is approximately the same as within the Sekhukhune District. The area where the proposed development is situated (Ward 27), however has only 67% living within formal dwellings and 22.5% of the residents that live within informal dwellings. The latter is almost double the figure of those within the FTLM and the Sekhukhune District[10].

FTLM can be seen as a water stressed municipality. According to the community survey of 2016, 58 255 households have access to piped water and 67 208 households have no access to piped water. Of the 39 wards in the FTLM, almost all the villages source water from boreholes, rivers, dams and tanks. The main reasons for this situation is illegal water connections, limited communal and aging infrastructure, drought, lack of financial resources, the topography of the area, as well as the number of informal and scattered settlements through the municipal area.[11]

Within Ward 27, 62% of the households obtain their water from the river, but 19.5% of the households do receive their water from a regional or local water service provider. The majority of households (72.4%) also use pit latrines[12].

Villages within Ward 27 all have access to electricity services, although there are some households that still need to be connected. The area however experiences frequent power outages[13].

7.4 Economic activities

The FTLM has the following investment opportunities:

- mining investment opportunity;
- land availability opportunity;
- tourism opportunity;
- funding source opportunity from private sector; and

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[9] Draft 2018/19 IDP/Budget for Fetakgomo Tubatse Local Municipality

[10] www.wazimap.co.za

[11] Draft 2018/19 IDP/Budget for Fetakgomo Tubatse Local Municipality

[12] www.wazimap.co.za

[13] Draft 2018/19 IDP/Budget for Fetakgomo Tubatse Local Municipality

- job creation opportunity from infrastructure investment.

Mining still presents the largest opportunity in the area and the mining activities and natural resources available in the area have created a definite potential to develop tourism and thereby to diversify the economic base of the municipality[14].

The mining industry is furthermore the municipality's leading job creator and key economic growth driver. With all major mining houses fully represented in the municipality, locals pin their hopes for jobs and income security in this sector. The mining sector accounts for 34% of the Municipality's total GVA and 54% of the total labour force in the formal sector. The job absorption patterns during a 12-year review period in the sector shows that year 2012 witnessed the highest number of jobs (1833) created.

The agriculture sector in the FTLM is still emerging and heavily under-invested. Lack of mechanisation makes smallholder farming one of the smallest contributors to the municipality's economic growth.

The manufacturing sector covers the manufacturing of goods, products and beverages. It also comprises the production, processing and preservation of meat, fish, fruit, vegetables, oils and dairy products; grain mill, starches and tobacco products; textile products; spinning, weaving; and petroleum products and nuclear fuel. This sector has a vast potential as job creator but is still in its infancy.

With regards to the tourism sector, it was noted that the unique selling benefits of local heritage sites and other tourism facilities in the municipality are not effectively profiled and marketed. The tourism sector is further being overshadowed by mining to the extent that more strategic focus is unevenly invested in the latter at its expense.

8. SCOPING OF POTENTIAL SOCIO-ECONOMIC IMPACTS OF THE PROJECT

The proposed project, irrespective of the site selection could have the following potential negative impacts on the adjacent local area that needs to be investigated in more detail during the impact assessment phase.

During the **construction phase** the following negative impacts could occur:

- Possible visual impacts on neighbouring landowners/operators, although it is not anticipated that the possible visual impacts would differ significantly from the existing visual impacts created by the mining activities.
- Intrusion impacts (although limited) as a result of the increased traffic flows and movement of workers to and from the site;

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[14] Draft 2018/19 IDP/Budget for Fetakgomo Tubatse Local Municipality

- Increase in labour costs for other sectors (mainly the agricultural sector) if unskilled labour is drawn down from these sectors to work at the mine;
- Increase in nuisance factors (e.g. noise, dust/air pollution) especially with regards to the extension of the main parking area due to the proximity to the office complex;
- Possible impact on existing infrastructure and servitudes;
- Possible impact on traffic flow on R577 when access crossing between the existing plant and the North Mine will be constructed with subsequent intrusion impacts;
- Potential increase in crime as result of the influx of people. Safety and security issues associated with the movement of the personnel however can be dealt with by the existing measures put in place by DCM.

