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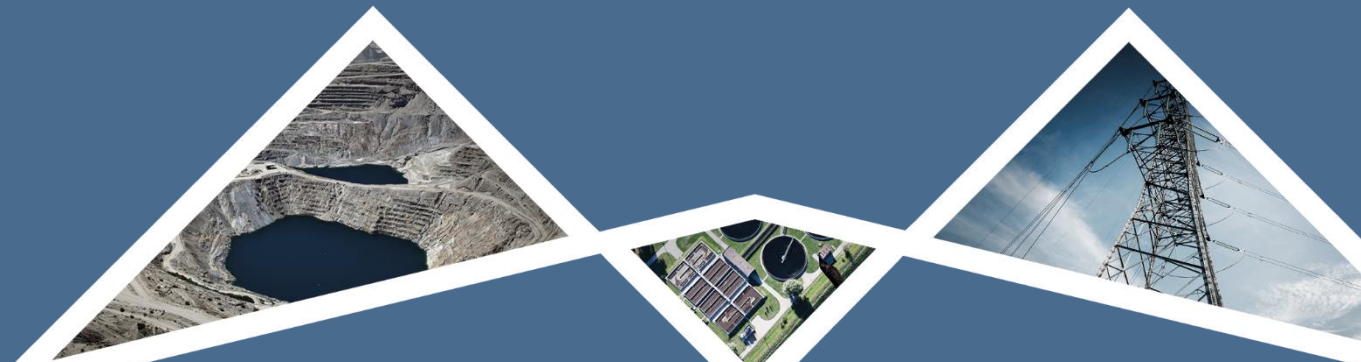
SCOPING REPORT

PROPOSED HARMONY NOOITGEDACHT TAILINGS STORAGE FACILITY PROJECT AND ASSOCIATED INFRASTRUCTURE

FS/30/5/1/2/2/85MR



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REVISION AND AMENDMENTS

REVISION DATE:	REV #	DESCRIPTION
2025/12/10	ORIGINAL DOCUMENT	Scoping Report for public review

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ACRONYMS AND ABBREVIATIONS

AIP	:	Alien Invasive Plant
ALARA	:	As Low As Reasonably Achievable
AQSR	:	Air Quality Sensitive Receptors
ASTM	:	American Standard Testing Methodology
CA	:	Competent Authority
CARA	:	Conservation of Agricultural Resources Act, 1983
CBA	:	Critical Biodiversity Area
CITES	:	Convention on International Trade in Endangered Species
CLO	:	Community Liaison Officer
CMA	:	Catchment Management Agency
CMS	:	Catchment Management Strategy
DESTEA	:	Department of Economic, Small Business Development, Tourism & Environment
DFFE	:	Department of Forestry, Fisheries and the Environment (previously DEA)
DMRE	:	Department of Mineral Resources and Energy (now DMPR)
DMPR	:	Department of Mineral and Petroleum Resources
DMP	:	Dust Management Plan
DSM	:	Digital Surface Model
DTM	:	Digital Terrain Model
DWS	:	Department of Water and Sanitation
EA	:	Environmental Authorisation
EBRD	:	European Bank for Reconstruction and Development
EC	:	Electrical Conductivity
ECA	:	Environmental Conservation Act
EAP	:	Environmental Assessment Practitioner
EIA	:	Environmental Impact Assessment
EIMS	:	Environmental Impact Management Services (Pty) Ltd
EN	:	Endangered
EMPr	:	Environmental Management Programme
ERP	:	Emergency Response Plan
ESA	:	Ecological Support Area
EWT	:	Endangered Wildlife Trust
FGDS	:	Free State Provincial Growth and Development Strategy
FSN	:	Free State North
FPA	:	Fire Protection Agency
GA	:	General Authorisation

Ga	:	Gigaannum
GHG	:	Greenhouse Gas
GIS	:	Geographic Information System
GISTM	:	Global Industry Standard for Tailings Management
GN	:	Government Notice
GQM	:	Groundwater Quality Management
GPR	:	Ground Penetrating Radar
HDPE	:	High Density Polyethylene
HIA	:	Heritage Impact Assessment
I&AP	:	Interested and Affected Party
IDP	:	Integrated Development Plan
IEM	:	Integrated Environmental Management
IFC	:	International Finance Corporation
IUCN	:	International Union for Conservation of Nature
IWULA	:	Integrated Water Use License Application
LC	:	Leachable Concentration
LED	:	Local Economic Development
LM	:	Local Municipality
LOM	:	Life of Mine
MAE	:	Mean Annual Evaporation
MAP	:	Mean Annual Precipitation
mbc	:	Meters Below Casing
MAR	:	Mean Annual Runoff
MHI	:	Major Hazard Installation
ML	:	Megalitre
MPRDA	:	Minerals and Petroleum Resources Development Act, 2002
MR	:	Mining Right
NAAQS	:	National Ambient Air Quality Standards
NB	:	Nominal Bore
NCR	:	Noise Control Regulations
NAEIS	:	National Atmospheric Emissions Inventory System
NDP	:	National Development Plan
NEM:AQA		National Environmental Management: Air Quality Act, 2004
NEM:WA	:	National Environmental Management: Waste Amendment Act, 2008
NEMA	:	National Environmental Management Act, 2002
NEMA	:	National Environmental Management Act, 1998

NEMBA	:	National Environmental Management: Biodiversity Act, 2004
NFEPA	:	National Freshwater Priority Areas
NGDB	:	National Groundwater Database
NGO	:	Non-Governmental Organization
NHRA	:	National Heritage Resources Act, 1999
NORM	:	Naturally Occurring Radioactive Material
NRWMP	:	National Radioactive Waste Management Policy
NT	:	Near Threatened
NWA	:	National Water Act, 1998
ONAs	:	Other Natural Areas
PAH	:	Polycyclic Aromatic Hydrocarbons
PHRA	:	Provincial Heritage Resources Authority
PIA	:	Palaeontological Impact Assessment
PMF	:	Probable Maximum Flood
POI	:	Point of Interest
PPP	:	Public Participation Process
PSDF	:	Provincial Spatial Development Framework
Ptn	:	(Farm) Portion
RE	:	Remaining Extent
REC	:	Recommended Ecological Category
RMO	:	Recommended Management Objective
RWD	:	Return Water Dam
SMAQMD	:	Sacramento Metropolitan Air Quality Management District
SA	:	South African
SAHRA	:	South African Heritage Resources Agency
SAMPI	:	South African Multidimensional Poverty Index
SANS	:	South African National Standards
SCC	:	Species of Conservation Concern
SDF	:	Spatial Development Framework
SIA	:	Social Impact Assessment
SLP	:	Social & Labour Plan
SO_4	:	Sulphate
SPC	:	Spatial Planning Category
SPLUMA	:	Spatial Planning and Land Use Management Act
SWMP	:	Stormwater Management Plan
TARP	:	Trigger Action Response Plan

TC	:	Total concentration
TDS	:	Total Dissolved Solids
TIA	:	Traffic Impact Assessment
TOPS	:	Threatened or Protected Species
TSF	:	Tailings Storage Facility
TSP	:	Total Suspended Particulates
VAC	:	Visual Absorption Capacity
VIA	:	Visual Impact Assessment
WMA	:	Water Management Area
WML	:	Waste Management License
WRD	:	Waste Rock Dump
WULA	:	Water Use License Application
WUL	:	Water Use License

EXECUTIVE SUMMARY

Harmony Gold Mining Company Limited (hereafter referred to as Harmony / "the applicant") has appointed Environmental Impact Management Services (Pty) Ltd (EIMS) as the Environmental Assessment Practitioner (EAP) to undertake the necessary environmental authorisation and associated consultation processes for a proposed new **Tailings Storage Facility** (TSF) Project **and associated infrastructure** near Welkom in the Matjhabeng Local Municipality in the Free State province.

An application for the Nooitgedacht TSF project was originally submitted to then Department of Mineral Resources and Energy (DMRE, now DMPR – Department of Minera and Petroleum Resources) in 2023 and subsequently an initial scoping report was made available for stakeholder review. However, since then, the project was delayed due to several reasons and additional infrastructure need to be included as part of a new application. The previous application was withdrawn and a new application is now being resubmitted for the project.

The applicant owns and operates a number of gold mines and plants in the Welkom region in the Free State and currently deposits tailings onto the Free State South 2 Tailings Storage Facility (TSF), St. Helena 4 TSF, St. Helena 123 TSF, Dam 23 TSF, Brand D TSF and Target 1&2 TSF. The current planned Life of Mine (LOM) of the Free State operations exceed the available deposition capacity of these TSFs and the applicant is therefore proposing to construct the proposed Nooitgedacht TSF to cater for this additional capacity. Nooitedact will cater for both the LoM as well as the reclamation of 23 additional TSFs over an approximate LoM of up 2050 (commissioning of the last reclamation station). This Free State Reclamation project will be for the reclamation of up to 3 older TSFs at any one time. This will allow for the continuation of jobs and investment into the Welkom area. Further thereto, the reclamation will result in the removal and cleaning of old historic tailings facility and placing it on one consolidated facility which is well managed and is lined in accordance too the new waste legislation and regulations , thereby removing potential sources of pollution from these old areas and allowing Harmony to rehabilitate the old footprints and open them to other land uses.

The TSF will cover an area of approximately 895 ha as shown in Figure 1. The proposed TSF will be located on Farm portions Mijannie 66 Ptn 0/RE, Goedgedacht 53 Ptn 0, Nooitgedacht 50 Ptn 0, Jacobsdal 37 Ptn 0 and Rheedersdam 31 Ptn 0.

Four new pipelines are required to be constructed:

- Two 10km long slurry lines from Harmony One Plant to the St Helena Booster Pump Station;
- One 16k long slurry line from Brand A TSF to the St Helena Booster Pump Station; and
- One 17km slurry line from the St Helena Booster Pump Station to FSN 1 TSF.

The pipelines will be flanged steel pipelines installed above-ground on pre-cast concrete plinths and a 3.5m wide access road, adjacent to the pipelines, will be cleared/graded to provide access for construction, maintenance and inspections.

The proposed pipelines traverse the following farm portions: Vlakplaats 125 Ptn 3, 4 and 5; Mijannie RE/66 Ptn 0; Toronto RE/115 Ptn 7 and 0; Rietpan 17 Ptn 0; Rietkuil 28 Ptn 0; Rheeders Dam 31 Ptn 0; Farm 41 Ptn 20; Ouders Gift 48 Ptn 0; Nooitgedacht 50 Ptn 0; Goedgedacht 53 Ptn 0; Theronia 71 Ptn 1 and 7; Jacobsrust 118 Ptn 0; St Helena 42 Ptn 2 and 3, Farm 80 Ptn 0, Stuirmanship 92 Ptn 1, 7 and 0, Saaiplaas 690 Ptn 1, 11, 15 and 0; Klippan 14 Ptn 1, 2 and 15, Marmageli 20 Ptn 0 and 157 Ptn 0.

In addition, a new **40 Megalitre (ML) low pressure water storage facility** is required to be constructed at farm Klippan 14 Ptn 2 which will cover an area of up to 2 ha. Return water will be fed to this facility where the water will then be taken to the plants and the active reclamation sites.

EIMS will compile and submit the required documentation in support of applications for:

- Environmental Authorisation (EA) and Waste Management License (WML) in accordance with the National Environmental Management Act – NEMA (Act 107 of 1998)- Listed activity: Listing Notice 2,

Activity 15 and various Listing Notice 1 and 3 activities as well as the National Environmental Management: Waste Act – NEMWA (Act 59 of 2008)- Activity B7, B10 and B11; and

- Water Use License (WUL) in accordance with the National Water Act – NWA (Act 36 of 1998). Water uses: Section 21 (c), Section 21 (i) and Section 21 (g). A separate application for a Water Use License (WUL) has been lodged with the Department of Water and Sanitation (DWS) for the water use triggers.

PURPOSE OF THE SCOPING REPORT

The purpose of the scoping process is to:

- Identify the policies and legislation that are relevant to the activity;
- To motivate the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the preferred location;
- To identify and confirm the preferred activity and technology alternative through an impact and risk assessment and ranking;
- Where appropriate, to identify and confirm the preferred site, through a detailed site selection process, which includes an impact and risk assessment process including cumulative impacts and a ranking process of all the identified alternatives focusing on the geographical, physical, biological, social, economic, and cultural aspects of the environment;
- To identify the key issues to be addressed in the assessment phase;
- To agree on the level of assessment to be undertaken, including the methodology to be applied, the expertise required, as well as the extent of further consultation to be undertaken to determine the impacts and risks the activity will impose on the preferred site through the life of the activity, including the nature, significance, consequence, extent, duration and probability of the impacts to inform the location of the development footprint within the preferred site; and
- To identify suitable measures to avoid, manage, or mitigate identified impacts and to determine the extent of the residual risks that need to be managed and monitored.

PUBLIC PARTICIPATION PROCESS

The Public Participation Process (PPP) for the proposed project has been undertaken in accordance with the requirements of the National Environmental Management Act (NEMA) in line with the principles of Integrated Environmental Management (IEM). The PPP commenced on 21 June 2024 with an initial notification and call to register as interested and affected parties (I&APs). The comments received from I&APs during the initial call to register and commenting period so far have been captured in Public Participation Report in Appendix C.

Comments received during this Scoping Report review period will also be collated and added to the Public participation report submitted to the Competent Authority (CA) with the Final Scoping Report. Should the CA accept the Scoping Report, an EIA Report including an EMPr, will be compiled and presented for public comment as part of this EIA process during which time further stakeholder engagement will take place.

This Scoping Report is being made available for public review and comment for a period of 30 days.

All comments and responses from the previous rounds of public participation conducted as part of the previously withdrawn applications for the Nooitgedacht TSF project are still included as part of the current comments and responses as these are still deemed to be applicable to the current application.

PROJECT ALTERNATIVES AND ENVIRONMENTAL IMPACT ASSESSMENT

Each of the identified risks and impacts at the various project phases were assessed. The assessment criteria include the nature, extent, duration, magnitude / intensity, reversibility, probability, public response, cumulative impact, and irreplaceable loss of resources.

The negative impacts, in particular, will be further interrogated and assessed during the EIA phase of the project. Potential preliminary mitigation measures have been identified and will be refined based on input from the Environmental Assessment Practitioner (EAP), public consultation, and specialist assessments during the EIA phase of the project. The associated EMPr will identify appropriate mitigation mechanisms for avoidance, minimisation and / or management of the negative impacts and enhancement of the positive aspects.

The assessment of location alternatives is limited due to the available open space in close proximity to the mining activities (and especially the gold processing plant). Several alternative sites were identified and assessed as part of a 2008 study completed by Golder Environmental. As part of the 2008 Golder Study various specialist input was obtained from ecological, surface water and groundwater specialists. During a Steering Committee meeting involving various stakeholders including DWS that was convened on 25 October 2007 the site selection findings were discussed and an optimal site selected. Nooitgedacht was agreed upon as the preferred site for the TSF (as agreed by the Steering Committee). The reasons for this is that the proposed footprint is largely brownfields with a partial greenfield take. The resultant negative impacts on agriculture and ecosystems are considered to be negligible but outweighed by the positive attributes of the site.

A biodiversity specialist was appointed to systematically evaluate the potential terrestrial biodiversity impacts associated with the proposed Nooitgedacht Tailings Storage Facility and to guide the application of the mitigation hierarchy in line with current legislation and best-practice guidelines. The specialist found that the Nooitgedacht TSF site selection demonstrated application of the mitigation hierarchy, with clear evidence of avoidance, minimization, and rehabilitation measures being prioritized and integrated into project planning. The remaining residual impacts will require careful management, ongoing monitoring, and, where necessary, the implementation of scientifically robust offset strategies. Continued engagement with regulatory authorities, local stakeholders, and conservation experts will be essential to ensure that the project achieves a balance between development needs and the long-term conservation of the region's unique biodiversity and ecosystem services. Based on this assessment and the alternative analysis conducted, the Nooitgedacht site is still considered the only favourable location for the TSF.

Currently cyclone deposition is the vastly preferred method of deposition for the majority of Harmony's current TSF operations due to the reasons described above. The environmental impacts associated with each deposition method are similar however cyclone deposition has higher water recovery rates and is also preferred from a geotechnical perspective. The Nooitgedacht TSF is designed to have a mix of Spiggot and Cyclone deposition. As such no other deposition methods or technologies will be considered in the EIA phase and cyclone deposition along with Spiggot deposition is nominated as the preferred alternative.

A trade-off study was conducted considering three options for the 40 megalitre Low Pressure (LP) water storage system (two HDPE lined earth dams, two concrete tanks or twelve Steel tanks.). The final preferred option will be provided in the EIA study.

The most significant risks and impacts identified at Scoping were those that remain high or moderately high in terms of significance even post mitigation measures being considered. The following preliminary identified impacts were determined to have a potentially **moderate - high** final significance at this stage:

- Mortality / disturbance of wildlife, specifically identified Species of Conservation Concern (SCC) ; during construction and operation;
- Fragmentation of ecosystems during construction;
- Reduction in air quality during operation;
- Decrease in runoff during construction, operation and decommissioning;
- Pollutants entering the surface water environment during operation;
- Groundwater quality impacts during operation and decommissioning / closure phases;
- Siltation of water resources during operation;

- Disturbance and degradation of wetlands during construction;
- Potential leaks and discharges leading to pollution of surrounding environment during operation;
- Visual impacts on sense of place during operation;
- Loss of land capability during construction;
- Impact on livelihoods during operation;
- Increase in social pathologies during construction;
- Impact on community expectations and social license to operate during construction and operation;
- Impacts on health and wellbeing;
- Reclamation and rehabilitation of Harmony's existing Freestate TSFs (positive impact); and
- Continued employment and economic impacts during construction and operation (positive impact).

Identified areas of **very high** sensitivity are due to the identified SCC (Species 15) within the TSF footprint as well as a heritage grave site located in the southeast of the TSF site. A relocation plan is being drafted for the SCC species. If relocation is completed these sensitivities will no longer be applicable and will fall away. Given the irreplaceable value and vulnerability of the SCC population at Nooitgedacht, it is essential that a comprehensive Biodiversity Action Plan (BAP) be developed. This plan must include a robust, scientifically justified translocation protocol – designed and implemented in line with best practice, regulatory requirements, and multi-disciplinary stakeholder input – to ensure the long-term viability and conservation of this threatened species.

With respect to the grave site , the TSF has been redesigned to avoid this sensitive area. These areas and sensitivities will be further refined in the EIA phase once further detailed assessments are completed, specifically sensitivities at the location for the new low pressure water system which are still to be defined. Other medium-high sensitivity areas include various soils, wetlands and hydrology high sensitivity areas. Mitigation will be required to ensure potential impacts relating to these areas are within acceptable limits. Two additional; heritage sites were also identified within the TSF site, and these sites will be removed from site through SAHRA permit applications.

PLAN OF STUDY FOR EIA

The following specialist studies will form part of the EIA report:

- Biodiversity (Terrestrial);
- Heritage;
- Agriculture Potential, Soils and Land capability;
- Geohydrology;
- Aquatic and Wetland (including hydropedology);
- Air quality;
- Climate Change;
- Closure Costing and Rehabilitation;
- Socio-Economic;
- Hydrology;
- Palaeontology;

- Traffic;
- Noise;
- Visual; and
- Health Risk and Radiological.

1 INTRODUCTION

Harmony Gold Mining Company Limited (hereafter referred to as Harmony / "the applicant") has appointed Environmental Impact Management Services (Pty) Ltd (EIMS) as the Environmental Assessment Practitioner (EAP) to undertake the necessary environmental authorisation and associated consultation processes for a proposed new Tailings Storage Facility (TSF) project and associated infrastructure near Welkom in the Matjhabeng Local Municipality in the Free State province.

The applicant owns and operates a number of gold mines and plants in the Welkom region in the Free State and currently deposits tailings onto the Free State South 2 Tailings Storage Facility (TSF), St. Helena 4 TSF, St. Helena 123 TSF, Dam 23 TSF, Brand D TSF and Target 1&2 TSF. The current planned Life of Mine (LOM) of the Free State operations exceed the available deposition capacity of these TSFs and the applicant is therefore proposing to construct the proposed Nooitgedacht TSF to cater for this additional capacity. Nooitgedacht TSF will also cater for reworking of multiple TSFs across the Welkom area extending over the next 30 years plus. Nooitedact will cater for both the LoM as well as the reclamation of 23 additional TSFs over an approximate LoM of up 2050 (commissioning of the last reclamation station). This Free State Reclamation project[1] will be for the reclamation of up to 3 older TSFs at any one time. This will allow for the continuation of jobs and investment into the Welkom area. Further thereto, the reclamation will result in the removal and cleaning of old historic tailings facility and placing it on one consolidated facility which is well managed and is lined in accordance too the new waste legislation and regulations , thereby removing potential sources of pollution from the old and allowing Harmony to rehabilitate the old footprints and open them to other land uses.

An application was submitted to the Department of Mineral Resources and Energy (DMRE, now DMPR – Department of Mineral and Petroleum Resources) for the proposed TSF in 2023 and subsequently an initial scoping report was made available for stakeholder review. However, since then, the project was delayed due to several reasons. A new EA application was resubmitted in August 2024. One of the reasons for the withdrawal and resubmission of a new application and availability of the revised scoping report for another 30 day comment period was the inclusion of additional slurry pipelines within the application. The application was then withdrawn again at the end of September 2024 as new activities related to the proposed low pressure water system were identified, which would require authorisation and need to be included in a new application. This new 2025 application now includes all associated infrastructure applied for previously as well as the newly proposed low pressure water system.

The propsoed **TSF** will cover an area of approximately 895 ha as shown in Figure 1. The proposed TSF will be located on Farm portions Mijannie 66 Ptn 0/RE, Goedgedacht 53 Ptn 0, Nooitgedacht 50 Ptn 0, Jacobsdal 37 Ptn 0 and Rheedersdam 31 Ptn 0.

Four new pipelines are required to be constructed:

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The pipelines will be flanged steel pipelines installed above-ground on pre-cast concrete plinths and a 3.5m wide access road, adjacent to the pipelines, will be cleared/graded to provide access for construction, maintenance and inspections. The diameter of the pipelines is as follows: approximately 600 mm residue pipelines and 800 mm for return water pipelines – however the exact sizes will be confirmed in the EIA phase once further design information becomes available.

The proposed pipelines traverse the following farm portions: Vlakplaats 125 Ptn 3, 4 and 5; Mijannie RE/66 Ptn 0; Toronto RE/115 Ptn 7 and 0; Rietpan 17 Ptn 0; Rietkuil 28 Ptn 0; Rheeders Dam 31 Ptn 0; Farm 41 Ptn 20; Ouders Gift 48 Ptn 0; Nooitgedacht 50 Ptn 0; Goedgedacht 53 Ptn 0; Theronia 71 Ptn 1 and 7; Jacobsrust 118 Ptn

[1] The Nooitgedacht project is one component of the Free State Reclamation project. The rest of the Free State Reclamation project will be permitted through other applications.

0; St Helena 42 Ptn 2 and 3, Farm 80 Ptn 0, Stuirmanship 92 Ptn 1, 7 and 0, Saaiplaas 690 Ptn 1, 11, 15 and 0; Klippan 14 Ptn 1, 2 and 15, Marmageli 20 Ptn 0 and 157 Ptn 0.

In addition, a new **40 Megalitre (ML) low pressure water storage facility** is required to be constructed at farm Klippan 14 Ptn 2 which will cover an area of up to 2 ha. Return water from the TSF will be fed to this facility where the water will then be transferred to the plants and the active reclamation sites.

EIMS will compile and submit the required documentation in support of applications for of applications for:

- Environmental Authorisation (EA) and Waste Management License (WML) in accordance with the National Environmental Management Act – NEMA (Act 107 of 1998) for various triggered waste activities and
- Water Use License (WUL) in accordance with the National Water Act – NWA (Act 36 of 1998). A separate application for a Water Use License (WUL) has been lodged with the Department of Water and Sanitation (DWS) for the water use triggers.

Refer to Section 4 of this report for further details with respect to specific activities being applied for.

The following details are relevant to the current application:

- Infrastructure will include the TSF and associated infrastructure including possible access roads and water management infrastructure including pipelines and a new low pressure water system.
- The TSF itself will cover a total area of up to 895 ha;
- Tailing deposition method to be used: cyclone deposition.
- The current design scope of the Nooitgedacht TSF is based on a height of 93m.
- The TSF barrier system is determined in consultation with the authorities and will follow relevant norms and standards for determination of liner requirements.

It should be noted that a separate EA and WML application has been conducted for the adjacent proposed **Valley TSF** to the immediate north of the area proposed for the Nooitgedacht TSF by the same applicant. That project is the subject of a separate application and public consultation process and should not be confused with this Nooitgedacht TSF application. In addition, separate applications for various activities will be lodged in the future as part of Harmony's Free State Reclamation Project mentioned above.

1.1 REPORT STRUCTURE

This report has been compiled in accordance with the 2014 NEMA EIA Regulations, as amended. A summary of the report structure, and the specific sections that correspond to the applicable regulations, is provided in Table 1 below.

Table 1: Report structure

Environmental Regulation	Description – NEMA Regulation 982 (2014) as amended	Section in Report
Appendix 2(2)(a):	Details of – i. The Environmental Assessment Practitioner (EAP) who prepared the report; and ii. The expertise of the EAP, including a curriculum vitae;	1.2 Appendix B
Appendix 2(2)(b):	The location of the activity. Including – i. The 21-digit Surveyor General code of each cadastral land parcel; ii. Where available, the physical address and farm name; iii. Where the required information in items (i) and (ii) is not available, the coordinates of the boundary of the property or properties;	2
Appendix 2(2)(c):	A plan which locates the proposed activity or activities applied for at an appropriate scale, or, if it is – i. A linear activity, a description and coordinates of the corridor in which the proposed activity or activities is to be undertaken; or ii. On a land where the property has not been defined, the coordinates within which the activity is to be undertaken;	2 and 3
Appendix 2(2)(d):	A description of the scope of the proposed activity, including – i. All listed and specified activities triggered; ii. A description of the activities to be undertaken, including associated structures and infrastructure;	3
Appendix 2(2)(e):	A description of the policy and legislative context within which the development is proposed including an identification of all legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks and instruments that are applicable to this activity and are to be considered in the assessment process;	4
Appendix 2(2)(f):	A motivation for the need and desirability for the proposed development including the need and desirability of the activity in the context of the preferred location;	5
Appendix 2(2)(h):	A full description of the process followed to reach the proposed preferred activity, site and location within the site, including – i. Details of all alternatives considered; ii. Details of the public participation process undertaken in terms of regulation 41 of the Regulations, including copies of the supporting documents and inputs; iii. A summary of the issues raised by interested and affected parties, and an indication of the manner in which the issues were incorporated, or the reasons for not including them; iv. The environmental attributes associated with the alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;	6, 7 and 9

Environmental Regulation	Description – NEMA Regulation 982 (2014) as amended	Section in Report
	v. The impacts and risks identified for each alternative, including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts – a. Can be reversed; b. May cause irreplaceable loss or resources; and c. Can be avoided, managed or mitigated; vi. The methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks associated with the alternatives; vii. Positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community that may be affected focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects; viii. The possible mitigation measures that could be applied and level of residual risk; ix. The outcome of the site selection matrix; x. If no alternatives, including alternative locations for the activity were investigated, the motivation for not considering such; and xi. A concluding statement indicating the preferred alternatives, including preferred location of the activity;	
Appendix 2(2)(i):	A plan of study for undertaking the environmental impact assessment process to be undertaken, including – i. A description of the alternatives to be considered and assessed within the preferred site, including the option of not proceeding with the activity; ii. A description of the aspects to be assessed as part of the environmental impact assessment process; iii. Aspects to be assessed by specialists; iv. A description of the proposed method of assessing the environmental aspects, including a description of the proposed method assessing the environmental aspects to be assessed by specialists; v. A description of the proposed method of assessing duration and significance; vi. An indication of the stages at which the competent authority will be consulted; vii. Particulars of the public participation process that will be conducted during the environmental impact assessment process; and viii. A description of the tasks that will be undertaken as part of the environmental impact assessment process; ix. Identify suitable measures to avoid, reverse, mitigate or manage identified impacts and to determine the extent of the residual risks that need to be managed and monitored;	11
Appendix 2(2)(j)	An undertaking under oath or affirmation by the EAP in relation to – i. The correctness of the information provided in the report; ii. The inclusion of comments and inputs from stakeholders and interested and affected parties; and iii. Any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested or affected parties;	13

Environmental Regulation	Description – NEMA Regulation 982 (2014) as amended	Section in Report
Appendix 2(2)(k):	An undertaking under oath or affirmation by the EAP in relation to the level of agreement between the EAP and interested and affected parties on the plan of study for undertaking the environmental impact assessment;	13
Appendix 2(2)(l):	Where applicable, any specific information required by the competent authority; and	None at this stage
Appendix 2(2)(m):	Any other matter required in terms of section 24(4)(a) and (b) of the Act.	None at this stage

1.2 DETAILS OF THE EAP

EIMS is appointed by the applicant as the independent EAP and to assist in preparing and submitting the WML application, Scoping and EIA Reports, and undertaking a Public Participation Process (PPP) in support of the proposed tailings storage facility. The contact details of the EIMS consultant and EAP who compiled this Report are as follows:

- Name: John von Mayer
- Tel No: +27 11 789 7170
- Fax No: +27 86 571 9047
- Project E-mail address: nooitgedacht@eims.co.za

In terms of Regulation 13 of the EIA Regulations (GN R. 982) as amended, an independent EAP, must be appointed by the applicant to manage the application. EIMS is compliant with the definition of an EAP as defined in Regulations 1 and 13 of the EIA Regulations, as well as Section 1 of the NEMA. This includes, inter alia, the requirement that EIMS is:

- Objective and independent;
- Has expertise in conducting EIA's;
- Comply with the NEMA, the environmental regulations and all other applicable legislation;
- Considers all relevant factors relating to the application; and
- Provides full disclosure to the applicant and the relevant environmental authority.

EIMS is a private and independent environmental management consulting firm that was founded in 1993. EIMS has in excess of 32 years' experience in conducting EIA's, including many EIA's for mines and mining related projects. Please refer to the EIMS website (www.eims.co.za) for company details and examples of EIA documentation currently available.

John von Mayer is a principal consultant at EIMS and has been involved in numerous large projects the past 16 years. He has experience in Project Management, small to large scale Environmental Impact Assessments, Environmental Auditing, Water Use Licensing, and Public Participation. He is a Registered Professional Natural Scientist (400336/11) with the South African Council Natural and Scientific Professions (SACNASP) as well as a registered Environmental Assessment Practitioners Association of south Africa (EAPASA) Environmental Practitioner (2019/1247). The Curriculum Vitae of the EAP that is responsible for the compilation of this Report is included in Appendix B.

1.3 SPECIALIST CONSULTANTS

Specialist studies are being undertaken to address the key impacts that require further investigation and these include:

- Biodiversity (Terrestrial);
- Heritage;
- Agriculture Potential, Soils and Land capability;
- Geohydrology;
- Climate Change;
- Aquatic and Wetland (including hydropedology);
- Air quality;

- Noise;
- Palaeontology;
- Visual;
- Hydrological;
- Traffic;
- Social; and
- Health Risk and Radiological.

Engineering inputs have been obtained to inform the design of the TSF. A closure assessment including a cost assessment will also be included as part of the studies conducted during the EIA phase.

The specialist studies listed above will involve the gathering of data relevant to identifying and assessing preliminary environmental impacts that may occur because of the proposed project. These preliminary impacts were assessed according to pre-defined impact rating methodology (Section 9.1). Preliminary mitigation / management measures to minimise potential negative impacts or enhance potential benefits are put forward in this Scoping Report and will be adjusted where relevant during the EIA phase once further assessments are concluded and input from the public has been considered.

2 DESCRIPTION OF THE PROPERTY

Table 2 indicates the farm portions that fall within the proposed project including details on the project location as well as the distance from the proposed project area to the nearest towns.

Table 2: Locality details

<table>
<tr><td>Farm Name</td><td colspan="3">The Tailings Storage Facility is located on the following farm portions: Mijannie 66 Ptn 0/RE, Goedgedacht 53 Ptn 0, Nooitgedacht 50 Ptn 0, Jacobsdal 37 Ptn 0 and Rheedersdam 31 Ptn 0.

The proposed pipelines traverse the following farm portions:
Vlakplaats 125 Ptn 3, 4 and 5; Mijannie RE/66 Ptn 0; Toronto RE/115 Ptn 7 and 0; Rietpan 17 Ptn 0; Rietkuil 28 Ptn 0; Rheeders Dam 31 Ptn 0; Farm 41 Ptn 20; Ouders Gift 48 Ptn 0; Nooitgedacht 50 Ptn 0; Goedgedacht 53 Ptn 0; Theronia 71 Ptn 1 and 7; Jacobsrust 118 Ptn 0; St Helena 42 Ptn 2 and 3, Farm 80 Ptn 0, Stuirmanship 92 Ptn 1, 7 and 0, Saaiplaas 690 Ptn 1, 11, 15 and 0; Klippan 14 Ptn 1, 2 and 15, Marmageli 20 Ptn 0 and 157 Ptn 0.

The proposed new 40ML low pressure water system is located on: Klippan 14 Ptn 2.</td></tr>
<tr><td>Application Area (Ha)</td><td colspan="3">• Approximately 895 Hectares / 8.95 km^2 (TSF footprint).
• 43 km x approximately 4m wide servitude (pipelines).
• Up to 23 750m^2 (low pressure water system facility footprint)</td></tr>
<tr><td>Magisterial District</td><td colspan="3">Matjhabeng Local Municipality within the Lejweleputswa District Municipality (Free State Province).</td></tr>
<tr><td>Distance and direction from nearest towns</td><td colspan="3">Welkom is located 3km southeast and Odendaalsrus is located 5.2 km north of the proposed TSF site. The geographic coordinates at the centre of the TSF site are 27°56'30.11"S and 26°39'43.96"E.</td></tr>
<tr><td rowspan="8">21-digit Surveyor General Code for Property on which Project is Located</td><td>Farm Name:</td><td>Portion:</td><td>21 Digit Surveyor General Code</td></tr>
<tr><td colspan="3">TSF
Centre point: 27°56'30.11"S and 26°39'43.96"E.</td></tr>
<tr><td>Mijannie 66</td><td>Ptn 0/RE</td><td>F03900000000006600000</td></tr>
<tr><td>Goedgedacht 53</td><td>Ptn 0</td><td>F03900000000005300000</td></tr>
<tr><td>Nooitgedacht 50</td><td>Ptn 0</td><td>F03900000000005000000</td></tr>
<tr><td>Jacobsdal 37</td><td>Ptn 0</td><td>F03900000000003700000</td></tr>
<tr><td>Rheedersdam 31</td><td>Ptn 0</td><td>F03900000000003100000</td></tr>
<tr><td colspan="3">Central to St Helena Pipeline
Start: 28° 0'51.51"S, 26°51'2.16"E
Middle: 28° 1'33.64"S, 26°47'32.92"E
End: 28° 1'26.99"S, 26°43'0.25"E

One Plant to St Helena Booster Pump Station Pipeline
Start: 28° 1'3.66"S, 26°45'2.74"E
Middle: 28° 2'26.72"S, 26°45'28.08"E
End: 28° 1'25.72"S, 26°42'59.89"E

St Helena Booster Pump Station to FSN1 Pipeline
Start: 28° 1'27.41"S, 26°43'3.54"E</td></tr>
</table>

	Middle: 28° 0'13.31"S, 26°41'12.30"E End: 27°55'43.84"S, 26°40'6.11"E		
	Vlakplaats 125	Ptn 3	F03900000000012500003
	Vlakplaats 125	Ptn 4	F03900000000012500004
	Vlakplaats 125	Ptn 5	F03900000000012500005
	Mijannie RE/66	Ptn 0	F03900000000006600000
	Toronto RE/115	Ptn 7	F03900000000011500007
	Toronto RE/115	Ptn 0	F03900000000011500000
	Rietpan 17	Ptn 0	F03900000000001700000
	Rietkuil 28	Ptn 0	F03900000000002800000
	Rheeders Dam 31	Ptn 0	F03900000000003100000
	Welkom Farm 41	Ptn 20	F03900000000004100020
	Ouders Gift 48	Ptn 0	F03900000000004800000
	Nooitgedacht 50	Ptn 0	F03900000000005000000
	Goedgedacht 53	Ptn 0	F03900000000005300000
	Theronia 71	Ptn 1	F03900000000007100001
	Theronia 71	Ptn 7	F03900000000007100007
	Jacobsrust 118	Ptn 0;	F03900000000011800000
	St Helena 42	Ptn 2	F03900000000004200002
	St Helena 42	Ptn 3	F03900000000004200003
	Welkom Farm 80	Ptn 0	F03900000000008000000
	Stuirmanship 92	Ptn 1	F03900000000009200001
	Stuirmanship 92	Ptn 7	F03900000000009200007
	Stuirmanship 92	Ptn 0	F03900000000009200000
	Saaiplaas 690	Ptn 1	F03500000000069000001
	Saaiplaas 690	Ptn 11	F03500000000069000011

	Saaiplaas 690	Ptn 15	F03500000000069000015
	Saaiplaas 690	Ptn 0	F03500000000069000000
	Klippan 14	Ptn 1	F03900000000001400001
	Klippan 14	Ptn 2	F03900000000001400002
	Klippan 14	Ptn 15	F03900000000001400015
	Marmageli 20	Ptn 0	F03900000000002000000
	Marmageli 20	Ptn 157	F03900000000002000157
Low Pressure Water System Centre point: 28° 2'5.43"S, 26°47'39.11"E			
	Klippan 14	Ptn 2	F03900000000001400002

The locality and extent of the proposed TSF and associated infrastructure is shown in Figure 1, and the proposed Nooitgedacht tailings storage facility and associated pipelines in relation to the existing mining right area is also shown.

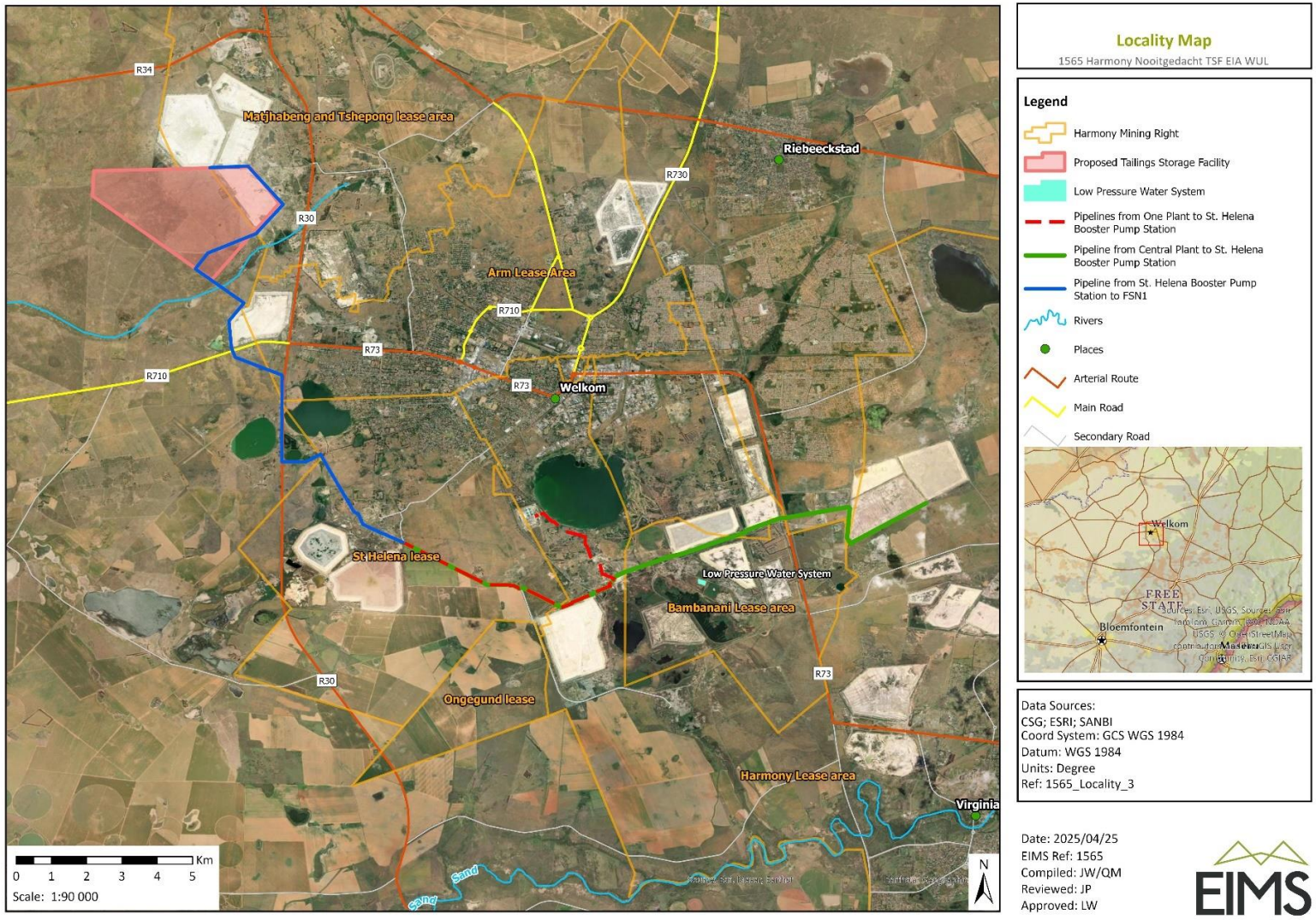


Figure 1: Aerial imagery locality map indicating the location of the proposed new Tailings Storage Facility and pipelines as well as the proposed Low Pressure Water System in relation to Harmony's mining right areas.

3 DESCRIPTION AND SCOPE OF THE PROPOSED ACTIVITY

Harmony (the applicant) holds an approved Mining Right (MR) and Environmental Management Programme (EMPr), in terms of the Minerals and Petroleum Resources Development Act (Act 28 of 2002, as amended) (MPRDA), for the mining of gold at various operations in the Welkom area. The applicant owns and operates a number of gold mines and processing plants in the Welkom region in the Free State and currently deposits tailings onto the Free State South 2 Tailings Storage Facility (TSF), St. Helena 4 TSF, St. Helena 123 TSF, Dam 23 TSF, Brand D TSF and Target 1&2 TSF. The current planned LOM of the Free State operations exceed the available deposition capacity of these existing TSFs and the applicant is therefore proposing to construct the proposed Nooitgedacht TSF to cater for this additional capacity. The Nooitgedacht TSF will also cater for reworking of multiple TSFs across the Welkom area extending over the next 30 years plus. Nooitedact will cater for both the LoM as well as the reclamation of 23 additional TSFs over an approximate LoM of up 2050 (commissioning of the last reclamation station). The Free State Reclamation project will be for the reclamation of up to 3 older TSFs at any one time. This will allow for the continuation of jobs and investment into the Welkom area. Further thereto, the reclamation will result in the removal and cleaning of old historic tailings facility and placing it on one consolidated facility which is well managed and is lined in accordance too the new waste legislation and regulations , thereby removing potential sources of pollution from the old areas and allowing Harmony to rehabilitate the old footprints and open them to other land uses.

In addition, four new pipelines are required to be constructed:

- Two 10km long slurry lines from Harmony One Plant to the St Helena Booster Pump Station;
- One 16k long slurry line from Brand A TSF to the St Helena Booster Pump Station; and
- One 17km slurry line from the St Helena Booster Pump Station to FSN 1 TSF.

The pipelines will be flanged steel pipelines installed above-ground on pre-cast concrete plinths and a 3.5m wide access road, adjacent to the pipelines, will be cleared/graded to provide access for construction, maintenance and inspections.

In addition to the above, a new 40ML low pressure water storage facility is required to be constructed which will cover an area of up to 2 ha. Return water will be fed to this facility where the water will then be transferred to the plants and the active reclamation sites. Refer to Figure 1 for the location of the low pressure water system. The water source for the reclamation operation will include:

- Return water from the Nooitgedacht TSF;
- Treated effluent from Waste Water Treatment works;
- Ground water from boreholes; and
- Overflow water from the Metallurgical Plants.

This area proposed for this low pressure water system is currently a very disturbed area and was in the past used as the thickener station for the Dam 13 dredging operations which occurred many years ago. Therefore, all of the concrete foundations that are currently on site will need to be removed in order to construct the new infrastructure. Further, the pipelines associated with the Nooitgedacht TSF will need to be extended to no longer discharge into Dam 13 but rather into the low pressure water system. The various associated pipelines for this facility however are to be included as part of separate applications and are therefore not assessed as part of this application.

EIMS will compile and submit the required documentation in support of applications for:

- Environmental Authorisation (EA) and Waste Management License (WML) in accordance with the National Environmental Management Act – NEMA (Act 107 of 1998)- Listed activity: Listing Notice 2, Activity 15 as well as various Listing Notice 1 and 3 activities and also the National Environmental Management: Waste Act – NEMWA (Act 59 of 2008)- Activity B7, B10 and B11; and

- Water Use License (WUL) in accordance with the National Water Act – NWA (Act 36 of 1998). Water uses: Section 21 (c), Section 21 (i) and Section 21 (g). A separate application for a Water Use License (WUL) has been lodged with the Department of Water and Sanitation (DWS) for the water use triggers.

A Tailings Storage Facility (TSF) is an engineered structure designed to safely contain and manage mining waste, known as tailings. It's not just a simple dam; it's a complex system that includes embankments, associated works, and procedures for managing the tailings and the water they contain. The primary goals of a TSF are to permanently store tailings and reclaim water for reuse in mining operations.

1. Tailings Transportation and Deposition:

- Tailings, a slurry of fine rock particles and water, are transported from the processing plant to the TSF, typically via pipelines.
- The tailings are then deposited within the TSF, usually in a controlled manner to allow for the separation of solids and water.

2. Separation of Water and Solids:

- TSFs are designed to facilitate the settling and consolidation of the tailings solids, allowing water to separate and be reclaimed.
- This separation can occur naturally through gravity or through mechanical processes.
- The reclaimed water is often recycled back into the mining process, reducing water consumption.

3. Embankment Construction and Maintenance:

- TSFs often feature embankments, or "tailings dams," constructed from locally sourced materials, including the tailings themselves.
- These embankments are designed to withstand the weight and pressure of the stored tailings and to prevent leakage or breaches.
- The embankments are typically raised progressively as the TSF fills with tailings.

4. Water Management:

- TSFs must also have systems in place to manage surface water runoff and groundwater infiltration.
- This may involve the use of drainage systems, seepage collection systems, and other measures to prevent uncontrolled water discharge.

5. Monitoring and Closure:

- TSFs are subject to ongoing monitoring to ensure their stability and safety.
- This monitoring may involve remote sensing, on-site inspections, and other techniques.
- At the end of the mine's life, the TSF is decommissioned, and the tailings are typically covered and revegetated to minimize environmental impacts.

Figure 2 below shows a simplified cross sectional diagram indicating the relevant design features typically associated with a TSF.

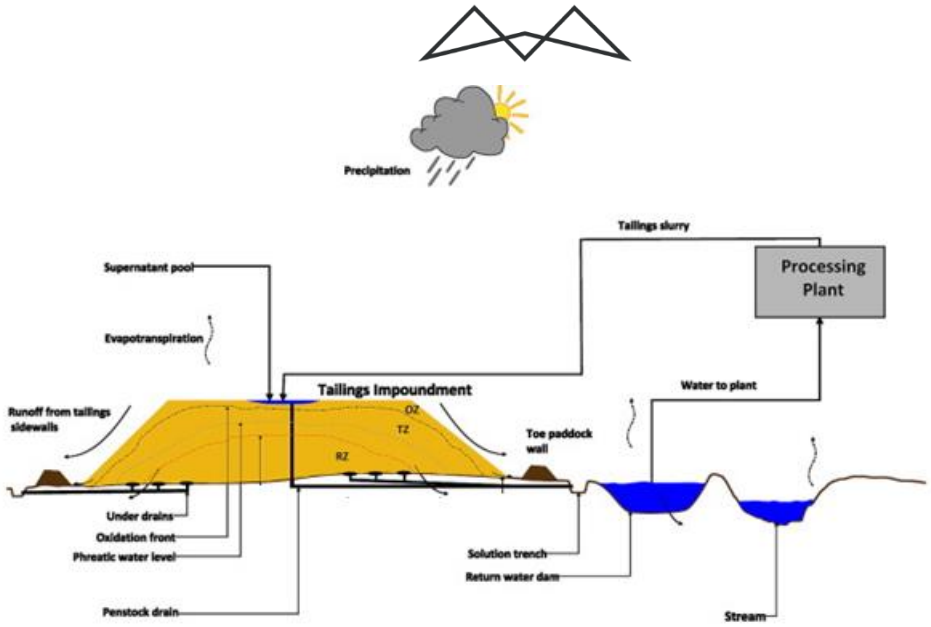


Figure 2: Cross section through a typical TSF

3.1 DESCRIPTION OF ACTIVITIES TO BE UNDERTAKEN

The construction phase of the project will consist of site establishment, site clearance, excavation, topsoil stockpiling, layering and compacting, prior to deposition of tailings at the site. No construction camps will be required and workers from surrounding towns will be transported to site.

Key parameters of the Nooitgedacht TSF design are as follows:

- Maximum final height: 93m
- Footprint area: 805 Ha
- Total capacity: 804 million tonnes
- Total deposition period at 2 000 000 tons per month: 34 years
- Maximum rate of rise (Basin): 3.77m/year
- Maximum rate of rise (Embankment): 2.89m/year
- Deposition method: Cyclone

The following operational activity details are relevant to the current application (refer to preliminary design report include in Appendix H for further technical detail):

- Tailings material be delivered to the site using existing slurry pipelines and deposition infrastructure.
- Infrastructure will include the TSF and associated infrastructure such as water management infrastructure including pipelines and a return water dam.
- The Nooitgedacht TSF will have a maximum height of 93m and a footprint area of approximately 805Ha.
- The Nooitgedacht TSF will be developed with an intermediate outer slope of 1V:3H between benches. The overall slope of the facility is 1V:4H. The inter-bench height is 10.5m and the benches are 10.5m wide. The engineered toe wall embankment is maximum 5m high with a 3m wide crest and an outer slope of 1V:1.5H and inner slope of 1V:2H. The toe wall embankment will be constructed in 150mm layers to 95% Proctor density at optimum moisture content. The minimum Factor of Safety against failure is 1.9 under drained conditions, 1.9 under undrained conditions, 1.3 under post seismic, post liquefaction or residual conditions and 1.3 under pseudo-static conditions.

- TSF barrier system will be determined in consultation with the authorities and in compliance with relevant norms and standards for determination of liner requirements in terms of the NEM:WA (GN R. 636). The waste material solutes classify as a Type 3 waste. This requires a Class C liner system.

Further design detail is provided in the sections that follow.

3.1.1 TSF LINER SYSTEM

The Nooitgedacht TSF will make use of a two-liner system as described below:

- Liner system 1 - Over the existing unlined FSN4 TSF footprint (existing TSF to the east of Figure 3) and the outer edge wall, where high liner stresses are present, the liner system comprises (from top down), a 300mm thick layer of tailings, 600kN/m geogrid (or similar approved), a 300mm thick layer of tailings, 1.5mm thick double textured HDPE liner underlain by a 300mm ripped and recompacted layer of in-situ base preparation material.

- Liner system 2 - The liner system in the inner basin area comprises (from top down), 1.5mm thick double textured HDPE liner underlain by a 300mm ripped and recompacted layer of in-situ base material.

The proposed TSF barrier system is shown in detail in Figure 3, Figure 4, and Figure 5.

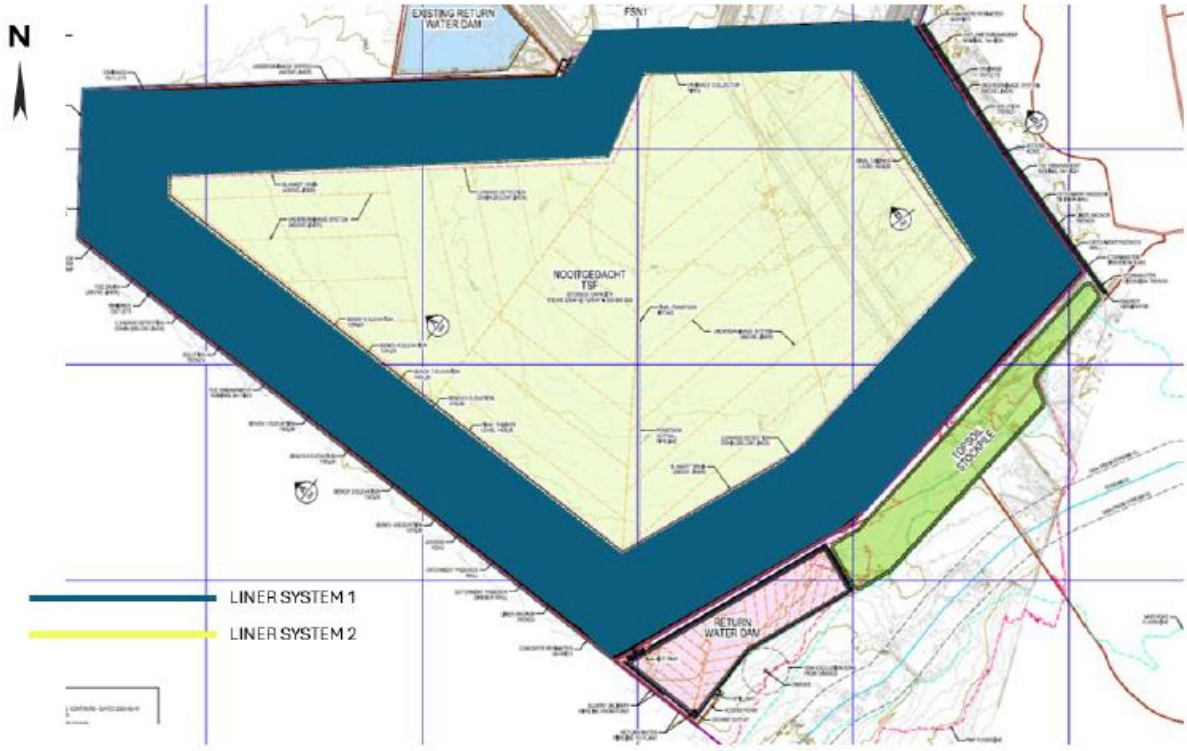


Figure 3: Liner systems proposed (preliminary design)

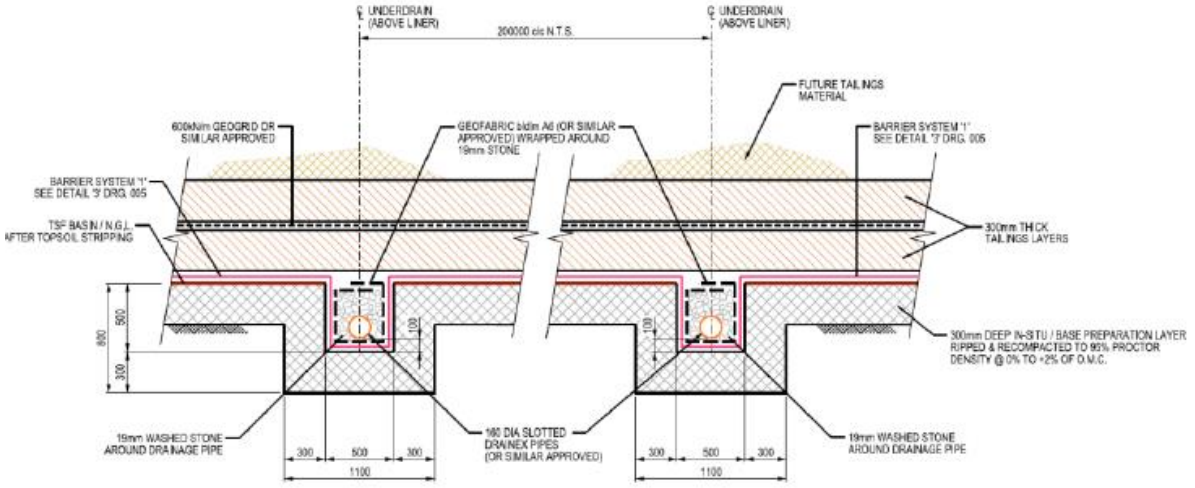


Figure 4: Liner system 1 (outer wall area)

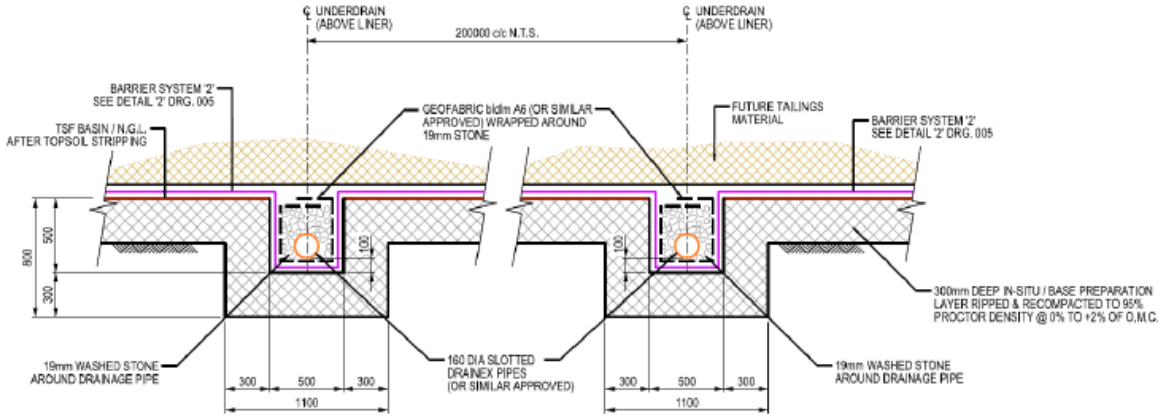


Figure 5: Liner system 2 (basin area)

3.1.2 UNDERDRAINAGE SYSTEM

The TSF drainage system is provided above the liner system to intercept seepage through the facility and to reduce static water head on the liner. The underdrainage system lowers the phreatic surface, improving the overall stability of the facility. The underdrainage system consists of toe drains, blanket drains and herringbone drains. Herringbone drainage is provided between the cyclone wall and the toe wall to ensure that the outer cyclone underflow wall remains drained.

The above liner toe drains comprise 160mm slotted HDPE pipe surrounded in 19mm stone overlain by a layer of 6mm stone all enclosed in a geofabric. The toe drain outlet pipes also discharge into the solution trench. The blanket drains comprise 160mm slotted Drainex HDPE pipes surrounded in 19mm stone overlain by a layer of 6mm stone and graded filter sand all enclosed in a geofabric. These drains intersect the starter wall with an HDPE pipe boot at the point of intersection with the liner.

The herringbone drainage pipes comprise 160mm slotted Drainex HDPE pipes surrounded in 19mm stone enclosed in a geofabric. The above-liner drains are spaced 200m apart. The herringbone drainage east of the TSF will flow towards the main collector pipe which then discharges into the RWD situated south-east of the TSF. The herringbone drainage system west of the TSF will flow towards the collector pipe which flows into the 6.5m x 6.5m x 2.6m deep sump situated south-west of the TSF. The sump has been designed to accommodate a volume of 110 m^3. Water collected in the sump will then be pumped into the solution trench for discharge into the RWD south-east of the TSF. A 250 TV Multotec vertical spindle pump with a flow rate of 115l/s and a head of 3m is proposed. Electricity must be provided to the vertical spindle pump from the RWD electrical supply.

At the 36m height of the adjacent Valley TSF, elevated drains will be installed on the Nooitgedacht TSF. The elevated drains will be designed just prior to installation based on actual measured tailings permeabilities at that time. Nooitgedacht TSF will be constructed against the existing FSN 1 TSF and the Valley TSF.

Tailings Separation and Wall construction:

Tailings Separation: Tailings slurry from a mineral processing plant is fed into a hydrocyclone, which separates the material into:

- Underflow: Coarser, sand-like particles.
- Overflow: Finer, silt- and clay-sized particles.

Wall Construction: The underflow (coarse material) is used to build the outer embankments or cyclone walls of the TSF. These walls are more stable and free-draining, which helps in maintaining the structural integrity of the facility.

Deposition of Fine Tailings: The overflow (fine material) is deposited inside the TSF, behind the cyclone walls.

3.1.3 BELOW LINER LEAKAGE DETECTION SYSTEM

The below liner leak detection drains will be monitored as part of the operations, maintenance, and surveillance plan to determine and quantify any leakage through the liner system. The below liner leakage detection was sized and spaced using the seepage rate through the liner. The below liner leak detection system also alleviates any possible water pressure build-up beneath the liner from a potential rise of the groundwater table.

In the event of a leak, the drains serve to locate the area of the leak. Once the area of the leak is located, monitoring of the area and maintenance of the phreatic level is required or further action will need to be taken. The below liner leakage detection drain comprises a 160mm slotted HDPE pipe surrounded in 19mm stone which is enclosed in a geofabric. The below liner leakage detection outlet pipes discharge into the solution trench. All drain outlets will be clearly marked to distinguish between the underdrains, blanket drains and leakage detection drains.

3.1.4 LINER TENSION FORCES

Due to the foundation and height of the facility there are high tensile forces induced on the liner. Liner stresses induced by the slopes of the facility exceed the liner tensile strengths. To alleviate these stresses, geogrid has been designed. The maximum shear stresses in the 600kN/m geogrid were determined. The maximum shear stresses (and forces) have been analysed against the yield strength of the 600kN/m geogrid to determine the Factor of Safety against yield (failure) under drained, undrained, post seismic conditions and pseudo-static conditions.

Other remedial measures were considered to reduce the liner stresses. These included adjusting the intermediate slopes and foundation saw tooths equally spaced along the failure surface. These did not reduce the induced liner stresses, and the geogrid was designed. The total tensile strain in the geomembrane is less than 1%. This is due to minimal movement expected because of the engineered base, reinforcing geogrid, and cushion tailings protection layer of the inverted barrier system. A 600kN/m geogrid (or similar approved) has been specified.

3.1.5 LINER SERVICE LIFE ASSESSMENT

The service life of a geomembrane is affected by various factors including UV exposure, temperature conditions and applied loading. The deposition life of the Nooitgedacht TSF is 34 years, after which, pending future reclamation, it may exist as a dormant TSF for a very long time. The main factors affecting the service life of a geomembrane is UV exposure and temperature. The geomembrane on the TSF will be covered during construction by tailings, therefore UV exposure will not have a detrimental effect on the service life of the geomembrane. The geomembrane can alternatively be covered using tailings underflow, but installation timing and tailings beach advancement will need to be considered during liner installation and construction. Due to risk to the membrane, the placed tailings layer is recommended.

The average minimum and maximum ambient temperature of the site is 10°C and 25°C respectively. Based on research conducted by the Geosynthetics Institute in USA “Geomembrane Lifetime Prediction: Unexposed and Exposed Conditions” originally published in 2005 and later updated in 2011, it is reported that an unexposed geomembrane at 25°C will have a design life of more than 250 years. It is noted that this time is for the geomembrane to reach the so called “half-life”, meaning the antioxidant in the geomembrane have reached 50% of their original value.

The projected service life of a geomembrane at Nooitgedacht TSF is 2 775 years at 10°C and decreases to 608 years at a temperature of 25°C. Climate change is expected to have minimal impact on the geomembrane since it will be insulated by tailings with low thermal conductivity. The geomembrane in the RWD will also be covered with concrete. Therefore, assessing service life within a 10°C to 25°C temperature range is reasonable.

3.1.6 DAM BREAK ANALYSIS

A dam break analysis for a TSF is a critical safety and risk assessment process used to evaluate the potential consequences of a failure or breach of the TSF. A feasibility dam break analysis was done by Geotheta in September 2023 using FLO-2D Overland Flood Modelling. The findings of this study are presented here:

Contours of the inundation area were used to develop a digital terrain model. These are accurate at 5m intervals which is considered sufficiently accurate for the purposes of establishing an indicative inundation zone. Given the range of possible failure scenarios, failure volumes and surface flow resistances that can occur, the contour intervals are therefore adequate for the purpose of this feasibility level study.

The proposed Nooitgedacht TSF is an Extreme Consequence Classification facility according to the Global Industry Standard on Tailings Management (GISTM) criteria. This is determined by analysing the impact a failure would have on life, the environment and infrastructure in the modelled inundation zone. The corresponding SANS 10286 hazard classification is High. Note that this is the facility’s “Consequence Classification”, and it is not at all linked to the likelihood of failure. The dam break analyses merely address the consequence should the facility fail. The consequence classification leads to the design criteria to be used to ensure that the facility is

adequately designed, operated, managed and closed so that the risk of failure is reduced to as low as reasonably practicable.

The analyses concluded that in the unlikely event of a failure, there would be extensive damage to both the natural environment and infrastructure within the inundation area. Tailings flowing into the river south of the facility, will result in the loss of aquatic wildlife and decrease in water quality. It is likely that the pollution of the river and loss of aquatic wildlife would have adverse impacts on the ecosystem of the area and adversely affect users of the water. The inundated area must be environmentally surveyed to identify the affected population, environment and infrastructure within the Zone of Influence. The flood event would inundate households and associated infrastructure located near the facility and the populated area to the north-east of the Nooitgedacht TSF. The potential population at risk falls between 100 – 1 000 people, with the potential loss of life not exceeding 100.

The rainy day tailings flow of a breach on the north eastern flank will affect the residential area of Odendaalsrus to the north of the facility. This flow could be diverted away from the nearby residential area by constructing a bund approximately 1m high at the edge of the residential area. This can reduce the probability of loss of life to ranges of 1:10 000 or better.

3.1.7 RETURN WATER DAM DESIGN

A return water dam in a TSF is used to collect water that drains from the tailings after they are deposited. This water can then be reused, helping to conserve water, reduce environmental impact, and maintain efficient mining operations. It plays a key role in recycling process water and managing water within the facility. The layout of the proposed Return Water Dam (RWD) is shown below:

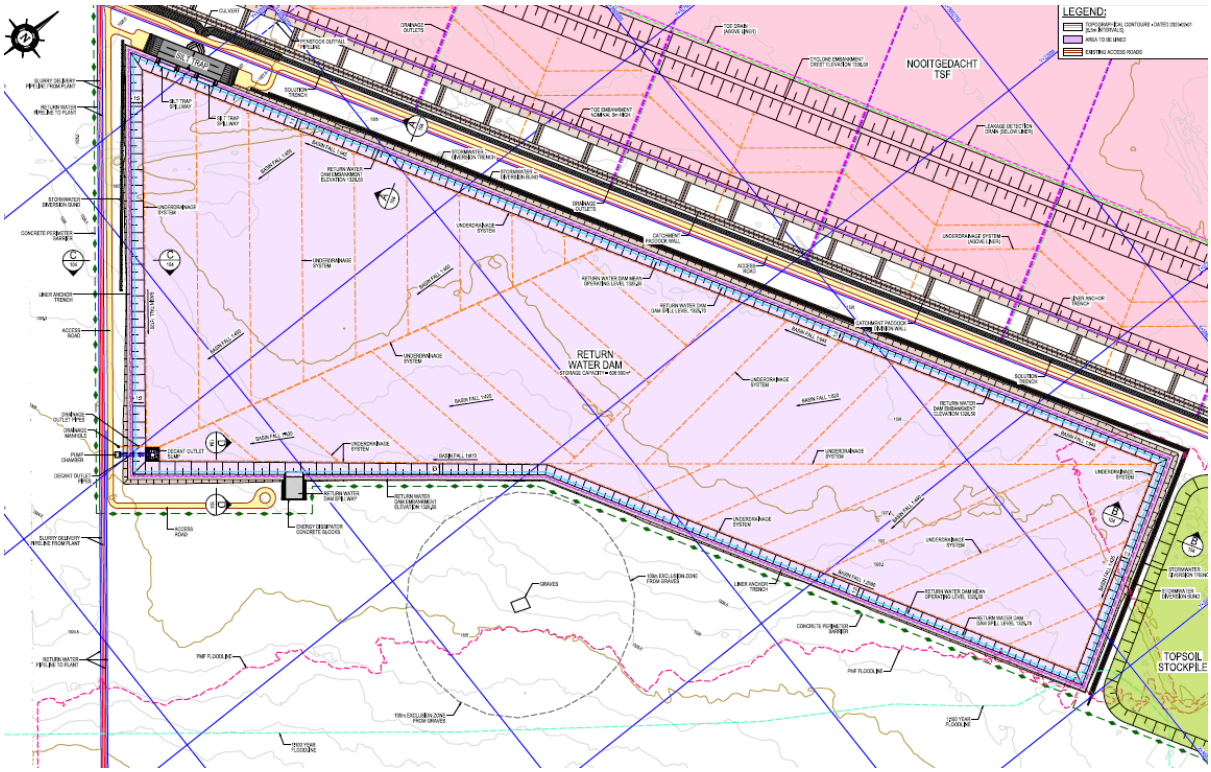


Figure 6: RWD design

The lined RWD is situated south-east of the TSF (refer to Figure 3). The basin of the RWD is formed by excavation into the ground materials. The material from excavations is all borrow material and will be used for the embankment walls of the RWD then the surplus will be used for the starter walls and cyclone walls of the TSF. The RWD has a total storage capacity of 606 500m^3. This provides adequate capacity to contain runoff from the TSF catchment area as well as the water that drains from the tailings itself. The stochastic water balance analysis indicates that the required RWD storage capacity is 606 500m^3. This ensures that the RWD does not spill more

than once every 50 years as required by Government Notice 704 of the National Water Act (Act No 36 of 1998). The RWD mean operating volume is 136 464m^3 at average 600mm deep. The mean operating volume was calculated by taking the volume of the fifth highest spill that is most likely to happen (470 036m^3), subtracted from the total storage capacity of the RWD (606 500m^3). The operating depth of 600mm is calculated by dividing the operating volume by the total area of the RWD. The depth of 600mm is recommended during the heavy rainfall seasons. This can be raised during the drier months.

The RWD itself is not classified as a dam with a safety risk in terms of Regulation 139 of the of the National Water Act. The requirements for a dam with a safety risk as indicated in Regulation 139 of the of the National Water Act do not apply.

The RWD spillway is designed to accommodate the expected Probable Maximum Flood (PMF), i.e. the 1:10 000 year 24-hour storm event, without overtopping of the RWD embankment. The RWD spillway was sized to have adequate capacity to safely discharge the PMF. The 1:10 000 year 24-hour storm event was calculated at 240mm. A concrete lined spillway is provided to safely discharge excess water without overtopping of the RWD embankment walls. The RWD spillway has a freeboard of 800mm and has been designed to discharge the 1:10 000 24-hour Probable Maximum Flood rate of 39.3m^3/sec over a 12-hour period.

A silt trap is provided upstream of the RWD. The silt trap includes cleaning infrastructure. The silt trap ensures that solids are captured before entering the RWD, thereby minimising sedimentation in the RWD. A sump has been included in each compartment of the silt trap to enable water and slurry to be pumped out to the TSF during operation, and prior to or after mechanical cleaning. The silt that is cleaned is then added on to the TSF.

The settling velocity calculation used in the design of the silt trap is 0.00207m/s. The discharge from the penstock calculation assuming flow from penstock inlets with 400mm pool depth is 1.436m^3/sec. The entrainment velocity and tangential velocity is 0.13m/s and 0.12m/s respectively. The design of silt trap is therefore 89m in length and 18.5m wide.

The RWD liner system (from top down) comprises the following (Figure 7):

- 200mm high perforated HDPE Geocells (SW-356/200HD or similar approved) filled with 20Mpa concrete.
- 1.5mm thick smooth HDPE membrane (GRI-GM13 and SANS 1526:2003 compliant).
- Ripping and recompacting 300mm of the in-situ base preparation material to 95% Proctor density at a moisture content between 0% and +2% of optimum moisture content.
- Underdrainage/leakage detection system comprising 160mm perforated HDPE pipes placed in a 300mm by 300mm trench. The pipes will be encased in 19mm washed stone and wrapped in geofabric.

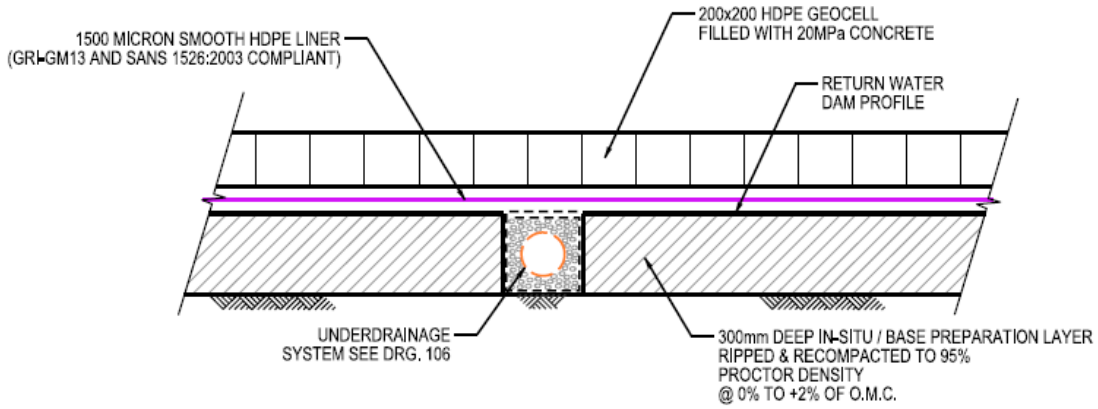


Figure 7: RWD liner system

The use of a geomembrane requires a protection layer to achieve intimate contact between the liner and the underlying clay to ensure overall liner functionality. The protection layer also provides durable protection to the liner against UV degradation and (possible) equipment and machine damage. The protection layer will be 200mm high concrete-filled perforated geocells. These will provide superior and long life protection compared to other options evaluated. The calculated RWD seepage is 1.4 x 10-4 L/ha/day.

An underdrainage system is provided beneath the RWD basin area. The underdrainage system acts as a leakage detection. The underdrainage system also alleviates any possible water pressure build-up beneath the liner caused by a potential rise of the groundwater table.

The underdrains comprise 160mm slotted HDPE pipes encased in 19mm washed stone. The stone will be wrapped in geofabric to prevent fines from entering the drains. The underdrains from the RWD basin lead to collection manholes located on the perimeter of the RWD. The manholes provide access to monitor under-liner seepage. The underdrainage system will be monitored as part of the operations, maintenance, and surveillance plan to determine and quantify any leakage through the liner system. Water extraction from the RWD will be by means of a decant outlet sump and pump chamber. The pump specification should be sized as a 400L centrifugal pump. The maximum operating flow rate in the pumping system is 155 000m^3/day. The pumping system can run for an average of 14 hours per day.

3.1.8 WATER MANAGEMENT STRUCTURES

The solution trench conveys effluent from the drain outlets as well as other contaminated water from the facility to the silt trap of the RWD. A 150mm thick reinforced concrete lined solution trench is provided at the perimeter of the Nooitgedacht TSF, except the northern flank which is butted up against existing FSN1 TSF. The trapezoidal solution trench is 1m deep with side slopes of 1V:1.5H and a base width of 1m. The solution trench of the Nooitgedacht TSF will accommodate the maximum peak discharge from the penstock of 2.87m^3/sec.

A concrete lined solution trench will be installed since the effluent is contaminated dirty water. This will prevent seepage of the drain effluent into the underlying soils. It also provides a durable surface for cleaning and maintenance. An HDPE liner can be considered; however, the liner is exposed and therefore deteriorates over time. Cleaning and maintenance will need to be done by hand and any damage caused to the liner will need to be repaired immediately.

The drainage collector sump is a distinct water management facility designed for the TSF drains. The drainage collector sump is situated to the south-west of the TSF. The sump has been designed to accommodate a volume of 110 m^3. Water collected in the sump will be pumped by a vertical spindle pump into the solution trench to the east of the sump and flow to the RWD.

The stormwater runoff water quality is to be monitored by the applicant as and when required. Drain water discharging from the Nooitgedacht TSF and RWD underdrainage outlet pipes are to be monitored by the Mine's environmental staff/consultants, at most annually.

Clean stormwater around the facility will be gravity-drained away from the Nooitgedacht TSF. Vehicle and equipment access ramps will increase run-off into the water system. The run-off from the side slopes of the TSF wall will be attenuated by the vegetation cover established during operations. A trapezoidal stormwater diversion trench and bund are provided along the upstream flank of the TSF to divert clean stormwater away from the TSF site. This ensures that clean and dirty water systems are kept separate. A bund wall will be constructed on the outer edge of the access road to prevent flow of water on the access road. The compacted diversion bund embankment is 2.5m high and has a 2.5m wide crest with outer slopes of 1V:1.5H. The diversion trench is 2.5m deep with side slopes of 1V:1.5H and a base width of 2.5m. Dirty runoff water within the Nooitgedacht TSF catchment area is routed to the RWD via the concrete lined solution trench.

3.1.9 ACCESS CONTROL

A perimeter fence will not be installed around the TSF complex as the fence is prone to theft. Perimeter barrier warning signs will be installed around the perimeter of the TSF complex as an alternative. The signs will be

installed during construction. All signs will comply with the Harmony Gold Mine standards. A 5m wide all weather access road is provided around the facility to all key infrastructure for operational and monitoring requirements.

3.1.10 TAILINGS SLURRY DELIVERY SYSTEM

Slurry will be delivered from the Harmony One Plant to the TSF site via an overland Cement Mortar Lined (CML) flanged steel pipe up to the perimeter of the TSF. Slurry will be distributed to cyclones via a 900 nominal bore (NB) steel delivery pipeline around the TSF perimeter. The flange specification is SABS 1123:2500/3. A 900NB pinch valve (or similar approved) will be used at every cyclone.

Tailings delivery stations are provided every 30m along the starter wall crests to convey tailings slurry from the ring main pipeline to the cyclones. As the facility is raised with tailings, the cyclones will be raised to the new crest elevation. The ring main will be lifted onto new berms as required.

Four new pipelines are required to be constructed:

- Two 10km long slurry lines from Harmony One Plant to the St Helena Booster Pump Station;
- One 16k long slurry line from Brand A TSF to the St Helena Booster Pump Station; and
- One 17km slurry line from the St Helena Booster Pump Station to FSN 1 TSF.

The pipelines will be flanged steel pipelines installed above-ground on pre-cast concrete plinths and a 3.5m wide access road, adjacent to the pipelines, will be cleared/graded to provide access for construction, maintenance and inspections.

3.1.11 DECANT SYSTEM

The initial decant system comprises a gravity decant and a 900mm HDPE outfall pipe. Intermediate penstock intake structures are each a reinforced concrete base with one 510mm precast concrete penstock ring intake. The final penstock intake structure is a reinforced concrete base with four 510mm precast concrete penstock ring intakes.

As the facility rises the penstock intakes will be raised by stacking standard precast concrete penstock rings. The penstock intake structure is located centrally within the TSF basin. The intermediate and final penstock concrete bases will be located on concrete piles driven to refusal.

Based on previous experience on similar projects, the 900mm HDPE pipe will provide sufficient usage for approximately 10 years, thereafter the pipe may be susceptible to long term creep failure. Due to the pipes being susceptible to creep failure, the 900mm HDPE pipes will be concrete encased.

The final penstock outfall pipe comprises two 900mm HDPE pipes encased in concrete. In an event of one of the HDPE pipes being defective, the second HDPE pipe will be functional. The main outfall pipe will flow towards the RWD. Once sufficient head is obtained between 20-25m high, the decant system will change to a syphon system.

A syphon system consists of a syphon head and floating catwalk. The syphon head consists of a fibreglass structure that is airtight and watertight to create buoyancy. A fibreglass outfall pipe which is cut out to accommodate the pan is placed below. Due to the buoyant force, the pan floats on top of the pool of water below the outfall pipe. Water then collects into the pan which then flows into the outfall pipe. To overcome the difference in height between the basin and the wall, a vacuum pump is needed to overcome the head. Once the head is overcome a natural syphon occurs. The detailed syphon system and floating catwalk will be designed just prior to being required based on the operating conditions at that time. The system will be required 9 years after deposition begins. Once the syphon is in operation, the existing 900mm HDPE outfall pipes will become redundant and will be sealed-off.

3.1.12 MAINTENANCE PLAN AND EMERGENCY MANAGEMENT PLAN

An operating, maintenance and surveillance manual has been prepared for the Nooitgedacht TSF. The objective of the manual is to provide a methodology for the safe, efficient and environmentally responsible management of the TSF and associated infrastructure. Adherence to the guidelines provided in the operating, maintenance

and surveillance manual will result in continued safe operations of the TSF for the design life. A Trigger Action Response Plan (TARP) and Emergency Response Plan (ERP) will also be developed by Harmony.

3.1.13 OPERATION AND DEVELOPMENT

Tailings will be cyclone deposited on the eastern, western and southern flanks of the Nooitgedacht TSF. No cyclone deposition will take place on the outer wall of FSN1 TSF which butts up against the Nooitgedacht TSF. Spigot deposition will be done from FSN1 for pool control only when required. Delivery piping will be placed on the dormant facilities as required. Upstream cyclone deposition will commence when the TSF is at the FSN 1 height of 36m.

During cyclone tailings deposition, the total tailings stream is split into a coarse fraction (underflow) and fine fraction (overflow) by centrifugal separation. The coarse underflow is usually discharged as a flare or spray in the shape of an inverted cone (spray discharge). A continuous discharge with the appearance of a rope (roping discharge) must be avoided. The optimum split of underflow is usually achieved when the underflow is spraying, but just at the point between spraying and roping. An underflow : overflow mass split of 17 : 83 was used in the stage capacity calculations.

The cyclones are supported on customised steel stands placed in such a manner that an underflow cone of about 1.2m high will be deposited. The cyclone and stand are then moved to an adjacent position to deposit another underflow cone. The cyclone should also be moved to fill in low spots between underflow cones to ensure an even horizontal surface along the top of the outer wall.

The fine overflow will be discharged into the basin through an overflow pipe connected to the cyclone. The end of the overflow pipe discharging into the basin should always be at a lower elevation than the cyclone vortex finder. During commissioning the overflow pipes must be long enough to discharge overflow directly into the basin area beyond the toe drains. Overflow must be discharged well beyond the coarse underflow zone and must not be discharged directly over the exposed toe or blanket drains during commissioning. Deposition of the tailings material must be done according to the deposition plan. The deposition plan must ensure that the rate of rise of the cyclone underflow is greater than the rate of rise of the basin. The deposition position into the basin is to be selected based upon managing the height of solids around the TSF perimeter and the shape of the pool. The deposition locations are to be rotated around the facility to ensure adequate beach formation and favourable pool location and size. Vegetation on the surface and outer slopes of the facility will reduce erosion and dust generation. Vegetation on all the outer side slopes is to be established at closure.

An initial layout map / design drawing of the TSF facility is included as Figure 9. This represents the latest design completed for the TSF which has already undergone several iterations. Certain details regarding the design are still to be updated and amended however a preliminary design report with further technical design information is included in Appendix H.

Stripped topsoil will be stored at the areas shown in Figure 9. The outer surface, the benches and the shape top surface of the TSF will ultimately be covered with a 300 mm thick layer of stripped and stockpiled topsoil retained from earlier construction removal. The topsoil will be grassed and vegetated to form a self-sufficient eco-system.

Details regarding the stockpile South East of Nooitgedacht TSF are as follows:

- 3.1. Volume: 927 500 m3
- 3.2. Footprint Area: 37 Ha
- Max height: 2.5 m

3.1.14 ADDITIONAL ANCILLARY INFRASTRUCTURE REQUIRED

The following additional infrastructure will be required to be constructed / installed adjacent to the site planned for the Nooitgedacht TSF:

- Diesel Storage during construction;
- Construction laydown area;

- Parking area;
- Workshop area; and
- Pump stations.

This infrastructure will be located on a brownfields site immediately adjacent to the site proposed for the Nooitgedacht TSF (refer to Figure 8 for approximate location). It should be noted that no borrow pits will be required for construction of the TSF. Some tailings material is required as part of the design which would be sourced from the existing FSN4 TSF. Further detail on the ancillary infrastructure required will be provided in the EIA report.

Figure 8: Approximate location of area for ancillary infrastructure listed above (pink polygon), adjacent to the TSF site (yellow footprint, red polygon).

3.1.15 CLOSURE AND DECOMISSIONING

The specific objectives that Harmony will adopt for rehabilitation and closure are to:

- Comply with national regulatory requirements;
- Protect the environment and public health and safety by using safe and responsible closure practices;
- Improve water quality;
- Establish self-sustaining vegetation that will stabilize the TSF;
- Develop end land uses that incorporate beneficial uses;
- Prevent health and safety risks to the surrounding community;
- Reduce the requirement for long-term monitoring and maintenance by establishing stable landforms;
- Enhance a positive socio-economic impact by achieving a sustainable land-use condition or alternatively as agreed upon with the applicable government regulator and affected communities; and
- Avoid or reduce costs and long-term liabilities to the company, government and public.

The closure of TSFs will involve their rehabilitation. Contour walls will be constructed, after which additives will be applied in order that favourable conditions for plant growth can occur. Once this has been achieved, vegetation will be planted on top and on the sides of the tailings to stabilise the tailings against wind and water

erosion. When the vegetation has been established maintenance and monitoring of the tailings dam will take place. The maintenance will take place over a period of three years, while the monitoring will take place over a period of five years on a quarterly basis by analysing samples for pollutants.

Maintenance and aftercare- Maintenance and aftercare is typically applied during the closure period (i.e. once active rehabilitation and closure is completed). Typically, aftercare and maintenance includes general maintenance activities including, soil amelioration, ongoing monitoring, control of alien invasive, and stability and settlement actions. Management of water within the mine area will include the management and maintenance of surface water controls, as well as ongoing closure phase monitoring of the water resources. The management of polluted water into the post-closure phase will be included and dealt with as a residual and latent impact.

3.1.16 PROJECT TIMELINES

The construction timeline is estimated at 55 months (4.6 years). This extended construction period will require further rigorous timeline and deposition access planning which will need to be confirmed with the construction contractor(s). Construction is expected to commence in 2026.

The deposition life of the Nooitgedacht TSF is 34 years, after which, pending future reclamation, it may exist as a dormant TSF for a very long time. A detailed closure plan will be developed during the life of the TSF. The objectives for the closure and rehabilitation of the TSF is to prevent pollution to the surrounding environment and ensure a stable facility is maintained.

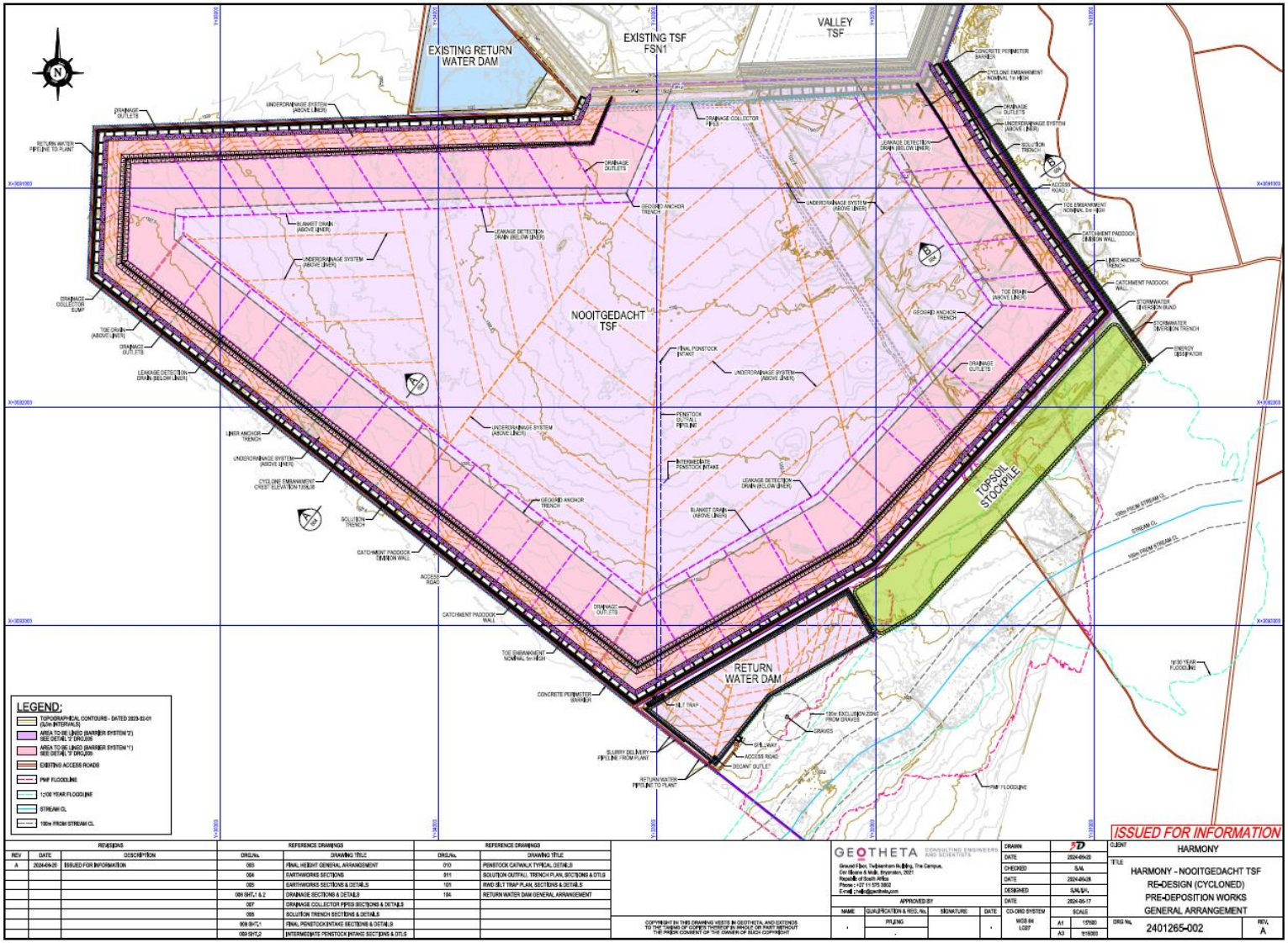


Figure 9: Preliminary general arrangement of the proposed Nooitgedacht TSF

4 POLICY AND LEGISLATIVE CONTEXT

This section provides an overview of the governing legislation identified which relates to the proposed project.

4.1.1 CONSITUTION OF THE REBPUBLIC OF SOUTH AFRICA

The constitution of any country is the supreme law of that country. The Bill of Rights in chapter 2 section 24 of the Constitution of South Africa Act (Act No. 108 of 1996) makes provisions for environmental issues and declares that: “Everyone has the right -

a) to an environment that is not harmful to their health or well-being; and

b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that:

i. prevent pollution and ecological degradation;

ii. promote conservation; and

iii. secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development”.

The EIA and associated impact mitigation actions are conducted to fulfil the requirement of the Bill of Rights.

4.1.2 THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT (MPRDA)

The MPRDA aims to “make provision for equitable access to, and sustainable development of, the nation’s mineral and petroleum resources”. The MPRDA outlines the procedural requirements that need to be met to acquire mineral and petroleum rights in South Africa. The MPRDA further governs the sustainable utilisation of South Africa’s mineral resources.

Several amendments have been made to the MPRDA. These include, but are not limited to, the amendment to Section 102 which concerns the amendment of rights, permits, programmes and plans, to requiring the written permission from the Minister for any amendment or alteration; and the Section 5A(c) requirement that landowners or land occupiers receive twenty-one (21) days’ written notice prior to any activities taking place on their properties. One of the most recent amendments requires all mining related activities to follow the full NEMA process as per the 2014 EIA Regulations, which came into effect on 4 December 2014 as was last amended in June 2021.

In support of the separate WML application specifically, the applicant is required to conduct an EIA process comprising of the preparation of environmental Scoping and EIA Reports, an EMPr, as well as Interested and Affected Party (I&AP) consultations, all of which must be submitted to the DMPR for adjudication. This report has been compiled in accordance with Regulation 49 of the MPRDA and Regulation 21 and Appendix 2 of the EIA Regulations (2014, as amended) in order to satisfy the criteria for a Scoping Report. This Scoping Report pertains to both the NEMA and the WML application for the proposed new Nooitgedacht TSF and associated infrastructure.

4.1.3 THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT (NEMA)

The main aim of the National Environmental Management Act, 1998 (Act 107 of 1998 – NEMA) is to provide for co-operative governance by establishing decision-making principles on matters affecting the environment. In terms of the NEMA EIA Regulations, the applicant is required to appoint an EAP to undertake the EIA process, as well as conduct the public participation process towards an application for EA/WML. In South Africa, EIA’s became a legal requirement in 1997 with the promulgation of regulations under the Environment Conservation Act (ECA). Subsequently, NEMA was passed in 1998. Section 24(2) of NEMA empowers the Minister and any MEC, with the concurrence of the Minister, to identify activities which must be considered, investigated, assessed and reported on to the competent authority responsible for granting the relevant EA. On 21 April 2006, the Minister of Environmental Affairs and Tourism (now DFFE) promulgated regulations in terms of Chapter 5 of the NEMA. These regulations, in terms of the NEMA, were amended in June 2010 and again in December 2014 as well as April 2017 and June 2021. The 2014 NEMA EIA Regulations (as amended) are applicable to this project.

Mining activities, including activities such as the proposed TSF officially became governable under the NEMA EIA Regulations (as amended) in December 2014 with the competent authority identified as the DMPR for the waste listed activities and for the NEMA listed activities.

The objective of the EIA Regulations is to establish the procedures that must be followed in the consideration, investigation, assessment and reporting of the listed activities that are triggered by the proposed project. The purpose of these procedures is to provide the competent authority with adequate information to make informed decisions which ensure that activities which may impact negatively on the environment to an unacceptable degree are not authorised, and that activities which are authorised are undertaken in such a manner that the environmental impacts are managed to acceptable levels.

In accordance with the provisions of Sections 24(5) and Section 44 of the NEMA the Minister has published Regulations (GN R. 982) pertaining to the required process for conducting EIA's in order to apply for, and be considered for, the issuing of an EA/WML. These EIA Regulations provide a detailed description of the EIA process to be followed when applying for EA/WML for any listed activity.

An environmental Scoping and Impact Assessment process is reserved for activities which have the potential to result in significant impacts which are complex to assess. Scoping and Impact Assessment studies accordingly provide a mechanism for the comprehensive assessment of activities that are likely to have more significant environmental impacts. Figure 10 below provides a graphic representation of all the components of a full EIA process.

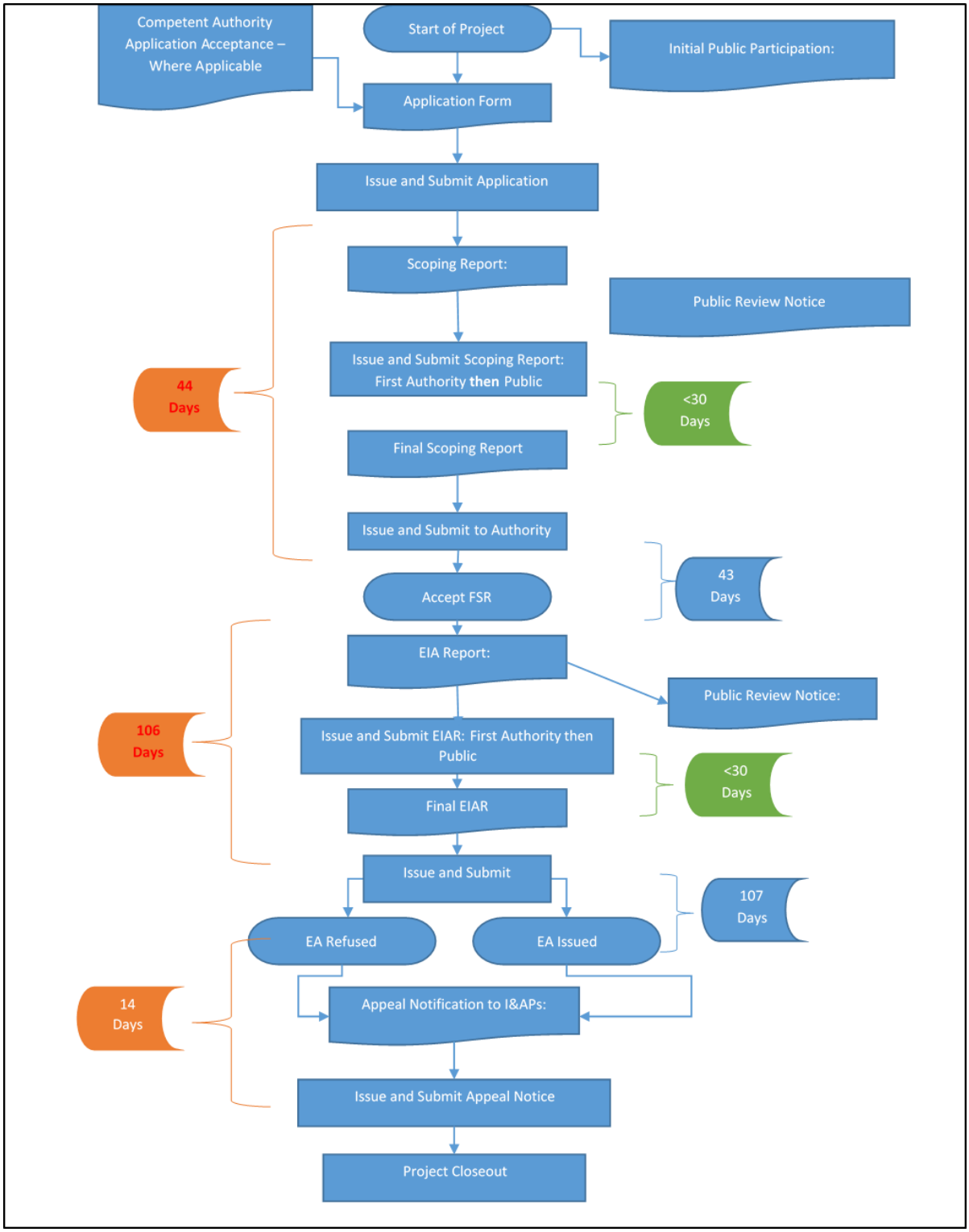


Figure 10: EIA process diagram

NEMA sets out the general objectives of IEM in South Africa, including to (section 23(2)), of which the following two are of relevance for this report:

- Identify, predict and evaluate the actual and potential impact on the environment, socio-economic conditions and cultural heritage, the risks and consequences and alternatives and options for mitigation of activities. This is to be done with a view to minimising negative impacts, maximising benefits and promoting compliance with the principles of environmental management set out in section 2 (of NEMA).

- Ensure that the effects of activities on the environment receive adequate consideration before actions are taken in connection with them

Section 24P of the NEMA requires that an applicant for an environmental authorisation relating to prospecting, mining or production must, before the Minister responsible for mineral resources issues the EA, comply with the prescribed financial provision for the rehabilitation, closure and ongoing post decommissioning management of negative environmental impacts. Therefore, the potential environmental liabilities associated with the proposed activity must be quantified and the method of financial provision indicated in line with the NEMA Financial Provision Regulations (2015). The financial provision costs will be presented in the EIA Report.

4.1.3.1 LISTED ACTIVITIES

In accordance with the provisions of Sections 24(5) and Section 44 of the NEMA the Minister has published Regulations (GN R. 982) pertaining to the required process for conducting EIA's in order to apply for, and be considered for, the issuing of an EA. These EIA Regulations provide a detailed description of the process to be followed when applying for EA for any listed activity.

The proposed TSF and associated infrastructure requires both an EA a WML to operate, this will be undertaken as an integrated application. The listed activities that are triggered by the project in terms of the 2014 EIA Regulations GN983, 984 and 985 promulgated under the National Environmental Management Act (Act 107 of 1998 - NEMA) are specified in Table 3 below:

Table 3: Relevant NEMA listed activities

Activity No(s):	Activity	Portion of the proposed project to which the applicable listed activity relates.
GN983, Activity 10	The development and related operation of infrastructure exceeding 1 000 metres in length for the bulk transportation of sewage, effluent, process water, waste water, return water, industrial discharge or slimes- (i) with an internal diameter of 0,36 metres or more; or (ii) with a peak throughput of 120 litres per second or more; excluding where- (a) such infrastructure is for the bulk transportation of sewage, effluent, process water, waste water, return water, industrial discharge or slimes inside a road reserve or railway line reserve; or (b) where such development will occur within an urban area.	Approximately 43 km of slurry pipelines will be required in three sections with a servitude of approximately 4 m wide. Four new pipelines are required to be constructed: • Two 10km long slurry lines from Harmony One Plant to the St Helena Booster Pump Station; • One 16k long slurry line from Brand A TSF to the St Helena Booster Pump Station; and • One 17km slurry line from the St Helena Booster Pump Station to FSN 1 TSF. The pipelines will be flanged steel pipelines of over 0,36m in diameter and installed above-ground on pre-cast concrete plinths and a 3.5m wide access road, adjacent to the pipelines, will be cleared/graded to provide access for construction, maintenance and inspections. The diameter of the pipelines is as follows: approximately 600 mm residue pipelines and 800 mm for return water pipelines – however the exact sizes will be confirmed in the EIA phase once further design information becomes available.

Activity No(s):	Activity	Portion of the proposed project to which the applicable listed activity relates.
GN983, Activity 12	The development of- (ii) infrastructure or structures with a physical footprint of 100 square metres or more; where such development occurs- (a) within a watercourse; or (c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse;- excluding- (aa) the development of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour; (bb) where such development activities are related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies; (cc) activities listed in activity 14 in Listing Notice 2 of 2014 or activity 14 in Listing Notice 3 of 2014, in which case that activity applies; (dd) where such development occurs within an urban area; (ee) where such development occurs within existing roads, road reserves or railway line reserves; or (ff) the development of temporary infrastructure or structures where such infrastructure or structures will be removed within 6 weeks of the commencement of development and where indigenous vegetation will not be cleared.	Various wetlands were identified within and in close proximity to the proposed TSF and associated pipelines site. Development will occur in and near several of these areas.
GN983, Activity 14	The development and related operation of facilities or infrastructure, for the storage, or for the storage and handling, of a dangerous good, where such storage occurs in containers with a combined capacity of 80 cubic metres or more but not exceeding 500 cubic metres.	Diesel will be stored during construction of the TSF at quantities still to be confirmed in the EIA report, however the total volume will likely exceed 80 cubic meters.
GN983, Activity 19	"The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse; but excluding where such infilling, depositing, dredging, excavation, removal or moving-	The TSF construction will require depositing and infilling of material of over 10 cubes from identified wetland areas.

Activity No(s):	Activity	Portion of the proposed project to which the applicable listed activity relates.
	(a) will occur behind a development setback; (b) is for maintenance purposes undertaken in accordance with a maintenance management plan; (c) falls within the ambit of activity 21 in this Notice, in which case that activity applies; (d) occurs within existing ports or harbours that will not increase the development footprint of the port or harbour; or (e) where such development is related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies."	
GN983, Activity 21D	Any activity including the operation of that activity which requires an amendment or variation to a right or permit in terms of section 102 of the Mineral and Petroleum Resources Development Act, as well as any other applicable activity contained in this Listing Notice or in Listing Notice 3 of 2014, required for such amendment.	Amendment of the approved Mining Right EMPr through a MPRDA Section 102 application will be required.
GN984, Activity 6	The development of facilities or infrastructure for any process or activity which requires a permit or licence or an amended permit or licence in terms of national or provincial legislation governing the generation or release of emissions, pollution or effluent, excluding- (i) activities which are identified and included in Listing Notice 1 of 2014; (ii) activities which are included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case the National Environmental Management: Waste Act, 2008 applies; (iii) the development of facilities or infrastructure for the treatment of effluent, polluted water, wastewater or sewage where such facilities have a daily throughput capacity of 2 000 cubic metres or less; or (iv) where the development is directly related to aquaculture facilities or infrastructure where the wastewater discharge capacity will not exceed 50 cubic metres per day.	The Tailings Storage Facility requires a Water Use License.
GN984, Activity 15	The clearance of an area of 20 hectares or more of indigenous vegetation, excluding where such	Clearance of over 20ha of indigenous vegetation will be required for the TSF and associated infrastructure footprints. The total area to be cleared is up to 897

Activity No(s):	Activity	Portion of the proposed project to which the applicable listed activity relates.
	clearance of indigenous vegetation is required for- (i) the undertaking of a linear activity; or (ii) maintenance purposes undertaken in accordance with a maintenance management plan.	ha, as well as approximately 43 km of pipelines in three sections with a servitude of approximately 4 m wide.
GN985 Activity 12	The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan. b. Free State iv. Areas within a watercourse or wetland; or within 100 metres from the edge of a watercourse or wetland	Clearance of over 300 square meters of indigenous vegetation is required and this may be located within wetland areas. Part of the site falls within a Critical Biodiversity Area (CBA) 1 as well as Ecological Support Area (ESA) 1 and 2 areas.
GN985 Activity 14	The development of- ii. infrastructure or structures with a physical footprint of 10 square metres or more; where such development occurs- (a) within a watercourse; (c) if no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse; b. Free State i. Outside urban areas: (ff) critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans as adopted by the competent authority or in bioregional plans. Excluding the development of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour.	Several watercourses will be directly affected by the TSF and pipelines construction.

4.1.3.2 THE NATIONAL WEB-BASED ENVIRONMENT SCREENING TOOL, 2019

On the 5th of July 2019, the Department of Forestry, Fisheries and the Environment (DFFE) issued a Notice of the requirement to submit a report generated by the National Web-based Environmental Screening Tool in terms of section 24(5)(h) of the NEMA, 1998 (Act No 107 of 1998) and Regulation 16(1)(b)(v) of the EIA regulations, 2014, as amended. The submission of this report is compulsory when applying for environmental authorisation in terms of Regulation 19 and Regulation 21 of the Environmental Impact Assessment Regulations, 2014 effective from the 4th of October 2019. The DFFE Screening Tool Report was generated on the 2nd of October 2023. The Screening reports for the various project components are provided in Appendix F of this report. The main findings to be discussed from the screening report are listed below.

The following summary of the study area's environmental sensitivities were identified in the Environmental Screening Report. The environmental sensitivities for the various proposed development footprints are indicated on Table 4.

Table 4: Environmental Sensitivity of Project Area.

Theme	Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
Agriculture Theme		**X (All infrastructure)**		
Animal Species Theme		**X (TSF and Pipelines)**	**X (LP Water System)**	
Aquatic Biodiversity Theme	**X (TSF and Pipelines)**			**X (LP Water System)**
Archaeological and Cultural Heritage Theme		**X (TSF and Pipelines)**	**X (LP Water System)**	
Civil Aviation (Solar PV) Theme		**X (TSF)**		**X (Pipelines and LP Water System)**
Defence Theme				**X (All infrastructure)**
Palaeontology Theme	**X (Pipelines)**	**X (TSF)**	**X (LP Water System)**	
Plant Species Theme	**X (pipelines)**			**X (TSF and LP Water System)**
Terrestrial Biodiversity Theme	**X (All infrastructure)**			

The information collected by the specialists and EAP's assessment may be used to confirm or dispute (as may be applicable) the environmental sensitivity ratings identified by the National Screening Tool. The EAP has undertaken a site sensitivity verification (Appendix F) and EAPs assessments/theme and sensitivity ratings identified by the Screening Tool are summarized in Table 5 below. Table 6 presents these Specialist Assessments/Studies as well as the motivations behind the EAP's decision of recommending or not recommending the undertaking of certain Specialist Assessments.

Table 5: Specialist Assessments/themes and Sensitivity Ratings identified by DFFE's Web-based Screening Tool.

Assessment Theme	Sensitivity Rating (Screening Report)	Sensitivity Rating (Site Verification)	Response
Agriculture Theme	High	Medium	Relative Agricultural Sensitivity was assessed to be low by the Site Sensitivity Verification Report (SSVR) included in Appendix F. The SSV found that there are some agricultural activities within the study area. Based on the aspects of the proposed development and current environmental conditions on site, it is anticipated that there will be low - moderate impacts on the agricultural potential. The proposed activities` buffer area often impede into "high" sensitivity crop fields. These sensitivities are associated with some arable land potential and capability conditions (i.e., soil status), therefore some high land capability areas will be impacted on by the TSF expansion and slurry pipelines. A medium sensitivity is suggested.
Animal Species Theme	High	Very High (based on specialist site visit)	The proposed development site has been transformed mainly due to the mining and agricultural activities which have disturbed the fauna habitats. Although the study area falls within Critical Biodiversity Area (CBA) 1 and a vulnerable ecosystem, the mining activities have significantly disturbed the natural ecosystem and therefore, there is a low likelihood of vulnerable, species of conservation concern (SCC) and/or protected fauna present within the area. However, even though the impacts on animal life is anticipated to be relatively low, the extent of the site and potential presence of important biodiversity cannot be excluded. During the specialist site visit one SCC (Sensitive Species 15) was recorded during the field assessment. Sensitive species 15 is categorised as VU on both a regional and an international scale. Additionally, the species is listed in the Convention on International Trade in Endangered Species (CITES) Appendix II, as well as a Threatened or Protected Species (TOPS). It is endemic to South Africa, where it is found only in the grasslands of the northern Free State and the southwestern parts of Mpumalanga with an estimated extent of occurrence of 37 617 km² (Alexander et al., 2018). The species is considered to be a habitat specialist, that is highly philopatric (tending to return to or remain near a particular site or area) for burrowing sites. The species is known to not disperse across the landscape to make new burrows should its habitat be destroyed (Alexander et al., 2018). A very high sensitivity is therefore suggested.
Aquatic Biodiversity Theme	Very High	High	Relative Aquatic Biodiversity Theme Sensitivity was assessed to be Very High-Sensitive for TSF and pipeline infrastructure. Based on review of desktop information as well as site verification, it was found that there are several pre-identified wetlands in and around the proposed development footprint. A high sensitivity is suggested.
Archaeological and Cultural Heritage Theme	High	High (based on specialist site visit)	Relative Archaeological and Cultural Heritage Theme Sensitivity was assessed to be High Sensitive for the TSF and pipeline infrastructure and subsequent to the SSVR being compiled the heritage specialist did subsequently identify heritage features on site of heritage significance. the high sensitivity is therefore confirmed.
Civil Aviation Theme	High	Low	Relative Civil Aviation Theme Sensitivity was assessed to be Low-Sensitive. The proposed development blends in with the existing land uses in the area and there is no anticipated impacts on civil aviation emanating from the project. The proposed development does not entail the establishment of high-rise structures, use of high frequency electromagnetic radiation nor reflecting infrastructure. Therefore,

Assessment Theme	Sensitivity Rating (Screening Report)	Sensitivity Rating (Site Verification)	Response
			based on the aspects of the proposed development and current environmental conditions on site, it is anticipated that there will be low impacts on Civil Aviation.
Defence Theme	Low	Low	Relative Defence Theme Sensitivity was assessed as there are no military bases / facilities present within the vicinity of the project site. The nearest defence facility is the military base in Kroonstad, approximately 60km northeast of the site. Therefore, based on the aspects of the proposed development and current environmental conditions on site, it is anticipated that there will be low impacts on defence facilities.
Palaeontology Theme	Very High	Low	Based on the PalaeoMap from SAHRIS, the Palaeontological Sensitivity of the proposed area of the project footprint occurs in an area with very high palaeo-sensitivity. The geology of the development indicates that fossils may be present in the development footprint which could be affected during certain construction activities. A site-specific field survey of the development footprint was conducted on foot and by motor vehicle on 17 April 2023. No fossiliferous outcrop was detected in the proposed development area. The apparent rarity of fossil heritage in the proposed development footprint suggests that the impact of the development will be of a low significance in palaeontological terms. A low sensitivity is therefore recommended.
Plant Species Theme	Very High	Medium	Relative Plant Species Sensitivity was assessed to be moderate as the SSVR found that the proposed development site has been transformed mainly due to the mining and agricultural activities which have disturbed the plant habitats. Based on the aspects of the proposed development and current environmental conditions on site, it is anticipated that there will be moderate impacts on the plant species and a medium sensitivity is suggested.
Terrestrial Biodiversity Theme	Very High	Very High	Relative Terrestrial Biodiversity Sensitivity was assessed to be Medium-Low Sensitive as the SSV found that the proposed development site has been transformed mainly due to the mining and agricultural activities which have disturbed the natural habitats and ecosystems. During the specialist site visit several SCC, Sensitive species 15 was recorded during the field assessment. Sensitive species 15 is categorised as VU on both a regional and an international scale. Additionally, the species is listed in the Convention on International Trade in Endangered Species (CITES) Appendix II, as well as a Threatened or Protected Species (TOPS). It is endemic to South Africa, where it is found only in the grasslands of the northern Free State and the southwestern parts of Mpumalanga with an estimated extent of occurrence of 37 617 km² (Alexander et al., 2018). The species is considered to be a habitat specialist, that is highly philopatric (tending to return to or remain near a particular site or area) for burrowing sites. The species is known to not disperse across the landscape to make new burrows should its habitat be destroyed (Alexander et al., 2018). A very high sensitivity is therefore suggested / confirmed.

Table 6: Summary of discussions regarding the undertaking of specialist Assessments.

SPECIALIST ASSESSMENT	DICUSSION AND MOTIVATION
Agricultural Impact Assessment	The SSV found that there are some agricultural activities within the study area. Although it is anticipated that there will be minimal impact on agricultural activities and/or land and as such, **an Agricultural Impact Assessment is recommended by the EAP** to confirm the potential impacts and outline the necessary mitigation measures.
Archaeological and Cultural Heritage Impact Assessment	Based on the potential sensitivities, a **Heritage Impact Assessment (HIA) is recommended** by the EAP to identify the heritage features and provide mitigation measures.
Palaeontology Impact Assessment	Based on the 1:250 000 SAHRIS PalaeoMap and the National Web-Based Screening Tool Report, the study area is located within a Medium Palaeo-Sensitivity area. The study area is located on an area which has been transformed. Based on the very high palaeo-sensitivity rating in the screening tool report, consequently the EAPs **recommendation that a Palaeontological Impact Assessment be undertaken** for the project as there may be impacts on palaeontology.
Terrestrial Biodiversity Impact Assessment	During the specialist site visit several SCC, Sensitive species 15 was recorded during the field assessment. Sensitive species 15 is categorised as VU on both a regional and an international scale. Additionally, the species is listed in the Convention on International Trade in Endangered Species (CITES) Appendix II, as well as a Threatened or Protected Species (TOPS). The species is considered to be a habitat specialist, that is highly philopatric (tending to return to or remain near a particular site or area) for burrowing sites. The species is known to not disperse across the landscape to make new burrows should its habitat be destroyed. A very high sensitivity is therefore suggested. A detailed relocation and monitoring programme for this species will be drafted and included in the EIA report.
Plant Species Assessment	Similarly, to the rationale above, the EAP recommends that a Terrestrial Biodiversity Assessment be undertaken to confirm if there are no Flora or Fauna SCC, or protected species within the development site. The **Plant Species Assessment will be covered by the Terrestrial Biodiversity Impact Assessment**.
Animal Species Assessment	Similarly, to the rationale above for Terrestrial Biodiversity Impact Assessment, the EAP recommends that a Terrestrial Biodiversity Assessment be undertaken to confirm protected species within the development site. The **Animal Species Assessment will be covered by the Terrestrial Biodiversity Impact Assessment**.
Aquatic Biodiversity Impact Assessment	Based on review of desktop information and site verification, it was found that there are pre-identified wetlands around the proposed development footprint. Even though these wetlands were noted to have been already impacted upon by the mining activities and therefore not in their natural state, their Present Ecological State (PES) and Site Ecological Importance (SEI) cannot be undermined. Therefore, the EAP **recommends that an Aquatic Biodiversity Assessment be undertaken** to assess the PES, SEI, risk matrix and provide necessary mitigation measures.
Hydrology Assessment	The proposed development entails the establishment of a medium-high hazardous waste facility which its integrity can be influenced by hydrological conditions and inversely, it can impact the hydrological conditions. Provided that hydrological analysis can assist in analysing the scope of the flood, position the runoff pollution sources, and predict geomorphological change on runoff, the **EAP recommends a Hydrology Assessment be undertaken for the project**.
Noise Impact Assessment	A noise impact assessment (NIA) predicts the impact that noise, from a proposed development, is likely to have on the surrounding area. An NIA is usually associated with large industries or developments with excessive noise generation such engineering companies, printing presses, textile mills, and metal works which immensely generate noise pollution. The noise from the machine's mechanical pneumatic drills, saws, and rotating belts usually produces intolerable sounds and are a nuisance to the public. Considering that the proposed development is for a TSF within an area used for similar activities, the EAP **recommend a Noise Impact Compliance Statement** is sufficient for the project.
Health Impact Assessment	Health impact assessment (HIA) is a tool that can help communities, decision makers, and practitioners make choices that improve public health. HIA can be used to evaluate objectively the potential health effects of a project or policy before it is built or implemented. HIA is usually undertaken for projects which can have health impacts on the surrounding communities. Based on the proposed project description, the establishment of the TSF can be associated with health impacts

SPECIALIST ASSESSMENT	DICUSSION AND MOTIVATION
	especially cumulative health impacts considering the existing TSF's in the area. Therefore, the EAP **recommends a Health Risk and Radiological Assessment be undertaken for the project.**
Socio-Economic Assessment	The overarching aim of undertaking a Socio-Economic Assessment of a projects is to develop an understanding of the current social and economic environment and aims to assess or assesses the potential impact of the project on the socio-economic environment. Socio-Economic Assessment are usually undertaken for projects which have an impact and/or affect the social and/or economic structures such as low-cost housing projects, mixed-use developments, upgrading of informal settlements, linear projects transecting different communities, etc. Based on the project information and the purpose of the development largely relating to the nature of the project being the same activity already undertaken on the site, minimal socio-economic influence / change is anticipated. However, the EAP **recommends a Socio-Economic Assessment** for the project due to the surrounding social structures and potential cumulative socio-economic impacts which may emerge from the project.
Ambient Air Quality Impact Assessment	Air Quality Impact Assessment (AQIA) is an evaluation, using approved computer models, of the ambient air quality impacts that the public may be expected to be exposed to due to air pollution emissions from one or more facilities. AQIA is an important technique for determining the relative contribution to ground level pollutant concentrations of specific current or future source emissions at receptor sites. AIQA is usually undertaken is for projects which will potentially emit and/or increase pollutant concentrations during construction and/or operational phases. Based on the project information, the EAP **recommends an Air Quality Impact Assessment** for the project as it will TSF processes will potentially emit and/or increase pollutant concentrations.
Additional Specialist Assessments Identified by the EAP	
Geohydrology Assessment	Hydrogeological assessments consider how proposed developments may be affected by groundwater and nearby surface water, in terms of potential flood risk and impact on structural foundations. Provided that the nature of the proposed development is a hazardous waste facility and it may affected and/or be affected by groundwater and the pre-identified nearby wetlands, the **EAP recommends a Geohydrology Assessment be undertaken for the project**.
Landscape/Visual Impact Assessment	Although the development is a TSF proposed within an area used for similar land uses however based on the proposed height of the TSF a **Landscape / Visual Impact Assessment is recommended** by the EAP.
Financial Provisions: Closure Costing	Financial provision plan is a form of security assessment. Before mining companies undertake mining activities, mining companies must assess what it will cost to rehabilitate the impact of their operations on the environment, and then they must set aside and secure the amount of money needed to cover that cost until the money is needed for rehabilitation. Therefore, a **Financial Provisions Closure costing is recommended** by the EAP.
Climate Change Impact Assessment	Climate change impact assessments seek to characterize, diagnose, and project risks or impacts of environmental change on people, communities, economic activities, infrastructure, ecosystems, or valued natural resource. The need to undertake Climate Change Impact Assessments as part of EIA Projects which may influence climate change has been on the rise as competent authorities seek to assess how the project has considered climate change. The EAP **recommends that a Climate Change Impact Assessment be undertaken** to evaluate how the TSF will impact on climate change and also how future climate change could affect the project.
Traffic Impact Assessment	A traffic impact study or traffic impact assessment is a study which assesses the effect that a particular development has on the transportation network. New developments are one of the major causes of traffic congestion in many of the major cities of developing countries, due to the absence of adequate mitigation measures. Developments usually increases and/or contributes to the traffic in the area during the construction phase as a result of construction vehicles going to and from the development site and traffic control measure such as 'Stop and Go'. It is anticipated that the proposed development of the TSF will increase the traffic congestion as various construction vehicles bearing various loads will be used during the construction of the TSF. Therefore, the EAP **recommends a Traffic Impact Assessment be undertaken for the project.**

SPECIALIST ASSESSMENT	DICUSSION AND MOTIVATION
Hydropedology	Soils not only control hydrological processes but also serve as indicators of hydrological behaviour. A hydropedogy assessment should be undertaken to investigate the hydropedological properties of the soils associated with the watercourses. **A hydropedology assessment is recommended** to understand and manage land use impacts and mitigating the impact of development on nearby watercourses.

4.1.4 NATIONAL ENVIRONMENTAL MANAGEMENT BIODIVERSITY ACT (NEMBA)

The National Environmental Management Biodiversity Act (Act No. 10 of 2004 – NEMBA) provides for the management and conservation of South Africa's biodiversity within the framework of the NEMA as well as the protection of species and ecosystems that warrant national protection. Within the framework of this act, various regulations are promulgated which provide specific requirements and management measures relating to protecting threatened ecosystems, threatened or protected species as well as the control of alien and invasive species. A summary of these regulations is presented below.

The National List of Ecosystems that are Threatened and Need of Protection (GN 1002 of 2011) are promulgated under the NEMBA and these Regulations provide for listing of threatened or protected ecosystems in one of the following categories:

Critically Endangered (CR) 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;

Endangered (EN) 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;

Vulnerable (VU) 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

Protected ecosystems, being ecosystems that are of high conservation value or of high national or provincial importance, although they are not listed as critically endangered, endangered or vulnerable.

Further regulations published under the NEMBA are the threatened or protected Species Regulations (GN R 152 OF 2007) which aims to:

(a) further regulate the permit system set out in Chapter 7 of the Biodiversity Act insofar as that system applies to restricted activities involving specimens of listed threatened or protected species;

(b) provide for the registration of captive breeding operations, commercial exhibition facilities, game farms, nurseries, scientific institutions, sanctuaries and rehabilitation facilities and wildlife traders;

(c) provide for the regulation of the carrying out of a specific restricted activity, namely hunting;

(d) provide for the prohibition of specific restricted activities involving specific listed threatened or protected species;

(e) provide for the protection of wild populations of listed threatened species; and

(f) provide for the composition and operating procedure of the Scientific Authority.

The Alien and Invasive Species Lists are promulgated under the NEMBA with the aim of protecting the quality and quantity of arable land in South Africa. Loss of arable land should be avoided and declared Weeds and Invaders in South Africa are categorised according to one of the following categories, and require control or removal:

Category 1a Listed Invasive Species: Category 1a Listed Invasive Species are those species listed as such by notice in terms of section 70(1)(a) of the Act as species which must be combated or eradicated;

Category 1b Listed Invasive Species: Category 1b Listed Invasive Species are those species listed as such by notice in terms of section 70(1)(a) of the Act as species which must be controlled;

Category 2 Listed Invasive Species: Category 2 Listed Invasive Species are those species listed by notice in terms of section 70(1)(a) of the Act as species which require a permit to carry out a restricted activity within an area specified in the Notice or an area specified in the permit, as the case may be; and

Category 3 Listed Invasive Species: Category 3 Listed Invasive Species are species that are listed by notice in terms of section 70(1)(a) of the Act, as species which are subject to exemptions in terms of section 71(3) and prohibitions in terms of section 71A of Act, as specified in the Notice.

In giving effect to the above, the Alien and Invasive Species Regulations (GNR 1020 of 2020) provide for amongst others, the prevention of the spread or allowing the spread of, any specimen of a listed invasive species.

4.1.5 NATIONAL ENVIRONMENTAL MANAGEMENT: PROTECTED AREAS ACT

The National Environmental Management Protected Areas Act (Act No. 57 of 2003 – NEMPAA) is intended to *"provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes"* and creating a *"national system of protected areas in South Africa as part of a strategy to manage and conserve its biodiversity".*

The NEMPAA defines various kinds of protected areas, namely: *"special nature reserves, national parks, nature reserves (including wilderness areas) and protected environments; world heritage sites; marine protected areas; specially protected forest areas, forest nature reserves and forest wilderness areas declared in terms of the National Forests Act, 1998 (Act 84 of 1998); and mountain catchment areas declared in terms of the Mountain Catchment Areas Act, 1970 (Act 63 of 1970)".*

There are no protected areas in the vicinity of the proposed site

4.1.6 THE NATIONAL ENVIRONMENTAL MANAGEMENT AIR QUALITY ACT (NEMAQA)

The National Environmental Management: Air Quality Act (Act No. 39 of 2004 as amended – NEMAQA) is the main legislative tool for the management of air pollution and related activities. The Object of the Act is:

- To protect the environment by providing reasonable measures for –
    i. the protection and enhancement of the quality of air in the republic;
    ii. the prevention of air pollution and ecological degradation; and
    iii. securing ecologically sustainable development while promoting justifiable economic and social development; and
- Generally, to give effect to Section 24(b) of the constitution in order to enhance the quality of ambient air for the sake of securing an environment that is not harmful to the health and well-being of people.

The NEMAQA mandates the Minister of Environment to publish a list of activities which result in atmospheric emissions and consequently cause significant detrimental effects on the environment, human health and social welfare. All scheduled processes as previously stipulated under the Air Pollution Prevention Act (APPA) are included as listed activities with additional activities being added to the list. The updated Listed Activities and Minimum National Emission Standards were published on the 22nd November 2013 (Government Gazette No. 37054). Metallic mineral processing plants are listed as a default category that requires reporting under NEMAQA.

According to the NEMAQA, air quality management control and enforcement is in the hands of local government with District and Metropolitan Municipalities as the licensing authorities. Provincial government is primarily responsible for ambient monitoring and ensuring municipalities fulfil their legal obligations, with national government primarily as policy maker and co-ordinator. Each sphere of government must appoint an Air Quality Officer responsible for co-ordinating matters pertaining to air quality management. Given that air quality management under the old Act was the sole responsibility of national government, local authorities have in the past only been responsible for smoke and vehicle tailpipe emission control.

The National Pollution Prevention Plans Regulations were published in March 2014 (Government Gazette 37421) and tie in with the National Greenhouse Gas (GHG) Emission Reporting Regulations which took effect on 3 April 2017. In summary, the Regulations aim to prescribe the requirements that pollution prevention plans of greenhouse gases declared as priority air pollutants, need to comply with in terms of the NEMAQA. The

Regulations specify who needs to comply, and by when, as well as prescribing the content requirements. Mines do have an obligation to report on the GHG emissions under these Regulations.

4.1.6.1 NATIONAL DUST CONTROL REGULATIONS

Dust fall is assessed for nuisance impact and not for inhalation health impact. The National Dust Control Regulations (Department of Environmental Affairs, 2013) prescribes measures for the control of dust in residential and non-residential areas. Acceptable dust fall rates are measured (using American Standard Testing Methodology (ASTM) D1739:1970 or equivalent) at and beyond the boundary of the premises where dust originates. In addition to the dust fall limits, the National Dust Control Regulations prescribe monitoring procedures and reporting requirements. Dust that may be created from the proposed TSF will be managed in accordance with these Regulations. In addition to the dustfall limits, the NDCR prescribe monitoring procedures and reporting requirements.

4.1.7 THE NATIONAL WATER ACT (NWA)

The National Water Act, 1998 (Act 36 of 1998 – NWA) makes provision for two types of applications for water use licenses, namely individual applications and compulsory applications. The NWA also provides that the responsible authority may require an assessment by the applicant of the likely effect of the proposed license on the resource quality, and that such assessment be subject to the NEMA EIA Regulations. A person may use water if the use is –

- Permissible as a continuation of an existing lawful water use ;
- Permissible in terms of a general authorisation (GA);
- Permissible under Schedule 1; or
- Authorised by a license.

These water use processes are described in Figure 11.

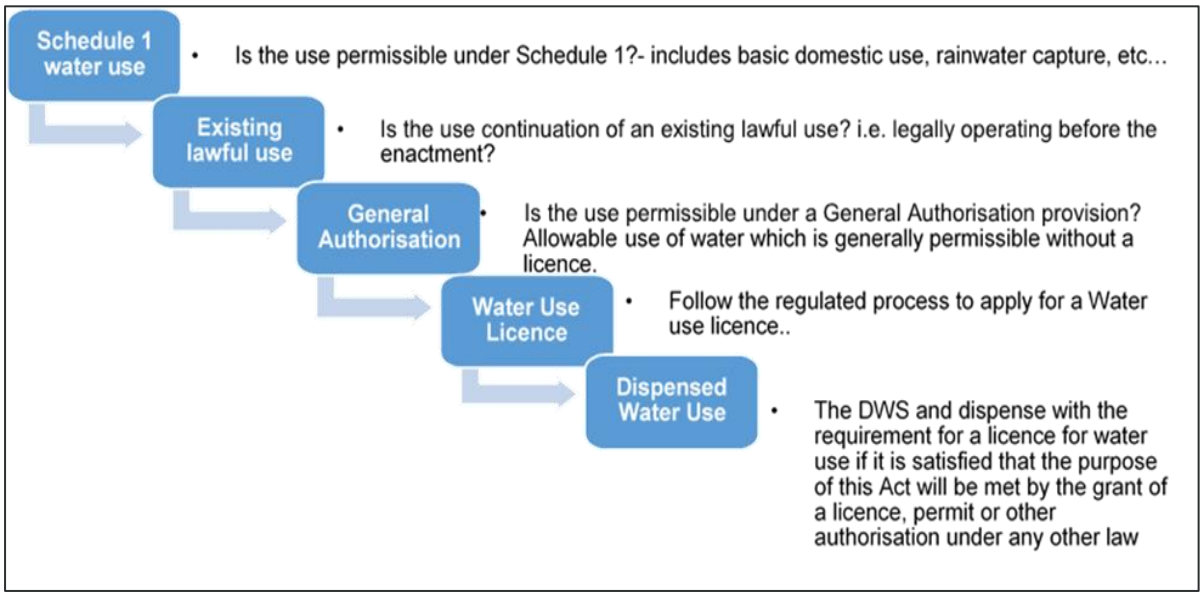


Figure 11: Authorisation processes for new water uses.

The NWA defines 11 water uses. A water use may only be undertaken if authorised by the Department of Water and Sanitation (DWS). The water uses for which an authorisation or license can be issued include:

- Taking water from a water resource;
- Storing water;

- Impeding or diverting the flow of water in a watercourse;
- Engaging in a stream flow reduction activity contemplated in section 36;
- Engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1);
- Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduits;
- Disposing of waste in a manner which may detrimentally impact on a water resource;
- Disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process;
- Altering the bed, banks, course or characteristics of a watercourse;
- Removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and
- Using water for recreational purposes.

Various Section 21 (c), Section 21 (i) and Section 21 (g) water uses are triggered by the project. A separate application for a Water Use License (WUL) has been lodged with the Department of Water and Sanitation (DWS) for the water use triggers.

Regulations Regarding the Safety of Dams in terms of section 123(1) of the national water act, 1998In South Africa, dam safety regulations are governed by the Dam Safety Office (DSO) under the Department of Water and Sanitation (DWS). These regulations apply to dams with a safety risk, which are generally those with a wall height exceeding 5 meters and a storage capacity greater than 50,000 cubic meters. The regulations mandate registration, classification, licensing, and adherence to specific procedures for construction, operation, maintenance, and decommissioning.

The TSF itself will constitute a dam with a safety risk in terms of these regulations. Dams with a safety risk must be classified in terms of the regulations and registered with the DSO.

4.1.7.1 **NWA GOVERNMENT NOTICE 704 (GN 704)**

GN 704 (Government Gazette 20118 of June 1999) was established to provide regulations on the use of water for mining and related activities aimed at the protection of water resources. The five main principal conditions of GN 704 applicable to this project are:

- Condition 4 – which defines the area in which, mine workings or associated structures may be located, with reference to a watercourse and associated flooding. Any residue deposit, dam, reservoir together with any associated structure or any other facility should be situated outside the 1:100 year flood-line. Any underground or opencast mining, prospecting or any other operation or activity should be situated or undertaken outside of the 1:50 year flood-line. Where the flood-line is less than 100 metres away from the watercourse, then a minimum watercourse buffer distance of 100 metres is required for infrastructure and activities;
- Condition 5 – which indicates that no residue or substance which causes or is likely to cause pollution of a water resource may be used in the construction of any dams, impoundments or embankments or any other infrastructure which may cause pollution of a water resource;
- Condition 6 – which describes the capacity requirements of clean and dirty water systems. Clean and dirty water systems must be kept separate and must be designed, constructed, maintained and operated to ensure conveyance the 1:50 year peak flow. Clean and dirty water systems should not spill into each other more frequently than once in 50 years. Any dirty water dams should have a minimum freeboard of 0.8m above full supply level;

- Condition 7 – which describes the measures which must be taken to protect water resources. All dirty water or substances which may cause pollution should be prevented from entering a water resource (by spillage, seepage, erosion, etc.) and ensure that water used in any process is recycled as far as practicable; and

- Condition 10 – which describes the requirements for operations involving extraction of material from the channel of a watercourse. Measures should be taken to prevent impacts on the stability of the watercourse, prevent scour and erosion resulting from operations, prevent damage to in-stream habitat through erosion, sedimentation, alteration of vegetation and flow characteristics, construct treatment facilities to treat water before returning it to the watercourse, and implement control measures to prevent pollution by oil, grease, fuel and chemicals.

The Nooitgedacht TSF itself will not be located within the 1:100 year floodline of a watercourse however it will be located within 100m from the edge of a watercourse (i.e. wetlands).

4.1.7.2 CATCHMENT MANAGEMENT STRATEGIES

South Africa is divided into nineteen Water Management Areas (WMAs). The delegation of water resource management from central government to catchment level is achieved by establishing Catchment Management Agencies (CMAs) at WMA level. Each CMA progressively develops a Catchment Management Strategy (CMS) for the protection, use, development, conservation, management and control of water resources within its WMA. This is to ensure that on a regional scale, water is protected, used, developed, conserved, managed and controlled in a sustainable and equitable manner for the benefit of all persons. The main instrument that guides and governs the activities of a WMA is the Catchment Management Strategy (CMS) which, while conforming to relevant legislation and national strategies, provides detailed arrangements for the protection, use, development, conservation, management and control of the region's water resources. The site is positioned within quaternary catchment C43B which has an area of 723 km^2 and is located within the Middle Vaal WMA. The Mahemspruit River is the only defined river relevant to this assessment (when considering the more detailed 1:50,000 topographical map data).

According to the Middle Vaal WMA Internal Strategic Perspective (2004), The land use in the Middle Vaal WMA is characterised by agriculture with the main irrigation crops being wheat, maize, groundnuts, sorghum and sunflowers. There are also extensive gold mining activities located in the Middle Vaal water management area. These activities are generating substantial return flow volumes in the form of treated effluent from the urban areas and mine dewatering that are discharged into the river system. These discharges are having significant impacts on the water quality in the main stem of the Vaal River in the Middle Vaal WMA.

The Broad Management Objectives within the Middle Vaal WMA include:

- To manage the water quality by setting Water Quality Objectives and developing a CMS as per the Water Quality Management Strategy.

- The monitoring of the system to provide management information for water quality management, abstraction control and input to the overarching operations and planning processes.

- Provide input into the supply of local authorities from local groundwater and surface water resources. This will be in the form of strategic level guidance as to where water can be obtained, and the level of study needed to be submitted with the license application.

- Promotion of WC&DM through the water service providers and local authorities to achieve efficient use of water. Only once efficient use has been achieved can further transfers be considered.

Harmony has submitted an IWULA to ensure that any water resources (surface and groundwater as well as wetlands) affected by the proposed project activities are licensed and managed in accordance with the relevant water and environmental legislation.

4.1.8 THE NATIONAL ENVIRONMENTAL MANAGEMENT WASTE ACT (NEMWA)

On 2 June 2014, the National Environmental Management: Waste Amendment Act came into force. Waste is accordingly no longer governed by the MPRDA but is subject to all the provisions of the National Environmental Management: Waste Act, 2008 (NEMWA).

Section 16 of the NEMWA must also be considered which states as follows:

1. A holder of waste must, within the holder's power, take all reasonable measures to-

    a) "*Avoid the generation of waste and where such generation cannot be avoided, to minimise the toxicity and amounts of waste that are generated;*

    b) Reduce, re-use, recycle and recover waste;

    c) Where waste must be disposed of, ensure that the waste is treated and disposed of in an environmentally sound manner;

    d) Manage the waste in such a manner that it does not endanger health or the environment or cause a nuisance through noise, odour, or visual impacts;

    e) Prevent any employee or any person under his or her supervision from contravening the Act; and

    f) *Prevent the waste from being used for unauthorised purposes.*"

These general principles of responsible waste management will be incorporated into the requirements in the EMPr to be implemented for this project.

Waste can be defined as either hazardous or general in accordance with Schedule 3 of the NEMWA (2014) as amended. "Schedule 3: Defined Wastes" has been broken down into two categories – Category A being hazardous waste; and Category B being general waste.

In order to attempt to understand the implications of these waste groups, it is important to ensure that the definitions of all the relevant terminologies are defined:

- Hazardous waste: means "any waste that contains organic or inorganic elements or compounds that may, owning to the inherent physical, chemical or toxicological characteristic of that waste, have a detrimental impact on health and the environment and includes hazardous substances, materials or objects within business waste, residue deposits and residue stockpiles."

- Residue deposits: means "any residue stockpile remaining at the termination, cancellation or expiry of a prospecting right, mining right, mining permit, exploration right or production right."

- Residue stockpile: means "any debris, discard, tailings, slimes, screening, slurry, waste rock, foundry sand, mineral processing plant waste, ash or any other product derived from or incidental to a mining operation and which is stockpiled, stored or accumulated within the mining area for potential re-use, or which is disposed of, by the holder of a mining right, mining permit or, production right or an old order right, including historic mines and dumps created before the implementation of this Act."

- General waste: means "waste that does not pose an immediate hazard or threat to health or to the environment and includes – domestic waste; building and demolition waste; business waste; inert waste; or any waste classified as non-hazardous waste in terms of the regulations made under Section 69."

Furthermore, the NEMWA provides for specific waste management measures to be implemented, as well as providing for the licensing and control of waste management activities. The proposed new TSF waste management activities in terms of Category B of GN R. 921 which states that "*a person who wishes to commence, undertake or conduct an activity listed under this Category, must conduct an environmental impact assessment process, as stipulated in the environmental impact assessment regulations made under section 24(5) of the*

National Environmental Management Act, 1998 (Act No. 107 of 1998) as part of a waste management license application."

4.1.8.1 WASTE MANAGEMENT ACTIVITIES

The listed activities that are triggered by the project in terms of GN921 promulgated under the National Environmental Management Waste Act (Act 59 of 2008 - NEMWA) are specified in Table 7 below:

Table 7: Applicable NEMWA Activities

Activity No(s):	Activity	Portion of the proposed project to which the applicable listed activity relates.
Category B, Activity B7	The disposal of any quantity of hazardous waste to land.	TSF operation
Category B, Activity B10	The construction of a facility for a waste management activity listed in Category B of this Schedule (not in isolation to associated waste management activity).	TSF construction
Category B, Activity B11	The 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 (Act No. 28 of 2002).	TSF establishment for mining activities

The Department of Mineral and Petroleum Resources (DMPR) has been identified as the CA for both the NEMA and NEM:WA activities listed activities triggered by the project. A separate application for a Water Use License (WUL) has also been lodged with the Department of, Water and Sanitation (DWS) for the water use triggers

4.1.8.2 NEMWA WASTE CLASSIFICATION AND MANAGEMENT REGULATIONS, 2013 (GN R. 634)

These regulations pertain to waste classification and management, including the management and control of residue stockpiles and residue deposits from a prospecting, mining, exploration or production operation which is relevant to the proposed project. The purpose of these Regulations is to –

- Regulate the classification and management of waste in a manner which supports and implements the provisions of the Act;
- Establish a mechanism and procedure for the listing of waste management activities that do not require a Waste Management License;
- Prescribe requirements for the disposal of waste to landfill;
- Prescribe requirements and timeframes for the management of certain wastes; and
- Prescribe general duties of waste generators, transporters and managers.

Waste classification, as presented in Chapter 4 of these regulations, entails the following:

- Wastes listed in Annexure 1 of these Regulations do not require classification in terms of SANS 10234;
- Subject to sub regulation (1), all waste generators must ensure that the waste they generate is classified in accordance with SANS 10234 within one hundred and eighty (180) days of generation;
- Waste must be kept separate for the purposes of classification in terms of sub regulation (2), and must not be mixed prior to classification;
- Waste-must be re-classified in terms of sub regulation (2) every five (5) years, or within 30 days of modification to the process or activity that generated the waste, changes in raw materials or other inputs, or any other variation of relevant factors;
- Waste that has been subjected to any form of treatment must be re-classified in terms of sub regulation (2), including any waste from the treatment process; and

- If the Minister reasonably believes that a waste has not been classified correctly in terms of sub regulation (2), he or she may require the waste generator to have the classification peer reviewed to confirm the classification.

Furthermore, Chapter 8 of the Regulations stipulates that unless otherwise directed by the Minister to ensure a better environmental outcome, or in response to an emergency so as to protect human health, property or the environment –

- Waste generators must ensure that their waste is assessed in accordance with the Norms and Standards for Assessment of Waste for Landfill Disposal set in terms of section 7(1) of the Act prior to the disposal of the waste to landfill;
- Waste generators must ensure that the disposal of their waste to landfill is done in accordance with the Norms and Standards for Disposal of Waste to Landfill set in terms of section 7(1) of the Act; and
- Waste managers disposing of waste to landfill must only do so in accordance with the Norms and Standards for Disposal of Waste to Landfill set in terms of section 7 (1) of the Act.

The TSF barrier system will be determined in consultation with the authorities and will be in compliance with these norms and standards.

4.1.8.3 NEMWA NATIONAL NORMS AND STANDARDS FOR THE DISPOSAL OF WASTE TO LANDFILL, 2013 (GN R. 636)

Once the waste has been assessed and waste type determined, these Norms and Standards can be used to determine the minimum requirements for the landfill and containment barrier design. This will distinguish between Class A, Class B, Class C, or Class D landfills and the associated containment barrier requirements. Although these Norms and Standards prescribe the containment barrier or liner design for each determined waste type, the recent amendments in chapter 3 of the regulations to the planning and management of residue stockpiles and residue deposits, a competent person must recommend the pollution control measures suitable for a specific residue stockpile or residue deposit on the basis of a risk analysis as contemplated in regulations 4 and 5 of the regulations. The recommendation should be founded on a risk analysis based on the characteristics and classification in regulation 4 and 5 of these Regulations, towards determining the appropriate mitigation and management measures.

4.1.8.4 THE REGULATIONS REGARDING THE PLANNING AND MANAGEMENT OF RESIDUE STOCKPILES AND RESIDUE DEPOSITS AND ASSOCIATED AMENDMENT

These Regulations promulgated under the waste act, which pertain to the planning and management of residue stockpiles and residue deposits from a prospecting, mining, exploration or production operation, were published in 2015 and were amended in 2018. The Regulations and associated amendment relate to the assessment of impacts and the analyses of risks relating to the management of residue stockpiles and residue deposits, and involve the following:

- The identification and assessment of environmental impacts arising from the establishment of residue stockpiles and residue deposits must be done as part of the environmental impact assessment conducted in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998);
- A risk analysis based on the characteristics and the classification set out in regulation 4 (characterisation of residue stockpiles and residue deposits) and 5 (classification of residue stockpiles and residue deposits) of these regulations must be used to determine the appropriate mitigation and management measures; and
- A competent person must recommend the pollution control measures suitable for a specific residue stockpile or residue deposit on the basis of a risk analysis as contemplated in regulations 4 and 5 of these Regulations.

As stated in Section 4.1.8.3, the proposed new TSF will be subject to these regulations. In this regard, the containment barrier design (including requirements for a liner and nature of the liner), will be addressed in accordance with chapter 3 of these Regulations and their associated amendments.

4.1.9 THE NATIONAL HERITAGE RESOURCES ACT (NHRA)

The National Heritage Resources Act (Act 25 of 1999 – NHRA) stipulates that cultural heritage resources may not be disturbed without authorisation from the relevant heritage authority. Section 34(1) of the NHRA states that, "*no person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority…*" The NHRA is utilised as the basis for the identification, evaluation and management of heritage resources and in the case of Cultural Resource Management (CRM) those resources specifically impacted on by development as stipulated in Section 38 of NHRA, and those developments administered through the NEMA, MPRDA and the Development Facilitation Act (FDA) legislation. In the latter cases the feedback from the relevant heritage resources authority is required by the State and Provincial Departments managing these Acts before any authorisations are granted for a development. The last few years have seen a significant change towards the inclusion of heritage assessments as a major component of Environmental Impact Processes required by the NEMA and MPRDA. This change requires us to evaluate the Section of these Acts relevant to heritage (Fourie, 2008).

The NEMA 23(2)(b) states that an integrated environmental management plan should, "*…identify, predict and evaluate the actual and potential impact on the environment, socio-economic conditions and cultural heritage*". A study of subsections (23)(2)(d), (29)(1)(d), (32)(2)(d) and (34)(b) and their requirements reveals the compulsory inclusion of the identification of cultural resources, the evaluation of the impacts of the proposed activity on these resources, the identification of alternatives and the management procedures for such cultural resources for each of the documents noted in the Environmental Regulations. A further important aspect to be taken into account of in the EIA Regulations under the NEMA relates to the Specialist Report requirements (Appendix 6 of EIA Regulations 2014, as amended).

The MPRDA defines 'environment' as it is in the NEMA and, therefore, acknowledges cultural resources as part of the environment. Section 39(3)(b) of this Act specifically refers to the evaluation, assessment and identification of impacts on all heritage resources as identified in Section 3(2) of the NHRA that are to be impacted on by activities governed by the MPRDA. Section 40 of the same Act requires the consultation with any State Department administering any law that has relevance on such an application through Section 39 of the MPRDA. This implies the evaluation of Heritage Assessment Reports in Environmental Management Plans or Programmes by the relevant heritage authorities (Fourie, 2008).

In accordance with the legislative requirements and EIA rating criteria, the regulations of the South African Heritage Resources Agency (SAHRA) and Association of Southern African Professional Archaeologists (ASAPA) have also been incorporated to ensure that a comprehensive and legally compatible Heritage Report is compiled.

4.1.10 ENVIRONMENT CONSERVATION ACT (ECA)

The Environment Conservation Act (Act 73 of 1989 – ECA) was, prior to the promulgation of the NEMA, the backbone of environmental legislation in South Africa. To date the majority of the ECA has been repealed by various other Acts, however Section 25 of the Act and the Noise Regulations (GN R. 154 of 1992) promulgated under this section are still in effect. These Regulations serve to control noise and general prohibitions relating to noise impact and nuisance.

4.1.10.1 **NOISE CONTROL REGULATIONS, 1992 (GN R.154)**

In terms of section 25 of the ECA, the National Noise Control Regulations (GN R. 154 – NCRs) published in Government Gazette No. 13717 dated 10 January 1992, were promulgated. The NCRs were revised under GN R. 55 of 14 January 1994 to make it obligatory for all authorities to apply the regulations. Provincial noise control regulations have been promulgated in Gauteng, Free State and Western Cape Provinces.

The NCRs will need to be considered in relation to the potential noise that may be generated mainly during the construction phase of the proposed project. The two key aspects of the NCRs relate to disturbing noise and noise nuisance.

Section 4 of the Regulations prohibits a person from making, producing or causing a disturbing noise, or allowing it to be made produced or caused by any person, machine, device or apparatus or any combination thereof. A disturbing noise is defined in the Regulations as "*a noise level which exceeds the zone sound level or if no zone sound level has been designated, a noise level which exceeds the ambient sound level at the same measuring point by 7 dBA or more*."

Section 5 of the NCRs in essence prohibits the creation of a noise nuisance. A noise nuisance is defined as "*any sound which disturbs or impairs or may disturb or impair the convenience or peace of any person".* The South African National Standard 10103 also applies to the measurement and consideration of environmental noise and should be considered in conjunction with these Regulations.

4.1.11 THE CONSERVATION OF AGRICULTURAL RESOURCES ACT (CARA)

The law on Conservation of Agricultural Resources (Act 43 of 1983) aims to provide for the conservation of the natural agricultural resources of the Republic by the maintenance of the production potential of land, by the combating and prevention of erosion and weakening or destruction of the water sources, and by the protection of the vegetation and the combating of weeds and invader plants. In order to achieve the objectives of this Act, control measures related to the following may be prescribed to land users to whom they apply:

- The cultivation of virgin soil;
- The utilisation and protection of land which is cultivated;
- The irrigation of land;
- The prevention or control of waterlogging or salination of land;
- The utilisation and protection of vleis, marshes, water sponges, water courses and water sources;
- The regulating of the flow pattern of run-off water;
- The utilisation and protection of the vegetation;
- The grazing capacity of veld, expressed as an area of veld per large stock unit;
- The maximum number and the kind of animals which may be kept on veld; The prevention and control of veld fires;
- The utilisation and protection of veld which has burned;
- The control of weeds and invader plants;
- The restoration or reclamation of eroded land or land which is otherwise disturbed or denuded;
- The protection of water sources against pollution on account of farming practices;
- The construction, maintenance, alteration or removal of soil conservation works or other structures on land; and
- Any other matter which the Minister may deem necessary or expedient in order that the objects of this Act may be achieved.

Further, different control measures may be prescribed in respect of different classes of land users or different areas or in such other respects as the Minister may determine. Preliminary impacts on the soil, biodiversity and water resources have been identified with regards to the proposed new TSF, and mitigation and management measures recommended. These will be updated during the EIA phase of this project as and where necessary.

4.1.12 CLIMATE CHANGE ACT 22, 2024

The Climate Change Act sets out the functions of the Presidential Climate Commission, which includes providing advice on the Republic's climate change response to ensure the realisation of the vision for effective climate change response and the long-term just transition to a climate-resilient and low-carbon economy and society.

The Climate Change Bill aligns with Council's strategic objective of a stakeholder-aligned national energy transition that achieves South Africa's decarbonisation targets whilst maintaining energy security and affordable access for all South Africans. The Climate Change Bill recognises that South Africa has a vital role to play in the global effort to reduce greenhouse gas emissions and that Southern Africa is especially vulnerable to those impacts of climate change which require urgent and appropriate adaptation responses. Harmony will be required to comply with greenhouse gas reporting requirements.

4.1.13 NATIONAL VELD AND FOREST FIRE ACT

The National Veld and Forest Fire Act 101 of 1998 is a key piece of legislation in South Africa aimed at reforming the legal framework surrounding veld and forest fires. Its primary purpose is to prevent and manage wildfires through coordinated efforts, particularly in rural and fire-prone areas. The Act encourages the formation of Fire Protection Associations (FPAs), which are legally recognized bodies that facilitate local collaboration among landowners, municipalities, and other stakeholders to predict, prevent, and suppress veldfires. These associations play a vital role in fire management by offering training, support, and technical expertise to their members.

For private developers and landowners, the Act imposes several important obligations. They are legally required to take reasonable precautions to prevent fires from starting or spreading from their property. This includes maintaining firebreaks, ensuring that controlled burns are conducted safely and in accordance with regulations, and joining or cooperating with local FPAs. Failure to meet these responsibilities can result in legal liability, especially if negligence leads to damage or loss caused by a fire. In such cases, landowners may face civil claims for damages, making it essential for them to understand and comply with the Act's provisions.

In essence, the Act not only promotes proactive fire management but also establishes a framework for accountability. Private developers and landowners must be vigilant and informed, as their actions—or lack thereof—can have significant legal and financial consequences. By participating in FPAs and adhering to fire safety regulations, they contribute to a safer and more resilient environment for their communities and the broader ecosystem.

4.1.14 THE SPATIAL PLANNING AND LAND USE MANAGEMENT ACT (SPLUMA)

The Spatial Planning and Land Use Management (Act 16 of 2013 – SPLUMA) is set to aid effective and efficient planning and land use management, as well as to promote optimal exploitation of minerals and mineral resources. The SPLUMA was developed to legislate for a single, integrated planning system for the entire country. Therefore, the Act provides a framework for a planning system for the country and introduces provisions to cater for development principles; norms and standards; inter-governmental support; Spatial Development Frameworks (SDFs) across national, provincial, regional and municipal areas; Land Use Schemes; and municipal planning tribunals. Furthermore, the SPLUMA strengthens the position of mining right holders when land needs to be rezoned for mining purposes. Rezoning of three of the properties for the Nooitgedacht TSF site from agricultural use to mining use will be required (Goedgedacht 53, Nooitgedacht 50 and Jacobsdal 37).

4.1.15 THE SUB-DIVISION OF AGRICULTURAL LAND ACT

In terms of the Subdivision of Agricultural Land Act (Act 70 of 1970), any application for change of land use must be approved by the Minister of Agriculture, and while under the Conservation of Agricultural Resources Act (Act 43 of 1983) no degradation of natural land is permitted. Rezoning of three of the properties for the Nooitgedacht TSF site from agricultural use to mining use will be required (Goedgedacht 53, Nooitgedacht 50 and Jacobsdal 37). The rezoning process is ongoing in parallel to the EA application process.