During the **operational phase** the following negative impacts could occur:

- Nuisance factors (e.g. increase in fallout dust and noise impacts)
- Negative visual impacts
- Potential negative impact on surface water pollution and groundwater pollution if leachate and seepage are not effectively contained. This could have negative downstream impacts on communities reliant on water from the river.

During the **decommissioning phase** the following negative impacts could occur:

- Reduced economic activities within the area with subsequent negative trickle down economic impacts;
- Negative impact on the revenue base of the local municipality;
- Loss of jobs and income of households due to closure
- Reduced or no benefits to the local communities experienced through the Mine's SLP

The proposed project could also have the potential positive impacts on the adjacent local area that needs to be investigated in more detail during the impact assessment phase. These include:

- Temporary job creation and increase in income of some households during the construction phase
- The project could provide short term income possibilities and the potential for capacity building and skills opportunities, especially for unskilled and semi-skilled local workers
- The project will enable the continuation of the existing operations which would ensure continued job creation and income for employees with associated benefits to the local municipality.

9. CHARACTERISTICS OF POTENTIAL SITES

9.1 Site B

Site B would be 24ha and the TSF is planned to be 37 m in height. Site B is located to the south of the road crossing of the R577 and the Richmond Road. The latter is used as access road to the Two Rivers Platinum Mine. Site B is thus located to the east of the TRP access road and west of the R577. It is approximately 1.3 km north of the existing DCM plant.

Site B is located within an area where various other mining infrastructure is situated. Mining activities of DCM and TRP are to the south, west, east and southwest of the proposed site location. Power lines traverses to the east of site B. These lines are between 120m and 150m from the R577 and alongside the R577. It is thus not anticipated that the electricity infrastructure would be affected by the proposed TSF and no services and infrastructure would have to be moved, but haulage would have be undertaken beneath the power lines.

Access from within the mining area and the R577 could easily be obtained. This is a public road and should the R577 be used it could create disturbances and safety risks. Limited additional road infrastructure would be required with resultant limited costs in this regard. The site is also in close proximity to the existing mining activities and limited distances would have to be covered to access the site during the construction and operational phases. It is considered that the movement of workers to and from the site, as well as the movement of equipment during the construction and operational phases would result in some negative impacts if the R577 is used.

No residential areas are in close proximity to the site. The nearest residential settlement is approximately 10 km away along the R577. The facility is in close proximity to the existing plant and office complex which could result in air quality impacts and noise intrusions.

Although the facility would be highly visible from both these roads, the proposed TSF will blend it with the existing overall sense of place, as the area is already disturbed by existing mining activities. The development of the TSF will thus not create a new impact on the sense of place.

DCM currently holds the mining rights for Portion 1 (Remaining Extent (RE)) and Portion 0 (RE) of the farm Dwarsrivier 372KT and surface rights for the said portions. The area where site B is proposed is currently not used for other purposes e.g. farming, and therefore one can conclude that no significant land-use sterilisation would occur.

The change in the land use due to the development of the proposed Khulu TSF on Site B fits the surrounding land-use in the area which include mining activities and mining infrastructure. Site access would also be easily available from the existing mining activities and the R577 or Richmond Road.

It is considered that the movement of workers to and from the site, as well as the movement of equipment during the construction and operational phases would result in limited negative impacts due to the site's proximity to the existing plant and available roads. Safety and security issues associated with the movement of the personnel can be dealt with by the existing measures put in place by DCM should the internal gravel road be used. Additional measures might be required if the R577 would be used.

The following figures provides a Google Earth view of Site B from the R577 (taken from the east) (Refer to figure 6) and from the Richmond access road to the TRP (taken from the west) (Refer to figure 7).

Figure 6: Google Earth view of Site B from the R577 (June 2021)

Figure 7: Google Earth view of Site B from the TRP access road (June 2021)

9.2 Site C

Site C is 21 Ha in extent and situated approximately 1.5 km to the south west of the R577 and office complex, and to the south of the processing plant. The facility proposed on Site C would be 49 m in height. Access to the site would be obtained via an existing gravel road from the R577 from the main administrative buildings of DCM.

The following photograph indicates the view of the northern section of the area of the proposed site. The photograph was taken from the eastern side of the site area.