4.1.16 OCCUPATIONAL HEALTH AND SAFETY ACT

The Occupational Health and Safety Act (Act 85 of 1993 - OHSA) provides for the health and safety of persons at work and for the health and safety of persons in connection with the use of plant and machinery; the protection of persons other than persons at work against hazards to health and safety arising out of or in connection with the activities of persons at work; to establish an advisory council for occupational health and safety; and to provide for matters connected therewith. Worker safety will form part of the contractor's safety requirements and be guided by the OHSA. This would entail a full health and safety file including but not limited to pre-mobilization medical assessments, work environment and task specific risk assessments and method statements etc. The project will be required to comply with the OHSA and or Mine Health and Safety Act (dependent on the specific aspect of the production operations). Therefore safety of all personnel will be guided by overarching South African legislation.

The Major Hazard Installation Regulations (GNR 692 of 30 July 2001) are promulgated under the OHSA and apply to employers, self-employed persons and users, who have on their premises, either permanently or temporarily, a major hazard installation or a quantity of a substance which may pose a risk that could affect the health and safety of employees and the public.

A "major hazard installation" (MHI| means an installation-

a) where more than the prescribed quantity of any substance is or may be kept, whether permanently or temporarily; or

b) where any substance is produced, processed, used, handled or stored in such a form and quantity that it has the potential to cause a major incident.

No MHI assessment is required for the Nooitgedacht TSF project in terms of this Act.

4.1.17 NATIONAL RADIOACTIVE WASTE DISPOSAL INSTITUTE ACT 53 OF 2008

In terms of this Act the generators of radioactive waste are responsible for technical, financial and administrative management of such waste within the national regulatory framework at their premises and when such waste is transported to an authorised waste disposal facility. The generators of radioactive waste are responsible for technical, financial and administrative management of such waste within the national regulatory framework at their premises and when such waste is transported to an authorised waste disposal facility.

Generators of radioactive waste must:

A) develop and implement site-specific waste management plans based on national policy;

B) provide all relevant information on radioactive waste as required by the chief executive officer;

C) demonstrate compliance with any conditions of a radioactive waste disposal certificate;

D) provide site access to staff of the Institute for inspection against any conditions of the radioactive waste disposal certificate.

The TSF slurry is considered radioactive waste. Generators of radioactive waste remain responsible for all liabilities in connection with such radioactive waste under their control.

4.1.18 THE HAZARDOUS SUBSTANCES ACT, 1973 (ACT NO. 15 OF 1973)

The Hazardous Substances Act, 1973 (Act No. 15 of 1973) in South Africa regulates substances that can cause harm to human health. It categorizes these substances based on their risk level and controls their manufacture, sale, use, and disposal. The Act also provides for inspections, enforcement measures, and penalties for violations. The Act defines hazardous substances as materials or mixtures that can cause harm to human health, ranging from mild irritation to severe illness or death.

The Act addresses the control of substances that can cause injury, ill-health, or death due to their hazardous properties. This includes substances found in mine tailings, which often contain heavy metals like arsenic, lead,

and mercury. The Act aims to regulate the handling, use, and disposal of these substances to protect human health and the environment.

4.2 OTHER APPLICABLE ACTS AND GUIDELINES

Other applicable acts and guidelines include various provincial and local guidelines and plans which are further described below.

4.2.1 NATIONAL POLICY AND PLANNING CONTEXT

4.2.1.1 INTERIM GUIDEANCE ON THE MANAGEMENT OF NORM TAILINS AND WASTE ROCK

The National Nuclear Regulator (NNR) exercises regulatory control related to nuclear safety and security for all the activities and facilities as defined in the NNR Act. The process waste generated at a mining and minerals processing facility, also known as slurry, is naturally radioactive because of the associated radionuclides in the uranium and thorium decay series that accompany the metals that are mined. The slurry, also referred to as Naturally Occurring Radioactive Material (NORM) residue, is pumped to containment areas for permanent or temporary storage and thus qualifies as radioactive waste facilities named NORM tailings dams, also interchangeably referred to as Tailings Storage Facilities (TSF).

This document provides guidance for the implementation of the requirements as set out in the draft General Nuclear Safety Regulations on the management of NORM tailings and waste rock. Due to the lengthy promulgation process for regulations, and the fact that the guidance provided is based on draft regulations, the Executive has resolved to issue this document as interim guidance. This document will be revised once the regulations in question have been promulgated.

The guidance is applicable to all NORM facilities which carry out activities and operations involving NORM tailings and waste rock containing uranium, thorium and their progeny. This guide extends to both authorised facilities regulated by the NNR and prospective applicants who wish to handle, process and dispose of NORM tailings and waste rock in terms of the provisions of the NNR Act and associated regulations.

This guideline contains information that provide guidance in terms of best practice in terms of EIA aspects that is related to mining and specifically mineral processing. While the best practice guidance must be taken into account, this document does not take the place of legal advice in a specific situation governed by legislation.

Key aspects of an NNR-approved Closure Plan include:

- Decommissioning Strategy: The plan specifies the methods for dismantling the facility, removing or treating radioactive materials, and decontaminating equipment and site surfaces.
- Environmental Protection: It includes measures to prevent or mitigate environmental damage from decommissioning activities, such as controlling dust, managing waste, and protecting water resources.
- Public and Worker Safety: The plan outlines procedures for protecting the health and safety of workers involved in decommissioning and the public who may be affected by the process.
- Long-Term Stewardship: The plan addresses the long-term management of any residual risks or contamination, ensuring that the site remains safe for the future.
- Financial Assurance: It demonstrates that sufficient financial resources are available to implement the closure plan and manage any long-term liabilities.
- Regulatory Compliance: The plan must be developed in accordance with the NNR's regulations and guidance documents.

4.2.2 PROVINCIAL POLICY AND PLANNING CONTEXT

4.2.2.1 FREE STATE NATURE CONSERVATION ORDINANCE 8 OF 1969

This Ordinance makes provision with respect to the protection and conservation of wildlife in the Free State Province. It makes provision for, among other things, hunting and the protection of wild animals, fishing and the

protection of aquatic resources, the protection of indigenous plants and the establishment and management of nature reserves. The Ordinance defines, in Schedule1, protected game and, in Schedule 2, ordinary game and sets out specific rules relating to hunting of each class of game. It also defines prohibited acts in respect of wild or exotic game and rules regarding the importation and exportation of endangered or exotic animals. According to the list of protected species under the Schedule, if any individuals of these plant species are to be disturbed, permits must be obtained from the Free State Department of Economic, Small Business Development, Tourism and Environmental Affairs (FSDESTEA). An assessment of floral species within the study area will be covered by the Terrestrial Biodiversity Assessment and will determine the type of species and their protection status (if any).

4.2.2.2 THE FREE STATE PROVINCIAL SPATIAL DEVELOPMENT PLAN

The Free State Provincial Spatial Development Framework (PSDF) is a policy document that promotes a 'developmental state' in accordance with national and provincial legislation and directives. It aligns with the Free State Provincial Growth and Development Strategy which has committed the Free State to 'building a prosperous, sustainable and growing provincial economy which reduces poverty and improves social development'. The PSDF includes comprehensive plans and strategies that collectively indicate which type of land-use should be promoted in the Province, where such land-use should take place, and how it should be implemented and managed. The proposed project is a mining activity within an area already being used for mining activities in addition to agricultural activities.

4.2.2.3 FREE STATE BIODIVERSITY PLAN (DESTEA, 2015)

The development of provincial biodiversity plans is a key component of the systematic biodiversity planning in South Africa and therefore a strong focus of the Biodiversity Planning Forum. Many of the innovative approaches and methodologies have been initiated and established through the development of these provincial biodiversity plans. A key objective of the PSDF is to integrate and standardize planning at all spheres of government in the province with specific reference to amongst others facilitating land-use classification of the entire land surface of the province. To this extent a set of dedicated Spatial Planning Categories (SPCs) were developed which provide a spatial framework to guide decision-making regarding land-use at all levels of planning. The SPCs represent a classification system that indicates the most suitable, or a range of, land use options for a certain piece of land. Associated with each SPC category is land use guidelines which when implemented ensures a balance between development and conservation. Mainstreaming of the biodiversity plan into spatial planning process will be achieved by aligning the biodiversity plan categories with those of the SPCs so that planning according to SPC will then automatically also adopt the biodiversity plan categories and their associated land use guidelines. Various biodiversity layers were overlaid to the study area and used to determine the sensitivity and/or certain requirements thereof.

The Free State Department of Environment and Nature Conservation has developed a Free State Biodiversity Sector Plan, called Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs). These biodiversity priority areas, together with protected areas, are important for the persistence of a viable representative sample of all ecosystem types and species as well as the long-term ecological functioning of the landscape. The identification of Critical Biodiversity Areas for the Free State was undertaken using a Systematic Conservation Planning approach. Available data on biodiversity features (incorporating both pattern and process, and covering terrestrial and inland aquatic realms), their condition, current Protected Areas and Conservation Areas, and opportunities and constraints for effective conservation were collated. The project area overlaps with various CBA1 and 2 and ESA 1 and 2 areas in terms of this plan.

4.2.3 PROVINCIAL POLICY AND PLANNING CONTEXT

4.2.3.1 THE MATJHABENG LOCAL MUNICIPALITY LAND USE SCHEME, 2021/22

These Scheme Regulations were compiled to align with Section 156 of the Constitution and to comply with the requirements of Chapter 5 of the Spatial Planning and Land Use Management Act, Act 16 of 2013. The general objective of these regulations and accompanying zoning scheme is to determine the rights of use of all land within the boundaries of the area, and for control over the execution of these rights and the utilization of this land. Land Use Zones are divided into land use zoning categories which specify the purposes for which buildings

and land in each of the categories may be erected and/or used. Within a specific Land Use Zone, "Permitted Land Uses" are allowed without any approval of the Municipality. Within a specific Land Use Zone, "Consent Land Uses" are allowed with the approval of the Authorised Employee, which is a Registered Professional Town and Regional Planner. All other buildings or land uses not included as permitted land uses or consent land uses may not be erected and/or used in the relevant land use zone. Based on the six (6) "SPC's categories as described in the PSDF and SDF, the proposed mining activity is located within an appropriate land use (mining area).

4.2.3.2 THE MATJHABENG LOCAL MUNICIPALITY SPATIAL DEVELOPMENT FRAMEWORK, 2013

All Municipalities are by law required to prepare Integrated Development Plans, which should include a Spatial Development Framework. A Spatial Development Framework is strategic and indicative in nature and is prepared at a broad scale. It is meant to guide and inform land development and management. The Spatial Development Framework (SDF) for Matjhabeng Local Municipality was reviewed and adopted by Council in 2013. The SDF that forms part of an integrated development plan, indicates the spatial implications thereof and lay down strategies, proposals, and guidelines for the future spatial development of the area to which it relates (including, without being limited to, development objectives, proposals for land reform, urban renewal, reconstruction, integration, environmental planning, transport planning, infrastructural planning, and urban design) so that the general well-being of the particular community and orderly planning of the area are promoted in the most effective manner. Considering the nature of the proposed activity within the nature of the receiving environment, the proposed activity is in line with the SDF. The draft 2022 SDF shows on the concept plan that there is potential for future industrial development expansion directly to the south east of the site.

4.2.3.3 THE MATJHABENG LOCAL MUNICIPALITY BY-LAWS ON SPATIAL PLANNING AND LAND USE MANAGEMENT, 2015

A by-law is a law that is passed by the Council of a municipality to regulate the affairs and the services it provides within its area of jurisdiction. They must be passed by a majority vote of a municipal council. In terms of the Constitution the executive and legislative authority of a municipality is exercised by the municipal council', and one of the methods by which this is done is by passing by-laws. A municipality may only make by-laws on matters that it has the right to administer. These matters are set out in Schedules 4B and SB of the Constitution. The Matjhabeng Local Municipality By-Laws on Spatial Planning and Land Use Management, 2015 By-Law applies to all land situated within the municipal area, including land owned by the state and by organs of state. It is applicable on all land where mining activities has taken place, a mining right has been issued and or any land zoned in any town planning scheme as "mining", or other similar zoning, allowing mining activities. Considering that the proposed project is a mining activity, the by-laws are applicable to the project and the applicant must ensure compliance with them.

4.2.4 INTERNATIONAL LEGISLATION AND STANDARDS

4.2.4.1 GLOBAL INDUSTRY STANDARD ON TAILINGS MANAGEMENT (GISTM) AND SOCIAL PERFORMANCE

The Global Industry Standard on Tailings Management (GISTM) was established to improve the safety and environmental integrity of tailings facilities worldwide. The GISTM is organised around six Topic areas, 15 Principles and 77 auditable Requirements. The aim of the standard is to adopt an integrated approach to tailings management. Social performance spans all six Topic Areas of the Standard, with specialist components defined in 14 (18 %) of the Standard's 77 Requirements, with a further 18 Requirements (23 % of the Standard) requiring operators to integrate social performance inputs into processes, systems, and decisions about tailings facility management (Joyce & Kemp, 2020).

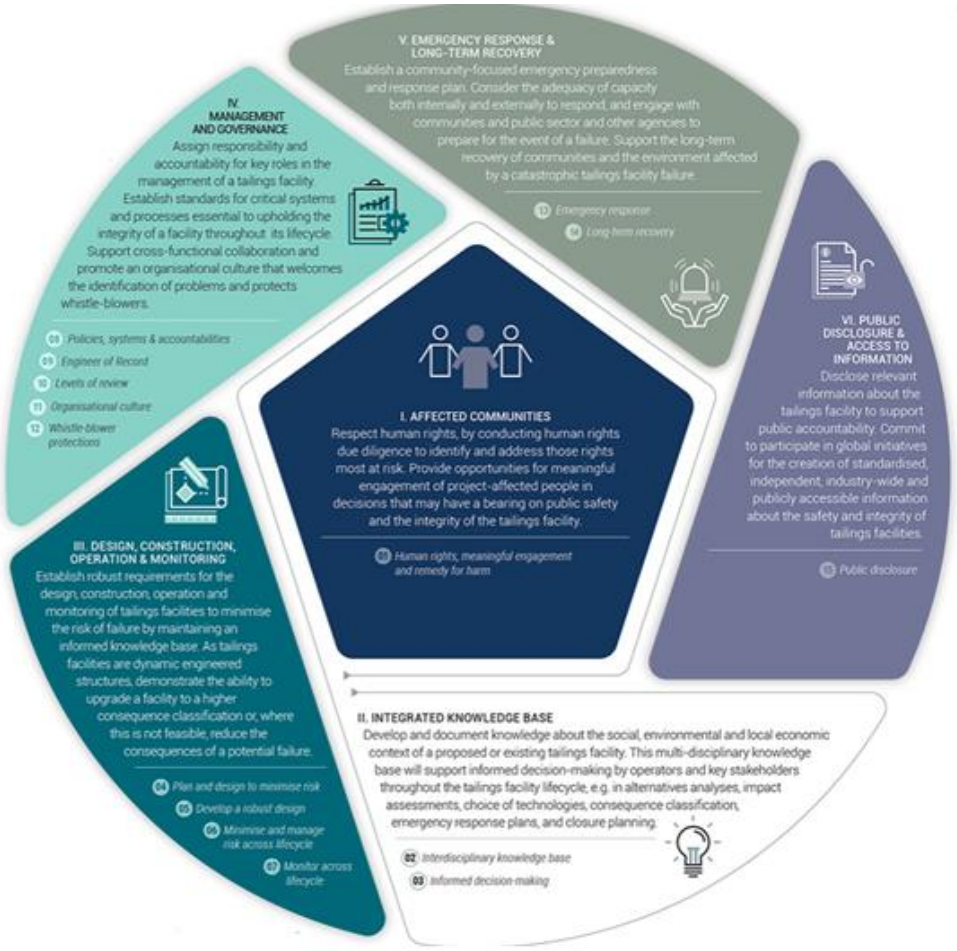


Figure 12: Summary of GISTM

Under Topic I, Affected Communities, there are four explicit social performance requirements namely: consideration of human rights throughout the lifecycle of the TSF; Free, prior, informed consent of indigenous and tribal people; meaningful engagement; and a grievance mechanism.

Topic II, Integrated Knowledge Base, package social, environmental, and local economic conditions together. Understanding of local context, human exposure and vulnerability is important in this topic. Impact assessment and mitigation plans fall under this topic.

Although Topic III, Design, Construction, Operation and Monitoring deals mainly with technical aspects, social requirements are included when additional steps to minimise consequences are considered, and in the mention that international standards should be followed if involuntary resettlement is required.

Topic IV, Management and Governance requires the establishment of a tailings governance framework and confirms the Environmental and Social Management System (ESMS) as an integral component. This topic nominates one or more Accountable Executive(s) as responsible for, amongst other matters, avoiding or minimising the consequences of a tailings facility failure for local people. Other requirements include multi-disciplinary risk assessments, and the review and audit of the ESMS as it relates to the tailings facility.

Topic V, Emergency Preparedness and Recovery, is critically important from a social performance perspective. It requires meaningful engagement with employees and contractors in the development of Emergency Preparedness and Response Plans, and 'locks in' the role of project-affected people in the co-development of community-focused emergency preparedness measures. Topic V also cover the long-term recovery of people and the environment in the event of a catastrophic failure event – a topic that is not covered in any other tailings or social performance standard. Requirement 14.1 asks operators to take reasonable steps, before a failure

event, to meaningfully engage with public sector agencies and other organisations that would participate in medium- and long-term social and environmental post-failure response strategies. These agencies are likely to be quite different to the first responder groups engaged. Topic V would involve post hoc impact assessments, and stakeholder engagement to develop and implement plans that enable the participation of affected people in restoration and recovery works and ongoing monitoring activities.

The documents listed under Topic VI, Public Disclosure and Access to Information, will likely be in the hands of other functions, such as external affairs and legal, many of these concerns fall within the purview of social performance. Regularly publishing and updating information and responding to reasonable requests for additional information is fundamental to meaningful engagement at the local-level, and for generating trust across the stakeholder spectrum (Joyce & Kemp, 2020). Harmony aims to align their operations with the requirements of the GISTM.

4.2.5 THE MINING AND BIODIVERSITY GUIDELINES, 2013

The Mining and Biodiversity Guidelines (2013) was developed by the Department of Mineral Resources, the Chamber of Mines, the SANBI and the South African Mining and Biodiversity Forum, with the intention to find a balance between economic growth and environmental sustainability. The Guideline is envisioned as a tool to "foster a strong relationship between biodiversity and mining, which will eventually translate into best practice within the mining sector. It provides a tool to facilitate the sustainable development of South Africa's mineral resources, in a way that enables regulators, industry and practitioners to minimise the impact of mining on the country's biodiversity and ecosystem services. It provides the mining sector with a practical, user- friendly manual for integrating biodiversity considerations into the planning processes and managing biodiversity during the operational phases of a mine, from exploration through to closure. The Guideline provides explicit direction in terms of where: mining-related impacts are legally prohibited; biodiversity priority areas may present high risks for mining projects; and biodiversity may limit the potential for mining.

In identifying biodiversity priority areas, which have different levels of risk against mining, the Guideline categorises biodiversity priority areas into four categories of biodiversity priority areas in relation to their importance from a biodiversity and ecosystem service point of view as well as the implications for mining in these areas:

A) Legally protected areas, where mining is prohibited;

B) Areas of highest biodiversity importance, which are at the highest risk for mining;

C) Areas of high biodiversity importance, which are at a high risk for mining; and

D) Areas of moderate biodiversity importance, which are at a moderate risk for mining.

The study area location will be assessed against the Mining and Biodiversity Guidelines (2013) spatial dataset to determine which categories it falls within. Based on review of available information, it is likely that that the project area is located within Category D due to the existing mining activities in the area.

4.2.6 NOISE STANDARDS

There are a few South African scientific standards (SABS) relevant to noise from mines, industry and roads. They are:

- South African National Standard (SANS) 10103:2008 – 'The measurement and rating of environmental noise with respect to annoyance and to speech communication';
- SANS 10210:2004 – 'Calculating and predicting road traffic noise';
- SANS 10328:2008 – 'Methods for environmental noise impact assessments';
- SANS 10357:2004 – 'The calculation of sound propagation by the Concave method';
- SANS 10181:2003 – 'The Measurement of Noise Emitted by Road Vehicles when Stationary'; and

- SANS 10205:2003 – 'The Measurement of Noise Emitted by Motor Vehicles in Motion'.

The relevant standards use the equivalent continuous rating level as a basis for determining what is acceptable. The levels may take single event noise into account, but single event noise by itself does not determine whether noise levels are acceptable for land use purposes. With regards to SANS 10103:2008, the recommendations are likely to inform decisions by authorities, but non-compliance with the standard will not necessarily render an activity unlawful per se.

4.2.7 NATIONAL RADIOACTIVE WASTE MANAGEMENT POLICY AND STRATEGY

The purpose of the National Radioactive Waste Management Policy and Strategy (NRWMP) published in 2005 is: *To ensure the establishment of a comprehensive radioactive waste governance framework by formulating, in addition to nuclear and other applicable legislation, a policy, and implementation strategy in consultation with all stakeholders.*

Within the national framework, the NRWMP is viewed as the starting point for the definition and selection of an appropriate solution for the management of radioactive waste. The NRWMP also addresses options for managing radioactive waste generated through the nuclear industry, as well as waste containing un-concentrated naturally occurring radioactive materials from the mining and minerals processing industries. In consideration of options for radioactive waste management, the document takes cognisance of the IAEA radioactive waste management principles (IAEA, 1995). In guiding the national strategy for radioactive waste management, several strategic points of reference in dealing with radioactive waste are defined. Two of the guiding principles that are of importance in terms of managing NORM are Principle No. 4 and Principle No. 13:

The aim (of a radioactive waste management strategy) shall be to achieve a maximum degree of passive safety in storage and disposal (Principle No. 4). The deliberate dilution of radioactive waste is not acceptable, however, in the case of NORM waste, the dilution of higher concentration material with lower concentration material will be considered if all relevant regulatory concerns are addressed (Principle No. 13).

In implementing the NRWMP, South Africa followed the IAEA guidelines regarding the definition and classification of radioactive waste as presented in IAEA.

5 NEED AND DESIRABILITY OF THE PROPOSED ACTIVITY

The applicant owns and operates a number of Gold Mines and plants in the Welkom region in the Free State and currently deposits tailings onto the Free State South 2 Tailings Storage Facility (TSF), St. Helena 4 TSF, St. Helena 123 TSF, Dam 23 TSF, Brand D TSF and Target 1&2 TSF. The current planned LOM of the Free State operations exceed the available deposition capacity of these TSFs and the applicant is therefore proposing to construct the proposed Nooitgedacht TSF and associated infrastructure to cater for this additional capacity. A reserve reclamation study which looked at the reclamation and treatment of the 774Mt of tailings contained in reserve status in TSFs in the Free State indicated that Harmony requires additional deposition space in future. Nooitedact will cater for both the LoM as well as the reclamation of 23 additional TSFs over an approximate LoM of up 2050 (commissioning of the last reclamation station). The Free State Reclamation project will be for the reclamation of up to 3 older TSFs at any one time. This will allow for the continuation of jobs and investment into the Welkom area. Further thereto, the reclamation will result in the removal and cleaning of old historic tailings facility and placing it on one consolidated facility which is well managed and is lined in accordance too the new waste legislation and regulations , thereby removing potential sources of pollution from the old areas and allowing Harmony to rehabilitate these old footprints and open them to other land uses. This will create substantial investment in the Welkom area and ensure Harmony is able to keep mining activities ongoing into the future.

The needs and desirability analysis component of the “Guideline on need and desirability in terms of the EIA Regulations (Notice 819 of 2014)” includes, but is not limited to, describing the linkages and dependencies between human well-being, livelihoods and ecosystem services applicable to the area in question, and how the proposed development’s ecological impacts will result in socio-economic impacts (e.g. on livelihoods, opportunity costs, etc.). Table 8 present the needs and desirability analysis undertaken for the project based on the guideline on need and desirability in terms of the EIA regulations.

Table 8: Needs and desirability analysis for the proposed TSF.

Ref No.	Question	Answer
1	Securing ecological sustainable development and use of natural resources	
1.1	How were the ecological integrity considerations taken into account in terms of: Threatened Ecosystems, Sensitive and vulnerable ecosystems, Critical Biodiversity Areas, Ecological Support Systems, Conservation Targets, Ecological drivers of the ecosystem, Environmental Management Framework, Spatial Development Framework (SDF) and global and international responsibilities.	A number of specialist studies will inform this application and include: • Biodiversity (Terrestrial) • Heritage • Agriculture Potential, Soils and Land capability • Geohydrology • Aquatic and Wetland (including hydropedology) • Air quality • Hydrology • Palaeontology • Noise (compliance statement) • Traffic • Social • Visual • Health Risk and Radiological • Closure Costing The conclusions of these studies will be included in the EIA report. Further, the mitigations and mitigations stemming from the specialists assessments will be included in the EMPr for implementation.
1.2	How will this project disturb or enhance ecosystems and / or result in the loss or protection of biological diversity? What measures were explored to avoid these negative impacts, and where these negative impacts could not be avoided altogether, what measures were explored to minimise and remedy the impacts? What measures were explored to enhance positive impacts?	Refer to baseline ecological statement in Section 8 below, and the impact assessment in Section 8.11 of this report. Further details will be provided in the EIA report.
1.3	How will this development pollute and / or degrade the biophysical environment? What measures were explored to either avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy the impacts? What measures were explored to enhance positive impacts?	

Ref No.	Question	Answer
1.4	What waste will be generated by this development? What measures were explored to avoid waste, and where waste could not be avoided altogether, what measures were explored to minimise, reuse and / or recycle the waste? What measures have been explored to safely treat and/or dispose of unavoidable waste?	Significant amounts of waste will not be generated during the operational phase, apart from the tailings material itself. During construction the types of waste generated include sewage waste, biodegradable wastes, and non-biodegradable solid waste as well as general construction waste. Waste has been identified as an impact and assessed in Section 9. However, it is anticipated that the following measures can be utilised to reduce the impact of the waste on the receiving environment: • Waste must be stored correctly. • All hazardous waste such as oil must be stored separately and disposed of at a registered facility. • Proof of disposal must be kept by the Applicant.
1.5	How will this project disturb or enhance landscapes and / or sites that constitute the nation's cultural heritage? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy the impacts? What measures were explored to enhance positive impacts?	A heritage impact assessment is being conducted as part of the EIA. Refer to section 9.3.3 for further information.
1.6	How will this project use and / or impact on non-renewable natural resources? What measures were explored to ensure responsible and equitable use of the resources? How have the consequences of the depletion of the non-renewable natural resources been considered? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy the impacts? What measures were explored to enhance positive impacts?	Refer to the impact assessment in Section 9 of this report. As a result of the fact that this project entails only a new TSF and pipelines, it is anticipated that this project will not lead to a significant impact or depletion of non-renewable resources.
1.7	How will this project use and / or impact on renewable natural resources and the ecosystem of which they are part? Will the use of the resources and / or impacts on the ecosystem jeopardise the integrity of the resource and / or system taking into account carrying capacity restrictions, limits of acceptable change, and thresholds? What measures were explored to firstly avoid the use of resources, or if avoidance is not possible, to minimise the use of resources? What measures were taken to ensure responsible and equitable use of the resources? What measures were explored to enhance positive impacts?	Refer to the impact assessment in Section 9 of this report. It is anticipated that the project will have a low - moderate impact on the localised ecology, as long as the identified SCC can safely be relocated through a relocation and monitoring programme.

Ref No.	Question	Answer
1.7.1	Does the proposed project exacerbate the increased dependency on increased use of resources to maintain economic growth or does it reduce resource dependency (i.e. de-materialised growth)?	The proposed project is only for additional deposition space required for Harmony's Free State operations.
1.7.2	Does the proposed use of natural resources constitute the best use thereof? Is the use justifiable when considering intra- and intergenerational equity, and are there more important priorities for which the resources should be used?	The proposed project will not, at this stage, involve the use of the natural resources apart from the TSF and associated infrastructure area to be cleared.
1.7.3	Do the proposed location, type and scale of development promote a reduced dependency on resources?	The proposed project is only for additional deposition space required for Harmony's Free State operations.
1.8	How were a risk-averse and cautious approach applied in terms of ecological impacts:	
1.8.1	What are the limits of current knowledge (note: the gaps, uncertainties and assumptions must be clearly stated)?	The limitations and/or gaps in knowledge are presented in Section 12.
1.8.2	What is the level of risk associated with the limits of current knowledge?	The level of risk is considered low at this stage.
1.8.3	Based on the limits of knowledge and the level of risk, how and to what extent was a risk-averse and cautious approach applied to the development?	At this stage it is anticipated that this project will not lead to a significant impact on the receiving environment. Refer to the impact assessment in Section 9 of this report.
1.9	How will the ecological impacts resulting from this development impact on people's environmental right in terms following?	
1.9.1	Negative impacts: e.g. access to resources, opportunity costs, loss of amenity (e.g. open space), air and water quality impacts, nuisance (noise, odour, etc.), health impacts, visual impacts, etc. What measures were taken to firstly avoid negative impacts, but if avoidance is not possible, to minimise, manage and remedy negative impacts?	The proposed activities are anticipated to have low negative ecological impacts. Refer to the impact assessment in Section 9 in this report.
1.9.2	Positive impacts: e.g. improved access to resources, improved amenity, improved air or water quality, etc. What measures were taken to enhance positive impacts?	
1.10	Describe the linkages and dependencies between human wellbeing, livelihoods and ecosystem services applicable to the area in question and how the development's ecological impacts will result in socio-economic impacts (e.g. on livelihoods, loss of heritage site, opportunity costs, etc.)?	A medium to low impact on third party wellbeing, livelihoods and ecosystem services is currently foreseen. Refer to the impact assessment in Section 9 of this report.

Ref No.	Question	Answer
1.11	Based on all of the above, how will this development positively or negatively impact on ecological integrity objectives / targets / considerations of the area?	The proposed activities are anticipated to have generally low negative ecological impacts. Refer to the impact assessment in Section 9 in this report.
1.12	Considering the need to secure ecological integrity and a healthy biophysical environment, describe how the alternatives identified (in terms of all the different elements of the development and all the different impacts being proposed), resulted in the selection of the "best practicable environmental option" in terms of ecological considerations?	Refer to Section 6 – where details of the alternatives are given and considered.
1.13	Describe the positive and negative cumulative ecological / biophysical impacts bearing in mind the size, scale, scope and nature of the project in relation to its location and existing and other planned developments in the area?	Refer to Section 9 of this report.
2	Promoting justifiable economic and social development	
2.1	What is the socio-economic context of the area, based on, amongst other considerations, the following:	
2.1.1	The IDP (and its sector plans' vision, objectives, strategies, indicators and targets) and any other strategic plans, frameworks or policies applicable to the area	Refer to Section 8.11 of this report for a breakdown of the demographics and social environment in the project area. The Matjhabeng IDP identifies Economic infrastructure and development as one of the key mayoral strategic priorities (IDP 2023/24). More detail will be provided in the Social Assessment report (Appendix D).
2.1.2	Spatial priorities and desired spatial patterns (e.g. need for integration of segregated communities, need to upgrade informal settlements, need for densification, etc.),	It is anticipated that the use of local labour will be utilised as far as possible. Labourers will mostly be sourced from surrounding towns and areas such as Welkom. The Free State Provincial Growth and Development Strategy (FGDS) is based on six pillars, each with its own set of drivers (FSDF, 2012). One of the drivers included is to minimise the impact of the declining mining sector and ensure that existing mining potential is harnessed.
2.1.3	Spatial characteristics (e.g. existing land uses, planned land uses, cultural landscapes, etc.), and	Refer to the baseline environment in Section 8 of this report. The TSF is located in a mining area and is surrounded by existing mining infrastructure .
2.1.4	Municipal Economic Development Strategy ("LED Strategy").	Considering the location and type of the activities, it is not anticipated to significantly promote or facilitate spatial transformation and sustainable urban development.

Ref No.	Question	Answer
2.2	Considering the socio-economic context, what will the socio-economic impacts be of the development (and its separate elements/aspects), and specifically also on the socio-economic objectives of the area?	Refer to the impact assessment in Section 9 in this report, specifically section 9.3.13.
2.2.1	Will the development complement the local socio-economic initiatives (such as local economic development (LED) initiatives), or skills development programs?	It is anticipated that the use of local labour will be utilised as far as possible. Labourers will mostly be sourced from surrounding towns and areas such as Welkom. In addition, Harmony has various social and LED initiatives required under their Social & Labour Plan (SLP) commitments.
2.3	How will this development address the specific physical, psychological, developmental, cultural and social needs and interests of the relevant communities?	Refer to the public participation process and feedback contained in Appendix C.
2.4	Will the development result in equitable (intra- and inter-generational) impact distribution, in the short- and long-term? Will the impact be socially and economically sustainable in the short- and long-term?	Refer to the impact assessment and mitigation measures in Section 9 of this report, specifically section 9.3.13. The TSF construction and operation will create employment and ensure Harmony can continue to employ current employees at their Free State operations.
2.5	In terms of location, describe how the placement of the proposed development will:	
2.5.1	Result in the creation of residential and employment opportunities in close proximity to or integrated with each other.	It is anticipated that the use of local labour will be utilised as far as possible. Labourers will mostly be sourced from surrounding towns and areas such as Welkom and Odendaalsrus. TSF construction and operation will create employment and ensure Harmony can continue to employ current employees at their Free State operations
2.5.2	Reduce the need for transport of people and goods.	The activities are not anticipated to have an impact on the transportation of goods and people.
2.5.3	Result in access to public transport or enable non-motorised and pedestrian transport (e.g. will the development result in densification and the achievement of thresholds in terms of public transport),	The activities are not anticipated to have any significant impact on the public transport.
2.5.4	Compliment other uses in the area,	The surrounding area is impacted by existing TSF facilities and associated infrastructure.
2.5.5	Be in line with the planning for the area.	Refer to item 2.1.1 of this table (above).

Ref No.	Question	Answer
2.5.6	For urban related development, make use of underutilised land available with the urban edge.	Not applicable. The proposed project is not located in an urban area.
2.5.7	Optimise the use of existing resources and infrastructure,	Refer to Section 3 of this report.
2.5.8	Opportunity costs in terms of bulk infrastructure expansions in non-priority areas (e.g. not aligned with the bulk infrastructure planning for the settlement that reflects the spatial reconstruction priorities of the settlement),	
2.5.9	Discourage "urban sprawl" and contribute to compaction / densification.	Not applicable. The proposed project is not located within an urban area and will not contribute to urban sprawl.
2.5.10	Contribute to the correction of the historically distorted spatial patterns of settlements and to the optimum use of existing infrastructure in excess of current needs,	Refer to items 2.5.7 – 2.5.9 of this table (above).
2.5.11	Encourage environmentally sustainable land development practices and processes	Refer to impact assessment in Section 9 of this report.
2.5.12	Take into account special locational factors that might favour the specific location (e.g. the location of a strategic mineral resource, access to the port, access to rail, etc.),	Refer to alternative analysis in Section 6.
2.5.13	The investment in the settlement or area in question will generate the highest socio-economic returns (i.e. an area with high economic potential).	It is anticipated that the use of local labour will be utilised as far as possible. Labourers will mostly be sourced from surrounding towns and areas such as Welkom. In addition, Harmony has various social and LED initiatives required under their various SLP commitments.
2.5.14	Impact on the sense of history, sense of place and heritage of the area and the socio-cultural and cultural-historic characteristics and sensitivities of the area, and	Refer to impact assessment in Section 9 of this report.
2.5.15	In terms of the nature, scale and location of the development promote or act as a catalyst to create a more integrated settlement?	Given the scale of the development it is not anticipated that the activities will contribute significantly to settlements or areas in terms of direct socio-economic returns however the development will allow operations at the Harmony One plant and various Harmony Welkom mining operations to continue.

Ref No.	Question	Answer
2.6	How was a risk-averse and cautious approach applied in terms of socio-economic impacts:	
2.6.1	What are the limits of current knowledge (note: the gaps, uncertainties and assumptions must be clearly stated)?	Refer to Section 12 of this report.
2.6.2	What is the level of risk (note: related to inequality, social fabric, livelihoods, vulnerable communities, critical resources, economic vulnerability and sustainability) associated with the limits of current knowledge?	The level of risk is low as the project is not expected to have far reaching negative impacts on socio-economic conditions.
2.6.3	Based on the limits of knowledge and the level of risk, how and to what extent was a risk-averse and cautious approach applied to the development?	The level of risk is low as the project is not expected to have far reaching negative impacts on socio-economic conditions.
2.7	How will the socio-economic impacts resulting from this development impact on people's environmental right in terms following:	
2.7.1	Negative impacts: e.g. health (e.g. HIV-AIDS), safety, social ills, etc. What measures were taken to firstly avoid negative impacts, but if avoidance is not possible, to minimise, manage and remedy negative impacts?	Refer to the impact assessment in Section 9 of this report. A health a radiation assessment is being conducted as part of the EIA – see section 9.3.11 for further information.
2.7.2	Positive impacts. What measures were taken to enhance positive impacts?	Refer to the impact assessment in Section 9 of this report, specifically section 9.3.13.
2.8	Considering the linkages and dependencies between human wellbeing, livelihoods and ecosystem services, describe the linkages and dependencies applicable to the area in question and how the development's socioeconomic impacts will result in ecological impacts (e.g. over utilisation of natural resources, etc.)?	Refer to the impact assessment in Section 9 of this report, specifically section 9.3.13.
2.9	What measures were taken to pursue the selection of the "best practicable environmental option" in terms of socio-economic considerations?	Refer to the impact assessment in Section 9 of this report, specifically section 9.3.13.
2.10	What measures were taken to pursue environmental justice so that adverse environmental impacts shall not be distributed in such a manner as to unfairly discriminate against any person, particularly vulnerable and disadvantaged persons (who are the beneficiaries and is the development located appropriately)? Considering the need for social equity and justice, do the alternatives identified, allow the "best practicable environmental option" to be selected, or is there a need for other alternatives to be considered?	Refer to the impact assessment in Section 9 of this report, specifically section 9.3.13.

Ref No.	Question	Answer
2.11	What measures were taken to pursue equitable access to environmental resources, benefits and services to meet basic human needs and ensure human wellbeing, and what special measures were taken to ensure access thereto by categories of persons disadvantaged by unfair discrimination?	By conducting an EIA Process, the applicant ensures that equitable access has been considered. Refer to the impact assessment in Section 9 of this report.
2.12	What measures were taken to ensure that the responsibility for the environmental health and safety consequences of the development has been addressed throughout the development's life cycle?	Refer to the impact assessment in Section 9 of this report. The EMPr which will be included in the EIA report will specify timeframes within which mitigation measures must be implemented.
2.13	What measures were taken to:	
2.13.1	Ensure the participation of all interested and affected parties.	Refer to Section 7 of this report, describing the public participation process undertaken for the proposed project.
2.13.2	Provide all people with an opportunity to develop the understanding, skills and capacity necessary for achieving equitable and effective participation,	Refer to Section 7 of this report, describing the public participation process undertaken for the proposed project. advertisement, notification letter and site notice have been made available in English, Afrikaans and Sesotho to assist in understanding of the project. Further public consultation will be held during the review period of the Scoping / EIA reports for the project.
2.13.3	Ensure participation by vulnerable and disadvantaged persons,	
2.13.4	Promote community wellbeing and empowerment through environmental education, the raising of environmental awareness, the sharing of knowledge and experience and other appropriate means,	
2.13.5	Ensure openness and transparency, and access to information in terms of the process,	
2.13.6	Ensure that the interests, needs and values of all interested and affected parties were taken into account, and that adequate recognition were given to all forms of knowledge, including traditional and ordinary knowledge,	
2.13.7	Ensure that the vital role of women and youth in environmental management and development were recognised and their full participation therein will be promoted?	
2.14	Considering the interests, needs and values of all the interested and affected parties, describe how the development will allow for opportunities for all the	Refer to Section 7 of this report, describing the public participation process undertaken for the proposed project.

Ref No.	Question	Answer
	segments of the community (e.g. a mixture of low-, middle-, and high-income housing opportunities) that is consistent with the priority needs of the local area (or that is proportional to the needs of an area)?	
2.15	What measures have been taken to ensure that current and / or future workers will be informed of work that potentially might be harmful to human health or the environment or of dangers associated with the work, and what measures have been taken to ensure that the right of workers to refuse such work will be respected and protected?	Potential future workers will have to be educated on a regular basis as to the environmental and safety risks that may occur within their work environment. Furthermore, adequate measures will have to be taken to ensure that the appropriate personal protective equipment is issued to workers based on the conditions that they work in and the requirements of their job.
2.16	Describe how the development will impact on job creation in terms of, amongst other aspects:	
2.16.1	The number of temporary versus permanent jobs that will be created.	It is anticipated that the use of local labour will be utilised as far as possible. Labourers will mostly be sourced from surrounding towns and areas such as Welkom and Odendaalsrus. Further details in terms of job figures and employment opportunities will be made available for the EIA-phase report.
2.16.2	Whether the labour available in the area will be able to take up the job opportunities (i.e. do the required skills match the skills available in the area).	
2.16.3	The distance from where labourers will have to travel.	
2.16.4	The location of jobs opportunities versus the location of impacts.	
2.16.5	The opportunity costs in terms of job creation.	
2.17	What measures were taken to ensure:	
2.17.1	That there were intergovernmental coordination and harmonisation of policies, legislation and actions relating to the environment.	The EIA Process requires governmental departments to communicate regarding any application. In addition, all relevant departments are notified at various phases of the project by the EAP.
2.17.2	That actual or potential conflicts of interest between organs of state were resolved through conflict resolution procedures.	
2.18	What measures were taken to ensure that the environment will be held in public trust for the people, that the beneficial use of environmental resources will serve the public interest, and that the environment will be protected as the people's common heritage?	Refer to Section 7 of this report, describing the public participation process implemented for the application, as well Section 8, the impact on any national estate.

Ref No.	Question	Answer
2.19	Are the mitigation measures proposed realistic and what long-term environmental legacy and managed burden will be left?	Refer to the impact assessment and mitigation measures in Section 9 of this report. All mitigation measures are considered to the realistic and implementable.
2.20	What measures were taken to ensure that the costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects will be paid for by those responsible for harming the environment?	At this stage the proposed activities are not anticipated to produce significant pollution, environmental damage or adverse health effects in the long term as long as the proposed mitigation measures are implemented.
2.21	Considering the need to secure ecological integrity and a healthy bio-physical environment, describe how the alternatives identified (in terms of all the different elements of the development and all the different impacts being proposed), resulted in the selection of the best practicable environmental option in terms of socio-economic considerations?	Refer to Section 6, description of the process followed to reach the proposed preferred site.
2.22	Describe the positive and negative cumulative socio-economic impacts bearing in mind the size, scale, scope and nature of the project in relation to its location and other planned developments in the area?	Refer to the impact assessment and mitigation measures in Section 9, with specific reference to Section 9.3.13. Further detail will be provided in the EIA report.

6 PROJECT ALTERNATIVES

As this application relates only to a new TSF and associated pipelines and infrastructure, there are limited feasible and/or reasonable alternatives that can be considered and which are described and motivated below.

6.1 LOCATION ALTERNATIVES

The assessment of location alternatives is limited due to the available open space in close proximity to the mining activities (and especially the gold processing plant). Several alternative sites were identified and assessed as part of a 2008 study completed by Golder Environmental with two additional sites also assessed in 2025. The various sites that were assessed are indicated in Figure 13 below.

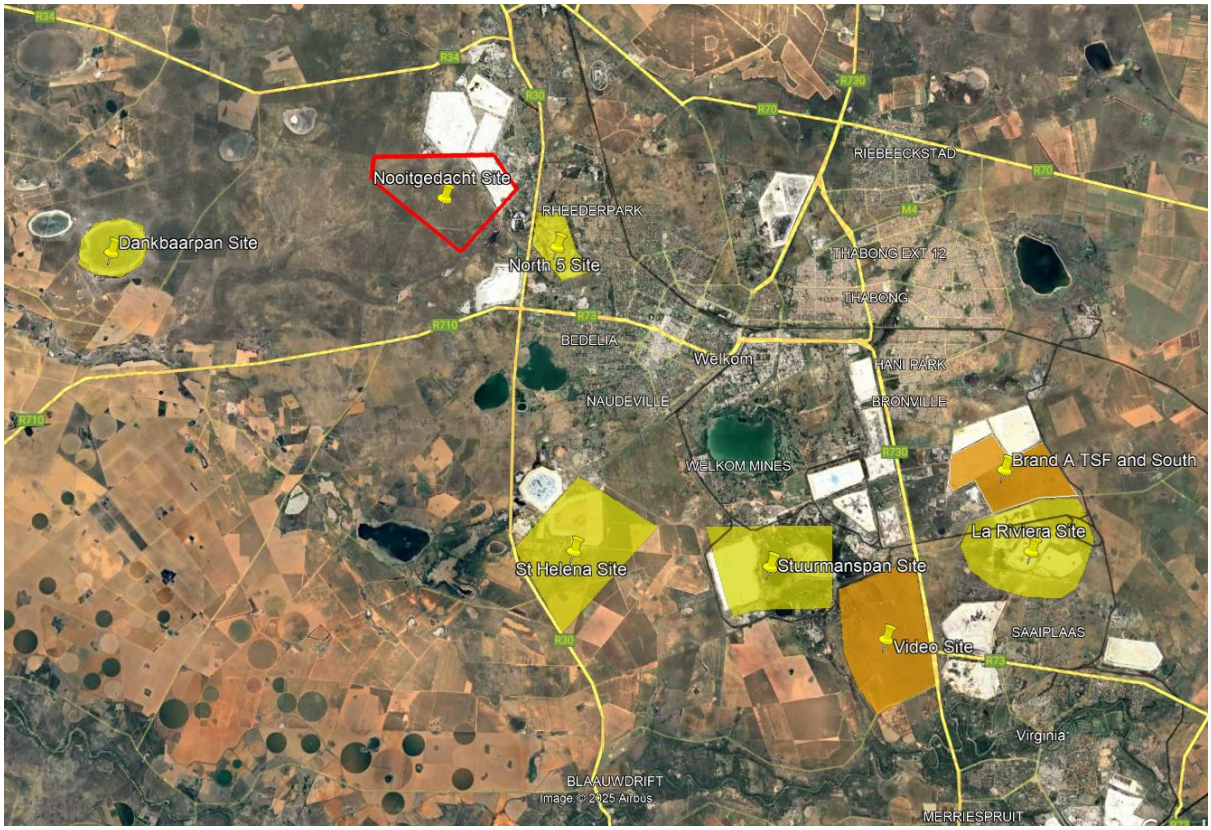


Figure 13: Various sites assessed in the Site Selection process.

As part of the 2008 Golder Study, input was obtained from various specialists including ecological, surface water and groundwater specialists. During a Steering Committee meeting involving various stakeholders including DWS that was convened on 25 October 2007 the site selection findings were discussed and an optimal site selected. Nooitgedacht (Site 1) was agreed upon as the preferred site for the TSF (as agreed by the Steering Committee). The reasons for the selection of the Nooitgedacht site as the preferred alternative was that the proposed footprint is largely brownfields with a partial greenfields take. The resultant negative impacts on agriculture and ecosystems are considered to be negligible but outweighed by the positive attributes of the site. A copy of the site selection summary report completed as part of the 2008 study is included in Appendix G.

In addition to the 2008 Golder site alternatives, an additional two sites were identified in 2025 namely Video Site and the Brand A TSF footprint extending south of the Brand TSF complex. Further detail on these options is provided below:

Existing Brand A TSF and the area to the immediate south of the Brand TSF complex:

The area south of the Brand TSF complex, once the Saaiplaas Shaft area is excluded, is too small to accommodate 800Mt of deposition. At the time of the original 2008 site selection, Brand D was in active deposition, Brand A

was dormant and Saaiplaas shaft was still in operation. Brand D is still in active deposition, Brand A is now reclaimed and the Saaiplaas shaft is no longer in operation.

Video site:

At the time of the original Golder 2008 site selection, this area was an active mine water evaporation area for excess underground water and therefore not considered. It was subsequently assessed in 2025 based on the fact that the dewatering and evaporation activities having ceased. The site was deemed as fatally flawed by the DWS in 2025 due to its proximity to the Sand River (<800 m) and the resultant risk of contamination of this important river system in the unlikely chance of dam failure.

6.1.1 MITIGATION HIERARCHY FOR THE LOCATION ALTERNATIVES

In accordance with the requirements of the NEMA and the principles of integrated environmental management, the mitigation hierarchy has been applied systematically throughout the alternatives assessment and site-selection process for the proposed TSF. The hierarchy provides a structured approach for preventing and managing environmental impacts by prioritising avoidance, followed by minimisation, rehabilitation / restoration, and, only as a last resort, biodiversity offsetting. Each of the nine disposal alternatives assessed—including eight surface sites and one underground option—was evaluated against these principles to ensure that potential environmental and socio-economic impacts were addressed in a logical and defensible manner. The following sections describe how each stage of the mitigation hierarchy was applied and how the preferred site was selected on the basis of both engineering feasibility and the lowest overall residual impact.

6.1.1.1 **AVOIDANCE**

Avoidance represents the first and most critical step of the mitigation hierarchy and was applied as the primary principle guiding the site-selection process for the proposed Tailings Storage Facility (TSF). A total of nine disposal alternatives—including eight surface sites and one underground deposition option—were screened and assessed to avoid significant environmental and socio-economic impacts as far as practicably possible. This step focused on identifying locations where key environmental features, sensitive habitats, or communities would not be adversely affected, while also considering engineering feasibility and the required deposition capacity of approximately 800Mt of tailings deposition. Through this process, several alternatives were excluded early due to unacceptable constraints, including proximity to settlements, incompatible land uses, and extensive aquatic sensitivities. The avoidance step therefore ensured that the project footprint was directed away from the most sensitive receiving environments from the outset.

6.1.1.2 **MINIMISATION**

Following the application of avoidance, the remaining feasible alternatives were subjected to a detailed minimisation assessment. This stage aimed to reduce the extent, duration, and intensity of potential impacts that could not be fully avoided. Comparative analysis considered topography, access, geotechnical suitability, existing disturbance, and the scale of socio-economic interactions for each of the nine options. The preferred site emerged as it could accommodate the required storage volume with the least disruption to surrounding communities and existing infrastructure. Importantly, although the preferred site contains habitat for a protected species (referred to as Species 15), careful design optimisation—such as refining the TSF footprint, configuring access routes, and positioning support infrastructure—has reduced the area of impact on sensitive habitat to the minimum practicable extent. The minimisation stage therefore ensured that residual impacts were substantially lowered before moving to further steps in the hierarchy.

6.1.1.3 **REHABILITATION / RESTORATION**

Rehabilitation and restoration measures form the third tier of the mitigation hierarchy and will be applied both during construction and throughout the operational life cycle of the TSF. These measures focus on restoring disturbed areas, stabilising exposed soils, and reinstating ecological functioning where practicable. Progressive rehabilitation will be implemented on temporarily disturbed areas, including laydown zones, construction footprints, and areas of incidental disturbance. The TSF design also incorporates engineered stormwater controls and vegetative stabilisation measures to ensure long-term landform stability and reduce erosion and dust generation. Although complete restoration of pre-project habitat conditions may not be achievable within

the TSF footprint, rehabilitation interventions will ensure that disturbance outside the permanent facility area is minimised and that the surrounding landscape retains ecological resilience.

6.1.1.4 OFFSETTING

Offsetting constitutes the final step of the mitigation hierarchy and is only applied to address significant residual impacts that remain after avoidance, minimisation, and rehabilitation measures have been fully exhausted. For the preferred TSF site, the presence of Species 15 represents such a residual impact. As the project footprint will unavoidably affect portions of this species' habitat, a biodiversity offset strategy is proposed that includes the translocation of individuals to suitable, secure offset sites with comparable ecological characteristics. This will be supported by long-term management commitments and scientific studies to ensure the persistence and viability of the species at the receiving locations. The application of offsets therefore aligns with national biodiversity offset principles and ensures that any unavoidable loss of ecological value is balanced through measurable conservation outcomes.

6.1.2 MITIGATION HIERARCHY ANALYSIS FOR ALTERNATIVE SITE LOCATIONS

A biodiversity specialist was appointed in 2025 to systematically evaluate the potential terrestrial biodiversity impacts associated with the proposed Nooitgedacht Tailings Storage Facility and to guide the application of the mitigation hierarchy in line with current legislation and best-practice guidelines, with relation to the identified Golder 2008 alternative sites for the TSF. The key findings for each site indicate the major advantages and disadvantages, with suggestions of alternative strategies to reduce environmental and human impact. Current data is represented by the summary table from the DFFE Screening Tool Report (Regulation 16(1)(v) of the Environmental Impact Assessment Regulations 2014, as amended). A copy of the Mitigation Hierarchy report is included in Appendix G and a discussion of each site location alternative is presented in the subsections below.

6.1.2.1 OPTION 1 - NOOITGEDACHT

<table>
<tr><td rowspan="3">Site 1 - Nooitgedacht</td><td>Previous Studies</td><td>

Preferred by the Steering Committee as the ideal position for a tailings facility.
Largely brownfields with partial greenfields take.
Existing tailings facilities nearby may be used for additional disposal.
Low agricultural potential, resulting in negligible negative impacts on agriculture and ecosystem.
Low impact on natural water quality due to distance from the Sand River and clean water systems.
Supported from an engineering perspective.
Potential dust transport to residential areas, but mitigation measures will be identified.
Sensitive Species 15 present; relocation planned as mitigation.

</td></tr>
<tr><td>Current Desktop Data</td><td>
<table>
<tr><th>Theme</th><th>Very High sensitivity</th><th>High sensitivity</th><th>Medium sensitivity</th><th>Low sensitivity</th></tr>
<tr><td>Agriculture Theme</td><td></td><td>X</td><td></td><td></td></tr>
<tr><td>Animal Species Theme</td><td></td><td>X</td><td></td><td></td></tr>
<tr><td>Aquatic Biodiversity Theme</td><td>X</td><td></td><td></td><td></td></tr>
<tr><td>Archaeological and Cultural Heritage Theme</td><td>X</td><td></td><td></td><td></td></tr>
<tr><td>Civil Aviation Theme</td><td></td><td>X</td><td></td><td></td></tr>
<tr><td>Defence Theme</td><td></td><td></td><td></td><td>X</td></tr>
<tr><td>Paleontology Theme</td><td></td><td>X</td><td></td><td></td></tr>
<tr><td>Plant Species Theme</td><td></td><td></td><td></td><td>X</td></tr>
<tr><td>Terrestrial Biodiversity Theme</td><td>X</td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td colspan="3">Ground Truth Site Visit (multiple times between 2023 & 2025)</td></tr>
<tr><td colspan="2">Observations</td><td>

Suitable size for a TSF large enough to accommodate 800Mt of Reclaimed tailings residue and future Run of Mine residue
Large population of SCC species 15 found on site.
Heavily disturbed grassland with limited sensitive terrestrial and flora receptors.
Patches of historical agriculture.
High alien and invasive plant (AIP) presence.
Themida triandra dominated grassland patches (which house the SCC populations).

</td></tr>
</table>

Site Pictures	 

6.1.2.2 OPTION 2 - ST HELENA

Site 2 - St Helena	Previous Studies	○ Second choice site, already impacted by tailings facilities (Free State South 6, 7, 8). ○ No additional impact on agricultural productivity expected. ○ Previously a drainage canal, now heavily impacted by mining. ○ Polluted water present, which may be improved through treatment and reuse. ○ Close to water resources and processing plant, reducing energy use for pumping. ○ Limited residential areas nearby, reducing dust/noise/visual impacts. ○ Poor ecosystem productivity due to proximity to an artificial, polluted wetland. ○ Local winds may blow dust to northern Virginia.
	Current Desktop Data	

Theme	Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
Agriculture Theme	X			
Animal Species Theme		X		
Aquatic Biodiversity Theme	X			
Archaeological and Cultural Heritage Theme				X
Civil Aviation Theme		X		
Defence Theme				X
Paleontology Theme			X	
Plant Species Theme				X
Terrestrial Biodiversity Theme	X			

Ground Truth Site Visit (September 2025)

Observations	• High levels of active agriculture land-use across >50% of the site. • A low number of small drainage/wetland features. • Actively maintained TSF and associated facilities. • Water storage and excess polluted water run-off forming wetland-like areas. • Limited natural terrestrial features remaining. • No SCCs recorded nor expected. • St. Helena 123 footprint is currently being used for deposition from Saaiplaas Plant. • After exclusion of active high potential agriculture land the site is too small for the FSR project.
Site Pictures	   

6.1.2.3 OPTION 3 - STUURMANSPAN

Site 3 - Stuurmanspan

Previous Studies

- Likely to have the least impact on air quality, especially wind-blown dust.
- Majority brownfields (~50%) but includes some prime agricultural land.
- Close to urban areas (Saaiplaas and Harmony).

Current Desktop Data

Theme	Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
Agriculture Theme		X		
Animal Species Theme			X	
Aquatic Biodiversity Theme	X			
Archaeological and Cultural Heritage Theme				X
Civil Aviation Theme		X		
Defence Theme				X
Paleontology Theme			X	
Plant Species Theme				X
Terrestrial Biodiversity Theme	X			

Ground Truth Site Visit (September 2025)

Observations

- Heavily degraded due to historical gold mining-related activities.
- Large wetlands present. Although these are heavily impacted by surrounding mining activities such as run-off from TSFs, they exhibited ecologically-functioning characterisitcs such as nesting wetland avifauna and various riparian flora species.
- Close proximity to Witpan, which is situated ~1.6km north.
- Direct drainage into Sand river (5km south) which presents risk to wider environment and downstream ecosystem health.
- Actively used by locals for livestock grazing.
- Some informal settlements noted.
- Small patch of degraded but recovering secondary grassland in northwestern corner of site inhabited by common terrestrial fauna and avifauna.
- Active agriculture immediately adjacent to the site.
- No SCCs recorded nor expected, however avifauna SCCs may temporarily pass through the site due to the large wetlands.
- Most of the area is a wetland and after exclusion of the wetland area the site is too small for the proposed deposition volume.

Site Pictures




6.1.2.4 OPTION 4 - LA RIVIERA

Site 4 - La Riviera

Previous Studies

- About 40% of the footprint already impacted; scores poorly for ecosystem due to greenfield land take.
- Some areas developing wetland characteristics.
- Historically used for grazing and cropping; 60% of site still agricultural.
- Cultural/historical importance as the first gold mine in the Free State; earmarked for tourism development.

Current Desktop Data

Theme	Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
Agriculture Theme		X		
Animal Species Theme			X	
Aquatic Biodiversity Theme				X
Archaeological and Cultural Heritage Theme				X
Civil Aviation Theme		X		
Defence Theme				X
Paleontology Theme			X	
Plant Species Theme				X
Terrestrial Biodiversity Theme	X			

Ground Truth Site Visit (September 2025)

Observations

- Small wetland-like areas created from excess water from mining processes on-site (small NFEPA seeps).
- Some residential areas located in northeastern corner.
- Historical croplands areas which show signs of secondary grassland recovery and use by common terrestrial fauna and avifauna (located throughout the periphery of the TSF areas). Could have potential for more agricultural use.
- Limited patches of grassland in southeastern section. These were heavily impacted and degraded, not suitable for SCC Species 15. Low likelihood of occurrence for this species.
- Harmony Gold Saaiplaas Plant within footprint (active gold plant).
- Active agriculture immediately adjacent to the site.
- No SCCs recorded nor expected, however avifauna SCCs may temporarily pass through the site due to the wetlands.

Site Pictures




6.1.2.5 OPTION 5 – NORTH 5[2]

Site 5 – North 5

Previous Studies

- Evaluated as a TSF site, but proximity to residential areas (~200m) led to exclusion from selection.
- FSN5 footprint is too small to accommodate 800Mt of tailings.

Current Desktop Data

Theme	Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
Agriculture Theme		X		
Animal Species Theme			X	
Aquatic Biodiversity Theme	X			
Archaeological and Cultural Heritage Theme				X
Civil Aviation Theme			X	
Defence Theme				X
Paleontology Theme		X		
Plant Species Theme				X
Terrestrial Biodiversity Theme	X			

Ground Truth Site Visit

Not evaluated further.

6.1.2.6 OPTION 6 - DANKBAARPAN[3]

Site 6 - Dankbaarpan

Previous Studies

- Immediately considered fatally flawed by the Department of Water Affairs and Forestry due to being situated directly on a pan.
- Not evaluated further.

Current Desktop Data

Theme	Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
Agriculture Theme		X		
Animal Species Theme				X
Aquatic Biodiversity Theme				X
Archaeological and Cultural Heritage Theme				X
Civil Aviation Theme		X		
Defence Theme				X
Paleontology Theme		X		
Plant Species Theme				X
Terrestrial Biodiversity Theme	X			

Ground Truth Site Visit

Not evaluated further - Immediately considered fatally flawed by the DWS due to being situated directly on a large pan. Note that there are large, heavily impacted populations of SCC Species 15 known to occur in this area surrounding Dankbaarpan.

6.1.2.7 OPTION 7 – EXISTING BRAND A TSF AND THE AREA TO THE IMMEDIATE SOUTH OF THE BRAND TSF COMPLEX

The area south of the Brand TSF complex, once the Saaiplaas Shaft area is excluded, is too small to accommodate 800Mt of deposition. At the time of the original 2008 site selection, Brand D was in active deposition, Brand A was dormant and Saaiplaas shaft was still in operation and therefore this site was not considered during the 2008 study. Brand D is still in active deposition while Brand A is now reclaimed and the Saaiplaas shaft is no

[2] North 5 is an additional site referenced in the Golder 2008 studies located approximately 10km east of the proposed Nooitgedacht TSF site.

[3] Dankbaarpan is an additional site referenced in the Golder 2008 studies located approximately 15km west of the proposed Nooitgedacht TSF site

longer in operation however the available footprint is insufficient for deposition of 800Mt which is required for the FSR Project. As such, this site is not suitable for further investigation.

6.1.2.8 OPTION 8 – VIDEO SITE

At the time of the original Golder 2008 site selection, this area was an active mine water evaporation area for excess underground water and therefore not considered. It was subsequently assessed in 2025 based on the fact that the dewatering and evaporation activities having ceased however the site was deemed as fatally flawed by the DWS in 2025 due to its proximity to the Sand River (<800 m). As such, this site is not suitable for further investigation.

6.1.2.9 OPTION 9 – UNDERGROUND DISPOSAL

Underground disposal was initially considered as part of the tailings deposition/disposal options however this option provided limited potential in terms of volume of disposal but most significantly, this option was rejected by DMPR as it would effectively sterilize a potential future resource should gold processing technology improve further.

6.1.3 APPLICATION OF MITIGATION HEIRARCHY

The site selection process has been informed by a robust combination of desktop screening, review of previous specialist studies, national and provincial screening tool outputs, and recent ground-truthing site visits. The Nooitgedacht site was selected as the preferred alternative following a rigorous site selection process that prioritized avoidance of the most sensitive ecological, social, and economic features at a local and regional scale. Despite this, from an ecological perspective, the site still overlaps with areas designated as "Very High" biodiversity sensitivity in the DFFE Screening Tool Report, including CBAs, ESAs, Endangered ecosystems, and a significant population of SCC (sensitive species 15). The site also contains several wetland systems and soils of moderate to high agricultural potential.

The project design has incorporated avoidance and minimization measures to the greatest extent feasible, including the establishment of buffer zones around sensitive habitats (e.g. watercourses). Rehabilitation and restoration actions are planned for degraded grassland and wetland buffer zones, with a focus on enhancing ecological connectivity, stabilizing soils, and controlling invasive species.

Nevertheless, some residual, unavoidable impacts remain – particularly the loss of SCC habitat and certain wetland areas. In accordance with the mitigation hierarchy and relevant legislation, offsetting is recognized as a last resort and will only be considered for these residual impacts, subject to robust scientific justification, regulatory approval, and meaningful stakeholder engagement. Any offset strategy must deliver measurable, additional conservation outcomes and prioritize local ecological integrity. At least 19 historic unlined TSF's in the Welkom region are earmarked to be reclaimed as part of the FSR Project and deposited onto the new lined Nooitgedacht TSF which will also have a lined Return Water Dam (RWD). This will reduce the legacy ground water contamination resulting from these 19 TSF's and once reclaimed, additional land will be freed up for alternative land use within the region. As such, the justification for the need and desirability of a new lined mega-TSF cannot be overstated.

The remaining residual impacts will require careful management, ongoing monitoring, and, where necessary, the implementation of scientifically robust offset strategies. Continued engagement with regulatory authorities, local stakeholders, and conservation and academic experts will be essential to ensure that the project achieves a balance between development needs and the long-term conservation of the region's unique biodiversity and ecosystem services.

The mitigation hierarchy is a structured, stepwise approach to managing biodiversity impacts from development, as required by South African environmental legislation (NEMA, NEMBA) and best-practice guidelines (EWT, SANBI, DFFE). The hierarchy prioritizes:

1. Avoidance

2. Minimization

3. Rehabilitation/Restoration

4. Offsetting

This section evaluates the application of the mitigation hierarchy to the Nooitgedacht TSF project, based on desktop screening, review of previous studies, screening tool outputs, and recent site verification.

6.1.3.1 AVOIDANCE

Desktop and Screening Tool Analysis:

- The Nooitgedacht site was selected through a multi-phase process, including a Strategic Environmental Assessment (SEA), specialist studies, and GIS-based screening.
- The site overlaps with areas of "Very High" terrestrial biodiversity sensitivity, including Critical Biodiversity Areas (CBAs), Ecological Support Areas (ESAs), Endangered ecosystems, and a significant population of SCC species 15, a Threatened or Protected Species (TOPS) and Species of Conservation Concern (SCC).
- The DFFE Screening Tool flagged the site for "Very High" terrestrial and aquatic biodiversity sensitivity, and "Very High" agricultural potential in some areas.

Previous Study Review:

- Multiple alternative sites were considered. Sites 5 and 6 were excluded due to fatal flaws (proximity to residential areas, insufficient size, or direct overlap with sensitive wetlands).
- The Nooitgedacht site was ultimately selected as the least environmentally and/or socio-economic impactful option, with the lowest potential for negative impacts on agriculture and water resources, and the best engineering feasibility.

Ground-Truth Site Visit Findings:

- Field surveys confirmed the presence of a large SCC population (61 burrows, >100 individuals), patches of high-quality grassland, and several provincially protected plant species.
- However, much of the site is already disturbed (historic agriculture, alien invasive plants, degraded grassland), and the project footprint was designed to avoid the most sensitive patches where possible.

Legislative and Guideline Context:

- NEMA and NEMBA require that avoidance of impacts on listed ecosystems and protected species is prioritized.
- The EWT Draft Mitigation Hierarchy Guideline (2023) states that avoidance is mandatory for "Very High" sensitivity areas, especially where irreplaceable populations or habitats are present.
- In terms of the IUCN Guidelines on Responsible Translocation of Displaced Organisms (2025), the avoidance principles emphasise preventing harm to species and ecosystems by prioritising site selection, timing, and project design measures that eliminate or substantially reduce the need for translocation and minimise direct and indirect impacts on organisms and their habitats. It is however acknowledged that in certain circumstances, avoidance is not always possible and therefore further mitigation hierarchy analysis is required to determine the most suitable way forward for SCC.

Conclusion:

The site selection process demonstrates a strong application of avoidance at the regional scale, but complete avoidance of impacts to SCC habitat and sensitive grasslands within the site is not possible if the project proceeds. The project footprint has been refined to avoid the highest-value patches where possible (i.e. watercourse buffers) and minimize overlap with key ecological features, but residual impacts remain.

6.1.3.2 MINIMIZATION

Desktop and Screening Tool Analysis:

The project design incorporates buffer zones around wetlands and sensitive habitats and restricts construction to already disturbed or lower-value areas where feasible.

Previous Study Review:

- Minimization strategies from past assessments include:
- Restricting construction to disturbed areas.
- Implementing buffer zones around sensitive habitats.
- Timing construction to avoid sensitive periods for fauna.
- Reducing the project footprint and using best-practice erosion and sediment controls.

Ground-Truth Site Visit Findings:

- Field verification confirmed that buffer zones and construction restrictions are feasible and effective in many areas, but some SCC (Species 15) habitat and wetland buffers will still be affected.
- The presence of alien invasive plants and degraded areas provides opportunities to focus development in less sensitive zones.

Legislative and Guideline Context:

- NEMA and NEMBA require that all reasonable measures be taken to minimize impacts that cannot be avoided.
- The EWT guideline emphasizes the need for robust minimization, especially where avoidance is not fully possible.
- In terms of the IUCN Guidelines on Responsible Translocation of Displaced Organisms (2025), the minimisation principles require that any translocation of displaced organisms be undertaken only after avoiding impacts to the greatest extent possible, and that all remaining interventions minimise risk by ensuring biological appropriateness, safeguarding animal welfare, maintaining ecological integrity, and applying the least intrusive, scientifically justified methods. It is however acknowledged that in certain circumstances, minimization is not always adequate to fully reduce negative impacts on SCC and therefore further mitigation hierarchy analysis is required to determine the most suitable way forward for SCC.

Conclusion:

Minimisation measures have been systematically incorporated into the project design based on the outcomes of both desktop assessments and field investigations, and additional refinement of the project footprint, strict adherence to defined buffer zones, and the application of adaptive management during construction are recommended to ensure that minimisation is achieved to the fullest practicable extent.

6.1.3.3 REHABILITATION/RESTORATION

Desktop and Screening Tool Analysis:

The site includes areas of degraded grassland and historic agriculture, which are suitable for targeted rehabilitation.

Previous Study Review:

Restoration actions proposed include:

- Rehabilitation of adjacent degraded habitats to enhance ecological connectivity.
- Re-vegetation of temporarily disturbed areas using indigenous species.
- Restoration of wetland buffers and stabilization of disturbed soils.

Ground-Truth Site Visit Findings:

- Field surveys identified specific areas where restoration can be most effective, particularly in degraded grassland and wetland buffer zones.
- Rehabilitation potential is moderate to high in these areas, but recovery of SCC species 15 habitat is not possible due to the species' site fidelity and slow recolonization.

Legislative and Guideline Context:

- NEMA and NEMBA require rehabilitation of disturbed areas to a functional state.
- The EWT guideline stresses that restoration is essential but cannot substitute for avoidance/minimization in "Very High" sensitivity areas.
- In terms of the IUCN Guidelines on Responsible Translocation of Displaced Organisms (2025), the rehabilitation and restoration principles emphasise reinstating ecological functionality and habitat conditions to support the long-term viability of translocated organisms, through scientifically informed habitat management, restoration of degraded areas, and ongoing monitoring to ensure that receiving environments remain suitable and resilient.

Conclusion:

Rehabilitation is both feasible and necessary for degraded areas; however, it cannot fully offset the loss of irreplaceable habitat for the threatened Species 15 or high-value grassland. Restoration efforts should therefore prioritise enhancing ecological connectivity, stabilising soils, and controlling invasive species to maximise residual ecological benefits.

6.1.3.4 OFFSETTING

Desktop and Screening Tool Analysis:

- Offsetting is only considered after all avoidance, minimization, and rehabilitation options have been exhausted.

Previous Study Review:

- Offsetting was not the initial option, but is recognized as a last resort for residual, unavoidable impacts.
- Any offset must be locally relevant, quantifiable, and designed to achieve measurable biodiversity gains.

Ground-Truth Site Visit Findings:

- The loss of SCC species 15 habitat and some wetland areas is unavoidable, triggering the need for offset consideration as the most appropriate method to ensure conservation of this species.
- The feasibility of SCC species 15 translocation is low, and offsetting for this species is particularly challenging.

Legislative and Guideline Context:

- NEMA, NEMBA, and the EWT guideline require that offsets are only used for residual impacts and must be scientifically justified, with regulatory approval.
- Offsets for TOPS-listed species and irreplaceable habitats are generally discouraged unless no alternatives exist.
- In terms of the IUCN Guidelines on Responsible Translocation of Displaced Organisms (2025), the offsetting principles state that translocation should be implemented only as a last resort to compensate for residual impacts, ensuring that relocated organisms are moved to suitable, secure habitats and supported by long-term management and monitoring to maintain population viability and ecological integrity.

Mitigation Hierarchy Conclusion:

Offsetting is often times required for residual impacts related to wetlands and grassland but is generally not currently supported for Species 15 populations due to inadequate scientific understanding of the correct translocation protocol and evidence of successful translocations. Species 15 is however under significant pressure from various developments in South Africa and the long-term conservation of this species is predicated on gaining a better understanding of this species suitability to translocation through a robust scientific approach to the planning, execution and long-term monitoring a translocated group of individuals. Harmony proposes an offset in which the translocation of Species 15 is designed in consultation with relevant authorities and key stakeholders (including EWT and Professor Graham Alexander from the University of the Witwatersrand) which will aim to deliver clear conservation outcomes whilst contributing significantly to the current lack of the scientific body of knowledge in this regard.

6.1.4 OVERALL CONCLUSION

The specialist found that the Nooitgedacht TSF site selection demonstrated application of the mitigation hierarchy, with clear evidence of avoidance, minimization, and rehabilitation measures being prioritized and integrated into project planning. The Nooitgedacht site is therefore considered the only suitable site for the TSF, given the volumes and space requirements and the disadvantages of the alternative sites noted in the sections above.

6.2 LAYOUT AND DESIGN ALTERNATIVES

6.2.1 TSF DESIGN

The total volume of material to be deposited of on the TSF is based on the forecast gold reserves to be processed at the existing One Plant, Central Plant and Saaiplaas plant. The potential to reduce the footprint of the new TSF would require altering the dimensions of the facility by making it either higher with steeper side slopes or lower with a greater footprint area. Increasing the height would result in greater visual impacts and possibly increasing the secondary impacts such as fugitive dust generation and erosion of the steeper side slopes. This would also lead to increasing the stability risks as well as more complex final closure requirements. Alternatively, reducing the height of the facility would result in a larger footprint however there is insufficient available space to do so in the proposed location. The TSF will be 93m in height based on the current design.

The EIA process being undertaken includes the assessment of potential impacts and the identification of environmental sensitivities within, and in, the vicinity of the proposed project area, thereby allowing for the recommendation of mitigation measures towards the avoidance, minimisation and / or management of the anticipated impacts. The layout will be planned to avoid any no-go areas identified from the various specialist studies, if required, otherwise no additional layout or design alternatives are considered applicable to this application. Various design alternatives have been investigated as part of the TSF design which has already undergone several design iterations based on identified environmental constraints (flood lines, sensitive areas, no-go areas etc). The current design (Appendix H) represents Harmony's most recent design updates which avoids identified no-go heritage areas and is based on a double liner system as described in Section 3.1 of this report. Further updates are still expected and an updated design will be presented in the EIA report.

6.2.2 LOW PRESSURE WATER SYSTEM

For the 40ML low pressure water system a trade-off study was conducted considering three options for the 40 megalitre Low Pressure (LP) water storage system. This area is currently a very disturbed area and was in the past used as the thickener station for the Dam 13 dredging operations which occurred many years ago. The location of the low pressure water system is shown in Figure 1 of this report. The following options are being considered by Harmony.

- Two HDPE lined earth dams – footprint 190m X 125m

- Two concrete tanks – footprint 95m X 45m

- Twelve Steel tanks. – footprint 210m X 65M

All of the water for the project will be pumped to the low pressure water system. The water source for the reclamation operation will include:

- Return water from the Nooitgedacht TSF;
- Treated effluent from Waste Water Treatment works;
- Ground water from boreholes; and
- Overflow water from the Metallurgical Plants.

The option with the smallest footprint, at ground level, that provides a simple suction manifold layout and positive suction head for the pumps at all times is the installation of the two 40m diameter concrete tanks however the final preferred option will be presented in the EIA report.

6.3 TECHNOLOGY ALTERNATIVES

The only available technology alternatives relate to the liner design for the TSF and the specific deposition method. The liner requirements and ultimate solution is based on the waste classification of the material and geohydrological modelling and risk assessment. No additional technology alternatives are considered applicable. Liner requirements will be discussed in further detail in the EIA phase report.

There are various deposition techniques which are applicable to tailings storage facilities. Once the tailings slurry (dilute or paste consistency) has arrived at the tailings storage area, there are several possible ways it can be deposited. These include the spigotting method, cyclone deposition and the paddocking method. Eash alternative is described below:

- **Spigots** are multiple outlets along a delivery pipeline. This technology is only used when it is easily possible to cause a gravitational grading split between the coarse and the tailings' fine fractions.

Figure 14: Example of spigot deposition (source: www.researchgate.net)

- **Paddock deposition** requires construction of small impoundments or containment berms with dried-out tailings borrowed from the previous layer deposited around the perimeter or edge of the paddock. These shallow paddocks are then filled with dilute slurry.

Figure 15: Example of paddock deposition

- In **cyclone deposition** is a cyclone deposition device consisting of conical housing equipped with a feed pipe that enters the cone at its larger diameter closed end. A second pipe enters the cone and intrudes into the body of the cone. The slurry feed enters under pressure and is forced to swirl with a spiral motion towards the smaller end. In the process, centrifugal forces cause the larger particles in the slurry to move down and away from the axis, towards the narrow exit of the cone. The net effect is that the

finer particles and most of the water leave the cyclone through the vortex finder and form the "overflow," while the partially dewatered larger particles leave at the opposite end as the coarser "underflow. The purpose of using a cyclone is to create underflow material that has good geotechnical characteristics, i.e., high permeability, fast consolidation and strength gain rate than the original tailings so that the underflow can be used to form an impoundment wall to the tailings storage facility. Effective operations of a cyclone TSF can also result in high water recoveries.