Figure 8: Site C (December 2018)

The existing mining activities of DCM are situated to the north of the site. Mining activities (tailings facility) of Two Rivers Platinum Mine are situated to the west of the proposed site. Site C thus falls within an area that is currently used for mining activities, although the site itself seems to consist of relatively undisturbed natural vegetation.

No residential areas are in close proximity to Site C. The nearest residential settlement is approximately 10-12 km away along the R577. The facility is not in close proximity to the existing plant and office complex and limited air quality impacts and noise intrusions are anticipated on any receptors.

Visual impacts on neighbouring landowners/operators could be possible. As there is existing mining infrastructure and associated activities undertaken in the area, the proposed Tailings Facility at Site C would, however, not result in visual impacts that differ from the existing mining activities in the area.

There is an existing access road to the site, thereby providing adequate access and reducing the costs of required road construction and infrastructure. The road, however, might require upgrading. The site is also in relative close proximity to the existing mining activities and limited distances would have to be covered to access the site during the construction and operational phases.

It is considered that the movement of workers to and from the site, as well as the movement of equipment during the construction and operational phases would result in limited negative impacts. Safety and security issues can be dealt with, but additional measures might be required due to the distance from the existing plant.

There is an Eskom servitude within close distance to the proposed site and a TRP pipeline traverses the site.

9.3 Site D

Site D is 19 Ha in extent and situated approximately 1 km to the east of the R577. The facility proposed on Site D would be 29 m in height. Access to the site would be obtained via an existing gravel road from the R577 passing administrative buildings of DCM.

The following photograph indicates the view to the proposed site in a northerly direction. The photograph was taken from the access road.

Figure 9: Site D (December 2018)

Existing mining activities to the north are visible. The site appears to be covered by natural vegetation. A distribution line servitude runs to the south of the site.

Existing mining activities and infrastructure are also situated to the south of the access road and to the south of the site (existing tailings facility). The area to the east of the proposed site is the property of the De Grooteboom Mine. Site D thus falls within an area currently used for mining activities.

No residential areas are in close proximity to Site D. The nearest residential settlement is approximately 10 km away along the R577. The facility is not in close proximity to the existing plant and office complex (across the R577 road) and limited air quality impacts and noise intrusions are anticipated on any receptors.

No negative visual impacts on landowners are thus anticipated. It is, however, anticipated that the tailings facility, if constructed on Site D, could be highly visible to the users of road R577.

As there are existing mining infrastructure and associated activities undertaken in the area, the proposed Tailings Facility at Site D would not result in new visual impacts, but would rather add to the existing visual impacts.

The existing access road could be used to access the site and limited additional road infrastructure would be required. Limited costs in this regard are thus foreseen. The site is also in close proximity to the existing mining activities and limited distances would have to be covered to access the site during the construction and operational phases.

It is considered that the movement of workers to and from the site, as well as the movement of equipment during the construction and operational phases would result in limited negative impacts, although the main road R577 would have to be crossed if transportation is required from the existing processing plant situated to the south of the R577. This could pose some safety issues, but it is anticipated that it could be successfully mitigated. Safety and security issues associated with the movement of the personnel can be dealt with by the existing measures put in place by DCM. Additional safety measures might be required at the facility once operational.

9.4 Site F

Site F is 17 Ha in extent and situated to the south of Site C. Site F is approximately 5 km from the R577 and the existing processing plant of DCM. The facility proposed on Site F would be 50 m in height. Access to the site would be obtained via an existing gravel road from the R577.

The following photograph indicates the view of the proposed site facing in a northerly direction. The existing mining activities (De Grooteboom) to the north east can be seen in the distance. The photograph was taken from the existing access road leading to the site.

Figure 10: Site F (December 2018)

A servitude (distribution line) runs to the east of the site along sections of the access road.

No residential areas are in close proximity to Site F, although the mining activities of De Grooteboom are in relative close proximity (± 500 m) which could pose risks to the site. The Mototolo Mine is situated approximately 4.5 km to the south of the proposed site.

The nearest residential settlement is approximately 15 km away along the R577. No negative visual impacts on landowners are thus anticipated. The facility is not in close proximity to the existing plant and office complex and limited air quality impacts and noise intrusions are anticipated on any receptors.