Figure 16: Example of cyclone deposition

Currently cyclone deposition is the vastly preferred method of deposition for the majority of Harmony's current TSF operations due to the reasons described above. The environmental impacts associated with each deposition method are similar however cyclone deposition has higher water recovery rates and is also preferred from a geotechnical perspective. The Nooitgedacht TSF is designed to utilize Cyclone deposition. As such no other deposition methods or technologies will be considered in the EIA phase and Cyclone deposition is nominated as the preferred alternative.

6.4 PROCESS AND ACTIVITY ALTERNATIVES

Process or activity alternatives imply the investigation of alternative processes, methods or activities to achieve the same goal for the proposed TSF. The current planned LOM of the Free State operations exceed the available deposition capacity of these TSFs and the applicant is therefore proposing to construct the proposed Nooitgedacht TSF to cater for this additional capacity and for this there are no feasible or applicable activity or process alternatives, additional deposition space will be required for the tailings material.

Underground disposal is not deemed feasible due to the amount of tailings material and limited available space in existing underground shafts. The disposal underground would also mean that Harmony could not reclaim and further process the tailings material at a future date when it becomes feasible to do so. There is therefore very limited potential for disposal of tailings material underground.

No other process or activity alternatives have been identified that could be applicable to this application.

6.5 NO GO ALTERNATIVE

The no go alternative would imply that no TSF is constructed for the safe deposition of new mine tailings from Harmony's Welkom operations. The current planned LOM of the Free State operations exceed the available deposition capacity of these TSFs and the applicant is therefore proposing to construct the proposed Nooitgedacht TSF to cater for this additional capacity. The no go option would mean that the new TSF project and associated infrastructure would not proceed and this would therefore negatively affect the future viability of Harmony's Welkom mining operations due to lack of deposition space. This would have a significant financial impact on Harmony as well as a direct negative impact on the workforce on the mine and surrounding businesses and communities that are directly or indirectly linked to the operations.

Nooitgedacht TSF will also cater for reworking of multiple TSFs across the Welkom area extending over the next 30 years plus, which would have a significant positive impact. TSFs will be reworked and processed at Central Plant, Saaiplaas plant and new modules will either be constructed at Central plant or Saaiplaas plant (or a new plant, however the plant is still in pre-feasibility at this stage). These TSFs will be fully reclaimed and then fully rehabilitated in the future. This will also allow Harmony to manage a single large TSF rather than having to deal with numerous smaller TSF sites, which should also improve the management related to the various environmental and social issues of the existing TSFs in the region. These opportunities will be lost if the project does not proceed.

As such, the no go alternative is not considered feasible or reasonable.

7 STAKEHOLDER ENGAGEMENT

The Public Participation Process (PPP) is a requirement of several pieces of South African legislation and aims to ensure that all relevant Interested and Affected Parties (I&APs) are consulted, involved and their comments are considered, and a record included in the reports submitted to the Authorities. The process ensures that all stakeholders are provided this opportunity as part of a transparent process which allows for a robust and comprehensive environmental study. The PPP for the proposed project needs to be managed sensitively and according to best practises to ensure and promote:

- Compliance with international best practice options;
- Compliance with national legislation;
- Establishment and management of relationships with key stakeholder groups; and
- Involvement and participation in the environmental study and authorisation/approval process.

As such, the purpose of the PPP and stakeholder engagement process is to:

- Introduce the proposed project;
- Explain the authorisations required;
- Explain the environmental studies already completed and yet to be undertaken (where applicable);
- Solicit and record any issues, concerns, suggestions, and objections to the project;
- Provide opportunity for input and gathering of local knowledge;
- Establish and formalise lines of communication between the I&APs and the project team;
- Identify all significant issues for the project; and
- Identify possible mitigation measures or environmental management plans to minimise and/or prevent negative environmental impacts and maximize and/or promote positive environmental impacts associated with the project.

7.1 GENERAL APPROACH TO SCOPING AND PUBLIC PARTICIPATION

The PPP for the proposed project has been undertaken in accordance with the requirements of the MPRDA and NEMA EIA Regulations (2014), and in line with the principles of Integrated Environmental Management (IEM). IEM implies an open and transparent participatory process, whereby stakeholders and other I&APs are afforded an opportunity to comment on the project and have their views considered and included as part of project planning.

An initial I&AP database has been compiled based on known key I&AP's, Windeed searches, and stakeholder databases provided by the mine. The I&AP database includes amongst others, landowners, communities, regulatory authorities and other special interest groups. Harmony (the applicant) is the current landowner for all properties on which infrastructure is proposed.

Note: All comments and responses from the previous rounds of public participation conducted as part of the previously withdrawn applications for the Nooitgedacht TSF project are still included as part of the current comments and responses correspondence documents as these comments are still deemed to be applicable to the current application.

7.1.1 LIST OF PRE-IDENTIFIED ORGANS OF STATE/ KEY STAKEHOLDERS IDENTIFIED AND NOTIFIED

Government Authorities and key stakeholders that were notified of the proposed project and include:

- Directly Affected and Adjacent landowners
- Eskom Soc Ltd
- Free State Department of Agriculture &Rural Development
- Free State Department of Agriculture& Rural Development
- Free State Department of Cooperative Governance and Traditional Affairs
- Free State Department of Economic, Small Business Development, Tourism and Environmental Affairs
- Free State Department of Health
- Free State Department of Mineral and Petroleum Resources
- Free State Department of Police, Roads and Transport
- Free State Department of Public Works and Infrastructure
- Free State Department of Small Business, Tourism, and Environmental Affairs
- Free State Department of Water and Sanitation
- Free State Development Corporation
- Free State Provincial Heritage Resources Authority
- Lejweleputswa District Municipality
- Matjhabeng Local Municipality
- Masilonyana Local Municipality
- National Department of Agriculture Land Reform and Rural Development
- National Department of Agriculture, Land Reform And Rural Development
- National Department of Forestry, Fisheries and Environment
- National Department of Transport
- National Department of Water and Sanitation
- National Energy Regulator of South Africa (NERSA)
- National Government of the Republic of South Africa
- National House of Traditional Leaders
- Sedibeng Water
- South African Civil Aviation Authority
- South African Heritage Resources Agency
- South African National Biodiversity Institute
- South African National Roads Agency Ltd
- South African National Parks
- Thusanong District Hospital
- Transnet Ltd SOC
- A & R Firearms and training
- Armgold/Harmony Freegold Joint Venture co Pty Ltd
- African Conservation Trust
- AfriForum
- Birdlife South Africa
- Botanical Society
- Die Melkkan
- Centre for Environmental Rights
- Council for Geoscience
- Directly Affected and Adjacent Landowners
- Earth Life Africa
- Endangered Wildlife Trust
- Environamics
- Federation for a Sustainable Environment
- Fidelity Security Services - Welkom
- Freegold Harmony Pty Ltd/Harmony Gold Mining Co Ltd
- Goldfields Equestrian Centre

- Griffons Rugby Union
- GroundWork SA
- Mining Affected Communities United in Action
- Phakisa Freeway
- Thusanong District Hospital
- Transnet Properties
- Ward councillors
- Welkom Airport FAWM
- Welkom Cemetery
- Welkom Paintball
- Western Holdings Primary School
- Wildlife and Environment Society of South Africa
- Working for Climate

7.1.2 INITIAL NOTIFICATION

The PPP commenced on the 16th of June 2025 with an initial notification and call to register. Interested and Affected Parties are welcome to register via email, direct letter, fax or by contacting EIMS telephonically. The initial notification was given in the following manner:

7.1.2.1 REGISTERED LETTERS, FAXES AND EMAILS

Notification letters (English, Afrikaans and Sesotho), faxes, and emails were distributed to all pre-identified key I&APs including government organisations, NGOs, relevant municipalities, ward councillors, landowners and other organisations that might be affected.

The notification letters included the following information to I&APs:

- List of anticipated activities to be authorised;
- Scale and extent of activities to be authorised;
- Information on the intended mining operation to enable I&APs to assess/surmise what impact the activities will have on them or on the use of their land;
- The purpose of the proposed project;
- Details of the affected properties (including details of where a locality map could be obtained);
- Details of the relevant NEMA Regulations;
- Initial registration period timeframes; and
- Contact details of the EAP.

7.1.2.2 NEWSPAPER ADVERTISEMENTS / GOVERNMENT GAZETTE

A newspaper advertisement describing the proposed project and EIA process was placed in the Vista News Newspaper (in English, Afrikaans, and Sesotho) with circulation in the vicinity of the study area on 12 June 2025. A newspaper advertisement was also placed in the Free State Sun newspaper, with circulation in the vicinity of the study area on 13 June 2025. A Gazette Notice was placed in the National Government Gazette (in English, Afrikaans, and Sesotho) on 20 June 2025. The newspaper adverts included the following information:

- Project name;
- Applicant name;
- Project location;
- Nature of the activity and application; and
- Relevant EIMS contact person for the project.

7.1.2.3 SITE NOTICE PLACEMENT

A1 Correx site notices in English and Afrikaans and Sesotho were placed at 10 locations within the local project area on the 18 June 2025. The on-site notices included the following information:

- Project name;
- Applicant name;
- Project location;
- Map of proposed project area;
- Project description;
- Legislative requirements; and
- Relevant EIMS contact person for the project.

7.1.2.4 POSTER PLACEMENT

A3 posters in English and Afrikaans and Sesotho were placed at local public gathering places in Welkom namely the Post Office and the Municipal Offices.

The notices and written notification afforded all pre-identified I&APs the opportunity to register for the project as well as to submit their issues/queries/concerns and indicate the contact details of any other potential I&APs that should be contacted. The contact person at EIMS, contact number, email and faxes were stated on the posters. Comments/concerns and queries were encouraged to be submitted in either of the following manners:

- Electronically (fax, email);
- Telephonically; and/or
- Written letters.

7.1.3 AVAILABILITY OF SCOPING REPORT AND PUBLIC MEETING

Notification regarding the availability of this Scoping Report for public review are given in the following manner to all registered I&APs (which includes key stakeholders and landowners):

- Registered letters with details on where the scoping report can be obtained and/or reviewed, public meeting date and time, EIMS contact details as well as the public review comment period;
- Facsimile notifications with information similar to that in the registered letter described above; and/or
- Email notifications with a letter attachment containing the information described above.

The scoping report is being made available for public review in XXXXX for a period of 30 days from 12 December 2025 – 2 February 2026.

The Scoping Phase Public Meeting is proposed to take place on XXXXX, at the XXXX, from TIME to TIME. The purpose of the meeting is to present and discuss the findings of this Scoping Report with Interested and Affected Parties.

Executive summaries of the report in English, Afrikaans and Sesotho will be provided on the EIMS website and at the same venues where the report is available for public review.

7.2 PUBLIC PARTICIPATION PROGRESS

Comments raised to date have been addressed in a transparent manner and included in the Public Participation Report (Appendix C). Specialist input into the EIA /EMPr phase will investigate and address any relevant I&AP concerns in more detail.

To date, the following key comments have been received and addressed:

- I&AP Registrations.
- Request for project description, shapefile, and locality map.
- Request from the South African Civil Aviation Authority to update the relevant contact information for future environmental impact analysis reports and requests for comments.
- Request for more information about Harmony mining operations and activities in the area.
- Mining Affected Communities United in Action (MACUA) raised various concerns regarding Public Participation Process conducted to ensure there is meaningful engagement that accommodates all affected communities and I&APs.
- Clarification on the assessment of the cumulative impact of existing tailing storage facilities.
- Request for clarity on the contents of the TSF and if it will pose any impacts on community health.
- Request for an explanation of the design, construction, and maintenance plans that will be in place during the construction and operation of the TSF.
- Request for clarity of the measure that will be applied to ensure compliance with mitigation measures.
- Request for a monitoring committee to be set up for the construction and operation of the project which must include members of the community and be provided with copies of all monitoring reports, audits, compliance notices, directives, and incident reports.
- Request for clarity of how climate change will be addressed and ensure the TSF does not flood during heavy rain seasons.
- Questions on how contamination of groundwater will be prevented, impacts of the project on informal cattle grazing.

8 ENVIRONMENTAL ATTRIBUTES AND BASELINE ENVIRONMENT

This section of the Scoping Report provides a description of the environment that may be affected by the proposed project. Aspects of the biophysical, social and economic environment that could be directly or indirectly affected by, or could affect, the proposed development have been described. This information has been sourced from existing information available for the area, baseline information received from certain specialists as well as previous reports undertaken for the Nooitgedacht TSF by Golder in 2008. Please note that further detailed specialist assessments are being completed to inform the EIA-phase report however many of these assessments have commenced and the baseline information from these preliminary studies was used to populate this section of the Scoping Report. The studies however will be further refined in the EIA phase of the project and the full assessments will be appended to that report. The DFFE screening tool was also used to inform this section, and a copy of the screening report is included in Appendix F.

Relevant specialist reports that have been completed to date are provided in Appendix D, however it should be noted that several of these studies still need to be updated to include an assessment of the new low pressure water system. These updated studies will be provided in the EIA report. In addition, the climate change study, traffic impact assessment and closure costing reports have not been completed at the time of preparing this scoping report and these studies will also be provided in the EIA report.

8.1 TOPOGRAPHY

The topography of the location of the proposed TSF is fairly flat, comprising of undulating terrain. An analysis of topographical data indicated a slope of less than 1:10 over most of the project area. Refer to Figure 17 for a topographical map of the project area.

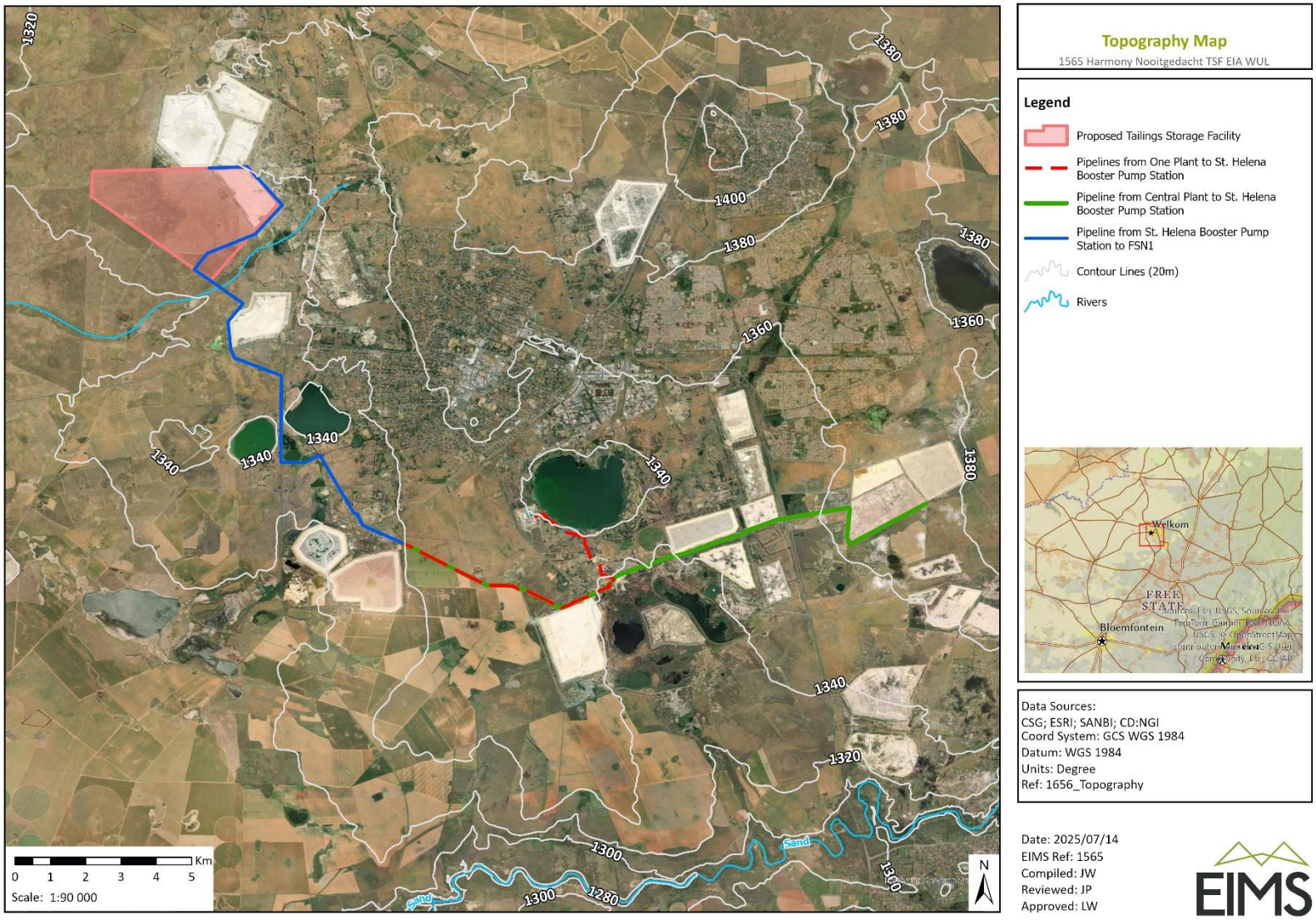


Figure 17: Topographical map of study area

8.2 GEOLOGY

The Free State Goldfield which forms a triangle between Allanridge, Welkom and Virginia, produces gold from auriferous bearing reefs situated within sediments of the Central Rand Group of the Witwatersrand Supergroup. A detailed description of the geology of the Welkom Goldfields is provided by in Minter *et. al* (1986). The mine geology, from shallow to deep, consist of the following:

- Karoo Supergroup;
- Ventersdorp Supergroup; and
- Witwatersrand Supergroup.

Sediments of the Vryheid Formation of the Ecca Group underlie the study area. The Vryheid Formation (Ecca Group) mainly comprises mudstone, siltstone and fine- to coarse-grained sandstone (pebbly in places).

Within the Free State Goldfield, the Ventersdorp Supergroup can be divided into the Pniel sequence, the Platberg Group and the basal Kliprivierberg Group consisting of alternating sediments, amygdaloidal and non-amygdaloidal andesitic lavas, tuffs and agglomerates (Minter *et.al*; 1986). Based on prospecting/exploration drilling, the Ventersdorp Supergroup has an average thickness of 1 319m in the study area.

The Witwatersrand Supergroup is unconformably overlain by the volcanic and sedimentary rock of the Ventersdorp Supergroup. Within the Free State Goldfield, the Witwatersrand Supergroup, comprising a thick succession of clastic sediments with minor intercalated lava flows, rests on the granites and schist of the Archean Basement. The Central Rand Group of the Witwatersrand Supergroup contains the economic reef horizons mined throughout the basin. The Central Rand Group is dominated by quartzite with minor shale and conglomerate. Several unconformities in the succession are overlain by the economic auriferous paleoplacers (reefs). Refer to Figure 18 for a map showing the regional geology. It should be noted that the general project area is a seismically active area.

The site is underlain by stiff clays and will provide suitable liner material for the tailings dam. Due to their inherently impermeable properties, together with the drainage designs, will minimise potential downward migration of contaminated water. Geotechnical engineering parameters were developed based on correlations between the findings from the geotechnical site investigation, similarly classified material as well as the analysis of the June 2023 cone penetration test results. The summarised geotechnical engineering parameters used for slope stability analyses and for the design of embankments etc are discussed in the attached preliminary design report in Appendix H.

Jones & Wagner completed sampling and geotechnical testing of the materials at the Nooitgedacht TSF in October 2008 (JAWS report reference: JW150/08/B680 – Rev 0). Additional SCPTu testing (Cone Penetration Test with pore pressure and seismic measurement) was done in 2024 on the Nooitgedacht footprint to confirm and provide current founding conditions. Geotechnical engineering parameters were developed based on correlations between the findings from the geotechnical site investigation, similarly classified material, and the analysis of the June 2023 SCPTu test results. The TSF cross sections were analysed at final height for drained, undrained, residual (post seismic) strength conditions, and for pseudo static conditions to determine slope stability design criteria with respect to the TSF.

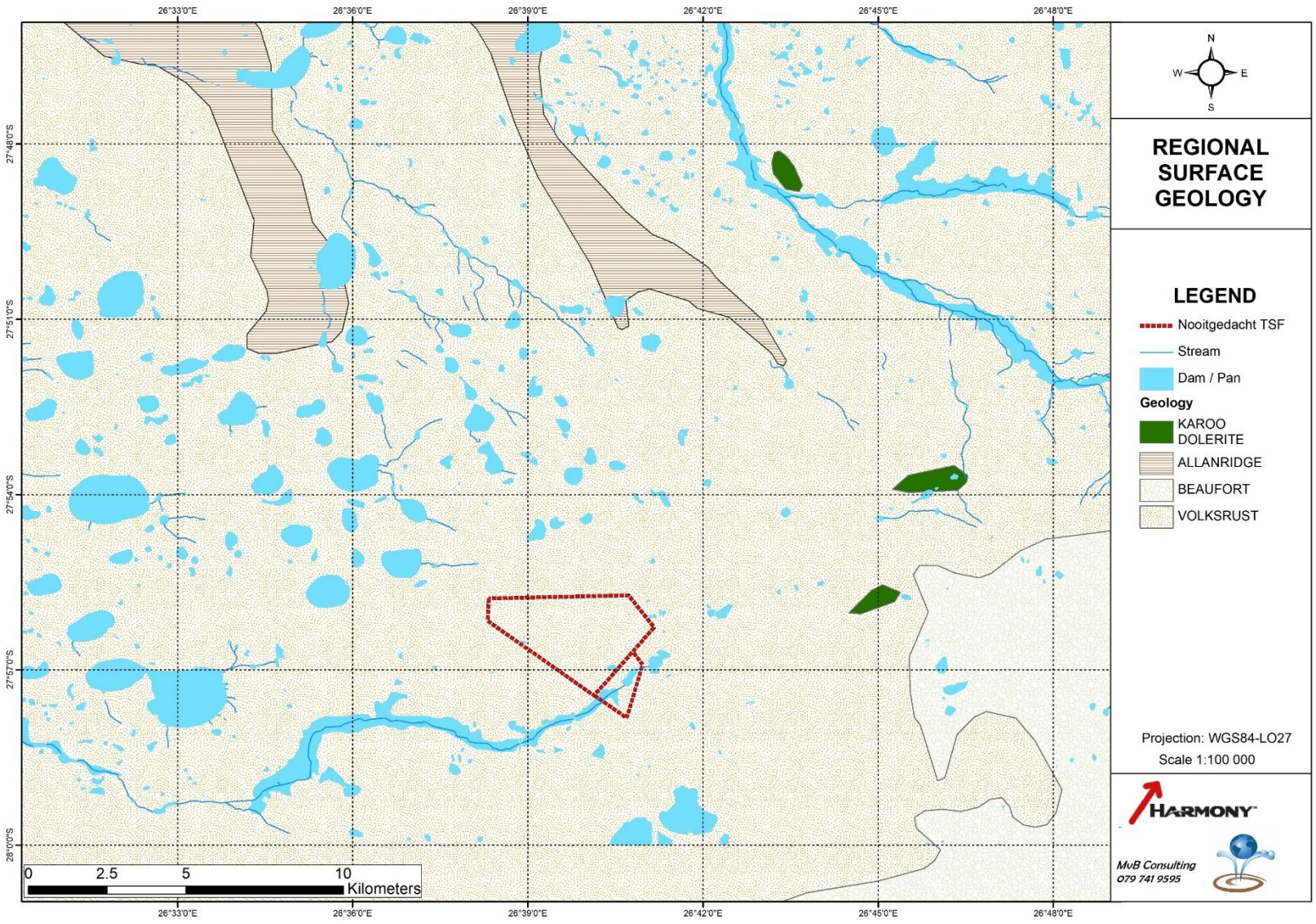


Figure 18: Regional surface geology

8.3 CLIMATE

The average climate for the site is presented in Figure 19 using the outcome of the investigation into rainfall and evaporation for the site. The combination of rainfall (Pegram, 2016) and evaporation and temperature (Schulze and Lynch, 2006) result in a cold arid steppe climate according to the Köppen-Geiger climate classification.

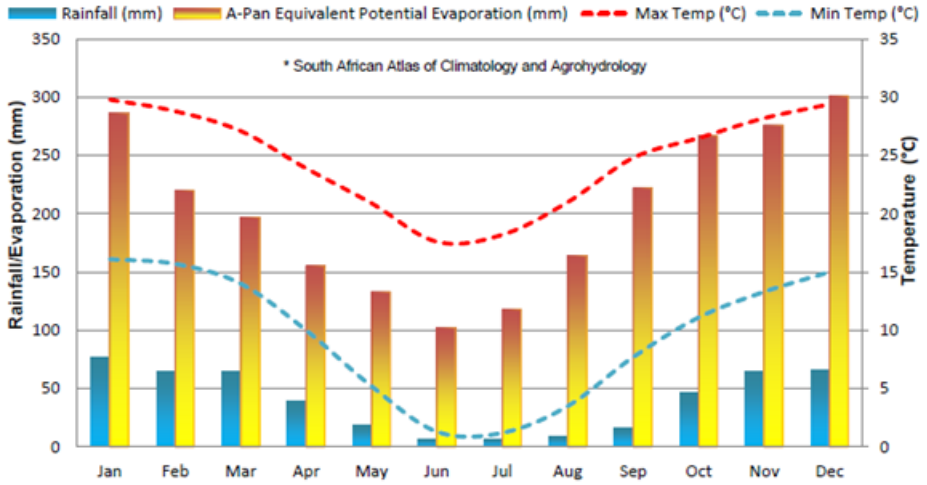


Figure 19: Climate summary

Evaporation data was sourced from the South African Atlas of Climatology and Agrohydrology (Schulze and Lynch, 2006) in the form of A-Pan equivalent potential evaporation. The average monthly evaporation distribution is presented in Table 9 and shows the site has an annual potential evaporation of 2,441mm. Hydrology and meteorology, including climate change increases in rainfall and evaporation is specifically taken into account as part of the engineering design of the TSF.

Table 9: Average Monthly A-Pan Equivalent Evaporation

Month	Evaporation (mm)
January	286
February	220
March	197
April	155
May	133
June	102
July	118
August	164
September	222
October	267
November	276
December	301

8.4 CULTURAL, HERITAGE AND FOSSIL RESOURCES

Heritage and paleontological studies were undertaken by PGS and Banzai Environmental respectively and the baseline information from those reports is presented in this section.

The Free State has a rich archaeological and historical history going back millions of years and includes significant aspects such as Later Stone Age rock art, Battlefields and Iron Age stonewalled enclosures. The general surroundings of the study area became a melting pot of contact and conflict as it represents one of many frontiers where San hunter- gatherers, Nguni and Sotho-Tswana agro-pastoralists, Dutch Voortrekkers and British Colonists all came together. The ravages of war also swept across these plains, and in particular the South African War (1899-1902) as well as the Boer Rebellion (1914-1915). The Free State has a rich archaeological and historical history going back millions of years and includes significant aspects such as Later Stone Age rock art, Battlefields and Iron Age stonewalled enclosures. The general surroundings of the study area became a melting pot of contact and conflict as it represents one of many frontiers where San hunter- gatherers, Nguni and Sotho-Tswana agro-pastoralists, Dutch Voortrekkers and British Colonists all came together. The ravages of war also swept across these plains, and in particular the South African War (1899-1902) as well as the Boer Rebellion (1914-1915).

A heritage screening report was compiled using the Department of Environmental Affairs National Web-based Environmental Screening Tool as required by Regulation 16(1)(v) of the Environmental Impact Assessment Regulations 2014, as amended. According to the heritage screening report, the project area has a Low Heritage Sensitivity. A site visit was conducted by the heritage specialist. The fieldwork was conducted by an archaeologist (Nikki Mann) and field assistant (Xander Fourie) from PGS on 23 March 2023. The fieldwork team were able to confirm that the study area was disturbed from historical agricultural activities and mining-related activities. The fieldwork conducted to evaluate the possible impact of the proposed development, has revealed the presence of two heritage resources. The remains of a historical homestead (NGD-01) were identified within the study area. The site was rated as having high to medium heritage significance. A low local significance trig beacon (NGD-02 / Heritage Site 2) was also identified.

PGS Heritage was appointed to conduct a Ground-Penetrating Radar (GPR) survey and test excavations to identify if there are any possible graves located at a historic homestead. The GPR survey report is included in Appendix D. The material identified on the surface and in the test excavations all appear to resemble evidence of dumping. No evidence of a homestead or human remains were identified.

During the GPR survey and test excavation work conducted on the 27th and 28th of November 2023, an additional grave site was identified and recorded. The informal burial ground is in an open field and contains approximately 15 graves. The area has been fenced but the fence is broken and has collapsed in certain sections. The area is overgrown with tall grasses and a bush is on the south-western side of the informal burial ground. The grave dressings include stone-packed mounds, concrete slabs with a brick border and granite dressing with small grey and white rocks in the middle. Only four of the graves have formal headstones (concrete and granite) whereas others have a single fieldstone or no headstone at all. The oldest discernible date on one of the headstones was 1963. No grave goods were located on or at the graves, and it appears as if the site had not been visited for a long time. The graves are overgrown with grass and weeds. All the graves are oriented West-East and are in three discernible lines, except for one grave which is oriented North-South. Refer to Figure 20 for locations of all identified significant heritage resources.

According to the Palaeosensitivity Map available on the South African Heritage Resources Information System database (SAHRIS), the Palaeontological Sensitivity of the proposed development areas are mostly rated high and moderate. A site-specific field survey of the development footprint was conducted on foot and by motor vehicle on 17 April 2023. No fossiliferous outcrops were detected in the proposed development area. The apparent rarity of fossil heritage in the proposed development footprint (including the associated pipeline and water storage infrastructure) suggests that the impact of the development will be of a low significance in palaeontological terms.

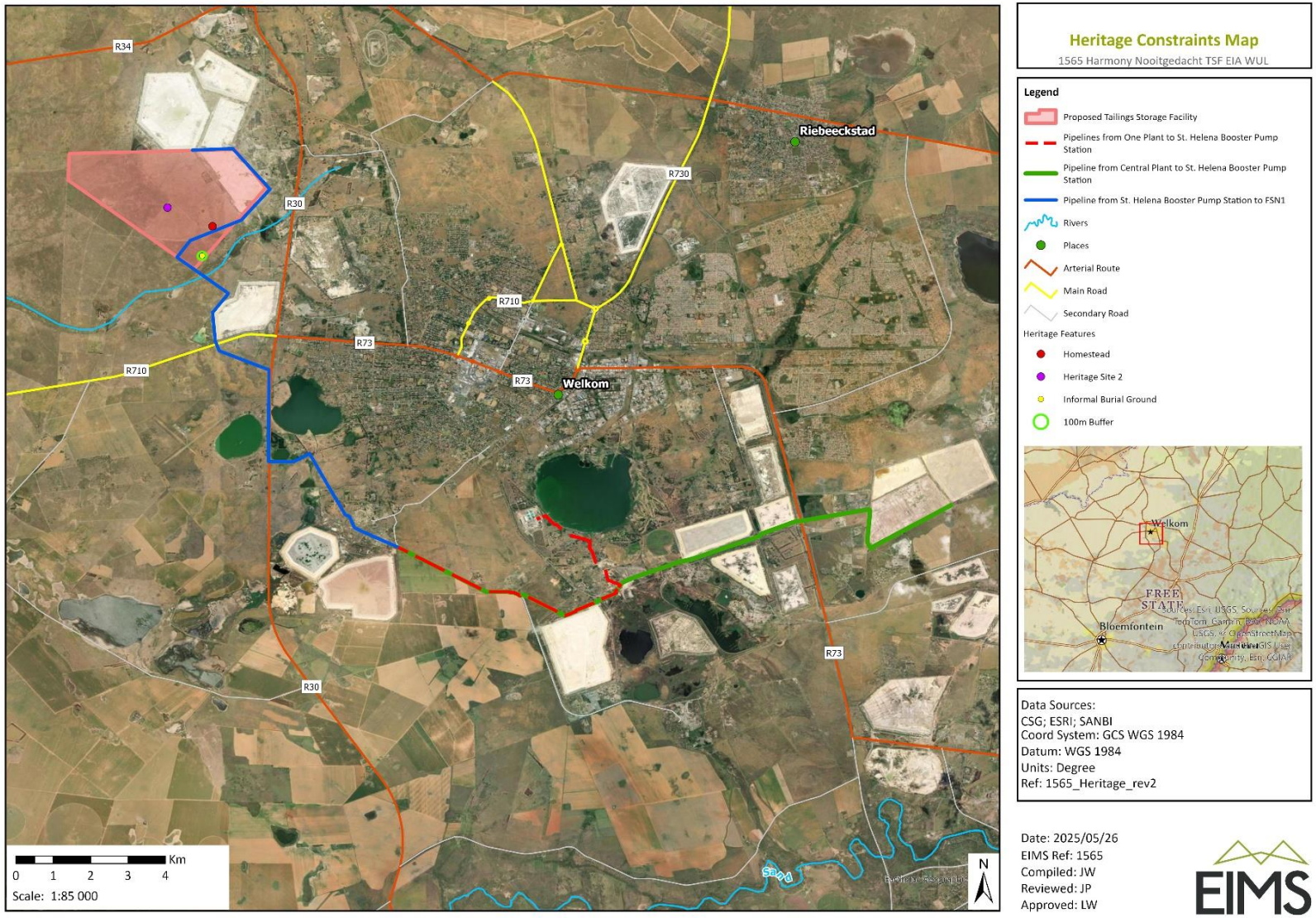


Figure 20: Location of identified heritage resources

8.5 SOILS

In considering the Soil Conservation Service for South Africa (SCS-SA) dataset of the site, soils are classified as being of hydrological C (moderately high runoff potential). The soils in the TSF area are mostly medium potential agricultural soils. The natural vegetation of the site is classified as Western Free State Clay Grassland (according to SANBI, 2018). 'Grassland' is predominant over the site according to the DFFE's 2020 land-cover dataset, with 'mines & quarries' positioned to the east in association with an existing TSF (FSN 4.2). Refer to Figure 21 for a map showing the soil types in the study area.

An assessment of the soils present within the project area was conducted during a field survey in March 2023. The site was traversed on foot. A soil auger was used to determine the soil form/family and depth. The soil was hand augured to the first restricting layer or 1,5 m. Soil survey positions were recorded as waypoints using a handheld Global Positioning System (GPS). Soils were identified to the soil family level as per the "Soil Classification: A Taxonomic System for South Africa" (Soil Classification Working Group, 2018). Landscape features such as existing open trenches were also helpful in determining soil types and depth.

Land capability and agricultural potential were briefly be determined by a combination of soil, terrain and climate features. Land capability is defined by the most intensive long-term sustainable use of land under rain-fed conditions. At the same time an indication is given about the permanent limitations associated with the different land use classes. Agricultural potential is determined by a combination of soil, terrain and climate features. Land capability classes reflect the most intensive long-term use of land under rain-fed conditions. The land capability is determined by the physical features of the landscape including the soils present. The land potential or agricultural potential is determined by combining the land capability results and the climate capability for the region.

The land capability sensitivity (DAFF, 2017) indicates a range of sensitivities expected throughout the project area, which is predominantly covered with "Moderate-High" sensitivities. Less area is characterized by sensitivities with "Very Low to Low" and "Moderate-Low to Moderate" sensitivity. Furthermore, crop field boundaries, were identified by means of the Screening Tool (2022), which are predominantly characterized by "High" sensitivities, within the project buffer zone. Based on site data, the specialist agrees with the Screening Tool sensitivities in most areas with "Moderate High" sensitivities which were demarcated for soil forms (i.e., Avalon, Pinedene, Molopo and Etosha soil forms) with a high land capability potential. Selected areas demarcated by the Screening Tool as "Moderate Low or High" can be categorised as "Very Low" and "Low" with soils like the Glenrosa and Witbank characterised with a low poor land capability. Overall, the project area can be classified as "Moderate" sensitivity. Actively cultivated areas along the pipeline routes with high productivity fields can be avoided to preserve them in the project. If rearranging the project around them or avoidance is not possible, stakeholders engagement can be done with owners of such crop fields for an appropriate compensation.

The project area is associated with arable soils. However, the available climatic conditions of low annual rainfall and high evapotranspiration potentially limits crop production for the area, resulting in land capabilities with "Moderate" ratings. The land capabilities associated with the assessment area are suitable for livestock grazing and rainfed cropping, which aligns with current land uses and sensitivities (Figure 22).

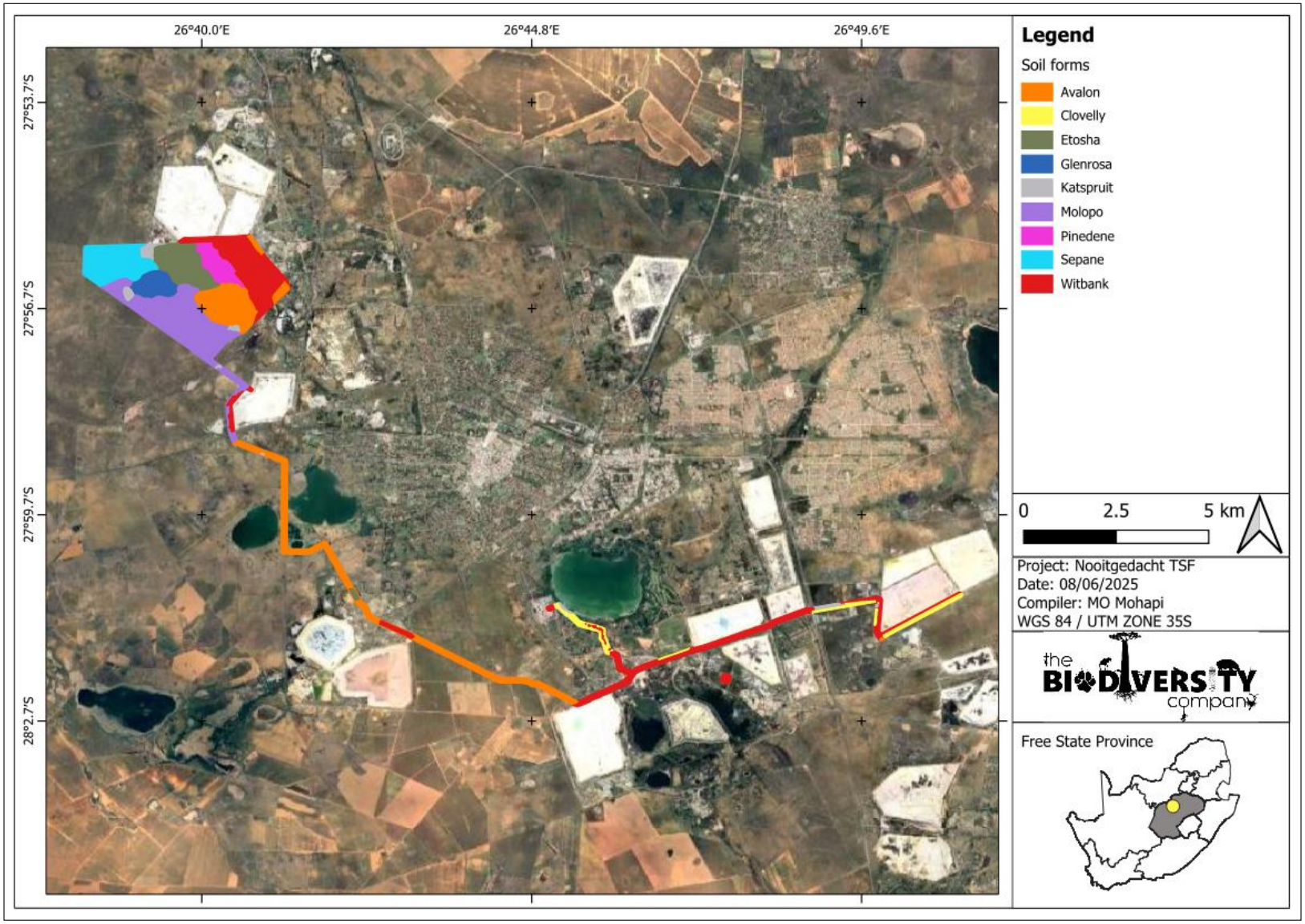


Figure 21: Soil types within study area.

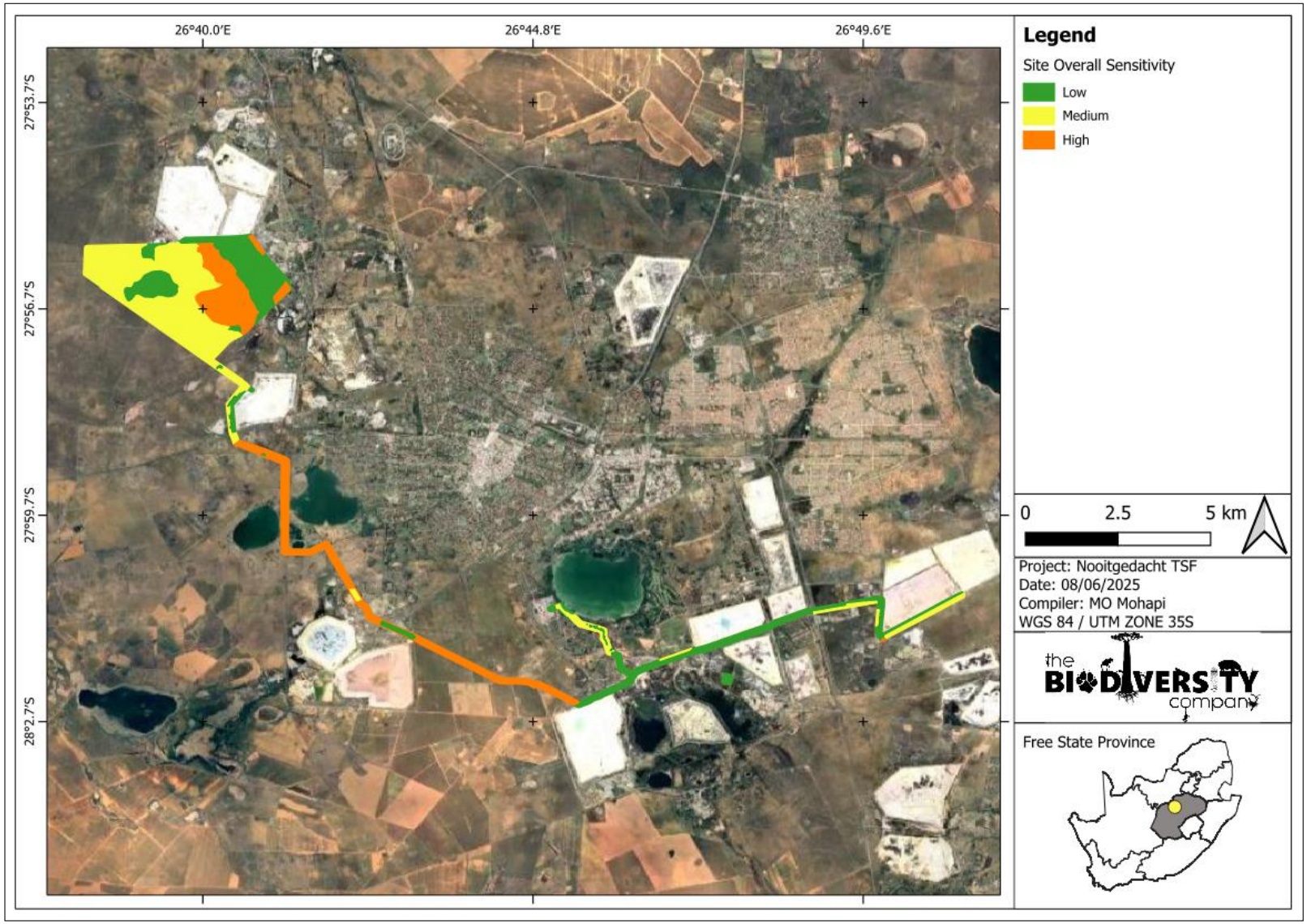


Figure 22: Agricultural sensitivity of the site

8.6 FLORA AND FAUNA

The approach adopted for the fauna and flora assessment has taken cognisance of the published Government Notice 320 in terms of NEMA dated 20 March 2020: “Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation”. The National Web based Environmental Screening Tool has characterised the plant and animal species as “very high sensitivity” and “high sensitivity” respectively (refer to Appendix F).

To determine the baseline ecological state of the area and to present a detailed description of the receiving environment, both a desktop assessment as well as a field survey were conducted during 11 to 13 April and 10 to 11 October 2023. Furthermore, the desktop assessment and field survey both involved the detection, identification and description of any locally relevant sensitive receptors and habitats, and the manner in which these sensitive features may be affected by the proposed development was also investigated.

8.6.1 FLORA

The project area is situated within the Grassland biome. This biome is centrally located in southern Africa, and adjoins all except the desert, fynbos and succulent Karoo biomes (Mucina & Rutherford, 2006). Major macroclimatic traits that characterise the grassland biome include:

a) Seasonal precipitation; and

b) The minimum temperatures in winter (Mucina & Rutherford, 2006).

The grassland biome is found chiefly on the high central plateau of South Africa, and the inland areas of KwaZulu-Natal and the Eastern Cape. The topography is mainly flat and rolling but includes the escarpment itself. Altitude varies from near sea level to 2 850 m above sea level.

Grasslands are dominated by a single layer of grasses. The amount of cover depends on rainfall and the degree of grazing. The grassland biome experiences summer rainfall and dry winters with frost (and fire), which are unfavourable for tree growth. Thus, trees are typically absent, except in a few localized habitats. Geophytes (bulbs) are often abundant. Frosts, fire and grazing maintain the grass dominance and prevent the establishment of trees. On a fine-scale vegetation type, the project area overlaps with the Western Free State Clay Grassland Vegetation (Figure 23).

The vegetation assessment was conducted throughout the extent of the project area. A total of 60 tree, shrub, herbaceous and graminoid plant species were recorded in the project area during the field assessment (Table 10). No SCC species were recorded nor are expected due to the nature of the project area. The list of plant species recorded is by no means comprehensive, and repeated surveys during different phenological periods not covered may likely yield up to 20% additional flora species for the project area. However, floristic analysis conducted to date is regarded as a sound representation of the local flora for the area.

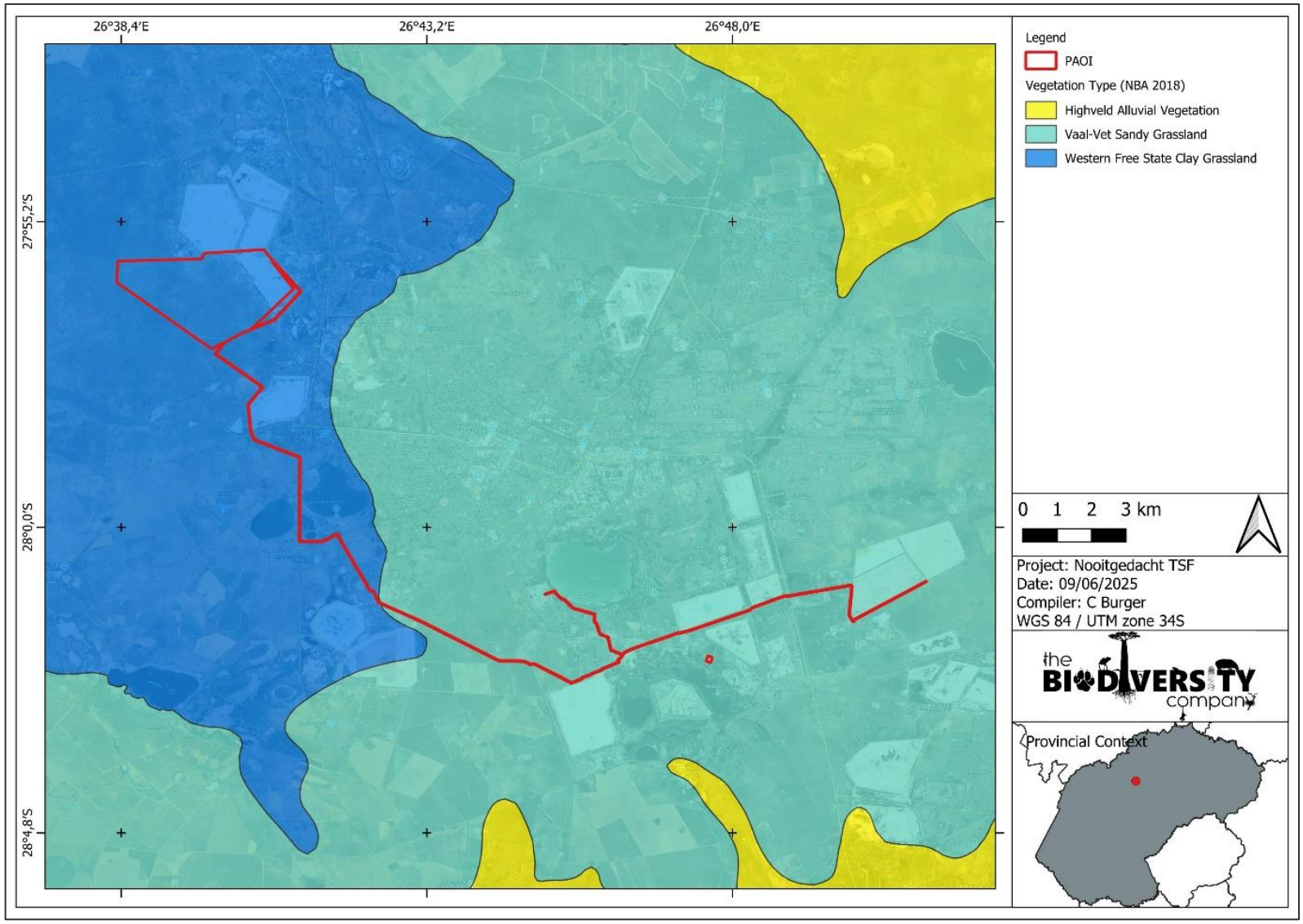


Figure 23: Vegetation map (BGIS, 2018)

Table 10: Trees, shrub and herbaceous plant species recorded in the project area

Family	Scientific Name	Threat Status (SANBI)	SA Endemic
Amaryllidaceae	*Ammocharis coranica*	LC-Schedule 6 Protected	Not Endemic
Anacardiaceae	*Searsia lancea*	LC	Not Endemic
Anacardiaceae	*Searsia leptodictya*	LC	Not Endemic
Asclepiadaceae	*Gomphocarpus fruticosus subsp. fruticosus*	LC	Not Endemic
Asparagaceae	*Asparagus cooperi*	LC	Not Endemic
Asparagaceae	*Asparagus laricinus*	LC	Not Endemic
Asphodelaceae	*Bulbine abyssinica*	LC	Not Endemic
Asteraceae	*Cotula anthemoides*	LC	Not Endemic
Asteraceae	*Felicia muricata subsp. muricata*	LC	Not Endemic
Asteraceae	*Geigeria burkei*	LC	Not Endemic
Asteraceae	*Nidorella anomala*	LC	Not Endemic
Asteraceae	*Stoebe plumosa*	LC	Not Endemic
Asteraceae	*Pseudognaphalium oligandrum*	LC	Not Endemic
Cyperaceae	*Cyperus congestus*	LC	Not Endemic
Cyperaceae	*Cyperus difformis*	LC	Not Endemic
Cyperaceae	*Schoenoplectus muricinux*	LC	Not Endemic
Caryophyllaceae	*Pollichia campestris*	LC	Not Endemic
Combretaceae	*Combretum erythrophyllum*	LC	Not Endemic
Fabaceae	*Vachellia karroo*	LC	Not Endemic
Hyacinthaceae	*Eucomis autumnalis*	LC-Schedule 6 Protected	Not Endemic
Pentzia Globosa	*Pentzia globosa*	LC	Not Endemic
Poaceae	*Aristida adscensionis*	LC	Not Endemic
Poaceae	*Aristida canescens subsp. canescens*	LC	Not Endemic
Poaceae	*Aristida congesta subsp. barbicollis*	LC	Not Endemic
Poaceae	*Aristida congesta subsp. congesta*	LC	Not Endemic
Poaceae	*Bewsia biflora*	LC	Not Endemic
Poaceae	*Cenchrus ciliaris*	LC	Not Endemic
Poaceae	*Chloris gayana*	LC	Not Endemic
Poaceae	*Cymbopogon caesius*	LC	Not Endemic
Poaceae	*Cynodon dactylon*	LC	Not Endemic
Poaceae	*Digitaria eriantha*	LC	Not Endemic
Poaceae	*Eragrostis chloromelas*	LC	Not Endemic
Poaceae	*Eragrostis curvula*	LC	Not Endemic
Poaceae	*Eragrostis gummiflua*	LC	Not Endemic
Poaceae	*Eragrostis obtusa*	LC	Not Endemic

Family	Scientific Name	Threat Status (SANBI)	SA Endemic
Poaceae	*Eragrostis superba*	LC	Not Endemic
Poaceae	*Heteropogon contortus*	LC	Not Endemic
Poaceae	*Hyparrhenia hirta*	LC	Not Endemic
Poaceae	*Hyperthelia dissoluta*	LC	Not Endemic
Poaceae	*Melinis repens*	LC	Not Endemic
Poaceae	*Panicum maximum*	LC	Not Endemic
Poaceae	*Paspalum dilatatum*	LC	Not Endemic
Poaceae	*Phragmites australis*	LC	Not Endemic
Poaceae	*Pogonarthria squarrosa*	LC	Not Endemic
Poaceae	*Setaria pumila*	LC	Not Endemic
Poaceae	*Setaria sphacelata var. Sericea*	LC	Not Endemic
Poaceae	*Setaria sphacelata var. sphacelata*	LC	Not Endemic
Poaceae	*Setaria sphacelata var. torta*	LC	Not Endemic
Poaceae	*Setaria verticillata*	LC	Not Endemic
Poaceae	*Sporobolus africanus*	LC	Not Endemic
Poaceae	*Themeda triandra*	LC	Not Endemic
Poaceae	*Trichoneura grandiglumis*	LC	Not Endemic
Poaceae	*Urochloa mosambicensis*	LC	Not Endemic
Polygalaceae	*Polygala hottentotta*	LC	Not Endemic
Rhamnaceae	*Ziziphus mucronata subsp. mucronata*	LC	Not Endemic
Scrophulariaceae	*Selago densiflora*	LC	Not Endemic
Solanaceae	*Solanum campylacanthum*	LC	Not Endemic
Solanaceae	*Lycium hirsutum*	LC	Not Endemic
Typhaceae	*Typha capensis*	LC	Not Endemic
Zygophyllaceae	*Tribulus terrestris*	LC	Not Endemic

Two species of protected plant species (*Eucomis autumnalis* and *Ammocharis coranica*) which are protected by the Free State Nature Conservation Ordinance 8 of 1969 were observed within the project area. According to the list of protected species under Schedule 6, if any individuals of these plant species are to be disturbed, permits must be obtained from the Free State DESTEA (Figure 24).

Figure 24: Protected flora recorded within the study area; A) *Ammocharis coranica* and B) *Eucomis autumnalis.*

Twenty-three (23) Ailen Invasive Plant (AIP) species were recorded within the project area (Table 11). These species are listed under the Alien and Invasive Species List 2020, Government Gazette No. GN1003 as Category 1b and Not Indigenous (Exotic) respectively. The twelve (12) species in green, are AIP species that must be controlled by implementing an AIP Management Programme, in compliance of section 75 of the NEMBA (Table 11).

Table 11: Summary of AIP recorded within the project area during the field survey period.

Family	*Scientific Name*	Alien Category
Amaranthaceae	*Atriplex nummularia*	Naturalized exotic
Amaranthaceae	*Gomphrena celosioides*	Naturalized exotic
Anacardiaceae	*Schinus terebinthifolius*	Naturalized exotic
Asteraceae	*Bidens pilosa*	Naturalized exotic
Asteraceae	*Cirsium vulgare*	NEMBA Category 1b.
Asteraceae	*Conyza bonariensis*	Naturalized exotic
Asteraceae	*Schkuhria pinnata*	Naturalized exotic
Asteraceae	*Tagetes minuta*	Naturalized exotic
Asteraceae	*Xanthium spinosum*	NEMBA Category 1b.
Asteraceae	*Flaveria bidentis*	NEMBA Category 1b.
Meliaceae	*Melia azedarach*	NEMBA Category 1b.
Myrtaceae	*Eucalyptus camaldulensis*	NEMBA Category 1b
Papaveraceae	*Argemone ochroleuca*	NEMBA Category 1b.
Pinaceae	*Pinus pinaster*	NEMBA Category 2
Poaceae	*Arundo donax*	NEMBA Category 1b.
Poaceae	*Cortaderia selloana*	NEMBA Category 1b.
Poaceae	*Eleusine coracana*	Naturalized exotic

Family	*Scientific Name*	Alien Category
Poaceae	*Pennisetum clandestinum*	NEMBA Category 1b.
Polygonaceae	*Persicaria lapathifolia*	Naturalized exotic
Solanaceae	*Datura ferox*	NEMBA Category 1b.
Tamaricaceae	*Tamarix chinensis*	NEMBA Category 1b.
Verbenaceae	*Verbena astrigera*	Naturalized exotic
Verbenaceae	*Verbena bonariensis*	NEMBA Category 1b.

8.6.2 FAUNA

Eight (8) mammal species were observed during the survey of the project area (Table 12) based on either direct observation or the presence of visual tracks and signs. Five (5) main terrestrial habitat types were delineated within the project area, including a set of water resources. Habitats within the assessment area that were observed to be utilised by threatened (local classification) species during the field survey, these species comprised of one (1) reptile species; and unique, important (CBA1/ESA 1 & 2) and low resilience habitats (wetlands); as well as habitat that is regarded as crucial to the survival of a threatened species (

Table 13).

Table 12: Summary of mammal species recorded within the project area

Family	Species	Common Name	Conservation Status	
			Regional	Global
Bathyergidae	*Cryptomys hottentotus*	Common Mole-rat	LC	LC
Canidae	*Lupulella mesomelas*	Black-backed jackal	LC	LC
Herpestidae	*Atilax paludinosus*	Water Mongoose	LC	LC
Herpestidae	*Suricata suricatta*	Suricate	LC	LC
Leporidae	*Lepus saxatilis*	Scrub Hare	LC	LC
Mustelidae	*Ictonyx striatus*	Striped Polecat	LC	LC
Sciuridae	*Geosciurus inauris*	South African Ground Squirrel	LC	LC
Herpestidae	*Cynictis penicillata*	Yellow Mongoose	LC	LC

One (1) species of reptiles and no amphibian species were recorded in the study area during survey period. One SCC, Sensitive species 15 was recorded during the field assessments. However, there is the possibility of more species being present, as certain herpetofauna species are secretive and require long-term surveys to ensure capture, although none were identified in follow up surveys.

Sensitive species 15 is categorised as VU on both a regional and an international scale. Additionally, the species is listed in the Convention on International Trade in Endangered Species (CITES) Appendix II, as well as a Threatened or Protected Species (TOPS). It is endemic to South Africa, where it is found only in the grasslands of the northern Free State and the southwestern parts of Mpumalanga with an estimated extent of occurence of 37 617 km² (Alexander et al., 2018). The species is considered to be a habitat specialist, that is highly philopatric (tending to return to or remain near a particular site or area) for burrowing sites. The species is known to not disperse across the landscape to make new burrows should its habitat be destroyed (Alexander et al., 2018).

Habitat loss due to agriculture is a continuing threat to Sensitive Species 15. Large portions of the grassland habitat are underlain by coal beds of varying quality and extent, and exploitation of coal for fuel has and will result in further habitat loss. Another substantial threat to the species is illegal collection for the pet trade to an extent that it is one of the most exported species from South Africa with 1 194 individuals exported between

1985 and 2014 for pet trade (Parusnath et al, 2017; UNEP-WCMC, 2017). Due to the sensitivity of this species, especially in regard to its illegal collection, no waypoints will be displayed or provided in this report. The locations and extent will be considered by the specialist and the EAP in the EIA phase to advise alternatives and impact assessment.

The Free State Department of Environment and Nature Conservation has developed a Free State Biodiversity Sector Plan, called Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs). These biodiversity priority areas, together with protected areas, are important for the persistence of a viable representative sample of all ecosystem types and species as well as the long-term ecological functioning of the landscape. The identification of Critical Biodiversity Areas for the Free State was undertaken using a Systematic Conservation Planning approach. Available data on biodiversity features (incorporating both pattern and process, and covering terrestrial and inland aquatic realms), their condition, current Protected Areas and Conservation Areas, and opportunities and constraints for effective conservation were collated. indicates that the PAOI overlaps with CBA 1, CBA 2 ESA 1, ESA 2, Other and Degraded areas (Figure 25).

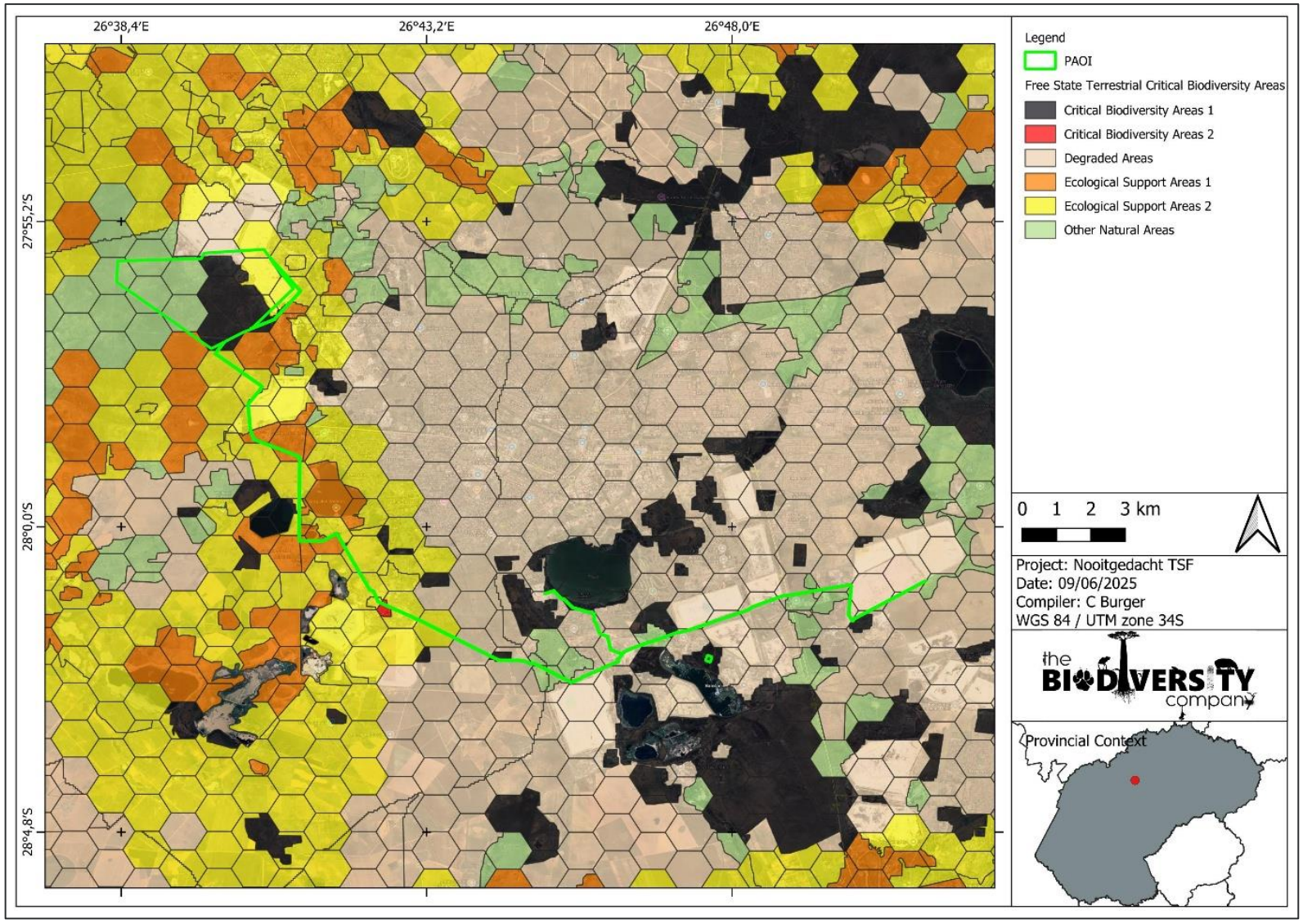


Figure 25: Project area in relation to Free State BSP

Table 13: Summary of habitat types delineated within the field assessment area

Habitat	Description	Ecosystem Processes and Services	Conservation Importance	Functional Integrity	Biodiversity Importance	Receptor Resilience	Site Ecological Importance
Grassland (Sensitive Species)	Grassland system with evidence of past and current grazing activities. Provides niche habitat to a VU species.	Provides grazing and foraging resources for indigenous fauna and livestock. Aids in the filtration of water permeating through the soil into the drainage areas. Important corridor for fauna dispersion within the landscape. Current human infringement occurs, especially in areas close to roads. Provides niche habitat to a VU species.	High Confirmed or highly likely occurrence of CR, EN, VU species that have a global EOO of > 10 km^2.	High	**High**	Low Habitat that is unlikely to be able to recover fully after a relatively long period: > 15 years required to restore ~ less than 50% of the original species composition and functionality	**Very High**
Wetlands	Permanently to seasonally wet portions of land as delineated by the wetland specialist. Even though somewhat disturbed, the ecological integrity, importance and functioning of these areas play a crucial role as a water resource system locally and regionally and an important habitat for various fauna and flora, including the SCC recorded.	Provides surface water resources within the landscape. Aids in trapping sediment and nutrients carried by surface runoff. Corridor for fauna dispersion within the landscape and important foraging and nesting habitat.	Medium > 50% of receptor contains natural habitat with potential to support SCC.	Medium Only narrow corridors of good habitat connectivity. Mostly minor current negative ecological impacts, with some major impacts and a few signs of minor past disturbance.	**Medium**	Low Habitat that is unlikely to be able to recover fully after a relatively long period: > 15 years required to restore ~ less than 50% of the original species composition and functionality	**High**
Secondary Grasslands	This habitat is associated with grassland habitat that has been exposed to modifications due to land use and mismanagement but differs from the degraded grassland in the extent of disturbance that has taken place, with the degraded grassland being	Provides grazing and foraging resources for indigenous fauna and livestock. Aids in the filtration of water permeating through the soil into the drainage areas. Important corridor for fauna dispersion within the	Medium > 50% of receptor contains natural habitat with potential to support SCC.	Medium Only narrow corridors of good habitat connectivity or larger areas of poor habitat connectivity and a busy used road network between intact habitat	**Medium**	Low Habitat that is unlikely to be able to recover fully after a relatively long period: > 15 years required to restore ~ less than	**High**

Habitat	Description	Ecosystem Processes and Services	Conservation Importance	Functional Integrity	Biodiversity Importance	Receptor Resilience	Site Ecological Importance
	exposed to more severe disturbance.	landscape. Current human infringement occurs, especially in areas close to roads.		patches. Mostly minor current negative ecological impacts, with some major impacts and a few signs of minor past disturbance.		50% of the original species composition and functionality	
Degraded Grasslands	Degraded Grassland is characterised by open grassland impacted by weed populations, low pioneer grasses, and AIPs. The habitat isn't entirely modified but in a constant disturbed state and can't recover to a more natural state due to ongoing disturbances and impacts received from grazing, edge effects from land use and mismanagement.	Provides grazing and foraging resources for indigenous fauna and livestock. Aids in the filtration of water permeating through the soil into the drainage areas. Important corridor for fauna dispersion within the landscape.	Medium > 50% of receptor contains natural habitat with potential to support SCC.	Medium Only narrow corridors of good habitat connectivity or larger areas of poor habitat connectivity and a busy used road network between intact habitat patches. Mostly minor current negative ecological impacts, with some major impacts and a few signs of minor past disturbance.	**Medium**	Medium Will recover slowly (~ more than 10 years) to restore > 75% of the original species composition and functionality of the receptor functionality	**Medium**
Modified/Artificial Wetlands	The modified and artificial wetland areas have little to no remaining natural vegetation due to land transformation by historic and current mining, agriculture and mismanagement. These habitats exist in a constant disturbed state as it cannot recover to a more natural state due to ongoing disturbances and impacts it receives.	The ecological services provided by this habitat are limited due to the extensive cover of impermeable surfaces and the large amount of bare land. Locally common bird species will forage and nest in the larger trees, and parts of the area may be considered a movement corridor.	Very Low No natural habitat remaining.	Very Low Several major current negative ecological impacts.	**Very Low**	Medium Will recover slowly (~ more than 10 years) to restore > 75% of the original species composition and functionality of the receptor functionality	**Very Low**

8.6.3 BIRDS AND BATS

Sixty (60) species were recorded in the project area during the survey based on either direct observation, vocalisations, or the presence of visual tracks & signs. One (1) (red text) species are rated as a SCC (Table 14). No bat species were observed during the field assessment and limited species are expected to occur within the project area due to a lack of suitable habitat.

Table 14: List of avifaunal species recorded for the project area

Species	Common Name	Conservation Status	
		Regional	Global
Acridotheres tristis	Myna, Common	Unlisted	LC
Afrotis afraoides	Korhaan, Northern Black	Unlisted	LC
Alopochen aegyptiaca	Goose, Egyptian	Unlisted	LC
Anas erythrorhyncha	Teal, Red-billed	Unlisted	LC
Anas sparsa	Duck, African Black	Unlisted	LC
Anas undulata	Duck, Yellow-billed	Unlisted	LC
Apus apus	Swift, Common	Unlisted	LC
Ardea cinerea	Heron, Grey	Unlisted	LC
Ardea intermedia	Egret, Yellow-billed (Intermediate)	Unlisted	LC
Ardea melanocephala	Heron, Black-headed	Unlisted	LC
Ardea purpurea	Heron, Purple	Unlisted	LC
Ardeola ralloides	Heron, Squacco	Unlisted	LC
Bostrychia hagedash	Ibis, Hadeda	Unlisted	LC
Bubulcus ibis	Egret, Cattle	Unlisted	LC
Burhinus capensis	Thick-knee, Spotted	Unlisted	LC
Charadrius tricollaris	Plover, Three-banded	Unlisted	LC
Chlidonias hybrida	Tern, Whiskered	Unlisted	LC
Chrysococcyx caprius	Cuckoo, Diderick	Unlisted	LC
Cisticola juncidis	Cisticola, Zitting	Unlisted	LC
Columba livia	Dove, Rock	Unlisted	LC
Corvus albus	Crow, Pied	Unlisted	LC
Elanus caeruleus	Kite, Black-shouldered	Unlisted	LC
Estrilda astrild	Waxbill, Common	Unlisted	LC
Euplectes afer	Bishop, Yellow-crowned	Unlisted	LC
Euplectes ardens	Widowbird, Red-collared	Unlisted	LC
Euplectes orix	Bishop, Southern Red	Unlisted	LC
Euplectes progne	Widowbird, Long-tailed	Unlisted	LC
Fulica cristata	Coot, Red-knobbed	Unlisted	LC
Himantopus himantopus	Stilt, Black-winged	Unlisted	LC
Hirundo dimidiata	Swallow, Pearl-breasted	Unlisted	LC
Lamprotornis bicolor	Starling, Pied	Unlisted	LC

Species	Common Name	Conservation Status	
		Regional	Global
Lanius collaris	Fiscal, Common (Southern)	Unlisted	LC
Lybius torquatus	Barbet, Black-collared	Unlisted	LC
Merops apiaster	Bee-eater, European	Unlisted	LC
Mycteria ibis	Stork, Yellow-billed	EN	LC
Myrmecocichla formicivora	Chat, Anteating	Unlisted	LC
Netta erythrophthalma	Pochard, Southern	Unlisted	LC
Numida meleagris	Guineafowl, Helmeted	Unlisted	LC
Passer domesticus	Sparrow, House	Unlisted	LC
Platalea alba	Spoonbill, African	Unlisted	LC
Plectropterus gambensis	Goose, Spur-winged	Unlisted	LC
Plegadis falcinellus	Ibis, Glossy	Unlisted	LC
Plocepasser mahali	Sparrow-weaver, White-browed	Unlisted	LC
Ploceus velatus	Masked-weaver, Southern	Unlisted	LC
Podiceps cristatus	Grebe, Great Crested	Unlisted	LC
Podiceps nigricollis	Grebe, Black-necked	Unlisted	LC
Prinia flavicans	Prinia, Black-chested	Unlisted	LC
Pternistis swainsonii	Spurfowl, Swainson's	Unlisted	LC
Quelea quelea	Quelea, Red-billed	Unlisted	LC
Saxicola torquatus	Stonechat, African	Unlisted	LC
Spatula hottentota	Teal, Hottentot	Unlisted	LC
Spilopelia senegalensis	Dove, Laughing	Unlisted	LC
Sporopipes squamifrons	Finch, Scaly-feathered	Unlisted	LC
Streptopelia capicola	Turtle-dove, Cape	Unlisted	LC
Sturnus vulgaris	Starling, Common	Unlisted	LC
Tachybaptus ruficollis	Grebe, Little	Unlisted	LC
Tadorna cana	Shelduck, South African	Unlisted	LC
Threskiornis aethiopicus	Ibis, African Sacred	Unlisted	LC
Vanellus armatus	Lapwing, Blacksmith	Unlisted	LC
Vanellus coronatus	Lapwing, Crowned	Unlisted	LC

8.7 SURFACE WATER AND WETLANDS

The site is positioned within quaternary catchment C43B. The Mahemspruit River is the only defined river relevant to this assessment (when considering the more detailed 1:50,000 topographical map data). Two additional (and significant) dams are within close proximity to the TSF site and are the focus of future flood modelling. This includes D-Dam Complex. This dam complex partitions water in various compartments and adds some complexity to understanding the routing of water towards the Mahemspruit River. Figure 28 illustrates the hydrological setting of the site. The Mahemspruit River located to the immediate east (200m at the closest point) of the TSF site is the only defined river relevant to this assessment. The hydrological environment is presented in Figure 28. The Nooitgedacht TSF is located outside of the calculated 100 year floodline for the watercourse. The TSF footprint has been based on the calculated floodline and specifically avoids this area

(Figure 29). In considering the flood results, the 1:50 and 1:100 RI events are noted as not affecting the site with the 1:100 RI event coming close to but not intersecting the proposed topsoil stockpile. PMF flood results (plus climate change) do not intersect the TSF and the topsoil stockpile which is positioned outside of the 1:100 RI flood-line. Since the topsoil stockpile is not a sensitive piece of site works (if affected by flooding), its avoidance of the 1:100 RI floodline and not the PMF flood-line is warranted.

The proposed TSF straddles a watershed and does not intersect any defined 1:50,000 topographical map rivers. There is one dam present in the TSF boundary, however, it is not associated with a defined river and has a relatively minor contributing catchment. The most significant river near the site is the Mahemspruit River to the south-east of the site. This river has a contributing catchment of approximately 32km^2 up to its point of assessment south of the site and was the primary focus of potential flooding to the site which is made possible by some lower-lying terrain slowly rising towards the TSF boundary.

With respect to wetlands, an initial site visit was conducted by a wetland specialist in April 2023. Several wetlands were identified and delineated within and in close proximity to the TSF site, including preliminary buffer areas.

During the site visit, nine HGM units were identified within the overall project area that relate to the proposed project (Figure 26). The wetland types were classified as four unchannelled valley bottoms (HGM 1, 2, 6 and 9), two channelled valley bottoms (HGM 3 and 8), and three depressions (HGM 4, 5 and 7). Multiple artificial wetlands, mostly seepage from the tailing's facilities were identified.