As there are existing mining infrastructure and associated activities undertaken in the area, the proposed Tailings Facility at Site F would not result in new visual impacts, but would rather add to the existing visual impacts.

The existing access road could be used to access the site, but as this site is the furthest from the existing mining activities, it would require extensive pipelines. The road might also have to be upgraded. The river crossings could furthermore be problematic. Limited additional road infrastructure would be required, but the cost (e.g. construction of infrastructure and operations) is anticipated to be more compared to Sites B, C and D.

It is considered that the movement of workers to and from the site, as well as the movement of equipment during the construction and operational phases would result in limited negative impacts although this site is furthest from the existing operations. Safety and security issues associated with the movement of the personnel can be dealt with by the existing measures put in place by DCM.

10. SITE SELECTION

The following table provides a summary of the criteria considered within the site selection process from a socio-economic perspective.

Table 5: Criteria for site selection

CRITERIA	SITE B	SITE C	SITE D	SITE F
Mining related land-uses or similar land-uses in the area	Yes	Yes	Yes	Yes
Presence of existing mining infrastructure in close proximity	Yes	Yes	Yes	Yes
Residential proximity	No	No	No	No
Possible negative visual impact on residents/land users/land owners that is different from existing visual impacts in area	No	No	No	No
Visual impacts for road users	Yes	No	Yes	No
Location suitability that could negatively affect the cost of the development	No	No	No	Yes
Distance from existing facilities and infrastructure (nearest: 1 and furthest: 4)	1	3	2 (R577 would have to be crossed)	4
Existing access roads	Yes	Yes	Yes	Yes
Status of access roads	Road upgrading could be required or R577 public	Road upgrading could be required	Road upgrading could be required	River crossing would be

CRITERIA	SITE B	SITE C	SITE D	SITE F
	road would be used with subsequent disturbances and safety risks			required. Road might have to be upgraded
Presence of existing servitude in close proximity to the site	Yes Electricity servitude will not be affected, but haulages would be undertaken underneath lines	Yes Eskom servitude, but TRP pipeline traverses site	Yes	Yes
Negative impacts associated with the movement of workers to and from the site which cannot be mitigated	No Crossing and use of R577 public road	No	Yes Crossing of R577 public road to access site from existing mining activities	No
Safety and Security Issues that cannot be mitigated	No	No	No	No

11. CONCLUDING REMARKS

Based on the assessment of the various proposed sites, the following concluding remarks should be noted:

- The location of existing mining infrastructure (whether from DCM or other mines) in close proximity to the sites was considered. The land-use for the sites thus seems compatible with mining development. With regards to the land-use and the presence of existing infrastructure to ensure a "goodness of fit", all sites ranked equally.
- The development of Site F could be limited due to the proximity of the other mining activities undertaken by other mines in the area such as De Grooteboom Mining.
- Sites B, C and F seem to have more pristine vegetation than Site D. The latter also have some existing mining activities just to the north of the site with associated disturbances to the natural vegetation. From a socio-economic perspective Site D is thus less pristine than Sites B, C and F;
- All the sites have gravel access roads which would assist in reducing the costs of required road construction and infrastructure, although road upgrading might be required for all the different sites;
- Sites C and F would have less visual impacts due to the distance of these sites to the public road and office complex. Sites B and D would be visible for road users of the R577. Site B would also be visible to road users that access the Two Rivers Platinum Mine complex. Considering the overall sense of place with the existing mining infrastructure, the negative impacts in this regard are deemed low.
- There are no residential developments in close proximity to any of the sites. In this regard all sites ranked equally.
- Sites B, C and D is in closer proximity to existing infrastructure and from a costing perspective could thus be more economically effective to develop compared to Site F. Movement of equipment and workers would have to be done across shorter distances with resultant less negative impacts in this regard;
- It is considered that the movement of workers to and from the sites, as well as the movement of equipment during the construction and operational phases would result in limited negative impacts. Safety and security issues associated with the movement of the personnel can be dealt with by the existing measures put in place by DCM.
- Additional safety and security measures could be required to be implemented at the sites during the operational phase.
- It is concluded that Sites B, C and Site D can be developed from a socio-economic perspective. Environmental considerations and costing associated with the sites would determine which site would be most preferred.

- Site F can be developed, but due to the ranking of the other sites, Site F is not recommended due to the limitations from other mining activities and distance to existing facilities and infrastructure.

Based on the initial desktop assessment of the socio-economic environment, the following concluding remarks should be noted:

- The proposed expansion of the Khulu TSF will not introduce new social risks and hazards but could increase the probability and scale of those already associated with the existing mining activities.
- Possible negative impacts on the socio-economic environment were identified and would be verified and further assessed during the detailed EIA Phase of the project.
- The positive impacts for the residents and/or businesses within the area mainly refer to short term employment creation and local economic spin-offs.

12. DETAILED STUDIES TO BE UNDERTAKEN DURING EIA

12.1 Further Literature Review

Relevant additional literature would be reviewed and incorporated into the report. The review would thus assist the consultants to obtain further demographic and socio-economic information about the receiving environment and to build on the initial profiling of the local population's socio-economic characteristics.

12.2 Consultation Sessions and Fieldwork

During the EIA phase, more primary data would also be gathered through consultation with the stakeholders and affected parties, and linkages with the public participation process.

12.3 Variables to be assessed

The following variables are typically assessed[15] as part of the SEIA:

- Population impacts
- Community/institutional arrangements
- Socio-economic changes
- Conflicts between local residents and newcomers
- Individual and Family level impacts
- Community infrastructure needs

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[15] Burdge, R.J. A community guide to Social Impact Assessment

- Intrusion impacts

For the purpose of assessing the impacts associated with the proposed project, the above variables will be adapted to allow for the assessment undertaken during the EIA phase. These variables would relate to the construction, operational and decommissioning phases of the proposed project.

During the EIA phase the anticipated impacts will be further assessed to determine which impacts would have a significant impact on the socio-economic environment.

12.4 Analysis of data compiled from parallel studies

If available, the SEIA team will study and analyse the information gathered by the biophysical studies. This information would include technical, environmental, economic and demographic aspects, land-use changes, impact on other facilities, services, and so forth. The SEIA will be done in parallel with the public participation process. This would help the social team to assess the impact of the proposed development on the direct (surrounding communities) and indirect (regional) environment.

12.5 Significance Criteria

As part of the SEIA Process, the anticipated socio-economic impacts would be rated according to a rating approach used and specified by the lead consultant. The impact assessment methodology makes provision for the assessment of impacts against the following criteria:

- Significance;
- Spatial scale;
- Temporal scale (duration);
- Probability; and
- Degree of certainty.

12.6 Reporting

The SEIA Report generally includes the following:

- A background description of the socio-economic environment including demographic and socio-economic characteristics, land-use profile and infrastructure requirements.
- A background description of the local economy.
- Linkages with the integrated development planning processes in the area.
- An assessment of the anticipated social and economic impacts – negative and positive (including core aspects needing attention).
- Rating of impacts.
- Formulation of specific mitigating strategies to minimise negative impacts and increase positive impacts of the proposed development.
- Conclusions and recommendations (also for further studies, if necessary).

- Social Management Plan

13. SOURCES CONSULTED

13.1 Documents

Becker, H.A. (1997). Social Impact Assessment: Method and experience in Europe, North America and the developing world. UCL Press: London

Becker, H.A. & Vanclay, F. (eds) (2003). The International Handbook of Social Impact Assessment: Conceptual and Methodological Advances. Edward Elgar: Cheltenham

Burdge, R.J. (1995). A community guide to Social Impact Assessment. Social Ecology Press: Middleton

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www.demarcation.org.za

www.fgtm.gov.za

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www.wazimap.co.za

14. EXPERIENCE RECORD OF THE CONSULTANT

Ms. Ingrid Snyman holds a BA Honours degree in Anthropology. She has more than twenty years' experience in the social field. Ms. Snyman has been involved in various Social Impact Assessments during her career as social scientist. These project themes consist of infrastructure development, waste management, road development, water and sanitation programmes, township and other residential type developments. She has also been involved in the design and management of numerous public participation programmes and communication strategies, particularly on complex development projects that require various levels and approaches.