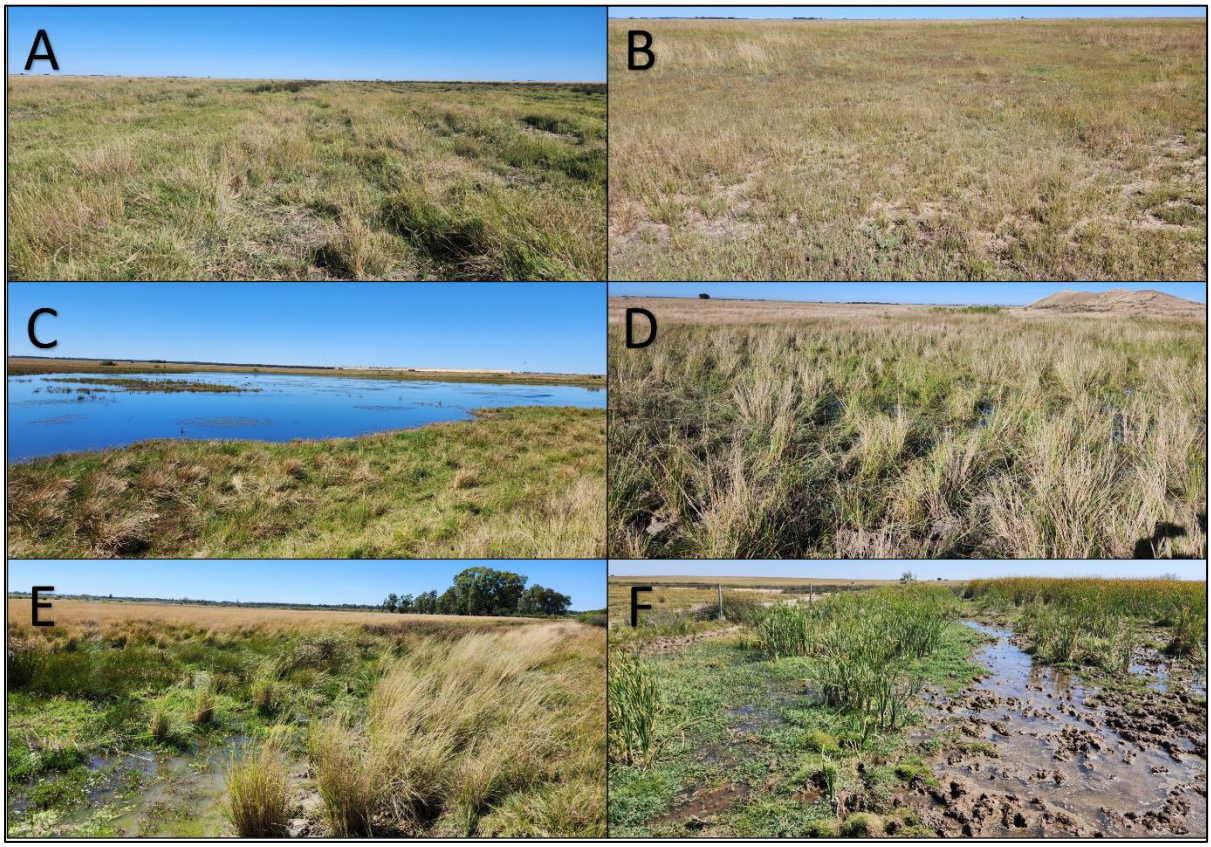


Figure 26: Photographical evidence of the different HGM units found within the study area. A) Unchanneled valley bottom., B) Depression wetland., C) Dam., D) Depression wetland., E & F) Channel valley bottom.

The ecosystem services provided by the wetland units identified on site were assessed and rated using the WET-EcoServices method (Kotze et al., 2008). The average ecosystem service scores for the delineated systems are illustrated in Table 15. The ecosystem services scores of the delineated wetlands ranges from intermediate to moderately high. Ecosystem services contributing to these scores include flood attenuation, streamflow regulation, sediment trapping, phosphate assimilation, nitrate assimilation, toxicant assimilation and erosion control.

Table 15: Average ecosystem service scores for delineated wetlands

High	Moderately High	Intermediate	Moderately Low
HGM 5	HGM 3	HGM 1	HGM 2
	HGM 4	HGM 8	
	HGM 6	HGM 9	
	HGM 7		

HGM 1 scored "Intermediate" ecosystem services scores. The wetland has been modified to an extent that some function has been lost. The wetlands have only a few hydrophyte species present attributed to the level of modification but will still play an important role in flood attenuation and streamflow regulation and water purification.

HGM 2, scored "Moderately Low" on the provision of benefits due to its small size, isolated nature and the low cover of hydrophyte vegetation present inside the wetland. Hydrophytes help with the accumulation of toxicants as well as phosphates and nitrates from the environment as well as provides habitat and resources so the removal of them lower the ecosystem services dramatically.

HGM 3, and 4 scored "Moderately High" on the provision of ecosystem services. The valley bottom wetlands will play a major role in streamflow regulation and flood attenuation which is important in terms of runoff from the tailing's facilities. The wetlands are well vegetated with hydrophytes which increases the potential to remove toxicants from water entering these systems. The depression wetlands are particularly important for the provision habitat and resources for a variety of fauna. The depression will also act as a sink where toxicants, nitrates, and phosphates from the environment.

HGM 5 scored the highest ecosystem services form all the HGM units due to the wide variety of habitats the systems provide for important species. This system plays a very important role for water birds that uses the pans for different lifecycle stages, the pans also play an important role in the assimilation of nitrates and phosphates as well as toxicants that flows from the residential areas into the pans. HGM 5 plays an important role in streamflow regulation as well as sediment trapping from the TSF. The HGM unit has high volumes of hydrophytes that plays an important role in sediment trapping and the assimilation of toxicants from the TSF and thus filters the water for cleaner water downstream.

HGM 6 and 7 have scored "Moderately High". HGM 6 is a grouping of depression wetlands that have good coverage of hydrophytes with surface water present making them a valuable resource point for fauna and hence are important in maintaining biodiversity within a relatively disturbed environment. HGM 7 is a channelled valley bottom wetland flowing from the TSF in the south towards the pans. The HGM unit thus plays an important role in the assimilation of toxicant from the TSF cleaning the water before it reaches bigger water courses.

HGM 8 scored "Intermediate" due to the low cover of hydrophytes within the wetlands. HGM 8 flows from HGM 7 into the surrounding grassland, where the wetland is subjected to overgrazing. The HGM unit is also subjected to erosion that removes high volumes of hydrophytes from the systems, subsequently lowering the potential to provide ecosystem services on a substantial scale.

Attributed to private ownership of most of the land that the wetlands are located within and, the subsequent restricted access to the public, the potential to be used for tourism, recreation and the provisioning of cultural benefits was assumed to be limited.

The results of the ecological Importance and Sensitivity assessment are shown in Table 16. Various components pertaining to the protection status of a wetland are considered for the IS, including Strategic Water Source Areas (SWSA), the National Freshwater Ecosystem Priority Areas (NFEPA). A wetland vegetation (wet veg) threat status and the protection status of the wetland. The IS for both the valley bottoms and the seep (artificial) wetlands were calculated to be "High", which combines the low protection status of the wet veg and the and the high threat status of the wetlands themselves. The depression wetlands scored "Moderate" sensitivities due to the low threat status of the wet veg and the low threat status of the wetlands themselves.

Table 16: The IS results for the delineated HGM units

HGM Type	NFEPA Wet Veg			NBA Wetlands			SWSA (Y/N)	Calculated IS
	Type	Ecosystem Threat Status	Ecosystem Protection Level	Wetland Condition	Ecosystem Threat Status 2018	Ecosystem Protection Level		
Unchannelled Valley Bottom (HGM 1, 2, 6 and 9)	Dry Highveld Grassland Group 3	Least Threatened	Not Protected	D/E/F Largely Modified	Critically	Not Protected	N	**High**
Channelled Valley Bottom HGM 3 and 8)	Dry Highveld Grassland Group 3	Least Threatened	Not Protected	A/B Largely Natural	Critically	Not Protected	N	**High**
Depression HGM 4, 5 and 7)	Dry Highveld Grassland Group 3	Least Threatened	Not Protected	A/B Largely Natural	Least Concerned	Not Protected	N	**Moderate**

The Recommended Ecological Category (REC) and Recommended Management Objective (RMO) for the wetland areas was determined from the results of the PES and EIS assessments. These assessments indicated that all wetland features within the site, had to an extent, underwent transformation as a result of historical and current impacts. Nevertheless, despite the altered ecological integrity of these systems, they are considered to provide some important ecological services. The appropriate REC and RMO estimated for the wetland areas is presented in Table 17 below.

Table 17: Summary of the REC and RMO categories assigned to the relevant wetlands

Wetland Unit	REC - RMO
HGM 1	D - Maintain
HGM 2	E - Maintain
HGM 3	D - Maintain
HGM 4	D - Maintain
HGM 5	D - Maintain
HGM 6	E - Improve
HGM 7	D - Maintain
HGM 8	C/D - Improve
HGM 9	E - Improve

It is worth noting that the scientific buffer calculation (Macfarlane et al., 2014) was used to determine the size of the buffer zones relevant to the proposed project. A pre-mitigation buffer of 56m and a post-mitigation wetland and watercourse buffer of 46 m is applicable in relation to the proposed TSF. Furthermore, a 32 m pre-mitigation and 15 m post-mitigation buffer is applicable to the wetlands in relation to the proposed pipelines. The buffer widths are attributed to pre-existing modifications to the wetlands and their immediate surrounding catchment and in consideration that pipelines are linear structures and are not anticipated to have a large impact radius.

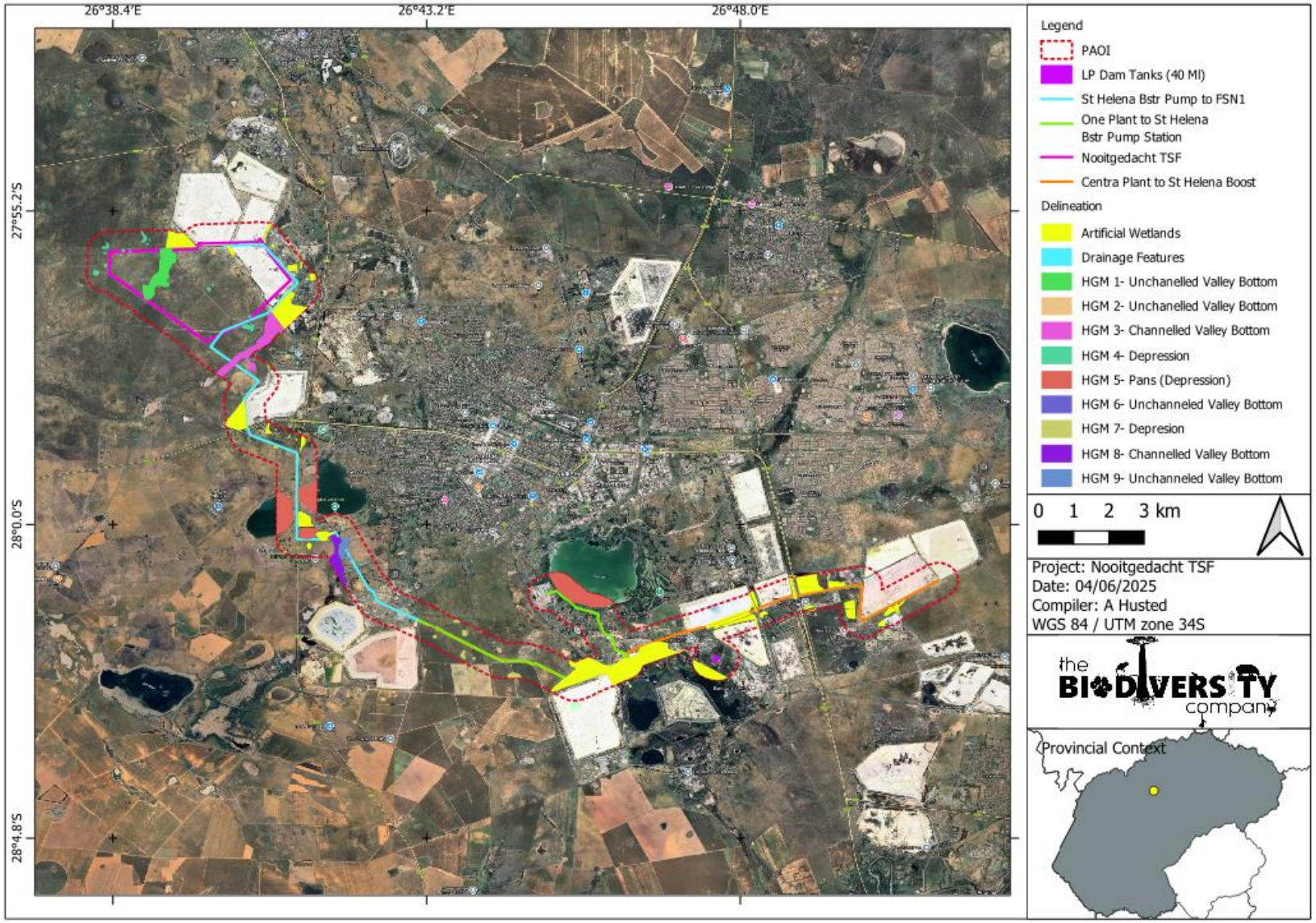


Figure 27: Identified delineated wetlands.

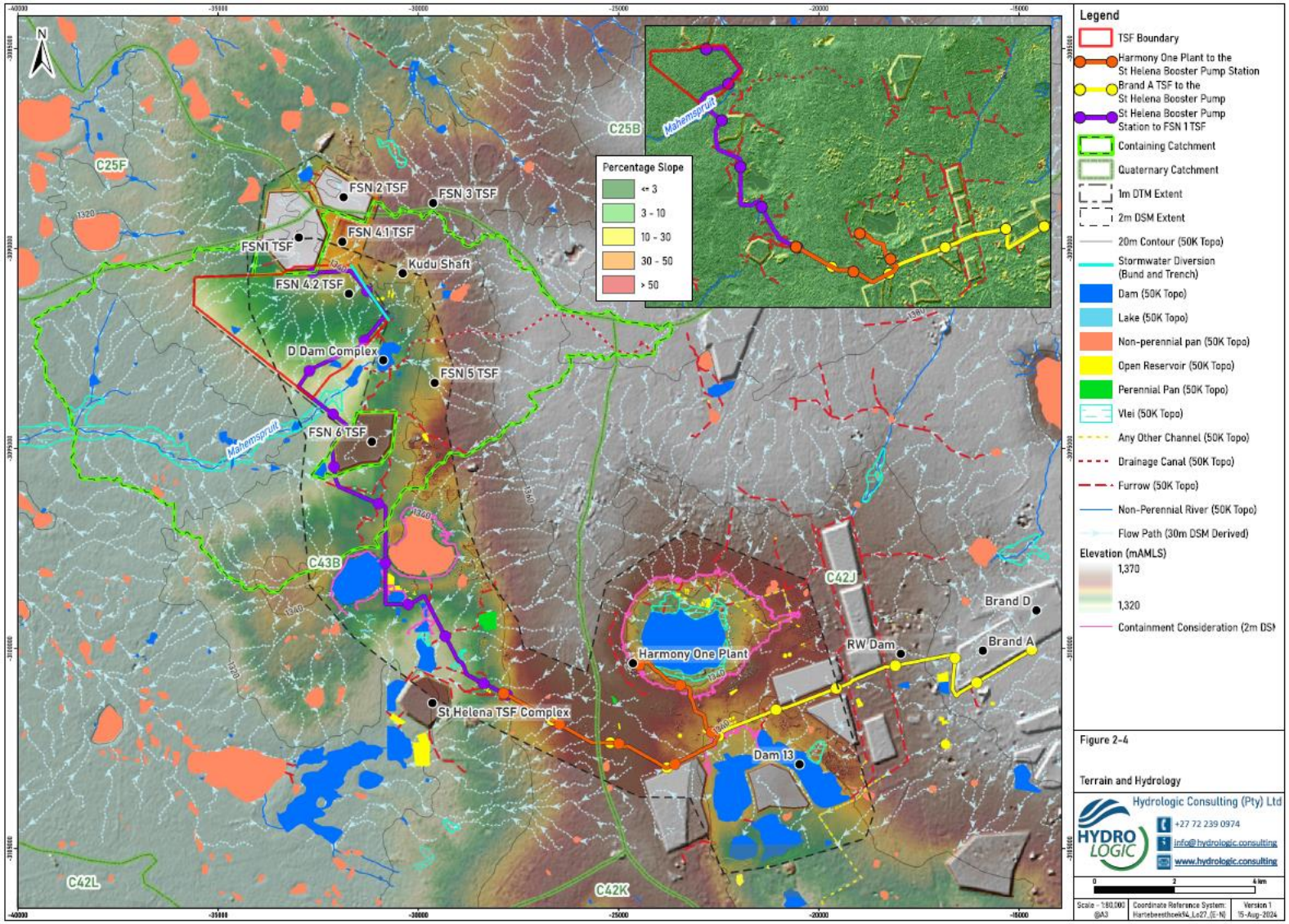


Figure 28: Terrain and Hydrology

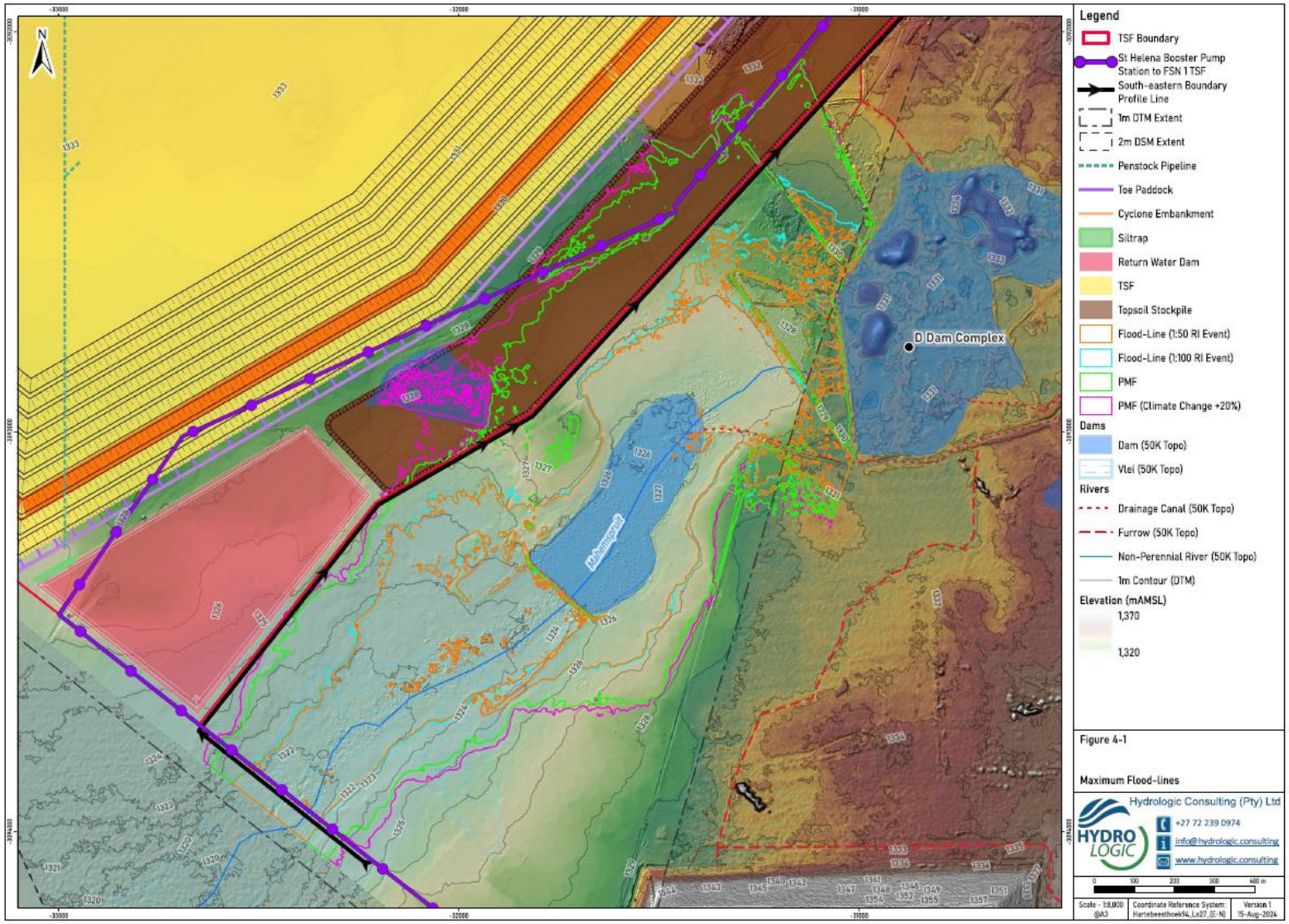


Figure 29: Flood lines in relation to TSF

8.8 GROUNDWATER

A new geohydrological specialist study was conducted as part of this EIA. The geohydrological setting and conceptual model of the study area is described according to the following criteria:

- Borehole information;
- Aquifer type;
- Groundwater use;
- Aquifer parameters;
- Aquifer recharge;
- Groundwater gradients and flow;
- Groundwater quality; and
- Aquifer classification.

8.8.1 BOREHOLE INFORMATION

During a study conducted by Golder Associates in 2009 eighteen new boreholes were drilled to assess the groundwater regime underlying the Nooitgedacht TSF and surrounds. Information from these boreholes was used to conduct the geohydrological assessment. The borehole information is summarised in Table 18. Subsequent to the Golder study new boreholes were drilled, which are currently used for groundwater monitoring. There is no information available on the new borehole and it appears if the Golder boreholes no longer exist. The localities of the current monitoring boreholes are shown on Figure 31.

Table 18: Borehole Information (Golder Associates, 2009)

ID	X	Y	Z	Depth (mbc)	Water Level (mbc)
BH1	26.65620	-27.92963	1335	90	5.50
BH2	26.65627	-27.92970	1331	36	6.41
BH3	26.65732	-27.94308	1334	73	54.03
BH4	26.65735	-27.94312	1336	24	Artesian
BH5	26.64065	-27.93760	1327	73	Dry
BH6	26.64062	-27.93755	1330	23	17.99
BH7	26.64061	-27.93019	1336	73	72.38
BH8	26.64057	-27.93023	1336	26	20.87
BH9	26.67978	-27.94499	1330	73	4.12
BH10	26.67975	-27.94496	1329	23	6.47
BH11	26.67250	-27.90450	1350	68	Artesian
BH12	26.67256	-27.90454	1348	27	Artesian
BH13	26.68095	-27.90938	1354	73	52.48
BH14	26.68097	-27.90936	1349	29	2.02
BH15	26.68849	-27.91220	1353	73	52.13
BH16	26.68845	-27.91220	1352	30	Dry

ID	X	Y	Z	Depth (mbc)	Water Level (mbc)
BH17	26.67954	-27.92358	1345	73	40.06
BH18	26.67952	-27.92365	1345	29	4.03

8.8.2 AQUIFER TYPE

The proposed TSF is situated on interbedded siltstone/sandstone and shale of the Vryheid Formation. Even though the shale and sandstone are not known to contain economic aquifers, groundwater contributes to stream flow and in some instances, high yielding boreholes have been recorded. The following three aquifers underlie the site:

- Weathered Aquifer (Karoo Formations): A shallow, weathered aquifer exists in the weathered shale and sandstone at an average depth of 10m – 20m below ground level. The most consistent water strike is located at the fresh bedrock / weathering interface. The hydraulic conductivity of the weathered aquifer is typically in the order of 0.1 m/day. The vertical permeability is in the order of 0.001 m/day to 0.00010 m/day, which is sufficiently low to confine the groundwater in the underlying fractured rock aquifer.
- Fractured Aquifer (Karoo Formations): The primary porosity of the Vryheid Formation is very low. Any water bearing capacity is therefore associated with secondary joints, bedding planes and faults. The contact zones of dolerite intrusions are characterised by cooling joints and fractures, which are considered the primary source of groundwater flow within the deeper formations. The hydraulic conductivity of the fractured rock aquifer is typically in the order of 0.001 m/day to 0.1 m/day. The depth to groundwater in this aquifer can be variable due to confining layers in parts of the study area.

  The two aquifers may or may not be hydraulically connected, dependent on the local geology.
- Witwatersrand / Ventersdorp Aquifer: The deep brine Witwatersrand aquifer is situated approximately 300m below surface. Mining prospecting boreholes indicated this level to be between 170m to 270m. This aquifer is thought to be connate (i.e. original formation water) or extremely old (fossil) water and is usually concentrated on geological structures such as fault zones or igneous intrusions (e.g. dykes). The time gap between the end of the Central Rand Group and the start of the Karoo deposition was in the order of 2.3 gigaannum (Ga). There is also a significant time gap between the Central Rand Group and the Ventersdorp Supergroup. During these intervening periods, the older rocks were uplifted and exposed to erosion and the near surface rocks to pressure release. This resulted in the forming of fractures in approximately the upper 150m of the rock succession. Subsequent land surface changes and inundation by a shallow sea allowed marine water to percolate into the network of fractures in the Witwatersrand and Ventersdorp rocks (Young, 1990).
- The major fractures that formed during the Ventersdorp tectonic events were filled with water to a depth of several kilometres. The impermeable nature of the overlying Karoo sediments, particularly the Dwyka Formation at the base of the Karoo, effectively sealed off the aquifer (Van Biljon, 1995). Post-Karoo movement and intrusions provided conduits for leakage from the Karoo aquifers to the deep Witwatersrand aquifer. However, the deep aquifer recharge from surface is regarded as negligible and at best localised (Van Biljon, 1995). The Witwatersrand aquifer has been largely dewatered during the past 40 years of mining and the water levels in the aquifer dropped significantly. In spite of the dewatering of the Witwatersrand aquifer, there is no evidence of dewatering of the Karoo aquifers.

It is therefore concluded that:

- There is no or very limited hydraulic connectivity between the Karoo aquifers and the deeper Witwatersrand aquifer.
- Recharge to the Witwatersrand aquifer is negligible.

- Once the Witwatersrand aquifer is dewatered (or the water level lowered) it will not recover. The estimated post-mining water level in the Witwatersrand aquifer will therefore be deeper than the pre-mining water level of ~200m below surface.

A graphical illustration of the aquifers is presented in Figure 30.

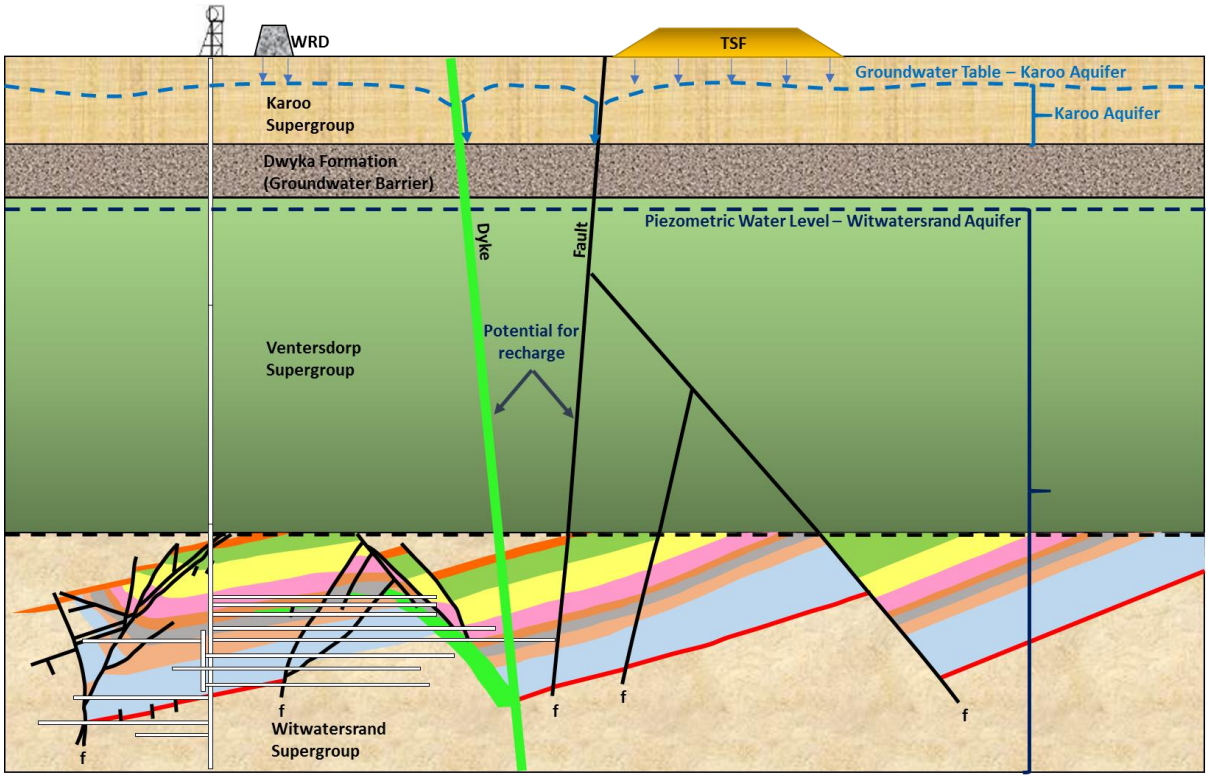


Figure 30: Graphical illustration of the aquifers in the study area

8.8.3 GROUNDWATER USE

There are no large-scale groundwater supply boreholes within the immediate study area. Farmers are, however, reliant on boreholes for domestic use and stock watering, however no private boreholes are located with a 2km radius of the site. There are no springs recorded in the area either. Percussion boreholes drilled through the Karoo established the following information:

- Number of Boreholes: 43
- Average Thickness of Karoo: 117m
- Percentage of boreholes intersecting dolerite in Karoo: 33%
- Average depth of dolerite from surface: 74m

The drilling indicated that groundwater occurrence is predominantly on the contact zones with dolerite intrusions and on the contact between the Karoo sediments and the Ventersdorp lavas. Measured yields vary from 0.10 litre per second (ℓ/sec) to 22 ℓ/sec.

8.8.4 AQUIFER PARAMETERS

The drilled boreholes noted above were pump tested by Golder Associates (2009). Important parameters that can be obtained from borehole or test pumping include Hydraulic Conductivity (K), Transmissivity (T) and Storativity (S). These parameters are defined as follows (Krusemann and De Ridder, 1991):

- Hydraulic Conductivity: This is the volume of water that will move through a porous medium in unit time under a unit hydraulic gradient through a unit area measured at right angles to the direction of flow. It is normally expressed in metres per day (m/day).
- Transmissivity: This is the rate of flow under a unit hydraulic gradient through a cross-section of unit width over the full, saturated thickness of the aquifer. Transmissivity is the product of the average hydraulic conductivity and the saturated thickness of the aquifer. Transmissivity is expressed in metres squared per day (m^2/day).
- Storativity: The storativity of a saturated confined aquifer is the volume of water released from storage per unit surface area of the aquifer per unit decline in the component of hydraulic head normal to that surface. Storativity is a dimensionless quantity.

The average transmissivity of the shallow aquifer is estimated at 2.3 m^2/day, while that of the deep aquifer is estimated at 0.9 m^2/day. The average transmissivity of the shallow aquifer is estimated at 2.3 m^2/day, while that of the deep aquifer is estimated at 0.9 m^2/day.

8.8.5 AQUIFER RECHARGE

Recharge is defined as the process by which water is added from outside to the zone of saturation of an aquifer, either directly into a formation, or indirectly by way of another formation. According to the Groundwater Assessment Phase II the recharge is approximately 4% of mean annual precipitation. This implies that approximately 8.64 mm/a of precipitation recharges the groundwater system which is lower than the GRAII values.

8.8.6 GROUNDWATER GRADIENTS AND FLOW

Figure 31 depicts the groundwater level elevations which, as expected, mimic the surface contours. Groundwater flow is perpendicular to the groundwater contours and flows predominantly towards the south-west.

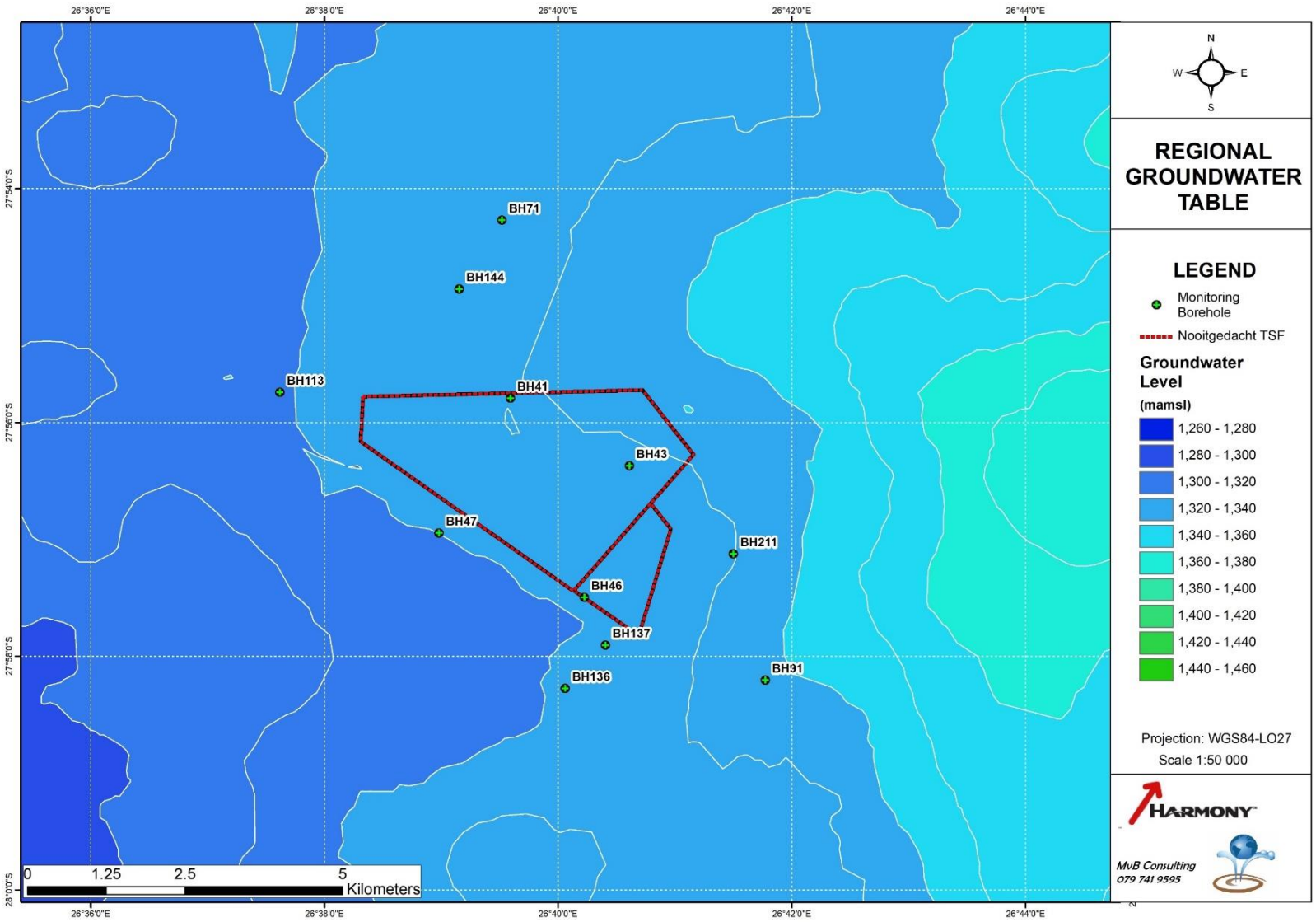


Figure 31: Regional groundwater gradient and existing borehole locations

8.8.7 GROUNDWATER QUALITY

The groundwater chemistry is compared to the South African Water Quality Guidelines (second edition) Volume 5: Agricultural Use: Livestock Watering (Department of Water Affairs and Forestry, 1996), as well as the SANS 241 (2015). The SANS 241 Drinking Water Specification is the definitive reference on acceptable limits for drinking water quality parameters in South Africa and provides guideline levels for a range of water quality characteristics. The SANS 241 (2015) Drinking-Water Specification effectively summarises the suitability of water for drinking water purposes for lifetime consumption.

The chemical concentrations are compared to the Guidelines for Livestock Watering. Where these guidelines are exceeded, the values are highlighted in red. In the absence of limits for livestock watering the chemical concentrations are compared to the SANS 241 (2015) Guidelines for Drinking Water.

The chemistry of the groundwater is presented in Table 19. The following is observed:

- The groundwater in the Free State is generally saline and most of the boreholes have Electrical Conductivity (EC) and Total Dissolved Solids (TDS) concentrations that exceed the guideline limits. Very high TDS concentrations are recorded in borehole BH46. This borehole is situated very close to a stream indicating that spillage is occurring or has occurred into this stream. The high concentrations are not attributed to natural plume migration.
- The high salt concentrations are primarily attributed to chloride, sulphate and sodium.
- The existing tailings facilities which are unlined have impacted on the surrounding groundwater environment. The extent of this impact is best illustrated through the sulphate (SO_4) concentrations in the monitoring boreholes (Table 19). The most impacted areas appear to be associated with the return water dams, and / or spillage into a surface stream and not necessarily the TSF itself.

Table 19: Groundwater chemistry

Parameter	SANS 241	DWAF	BH71	BH144	BH41	BH47	BH43	BH46	BH211	BH137	BH136	BH91	BH113
pH	<5 - >9.7	NG	8.29	7.61	7.89	8.63	2.63	7.80	8.19	8.87	7.66	7.83	8.06
EC mS/m	170	NG	615	1 641	906	146	1 355	4 980	142	141	2 234	302	74
TDS mg/L	1 200	1 000	3 860	11 124	6 110	1 029	8 997	39 137	852	863	14 881	2 381	472
Total Alk mg/L	NG	NG	244	513	501	190	6	551	238	518	472	405	194
Cl mg/L	300	1 500	1 373	4 466	2 229	246	5 106	16 284	171	105	6 854	562	94
SO_4 mg/L	500	1 000	939	2 660	1 583	107	1 121	8 622	233	115	2 723	834	84
NO_3-N mg/L	11	100	38.77	<0.46	0.50	51.43	1.63	<0.46	<0.46	0.59	1.55	<0.46	0.81
Ca mg/L	NG	1 000	284	478	182	31	823	738	90	13	528	241	13
Mg mg/L	NG	500	172	279	214	24	671	1 979	33	4	487	121	10
Na mg/L	200	2 000	746	2 902	1 576	268	1 254	11 146	171	306	3 975	348	138
K mg/L	NG	NG	26	24	18	8	15	29	8	2	19	26	11
Fe mg/L	2	10	0.009	<0.009	0.090	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	0.016	<0.009
Mn mg/L	0.4	10	0.001	<0.001	2.142	<0.001	12.288	<0.001	<0.001	<0.001	<0.001	<0.001	0.011

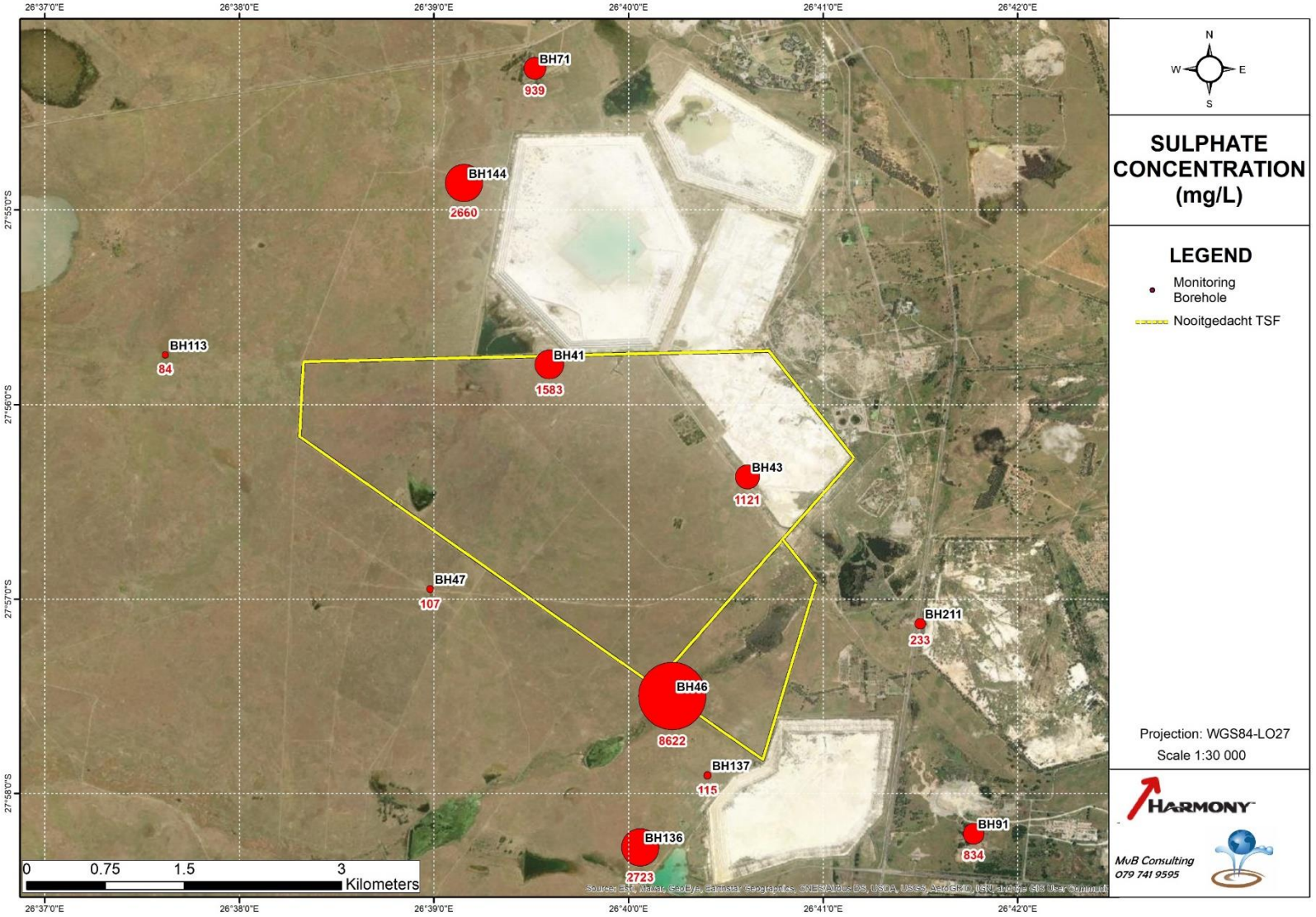


Figure 32: Sulphate concentration distribution in the groundwater monitoring boreholes.

8.8.8 AQUIFER CLASSIFICATION

An aquifer classification system provides a framework and objective basis for identifying and setting appropriate levels of groundwater resource protection. This would facilitate the adoption of a policy of differentiated groundwater protection.

The aquifer classification system used to classify the aquifers is the proposed National Aquifer Classification System of Parsons (1995). This system has a certain amount of flexibility and can be linked to second classifications such as a vulnerability or usage classification. Parsons suggests that aquifer classification forms a very useful planning tool that can be used to guide the management of groundwater issues. He also suggests that some level of flexibility should be incorporated when using such a classification system.

The South African Aquifer System Management Classification is presented by five major classes:

- Sole Source Aquifer System;
- Major Aquifer System;
- Minor Aquifer System;
- Non-Aquifer System; and
- Special Aquifer System.

The following definitions apply to the aquifer classification system:

- Sole source aquifer system: “An aquifer that is used to supply 50% or more of domestic water for a given area, and for which there are no reasonable alternative sources should the aquifer become depleted or impacted upon. Aquifer yields and natural water quality are immaterial”.
- Major aquifer system: “Highly permeable formations, usually with a known or probable presence of significant fracturing. They may be highly productive and able to support large abstractions for public supply and other purposes. Water quality is generally very good”.
- Minor aquifer system: “These can be fractured or potentially fractured rocks that do not have a high primary permeability, or other formations of variable permeability. Aquifer extent may be limited and water quality variable. Although this aquifer seldom produces large quantities of water, they are both important for local supplies and in supplying base flow for rivers”.
- Non-aquifer system: “These are formations with negligible permeability that are generally regarded as not containing groundwater in exploitable quantities. Water quality may also be such that it renders the aquifer unusable. However, groundwater flow through such rocks does occur, although imperceptible, and needs to be considered when assessing risk associated with persistent pollutants”.
- Special aquifer system: “An aquifer designated as such by the Minister of Water Affairs, after due process”.

After rating the aquifer system management and the aquifer vulnerability, the points are multiplied to obtain a Groundwater Quality Management (GQM) index. Based on the above, the aquifers in the study area are classified as follows:

Table 20: Aquifer Classification

Description	Aquifer	Vulnerability	Rating	Protection
Weathered Aquifer	Minor (2)	2	4	Medium
Fractured Aquifer	Minor (2)	1	2	Low

8.9 AIR QUALITY

The wind roses comprise 16 spokes, which represent the directions from which winds blew during a specific period. The colours used in the wind roses below reflect the different categories of wind speeds: the yellow area, for example, represents winds in between 4 and 5 m/s. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories. The frequency with which calms occurred, i.e. periods during which the wind speed was below 1 m/s, are also indicated. The period wind field and diurnal variability in the wind field are both shown in Figure 34 while the seasonal variations are shown in Figure 35.

During the 2019 to 2021 period, the wind field was dominated by winds from the north-northeast and northeast, followed by northerly and easterly winds. During the day (6AM – 6PM), the prevailing wind field is from the north to northeast and the west, with less frequent winds from the north-westerly sector, the easterly sector and the south-west. During the night, the wind field shifts to the easterly sector (north-northeast to east-southeast), with very little flow from the westerly sector. Long-term air quality impacts are therefore expected to be the most significant to the south and southwest of the project area. The strongest winds (more than 6 m/s) were also from the north and northeast and occurred mostly during the day, with 15 m/s the highest wind speed recorded. The average wind speed over the three years is 3.7 m/s, with calm conditions occurring for 3.5% of the time.

Seasonally, the wind flow pattern conforms to the period average wind flow pattern. The seasonal wind field shows little seasonal differences in the wind fields. During summer and spring, the dominant winds are from the north-northeast to east, with more frequent westerly winds during spring. Autumn reflects dominant north-easterly and easterly winds, with a similar wind field during winter, but with more frequent north-northeasterly and east-southeasterly winds.

According to the Beaufort wind force scale (https://www.metoffice.gov.uk/guide/weather/marine/beaufort-scale), wind speeds between 6-8 m/s equates to a moderate breeze, with wind speeds between 9-11 m/s referred to as a fresh breeze. Wind speeds between 11-14 m/s are described as a strong breeze with winds between 14-17 m/s near gale force winds and 17-21 m/s as gale force winds. Over the 3-year period, wind speeds within 14-17 m/s occurred for 0.03% of the time, and winds between 11-14 m/s for 0.46%. The likelihood for wind erosion to occur from open and exposed surfaces, with loose fine material, but taking into account that the TSF surfaces are typically crusted, was estimated when the wind speed exceeds 9 m/s (Mian & Yanful, 2003). Wind speeds exceeding 9 m/s occurred for 2.27% over the 3-year period.

Air Quality Sensitive Receptors (AQSRs) refer to places where humans reside. Ambient air quality guidelines and standards, have been developed to protect human health. Ambient air quality, in contrast to occupation exposure, pertains to areas outside of an industrial site or boundary where the public has access to and according to the Air Quality Act, excludes air regulated by the Occupational Health and Safety Act (Act No 85 of 1993).

A map showing locations of AQSRs within the project area of influence is included in Figure 33. These include residential areas, farmsteads, schools and hospitals. The closest towns in the immediate region of the project include Welkom and its suburbs (located about 4 km southeast of the Project boundary) and Odendaalsrus (located about 5 km north of the Project boundary). Typically the maximum zone of significant change with respect to air quality impacts is 5km from the project site.

Harmony samples dust fallout at 44 locations (4 samplers each at 11 sites). Of these sites, five are within the study domain, i.e. Odendaalsrus, Rheederpark, Flamingo Park, Bedelia and St Helena. Dust fallout rates were sampled during the most recent period for which data was available (July 2016 to May 2017). Most of the sites, but specifically the ones in the vicinity of the project (i.e. Odendaalsrus, Rheederpark, Flamingo Park, Bedelia and St Helena) are in non-compliance, where it exceeded the residential and non-residential limits more than two months in 2017 and for two sequential months.

8.9.1.1 EXISTING SOURCES OF ATMOSPHERIC EMISSION - AGRICULTURE

Neighbouring land-use in the surrounding of the proposed project comprises predominantly of agriculture activities to the west and south and urban activities to the east, with mining activities to the immediate north and east of the area proposed for the TSF. These land-uses contribute to baseline pollutant concentrations via

fugitive and process emissions, vehicle tailpipe emissions, household fuel combustion, biomass burning and windblown dust from exposed areas.

Agriculture is a major land-use activity within and beyond the project area of influence. These activities include crop farming such as maize, and livestock farming. Particulate matter is the main pollutant of concern from agricultural activities as particulate emissions are derived from windblown dust, burning crop residue, and dust entrainment as a result of vehicles travelling along dirt roads. In addition, pollen grains, mould spores and plant and insect parts from agricultural activities all contribute to the particulate load. Should chemicals be used for crop spraying, they would typically result in odiferous emissions. Crop residue burning is also an additional source of particulate emissions and other toxins. Due to the small scale of farming activities these are regarded to have an insignificant cumulative impact.

Livestock farms, especially cattle, are also significant sources of fugitive dust especially when feedlots are used and the cattle graze in confined areas. Pollutants include ammonia (NH3), hydrogen sulfide (H2S), methane (CH4), carbon dioxide (CO2), oxides of nitrogen (NOx) and odour related trace gasses. According to the US-EPA, cattle emit methane through a digestive process that is unique to ruminant animals called enteric fermentation. The calf-cow sector of the beef industry was found to be the largest emitter of methane emissions. Where animals are densely confined the main pollutants of concern include dust from the animal movements, their feed and their manure, ammonia (NH3) from the animal urine and manure, and hydrogen sulfide (H2S) from manure pits.

Organic dust includes dandruff, dried manure, urine, feed, mould, fungi, bacteria and endotoxins (produced by bacteria, and viruses). Inorganic dust is composed of numerous aerosols from building, materials and the environment. Since the dust is biological it may react with the defence system of the respiratory tract. Odours and VOCs associated with animal manure is also a concern when cattle are kept in feedlots. The main impact from methane is on the dietary energy due to the reduction of carbon from the rumen. Dust and gasses levels are higher in winter or whenever animals are fed, handled or moved.

8.9.1.2 EXISTING SOURCES OF ATMOSPHERIC EMISSION - MINING

Particulates represent the main pollutant of concern at mining operations, whether it is underground or opencast. The amount of dust emitted by these activities depends on the physical characteristics of the material, the way in which the material is handled and the weather conditions (e.g. high wind speeds, rainfall, etc.). Mining of gold, as well as ore extraction and processing plants are all commercial activities situated in the region of the project. Particulate matter (PM) in gold mining operations originates from various sources, including ore extraction and processing, vehicle traffic, and tailings storage facilities. Specifically, activities like drilling, blasting, crushing, and the transportation of materials also contribute to PM emissions. Wind erosion from tailings ponds and waste rock dumps are additional sources.

8.9.1.3 EXISTING SOURCES OF ATMOSPHERIC EMISSION - DOMESTIC FUEL COMBUSTION

Domestic households are known to have the potential to be one the most significant sources that contribute to poor air quality within residential areas. Individual households are low volume emitters, but their cumulative impact is significant. It is likely that households within the local communities or settlements utilize coal, paraffin and/or wood for cooking and/or space heating (mainly during winter) purposes. Pollutants arising from the combustion of wood include respirable particulates, CO and SO_2 with trace amounts of polycyclic aromatic hydrocarbons (PAHs), in particular benzo(a)pyrene and formaldehyde. Particulate emissions from wood burning have been found to contain about 50% elemental carbon and about 50% condensed hydrocarbons.

Coal burning also emits a large amount of gaseous and particulate pollutants including SO_2, heavy metals, PM including heavy metals and inorganic ash, CO, PAHs (recognized carcinogens), NO_2 and various toxins. The main pollutants emitted from the combustion of paraffin are NO_2, particulates, CO and PAHs.

8.9.1.4 EXISTING SOURCES OF ATMOSPHERIC EMISSION - FUGITIVE DUST SOURCES AND ROADS

These sources are termed fugitive because they are not discharged to the atmosphere in a confined flow stream. Sources of fugitive dust identified in the study area include paved and unpaved roads and wind erosion of sparsely vegetated surfaces.

Emissions from unpaved roads constitute a major source of emissions to the atmosphere in the South African context. When a vehicle travels on an unpaved road the force of the wheels on the road surface causes pulverization of surface material. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong turbulent air shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed. Dust emissions from unpaved roads vary in relation to the vehicle traffic and the silt loading on the roads. Unpaved roads in the region are mainly haul and access roads.

Emissions from paved roads are significantly less than those originating from unpaved roads, however they do contribute to the particulate load of the atmosphere. Particulate emissions occur whenever vehicles travel over a paved surface. The fugitive dust emissions are due to the re-suspension of loose material on the road surface. Paved roads in the region include the R710, R73, R30 and R34.

8.9.1.5 EXISTING SOURCES OF ATMOSPHERIC EMISSION - WIND EROSION OF OPEN AREAS

Windblown dust generates from natural and anthropogenic sources. For wind erosion to occur, the wind speed needs to exceed a certain threshold, called the threshold velocity. This relates to gravity and the inter-particle cohesion that resists removal. Surface properties such as soil texture, soil moisture and vegetation cover influence the removal potential. Conversely, the friction velocity or wind shear at the surface is related to atmospheric flow conditions and surface aerodynamic properties. Thus, for particles to become airborne, its erosion potential has to be restored; that is, the wind shear at the surface must exceed the gravitational and cohesive forces acting upon them, called the threshold friction velocity. Every time a surface is disturbed, its erosion potential is restored (US EPA, 2004). Erodible surfaces may occur as a result of agriculture and/or grazing activities.

8.9.1.6 EXISTING SOURCES OF ATMOSPHERIC EMISSION - VEHICLE TAILPIPE EMISSIONS

Emissions resulting from motor vehicles can be grouped into primary and secondary pollutants. While primary pollutants are emitted directly into the atmosphere, secondary pollutants form in the atmosphere as a result of chemical reactions. Significant primary pollutants emitted combustion engines include carbon dioxide (CO_2), carbon (C), sulfur dioxide (SO_2), oxides of nitrogen (mainly NO), particulates and lead. Secondary pollutants include NO2, photochemical oxidants such as ozone, sulfur acid, sulphates, nitric acid, and nitrate aerosols (particulate matter). Vehicle type (i.e. model-year, fuel delivery system), fuel (i.e. oxygen content), operating (i.e. vehicle speed, load) and environmental parameters (i.e. altitude, humidity) influence vehicle emission rates. Transport in the vicinity of the project is via trucks and private vehicles along the R710, R73, R30 and R34 roads (which are the main sources of vehicle tailpipe emissions), as well as vehicles and machinery travelling on unpaved and private roads.

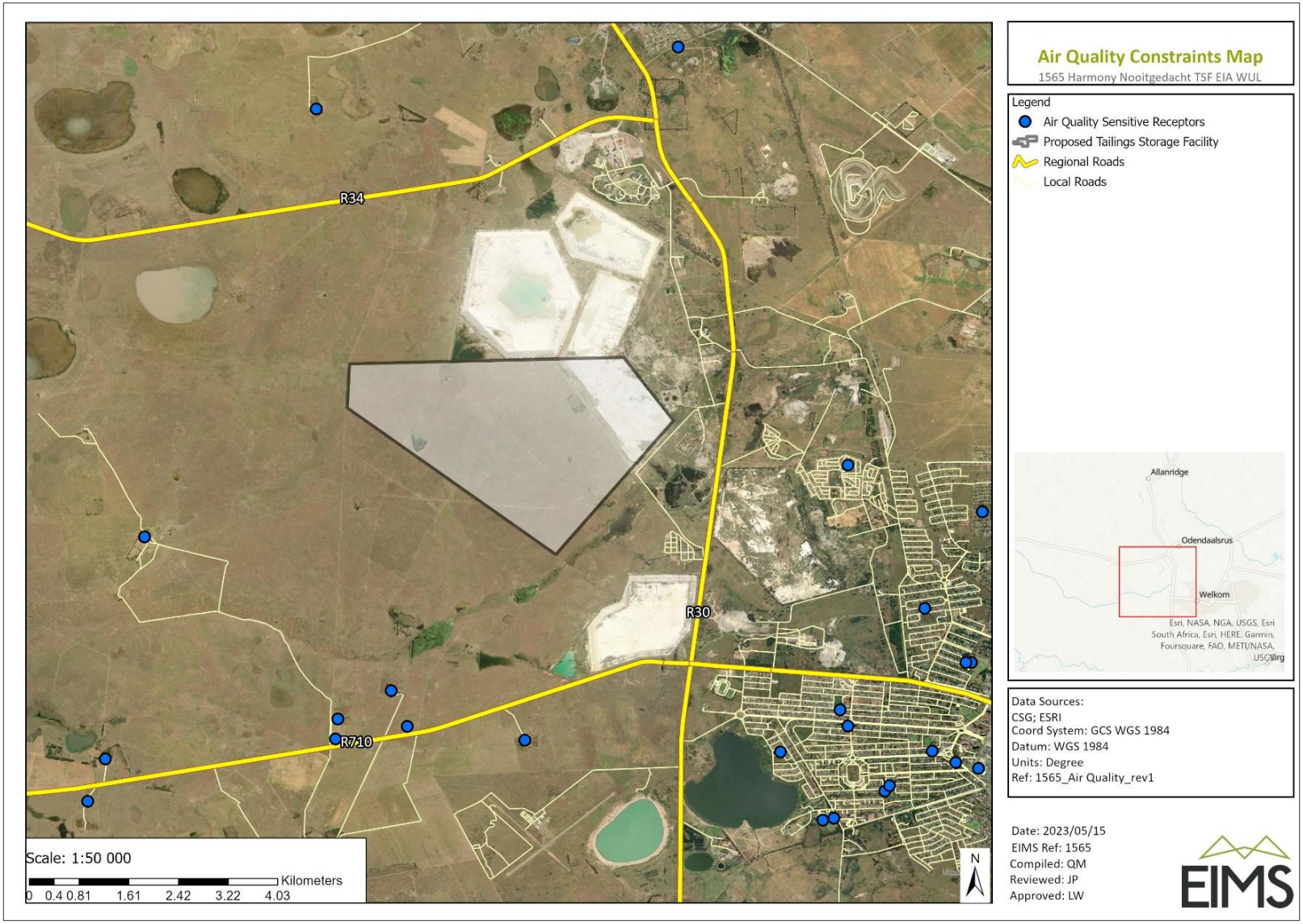


Figure 33: Location of sensitive receptors relative to the Project Area of Influence.

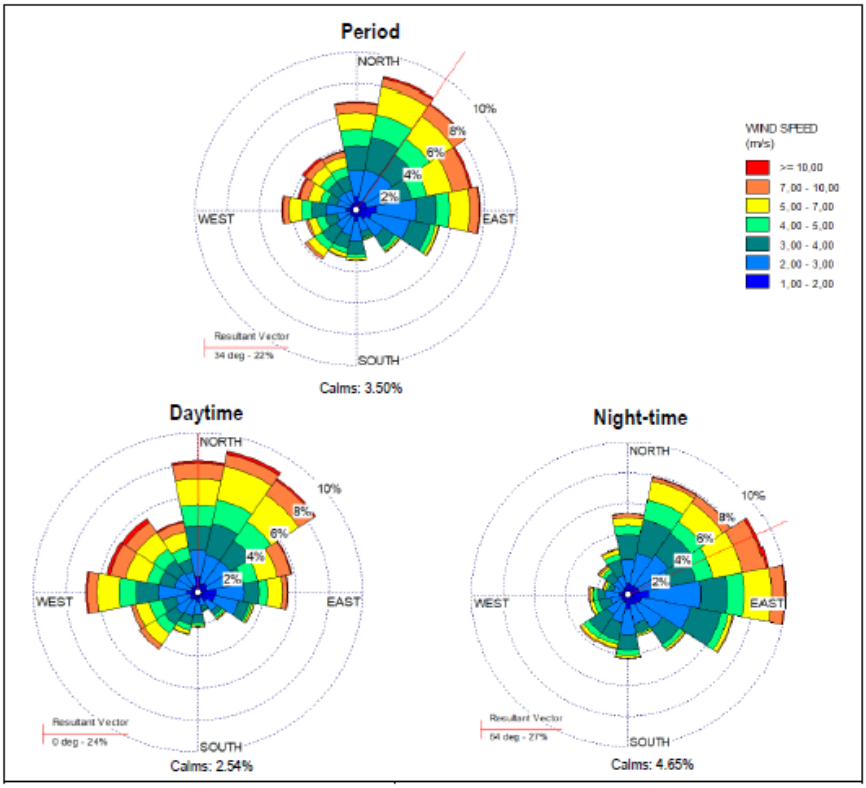


Figure 34: Period, day- and night-time wind roses (SAWS Welkom Data, 2019 to 2021).

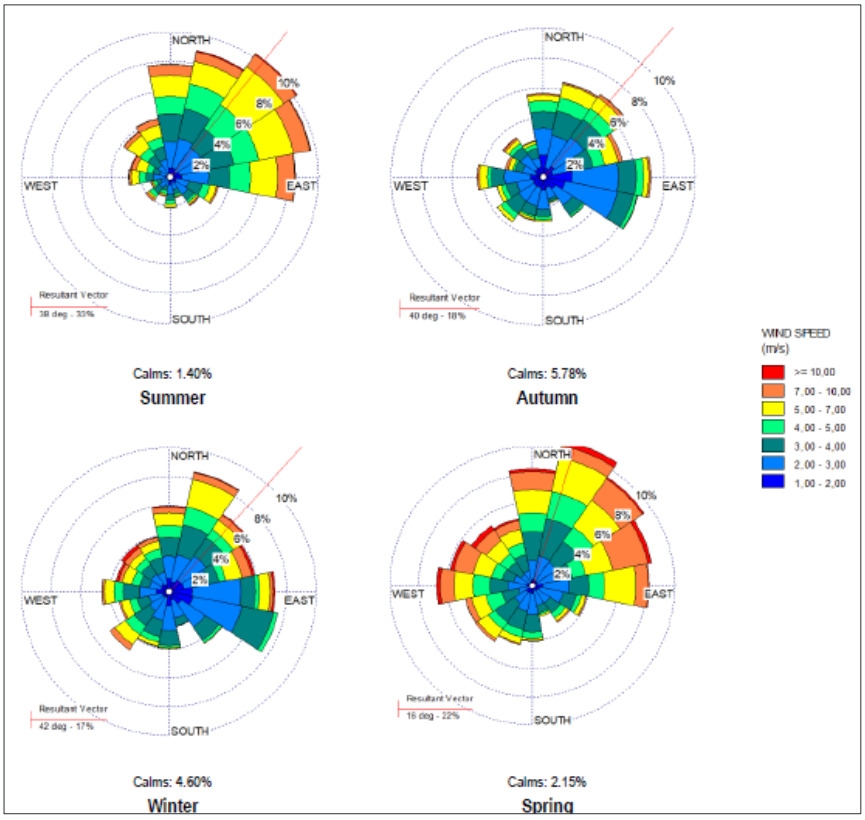


Figure 35: Seasonal wind roses (SAWS Welkom Data, 2019 to 2021)).

8.10 VISUAL RECEPTORS AND LANDSCAPE CHARACTER

A visual study was undertaken by Graham Young (refer to Appendix D) and the baseline information from that study is presented in this section. The site is located within an area that is predominantly surrounded by existing mining infrastructure and agricultural activities. There are no protected areas in the vicinity of the proposed site. The existing visual condition of the landscape that may be affected by the proposed Project has been described. Most of the study area's scenic quality has been rated moderate to low within the context of the sub-region, and sensitive viewing areas and landscape types identified and mapped indicating potential sensitivity to the project, specifically from farmsteads and people travelling along arterial roads west of the site. The site is in a landscape type rated as moderate to low.

The study area comprises a combination of landscape character types including open grassland (grazing) with some pans, agricultural lands, urbanisation and settlements, and mining and associated infrastructure. The characteristics of the study area can be divided into two distinct zones, the western section, natural/faming zone and the central/eastern section, dominated by mining and settlement landscape types. The proposed Nooitgedacht TSF is on open veld, adjacent to existing mining and agricultural land uses. The result is a landscape characterised by mixed aesthetic and visual qualities.

The original landscape, of which there remain remnants of it scattered throughout the western section was Western Free State Clay Grassland (Mucina and Rutherford 2006:384), scattered with Highveld Salt Pans (Mucina and Rutherford 2006:619). The salt pans manifest as depressions in the landscape containing temporary water bodies containing many species of important taxa. The slightly irregular undulating grasslands are dominated by *Themeda triandra* and other grasses that attribute to desired grazing lands. Dotted across the grasslands at the homesteads are usually tall stands of exotic trees.

Impacts on views are the highest when viewers are identified as being sensitive to change in the landscape, and their views are focused on and dominated by the change. The visual impact of the TSF itself will cause changes in the landscape that are noticeable to viewers experiencing the study area from the R710 and R34, and most importantly the farmsteads west of the development area. Visual impacts that would potentially result are likely to be adverse, long-term, and will cause a moderate loss to the baseline landscape and visual resources resulting in a worst case scenario of moderate severity negative impact. Effective mitigation is possible and could somewhat reduce the impact.

The visual receptors identified at desktop level within the project area of influence[4] are shown in Figure 36 which identifies receptor locations where people would most likely be susceptible to negative changes in the landscape caused by the physical presence of the Project. The main areas of concern might be:

- Farmsteads associated with rural development to the west, north west and south west of the Project site.
- Residential areas east of the development site (Rheederpark, Odendaalsrus, Flamingo Park, Seemeeu Park and Bedelia).
- Travellers along the R34, R30 and R710 arterial routes.

People living and passing through these locations will experience some negative change and loss of the baseline landscape aesthetic due to the scale and extent of the TSF. Also, due to the low Visual Absorption Capacity of the western section of the study area, sensitive views to the development would often be open and unobstructed (i.e. the TSF would dominate the view). These negative changes would occur over an extended time frame i.e. over the life of the mine and beyond as the TSF would remain as a residual structure in the landscape and represent the worst case scenario, which is assessed in this report.

[4] The extent of the study area is determined by the zone of potential influence, which in this study relates to a radius of 5,0km around the Project site. At 5,0km and beyond the development would recede into the background of views and or be screened by topography and vegetation.

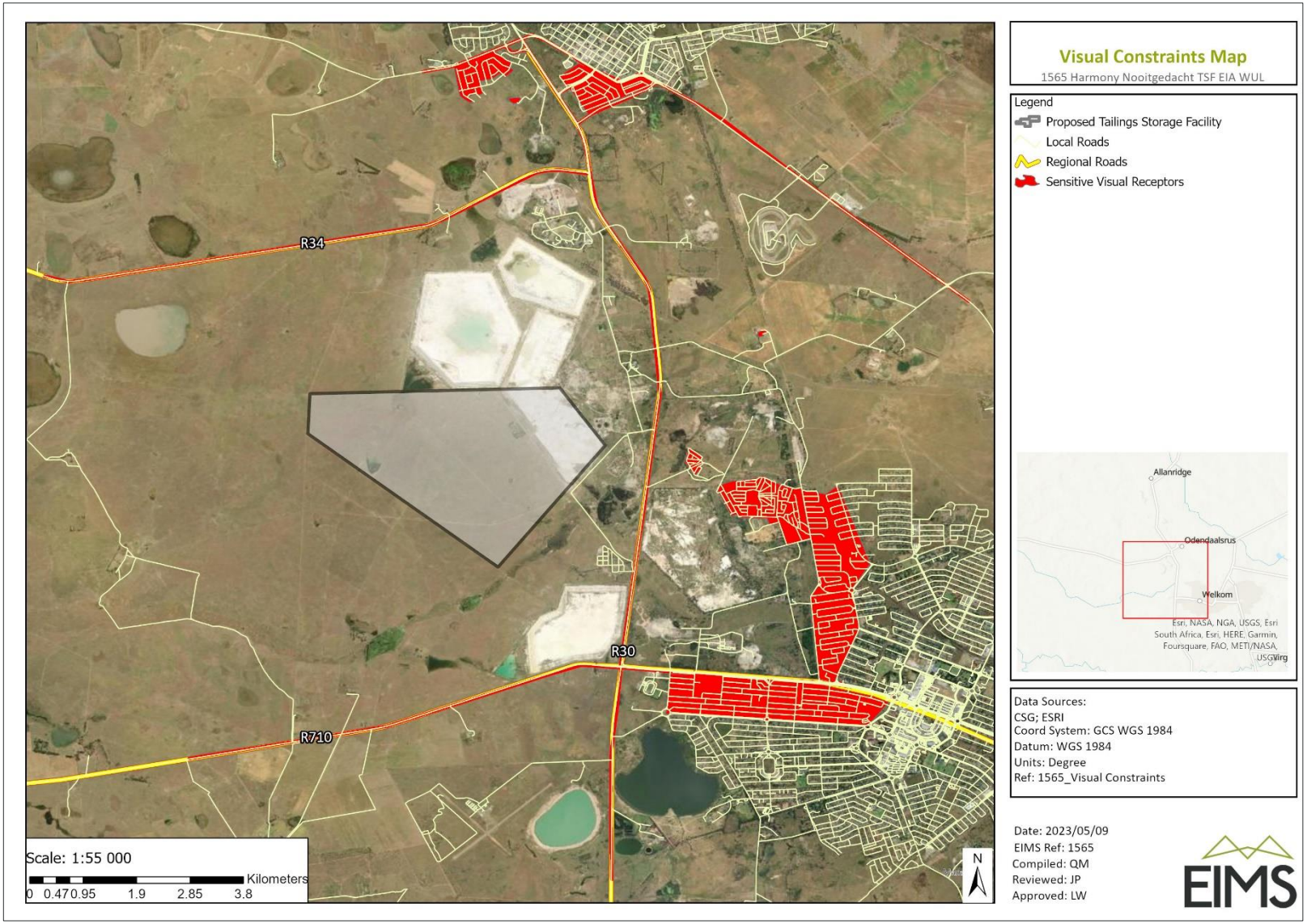


Figure 36: Visual sensitive receptor areas.

8.11 SOCIO-ECONOMIC

The Lejweleputswa District Municipality is situated in the north western part of the Free State and borders the North West Province to the north; the Fezile Dabi and Thabo Mofutsanyane District Municipalities to the north-east and east respectively; the Xhariep District Municipality and Mangaung Metropolitan Municipality to the south; and the Northern Cape Province to the west. The LDM is accessible from Johannesburg, Cape Town, Klerksdorp and Kimberley through one of South Africa's main national roads, the N1. The district covers an area of 32 286 km^2 and make up almost a third of the Free State province. It consists of the Masilonyana, Matjhabeng, Nala, Tokologo and Tswelopele Local Municipalities (www.lejweleputswa.co.za). The economy of the district relies heavily on the gold mining sector which is dominant in the Matjhabeng and Masilonyana Local Municipalities (Lejweleputswa DM IDP 2021/22). The mining sector is on a downward trend and many businesses that have traditionally depended on the mining sector have either closed down are in the process of closing down. The other municipalities are dominated by agriculture.

The main towns in the Matjhabeng Local Municipality (LM) are Welkom, Odendaalsrus, Virginia, Hennenman, Allanridge and Ventersburg (www.matjhabeng.fs.gov.za). The economy of the municipality is centred on mining activities in and around Welkom, Allanridge, Odendaalsrus and Virginia. Manufacturing aimed at the mining sector exists to a limited extent in the above towns, with other activities being limited. Other main economic sectors include manufacturing, tourism, agriculture, gold jewellery, transportation (logistics), and retail (Matjhabeng LM IDP 2022/2023).

The MLM economy is relatively diversified with three key production sectors, mining (37,9%), government (15,9%) and trade (14,7%). These sectors also support output in other industries including construction (2,4%), manufacturing (8%) and transportation (6,2%). Notably, despite the rural nature of the region the agriculture sector accounts for only 1,1% of output. The dominant sector in Lejweleputswa is the mining sector with a location quotient of 5.05 in 2014, which has declined slightly from 5.10 in 2005. By its nature mining is more export orientated and brings into the economy of the region more money than any other sector in the region. Agriculture follows the mining sector though very small as compared to the mining sector (Mathjabeng IDP 2022/2023)

The number of households in the study area has increased on all levels. The proportionate increase in households were greater than the increase in population on all levels and exceeded the growth in households of 12.3% on a national level. The average household size has shown a decrease on all levels, which means there are more households, but with less members.

Table 21: Population density and growth estimates (sources: Census 2011, Community Survey 2016)

Area	Size in km2	Population 2011	Population 2016	Population density 2011	Population density 2016	Growth in population (%)
Free State Province	129,825	2,745,590	2,834,714	21.15	21.83	3.25
Lejweleputswa DM	31,930	627,626	649,964	19.66	20.36	3.56
Matjhabeng LM	5,155	406,461	428,843	78.85	83.19	5.51

The intensity of poverty experienced refers to the average proportion of indicators in which poor households are deprived (Statistics South Africa, 2014). The intensity of poverty has increased slightly on all levels. The intensity of poverty and the poverty headcount is used to calculate the South African Multidimensional Poverty Index (SAMPI) score. A higher score indicates a very poor community that is deprived on many indicators. The SAMPI score in the Matjhabeng LM area has decreased, suggesting an improvement in some aspects relating to poverty in this area (Table 22).

Table 22: Poverty and SAMPI scores (sources: Census 2011 and Community Survey 2016).

Area	Poverty headcount 2011 (%)	Poverty intensity 2011 (%)	SAMPI 2011	Poverty headcount 2016 (%)	Poverty intensity 2016 (%)	SAMPI 2016
Free State Province	5.5	42.2	0.023	5.5	41.7	0.023
Lejweleputswa DM	5.6	42.8	0.024	4.8	42.2	0.020
Matjhabeng LM	5.5	43.0	0.024	4.3	41.8	0.018

Ward 35 has the highest proportion of people of economically active age (aged between 15 years and 65 years) that are employed. Since 2010 employment in the gold mining industry showed a steady decline from 157 019 in 2010 to 93 841 in 2022 (www.mineralscouncil.org.za). As such the proportion unemployed people in the area are likely to have increased since 2011. Ward 35 has the highest average household income, indicating more employed people than on local, district or provincial level (see Figure 37).

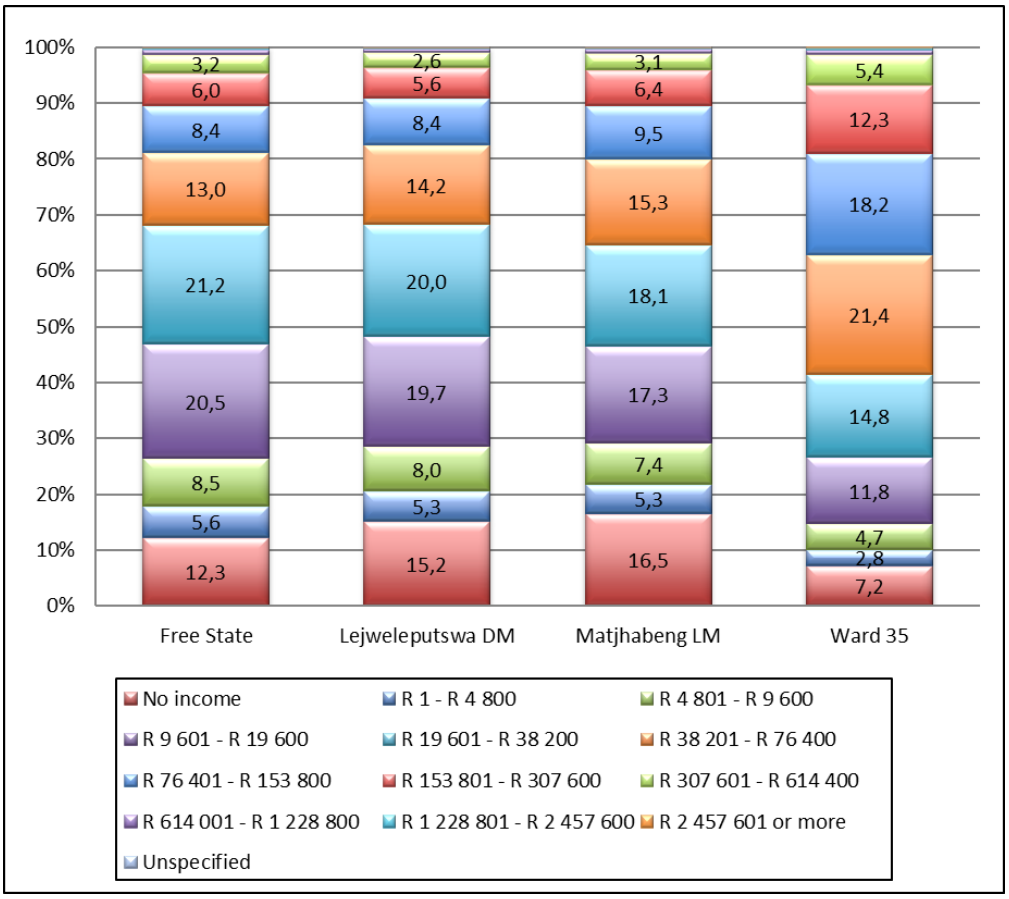


Figure 37: Annual household income (shown in percentage, source: Census 2011)

Ward 35 has the lowest incidence of households that access to water from a local or a regional water scheme, but the highest incidence of households that get their water from another source. Census 2011 does not specify

what the 'other' water sources include. Access to piped water, electricity and sanitation relate to the domain of Living Environment Deprivation as identified by Noble et al (2006). Just over three quarters of households in Ward 35 has access to piped water inside the dwelling. This is much higher than on local, district and provincial level. The majority of households in Ward 35 have access to any sanitation services, with the bulk of the households in the ward having access to flush toilets that are connected to a sewerage system.

8.12 LAND USE

The Nooitgedacht TSF is situated on open veld within a minging area, surrounded predominantly by mining activities and agricultural activities. Existing TSFs are located to the north and south of the proposed Nooitgedacht TSF, with part of the footprint of the Nooigedacht TSF extending on the existing FSN4 footprint in the easternmost section.

One of the Key Issues that have been identified for the MLM are the decline of the mining sector in recent years. Matjhabeng represents the hub of mining activity in the Free State province. Based on the concept plan and Vision for Matjhabeng LM, the overall development proposals for Matjhabeng LM is the growth and development of the municipality which was previously reliant on the Mining Sector, to now prioritise and focus its energy on the other growing sectors of manufacturing, retail, tourism and agriculture, however mining is still considered a key focus for LED in the IDP (Matjhabeng IDP 2022/2023).

Neighbouring land-use in the surrounding of the proposed project comprises agriculture activities as well as urban areas to the east of the proposed TSF site. Agriculture is a major land-use activity within and beyond the overall project boundary. These activities include crop farming such as maize, and livestock farming. This includes commercial and commonage cattle farming. The proposed pipelines and LP water storage system area located within, and for the most part, adjacent to existing Harmony mining operations and infrastructure.

Welkom is located 3km southeast and Odendaalsrus is located 5.2 km north of the proposed TSF site. There are a number of airfields and landing strips within the municipal area. The Welkom airport is located 5km south of the proposed TSF site. The Welkom/Thabong area includes Bronville and Riebeeckstad is the most populous area in Matjhabeng LM. The major road network routes entering Welkom include the R30 from Odendaalsrus entering Welkom Centre .

There are several neighbouring renewable energy applications approved for the area immediately northeast of the TSF. These include Harmony's own solar PV projects to the immediate north and the SunElex PV applications further to the north (Figure 38).

Town expansion for the Welkom area is proposed to take place north towards Odendaalsrus. Residential expansion is noted within the Lotgeval area north of Welkom. The changes with development relating to this region is the accessibility to bulk infrastructure. The draft 2022 SDF for Matjhabeng Municipality shows on the concept plan, that there is potential for future industrial development expansion directly to the south east of the site (Figure 39).

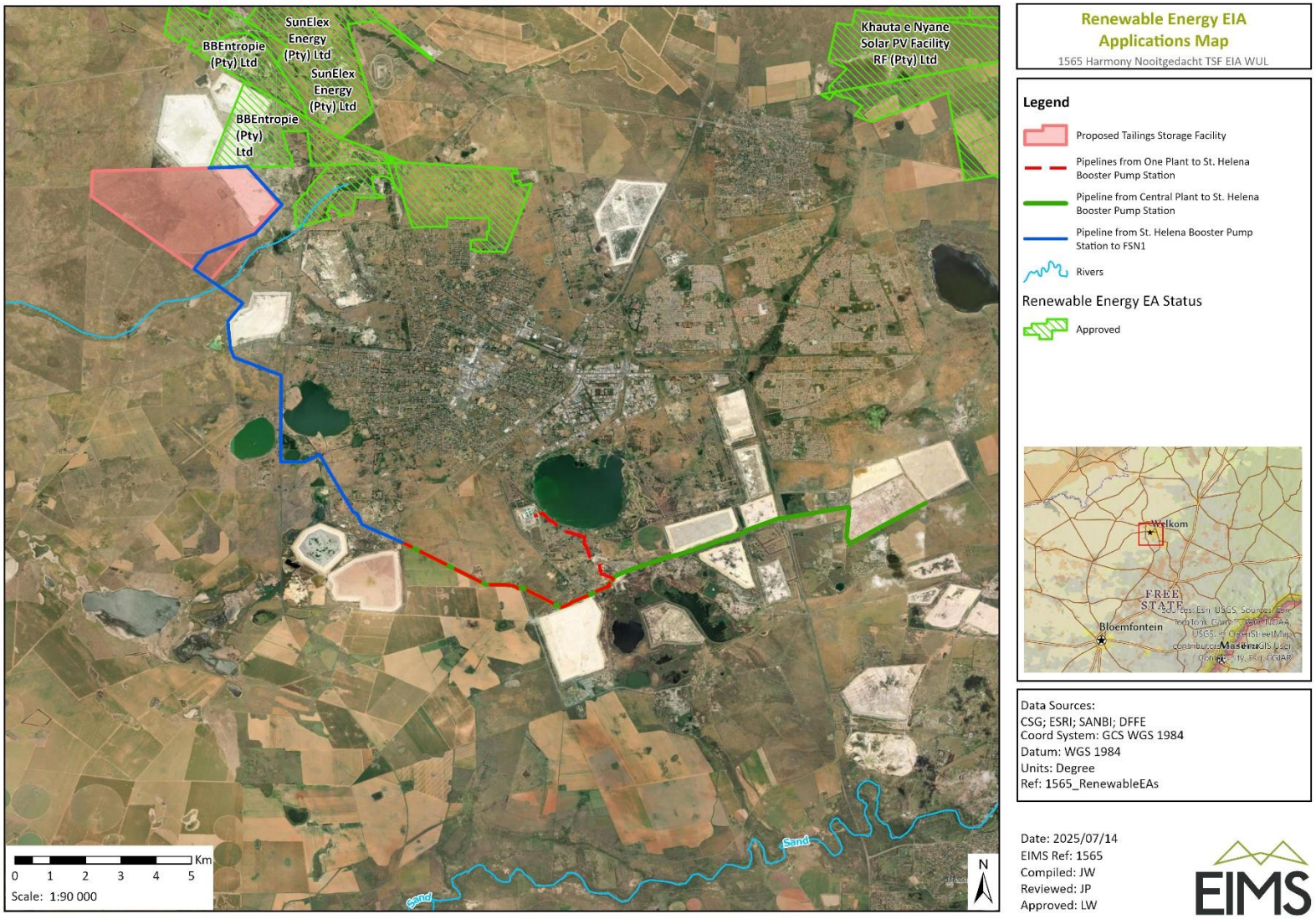


Figure 38: Map showing renewable energy facilities in proximity to the project

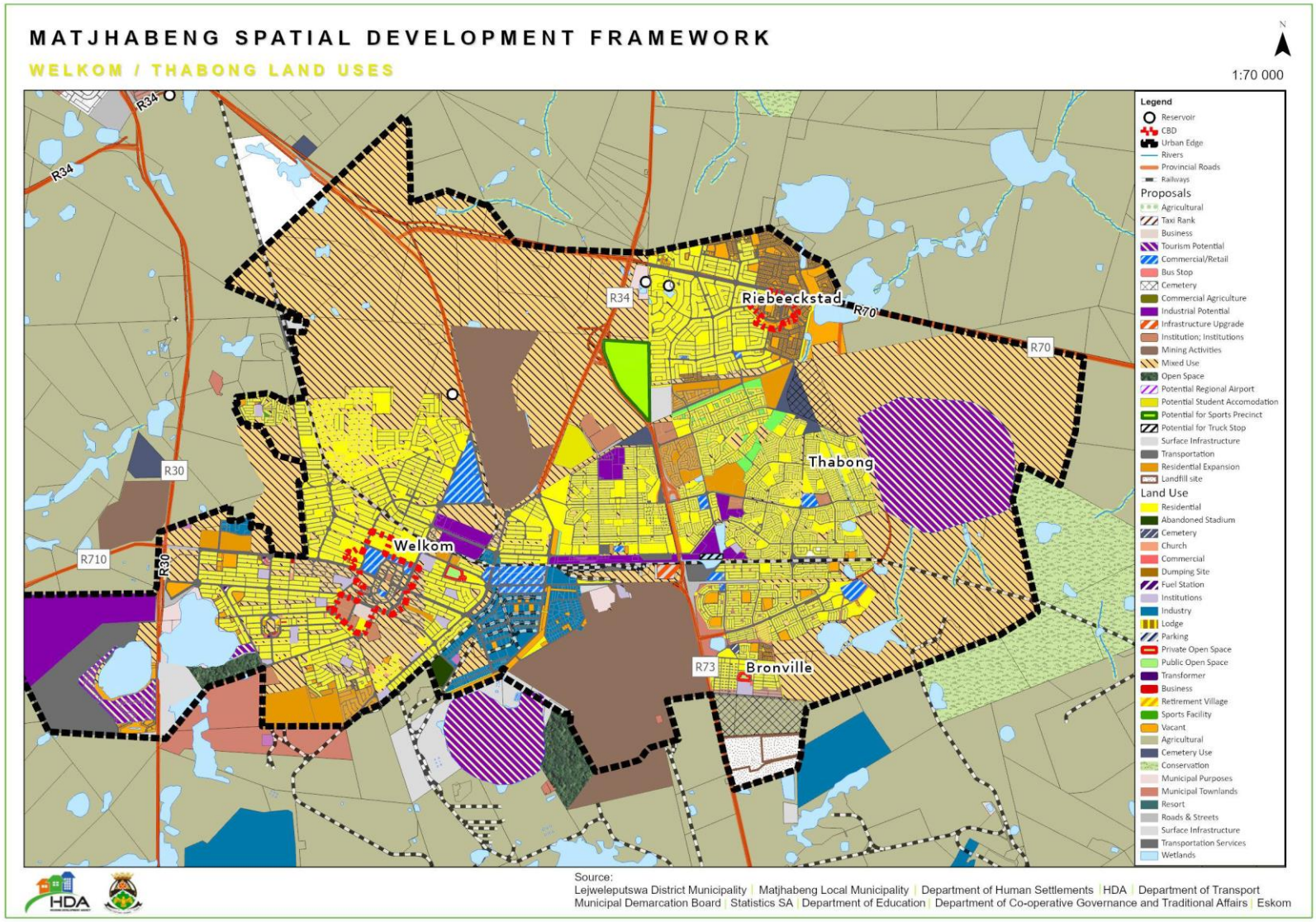


Figure 39: Matjhabeng SDF concept plan

9 ENVIRONMENTAL IMPACT ASSESSMENT

9.1 IMPACT ASSESSMENT METHODOLOGY

The impact significance rating methodology, as provided by EIMS, is guided by the requirements of the NEMA EIA Regulations 2014 (as amended). The broad approach to the significance rating methodology is to determine the environmental risk (ER) by considering the consequence (C) of each impact (comprising Nature, Extent, Duration, Magnitude, and Reversibility) and relate this to the probability/ likelihood (P) of the impact occurring. This determines the environmental risk. In addition, other factors, including cumulative impacts and potential for irreplaceable loss of resources, are used to determine a prioritisation factor (PF) which is applied to the ER to determine the overall significance (S). The impact assessment will be applied to all identified alternatives. Where possible, mitigation measures will be recommended for impacts identified.

9.1.1 DETERMINATION OF ENVIRONMENTAL RISK

The significance (S) of an impact is determined by applying a prioritisation factor (PF) to the environmental risk (ER). The environmental risk is dependent on the consequence (C) of the particular impact and the probability (P) of the impact occurring. Consequence is determined through the consideration of the Nature (N), Extent (E), Duration (D), Magnitude (M), and reversibility (R) applicable to the specific impact.

For the purpose of this methodology the consequence of the impact is represented by:

$$\boldsymbol{C = \frac{(E + D + M + R) * N}{4}}$$

Each individual aspect in the determination of the consequence is represented by a rating scale as defined in Table 23 below.

Table 23: Criteria for Determining Impact Consequence.

Aspect	Score	Definition
Nature	- 1	Likely to result in a negative/ detrimental impact
	+1	Likely to result in a positive/ beneficial impact
Extent	1	Activity (i.e. limited to the area applicable to the specific activity)
	2	Site (i.e. within the development property boundary),
	3	Local (i.e. the area within 5 km of the site),
	4	Regional (i.e. extends between 5 and 50 km from the site
	5	Provincial / National (i.e. extends beyond 50 km from the site)
Duration	1	Immediate (<1 year)
	2	Short term (1-5 years),
	3	Medium term (6-15 years),
	4	Long term (the impact will cease after the operational life span of the project),
	5	Permanent (no mitigation measure of natural process will reduce the impact after construction).
Magnitude/	1	Minor (where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected),

Aspect	Score	Definition
Intensity	2	Low (where the impact affects the environment in such a way that natural, cultural and social functions and processes are slightly affected),
	3	Moderate (where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way),
	4	High (where natural, cultural or social functions or processes are altered to the extent that it will temporarily cease), or
	5	Very high / don't know (where natural, cultural or social functions or processes are altered to the extent that it will permanently cease).
Reversibility	1	Impact is reversible without any time and cost.
	2	Impact is reversible without incurring significant time and cost.
	3	Impact is reversible only by incurring significant time and cost.
	4	Impact is reversible only by incurring prohibitively high time and cost.
	5	Irreversible Impact

Once the C has been determined the ER is determined in accordance with the standard risk assessment relationship by multiplying the C and the P. Probability is rated/ scored as per Table 24.

Table 24: Probability Scoring.

Probability	1	Improbable (the possibility of the impact materialising is very low as a result of design, historic experience, or implementation of adequate corrective actions; <25%),
	2	Low probability (there is a possibility that the impact will occur; >25% and <50%),
	3	Medium probability (the impact may occur; >50% and <75%),
	4	High probability (it is most likely that the impact will occur- > 75% probability), or
	5	Definite (the impact will occur),

The result is a qualitative representation of relative ER associated with the impact. ER is therefore calculated as follows:

ER= C x P

Table 25: Determination of Environmental Risk.

Consequence	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5
		1	2	3	4	5
		Probability				

The outcome of the environmental risk assessment will result in a range of scores, ranging from 1 through to 25. These ER scores are then grouped into respective classes as described in Table 26.

Table 26: Significance Classes.

Environmental Risk Score	
Value	Description
< 9	Low (i.e. where this impact is unlikely to be a significant environmental risk).
≥9 - <17	Medium (i.e. where the impact could have a significant environmental risk),
≥17	High (i.e. where the impact will have a significant environmental risk).

The impact ER will be determined for each impact without relevant management and mitigation measures (pre-mitigation), as well as post implementation of relevant management and mitigation measures (post-mitigation). This allows for a prediction in the degree to which the impact can be managed/mitigated.

9.1.2 IMPACT PRIORITISATION

Further to the assessment criteria presented in the section above, it is necessary to assess each potentially significant impact in terms of:

1. Cumulative impacts; and
2. The degree to which the impact may cause irreplaceable loss of resources.

To ensure that these factors are considered, an impact prioritisation factor (PF) will be applied to each impact ER (post-mitigation). This prioritisation factor does not aim to detract from the risk ratings but rather to focus the attention of the decision-making authority on the higher priority/significance issues and impacts. The PF will be applied to the ER score based on the assumption that relevant suggested management/mitigation impacts are implemented.

Table 27: Criteria for Determining Prioritisation.

Cumulative Impact (CI)	Low (1)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is unlikely that the impact will result in spatial and temporal cumulative change.
	Medium (2)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.
	High (3)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/ definite that the impact will result in spatial and temporal cumulative change.
Irreplaceable Loss of Resources (LR)	Low (1)	Where the impact is unlikely to result in irreplaceable loss of resources.
	Medium (2)	Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.
	High (3)	Where the impact may result in the irreplaceable loss of resources of high value (services and/or functions).

The value for the final impact priority is represented as a single consolidated priority, determined as the sum of each individual criteria represented in Table 27. The impact priority is therefore determined as follows:

Priority = CI + LR

The result is a priority score which ranges from 3 to 9 and a consequent PF ranging from 1 to 1.5 (Refer to Table 28).

Table 28: Determination of Prioritisation Factor.

Priority	Ranking	Prioritisation Factor
2	Low	**1**
3	Medium	**1.125**
4	Medium	**1.25**
5	Medium	**1.375**
6	High	**1.5**

In order to determine the final impact significance, the PF is multiplied by the ER of the post mitigation scoring. The ultimate aim of the PF is an attempt to increase the post mitigation environmental risk rating by a full ranking class, if all the priority attributes are high (i.e. if an impact comes out with a medium environmental risk after the conventional impact rating, but there is significant cumulative impact potential and significant potential for irreplaceable loss of resources, then the net result would be to upscale the impact to a high significance).

Table 29: Final Environmental Significance Rating.

Significance Rating	Description
<-17	High negative (i.e. where the impact must have an influence on the decision process to develop in the area).
≥-17, ≤-9	Medium negative (i.e. where the impact could influence the decision to develop in the area).
>-9, < 0	Low negative (i.e. where this impact would not have a direct influence on the decision to develop in the area).
0	No impact
>0, <9	Low positive (i.e. where this impact would not have a direct influence on the decision to develop in the area).
≥9, ≤17	Medium positive (i.e. where the impact could influence the decision to develop in the area).
>17	High positive (i.e. where the impact must have an influence on the decision process to develop in the area).

The significance ratings and additional considerations applied to each impact will be used to provide a quantitative comparative assessment of the alternatives being considered. In addition, professional expertise and opinion of the specialists and the environmental consultants will be applied to provide a qualitative comparison of the alternatives under consideration. This process will identify the best alternative for the proposed project.

9.2 IMPACTS IDENTIFIED

This Section presents the potential impacts that have been identified during the scoping phase assessment. It should be noted that this report will be made available to I&AP's for review and comment and their comments and concerns will be addressed in the final Scoping report submitted to the CA for adjudication. The results of

the public consultation will be used to update the identified potential impacts which will be further refined during the course of the EIA assessment and consultation process.

Potential environmental impacts were identified during the scoping process. These impacts were identified by the EAP, the appointed specialists, as well as the public. Table 30 provides the list of potential impacts identified.

Without proper mitigation measures and continual environmental management, most of the identified impacts may potentially become cumulative, affecting areas outside of their originally identified zone of impact. The potential cumulative impacts have been identified, evaluated, and mitigation measures suggested which will be updated during the detailed EIA level investigation.

When considering cumulative impacts, it is important to bear in mind the scale at which different impacts occur. There is potential for a cumulative effect at a broad scale, such as regional deterioration of air quality, as well as finer scale effects occurring in the area surrounding the activity. The main impacts which have a cumulative effect on a regional scale are related to the transportation vectors that they act upon. For example, air movement patterns result in localised air quality impacts having a cumulative effect on air quality in the region. Similarly, water acts as a vector for distribution of impacts such as contamination across a much wider area than the localised extent of the impacts source. At a finer scale, there are also impacts that have the potential to result in a cumulative effect, although due to the smaller scale at which these operate, the significance of the cumulative impact is lower in the broader context.

Table 30: Preliminary identified environmental impacts.

Main Activity / Action / Process	Ancillary Activity	Geo-physical (geology, topography, air, water)	Biological	Socio-economic	Heritage and cultural
Site preparation (Planning)	Vegetation clearance Planned placement of infrastructure Topsoil stripping		○ Temporary disturbance of wildlife		○ Disturbance/ destruction of archaeological sites or historic structures (if any)
Human resources management (Planning)	Employment/recruitment I&AP consultations Environmental awareness training HIV/AIDS Awareness programmes Integration with Municipalities' strategic long-term planning			○ Employment opportunities.	
Earthworks (Construction)	Stripping and stockpiling of soils (TSF) Levelling, grubbing and bulldozing (TSF) Removal of waste and cleared vegetation (TSF) Preparing trenches and foundations (TSF) Establishing storm water management measures (TSF) Establishment of firebreak (TSF)	○ Erosion due to storm water runoff ○ Impact due to topsoil stripping ○ Surface and ground water contamination ○ Loss of fertility ○ Loss of flow paths ○ Emissions and dust ○ Impacts on wetlands and watercourses ○ Climate change impacts ○ Air Quality impacts and dust generation	○ Loss/ destruction of natural habitat ○ Introduction/ Invasion by Alien Species ○ Displacement of faunal species	○ Visual impact and impact on sense of place ○ Nuisance and impact on sense of place (i.e. noise, dust, etc.). ○ Safety and security (i.e. access to properties, theft, fire hazards, etc.). ○ Impact on existing infrastructure (i.e. roads, fences, etc.) ○ Perceptions and expectations ○ Employment opportunities	Disturbance/ destruction of archaeological sites or historic structures ○ Disturbance/ destruction of fossils
Civil Works (Construction)	Establishment of infrastructure and services Mixing of concrete and concrete works Establishment of pipelines and water storage system Sewage and sanitation	○ Erosion due to storm water runoff ○ Impact due to topsoil stripping ○ Loss of fertility ○ Loss of flow paths	○ Loss/ destruction of natural habitat ○ Loss of SCC ○ Introduction/ Invasion by Alien Species	○ Visual impact and impact on sense of place ○ Nuisance and impact on sense of place (i.e. noise, dust, etc.).	○ Disturbance/ destruction of archaeological sites or historic structures ○ Disturbance/ destruction of fossils

Main Activity / Action / Process	Ancillary Activity	Geo-physical (geology, topography, air, water)	Biological	Socio-economic	Heritage and cultural
	Establishment of waste area Access control and security (TSF) General site management	○ Emissions and dust ○ Surface ground water contamination ○ Impacts on wetlands and watercourses ○ Climate change impacts	○ Displacement of faunal species	○ Safety and security (i.e. access to properties, theft, fire hazards, etc.). ○ Impact on existing infrastructure (i.e. roads, fences, etc.) ○ Perceptions and expectations ○ Employment opportunities	
Deposition at TSF (Operation)	Deposition of tailings (TSF) Maintenance and management of stormwater system (TSF) Water management (TSF)	○ Impacts on surface and/or groundwater quality due to leachate and potential spillages ○ Loss of fertility ○ Loss of flow paths ○ Emissions and dust ○ Climate change impacts ○ Air Quality impacts and dust generation ○ Decrease in runoff ○ Flood Risk		○ Visual impact and impact on sense of place ○ Nuisance and impact on sense of place (i.e. noise, dust, etc.). ○ Safety aspects related to radiation and health as well as stability.	
Closure and Rehabilitation of TSF (Decommissioning and Closure)	Revegetation (TSF) Slope stabilisation (TSF) Erosion control (TSF and pipelines)	○ Emissions and dust ○ Impacts on surface and/or groundwater ○ Radiation impacts	○ Alien and invasive species	○ Safety and security (i.e. access to properties, theft, fire hazards, etc.). ○ Perceptions and expectations ○ Visual and dust	
Maintenance (Post closure)	Initiate maintenance and aftercare program (TSF) Environmental aspect monitoring (TSF)	○ Emissions and dust ○ Erosion ○ Surface and groundwater quality ○ Radiation impacts	○ Alien and invasive species ○ Vegetation establishment	○ Visual ○ Site security and access control	

9.3 DESCRIPTION AND PRELIMINARY ASSESSMENT OF IMPACTS

The following potential impacts were identified during the scoping phase assessment and were assessed in terms of nature, significance, consequence, extent, duration and probability. These preliminary impact calculations will be subject to amendment based on the EIA phase assessment and the results of public consultation undertaken during the Scoping as well as EIA phases. The preliminary scoping level impact assessment matrix (including pre- and post-mitigation assessment) is included in Appendix E. Preliminary mitigation / management measures to minimise potential negative impacts or enhance potential benefits are put forward in this Scoping Report and will be adjusted where relevant during the EIA phase. Relevant specialist reports that have been completed to date are provided in Appendix D, however it should be noted that several of these studies still need to be updated to include a more detailed assessment of the new low pressure water system. These updated studies will be provided in the EIA report. In addition, the climate change study and traffic impact assessments have not been completed at the time of preparing this scoping report and will also be provided in the EIA.

9.3.1 GROUNDWATER (GEOHYDROLOGY) IMPACTS

The proposed Nooitgedacht TSF will be built adjacent to an existing tailings facility. There is already an impact from the existing facility, which will continue if left unrehabilitated. The current impacts from the existing TSF was used as the base case and future impacts over 50-and 100-year periods were simulated as the "do-nothing" scenario. The date of construction of these facilities is unclear but it was assumed that the dams were established during the 1970's. The impact from the existing dams were therefore modelled, based on this assumption. The current impact is mainly towards the southwest and the Mahemspruit. The impact from the existing facilities were therefore modelled, based on this assumption, and the current modelled impact from these dams are shown in Figure 40.

Assuming that the existing facility is 50 years old, the average plume migration can be estimated based on Darcy's law. Contaminants are transported in groundwater by advection, that is, the movement of a solute at the speed of the average linear velocity of groundwater (Anderson, et. al., 1992).

The hydraulic conductivity for the weathered aquifer is estimated as 0.289 m/day. The groundwater gradient averages 0.6% in the study area. The porosity of the aquifer material is estimated to be between 3 - 7% (AquiSim Consulting, 2012). Applying the above formula to the study area assuming a porosity of 5% it is calculated that the groundwater velocity averages a rate of 0.035 m/day or 12.66 m per annum. Over the 50-year period the plume migration is estimated at 633m, which is supported by the numerical modelling. The potential of impacted seepage from surface infrastructure (tailings dam) affecting downgradient receptors was evaluated. The first part of the assessment looks at the potential future impact from the proposed Valley TSF[5] only and the second part of the assessment looks at the cumulative impact from the existing infrastructure and the proposed infrastructure.

The numerical model was used to simulate the following scenarios:

- Contaminant seepage from the Tailings Dam without any liner for periods 10-, 50- and 100-years; and
- Contaminant seepage from the Tailings Dam with an engineered liner for periods 50- and 100-years.

[5] Please note that a separate EA and WML application is being conducted for the adjacent proposed Valley TSF to the immediate north of the area proposed for the Nooitgedacht TSF by the same applicant. That project is the subject of a separate application and public consultation process and should not be confused with this Nooitgedacht TSF application.

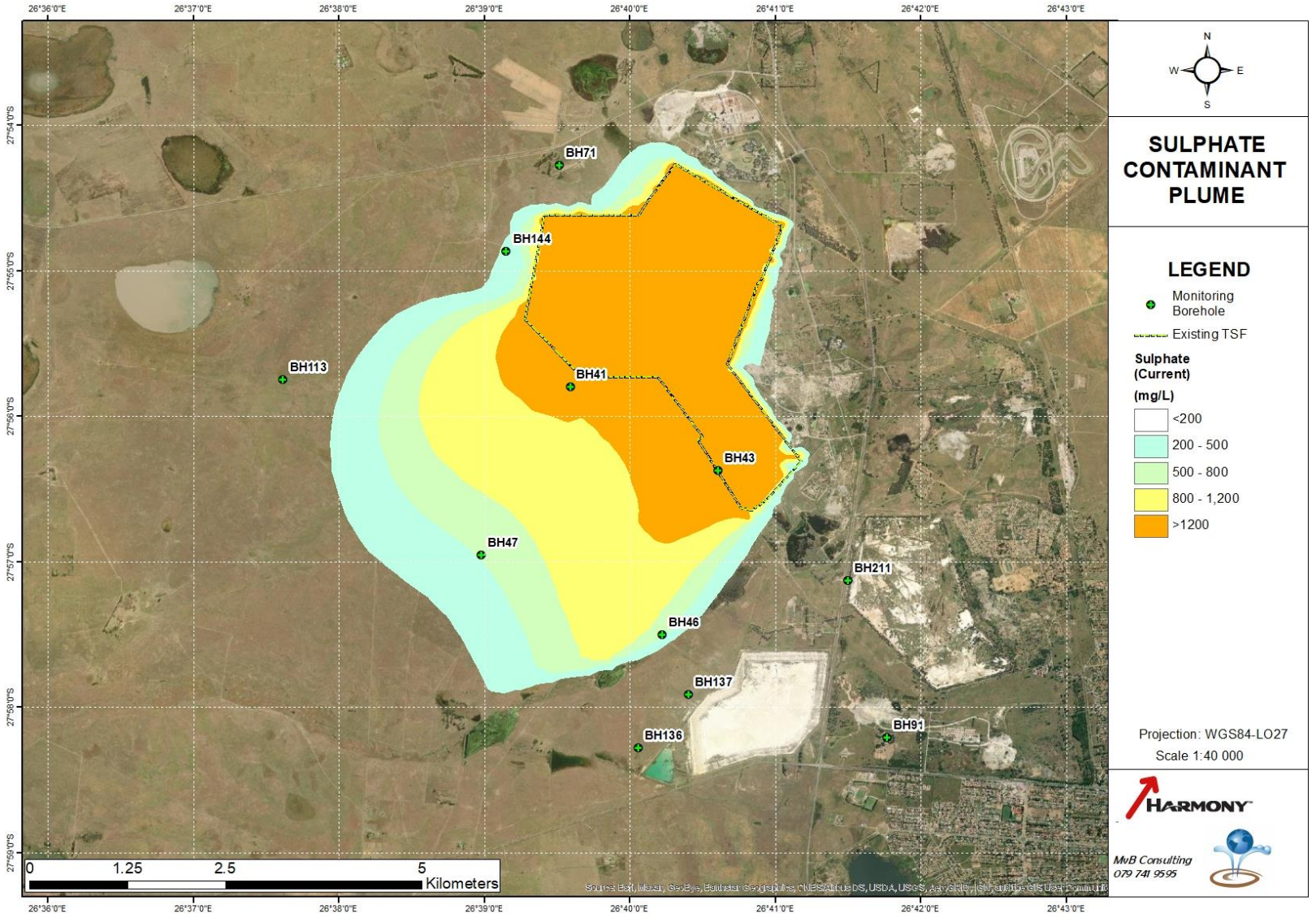


Figure 40: Simulated current sulphate plume from existing tailings facilities

The Nooitgedacht Tailings Dam was modelled as a constant source (worst-case scenario) as it is assumed that the facility will continue to release impacted seepage to the environment. The impacts after 10 years, 50 years and 100 years were simulated and the results presented in Figure 41 to Figure 43.

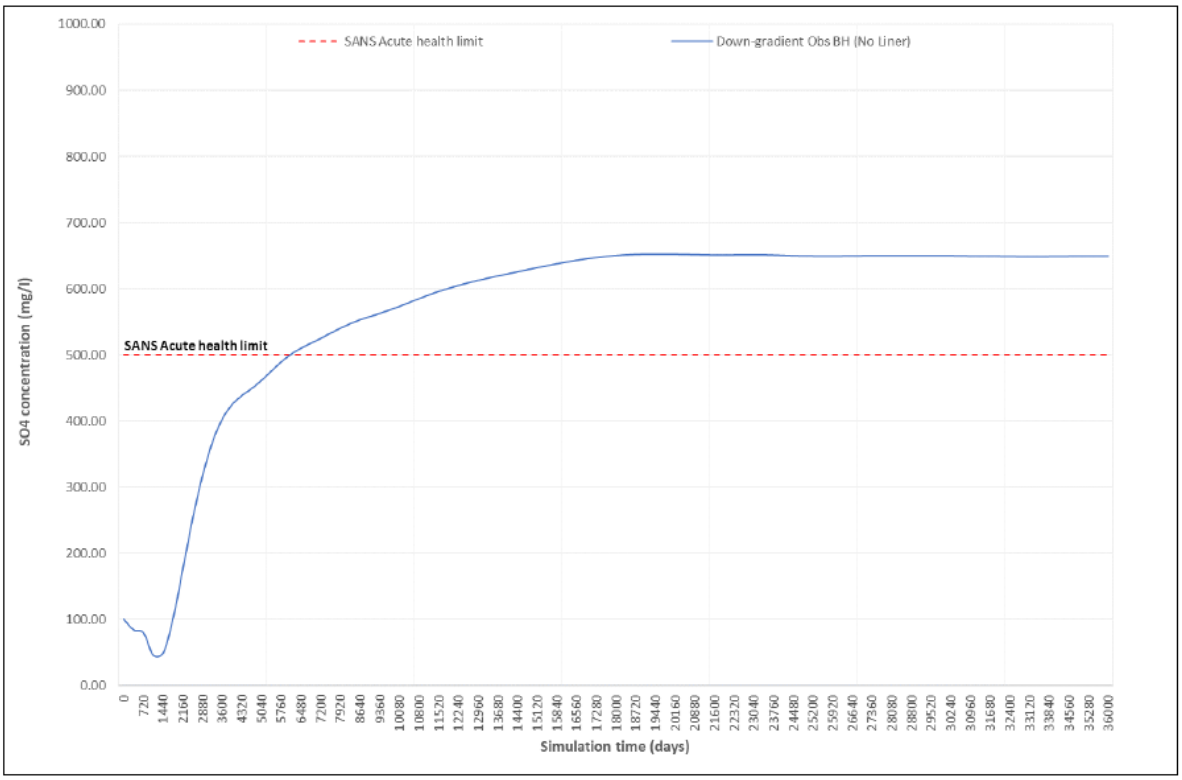


Figure 41: Simulated sulphate concentration in an observation borehole over time.

Jones & Wagener classified the tailings material that will be deposited on Nooitgedacht as a Type 3 waste that requires a Class C barrier system. The expected seepage rate through such a liner system may be in the order of 140 litres / hectare / day. These leakage rates were included in the model and the impact simulated. The result from the 100-year simulation is presented in Figure 45 and shows that any contamination from the site will be contained. The small volume of seepage that may flow through the liner system is diluted to the extent that contamination is not detected.

The following four scenarios were modelled:

- The impacts from the existing tailings facility as well as the proposed Nooitgedacht TSF, after 50 years.
- The impacts from the existing tailings facility as well as the proposed Nooitgedacht TSF, after 100 years.
- The impacts from the existing tailings facility as well as the proposed Valley and Nooitgedacht TSF's, after 50 years.
- The impacts from the existing tailings facility as well as the proposed Valley and Nooitgedacht TSF's, after 100 years.

The results from the above simulations are shown in Figure 44 to Figure 47.

A comparison of the various impacts is summarised in Table 31. The comparison is made based on the extent of the 1000 mg/L SO4 plume, which is the livestock watering guideline. It is evident from this assessment that the area is already impacted by the historical activities. Plume migration is, however, slow and although the simulated plume has reached the Mahemspruit, the concentrations are <1000 mg/L. The Mahemspruit is, however, impacted not only by this tailings facility, but also by other contaminant sources in the region.

The expected contribution of the impact from the proposed adjacent Valley TSF is low and contained within the current impacted footprint. The cumulative impact of the current and proposed tailings facilities (both Valley and Nooitgedacht) will continue to impact on the Mahemspruit, but the simulated concentrations remain <500 mg/L. It is important to note that the impact simulations assume a constant source, without any remediation. In other words, a worst-case scenario. The reality is that the source will become depleted over time and the source concentration will improve. This, together with a rehabilitation plan will greatly improve the situation and lessen the impact.

Table 31: Comparison of the potential impacts from the various scenarios

Impact Assessment	**Impacted Area (Ha)**	**Area Increase (Compared to the "do-nothing" scenario) (Ha)**
Do nothing Scenario		
Current Impact (1 000 mg/L)	1 299	
Impact in 50 Years (1 000 mg/L)	1 392	
Impact in 100 Years (1 000 mg/L)	1 398	
Impact from Nooitgedacht TSF only		
Impact from Nooitgedacht only in 50 Years (1 000 mg/L)	1 066	321
Impact from Nooitgedacht only in 1000 Years (1 000 mg/L)	1 121	373
Impact from Existing and Nooitgedacht TSF		
Impact from existing TSF and Nooitgedacht TSF in 50 years (1 000 mg/L)	2 323	953
Impact from existing TSF and Nooitgedacht TSF in 100 years (1 000 mg/L)	2 454	1 084

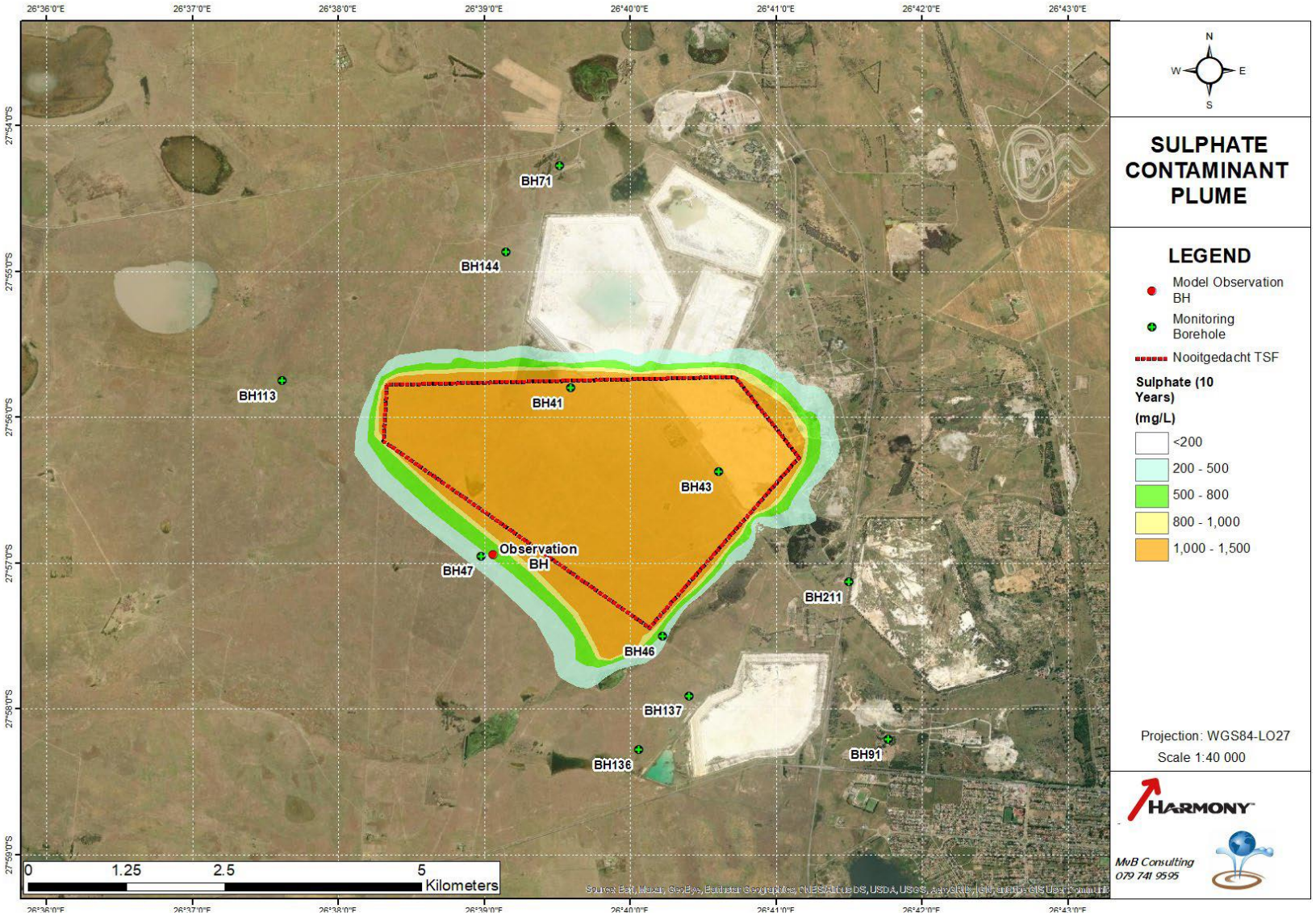


Figure 42: Simulated sulphate plume after 10 years without a liner

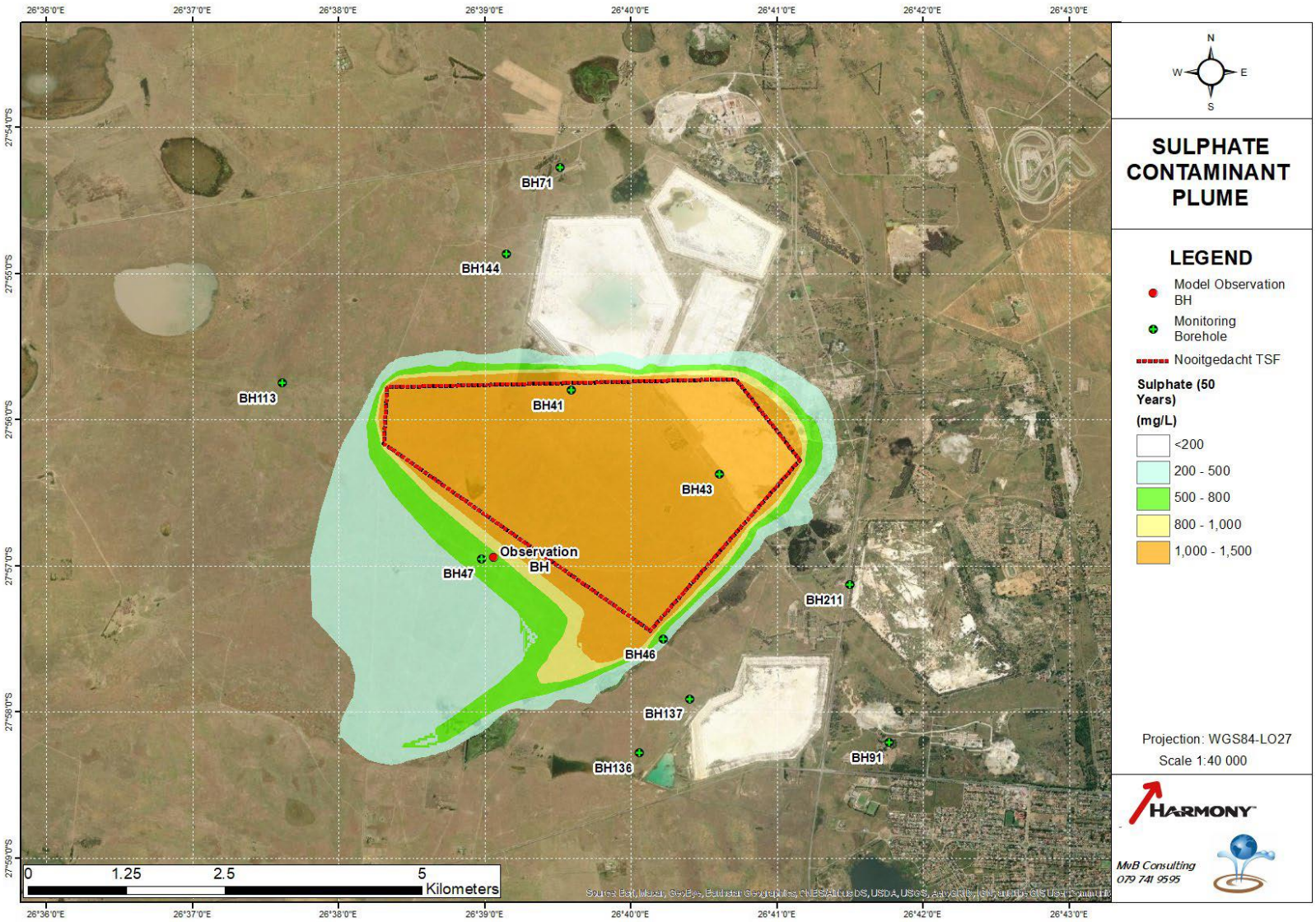


Figure 43: Simulated sulphate plume after 50 years without a liner

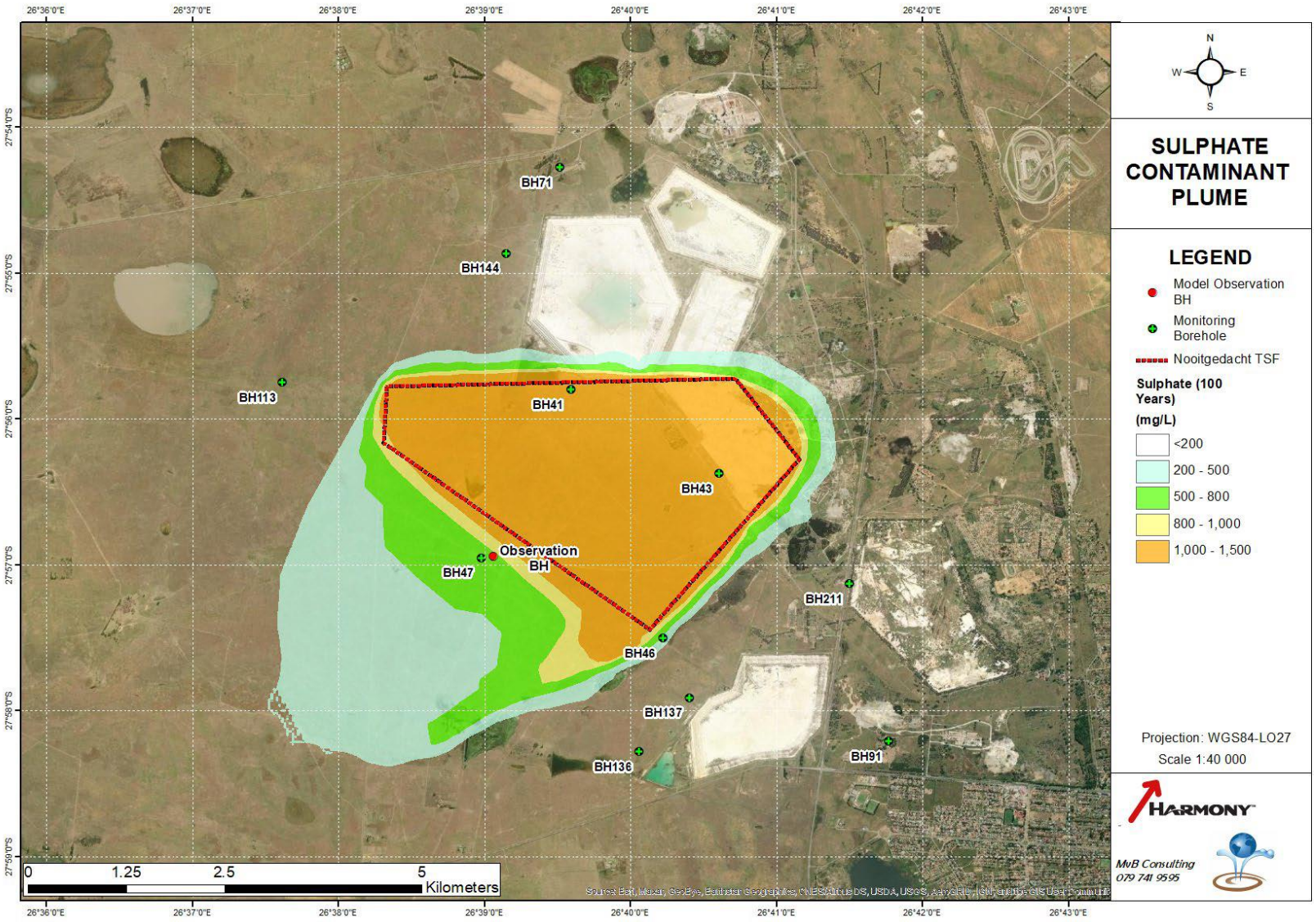


Figure 44: Simulated sulphate plume after 100 years without a liner

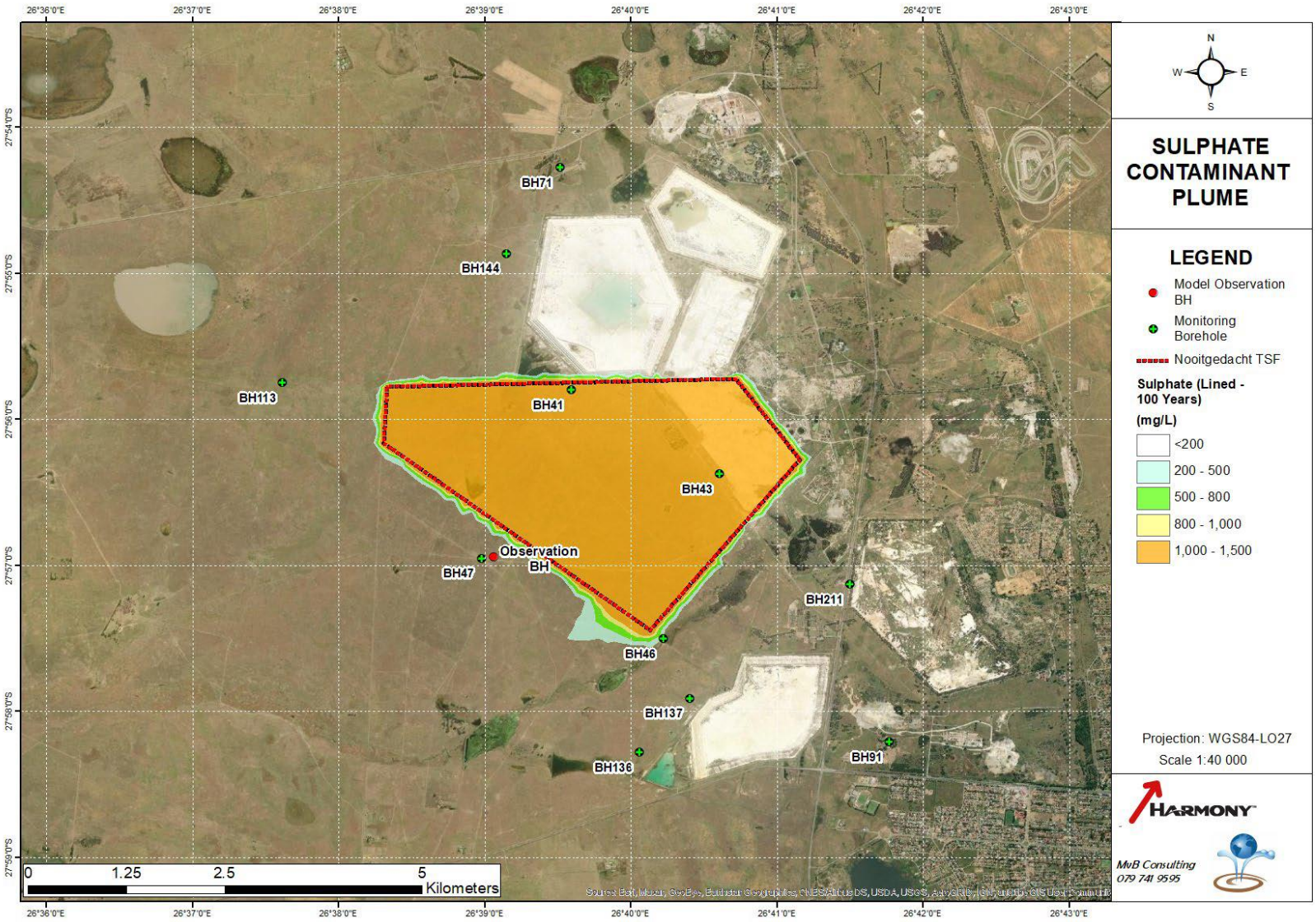


Figure 45: Simulated sulphate plume after 100 years with a liner

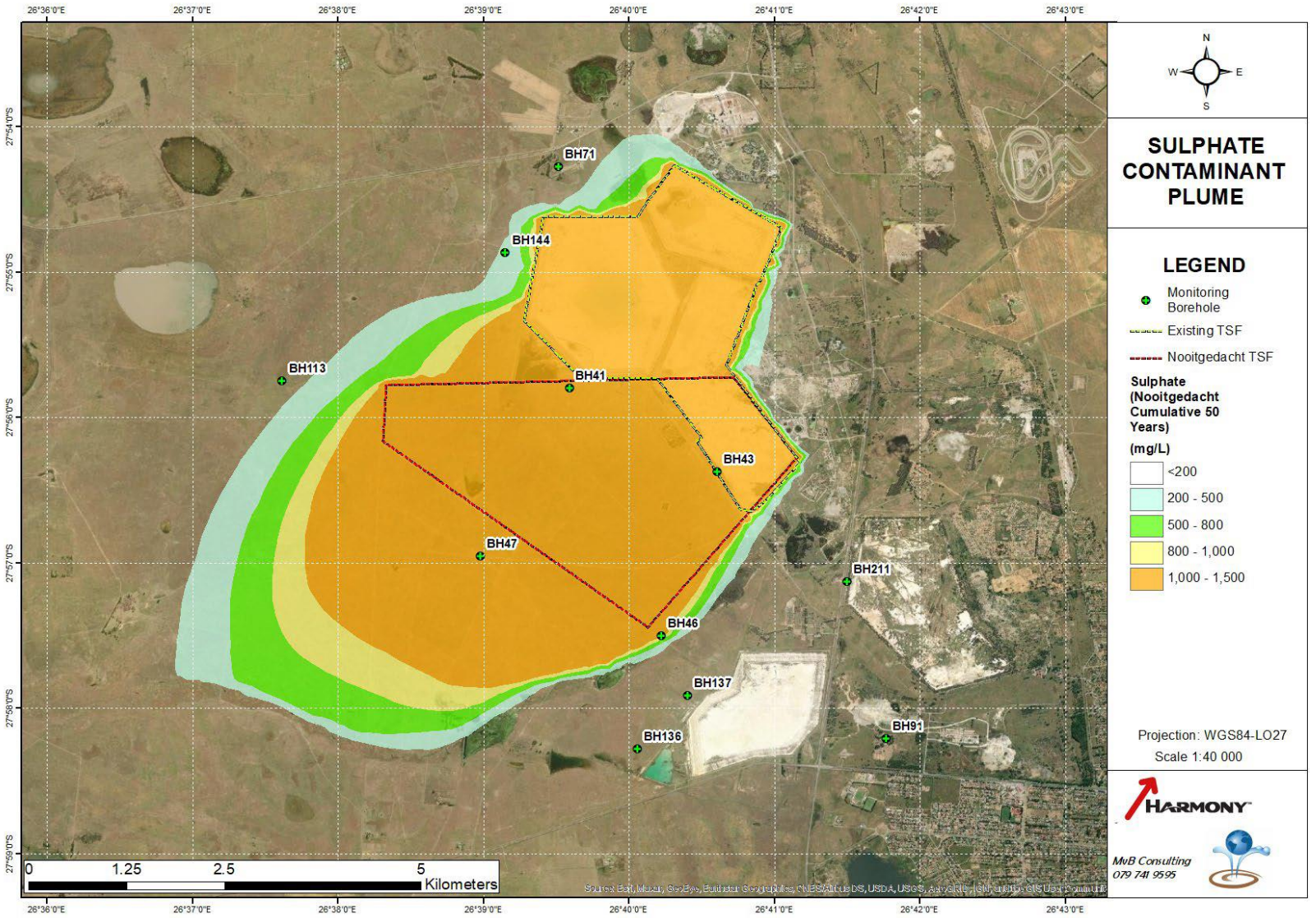


Figure 46: Cumulative impact from the existing and Nooitgedacht TSF after 50 years

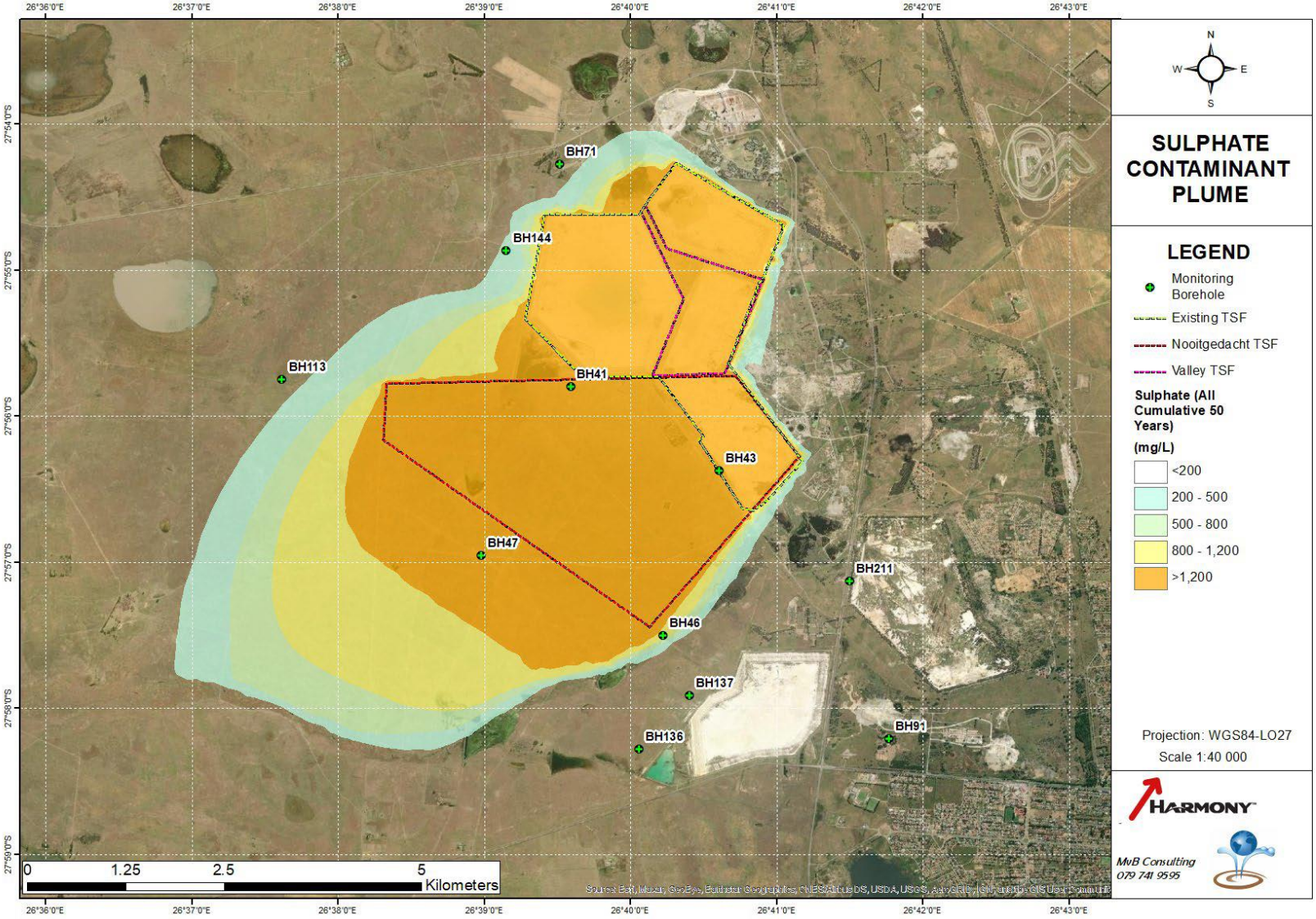


Figure 47: Cumulative impact from the existing TSFs, Proposed Valley TSF and Proposed Nooitgedacht TSF's after 100 years

9.3.1.1 GROUNDWATER MITIGATION MEASURES

A long-term monitoring programme should be developed based on the guideline documented in Best Practice Guideline G3 Water Monitoring Systems (2007) available from the DWS. These guidelines are summarised and implemented in the proposed monitoring plan.

Monitoring within a project area consists of various components as illustrated by the overall monitoring process. It should be recognised and understood that the successful development and implementation of an appropriate, accurate and reliable monitoring programme requires that a defined structured procedure be followed. A monitoring programme should include the location of all monitoring points (indicated on a map), the type of data to be collected, as well as the data collection (protocol / procedure / methodology, frequency of monitoring and parameters determined, quality control and assurance), management (database and assessment) and reporting procedures. This programme should then be implemented. The results from the monitoring programme should be representative of the actual situation. To ensure that the monitoring programme functions properly, an operating and maintenance programme should be developed and implemented. A data management system is necessary to ensure that data is stored / used optimally and is accessible to all the relevant users. The monitoring programme should include quality control measures. It is important to note that this programme is dynamic and should change as the mine and water management needs change.

Effective groundwater monitoring systems consist of the following components:

- Groundwater quality monitoring system.
- Groundwater flow monitoring system.
- Data and information management system.

When designing the monitoring system, the following issues should also be taken into consideration:

- Potential or actual water use.
- Aquifer or catchment vulnerability.
- Toxicity of chemicals.
- Potential for seepage or releases.
- Quantities and frequency of release to the environment (point and non-point).
- Management measures in place to minimise risk.

Groundwater sampling should be done in accordance with industry standards. The sampling procedures are discussed in detail in:

- Weaver, J.M.C. 1992a. Groundwater sampling: A comprehensive guide for sampling methods (WRC Report No. TT 54/92). Pretoria: Water Research Commission.
- Weaver, J.M.C. 1992b. Groundwater sampling: An abbreviated field guide for sampling methods (WRC Report No. TT 56/92). Pretoria: Water Research Commission.

These sampling procedures should be adhered to.

In terms of the groundwater monitoring network, three additional borehole pairs (one shallow and one deep) are recommended as shown in Figure 48.

The following is recommended in terms of monitoring:

- Groundwater levels.
- Groundwater quality.
- Data should be stored electronically in an acceptable database.

- On the completion of every sampling run a monitoring report should be written. Any changes in the groundwater levels and quality should be flagged and explained in the report.
- A compliance report can be submitted to DWS once a year, if required.

In terms of monitoring frequency, the following is recommended:

- A comprehensive quarterly analysis of the dedicated monitoring boreholes.
- Groundwater levels should be monitored monthly in the dedicated groundwater monitoring boreholes.
- Rainfall should be monitored daily.

Samples should be submitted to a SANAS accredited laboratory. The following recommended parameters to be analysed for include: pH, Electrical Conductivity, Total Dissolved Solids, Total Alkalinity. Anions and Cations (Ca, Mg, Na, K, NO3, NH4, Cl, SO4, F, Fe, Mn, Al, Cr).

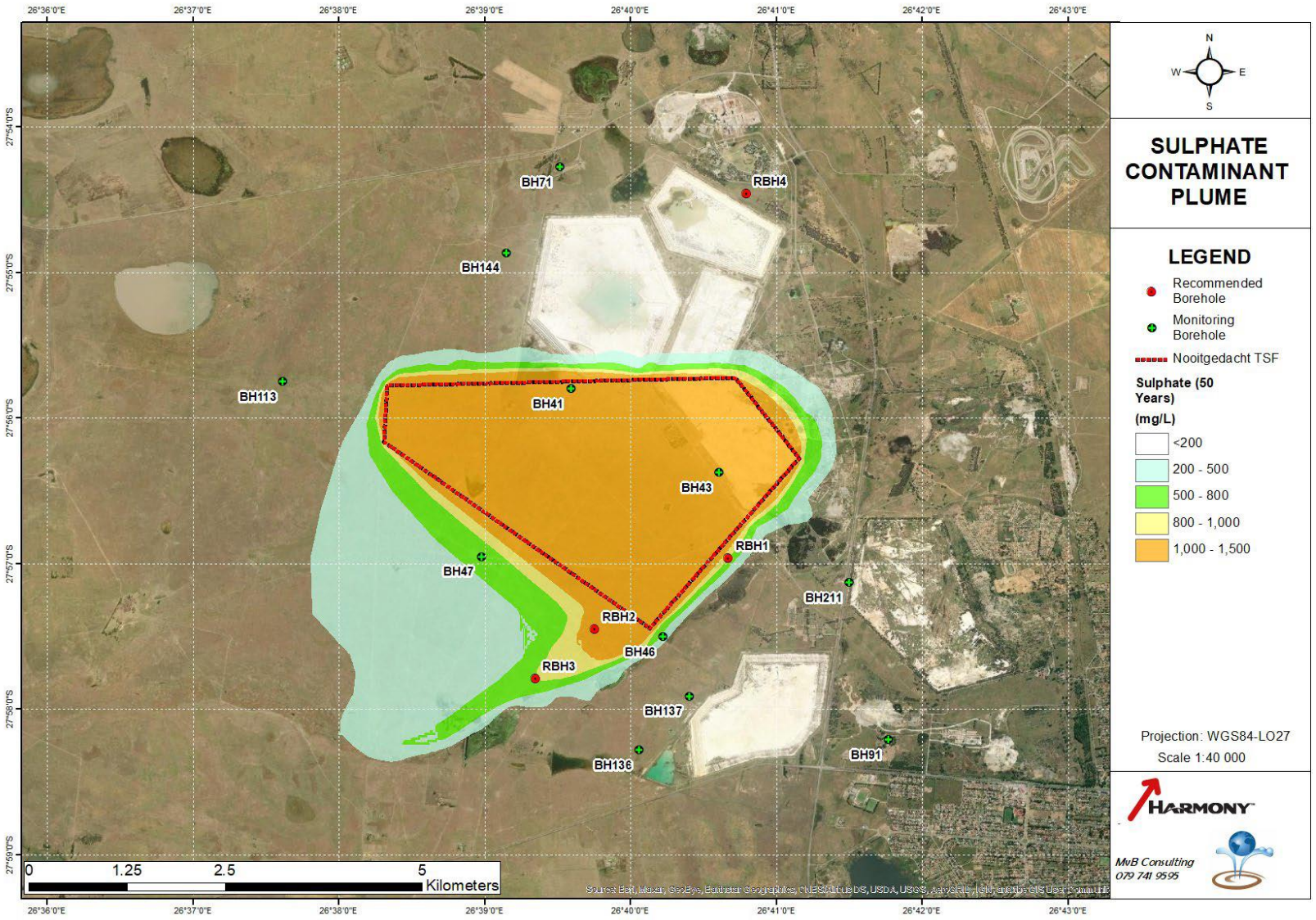


Figure 48: Recommended groundwater monitoring network

9.3.2 VISUAL IMPACTS

Impacts on views are the highest when receptors are identified as being sensitive to change in the landscape, and their views are focused on and dominated by the changes to the landscape. The results of the public participation process where not know at the time of writing this report and generic sensitivities were ascribed to indicate that visual issues are potentially a concern to some of the I&APs, particularly those living in residential areas east of the TSF site.

The cause of these anticipated visual impacts would be:

Establishment Phase:

- Removal of vegetation, the building of access roads, earthworks, and exposure of earth to establish the areas to be developed for the TSF;
- The physical presence of TSF dam walls beginning to rise above the existing TSF on which it will be built; and
- The generation of dust by establishment activities.

Operational Phase

- Dust generation;
- The physical presence of the TSF; and
- The potential light pollution along the boundary fence of the property and the cause of a spotlight effect.

Refer to the VIA included in Appendix D for simulation views of the TSF from various viewing points indicative of typical views towards the proposed TSF.

9.3.2.1 **CONSTRUCTION PHASE VISUAL IMPACTS**

Establishment activities include the earthworks required to create access routes to establish equipment on the existing TSF. Dust would be generated during this phase. Establishment activities would have a negligible effect on the landscape's visual quality and sense of place relative to its baseline as the activities would not contrast with the patterns that define the visual structure of the landscape. And the change would be restricted to a localized area.

The impact on the visual environment during the establishment phase is assessed to have a low magnitude (i.e. where the impact affects the environment in such a way that natural, cultural and social functions and processes are slightly affected) and would occur over the short term (1-5 years). The unmitigated impact would be localized but would extend beyond the project site to adjacent areas, and the significance of impact is predicted to be low (i.e. impact would not have a direct influence on the decision to develop in the area if it is mitigated).

9.3.2.2 **OPERATIONAL PHASE VISUAL IMPACTS**

Operational activities material being deposited from Harmony's plants at the TSF and security lights. The impact on the visual environment during the operational phase is assessed to have a moderate magnitude (i.e. where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way) and would occur over the long term (37 years). The unmitigated impact would be regional and would extend beyond the site to adjacent areas (beyond 5 km from the TSF). The significance of impact is predicted to be moderate (i.e. the impact could have a direct influence on the decision to develop the area).

Visual intrusion deals with contextualism, i.e. how well does a Project activity fit with or disrupt/ enhance the ecological and cultural aesthetic of the landscape as a whole? The simulations in the VIA (Appendix D) illustrate the effect that Project activities will have on views experienced from various viewing points indicative of typical views towards the proposed mine. When visible the TSF would appear in the middle-ground (up to 3,0km from the viewer) of views from west and east, ,primarily from the R34 (north west), the R30 (east) and the R710 (south west). The most exposed views of the facility are from the R30. Distance tends to reduce the intrusive nature of

the TSF when viewed from the R34 and the R710, which at its closest to the receptor, is 2.5km away. The facility would always be viewed within a scene that includes existing mining infrastructure and therefore, do not appear out of place, and therefore its potential for visual intrusion is reduced.

9.3.2.3 POST-CLOSURE AND REHABILITATION PHASE VISUAL IMPACTS

Rehabilitation activities at the TSF side slopes and surface area, until the areas are self-sustaining. The impact on the visual environment during the post-closure and rehabilitation phase is assessed to have a minor magnitude (Where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected (no associated consequences)) and would occur over the short term. The unmitigated impact would be localized but would extend beyond the Harmony Minig Right area to adjacent areas. The significance of impact is predicted to be low (Impact or benefit that requires management but that would not have a direct influence on the decision to develop in the area if it is mitigated.

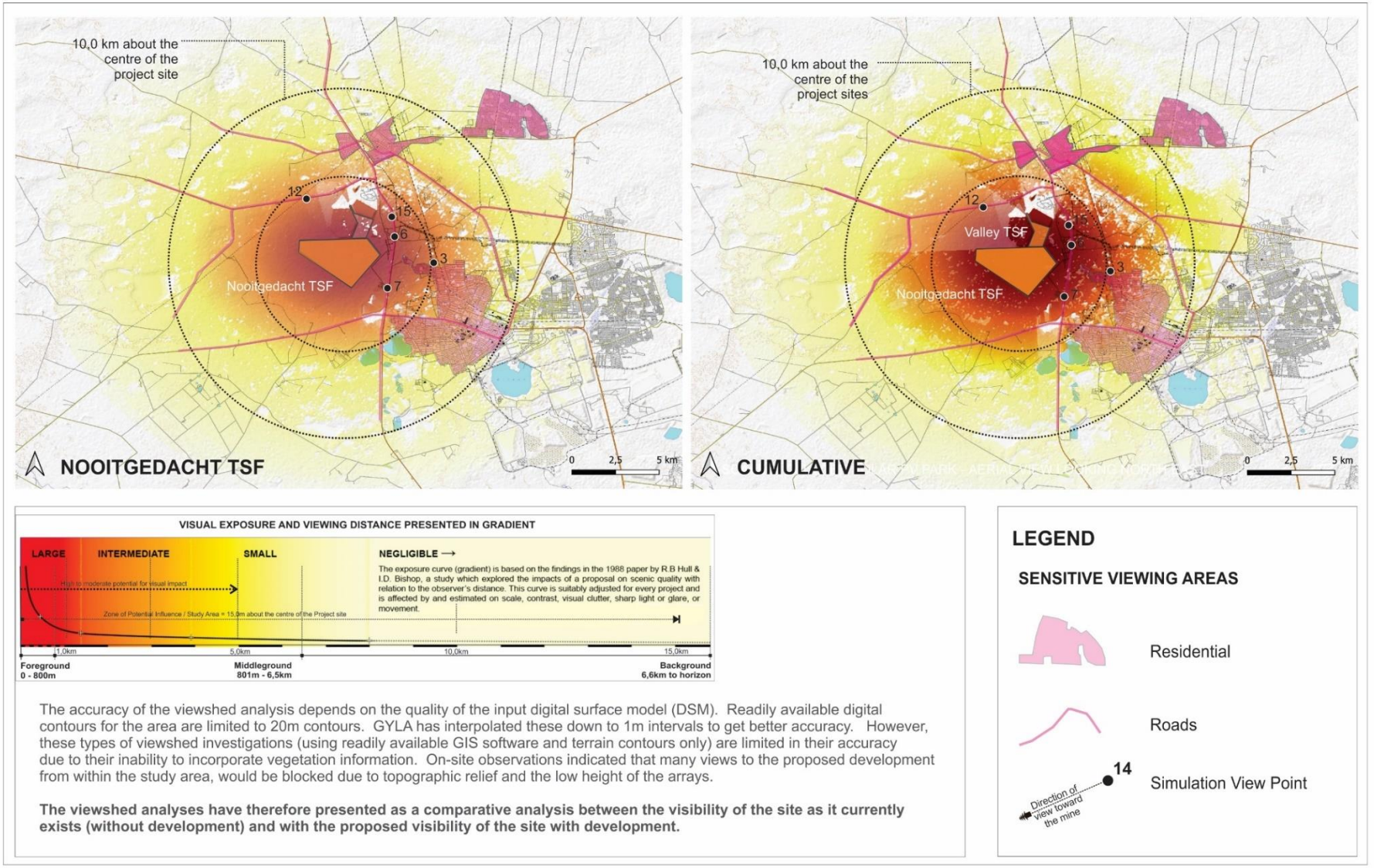


Figure 49: Viewshed analyses undertaken for the Nooitgedacht TSF (including cumulative impact of the proposed Valley TSF)

9.3.2.4 **VISUAL MITIGATION MEASURES**

In considering mitigating measures three rules are considered - the measures should be feasible (economically), effective (how long will it take to implement and what provision is made for management/maintenance), and acceptable (within the framework of the existing landscape and land use policies for the area). To address these, the following principles have been established:

- Mitigation measures should be designed to suit the existing landscape character and needs of the locality. They should respect and build upon landscape distinctiveness.
- It should be recognized that many mitigation measures, especially the establishment of planted screens and rehabilitation, are not immediately effective.

The following general options are recommended:

9.3.2.4.1 PLANNING AND SITE DEVELOPMENT MITIGATION

- Development footprints should be demarcated and clearing to occur within the demarcated areas.
- Ensure, wherever possible, natural indigenous vegetation and tall trees (specifically in areas between the TSF and the R30) are retained and incorporated into the site rehabilitation.
- All topsoil that occurs within the proposed footprint of an activity must be removed and stockpiled for later use. The construction contract must include the stripping and stockpiling of topsoil. Topsoil would be used later during the rehabilitation phase of disturbed areas and the waste facilities. The presence of degraded areas, which are not rehabilitated, will increase the overall visual impact.
- Apply dust suppression methods to limit the dust generated during the establishment phase.
- Before commencing operation, develop a post-closure rehabilitation plan to acceptable topographic and ecological conditions, particularly for the waste facilities.

9.3.2.4.2 EARTHWORKS MITIGATION

- Earthworks should be executed in such a way that only the footprint and a small 'construction buffer zone' around the proposed TSF are exposed. In all other areas, the naturally occurring vegetation should be retained, as well as tall trees, especially along the periphery of the site.
- Topsoil must be exposed for the minimum time possible to avoid prolonged exposure to wind and water erosion and to minimise dust generation. Should the topsoil stockpile be in place for more than 3 months, they should be hydroseeded with indigenous grasses.
- Any soil must be exposed for the minimum time possible once cleared of vegetation to avoid prolonged exposure to wind and water erosion and to minimise dust generation.

9.3.2.4.3 LANDSCAPING AND ECOLOGICAL APPROACH MITIGATION

Where new vegetation is proposed to be introduced to the site, an ecological approach to rehabilitation, as opposed to a horticultural approach should be adopted. For example, communities of indigenous plants will enhance biodiversity, a desirable outcome for the area. This approach can significantly reduce long-term costs as less maintenance would be required over conventional landscaping methods as well as the introduced landscape being more sustainable.

9.3.2.4.4 GOOD HOUSEKEEPING

"Housekeeping" procedures should be developed for the project to ensure that the Project site and lands adjacent to it are kept clean of debris, garbage, fugitive trash, or waste generated onsite; procedures should extend to control of "track out" of dirt on vehicles leaving the active sites and entering the public domain.

9.3.2.4.5 LIGHTING MITIGATION

Light pollution is largely the result of bad lighting design, which allows artificial light to shine outward and upward into the sky, where it is not wanted, instead of focusing the light downward, where it is needed. Ill-

designed lighting washes out the darkness of the night sky and radically alters the light levels in rural areas where light sources shine as 'beacons' against the dark sky and are generally not wanted. Simple changes in lighting design and installation yield immediate changes in the amount of light spilled into the atmosphere. The following are measures, to minimize light pollution beyond the perimeter of the project, that must be considered in the lighting design of the Project:

- Install light fixtures that provide precisely directed illumination to reduce light "spillage" beyond the immediate surrounds of the site i.e. lights (spotlights) are to be aimed away from sensitive viewing areas.
- Avoid high pole top security lighting along the periphery of the site and use only lights that are activated on illegal entry to the site.
- Minimise the number of light fixtures to the bare minimum, including security lighting.

9.3.3 HERITAGE IMPACTS

The fieldwork component of the study was aimed at identifying tangible remains of archaeological, historical and heritage significance. The fieldwork was conducted by an archaeologist and field assistant from PGS on 23 March 2023. At times, the archaeological visibility of the area was not ideal for surveying due to dense grass cover. The fieldwork conducted to evaluate the possible impact of the proposed development, has revealed the presence of one (2) heritage resources (refer back to Figure 20). The remains of a historical homestead (NGD-01) were identified within the study area. The structure was depicted at this locality on the 2726DC topographical sheet dating to 1952. The site is therefore older than 60 years. PGS Heritage was appointed to conduct a Ground-Penetrating Radar (GPR) survey and test excavations to identify if there are any possible graves located at a historic homestead. The GPR survey report is included in Appendix D. The material identified on the surface and in the test excavations all appear to resemble evidence of dumping. No evidence of a homestead or human remains were identified. Based on this no further mitigation is required except for Harmony to apply for destruction of the site through a SAHRA permit application.

A low local significance trig beacon (NGD-02) was also identified in the centre of the TFS site. Avoidance is not possible so Harmony must apply for a HRA S34 permit for removal of the beacon as the structure is over 60 years old.