CURRICULUM VITAE: INGRID SNYMAN

Name:	**Ingrid Helene Snyman**		
Profession:	Social Development Consultant	**Name of firm:**	Batho Earth
Years of Experience:	20 + years		

KEY QUALIFICATIONS

- Social Impact Assessment (SIA)
- Public Participation programmes
- Communication, development of community structures and community facilitation
- Community-based training and
- Workshop reports

EDUCATION

1992:	B A (Political Science) University of Pretoria
1995:	B A (Hons) Anthropology University of Pretoria
1996 - 1997:	Train the Trainers Centre for Development Administration – UNISA

EXPERIENCE RECORD

2000 to date	Independent Development Consultant: Batho Earth
1996 to 2000	Social Consultant: Afrosearch (Pty) Ltd.

PROJECT EXPERIENCE

Mining Industry

- SIA for the proposed Beeshoek Optimisation Project, near Postmasburg, Northern Cape (ongoing)
- SIA for proposed Gloucester development, near Postmasburg, Northern Cape (ongoing)
- SEIA for the Blesboklaagte Colliery Section 102, Mpumalanga
- SEIA for the proposed Kareerand Tailings Storage Facility (TSF) Expansion Project, Near Stilfontein, North West Province
- SEIA for the proposed Khumani Mine, Mokaning Expansion, Kathu, Northern Cape Province (ongoing)
- SEIA and PPP for the proposed Theta Hill Gold Mining Project near Pilgrim's Rest, Mpumalanga
- SIA for the proposed Khulu TSF at Dwarsrivier Mine, near Steelpoort, Limpopo Province (ongoing)
- Social Risk Assessment for Dwarsrivier Chrome Mine, near Steelpoort, Limpopo Province
- SIA for the proposed Vandyksdrift Central (VDDC) Mining: Infrastructure Development, Mpumalanga
- PPP for the development of various additional listed activities at the Dwarsrivier Chrome Mine, near Steelpoort, Limpopo Province
- SIA for the proposed Project 10161 and Project 10167 (Gold Mining) by Stonewall (Pty) Ltd., near Sabie and Pilgrims Rest, Mpumalanga
- SIA for the Manganese Mine North West of Hotazel, Northern Cape (Mukulu Environmental Authorisation Project)
- SIA for the proposed South32 SA Coal Holdings Middelburg Colliery Environmental Management Plan (EMP) and Water Use Licence (WUL) Application Project (Life of Asset Open Cast Expansion and Dispatch Rider Project), Middelburg, Mpumalanga
- SIA for the proposed Manganese Mine on the Remaining Extent of the Farm Paling 434, Northern Cape Province: Revision And Amendment Of Existing Approved Environmental Management Programme (EMP) For A Mining Right
- SIA and Public Participation for the proposed Western Bushveld Joint Venture Project (Maseve Platinum Mine), North West Province
- Public Participation for Sable Platinum for the proposed prospecting application on the farm Doornpoort, Pretoria, Gauteng
- Public Participation for the prospecting application on the farms Frischgewaagd and Kleinfontein,

Mpumalanga Province for PTM

- SIA to determine the impact of the Tharisa Mine on the neighbouring properties and property owners, Buffelspoort area, near Marikana, North West Province
- Public Participation for the prospecting application on the farm Klipfontein, Gauteng for PTM
- SIA as part of the Basic Assessment for the extension of the Komati coal stockyard, Mpumalanga
- SIA for the proposed Dorstfontein Mine Western Expansion Project, Kriel, Mpumalanga
- SIA for the proposed Grootboom Platinum Mine, Steelpoort, Limpopo Province
- SIA for the proposed Dorstfontein Mine Expansion Project, Kriel, Mpumalanga

Mixed Use Land/Housing Developments

- SEIA for the Gauteng Rapid Land Release Programme: Four Sites: Hekpoort / Bryanston / Lenasia / Rietfontein (Ennerdale), Gauteng
- SIA for the proposed Wildealskloof Mixed Use Development near Bloemfontein, Free State (ongoing)
- SIA for the proposed Mixed Land Use Township Establishment on the Remainder of Portion 406 of the Farm Pretoria Town and Townlands 351 JR, and investigation with regards to the possible resettlement of households, Salvokop, Tshwane CBD
- SIA for the proposed Mixed Land Use Development situated on the Remainder of Allandale 10 IR, known as Rabie Ridge Ext 7, Midrand, Gauteng
- SIA as part of the Basic Assessment for the proposed development of Project One (1) of the Vosloorus Extension 9 High Density Housing Project, Ekurhuleni Metropolitan Municipality
- SIA for the proposed Mapochsgronde Residential Development, Roossenekal, Limpop Province
- SIA for the proposed Cullinan Estate Development, Cullinan, Gauteng
- SIA for the proposed Vlakfontein Residential Development and investigation with regards to the possible resettlement of individual households, Brakpan, Gauteng
- SIA for the proposed township development/eco-estate on the farm Grants Valley, Eastern Cape

Bulk Infrastructure and Supply

- SIA for the proposed Integrated Public Transport Network for the Mangaung Metropolitan Municipality (ongoing)
- SEIA for proposed Olifantsfontein Landfill, Gauteng (ongoing)
- SEIA for the proposed K43 Road Construction near Lenasia, Gauteng
- SIA for the proposed Mangaung Bus Depot for the Integrated Public Transport Network (IPTN) in Bloemfontein, Free State
- SEIA for the proposed Greenwich Landfill Site, Newcastle, KwaZulu Natal
- SIA for the proposed Mangaung Gariep Water Augmentation Project, Free State
- SIA for the proposed development of the new Tshwane Regional General Waste Disposal Facility (Multisand Landfill), Pretoria, Gauteng Province
- SIA as part of the Basic Assessment for the proposed K97 Road northbound of the N4 at Bon Accord and investigation with regards to the possible resettlement of business premises, Pretoria, Gauteng
- SIA for the proposed extension of the Wemmershoek Wastewater Treatment Works (WWTW), decommissioning of the Franschhoek WWTW and construction of a transfer and outfall sewer between the two works, Franschhoek, Western Cape
- SIA for the proposed Lefaragathle, Mogono, Rasimone, Chaneng outfall sewer and Chaneng sewer treatment plant, Rustenburg (Phokeng), North West Province
- SIA for the proposed upgrading of railway stations and railway line for Metrorail in Mamelodi, Gauteng
- SIA for the proposed ACSA Remote Aprons Project, O.R. Tambo International Airport, Gauteng
- Public Participation and SIA as part of the Environmental Scoping Study for the proposed upgrading of the Waterval Water Care Works

Ecosystem Services Review

Proposed Ngonye Falls Hydro-Electric Power Plant Project, Western Province, Zambia: Biodiversity Assessment: Stakeholder Engagement Plan and Social Assessment for the Ecosystem Services Review (ESR)

Projects related to electricity generation, transmission and distribution

- SIA for the proposed Crowthorne-Lulamisa power line, Midrand, Gauteng
- SIA as part of the Basic Assessment for the proposed Crowthorne Underground Cable, Gauteng
- SIA as part of the Basic Assessment for the proposed Diepsloot East Servitude and substation, Gauteng
- SIA for the proposed Mitchells Plain-Firgrove-Stikland Transmission Line project and investigation with regards to the possible resettlement of individuals within Mitchells Plain, Western Cape
- SIA for the proposed 400 kV Transmission Power Line for approximately 10km to the west of the existing Marathon Substation and possible resettlement of homesteads, Nelspruit area, Mpumalanga
- SIA as part of the Basic Assessment for the proposed construction of a 400 kV transmission line between the Ferrum substation (Kathu) and the Garona substation (Groblershoop), Northern Cape Province
- SIA as part of the Basic Assessment for the proposed construction of the Eskom Rhombus-Lethabong 88kv Powerline and Substation, North West Province
- SIA for the proposed Aberdeen-Droerivier 400 kV Transmission Power Line, Eastern and Western Cape Province
- SIA for the proposed Houhoek Substation Upgrade and Bacchus-Palmiet Loop-In and Loop-Out, near Botrivier, Western Cape Province
- SIA for the proposed Arnot-Gumeni 400 kV Transmission Power Line, Mpumalanga
- SIA for the proposed Aggeneis-Oranjemond Transmission Line project, Northern Cape Province
- SIA for the proposed Ariadne-Venus Transmission Line, KwaZulu Natal
- SIA for the proposed Dominion Reefs Power Line project, North West Province
- SIA for the proposed Kyalami Strengthening Project, Kyalami, Gauteng
- SIA for the proposed Apollo Lepini 400 kV Transmission Line Project, Tembisa, Gauteng
- Public Participation for the proposed new Medupi (then referred to as Matimba B) coal-fired power station in the Lephalale area, Limpopo Province
- Public Participation and SIA for the proposed Poseidon-Grassridge No. 3 400 kV Transmission line and the extension of the Grassridge Substation, Eastern Cape Province
- Public Participation and SIA for the proposed construction of power lines between the Grassridge Substation (near Port Elizabeth) and the Coega Industrial Development Zone, Eastern Cape Province
- Public Participation and SIA for the Matimba-Witkop No. 2 400 kV Transmission line in the Limpopo Province