During the GPR survey and test excavation work conducted on the 27th and 28th of November 2023, an additional grave site was identified and recorded. The informal burial ground is in an open field and contains approximately 15 graves. The area has been fenced but the fence is broken and has collapsed in certain sections. The area is overgrown with tall grasses. The grave dressings include stone-packed mounds, concrete slabs with a brick border and granite dressing with small grey and white rocks in the middle. Only four of the graves have formal headstones (concrete and granite) whereas others have a single fieldstone or no headstone at all. The oldest discernable date on one of the headstones was 1963. No grave goods were located on or at the graves, and it appears as if the site had not been visited for a long time. The graves are overgrown with grass and weeds. All the graves are oriented West-East and are in three discernable lines, except for one grave which is oriented North-South.

9.3.3.1 **HERITAGE MITIGATION MEASURES**

It is always possible that cultural material may be exposed during construction and may be recoverable, keeping in mind delays can be costly during construction and as such must be minimised. Development surrounding mining and construction results in significant disturbance; however, any excavation work offers a window into the past, and it thus may be possible to rescue some of the data and materials.

The study area occurs within a greater historical and archaeological context as identified during the desktop and fieldwork phase. Soil clearance may uncover unmarked graves. During the Construction Phase, it is important to recognize any significant material being unearthed, making the correct judgment on which actions should be taken.

All burial grounds and graves must be retained and avoided with a buffer zone of 100 m as per SAHRA guidelines. The client will need to make provisions for access should any Next-of-Kin wish to visit the graves. If this is not possible to conserve the burial ground, the graves should be relocated after completion of a detailed grave relocation process, that includes a thorough stakeholder engagement component, adhering to the requirements of Section 36 of the NHRA and its regulations as well as the National Health Act and its regulations and any provincial legislation.

Destruction permits should be obtained from SAHRA for the trig beacon and homestead identified within the TSF footprint. It is recommended that the following chance find procedure should be implemented.

- An appropriately qualified heritage practitioner / archaeologist must be identified to be called upon if any possible heritage resources or artefacts are identified.
- Should an archaeological site or cultural material be discovered during construction (or operation), the area should be demarcated, and construction activities halted.
- The qualified heritage practitioner / archaeologist will then need to come out to the site and evaluate the extent and importance of the heritage resources and make the necessary recommendations for mitigating the find and the impact on the heritage resource.
- The contractor therefore should have some sort of contingency plan so that operations could move elsewhere temporarily while the materials and data are recovered.
- Construction can commence as soon as the site has been cleared and signed off by the heritage practitioner / archaeologist.

9.3.4 PALEONTOLOGY IMPACTS

The study area is underlain by the aeolian sand as well as the Permian Volksrust Formation (Ecca Group, Karoo Supergroup). The PalaeoMap of the South African Heritage Resources Information System (SAHRIS) indicates that the Palaeontological Sensitivity of the aeolian sand is moderate while that of the Volksrust Formation (Ecca Group, Karoo Supergroup) is High (Almond et al, 2013; SAHRIS website). However, the Palaeotechnical report of the Free State (Groenewald et al, 2014) allocated a Moderate Palaeontological Sensitivity to the development site. Updated geology (Council of Geosciences, Pretoria) indicates that the development area is underlain by superficial alluvium, colluvium, elluvium and gravel as well as the Volksrust Formation (Ecca Group).

A site-specific field survey of the development footprint was conducted on foot and by motor vehicle on 17 April 2023. No fossiliferous outcrop was detected in the proposed development area. The apparent rarity of fossil heritage in the proposed development footprint suggests that the impact of the development will be of a Low significance in palaeontological terms. It is therefore considered that the proposed development is deemed appropriate and feasible and will not lead to damaging impacts on the palaeontological resources of the area. The construction of the development may thus be permitted in its whole extent, as the development footprint is not considered sensitive in terms of palaeontological resources.

9.3.4.1 **PALAEONTOLOGY MITIGATION MEASURES**

If fossil remains are discovered during any phase of construction, either on the surface or exposed by excavations the Chance Find Protocol must be implemented by the ECO/site manager in charge of these developments. These discoveries ought to be protected (if possible, in situ) and the ECO/site manager must report to SAHRA so that mitigation (recording and collection) can be carry out by a palaeontologist.

Preceding any collection of fossil material, the specialist would need to apply for a collection permit from SAHRA. Fossil material must be curated in an accredited collection (museum or university collection), while all fieldwork and reports should meet the minimum standards for palaeontological impact studies suggested by SAHRA. The following details the chance find procedure:

- If a chance find is made the person responsible for the find must immediately stop working and all work that could impact that finding must cease in the immediate vicinity of the find.

- The person who made the find must immediately report the find to his/her direct supervisor which in turn must report the find to his/her manager and the ESO or site manager. The ESO or site manager must report the find to the relevant Heritage Agency (South African Heritage Research Agency, SAHRA). (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za). The information to the Heritage Agency must include photographs of the find, from various angles, as well as the GPS co-ordinates.
- A preliminary report must be submitted to the Heritage Agency within 24 hours of the find and must include the following: 1) date of the find; 2) a description of the discovery and a 3) description of the fossil and its context (depth and position of the fossil), GPS co-ordinates.
- Photographs (the more the better) of the discovery must be of high quality, in focus, accompanied by a scale. It is also important to have photographs of the vertical section (side) where the fossil was found.
- Upon receipt of the preliminary report, the Heritage Agency will inform the ESO (or site manager) whether a rescue excavation or rescue collection by a palaeontologist is necessary.
- The site must be secured to protect it from any further damage. No attempt should be made to remove material from their environment. The exposed finds must be stabilized and covered by a plastic sheet or sand bags. The Heritage agency will also be able to advise on the most suitable method of protection of the find.
- If the fossil cannot be stabilized the fossil may be collected with extreme care by the ESO. Fossils finds must be stored in tissue paper and in an appropriate box while due care must be taken to remove all fossil material from the rescue site.
- Once the Heritage Agency has issued the written authorization, the developer may continue with the development on the affected area.

9.3.5 HYDROLOGY IMPACTS

The detail of the flood modelling for the site is presented in Appendix A of the attached hydrological assessment (Appendix D). Since the modelling of flooding is (as undertaken), an approximation of reality, various assumptions and limitations are relevant (when considering the model results). These have been highlighted at various places in this report and are also outlined in Appendix A. The most significant river near the site is the Mayemspruit River to the south-east of the site. This river has a contributing catchment of approximately 32km^2 up to its point of assessment south of the site and was the primary focus of potential flooding to the site which is made possible by some lower-lying terrain slowly rising towards the TSF boundary. The extent of the flood model covered approximately 2.3km of the defined non-perennial river (the Mahemspruit). Flood modelling utilised a combination of the 1m Digital Terrain Model (DTM), 2m DSM and 30m Digital Surface Model (DSM) for the development of the hydrological model and a combination of the 1m DTM and 2m DSM for the development of the hydraulic (HEC-RAS) model. The availability of a continuous 1m DTM and 2m DSM allowed for the adoption of a 2D flood model approach using HEC-RAS. The latest

In considering the flood results presented in the figures, the 1:50 and 1:100 RI events are noted as not affecting the site with the 1:100 RI event coming close to, but not intersecting, the proposed topsoil stockpile. The situation is different with the PMF events with both intersecting the proposed topsoil stockpile. These, however, are the only proposed works that are affected by the PMF events with the TSF itself outside of the PMF and PMF plus climate change flood-lines.

Inaccuracies in the flood modelling (due to both general limitations in modelling such as the limit of the 1m DTM as well as the poorly understood influence of the D-Dam Complex), should be factored into the interpretation of the results (i.e. an additional freeboard could still be relevant due to potential error).

Figure 43 presents the results of the identified site sensitives as they relate to the surface water environment. This figure illustrates that there are parts of the TSF and proposed pipelines that are within sensitive areas. This includes the influence of two dams located within the TSF and the dam on the Mahemspruit, otherwise the

sensitive areas affecting the TSF relate to the influence of the PMF flood results (including the PMF plus climate change results), since the 1:100 RI flood event (medium sensitivity) falls out of the site. The two dams over the TSF footprint are expected to be removed and will therefore not be of relevance while the influence of the PMF flood events and dam on the Mahemspruit remain the only other sources of site sensitivity to the TSF. It should be noted that this report does not consider the influence of wetlands, which will require consideration by a wetland specialist.

The pipelines cross two non-perennial rivers per the 1:50,000 topographical map data and a formalised river (furrow). The remaining drainage intersecting the pipelines is constructed (furrows). Large areas are nevertheless managed by these furrows and as such, they fall within the conceptual definition of a watercourse insofar as their having the potential to cause flooding and route pollutants downstream. Watercourse buffers have consequently been derived from the 1:50,000 topographical map features inclusive of dams, drainage canals, furrows, non-perennial river, nonperennial pans, perennial pans and vleis. Hydrological features have been defined according to the NGI's 1:50,000 topographical map data and this report does not intend to alter their classification.

9.3.5.1 SOIL EROSION

Eroded soils have the potential to cause sedimentation of downstream watercourses. The construction of infrastructure will lead to new areas being disturbed, resulting in the potential for soil erosion to occur during times of rainfall or through persistent streamflow, while the decommissioning of this infrastructure will result in the same. If not mitigated, erosion could continue during the operational phase, although it is expected soils would settle to a degree, reducing the potential volume of erosion for any given rainfall event. The rehab/closure phase would have a similar risk of erosion to the construction phase.

During operation, the TSF is surrounded by toe paddocks reporting to the RWD which has a silt trap at its entry. This will limit the potential for erosion to enter the environment. While not chemically dirty, a proposed Topsoil Stockpile is noted to the east of the TSF. This stockpile requires stormwater management or concurrent remediation through or stabilisation of soils (assuming there are no potential sources of contaminant within the soil that necessitate removal) to limit the entrainment of sediment in runoff which may otherwise enter the surface water environment. Soil erosion may otherwise occur during all phases (from this stockpile).

Disturbed areas should consequently be stabilised, with erosion control methods used where stabilisation is not possible. Rehabilitation for the site should be inclusive of topsoil replacement and revegetation of disturbed areas. River channels, furrows and drainage canals should not have any infrastructure placed within them unless essential. Consideration should be given to the enhanced erosion potential in this instance.

9.3.5.2 POLLUTANTS ENTERING ENVIRONMENT

Operation of earthmoving machinery or maintenance of vehicles on-site during construction, operation, decommissioning, and rehab/closure (including the possible storage or handling of hydrocarbons) poses a potential source of hydrocarbon contamination regarding the surface water environment. Vehicles and machinery should consequently be well maintained, stored/parked with drip trays and with an emergency response strategy for unforeseen hydrocarbon spills. For the most part, potential pollutants are already limited by the design of the project given the containing nature of the TSF.

A stormwater management plan per GN 704 requirements is likely necessary on the basis that the TSF is designed not to spill (and therefore shouldn't spill more than once every 50 years).

A TSF failure while a highly unlikely event has the potential to cause severe pollution of the downstream environment while poor operation of the TSF and RWD could see unplanned spill from the RWD. Adequate engineering and operation of the TSF would mitigate these two potential impacts.

9.3.5.3 DECREASE IN RUNOFF

The proposed construction of the TSF and related surface infrastructure will increase impermeable hardstanding, however with a containment philosophy in place as enabled by the self-containing TSF basin, toe paddocks and RWD, overall runoff from the site will be decreased to near zero.

A decrease in runoff is a typical impact associated with the containment of dirty areas on mines and the mitigation of this impact is often not practical or possible with a reduction in mean annual runoff an expected outcome. The runoff would be able to return to the catchment post closure so this impact would only relate to the operational phase of the TSF.

This mean annual runoff reduction is informed by the area of the contained TSF/RWD to that of the containing catchment and quaternary catchment of relevance. At a containing catchment level (80.1km^2), the TSF/RWD containment results in a proportional containment of 10.8% while at a quaternary level (723.4km^2) the proportional containment is 1.2%.

9.3.5.4 **FLOOD RISK**

Flood risk is both an impact on the proposed TSF (flooding originating beyond the TSF) and on the environment (flooding originating from the TSF) and includes:

- An unplanned TSF failure resulting in downstream flooding (flooding originating from the TSF);
- Flooding from the Mahemspruit River (flooding originating beyond the TSF); and
- Surface water run-on towards the TSF (flooding originating beyond the TSF).

This risk is expected to be present during the construction, operational, decommissioning and rehab/closure phases (flooding originating beyond the TSF) and during the operational, decommissioning and rehab/closure phases (flooding originating from the TSF). The consequence of flooding is potentially severe, however, flooding originating beyond the TSF has been mitigated through the addition of a stormwater bund and trench collecting runoff (surface water run-on) originating to the east of the site while the positioning of the TSF and associated infrastructure places the facility away from modelled flooding. This includes the PMF flood results (plus climate change) which do not intersect the RWD and TSF and the topsoil stockpile which is positioned outside of the 1:100 RI flood-line. Since the topsoil stockpile is not a sensitive piece of site works (if affected by flooding), its avoidance of the 1:100 RI floodline and not the PMF flood-line is warranted.

Flooding originating from the TSF due to an unplanned failure while highly unlikely to occur, has both flooding and pollutant implications. In a similar sense, flooding originating beyond the TSF (caused by surface water run-on) could see the toe-paddock and RWD storage capacity compromised leading to a spill of pollutants.

The proposed TSF's position near the D-Dam complex and Mahemspruit River was the focus of the flooding assessment. The following sensitivity bands were classified (Figure 50):

- Prevent Development: A 32m watercourse buffer (also applicable to NEMA activities) was used to define the functional area of the watercourse. This 32m buffer factors in the potential error in the 1:50,000 topographical map dataset. All development should be prevented in this area unless water-compatible or otherwise crossing over a watercourse (with flood risk factored in).
- High: The defined 1:50 RI flood-line also applies to GN 704 and presents a probable area in which flooding could occur (once every 50-years). There is a strong disincentive towards development within this area.
- Medium: A 100m buffer distance matches GN 704's and DWS Notice 509 of 2016 prescribed buffer distance and is the minimum distance to a watercourse requiring motivation if works/infrastructure are going to be permitted, including a written exemption from the Minister of the Department of Water and Sanitation. GN 704 and DWS Notice 509 of 2016 also refer to the 1:100 RI flood event which has been used as a secondary consideration for the medium sensitivity analysis. There is a medium disincentive towards development within this area.
- Low: A 200m buffer distance is a reasoned maximum distance from a watercourse which in most instances will reflect the largest distance over which flooding would need to be considered. The PMF plus climate change flood-line for the Mahemspruit is the maximum hypothetical extent of flooding that may be generated from this river and consequently has the lowest sensitivity rating. There is a low disincentive towards development within this area.

- Remainder: There is no sensitivity classification for the remainder of the site.

9.3.5.5 HYDROLOGY MITIGATION MEASURES

The following mitigation is recommended to reduce potential hydrology impacts to acceptable levels:

9.3.5.5.1 SURFACE WATER MONITORING

Potential contaminants of concern that need to be monitored are expected to have already been identified based on the historical quarterly surface water quality monitoring that has been undertaken. The understanding of the mine's processes and the associated contaminants that might be released in the event of a failure in an aspect of the TSF's (e.g. toe paddock rupture, RWD overflow or soil erosion off the topsoil stockpile) is likewise expected to be clearly understood with monitoring reflecting this.

One additional SW monitoring point should ideally be added to current monitoring for the greater Harmony Operation (27° 57' 49" S and 26° 36' 25" E). Quarterly monitoring reports should be produced to differentiate seasonal variations and general trends due to the mining activities, with a comparison of water samples to standards and guidelines set by the DWS and an analysis of parameters over time so that trends can be established.

9.3.5.5.2 ADDITIONAL MITIGATION

Additional mitigation measures are proposed below:

- Implement and maintain a GN 704 compliant stormwater management plan to manage run-on towards the TSF.
- Develop the TSF using sound engineering to limit the likelihood of a failure.
- Maintain and operate the TSF to limit the potential for failure.
- Monitor the TSF to identify any potential failures/slumps.
- Considering a flood-protection berm on the south-eastern side of the TSF (as discussed in Section 4.5 of this report).[6]
- Keeping the contained dirty area to a minimum thereby limiting this impact.
- Discharge excess water of an acceptable quality back into the surface water environment (river).
- Keep activity within the managed dirty water footprint where possible.
- Store hydrocarbons off-site where possible or otherwise implement hydrocarbon storage with adequate bunding.
- Handle hydrocarbons carefully to limit spillage.
- Ensure vehicles are regularly serviced so that hydrocarbon leaks are limited.
- Use drips trays for stationary vehicles or otherwise park over areas suited to their storage (e.g. with an oil interceptor) and designate a single location for refuelling and maintenance where possible.
- Keep a spill kit on site to deal with any hydrocarbon leaks.
- Remove soil from the site which has been contaminated by hydrocarbon spillage.
- Undertake surface water monitoring to enable change detection related to contaminants originating from the site.
- Pollution potential within watercourses must be considered in the designs to stop an unforeseen failure or breach.
- Maintain and operate the TSF/RWD to limit the potential for overfilling of the RWD that leads to a spill.

[6] The soil stockpile is the berm, designed specifically for this mitigation measure

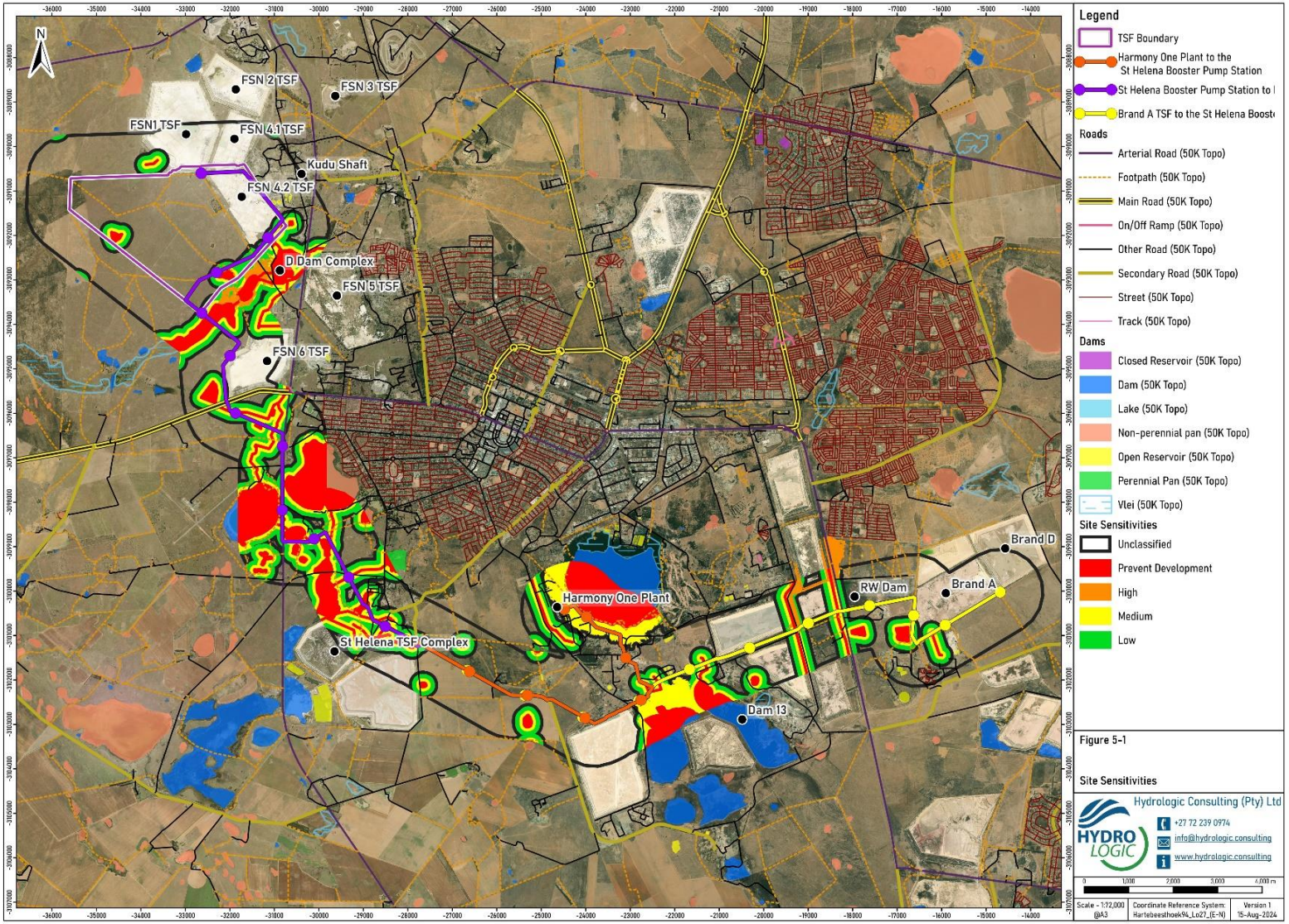


Figure 50: Hydrological sensitivity for the TSF and associated infrastructure

9.3.6 IMPACTS ON WETLANDS AND AQUATIC ECOLOGY

The impact assessment considered the anticipated direct and indirect impacts to the wetland systems as a result of the proposed tailings facility and associated infrastructure. In accordance with the mitigation hierarchy, the preferred mitigatory measure is to avoid impacts by considering options in project location, sitting, scale, layout, technology and project/activity phasing to avoid impacts.

Three levels of risk have been identified and considered for the overall risk assessment, these include high, medium, and low risks. Due to the destructive characteristics of a new tailing's facility on wetlands, High risks are expected for the project. Medium risk refers to wetland areas where the impacts will only occur inside the wetlands buffer and not on the wetlands themselves. Low risks are wetland systems where both the wetlands and their buffers are avoided by die proposed activities. The High risks were the priority for the risk assessment, focussing on the expected potential for these direct risks.

Due to the fact that direct impacts to the wetlands (and buffers) will not be avoided by the TSF itself, the risk assessment considered all direct and indirect risks posed to these systems as a result of the project. During the site visit, nine HGM units were identified within the overall project area that relate to the proposed development. The wetland types were classified as four unchannelled valley bottoms (HGM 1, 2, 6 and 9), two channelled valley bottoms (HGM 3 and 8), and three depressions (HGM 4, 5 and 7). Multiple artificial wetlands, mostly seepage from the existing tailing's facilities were identified within the project area.

Drainage features (or lines) were also identified throughout the project area. These features are referred to as 'A' Section channels that convey surface runoff immediately after a storm event and are not associated with a baseflow (DWAF, 2005). Many of these features were likely artificially created to regulate water runoff and overflows between the TSF's and natural watercourse systems.

A risk assessment was conducted to investigate the level of risk posed by proposed project. The post-mitigation risks for the TSF and the proposed slurry and return water pipelines in all respective project phases presented within the "Moderate" and "Low" significance classes. The "Moderate" risks are associated with the nature of the TSF development to alter the hydrological dynamics of the local area and subsequently the watercourses. Furthermore, in consideration that the TSF development will result in the loss of ≈ 63 ha in wetland surface area water quality impairments are inevitable even with the implementation of mitigation measures. The "Moderate" risks associated with the proposed slurry pipelines relate to the activity occurring within the delineated wetlands for which impacts can only be mitigated against to a certain degree. During the operational phase for the TSF a risk assessment was conducted to investigate the level of risk posed by proposed project. The post-mitigation risks for the TSF and the proposed slurry pipelines in all respective project phases presented within the "Moderate" and "Low" significance classes. The "Moderate" risks are associated with the nature of the TSF development to alter the hydrological dynamics of the local area and subsequently the watercourses. The "Moderate" risks associated with the proposed slurry pipelines relate to the activity occurring within the delineated wetlands for which impacts can only be mitigated against to a certain degree. During the operational phase for the TSF and pipelines, the risk significance will decrease, however some residual "Moderate" and "Low" risks will still be potential attributed to water quality and hydrological changes resulting from the activities.

The cumulative impact of the proposed project is deemed to be "Moderate" owing to the loss of some functional wetlands and attributed to the high-risk nature of tailings projects. It is worth noting that the scientific buffer calculation (Macfarlane *et al*., 2014) was used to determine the size of the buffer zones relevant to the proposed project. A pre-mitigation buffer of 56 m and a post-mitigation wetland and watercourse buffer of 46 m is applicable in relation to the proposed TSF. Furthermore, a 32 m pre-mitigation and 15 m post-mitigation buffer is applicable to the wetlands in relation to the proposed pipelines. The buffer widths are attributed to pre-existing modifications to the wetlands and their immediate surrounding catchment and in consideration that pipelines are linear structures and are not anticipated to have a large impact radius.

9.3.6.1 **WETLANDS MITIGATION**

In the event wetland systems will be lost, a compensation strategy must be compiled for the project, and this should prioritize the on-site rehabilitation of proximal water resources. If all other mitigation measures are

adhered to no fatal flaws are expected for the proposed project. It is the opinion of the specialist that the project may be favourably considered, on condition all prescribed mitigation measures and supporting recommendations are implemented.

Various additional mitigation measures are included in the accompanying wetland specialist report (Appendix D). Key mitigation measures are included below:

- Make sure that all the HGM units and their buffers within the proximity of the TSF site are avoided completely (except for those that are directly within the TSF footprint – namely HGM 1, 2 and 4).
- Adhere to the prescribed wetland buffers (except for directly affected wetlands occurring within the TSF footprint – HGM 1, 2 and 4). Restrict all non-essential activities (e.g. cement mixing and equipment or machinery storage) to outside of wetlands and their prescribed buffers.
- Educate staff and relevant contractors on the location and importance of the identified wetlands through toolbox talks and by including them in site inductions as well as the making them aware of the overall site plan which should indicate sensitive areas, waste disposal areas and any other relevant project specifics.
- Conduct regular inspections along the TSF and pipeline routes to ensure the integrity of the facility i.e. check for leaks.
- Devise and implement a stormwater management plan.
- Use existing pipeline servitudes as far as possible.
- Install sandbags on downstream side of the TSF footprint to trap sediment until the site has been constructed and vegetation has re-established.
- Appropriately contain any generator diesel storage tanks, machinery spills (e.g. accidental spills of hydrocarbons oils, diesel etc.) or construction materials on site (e.g. concrete) in such a way as to prevent them leaking.
- No machinery should be allowed to be parked in any wetlands.
- Any water to be released into the environment from dewatering activities associated with temporary excavations during the construction must undergo filtration before it is released to minimise sediment laden water from entering the watercourses.
- Implement a Stormwater Management Plan.
- Exposed road surfaces awaiting grading must be stabilised to prevent the erosion of these surfaces. Signs of erosion must be addressed immediately to prevent further erosion. Temporary and permanent erosion control methods may include silt fences, flotation silt curtains, retention basins, detention ponds, interceptor ditches, seeding and sodding, riprap of exposed embankments, erosion mats, and mulching.
- A combination of step like grassed berms or perforated bricks and silt traps must be placed in the preferential flow paths along the site and roads to prevent scouring of the road margins and subsequent sedimentation of the downslope water resources.
- Mixing of concrete must under no circumstances take place in any wetland or their buffers.
- Regularly maintain stormwater infrastructure, pipes, pumps and machinery to minimise the potential for leaks. Check for oil leaks, keep a tidy operation, install bins and promptly clean up any spills or litter.
- Promptly remove all alien and invasive plant species that may emerge during construction (i.e. weedy annuals and other alien forbs) must be removed.
- Try to reduce the disturbance footprint and the unnecessary clearing of vegetation on either side of the TSF facility when traversing wetlands.

- Stormwater and sediment control infrastructure must be regularly maintained to ensure proper functionality and aim to release only clean water (clean water is defined as stormwater run-off from areas which fall outside operational areas and are not contaminated) into the environment. Avoid the creation of concentrated flow paths wherever possible.
- Any exposed earth should be rehabilitated promptly by planting suitable vegetation (vigorous indigenous grasses) to protect the exposed soil. Where required, the rehabilitation of watercourse banks must take place following construction. Key areas where erosion has occurred should be rehabilitated through bank reprofiling to gentler gradients and the revegetation of the wetland periphery areas. Revegetate bare or denuded areas for the TSF and pipelines as soon as possible.
- At crossing points restrict all construction activities to a 10 m corridor on either side of the pipeline route. Demarcate the 10 m construction corridor as well as the prescribed 15 m buffer on the ground (e.g. pained wooden poles).
- Construct as far as possible during winter when flow volumes are lowest, prioritise this for crossing sites. This will reduce impacts to wetlands due to soil poaching (compaction) and vegetation trampling under peak saturation levels. Additionally, the risk of vehicles getting stuck and further degrading the vegetation integrity is lowest during this time.
- Avoid working in areas with alien vegetation as dispersal into unaffected areas may be aided through vehicular movement. Once and if detected, control the spread of any existing colonies of AIPs. Should alien vegetation infestation be considered a contributing factor to ecosystem degradation on the site, the implementation of an alien invasive management plan should be considered. The use of herbicides is not recommended in or near wetlands to control alien vegetation (opt for mechanical removal).
- Ensure soil stockpiles and concrete / building sand are sufficiently safeguarded against rain wash.
- Provide appropriate sanitation facilities during construction and service them regularly

9.3.7 IMPACTS ON SOILS

Infrastructure within the Nooitgedacht TSF project and associated infrastructure project area includes new infrastructure and pipelines, top stockpile area, TSF expansion area and access roads. The proposed activities` buffer area often impede into “High” sensitivity crop fields. These sensitivities are associated with some arable land potential and capability conditions (i.e., Soil status), therefore high land capability areas will be impacted on by the TSF expansion.

Impacts were assessed in terms of the proposed TSF expansion project and associated infrastructure, operational and decommissioning phases.

9.3.7.1 **PLANNING PHASE IMPACTS**

The planning phase activities are considered a low risk as they typically involve desktop assessments and initial site inspections. This would include preparations and desktop work in support of waste management plans, environmental and social screening assessments, finalising well sites and facilities and consultation with various contractors involved with a diversity of proposed project related activities going forward.

The results indicate “Medium” post-mitigation significance score ratings for the project. It is therefore clear that the project is expected to have a low impact on land potential resources. It is worth noting that some “High” sensitivity crop field areas were identified in the Screening Tool in the project area buffer zone. The specialist agrees with the Screening Tool sensitivities in most areas with “Moderate High” sensitivities based on the site-verified soil forms (i.e., Avalon, Pinedene, Molopo and Etosha soil forms) with a high land capability potential associated to these areas (Figure 51). If avoidance of such areas is not feasible - stakeholder engagement should occur to discuss reasonable compensation of any affected persons for any proven loss of livelihoods.

9.3.7.2 **CONSTRUCTION PHASE IMPACTS**

The project will result in the stripping of topsoil related to the construction of the TSF and alterations to the existing land uses as a result of the TSF replacing open veld areas. The changes in the land use will be from

natural or semi-agricultural to mining activities development (or transformed). It will impact on areas expected to have high agricultural land capability potential (in some areas) even though they are currently not actively cultivated, with some aspects affecting “Moderate High” sensitivity areas. It is possible that suitable agricultural land with a potential to be used for cropping practices could become fragmented, resulting in these portions no longer being deemed feasible to farm in the future, however it should be noted that pipelines mostly follow existing servitudes.

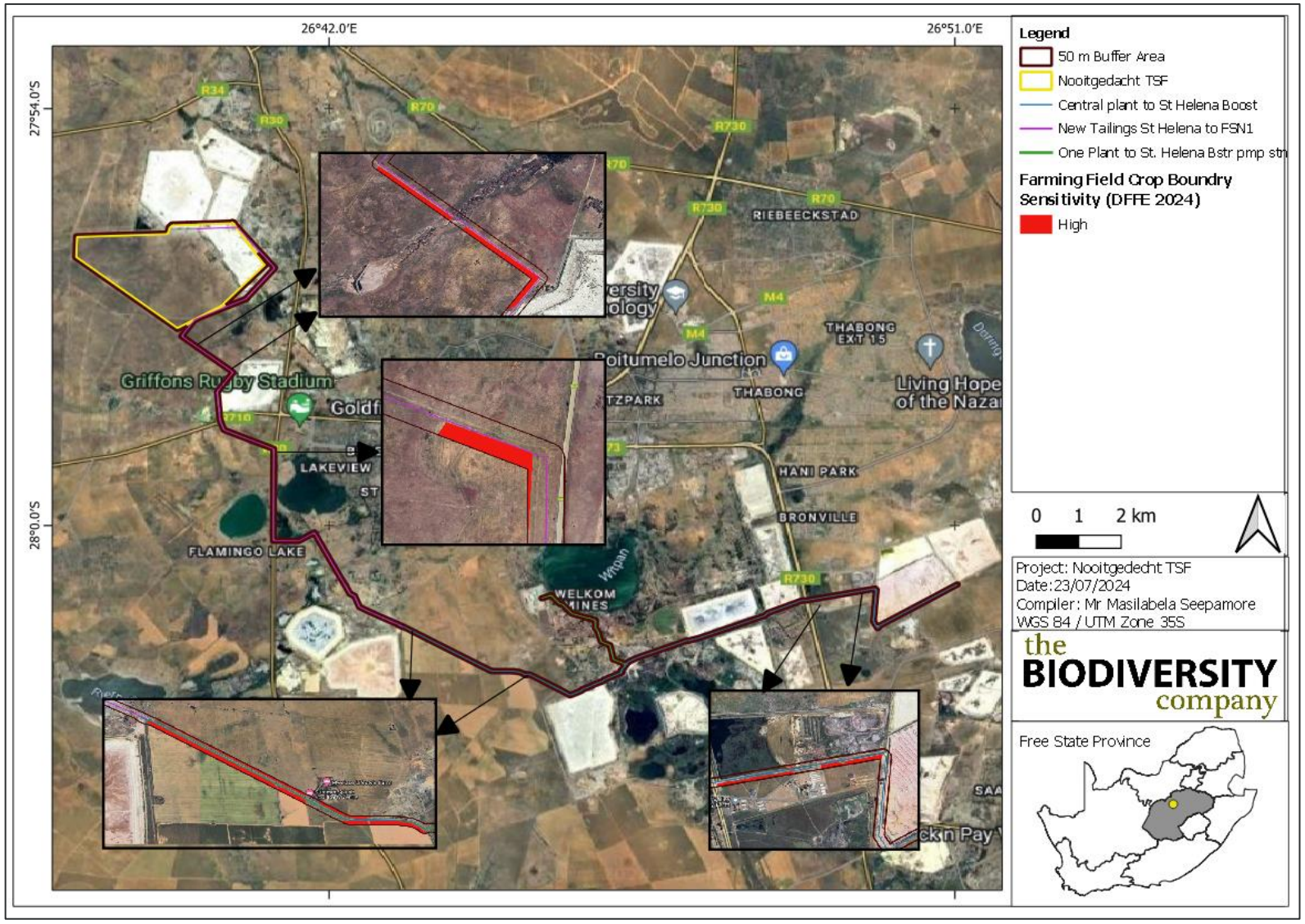


Figure 51: Infrastructure within proximity to sensitive crop fields

During the construction phase, topsoil often will be cleared, stripped and topsoil stockpiled. Access roads will be created with trenches being dug for the installation of and pipelines. Contractor and laydown yards will also be cleared with construction material being transported to laydown yards. Potential erosion is expected during the construction phase due to some erodable soils within the footprint assessment area, such as the Sepane, Katspruit and Glenrosa soil forms. The removal of vegetation and changes to the local topography could result in an alteration to surface run-off dynamics. Erosion of the area could result in further loss of soil forms suitable for agriculture and these soils will deposit in downslope areas such as the local watercourses, negatively affecting these ecologically sensitive ecosystems. Soil compaction can also result due to increased traffic on site along the proposed project area. The disturbed soil profiles will change from the original natural condition even through proper stockpiles will be stored. Disturbed soils can result in further water and nutrient losses from the soil matrix.

9.3.7.3 OPERATIONAL PHASE IMPACTS

During the operational phase, limited impacts are foreseen. Only the footprint area will be disturbed, and this will minimise soil and vegetation disturbance of the surrounding area. Revegetation will be carried out on exposed surrounding areas to avoid surface erosion. Maintenance of vegetation, infrastructure maintenance will have to be carried out throughout the life of the project. It is expected that these maintenance practices can be undertaken by means of manual labour.

The operational phase of the TSF Expansion (Constructed Infrastructure) includes anthropogenic movement and activities. The relevant infrastructure will be maintained by professionals throughout the lifetime of the operation. Besides compaction and erosion caused by increased traffic and surface water run-off for the area, few aspects are expected to be associated with this phase. Monitoring of soil erosion and compaction is important during this stage. The spread of alien invasive species will be a risk, predominantly adjacent to developed aeras (edge effect). Soil contamination from unplanned tailings discharges (i.e. leaks from pipelines and failure of TSF containment) as well as loss of topsoil resource from the topsoil stockpile from wind or water erosion or flooding could be significant impacts.

9.3.7.4 DECOMMISSIONING PHASE IMPACTS

The cumulative decommissioning impacts on soils, specifically erosion and compaction, post-mitigation have been scored “Low,” indicating that the potential incremental, interactive, sequential, and synergistic impacts are limited. It is probable that the impact will result in spatial and temporal cumulative change.

9.3.7.5 SOILS MITIGATION MEASURES

The mitigations within this section have been taken into consideration during the impact assessment in cases where the post-mitigation environmental risk is lower than that of the pre-mitigation environmental risk. Additionally, the implementation of these strategies will improve the possibility of restoring degraded soil resources, which are likely to be impacted upon the construction and operational phases, respectively. Key mitigation measures include:

- A spill response kit must be available at all times. The incident must be reported on and if necessary, a biodiversity specialist must investigate the extent of the impact and provide rehabilitation recommendations
- Vegetate or cover all stockpiles after stripping/removing soils;
- Storage of potential contaminants should be undertaken in bunded areas;
- All contractors must have spill kits available and be trained in the correct use thereof;
- All contractors and employees should undergo induction which is to include a component of environmental awareness. The induction is to include aspects such as the need to avoid littering, the reporting and cleaning of spills and leaks and general good “housekeeping”;
- No cleaning or servicing of vehicles, machines and equipment may be undertaken in water resources;

- Have action plans on site, and training for contractors and employees in the event of spills, leaks and other impacts to the aquatic systems;
- Continuously monitor erosion on site; and
- Monitor compaction on site.
- Adhere to the project footprint buffers as much as possible to minimise soil effects on the land capability of surrounding soils and prevent the effects.
- TSF stockpiling operations activities should be restricted to the defined limits of the project footprint.
- Avoidance of any actively cultivated and productive areas located within the project buffer area is required where feasible. Where avoidance is not feasible stakeholder engagement should occur to discuss reasonable compensation of any affected persons for any proven loss of livelihoods;
- Make use of existing roads or upgrade these tracks before new roads are constructed. The number and width of internal access routes must be kept to a minimum;
- A stormwater management plan must be implemented for the development. The plan must provide input into the road network and management measures;
- Topsoil stockpiles should be managed and stripped soils properly demarcated according to their proper layers especially the topsoil. Also prevent and minimise erosion (e.g., use of embedded geotextile controls) and contamination from the stockpile. Vegetate or cover all stockpiles after stripping/removing soils.
- Rehabilitation of the area must be initiated from the onset of the project. Soil stripped from infrastructure placement can be used for rehabilitation efforts; and
- An alien invasive plant species and control programme must be implemented from the onset of the project

9.3.8 IMPACTS ON TERRESTRIAL BIODIVERSITY AS WELL AS BIRDS AND BATS

The Project Area is predominantly made up of modified habitat, and what little grassland remains is severely degraded and experiencing high levels of impacts due to the proximity to mining activities. Certain portions of the Project Area intercept CBA and ESA areas, however, these are consistently disturbed in nature and cannot recover to a more natural state due to ongoing disturbances and impacts received from grazing, edge effects from land use and mismanagement.

Completion of the terrestrial biodiversity assessment led to a disputing of the 'Very High' classification for the terrestrial biodiversity theme sensitivity as allocated by the National Environmental Screening Tool. The Project Area is instead assigned an overall sensitivity of 'Low', with the modified areas assigned a sensitivity of 'Very Low' and degraded grassland a sensitivity of 'Low'. The water resource habitat is assigned a sensitivity of 'Medium'.

Anticipated Impacts include potential destruction, fragmentation and degradation of habitats and ecosystems; Spread and/or establishment of alien and/or invasive species; Direct mortality of fauna; Reduced dispersal/migration of fauna; environmental pollution due to water/ mine drainage runoff and disruption/alteration of ecological life cycles (breeding, migration, feeding) due to noise, dust and light pollution. Unplanned events such as fire or hydrocarbon spills could also damage the environment.

The focus of mitigation measures is to reduce the significance of potential impacts associated with the development and thereby to:

- Prevent the further loss and fragmentation of vegetation communities and the CBA/ESA areas in the vicinity of the project area;
- Conserve sensitive receptors linked with wetland habitats to ensure that the functional integrity of all systems is ensured;

- As far as possible, reduce the negative fragmentation effects of the development and enable safe movement of faunal species;
- Prevent the direct and indirect loss and disturbance of faunal species and community (including confirmed SCC); and
- Adequately follow the guidelines for interpreting the Site Ecological Importance ratings assigned to the Project Area.

9.3.8.1 TERRESTRIAL BIODIVERSITY MITIGATION MEASURES

It is important to consider that undeveloped portions of land can still contribute to land management objectives and protection targets to some degree. It is recommended that care be taken during construction to adhere to mitigation measures. An AIP management plan must be implemented as a priority to prevent the further spread and proliferation of AIP species to the surrounding grassland areas. Installation of leak warning and detection systems on all pipelines must also be made a priority to prevent damage caused by pipe leaks on the surrounding natural areas, particularly near to water resources.

Various additional mitigation measures are included in the accompanying terrestrial specialist report (Appendix D). Key mitigation measures are included below:

- A relocation and monitoring plan will be required for the SCC found on site. Permits will be required to be obtained for this from the provincial environmental authority.
- Laydown and construction preparation activities (such as cement mixing, temporary toilets, etc.) must be limited to already modified areas as far as possible and should take up the smallest footprint possible.
- Toilets at the recommended Health and Safety standards must be provided. These should be emptied regularly and once no longer required, they must be pumped dry to prevent leakage into the surrounding environment and removed from site.
- Any holes/deep excavations must be done in a progressive manner on a needs basis only. No holes/excavations may be left open overnight. In the event holes/excavations are required to remain open overnight, these areas must be covered to prevent fauna falling into these areas and subsequently inspected prior to backfilling.
- It is recommended that areas to be developed/disturbed be specifically demarcated so that during the construction/activity phase, only the demarcated areas be impacted upon. This should also prevent movement of staff or any individual into highly sensitive areas and the surrounding environments, i.e the wetlands and Very High sensitivity areas. Signs must be put up to enforce this. Where a registered disposal facility is not available close to the project area, the contractor shall provide a method statement with regard to waste management. Under no circumstances may domestic waste be burned on site.
- The construction contractor should supply sealable and properly marked domestic waste collection bins and all solid waste collected shall be disposed of at a licensed disposal facility.
- Driving on access roads close to these areas should be prevented in order to reduce or prevent wildlife road mortalities which occur more frequently during this period.
- Areas of indigenous vegetation outside proposed development footprints, even secondary communities outside of the direct project footprint, should not be fragmented or disturbed further.
- The clearing of vegetation must be minimised where possible. All activities must be restricted to within the authorised areas.
- Any materials must be removed from the project area once the construction phase has been concluded. No permanent construction phase structures should be permitted. Construction buildings should

preferably be prefabricated or constructed of re-usable/recyclable materials. No storage of vehicles or equipment will be allowed outside of the designated laydown areas.

- Areas that are denuded during construction need to be re-vegetated with indigenous vegetation according to a habitat rehabilitation plan, to prevent erosion during flood and wind events and to promote the regeneration of functional habitat. This will also reduce the likelihood of encroachment by alien invasive plant species.
- A hydrocarbon spill management plan must be put in place to ensure that, should there be any chemical spill, it does not run into the surrounding areas. The Contractor shall be in possession of an emergency spill kit that must always be complete and available on site.
- No indigenous fauna or flora may be intentionally removed from site without approval from the designated environmental official. No AIP may be intentionally introduced onto the site A fire management plan needs to be compiled and implemented to restrict the impact fire would have on the surrounding areas.
- All vehicles and personnel must make use of existing roads and walking paths as far as possible, especially construction/operational vehicles.
- Precautions must be taken against the erosion damage that would be caused by unplanned pipe leaks. This involves the installation of leak warning and detection systems.
- Monitoring of the pipeline must be undertaken to detect leaks and monitoring should be undertaken in line with Harmony's current monitoring requirements.
- Clearing and disturbance activities must be conducted in a progressive linear manner, always outwards and away from the centre of the project area and over several days, so as to provide an easy escape route for all small mammals and herpetofauna.
- The areas to be disturbed must be specifically and responsibly demarcated to prevent the movement of staff or any individual into the surrounding environments, signs must be put up to enforce this. No construction staff are to be allowed outside of the authorised and fenced off construction areas at any time.
- The duration of the activities should be minimised to as short a term as possible, to reduce the period of disturbance on fauna.
- No intentional trapping, killing, or poisoning of any wildlife is to be allowed and signs must be put up to enforce this.
- Compile and implement an alien vegetation management plan from the onset of construction. The plan must identify areas for action (if any) and prescribe the necessary removal methods and frequencies to be applied. This plan must be also prescribing a monitoring plan and be updated as/when new data is collated.
- The footprint area of the construction should be kept to a minimum. The footprint area must be clearly demarcated to avoid unnecessary disturbances to adjacent areas. Footprints of the roads must be kept to prescribed widths.
- A pest control plan must be put in place and implemented; it is imperative that poisons not be used to control pests.
- Dust-reducing mitigation measures must be put in place and must be strictly adhered to in order to limit pollution of water, soil dust precipitation and dust pollution entering the environment . This includes the wetting of exposed soft soil surfaces. No non-environmentally friendly suppressants may be used as this could result in the pollution of water sources.
- Access to waste storage areas by vulnerable fauna must be prevented to avoid injury or entablement.

- All construction disturbed areas not required for operational phase footprints to be rehabilitated and landscaped after construction is complete. Rehabilitation of all the disturbed areas existing in the project area must be made a priority. Topsoil must also be utilised, and any disturbed area must be re-vegetated with plant and grass species which are endemic to this vegetation type.
- Progressive rehabilitation will enable topsoil to be returned more rapidly, thus ensuring more recruitment from the existing seedbank. Any woody material removed can be shredded and used in conjunction with the topsoil to augment soil moisture and prevent further erosion.
- All personnel and contractors to undergo Environmental Awareness Training. A signed register of attendance must be kept for proof. Discussions are required on sensitive environmental receptors within and near to the project area to inform contractors and site staff of the presence of SCC and protected species and sensitive habitat, their identification, conservation status and importance, biology, habitat requirements and management requirements in line with the Environmental Authorisation and within the EMPr.
- Minimise noise disturbances as far as possible. Noise must be kept to an absolute minimum during the evenings and at night to minimize all possible disturbances to amphibian species and nocturnal mammals
- Minimisation of light pollution and artificial habitat creation. Only use lights with low sensitivity motion sensors that switch off automatically. Only use lights if/when required for the operation.
- Once a final proposed footprint is defined, a thorough site walk through must be conducted for the footprint by several trained individuals and a species specialist immediately prior to the commencement of land-clearing/construction activities. This is such that any fauna species present can move out of the area, and any active nests/dens and/or observed SCC must be noted and GPS pinned, and activities must halt until the relevant specialist is able to determine the most appropriate course of action.
- Any land clearing must be done over at least three days and conducted linearly and successively – always towards an open area away from the centre of the project area of influence (allowing animals a safe evacuation route).
- All vehicles accessing the site should adhere to a low speed limit on site (40 km/h max) to avoid collisions with susceptible avifauna, such as nocturnal and crepuscular species (e.g. nightjars and owls) which sometimes forage or rest on roads, especially at night.
- Schedule activities and operations during least sensitive periods, to avoid migration, nesting and breeding seasons for fauna. Activities should take place during the day in the case.
- Wildlife-permeable fencing with holes large enough for mongoose and other smaller fauna should be installed, the holes must not be placed in the fence where it is next to a major road as this will increase road killings in the area.
- Use environmentally friendly cleaning and dust suppressant products.

9.3.9 IMPACTS ON AIR QUALITY

Dispersion simulation was undertaken to determine highest daily, frequency of exceedance and annual average ground level concentrations for PM10 and PM2.5 and dustfall rates for the baseline and project scenarios. These averaging periods were selected to facilitate the comparison of simulated pollutant concentrations with relevant air quality guidelines and health effect screening levels as well as dustfall regulations.

Simulated PM10 concentrations due to project operations were within the daily PM10 NAAQS at all of the identified sensitive receptors, as were simulated PM2.5 concentrations within the post-2030 daily PM2.5 National Ambient Air Quality Standards (NAAQS) at all sensitive receptors. Annual average PM10 and PM2.5 concentrations were within the respective NAAQSs at all receptors. The simulated dust deposition was within National Dust Control Regulations (NDCR) for residential areas at the closest sensitive receptors.

9.3.9.1 CONSTRUCTION PHASE AIR QUALITY IMPACTS

TSFs are built over three stages: initial construction, operation, and closure (Cox et. al., 2022). The initial construction of a TSF includes constructing the infrastructure and structures that need to be in place before depositing any waste products. During operation, as more tailings are produced, the initial dam is raised through a series of 'lifts.' This stage of construction for the TSF may occur over decades, depending on the LOM. At the end of mine life, the closure plan will be implemented. The closure plan progressively reclaims the TSF to an extent wherein the facility is integrated into the surrounding landscape. This process requires active dam maintenance and monitoring post-closure. Air quality impacts relating to the other project components (pipelines, water storage facility etc) are not considered significant.

The main pollutant of concern from initial construction operations is particulate matter, including PM10, PM2.5 and TSP (Total Suspended Particulates). PM10 and PM2.5 concentrations are associated with potential health impacts due to the size of the particulates being small enough to be inhaled. Nuisance effects are caused by the TSP fraction (20 µm to 75 µm in diameter) resulting in soiling of materials and visibility reductions. This could in effect also have financial implications due to the requirement for more cleaning materials.

Activities resulting in the release of these pollutants include topsoil removal, material loading and hauling, stockpiling, grading, bulldozing, as well as metal and concrete works for the establishment of infrastructure. Each of these operations has its own duration and potential for dust generation. It is anticipated that the extent of dust emissions would vary substantially from day to day depending on the level of activity, the specific operations, and the prevailing meteorological conditions. This contrasts with most other fugitive dust sources where emissions are either relatively steady or follow a discernible annual cycle. It is often necessary to estimate area wide construction emissions, without regard to the actual plans of any individual construction process.

Quantified construction emissions are usually lower than operational phase emissions and since the construction schedule was not available (and due to their temporary nature); and the likelihood that these activities will not occur concurrently at all portions of the site; dispersion simulation was not undertaken for construction emissions.

9.3.9.2 OPERATIONAL PHASE AIR QUALITY IMPACTS

A specific concern is windblown dust from the Nooitgedacht TSF resulting in dust deposits and potentially health impacts in the nearby residential area of Welkom and surrounding AQSRs. Wind-blown dust from mine waste facilities can be a significant source of dust emissions with high dust concentrations reported near mining sites, affecting both the environment and human health. A number of studies have been conducted on the impact from mine tailings – specifically gold mine tailings – on residential areas around and close to the base of these tailings facilities (Ojelede et al., 2012; Phakedi, 2011; Annegarn, 2006; Annegarn et al., 2000; 2010). These studies indicated that slimes dams in close proximity to human settlements pose a health risk, with measured PM10 concentrations during storm events reported to be between 171 µg/m³ and 462 µg/m³ (Ojelede et al., 2012).

Aside from the concern for dust impacts, the metal content in the slimes pose potential health risks. A study conducted by Maseki (2013) found a range of heavy metals within four gold slimes dams assessed – these included amongst others potassium (K), chromium (Cr) manganese (Mn), nickel (Ni), cadmium (Cd), gold (Au), lead (Pb), Iron (Fe), zinc (Zn), arsenic (As) and uranium (U). In addition, radionuclides are also associated with gold mine tailings.

Wind erosion is a complex process, including three different phases of particle entrainment, transport and deposition. It is primarily influenced by atmospheric conditions (e.g. wind, precipitation and temperature), soil properties (e.g. soil texture, composition and aggregation), land-surface characteristics (e.g. topography, moisture, aerodynamic roughness length, vegetation and non-erodible elements) and land-use practice (e.g. farming, grazing and mining) (Shao, 2008).

Windblown dust generates from natural and anthropogenic sources. For wind erosion to occur, the wind speed needs to exceed a certain threshold, called the friction velocity. This relates to gravity and the inter-particle cohesion that resists removal. Surface properties such as soil texture, soil moisture and vegetation cover

influence the removal potential. Conversely, the friction velocity or wind shear at the surface is related to atmospheric flow conditions and surface aerodynamic properties. Thus, for particles to become airborne the wind shear at the surface must exceed the gravitational and cohesive forces acting upon them, called the threshold friction velocity (Shao, 2008).

The US EPA indicates a friction velocity of 5.4 m/s to initiate erosion from coal storage piles (US EPA, 2006) and Mian & Yanful (2003) calculated a wind speed in excess of 9 m/s is required to initiate wind erosion from two tailings storage facilities in in New Brunswick and Ontario, Canada. Thus, the likelihood exists for wind erosion to occur from open and exposed surfaces, with loose fine material, when the wind speed exceeds at least 5.4 m/s.

As indicated, any binding properties would reduce the potential for wind erosion. One of the most effective measures of minimizing wind erosion emissions from tailings storage facilities is re-vegetation. The control efficiency of vegetation is given as 40% for non-sustaining vegetation and 90% for re-vegetation. Secondary rehabilitation would up the control efficiency to 60% for non-sustaining vegetation (NPI, 2012). The proposed TSF would not be covered during operations and therefore pose the largest risk for wind-blown dust.

Isopleth contour plots for simulated highest daily and annual average PM10 concentrations for the project unmitigated scenario are provided in Figure 52 and Figure 53 respectively. Simulated highest daily and annual average PM2.5 concentrations for the project scenario are provided in Figure 54 and Figure 55 respectively. Simulated ground level concentrations at AQSRs are provided in Table 32 and Table 33 for PM10 and PM2.5 respectively. Highest daily dustfall rates are provided in Figure 56 and Table 34.

Since plants are constantly exposed to air, they are the primary receptors for both gaseous and particulate pollutants of the atmosphere. In terrestrial plant species, the enormous foliar surface area acts as a natural sink for pollutants especially the particulate ones. Vegetation is an effective indicator of the overall impact of air pollution particularly in context of PM (Rai, 2016). After deposition onto vegetation, the effect of particulate matter depends on the composition of the dust. South African ambient standards are set in terms of PM2.5 and PM10 but internationally it is recognised that there are major differences in the chemical composition of the fine PM (the fraction between 0 and 2.5 µm in aerodynamic diameter) and coarse PM (the fraction between 2.5 µm and 10 µm in aerodynamic diameter). The former is often the result of chemical reactions in the atmosphere, whereas the latter often consists of primary particles due to abrasion, crushing, soil disturbances and wind erosion (Grantz, Garner, & Johnson, 2003). The project impact on vegetation is illustrated in Figure 56, with the green impact area showing plant exposure to dust fall rates greater than 400 mg/m²-day. These simulation consider the prevailing baseline air quality and therefore represent a cumulative impact.

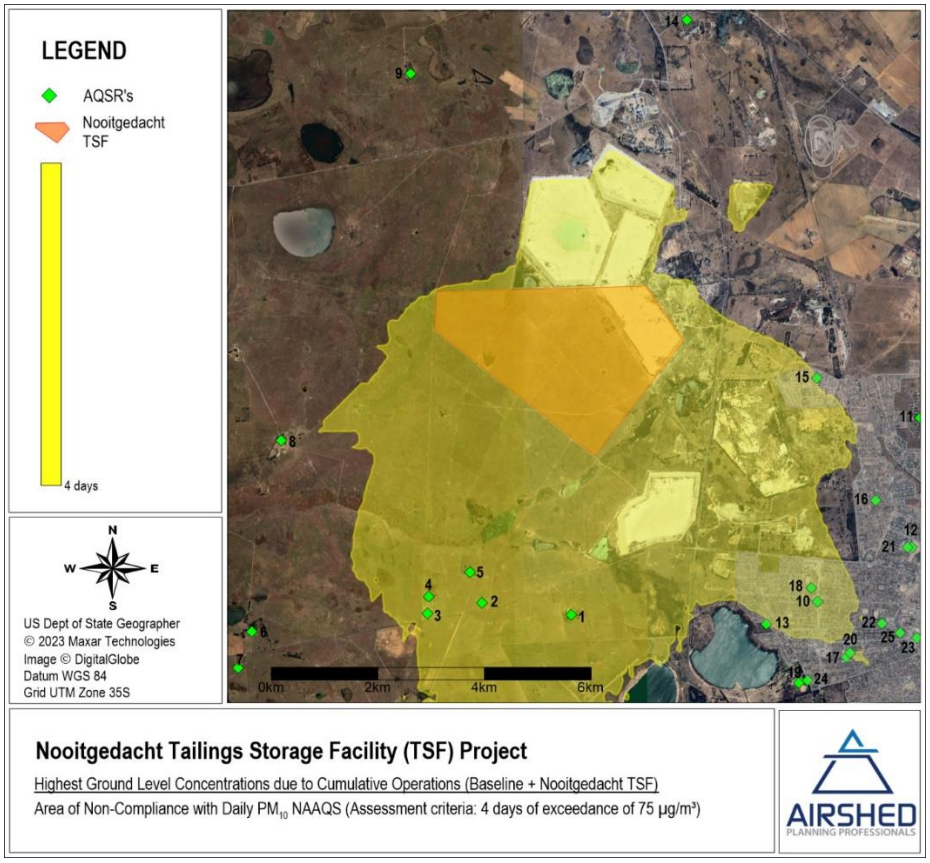


Figure 52: Project scenario – Area of non-compliance with daily PM_{10} NAAQS (unmitigated)

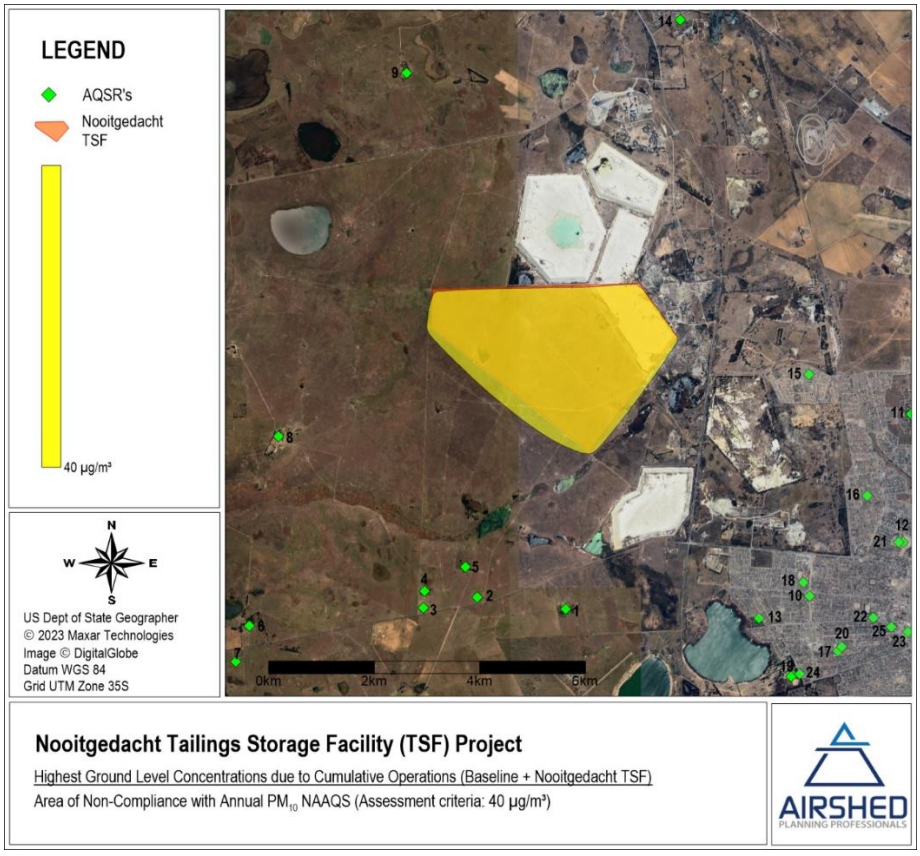


Figure 53: Project scenario – Area of non-compliance with annual PM_{10} NAAQS (unmitigated)

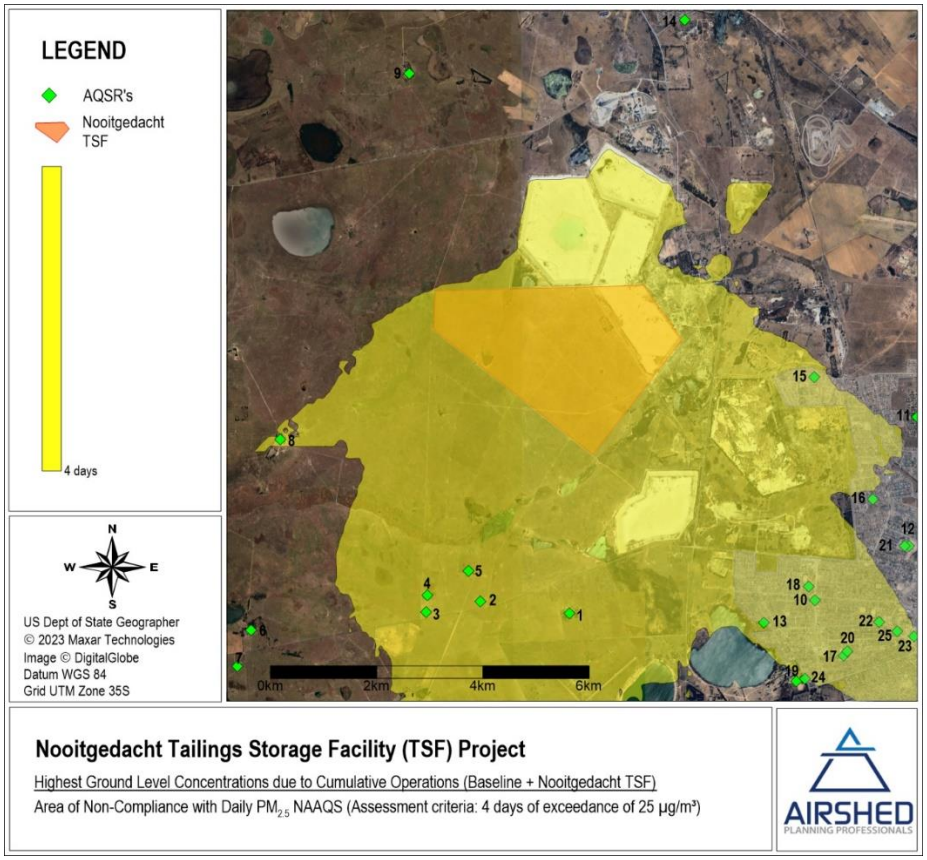


Figure 54: Project scenario – Area of non-compliance with daily $PM_{2.5}$ NAAQS (unmitigated)

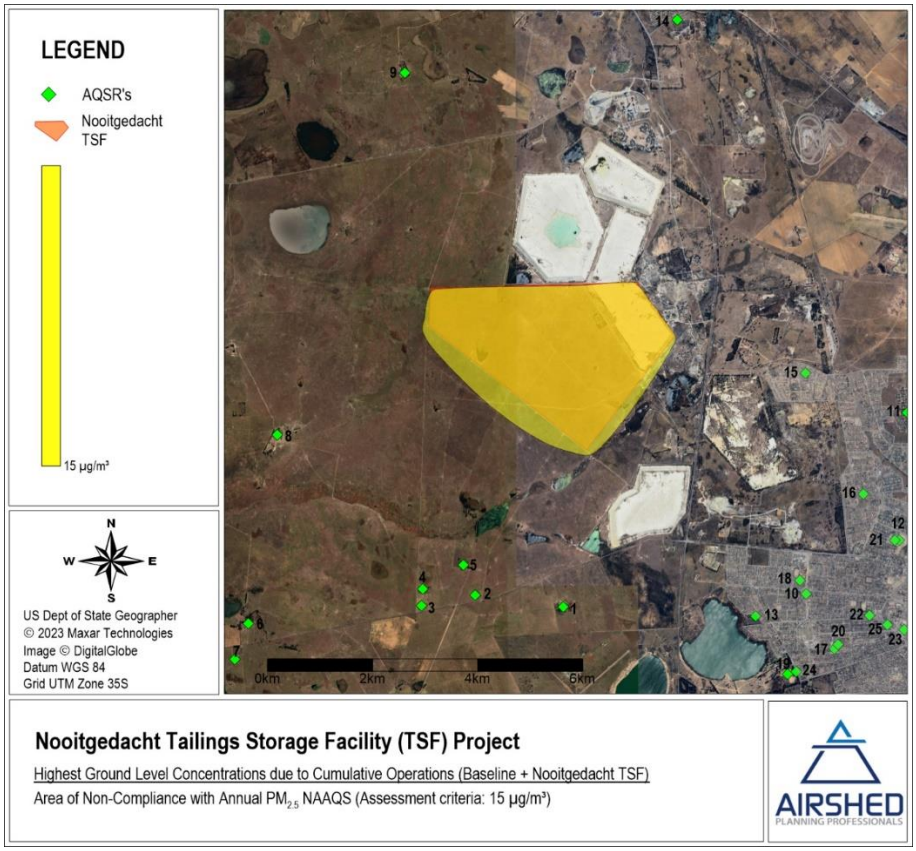


Figure 55: Project scenario – Area of non-compliance with annual $PM_{2.5}$ NAAQS (unmitigated)

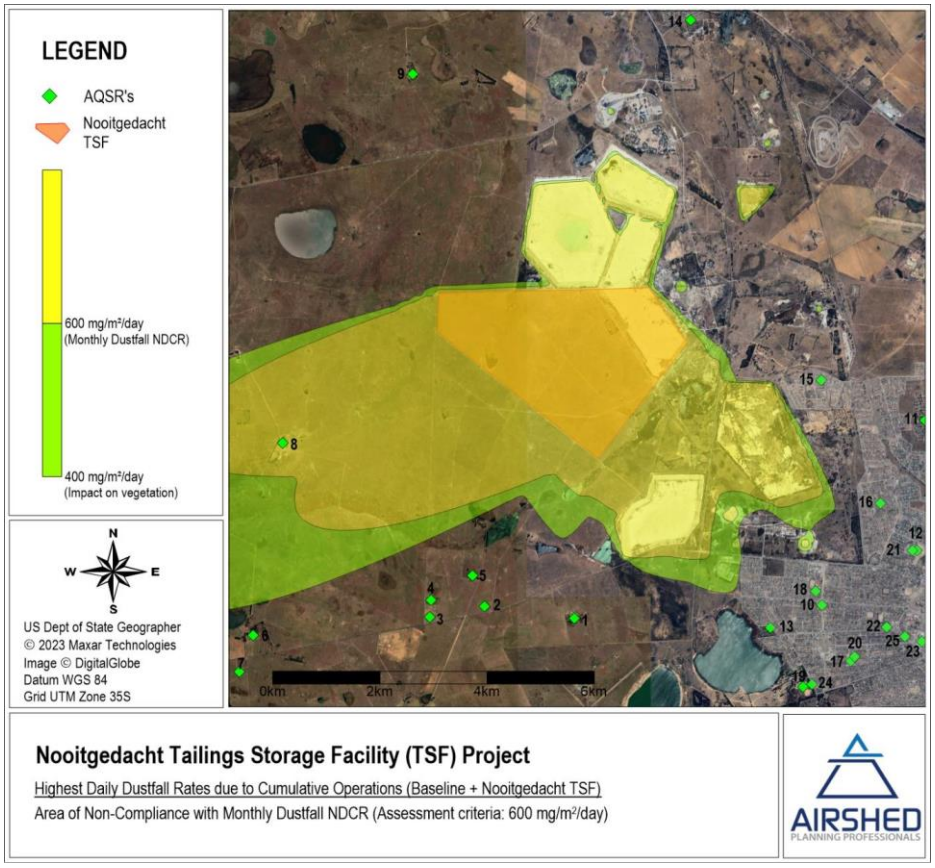


Figure 56: Project scenario – Area of non-compliance with monthly dustfall NDCR (unmitigated)

Table 32: Simulated AQSR PM_{10} concentrations (in µg/m³) due to project operations (unmitigated)

AQSRs	Name	Highest Daily	Annual	No of Exceedances	Compliance (Yes/No)
	NAAQS	**75**	**40**	**4**	**-**
AQSR1	Farmstead 1	360.66	2.38	5	No
AQSR2	Farmstead 2	340.65	3.13	5	No
AQSR3	Farmstead 3	194.97	2.39	4	Yes
AQSR4	Farmstead 4	203.82	2.65	5	No
AQSR5	Farmstead 5	348.92	3.46	7	No
AQSR6	Farmstead 6	467.77	2.40	1	Yes
AQSR7	Farmstead 7	272.77	1.73	0	Yes
AQSR8	Farmstead 8	1125.40	6.13	3	Yes
AQSR9	Farmstead 9	1.07	0.11	0	Yes
AQSR10	Bedelia	650.48	2.42	6	Yes
AQSR11	Flamingo Park	240.01	1.34	1	Yes
AQSR12	Jim Fouche Park	152.68	1.17	3	Yes
AQSR13	Lakeview	941.73	3.19	4	Yes
AQSR14	Odendaalsrus	0.85	0.12	0	Yes
AQSR15	Rheederpark	319.08	2.00	4	Yes
AQSR16	Seemeeu Park	192.28	1.89	3	Yes
AQSR17	St Helena	541.21	1.97	4	Yes
AQSR18	Bedelia Primary School	687.56	2.58	6	No
AQSR19	St Andrew's School	648.76	2.24	3	Yes

AQSRs	Name	Highest Daily	Annual	No of Exceedances	Compliance (Yes/No)
AQSR20	St Helena School	526.13	1.94	4	Yes
AQSR21	Welkom Gymnasium School	157.90	1.20	3	Yes
AQSR22	Welkom Preparatory School	449.53	1.71	3	Yes
AQSR23	Mediclinic Welkom Hospital	359.87	1.33	3	Yes
AQSR24	St Helena Private Hospital	654.31	2.24	3	Yes
AQSR25	Welkom Sub-Acute Hospital	405.24	1.51	3	Yes

Table 33: Simulated AQSR $PM_{2.5}$ concentrations (in µg/m³) due to project operations (unmitigated)

AQSRs	Name	Highest Daily	Annual	No of Exceedances	Compliance (Yes/No)
	NAAQS	**25**	**15**	**4**	**-**
AQSR1	Farmstead 1	72.63	1.11	6	No
AQSR2	Farmstead 2	88.12	1.47	8	No
AQSR3	Farmstead 3	65.82	1.12	7	No
AQSR4	Farmstead 4	70.93	1.24	7	No
AQSR5	Farmstead 5	101.32	1.63	8	No
AQSR6	Farmstead 6	97.45	1.13	2	Yes
AQSR7	Farmstead 7	54.69	0.81	0	Yes
AQSR8	Farmstead 8	150.32	2.89	4	Yes
AQSR9	Farmstead 9	0.38	0.05	0	Yes
AQSR10	Bedelia	108.69	1.12	7	No
AQSR11	Flamingo Park	29.33	0.63	4	Yes
AQSR12	Jim Fouche Park	39.28	0.55	3	Yes
AQSR13	Lakeview	155.58	1.48	6	No
AQSR14	Odendaalsrus	0.33	0.05	0	Yes
AQSR15	Rheederpark	45.50	0.93	5	No
AQSR16	Seemeeu Park	51.66	0.88	3	Yes
AQSR17	St Helena	89.42	0.92	6	No
AQSR18	Bedelia Primary School	115.42	1.19	7	No
AQSR19	St Andrew's School	107.30	1.05	4	Yes
AQSR20	St Helena School	87.12	0.91	6	No
AQSR21	Welkom Gymnasium School	40.01	0.56	3	Yes
AQSR22	Welkom Preparatory School	75.63	0.80	6	No
AQSR23	Mediclinic Welkom Hospital	61.75	0.62	5	No
AQSR24	St Helena Private Hospital	108.26	1.05	4	Yes
AQSR25	Welkom Sub-Acute Hospital	68.52	0.70	5	No

Table 34: Simulated AQSR dustfall rates (in mg/m²/day) due to Project operations (unmitigated)

AQSRs	Name	30-day average
	NDCR	**600**

AQSRs	Name	30-day average
AQSR1	Farmstead 1	130.69
AQSR2	Farmstead 2	209.00
AQSR3	Farmstead 3	139.04
AQSR4	Farmstead 4	143.11
AQSR5	Farmstead 5	207.62
AQSR6	Farmstead 6	305.26
AQSR7	Farmstead 7	211.16
AQSR8	Farmstead 8	763.14
AQSR9	Farmstead 9	3.84
AQSR10	Bedelia	210.84
AQSR11	Flamingo Park	117.35
AQSR12	Jim Fouche Park	100.84
AQSR13	Lakeview	285.59
AQSR14	Odendaalsrus	2.76
AQSR15	Rheederpark	159.26
AQSR16	Seemeeu Park	192.10
AQSR17	St Helena	174.40
AQSR18	Bedelia Primary School	223.71
AQSR19	St Andrew's School	205.08
AQSR20	St Helena School	171.26
AQSR21	Welkom Gymnasium School	102.28
AQSR22	Welkom Preparatory School	162.49
AQSR23	Mediclinic Welkom Hospital	117.33
AQSR24	St Helena Private Hospital	204.23
AQSR25	Welkom Sub-Acute Hospital	140.07

Simulated PM10 and PM2.5 concentrations due to baseline operations were well within NAAQS at the closest identified sensitive receptors. The simulated dust deposition was within NDCR for residential areas at the closest sensitive receptors.

Simulated PM10 concentrations due to unmitigated project operations exceeded the daily PM10 NAAQS at five (5) of the 25 closest identified sensitive receptors, whereas simulated PM2.5 concentrations exceeded the post-2030 daily PM2.5 NAAQS at 14 of the 25 closest identified sensitive receptors. Annual average PM10 and PM2.5 concentrations were within the respective NAAQSs at all receptors. The simulated dust deposition exceeded the NDCR for residential areas at one (1) of the 25 closest sensitive receptors.

In assessing the **mitigated** impact, it was assumed that the slopes of the Nooitgedacht TSF was vegetated, and a control efficiency of 80% was achieved. Isopleth contour plots for simulated highest daily PM10 and PM2.5 concentrations for the mitigated project scenario are provided in Figure 57 and Figure 58 respectively. Highest daily dustfall rates are provided in Figure 59.

Simulated PM10 and PM2.5 concentrations due to mitigated operations were within NAAQS at the closest identified sensitive receptors. The simulated dust deposition was within NDCR for residential areas at the closest sensitive receptors.