Photovoltaic and Wind Energy Facilities

- SIA for the proposed Christiana PV facility on the farm Hartebeestpan, North West Province
- SIA for the proposed Hertzogville PV facility on the farms Albert and Wigt, Free State Province
- SIA for the proposed Morgenzon PV facility on the farm Morgenzon, Northern Cape Province
- SIA as part of the Basic Assessment Process for the Exxaro Photovoltaic Facility, Lephalale, Limpopo Province
- SIA for the Upington Solar Energy Facility, Northern Cape Province
- SIA for the Kleinbegin Solar Energy Facility, Northern Cape Province
- SIA for the proposed Ilanga solar thermal power plant facility on a site near Upington, Northern Cape Province
- SIA and public participation for the proposed Karoo Renewable Energy Facility, Northern Cape
- SIA for the Wag'nbiekiespan Solar Energy Facility, Northern Cape Province
- SIA for the proposed Kathu and Sishen Solar Energy Facilities, Northern Cape Province
- Public Participation and SIA for the proposed Thupela Waterberg Photovoltaic Plant, Limpopo Province
- SIA for the proposed Kannikwa Vlakte Wind Farm Project, Northern Cape

Public Participation

- Beeshoek Optimisation Project, Northern Cape Province
- Mixed Land Use Development Referred to as Mogale Ext 42, 43 And 44, Muldersdrift, Mogale, Gauteng Province
- Proposed Khumani Mokaneng Extension, Northern Cape Province
- Proposed Theta Project, Mpumalanga
- Dwarsrivier Chrome Mine (Pty) Ltd.: Environmental Authorisation Application for various Listed Activities at the Dwarsrivier Chrome Mine, Near Steelpoort, Limpopo Province (ongoing)

- Proposed Project 10161 and Project 10167 (Gold Mining) by Stonewall (Pty) Ltd., near Sabie and Pilgrims Rest, Mpumalanga
- Piggery near Modimolle, Limpopo Province
- Truck Stop Development, Buffelspoort, North West Province
- Upgrading of the Menlyn Road Network and the investigation, as well as negotiations with regards to the resettlement of households, Pretoria, Gauteng
- Platinum Highway Project from the N1 (Gauteng) to the Botswana Border (North West Province), including investigations with regards to the possible resettlement of individual households
- Brewery and associated industrial activities for Heineken Supply Co (Pty) Ltd, Kempton Park, Gauteng.

15. DECLARATION OF INDEPENDENCE

In terms of the National Environmental Management Act (Act No. 107 of 1998) (NEMA), as amended in respect of the EIA Regulations of December 2014, and GNR 982 published on 4 December 2014, an independent consultant must be appointed to act on behalf of the client. In this regard Batho Earth submit that they have:

- The necessary required expertise to conduct a Social Impact Assessment, including the required knowledge and understanding of any guidelines or policies that are relevant to the proposed process;
- Undertaken all the work and associated studies in an objective and independent manner, even if the findings of these studies are not favourable to the project proponent;
- No vested financial interest in the proposed project or the outcome thereof, apart from remuneration for the work undertaken under the auspices of the above-mentioned regulations;
- No vested interest, including any conflicts of interest, in either the proposed project or the studies conducted in respect of the proposed project, other than complying with the required regulations; and
- Disclosed any material factors that may have the potential to influence the competent authority's decision and/or objectivity in terms of any reports, plans or documents related to the proposed project as required by the regulations