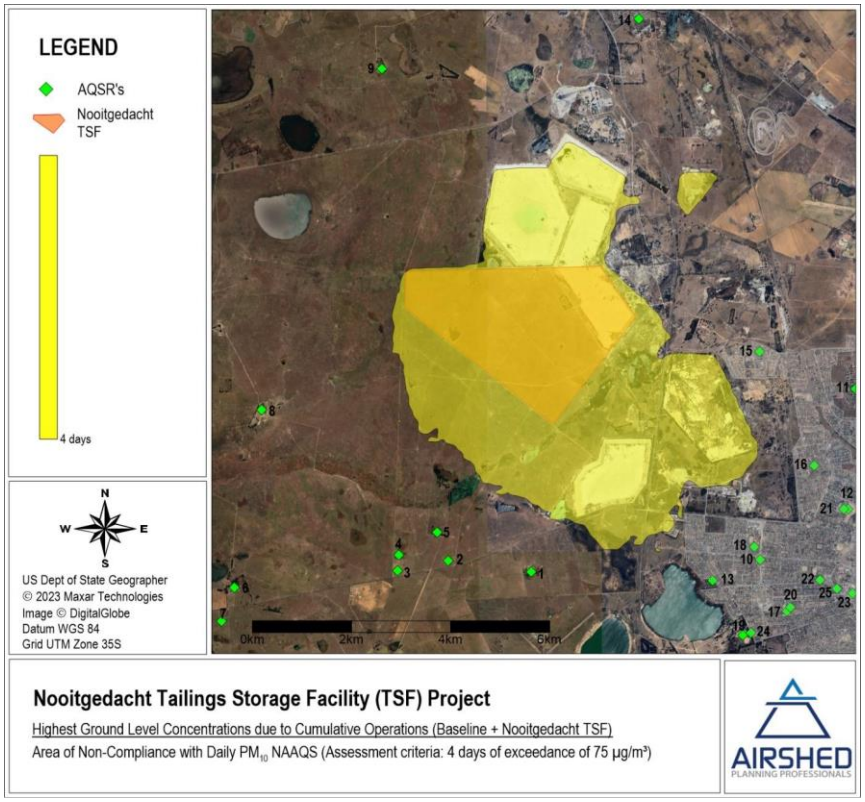


Figure 57: Area of non-compliance with daily PM10 NAAQS (mitigated)

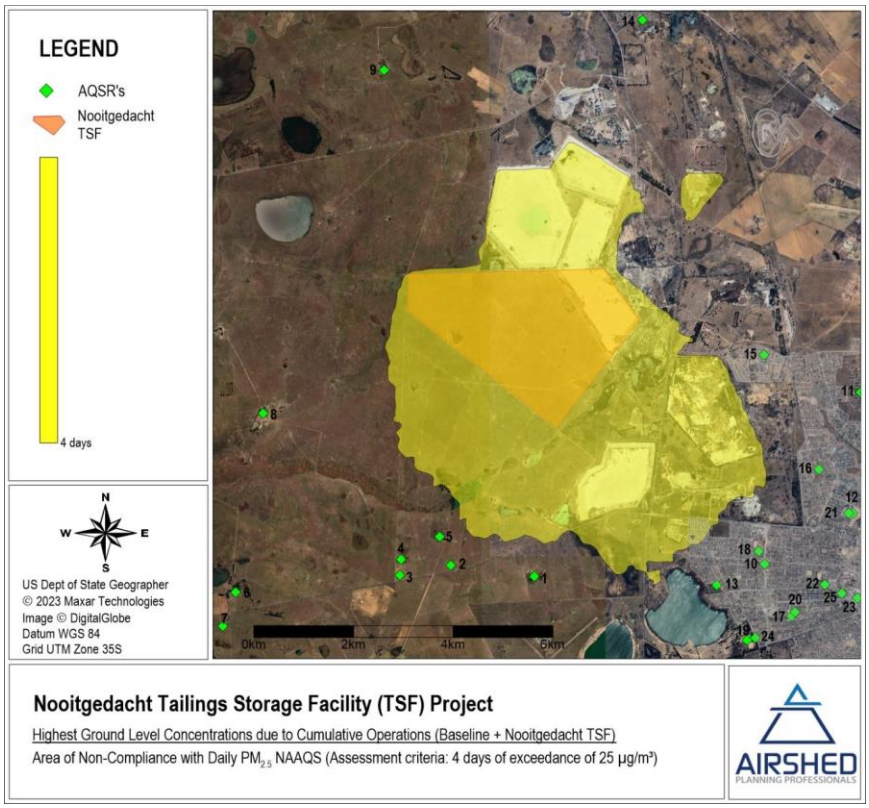


Figure 58: Area of non-compliance with daily PM2.5 NAAQS (mitigated)

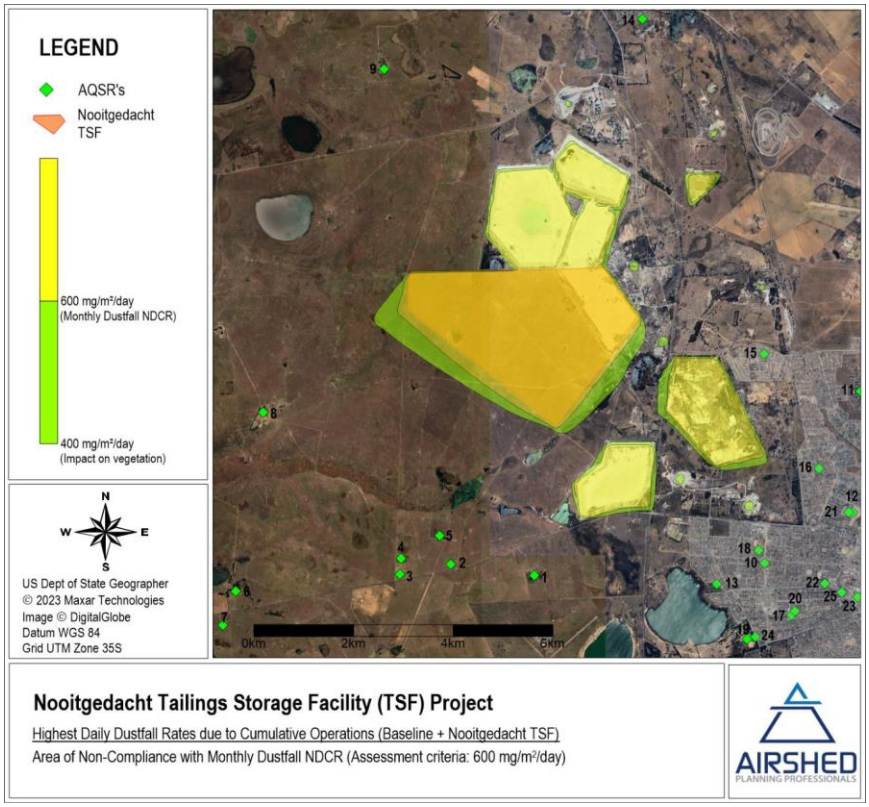


Figure 59: Area of non-compliance with monthly dustfall NDCR (mitigated)

9.3.9.3 CLOSURE PHASE AIR QUALITY IMPACTS

All operational activities will have ceased by the closure (decommissioning and post-closure) phase of the project. This will result in a positive impact (relative to operations) on the surrounding environment and human health. The potential for impacts during the closure phase will therefore depend on the extent of rehabilitation efforts to be undertaken at the Nooitgedacht TSF. In general, a combination of soil or rock covers in association with vegetation offers the most protection and stability to the often highly erosive tailings material.

During construction of the vegetative cover, earth and civil works are likely to generate vehicle and wind entrained dust from deposition of material on the TSF. Although the impact is likely to be site-specific, dust suppression techniques such as wetting roads, or application of dust palliatives, are required. Once vegetated the potential for wind entrained particulates should become similar to background conditions.

9.3.9.4 AIR QUALITY MITIGATION MEASURES

The establishment of objectives and targets with regards to fugitive emissions are important to minimise the impacts of these emissions on the surrounding environment. Key performance indicators against which progress of implemented mitigation and management measures may be assessed, form the basis for all effective environmental management practices. In the definition of key performance indicators careful attention is usually paid to ensure that progress towards their achievement is measurable, and that the targets set are achievable given available technology and experience.

9.3.9.4.1 DUST MANAGEMENT MEASURES

A Dust Management Plan (DMP) for the Nooitgedacht operations should be compiled to follow an iterative process, including: implementation, monitoring, reporting, reviewing and adjustment to the necessary steps. Any approach that either binds the particles together and make it more resistant to wind erosion or reduce to the force of the wind will result in a reduction in windblown dust emissions. Surface treatment techniques to reduce dust generation include: wet suppression, chemical stabilisation, covering of surface with less erodible aggregate material and the vegetation of open areas. Wet suppression (the use of sprinklers) can achieve results in the short-term but will require constant maintenance and management to remain effective.

Substantial research has been done on erosion from gold mine tailings. Parameters which have the potential to impact on the rate of emission of fugitive dust include the extent of surface compaction, moisture content, ground cover, the shape of the storage pile, particle size distribution, wind speed and precipitation. Any factor that binds the erodible material, or otherwise reduces the availability of erodible material on the surface, decreases the erosion potential of the fugitive source. High moisture contents, whether due to precipitation or deliberate wetting, promote the aggregation and cementation of fines to the surfaces of larger particles, thus decreasing the potential for dust emissions. Surface compaction and ground cover similarly reduces the potential for dust generation (Burger et al., 1997).

Rock cladding or armouring of the sides of tailings dams has been shown in various international studies to be effective in various instances in reducing wind erosion of slopes. Cases in which rock cladding has been found to be effective in this regard generally involve rock covers of greater than 0.5 m in depth (Ritcey, 1989; Jewell and Newson, 1997). The application of a 300 mm layer of fine rock was found to be the most successful of the non-vegetative measures, resulting in an erosion control efficiency of 90% if the base is levelled and compacted – wind erosion is considered to reduce by 100% through the addition of such a rock cover. In addition, screens could be installed on the crest of the tailings dam walls mainly to act as windbreaks and to reduce the potential for dust deposition on the vegetated side walls, hence curbing the growth of the grass.

Vegetation is also considered the most effective control measure in terms of its ability to also control water erosion. In investigating the feasibility of vegetation types the following properties are normally taken into account: indigenous plants; ability to establish and regenerate quickly; proven effective for reclamation elsewhere; tolerant to the climatic conditions of the area; high rate of root production; easily propagated by seed or cuttings; and nitrogen-fixing ability. The long-term effectiveness of suitable vegetation selected for the site will be dependent on (a) the nature of the cover, and (b) the availability of aftercare. The use of vegetation cover should be investigated and implemented to address this impact.

9.3.9.4.2 PERFORMANCE INDICATORS

Source monitoring at operational activities can be challenging due to the fugitive and wind-dependent nature of particulate emissions. The focus is therefore rather on receptor-based performance indicators i.e. compliance with ambient air quality standards and dustfall regulations.

It is recommended that the current dustfall monitoring network be maintained and the monthly dustfall results used as indicators to tract the effectiveness of the applied mitigation measures. Dustfall collection should follow the ASTM method as per the NDCRs. The ASTM method covers the procedure of collection of dustfall and its measurement and employs a simple device consisting of a cylindrical container exposed for one calendar month (30 ±2 days). The method provides for a dry bucket, which is advisable in the dry environment. The cause of the high dustfall rates should be investigated and these levels should be reduced to be within compliance with the NDCR.

Periodic inspections and external audits are essential for progress measurement, evaluation, and reporting purposes. It is recommended that site inspections and progress reporting be undertaken at regular intervals (at least quarterly), with annual environmental audits being conducted. Annual environmental audits should be continued at least until closure. Results from site inspections and monitoring efforts should be combined to determine progress against source- and receptor-based performance indicators. Progress should be reported to all interested and affected parties (I&APs), including authorities and persons affected by pollution.

Stakeholder forums provide possibly the most effective mechanisms for information dissemination and consultation. Management plans should stipulate specific intervals at which forums will be held and provide information on how people will be notified of such meetings. Given the proximity of the study site to the nearby communities and farmsteads, it is recommended that such meetings be scheduled and held at least on an annual basis. A complaints register must be kept at all times.

Financial provision budget should provide a clear indication of the capital and annual maintenance costs associated with dust control measures and dust monitoring plans. It may be necessary to make assumptions about the duration of aftercare prior to obtaining closure. This assumption must be made explicit so that the financial plan can be assessed within this framework. Costs related to inspections, audits, environmental

reporting and I&APs liaison should also be indicated where applicable. Provision should also be made for capital and running costs associated with dust control contingency measures and for security measures. The financial plan should be audited by an independent consultant, with reviews conducted on an annual basis.

9.3.10 IMPACT ON CLIMATE CHANGE

At the time of drafting this scoping report the climate change study has not been completed. This study will form part of the EIA report. Local reporting requirements have yet to be developed to describe and assess environmental impacts for GHGs. Guidance is thus taken from international guidelines such as that developed for the Sacramento Metropolitan Air Quality Management District (SMAQMD, 2014). As part of the process to determine if a full GHG analysis and mitigate programme is required, an Initial Study is implemented to determine if a project may have a significant effect on the environment. As such a threshold of 1.1 Gg CO_2e (project construction phase) and 10 Gg CO_2e (operational phase) for stationary source projects per year is applied to new projects (SMAQMD, 2014). These thresholds were based on capturing 90% of the development projects across the state, ensuring that small projects, which generally have low emission levels, and would generally not be considered significant. As an alternative method of measure, a GHG threshold may be based on the classification of projects by the European Bank for Reconstruction and Development (EBRD), in which projects contributing more than 25 Gg CO_2e per year to have significant GHG emissions (EBRD 2019). This is in line with the International Finance Corporation (IFC 2012). Section 8 of the IFC Performance Standards on Environmental and Social Sustainability: "For projects that are expected to or currently produce more than 25 000 Gg CO_2e annually the client will quantify direct emissions from the facilities owned or controlled within the physical project boundary, as well as indirect emissions associated with the off-site production of energy used by the project. Quantification of GHG emissions will be conducted by the client annually in accordance with internationally recognised methodologies and good practice". In terms of the Equator Principles, a developer that is seeking funding from a financial institution that subscribes to the Equator Principles is required to publicly report on its combined Scope 1 and Scope 2 GHG emissions if it exceeds 100 Gg CO_2e annually, for the operational phase of the project, during the life of the loan (Equator Principles, 2013). The Equator Principles also encourage clients to report publicly on projects emitting over 25 Gg CO_2e, in line with the IFC Performance Standards (Equator Principles, 2013). As a further example, the South African Declaration of Greenhouse Gases as Priority Pollutants (Government Gazette 40966 of 21 July 2017) define production processes in Annexure A of the Declaration with the requirement to submit a Pollution Prevention Plan (PPP) to the Minister for approval with GHG in excess of 100 Gg CO_2e.

When evaluating significance, all new GHG emissions contribute to a negative environmental impact; however, some projects could replace existing development or baseline activity that has a higher GHG profile. Therefore, the significance of a project's emissions should be based on its net impact over its lifetime, which may be positive, negative or negligible. To meet the South African (SA) NDC targets and interim budgets, action is required to reduce GHG emissions from all sectors, including projects in the built and natural environment. The proposed project must therefore consider whether and how the project will contribute to or jeopardise the achievement of these targets. Such an assessment would however require a much broader evaluation of the project against all current energy mix and their resources practiced in South Africa. In the absence of such a comprehensive assessment, the current assessment will rely on using thresholds to define the significance of the GHG impact.

The proposed intensity rating for annual emissions is as follows:

- 25 Gg CO_2e : Very Low (i.e., threshold used by EBRD, IFC and Equator Principals)
- 25 – 100 Gg CO_2e : Low (i.e., DFFE PPP requirement threshold is 100 Gg CO_2e)
- 100 – 500 Gg CO_2e : Medium (i.e., DFFE PPP to 0.1% of the total gross SA GHG emissions)
- 500 – 5 000 Gg CO_2e : High (i.e., 0.1% to 1.0% of the total gross SA GHG emissions)
- >5 000 Gg CO_2e : Very High (i.e., more than 1.0% of the total gross SA GHG emissions)

The combined GHG emissions for project construction operations will be provided in the EIA report and have not yet been calculated.

9.3.10.1 **CLIMATE MITIGATION MEASURES**

Harmony will be required to report carbon dioxide equivalent (CO_2e) emissions annually via the NAEIS. Additional mitigation will be provided in the EIA report if required based on the recommendations from the Climate Change specialist study once completed.

9.3.11 HEALTH AND RADIATION IMPACTS

The main objective of the radiological public safety assessment is to assess the potential impact on members of the public that may occur during the operational phase of the Projects, with due consideration of the impact that may occur during the post-closure phase. How members of the public are exposed to ionising radiation induced by the Projects may be different depending on the operational conditions and the specific point in time (either present or future).

Sources of radiation exposure to members of the public associated with mining and mineral processing facilities are often advertently induced. Although the key elements responsible for radiation exposure are naturally occurring radionuclides, human-induced conditions and activities may enhance concentrations of naturally occurring radionuclides in the accessible environment. Alternatively, the potential for human exposure to naturally occurring radionuclides in products, by-products, residues, and other wastes may be enhanced by moving these radionuclides from inaccessible locations to locations where humans can be subject to radiation exposure.

To pose a radiological risk to members of the public and the environment, the naturally occurring radionuclides must first be released from the sources of radiation exposure into the environment. As used here, sources refer to any entity that contains radioactivity and has the potential to release radioactivity into the environment. Release mechanisms can be generalised into the following natural and human-induced conditions:

- The release of radionuclides through natural conditions:
    - Solid release (e.g., windblown dust);
    - Water-mediated release (e.g., leaching through tailings storage facility); and
    - Gas-mediated release (e.g., radon gas exhalation).
- Direct gamma radiation; and
- Controlled or uncontrolled releases of radionuclides as solids or liquids into the environment.

Controlled releases are human-induced as part of the normal operating conditions, while uncontrolled releases are associated with accidents and incidents that are outside the scope of normal operating conditions (e.g., excessive water erosion, pipeline bursts, releases from storage dams overflowing their capacity, or the breaking of dam walls).

A distinction can be made between primary and secondary sources of radiation exposure. The primary sources are associated with physical features or entities at a mining and mineral processing operation, with the potential of naturally occurring radionuclides to be released into the environment. Examples of primary sources that are generally associated with mining and mineral processing opera0tions include:

- Tailings Storage Facilities (TSFs), Waste Rock Dumps (WRDs) or any other stockpile facility used to store waste or other residue material on the surface, from which naturally occurring radionuclides may be dispersed in solid (dust), liquid (seepage), or gaseous (radon gas) form;
- Open pits that developed following open cast mining to extract rock or minerals from the orebody, from which naturally occurring radionuclides may be dispersed in solid (dust), liquid (seepage), or gaseous (radon gas) form;
- Mineral processing activities, where radioactive gasses and dust may be released from the commination (e.g., crushing, milling, and screening) and beneficiation of ore containing radionuclides;

- Water management facilities (e.g., return water dams, process control dams, and evaporation ponds), used to manage excess water generated through mining, mineral processing, and residue disposal activities, and where water may be released to the environment;
- Materials handling activities (e.g., the transfer of material containing naturally occurring radionuclides from one point or facility to another), during which radioactive dust may be released to the environment; and
- Mine ventilation shafts increase airflow in underground workings, where gasses and dust generated underground may be released with the outflowing air.

Radioactivity released from the primary sources into the environment may accumulate in the physical compartments of the environmental system (e.g., groundwater, surface water bodies, surface soils, sediments, etc.), potentially resulting in what can be termed secondary sources of radiation exposure. The following serve as examples of secondary radiation sources:

- Continuous deposition and accumulation of naturally occurring radionuclides associated with airborne dust or contaminated irrigation water on surface soils, resulting in the development of a secondary source at the soil surface;
- Continuous deposition of naturally occurring radionuclides associated with airborne dust in a surface water body, resulting in the development of a secondary source in the sediments and surface water body;
- Uncontrolled release of contaminated mine residue (e.g., tailings material) through surface water erosion of existing TSFs or other stockpile facilities;
- Uncontrolled release (e.g., spillage) of contaminated mine residue (e.g., tailings material) or water on surface soils from pipelines or storage dams, resulting in the development of a secondary source at the soil surface; or
- Uncontrolled release (e.g., spillage) of contaminated mine residue (e.g., tailings material) or water in a surface water body from pipelines or storage dams (as appropriate), resulting in the development of a secondary source in the sediments and surface water body.

Members of the public may potentially be subject to radiation exposure from both primary and secondary sources at a mining and mineral processing operation, with expected differences in modes and duration of exposure.

9.3.11.1 CONSTRUCTION PHASE RADIOLOGICAL IMPACTS

The proposed Nooitgedacht TSF is a new facility and infrastructure (e.g., TSF, pipelines, LP water system and topsoil stockpiles). To establish this infrastructure, some construction work will be necessary, including site clearance and footprint preparation for the TSF extension areas and the construction or upgrade of access roads.

Activities performed in these areas during the construction phase will not induce a potential radiological impact on members of the public since the activities do not involve the handling, processing, or releasing of radioactive material to the environment per se. This means that the potential radiological impact on members of the public through the relevant pathway during the construction phase is negligible.

9.3.11.2 OPERATIONAL PHASE RADIOLOGICAL IMPACTS

The radiological impact assessment for the operational phase considers the potential contribution through all three environmental pathways (i.e., surface water, groundwater and atmospheric). However, due to the slow-moving nature of any radionuclide contaminant plume that originates from the facilities through the groundwater system, the potential radiological impact through the groundwater pathway will only occur during the post-closure.

During the operational phase, the following activities were identified that may result in a radiological impact on members of the public:

- Emission and dispersion of particulate matter containing radionuclides from the existing and proposed TSFs: During the operational phase wind erosion will serve as a source of windblown dust (i.e., wind erosion) to the atmosphere for the duration of the operational period. These particulate matter containing radionuclides are dispersed into the environment through the atmospheric pathways. The emission and subsequent dispersion of the particulate matter into the atmosphere results in an airborne radionuclides concentration associated with the PM10, and a soil radionuclides concentration following the deposition of the TSP. Through secondary pathways, the radionuclides in the soil may be transferred to crops and animal products. Contributions to the total effective dose to receptors identified for the Projects include inhalation of airborne dust, ingestion of contaminated soil, crops and animal products, and external gamma radiation through cloud shine and ground shine; and
- Exhalation and dispersion of radon gas from the existing and proposed Nooitgedacht TSF: During the operational phase, radon gases are generated in the tailings material at the TSF areas due to the presence of Ra-226 This means that these gases are exhaled continuously from this facility into the atmosphere.

9.3.11.3 POST-CLOSURE RADIOLOGICAL IMPACTS

Before the actual closure of the proposed Nooitgedacht TSF and as part of the anticipated licensing conditions and requirements, a decommissioning and closure plan will be prepared for submission and approval by the regulatory authorities. Amongst others, this plan will define in detail all the activities that will be performed and how the associated radiological impact during the decommissioning and closure phase will be managed.

The following activities were identified that may result in a radiological impact on the receptors during the post-closure phase:

- Implementation of the approved decommissioning plan;
- Exhalation of radon gas and the emission of particulates matter (PM10 and TSP) that contain radionuclides from the remaining facilities (e.g., TSF); and
- Leaching and migration of radionuclides from the remaining facilities (e.g., TSF).

The implementation of the National Nuclear Regulator (NNR)-approved decommissioning plan will result in a positive impact (relative to the operating scenario) in the sense that all surface infrastructure that contained or that is contaminated with radionuclides is demolished, decontaminated (to the extent possible) and removed from the site and compliance with clearance criteria has been demonstrated.

A gamma radiation survey supplemented with full-spectrum radioanalysis of soil samples will be performed at the infrastructure sites, followed by appropriate rehabilitation and clean-up operations for conditional or unconditional clearance from the regulatory authority. In addition, any area that may have become contaminated during or because of operational activities will also be rehabilitation and clean-up for conditional or unconditional clearance.

During the post-closure phase, some of the facilities (e.g., TSF) will remain at the surface and continue to serve as sources of radiation exposure to members of the public. These facilities will serve as a source of windblown dust (i.e., wind erosion) to the atmosphere during the post-closure period. During the same period, radon gas generated in the tailings materials due to the presence of Ra-226 will continue to be exhaled into the atmosphere.

The emission and subsequent dispersion of the particulate matter into the atmosphere results in an airborne radionuclides concentration associated with the PM10, and a soil radionuclides concentration following the deposition of the TSP. Through secondary pathways, the radionuclides in the soil may be transferred to crops and animal products. Contributions to the total effective dose to receptors include inhalation of airborne dust, ingestion of contaminated soil, crops and animal products, and external gamma radiation through cloud shine and ground shine. Following the exhalation and subsequent dispersion of the radon gas into the atmosphere, inhalation of the airborne gas contributes to the total effective dose to receptors.

From the commissioning of a TSF, radionuclides contained in the tailings material leach from the TSF to the underlying strata. The rate of leaching is controlled by complex geochemical and hydrological processes but generally is a slow process. Once in the underlying strata, migration of these radionuclides is equally slow along the groundwater flow path. Abstraction of groundwater for personal or agricultural purposes may result in a radiological impact on receptors through direct ingestion of water or the ingestion of crops and animal products as secondary pathways. The radiological impact along the groundwater pathway only manifests itself during the post-closure period hundreds to thousands of years after closure.

9.3.11.4 **RADIOLOGICAL MITIGATION MEASURES**

The following preliminary mitigation is recommended:

9.3.11.4.1 EXHALATION AND DISPERSION OF RADON GASES

For Exhalation and Dispersion of Radon Gases, the management objective would be to first ensure that radiation exposure is below the regulatory compliance criteria (i.e., the dose constraint), and secondly to optimise the radiation protection by applying the ALARA principle (As Low As Reasonable Achievable - economic and social factors taken into consideration).

The total effective dose as a contribution from radon gas released from the tailings material at the TSF areas is well below the regulatory compliance criteria based on conceptual model predictions, which means that from a compliance perspective, no additional management or mitigation measures are required for radon inhalation. From a dose optimisation perspective, the following can be noted:

- The radon exhalation rate from the surface of tailings material is determined by several factors, of which moisture content is one. This means that for the area at a TSF that is wet (i.e., beach area), the radon exhalation rate will be reduced marginally. However, it is not effective to wet the TSF deep enough (2 to 4 m) to reduce the radon exhalation rate marginally.
- The most effective way to reduce the radon exhalation rate for the TSF is to provide a covering layer. This will increase the diffusion length to allow for the decay of the radon progeny before being released from the tailings surface.
- The area around the proposed site for the construction of the concrete water tanks is probability already a mining-related impacted area. However, it is recommended that, before construction commences, the current radiation levels on the site be determined through a site-wide gamma radiation survey. The radiation and dose rate levels would provide a reference point for the rehabilitation of the area at the end of the operational life of the proposed infrastructure.

9.3.11.4.2 EMISSION AND DISPERSION OF PARTICULATE MATTER

For Emission and Dispersion of Particulate Matter, the management objective would be to first ensure that radiation exposure is below the regulatory compliance criteria (i.e., the dose constraint), and secondly to optimise the radiation protection by applying the ALARA principle.

The contribution of dust inhalation is less than 10% (on average) of the total effective dose for all age groups at selected receptor locations based on the conceptual model predictions for operation and post closure phases. This means that from a regulatory compliance perspective, no additional management or mitigation measures are required for dust inhalation. The contribution of external exposure (cloud shine and ground shine) is less than 2% (on average) of the total effective dose for all age groups at selected receptor locations. This means that from a regulatory compliance perspective, no additional management or mitigation measures are required for external gamma radiation. The contribution of animal and crop ingestion is less than 15% (on average) of the total effective dose for all age groups at selected receptor locations. This means that from a regulatory compliance perspective, no additional management or mitigation measures are required for the ingestion pathways.

In addition, the total effective dose at the same receptor locations is less than 5% (on average) of the dose constraint of 250 µSv.year-1 for public exposure.

From a dose optimisation perspective, the following mitigation measures can be applied. These measures, which are in line with the measures proposed in the air quality impact assessment (Airshed, 2023), will contribute to a reduction in the total effective dose if applied for the duration of the operational period:

- Develop an air quality management plan for the proposed Nooitgedacht TSF, including air quality monitoring to ensure compliance at upwind and downwind locations; and
- Vegetation of exposed areas of the TSF and wind barriers to reduce wind erosion and/or the application of dust suppressants.

9.3.11.4.3 POST CLOSURE MITIGATION

For Post-Closure impacts, the management objective would be to first ensure that radiation exposure is below the regulatory compliance criteria (i.e., the dose constraint), and secondly to optimise the radiation protection by applying the ALARA principle.

The total effective dose as a contribution from the windblown dust, as well as radon gas released from the remaining facilities, based on conceptual model predictions, is well below the regulatory compliance criteria (dose constraint), which means that from a compliance perspective, no additional management or mitigation measures are required.

From a dose optimisation perspective, the following mitigation measures that are in line with the measures proposed by the air quality impact assessment (Airshed, 2023) can be applied for the post-closure phase:

- Vegetation of exposed areas of the TSF and wind barriers to reduce wind erosion and/or the application of dust suppressants;
- Covering layer over the exposed area of the TSF areas to reduce wind erosion and radon exhalation; and
- Implementation of a passive groundwater remediation system downstream of the TSF to capture the contaminant plume.

9.3.12 SAFETY AND UNPLANNED EVENTS IMPACTS

9.3.12.1 **DAM FAILURE**

A feasibility dam break analysis was completed by Geotheta using FLO-2D Overland Flood Modelling. The Dam Break Analysis was completed on the Nooitgedacht TSF only. Further assessment will need to be done should the surrounding TSF's breach concurrently. The analysis showed the expected inundation area of the Nooitgedacht TSF, together with the flow depths and mud-flow velocities that would occur in the unlikely event that the facility fails (unplanned risk). The analyses concluded that there would be extensive damage to both the natural environment and infrastructure within the inundation area (Figure 60).

Tailings flowing into the river will result in the loss of aquatic wildlife and decrease in water quality. It is likely that the pollution of the river and loss of aquatic wildlife would have adverse impacts on the ecosystem of the area and also adversely affect users of the water.

The flood event would inundate households and associated infrastructure located near the facility and the populated area to the north east of the Nooitgedacht TSF. The potential population at risk falls between 100 – 1 000, with the potential loss of life not exceeding 100.

The SANS 10286 Code of Practice for Mine Residue, requires that all mine residue deposits be classified into one or a combination of the following safety categories:

- High hazard;
- Medium hazard; and
- Low hazard.

The safety classification of the Nooitgedacht TSF was determined by analysing the zone of influence and applying the safety classification criteria provided in the SANS 10286 Code of Practice for Mine Residue. Based on SANS 10286, the Nooitgedacht TSF has a high hazard classification rating (Table 35).

Table 35: Safety classification criteria

No of residents in zone of influence	No of workers in zone of influence[1]	Value of third party property in zone of influence[2]	Depth to underground mined workings[3]	Classification
0	<10	0-R2 m	>200 m	Low hazard
1-10	11-100	R2 m-R20 m	50 m-200 m	Medium hazard
>10	>100	>R20 m	<50 m	High hazard

1) Not including workers employed solely for the purposes of operating the deposit
2) The value of third party property should be the replacement value in 1996 terms
3) The potential for collapse of the deposit into the underground workings effectively extends the zone of influence to below ground level.

The environmental classification of the TSF is a residue deposit with a significant impact on any environmental component.

Table 36: Environmental classification criteria

Aspect under consideration	Environmental classification		
	Significant	Possibly significant	Not significant
Surface and groundwater	Deposit has potential to contaminate water that may be consumed by humans.	Deposit has potential to contaminate water that may be consumed by flora or fauna.	No contamination of water supplies likely.
Land	Deposit has potential to permanently render surrounding land unsuitable for its pre-existing potential.	Release of residue from the deposit could have a long-term detrimental effect on land.	Release of residue from the deposit can be completely remediated.
Air	Deposit has potential to degrade air quality to a level that is detrimental to human health.	Deposit has potential to elevate dust nuisance (only) to an unacceptable level.	Deposit has negligible potential to adversely affect air quality.
Physical security	Residue has potential to cause injury on release as a result of structural failure. [1]	Residue has potential to cause injury as a result of structural failure [2]	Residue has negligible potential to cause harm through structural failure.
Business environment	Failure of Deposit has potential to result in business failure of operation.	Failure of Deposit has potential to result in significant economic loss.	Low potential for failure of Deposit to result in economic loss.
Social environment	Failure of Deposit could lead to severe adverse publicity, resulting in business failure and impairment of credibility.	Failure of Deposit could lead to adverse publicity, leading to regulatory intervention and/or financial loss.	Failure of Deposit is unlikely to lead to adverse publicity or indirect losses.
Government	Failure of deposits can lead to Harmony receiving directives/penalties.	Possibility of notice	None

The consequence classification of the Nooitgedacht TSF was determined by analysing the zone of influence and applying the consequence classification criteria provided in Table 11 of Global Industry Standard on Tailings Management (GISTM). The Nooitgedacht TSF is categorised as an Extreme Consequence Classification facility due to the impact a failure of this facility would have on the life, environment and infrastructure in the inundation zone modelled during the dam break analysis. The site has a low seismic hazard. The engineers have designed the Nooitgedacht facility to fully withstand a 1:10 000-year earthquake by having a downstream deposited, well drained, outer embankment which will not be saturated and will not fail from seismic activity.

High economic losses affecting infrastructure are anticipated within the zone of influence of the facility. The affected infrastructure comprises the mine's own access road, solution trench, return water dam and the silt trap (all part of this design). Other infrastructure such as farmhouses and nearby mining operations may also be affected.

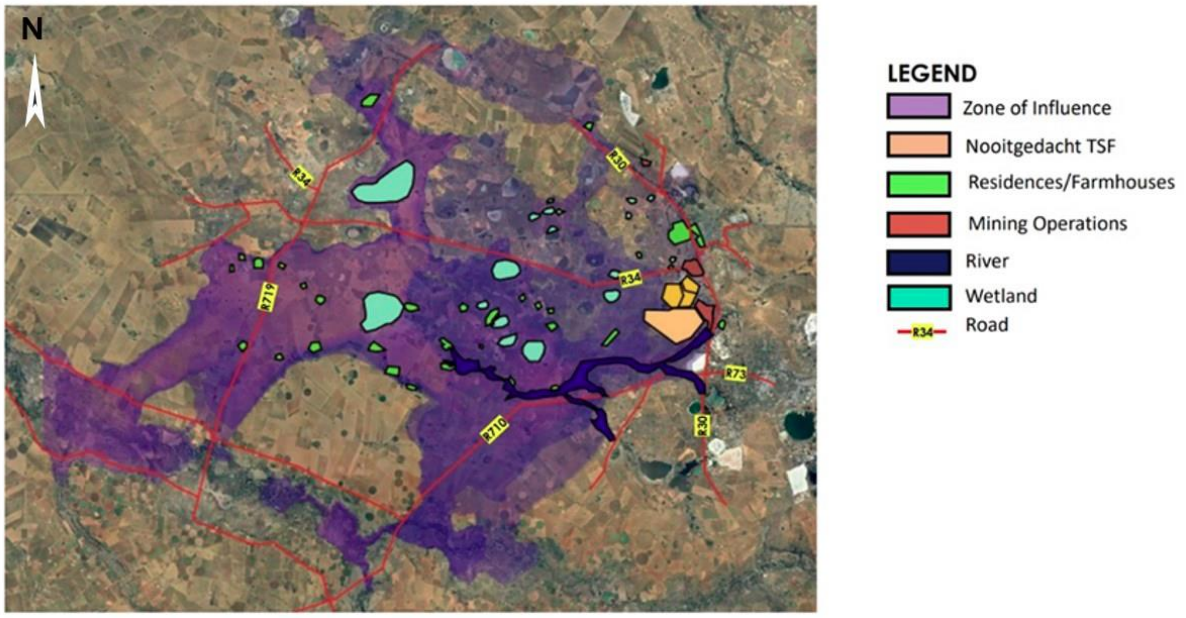


Figure 60: Zone of influence

9.3.12.2 CLIMATE CHANGE AFFECTING THE STABILITY OF THE LINER

The projected service life of a geomembrane at Nooitgedacht TSF is 2 775 years at 10°C and decreases to 608 years at a temperature of 25°C. The rising water table affecting the stability/ or functioning of the liner is a potential risk. Other risks include the degeneration of the geomembrane due to UV exposure. Design mitigation is required to ensure stability of the liner with respect to future predicted climate change.

9.3.12.3 PIPELINE RUPTURES AND LOCALIZED TOE DRAIN FAILURES

Pipeline ruptures are a potential unplanned risk associated specifically with the pipelines carrying residue and process water to and from the TSF. Another potential risk is localized toe drain failures. Regular inspections and maintenance of the toe drains will be required in order to reduce this potential risk .

9.3.12.4 SAFETY MITIGATION MEASURES

Based on the preliminary design of the new Nooitgedacht TSF, the following conclusions and recommendations can be drawn:

- Nooitgedacht TSF will be developed with an intermediate outer slope of 1V:3H between benches. The overall slope of the facility is 1V:4H. The inter-bench height is 10.5m and the benches are 10.5m wide.
- The engineered toe wall embankment is maximum 5m high with a 3m wide crest and an outer slope of 1V:1.5H and inner slope of 1V:2H.

- The cyclone walls will be constructed 55m away from the toe wall, providing an elevated platform to allow for downstream overflow tailings deposition. The cyclone wall has a maximum height of 11m with a 5m wide crest, and outer and inner slopes 1V:2H. This transitions to a 1m nominal wall.
- The cyclone walls will be constructed 55m away from the toe wall, providing an elevated platform to allow for downstream overflow tailings deposition. The cyclone wall has a maximum height of 11m with a 5m wide crest, and outer and inner slopes 1V:2H. This transitions to a 1m nominal wall.
- The gold tailings material classified as a Type 3 waste. This necessitates a Class C barrier system. The cyclone walls will be constructed 55m away from the toe wall, providing an elevated platform to allow for downstream overflow tailings deposition. The cyclone wall has a maximum height of 11m with a 5m wide crest, and outer and inner slopes 1V:2H. This transitions to a 1m nominal wall.
- The Nooitgedacht TSF liner must comprise two different sections as specified in the design report:
    - Liner system 1 - Liner system 1 - Over the existing FSN4 TSF footprint and outer edge, where high liner stresses are present, the liner system comprises (from top down), a 300mm thick layer of tailings, 600 kN/m geogrid (or similar approved), a 300mm thick layer of tailings, 1.5mm thick double textured HDPE liner underlain by a 300mm ripped and recompacted layer of in-situ base preparation layer.
    - Liner system 2 - The liner system in the inner basin area comprises (from top down), 1.5mm thick double textured HDPE liner, underlain by a 300mm ripped and recompacted in-situ base preparation layer.
- Install the liner / membrane according to design specifications and industry best practice to prevent UV exposure and degradation.
- Warning signs should be installed around the TSF. A 5m wide access road must be provided around the facility for operational and monitoring requirements.
- The facility is to be constructed and operated to ensure that the designed outer slope profile is achieved, and that operations are safe and environmentally responsible.
- Safe operating systems and procedures are to be implemented during operation of the facility.
- Monitoring of the facility is to be undertaken as outlined in the Operating, Maintenance and Surveillance Manual.
- The rainy day tailings flow of a breach on the north eastern flank will affect the residential area of Odendaalsrus to the north of the facility. This flow could be diverted away from the nearby residential area by constructing a (dump rock) bund approximately 1m high at the edge of the residential area. This can reduce the probability of loss of life to ranges of 1:10 000 or better. The bund must be designed to withstand flow erosion.
- A TSF failure contingency plan together with an Emergency Response Process for the potentially affected communities should be in place prior to operations commencing.
- The timing and beach advancement must be reconsidered during installation and approved by the appointed registered engineer.

9.3.13 SOCIAL IMPACTS

Sources of social impacts are often not as clear-cut as those in the biophysical environment. Social impacts are not site-specific but occur in the communities surrounding the proposed site – where the people are. Mitigation measures are context specific and the mitigation measures in this report should be viewed as guidelines.

Given that Harmony has existing TSFs in close proximity to where the new facility is proposed, it must be considered that many of the impacts are existing impacts. When considering existing impacts, the complexity of the social environment must be contemplated. Social impacts are not site-specific but occur in communities surrounding the site. The activities taking place in the area surrounding the project site has also caused a number

of impacts. From a social perspective it is not possible to pinpoint which percentage of any given impact result from a specific activity or proponent. For example, agricultural, tourism and mining activities may cause an influx of people into an area due to the possibility of employment creation. It is not possible to say, for example, that 30% of people moving into the area looked for an agricultural job, 60% for a mining job and 10% for a tourism job. It is possible to say that all these industries contributed to the honeypot effect (project-induced in-migration where people move to the project site in search of work or economic opportunities that arise from the project) that compounded unemployment in the area. Harmony and its activities are not the only responsible party for the existing social impacts in the area, but the mine does contribute greatly to these impacts and will continue to do so through the life of mine.

The following potential social impacts will be triggered by the proposed Nooitgedacht TSF project:

9.3.13.1 **IMPACT ON LIVELIHOODS**

A livelihood refers to the way of life of a person or household and how they make a living, in particular, how they secure the basic necessities of life, e.g., their food, water, shelter and clothing, and live in the community (Vanclay et al., 2015). The farming community in the area is close-knit, and the majority of stakeholders that will be affected by the project rely on farming as a livelihood, in some cases for generations. This includes vulnerable parties like farm workers. The farms are not only their homes, but their businesses. They generate their income from the land. Any aspect that impacts on the ability of a farmer to make a living from his/her land can be seen as an impact on his/her livelihood. The majority of farmers in the area farm with livestock. They report a decrease in the carrying capacity of the land and the birth rates of the livestock. According to the farmers all red grass, an important source of food for the livestock, has disappeared from the area. The farmers feel that they are stuck with farms that have no value and cannot be sold due to the current pollution levels.

There are three major impacts on the livelihoods of the farming community. The first is the cumulative impact on water sources. Harmony provides water to the direct neighbours, but not to all the affected farmers downstream or on the commonage. Farmers are no longer able to use their boreholes due to the water quality – the water is not safe for human or animal use. The proposed TSF will block some of the roads to the current water delivery points. This means that farmers will have to build pipelines and pump water to camps for their animals at their own cost. Another issue is the management of storm water(mine) and sewage (municipality). Farmers claim that it is not managed well at the moment, municipal sewage is pumped into slimes dams and storm water trenches, and contaminated storm water ends up in the Mahemspruit, an intermittent stream in the area, causing pollution for kilometres downstream. Farmers feel that their land has been sterilised by the water and dust pollution, and that they have been forced to decrease farming activities since 1981.

The second impact on the livelihoods of the farmers is the white dust that settles on the soil and plants. Farmers claim that it has an impact on the productivity of the land, as plants cannot photosynthesise, and the soil is less fertile. Plants are less palatable to the animals, and when the animals eat the plants, they also ingest the white dust, which farmers believe is poisonous to their livestock. Farmers reported that the productivity of the land is already compromised, and that the birth-rate of livestock has decreased significantly. The construction of the new TSF will compound these issues.

The third impact on livelihoods is related to fences. Farmers indicated that fences corrode very quickly, and that they are constantly replacing fences. They claim that a fencepost can disintegrate within a year. The farmers need to keep their cattle on their property, but with the bad state of fences it is easier for people to cut the wires and steal cattle. With the construction activities associated with the new TSF there will be more activities and people in the area, and sturdy fences become even more important. The new TSF should also be fenced when operational, with fences strong enough to keep people and livestock out of the area.

Any negative impact on the livelihood of a farmer impacts on farmworkers, who are much less resilient. Many of the affected people have dependents such as elderly parents and young children, in addition to their workers. Impacts on livelihoods are seen as some of the most significant impacts from a social perspective, as the ripple effect of this impact can be felt on so many levels, and people always experience this impact severely on a personal level.

9.3.13.2 COMMUNITY EXPECTATIONS AND SOCIAL LICENSE TO OPERATE

The Matjhabeng Local Municipality is highly politicised and experience frequent service delivery protests. The areas closest to the proposed TSF are Rheederpark Extension 2, Jabulani Village and Reahola Housing Association. Farmers and community members expressed that they do not feel that Harmony has a social license to operate from the local people. They claim to that the community spokesperson for Harmony constantly changes and often makes commitments that are not met. Farmers said that they have become emotional about the issues, because it feels as if nothing that they do makes any difference. Community members feel that they do not receive any support from the mine, and that at the end of the life of the mine, it will pack up and leave without considering the people that are left behind. Due to the mistrust, and the expectations that some community members have, there is a strong possibility of local conflict. The current reality in South Africa is that communities tend to resort to violent protests if they feel that they are not heard. There is a risk that lives can be in danger and property damaged during these protests, and the mine should have emergency procedures in place should there be protests of this nature that endangers its assets and the lives of staff and community members.

Although some of the community expectations are realistic, the extent to which the mine can meet some of the expectations are limited. Unless the expectations of the community are managed carefully, this impact may pose a significant risk to the mine on different levels.

9.3.13.3 HEALTH AND WELLBEING

The proposed construction of the TSF will create dust, which will continue in the operational phase of the project. The dust potentially has health impacts and impact on the grazing areas of farmers. Dust is also a significant nuisance factor, because even if it is within the legal limits, it is something that is visible to the communities. Communities report that they suffer from asthma, sinusitis, nose bleeds and allergies, which they ascribe to the dust.

People also report that vulnerable parties such as children and the elderly became ill as a result of bathing in the untreated borehole water downstream. The fact that the farmers do not have access to potable water even though they do have boreholes and surface water on their properties and need to rely on external parties (the mine) for water, is another concern that affects their wellbeing. The farmers feel that the establishment of a new TSF will increase the already negative impact.

Another concern is the presence of illegal mine workers (zama-zamas) and open shafts. Farmers claim that illegal mine workers steal their cattle and throw the carcasses down abandoned shafts to provide food for the people working underground. The farmers claim that the mine does not close the abandoned shafts, making it easy for the illegal mine workers to enter the shafts. They also allow the illegal mine workers to continue with their activities and reign of terror. The illegal mine workers are often heavily armed, and farmers and community members are too scared to get close to them. Apart from the zama-zamas there are also other criminal elements in the area, causing a general feeling of unsafety. The lack of fences aggravates this aspect. The farmers and communities fear that during the construction period when there is an increase in activity around the site it may provide new opportunities for the criminals already active in the area.

Although the likelihood is low there is always a risk that a TSF may fail, with dire consequences to people and the environment. Farmers and communities living in the zone of influence of a TSF should be included in the emergency preparedness planning in case of such an event.

9.3.13.4 ECONOMIC IMPACTS FROM A SOCIAL PERSPECTIVE

The project will ensure job security for currently employed people as they will be able to continue with their current jobs. This impact would be experienced on a wider level since it will allow them to meet the needs of their family members. It is not clear how long the construction phase will be, or how many jobs will be created, but in a similar project the construction phase was 5 years and approximately 300 jobs were created, of which the majority were unskilled or semi-skilled (GCS,2020). Wages that employees receive will increase their spending power in the study area. This will be especially beneficial to retail and other service providers. The job creation will be a significant positive impact during the construction phase. There are high levels of poverty and

unemployment in the area, and this may cause significant competition for jobs. Communities indicated that job opportunities must be shared in a transparent manner and communicated widely. For general jobs they do not want the mine to use a list of people that qualify, but rather that names are thrown in a hat and drawn by a community member or the ward councillor. In the past competition for jobs caused significant conflict in the area, and therefore this aspect must be handled with care.

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

9.3.13.5 INCREASE IN SOCIAL PATHOLOGIES SUCH AS PROSTITUTION, SEXUALLY TRANSMITTED DISEASES, TEENAGE PREGNANCIES AND ALCOHOL AND SUBSTANCE ABUSE

The construction of the tailings dam will include specialised construction teams. It is not clear where the construction workers will be housed, but it is anticipated that the levels of activities in the local areas will increase, especially during weekends. Depending on where they come from, workers will probably not be able to go home every weekend. People with access to more money and different value systems may mix with local community members.

In-migration triggers a dramatic rise in the “four M’s”: men, money, movement (influx), and mixing (i.e., the interaction between high and low disease prevalence groups). These factors are the conditions necessary to produce a surge in sexually transmitted diseases. Other drivers of the HIV epidemic that may be relevant for the project include high levels of alcohol and drug abuse, transactional and commercial sex, sexual and gender-based violence, migratory labour, poverty, income disparities and unequal access to prevention, treatment, and care. Another important consideration is the impact of contractors bringing in materials from other provinces, especially during the construction phase. The truck drivers are often required to stop overnight. The truck stops become “hot spots” with a considerable pull factor luring people with economic opportunities, including sex work. It is difficult to manage these transient factors, but it does contribute to the spread of the disease amongst transportation routes, and it is therefore important to consider the impact.

Given the high unemployment levels in the area, people may deploy livelihood strategies such as prostitution. Vulnerable parties such as young girls may also fall victim to sexual predators and there can be an increase in teenage pregnancies. Promiscuous behaviour can lead to an increase in the spread of sexually transmitted diseases. There may be an increase in alcohol and substance abuse due to these substances being more easily available.

9.3.13.6 SOCIAL MITIGATION MEASURES

The following mitigation is proposed:

- Harmony must establish an environmental forum that include all the affected farmers - neighbouring and downstream. Results of water and dust monitoring must be shared with the public through the forum.
- If current water delivery points are affected by the placing of the new TSF new points must be determined with input from the farmers. These points must be easily accessible. If water pipes are required, the mine must provide and install the pipes.
- Dust suppression activities should be conducted as prescribed by the relevant specialist.
- If there are actual losses due to the activities performed by Harmony, the landowner should be compensated for their losses. Harmony must have a claims procedure that is communicated to all affected landowners. In order to receive compensation, the claim forms must be submitted to the Harmony Community Liaison Officer (CLO). Compensation should follow the IFC principles, which states that market related prices should be paid, and if anything is restored, it must be to the same or better standards than before.

- If areas are fenced, the fences must be checked on a daily basis for the duration of the construction period. All broken fences must be reported to the farmer and the Harmony CLO.
- Harmony must continue to invest in their Stakeholder Relations Division.
- Harmony must continue to implement their grievance mechanism and ensure that it is community-friendly. Harmony must continue to address and keep record of community grievances. Harmony must continue to keep a grievance register. It is important to have documented evidence of community/mine interactions. This will assist the mine to track the issues, and the community to see what actions the mine has taken.
- The mine must include planning and budgeting for external conflict situations (such as roadblocks or invasions) in their emergency response procedure and ensure that their current insurance remains updated. They must also periodically review their stakeholder engagement plan to guide their interaction with stakeholders.
- The relevant specialists will provide scientific mitigation measures for the dust and water issues. From a social perspective it is important to continue to communicate the mitigation, monitoring and management measures to the affected parties. Ongoing rehabilitation can play an important role in minimising the impact.
- The mine Social Relations Manager should establish relationships with the surrounding farmers. This can include a yearly courtesy visit and sharing of environmental data to keep the farmers informed. All meetings should be recorded, and records must be included in the communication register.
- The mine management should with engage with the farmers about water supply. The negotiations must be recorded.
- Conduct a water census and repeat periodically as recommended by the relevant specialists. Keep the affected people informed about the census and monitoring results. Share water monitoring results with farmers once a year.
- The mine must ensure that its properties are fenced, the fences are intact, and all abandoned shafts must be covered.
- Harmony must investigate and where possible and feasible adopt and / or adapt the Global Industry Standard on Tailings Management for the new TSF.
- Skills development plans must be focussed on skills that the mine needs, and that are also transferable. Support must be given to people after the training to ensure that their newly acquired skills can be implemented.
- The mine should put measures in place to ensure the most effective local employment strategy.
- Harmony should ensure a fair number of secondary economic opportunities are given to local contractors. A percentage of goods as determined by Harmony and the relevant stakeholders must also be procured locally. Services and goods must be procured locally as far as reasonably possible. Aspects of this positive impact will occur by default when the construction force lives locally and they utilise local services and support local shops.
- Toolbox talks should include talks about the impact of promiscuous behaviour. Harmony should develop an in-house infectious diseases strategy to address health issues within the workforce and align the strategy with a community HIV strategy implemented by a non-profit organisation. Local schools and communities living close to the project must be included in the strategy. The strategy should include voluntary counselling and testing and training of peer educators. A workforce code of conduct should be developed to maximise positive employee behaviour in the local community and optimise integration.
- Extend the workplace programme for HIV beyond the company's operations, and include all contractors, suppliers, transportation companies and local communities. Make it a contractual

requirement. The spread of HIV along transportation routes (roads and railways) is well documented, so this component of the project (transportation of all goods and services to and from the project site) needs special attention.

9.3.14 CUMULATIVE IMPACTS

A cumulative impact, in relation to an activity, refers to the impact of an activity that in itself may not be significant, but may become significant when added to the existing and potential impacts eventuating from similar or diverse undertaking in the area.

Cumulative impacts have been considered in further detail within the specialist studies in Appendix D and in the specialist assessment of the impacts as per the methodology provided in Section 9.1.2. Several tailings storage facilities already exist in the area, which is mostly already heavily modified due to existing mining infrastructure. The proposed Valley TSF is a separate, smaller TSF that is also proposed to the immediate north of the site for the Nooitgedacht TSF. Therefore there is potential for cumulative negative impacts to arise.

The potential direct cumulative impacts as a result of the proposed project are expected to be associated predominantly with:

- Visual impact on the surrounding area.

The potential indirect cumulative impacts as a result of the proposed project are expected to be associated predominantly with:

- Flora, fauna and ecological processes – at a regional level and driven primarily by the on-going negative effects of mining activities in the area.
- Groundwater and air quality impacts – at a local level driven by the large number of existing TSFs in the area.
- Impacts on health and wellbeing are cumulative with other social pressures in the area.
- Increased pressure on road and other infrastructure.

It should be noted however that Nooitgedacht TSF will cater for reworking of multiple TSFs across the Welkom area extending over the next 30 years plus to at least 19 existing TSF facilities (Figure 61). TSFs will be reworked and processed at Central Plant, Saaiplaas plant and new modules will either be constructed at Central plant or Saaiplaas plant (or a new plant, however the plant is still in pre-feasibility at this stage). These TSFs will be fully reclaimed and then fully rehabilitated in the future. This will also allow Harmony to manage a single large TSF rather than having to deal with numerous smaller TSF sites, which should also improve the management related to the various environmental and social issues of the existing TSFs in the region.

This reclamation and rehabilitation of existing Harmony TSFs will significantly reduce the following cumulative impacts associated with the existing Harmony TSFs in the Welkom region:

- Cumulative groundwater contamination impacts from existing Harmony TSFs in the region;
- Cumulative health and radiation impacts from existing Harmony TSFs in the region;
- Cumulative air quality and dust / nuisance issues from the existing Harmony TSF's in the region; and
- Safety impacts and risks associated with the existing TSFs.

In addition, it will have a significant positive social impact relating to the continued employment and continuation of mining (reclamation) at Harmony's various Free State operations. Cumulatively this is considered a significant positive environmental impact (and social benefit) for the entire Harmony Free State operation area into the future.

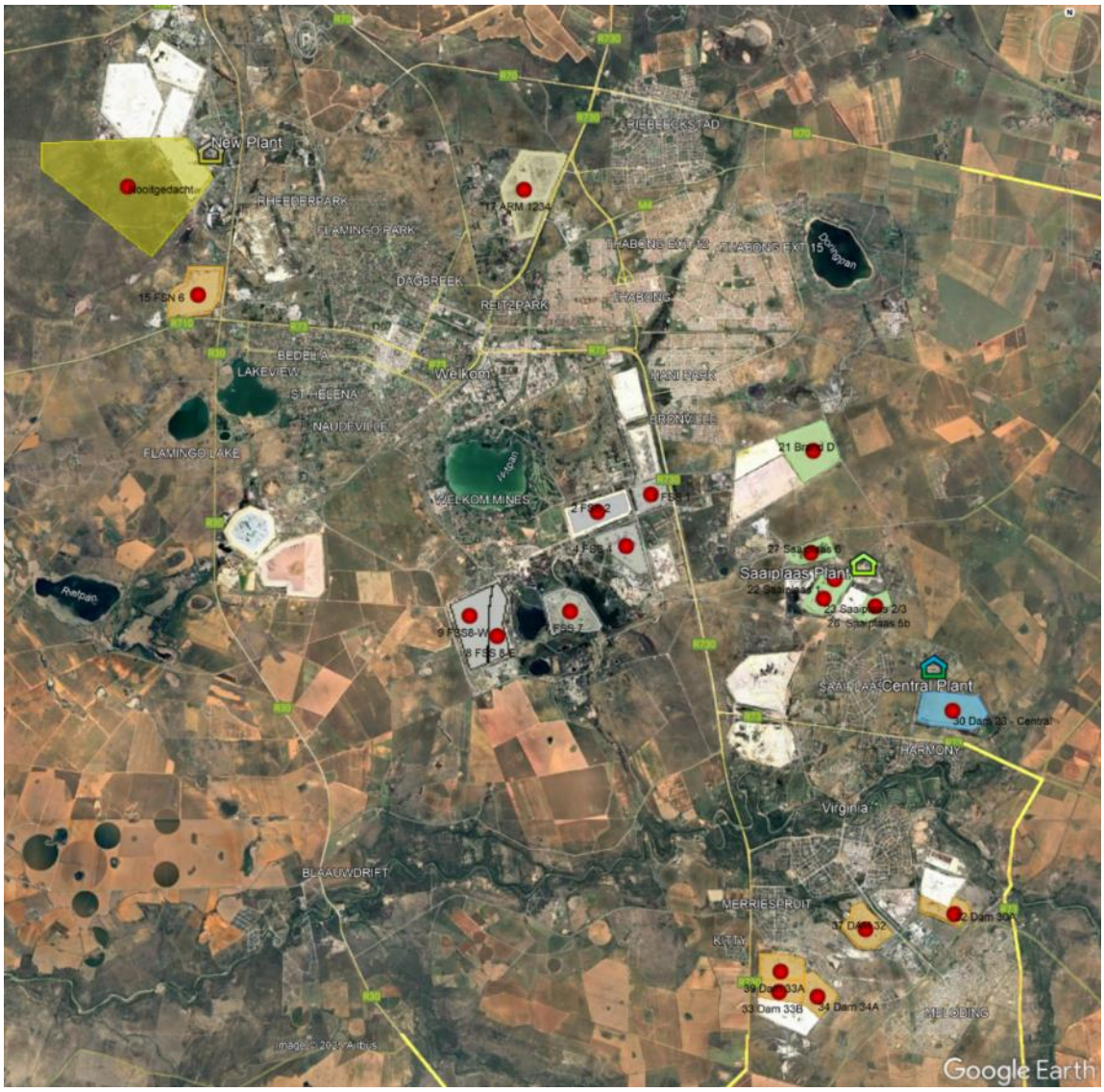


Figure 61: 19 existing unlined Tailings Storage Facilities (TSFs) will be reclaimed and deposited onto the new lined Nooitgedacht TSF

Refer to Table 37 for a summary of impact assessment scoring for each identified impact (see Appendix E for a larger version).

Table 37: Preliminary impact assessment matrix (refer to Appendix E for full size version)

		Pre-Mitigation							Post Mitigation								Priority Factor Criteria			
Impact	Phase	Nature	Extent	Duration	Magnitude	Reversibility	Probability	Pre-mitigation ER	Nature	Extent	Duration	Magnitude	Reversibility	Probability	Post-mitigation ER	Confidence	Cumulative Impact	Irreplaceable loss	Priority Factor	Final score
Impacts on Visual Environment and Sense of Place	Construction	-1	3	2	2	2	3	-6,75	-1	3	2	3	2	3	-7,5	Medium	1	1	1,00	-7,5
Impacts on Visual Environment and Sense of Place	Operation	-1	4	4	3	4	4	-15	-1	4	4	3	4	4	-15	High	2	1	1,13	-16,875
Impacts on Visual Environment and Sense of Place	Rehab and closure	-1	4	2	2	3	3	-8,25	-1	3	2	2	3	2	-5	Medium	2	1	1,13	-5,625
Increase in air quality impacts due to construction of the TSF	Construction	-1	3	2	3	2	4	-10	-1	2	2	3	2	3	-6,75	Medium	1	1	1,00	-6,75
Increase in air quality impacts due to the operation of Valley TSF	Operation	-1	3	4	4	4	3	-11,25	-1	3	4	2	3	3	-9	Medium	1	1	1,00	-9
Increase in air quality impacts due to decommissioning and closure	Rehab and closure	-1	3	2	3	2	4	-10	-1	2	2	3	2	3	-6,75	Medium	1	1	1,00	-6,75
Disturbance / destruction of sites of heritage significance	Construction	-1	2	4	3	5	3	-10,5	-1	1	5	1	2	1	-2,25	Medium	1	1	1,00	-2,25
Disturbance / destruction of palaeontological resources	Construction	-1	1	5	4	5	4	-15	1	1	5	2	5	2	6,5	Medium	1	1	1,00	6,5
Impact on livelihoods	Construction	-1	3	4	5	4	5	-20	-1	2	2	4	3	4	-11	High	3	3	1,50	-16,5
Impact on livelihoods	Operation	-1	3	4	5	3	5	-18,75	-1	3	4	4	4	4	-15	High	3	3	1,50	-22,5
Impact of community expectations and social licence to operate	Construction	-1	4	4	4	3	5	-18,75	-1	3	3	3	3	4	-12	High	3	2	1,38	-16,5
Impact of community expectations and social licence to operate	Operation	-1	3	4	4	3	4	-14	-1	2	2	3	3	4	-10	High	2	2	1,25	-12,5
Impact on health and wellbeing	Construction	-1	2	2	3	3	5	-12,5	-1	2	2	3	3	4	-10	High	2	1	1,13	-11,25
Impact on health and wellbeing	Operation	-1	2	3	5	4	5	-17,5	-1	2	2	3	3	4	-10	High	2	1	1,13	-11,25
Impact on health and wellbeing	Decommissioning	-1	2	3	5	3	5	-16,25	-1	2	2	4	3	4	-11	High	2	1	1,13	-12,375
Economic impacts from social perspective	Construction	1	3	2	4	2	4	11	1	3	3	4	2	4	12	High	2	1	1,13	13,5
Economic impacts from social perspective	Operation	1	3	3	4	2	4	12	1	2	2	3	2	3	6,75	High	3	3	1,50	10,125
Increase in social pathologies	Construction	-1	3	2	4	3	4	-12	-1	3	3	4	3	4	-13	High	2	1	1,13	-14,625
Noise impacts	Construction	-1	1	1	2	1	2	-2,5	-1	1	1	1	1	2	-2	Medium	1	1	1,00	-2
Noise impacts	Operation	-1	1	1	2	1	2	-2,5	-1	1	1	1	1	2	-2	Medium	1	1	1,00	-2
Noise impacts	Decommissioning	-1	1	1	2	1	2	-2,5	-1	1	1	1	1	2	-2	Medium	1	1	1,00	-2
Noise impacts	Rehab and closure	-1	1	1	2	1	2	-2,5	-1	1	1	1	1	2	-2	Medium	1	1	1,00	-2
Exhalation and dispersion of radon gas to the atmosphere during the operational phase of the Projects	Operation	-1	2	5	1	3	2	-5,5	-1	2	5	1	3	1	-2,75	Medium	1	1	1,00	-2,75
Emission and dispersion of particulate matter that contains radionuclides to the atmosphere during the operational phase	Operation	-1	2	5	1	2	2	-5	-1	2	5	1	2	1	-2,5	Medium	1	1	1,00	-2,5
Implementation of the NNR-approved decommissioning plan	Rehab and closure	1	2	5	4	5	4	16	1	2	5	4	5	4	16	Medium	1	1	1,00	16
Reclamation of exisating Harmony TSFs	Operation	1	4	5	5	5	4	19	1	4	5	5	5	5	23,75	Medium	3	1		0
Exhalation, emission and dispersion of radon gas and particulate matter that contains radionuclides during the post-closure phase	Rehab and closure	-1	2	5	1	2	2	-5	-1	2	5	1	2	1	-2,5	Medium	1	1	1,00	-2,5
Leaching and migration of radionuclides from the TSF during the post-closure phase	Rehab and closure	-1	3	5	1	3	2	-6	-1	3	5	1	3	2	-6	Medium	1	1	1,00	-6
Destruction, further loss and fragmentation of the of habitats, ecosystems and vegetation community;	Construction	-1	3	5	4	3	4	-15	-1	3	3	3	3	3	-9	Medium	2	2	1,25	-11,25
Introduction of alien and invasive species, especially plants;	Construction	-1	3	4	3	3	3	-9,75	-1	2	3	3	2	2	-5	Medium	2	2	1,25	-6,25
Displacement of the indigenous faunal community (incl bird and bats) due to habitat loss, direct mortalities, and disturbance (road collisions, noise, dust, light, vibration, and poaching).	Construction	-1	3	5	5	4	5	-21,25	-1	3	5	4	3	5	-18,75	Medium	2	3	1,38	-25,78125
Potential leaks, discharges, pollutant from machinery and storage leaching into the surrounding environment.	Construction	-1	3	3	3	3	3	-9	-1	3	3	1	3	2	-5	Medium	2	2	1,25	-6,25
Continued encroachment of an indigenous vegetation community by alien invasive plant species as well as erosion due to disturbed soils	Operation	-1	3	4	3	3	3	-9,75	-1	2	3	3	3	2	-5,5	Medium	2	2	1,25	-6,875
Continued displacement and fragmentation of the faunal community (including threatened or protected species) due to ongoing anthropogenic disturbances (noise, dust and vibrations) and habitat degradation/loss (litter, road mortalities and/or poaching).	Operation	-1	3	5	4	3	4	-15	-1	3	5	4	2	4	-14	Medium	2	3	1,38	-19,25
Potential leaks, discharges, pollutant from the TSF spreading into the surrounding environment.	Operation	-1	2	3	4	2	4	-11	-1	2	3	3	2	4	-10	Medium	2	2	1,25	-12,5
Loss of land capability, Soil compaction, Soil erosion, Land degradation, Nutrient and water storage	Planning	-1	3	3	4	4	3	-10,5	-1	1	1	1	1	1	-1	Low	1	1	1,00	-1
Loss of land capability, Soil compaction, Soil erosion, Land degradation, Nutrient and water storage	Construction	-1	3	4	4	3	4	-14	-1	2	3	3	3	3	-8,25	High	2	3	1,38	-11,34375
Loss of land capability, Soil compaction, Soil erosion, Land degradation, Nutrient and water storage	Operation	-1	3	3	3	3	3	-9	-1	2	3	2	3	2	-5	Medium	2	3	1,38	-6,875
Loss of land capability, Soil compaction, Soil erosion, Land degradation, Nutrient and water storage	Decommissioning	-1	2	2	2	3	3	-6,75	-1	2	2	1	3	2	-4	Low	2	2	1,25	-5
Loss of land capability, Soil compaction, Soil erosion, Land degradation, Nutrient and water storage	Rehab and closure	-1	2	2	2	2	2	-4	-1	2	2	1	2	1	-1,75	Low	1	2	1,13	-1,96875
Direct loss, disturbance and degradation of wetlands.	Construction	-1	2	1	5	3	4	-11	-1	2	1	4	3	3	-7,5	High	2	2	1,25	-9,375
Increased bare surfaces, runoff and potential for erosion	Construction	-1	2	1	3	3	3	-6,75	-1	2	1	2	3	3	-6	High	2	2	1,25	-7,5
Degradation of wetland vegetation and the introduction and spread of alien and invasive vegetation	Construction	-1	2	1	4	3	4	-10	-1	2	1	3	3	3	-6,75	High	2	2	1,25	-8,4375
Increased sediment loads to downstream reaches	Construction	-1	2	1	3	3	3	-6,75	-1	2	1	2	3	3	-6	High	2	2	1,25	-7,5
Contamination of wetlands with hydrocarbons due to machinery leaks and eutrophication of wetland systems with human sewerage and other waste.	Construction	-1	2	1	3	3	2	-4,5	-1	2	1	2	3	2	-4	High	2	2	1,25	-5
Disruption of wetland soil profile and alteration of hydrological regime	Construction	-1	2	1	3	3	3	-6,75	-1	2	1	2	3	3	-6	High	2	2	1,25	-7,5
Siltation of water resources	Operation	-1	2	4	2	3	3	-8,25	-1	2	4	2	3	3	-8,25	High	2	2	1,25	-10,3125
Degradation of wetland vegetation and proliferation of alien and invasive species	Decommissioning	-1	2	1	4	3	4	-10	-1	2	1	3	3	3	-6,75	High	2	2	1,25	-8,4375
Disruption of wetland soil profile, hydrological regime and increased sediment loads	Decommissioning	-1	2	1	3	3	3	-6,75	-1	2	1	2	3	3	-6	High	2	2	1,25	-7,5
Groundwater contamination	Operation	-1	3	3	3	3	4	-12	-1	2	2	3	3	4	-10	Medium	2	2	1,25	-12,5
Cumulative groundwater contamination	Operation	-1	3	4	3	3	4	-13	-1	2	3	3	3	4	-11	Medium	2	2	1,25	-13,75
Groundwater contamination	Decommissioning	-1	3	3	3	3	4	-12	-1	2	2	2	3	3	-6,75	Medium	2	2	1,25	-8,4375
Cumulative groundwater contamination	Decommissioning	-1	3	4	3	3	4	-13	-1	2	2	2	3	3	-6,75	Medium	2	2	1,25	-8,4375
Soil Erosion	Construction	-1	4	4	3	3	4	-14	-1	1	2	2	2	3	-5,25	Medium	2	1	1,13	-5,90625
Soil Erosion	Operation	-1	3	4	2	2	4	-11	-1	1	2	2	2	3	-5,25	Medium	2	2	1,25	-6,5625
Pollutants Entering the Surface Water Environment	Construction	-1	4	2	3	5	4	-14	-1	3	2	1	3	2	-4,5	Medium	2	1	1,13	-5,0625
Pollutants Entering the Surface Water Environment	Operation	-1	5	4	5	5	3	-14,25	-1	5	2	5	5	2	-8,5	Medium	2	3	1,38	-11,6875
Decrease in Runoff	Construction, operation, decomissioning	-1	4	4	2	5	5	-18,75	-1	4	4	2	5	5	-18,75	Medium	2	1	1,13	-21,09375
Decrease in Runoff	Rehab and closure	-1	4	4	2	5	5	-18,75	-1	1	1	1	1	5	-5	Medium	2	1	1,13	-5,625
flood Risk	All phases	-1	4	1	5	5	1	-3,75	-1	4	1	5	5	1	-3,75	Medium	1	3	1,25	-4,6875
Traffic Related Imapcts	Construction	-1	2	2	4	5	3	-9,75	-1	2	2	3	3	1	-2,5	Medium	2	2	1,25	-3,125

10 SENSITIVITY MAPPING

Environmental sensitivity mapping provides a strategic overview of the environmental, cultural and social assets in a region. The sensitivity mapping technique integrates numerous datasets (basemaps and shapefiles) into a single consolidated layer making use of Geographic Information System (GIS) software and analysis tools. Environmental sensitivity mapping is a rapid and objective method applied to identify areas which may be particularly sensitive to development based on environmental, cultural and social sensitivity weightings – which is determined by specialists input within each respective field based on aerial or ground-surveys. Therefore, the sensitivity mapping exercise assists in the identification of low, medium and highly sensitive areas within the study area, towards selecting the preferred location, design and layout, and process or technology alternatives for the proposed activities and infrastructure. This sensitivity mapping approach allows for the proposed activities to be undertaken whilst protecting identified sensitive environmental areas / features. Furthermore, environmental sensitivity is used to aid in decision-making during consultation processes, forming a strategic part of Environmental Assessment processes. Table 38 below provides a breakdown of the sensitivity rating and weightings applied to determine the sensitivity score of each aspect. Figure 62 presents the preliminary combined sensitivity map for the project, specifically the TSF and pipelines areas. The areas of **very high** sensitivity are due to the identified SCC within the TSF footprint. A relocation plan is being drafted for these species. If relocation is completed these sensitivities will no longer be applicable. Another area of very high sensitivity is the graveyard identified in the south-east of the TSF footprint. This area and associated 100m buffer will need to be avoided by the development and access provisions for next of kin must be provided, or alternatively a grave relocation process will need to be undertaken[7]. These areas and sensitivities will be further refined in the EIA phase once further detailed assessments are completed, specifically sensitivities at the location for the new low pressure water system which are still to be defined. Other high sensitivity areas include various soils, wetlands and hydrology high sensitivity areas. Mitigation will be required to ensure potential impacts relating to these areas are within acceptable limits. Three heritage sites were also identified within the TSF site, and these sites will be avoided, or alternatively removed from site through SAHRA permit applications. This map will be updated for the EIA phase of the project if additional sensitivities are identified.

Table 38: Sensitivity rating and weighting

Sensitivity Rating	Description	Weighting
Least concern	The inherent feature status and sensitivity is already degraded or contain no inherent sensitivities. The proposed development will not affect the current status and/or may result in a positive impact. These features would be the preferred alternative for mining or infrastructure placement.	-1
Low/Poor	The proposed development will not have a significant effect on the inherent feature status and sensitivity.	0
Medium	The proposed development will moderately negatively influence the current status of the feature.	1
High	The proposed development will have a significantly negative influence on the current status of the feature.	2

[7] The latest design of the TSF avoids this grave area, as per the design information provided in Appendix H

Sensitivity Rating	Description	Weighting
Very High	The proposed development will have a very high significant negative influence on the current status of the feature.	3

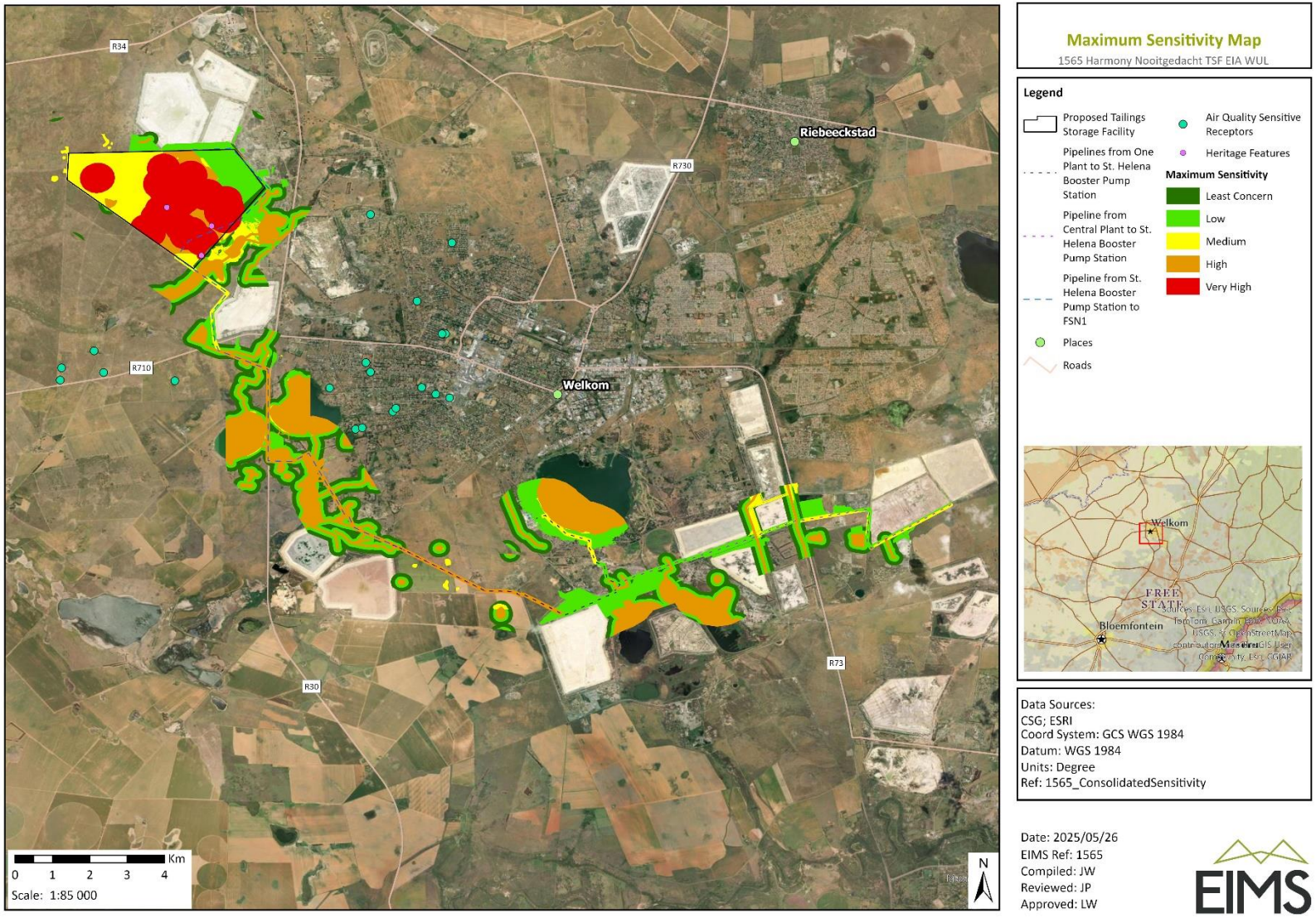


Figure 62: Combined scoping sensitivity map

11 PLAN OF STUDY FOR ENVIRONMENTAL IMPACT ASSESSMENT

The section below outlines the proposed plan of study which will be conducted for the various environmental aspects during the EIA Phase. It is also important to note that the plan of study will also be guided by comment obtained from I&AP's and other stakeholders during the PPP.

11.1 DESCRIPTION OF ALTERNATIVES TO BE CONSIDERED IN EIA PHASE

Owing to the nature of the proposed TSF and associated infrastructure, there are limited reasonable or feasible alternatives that can be considered as per the motivation provided in Section 6. The EIA process being undertaken includes the assessment of potential impacts and the identification of environmental sensitivities within and in the vicinity of the proposed project area thereby allowing for the recommendation of mitigation measures towards the avoidance, minimisation and / or management of the anticipated impacts. The layout and design of the TSF will be planned to avoid any additional no-go areas identified from the various specialist studies, if required. In addition, the preferred option for the new low pressure water system described in Section 6.2.2 will be provided in the EIA report. Apart from these design and technology alternatives no additional alternatives are considered applicable to this application at this stage.

11.2 DESCRIPTION OF THE ASPECTS TO BE ASSESSED AS PART OF THE EIA PROCESS

The following aspects will be assessed further during the EIA phase investigation to be undertaken, many of which have already been completed and are attached in Appendix D (however further updates to certain reports may be required for the EIA phase):

- Biodiversity (Terrestrial);
- Aquatics and Wetlands (including hydropedology);
- Heritage;
- Agriculture Potential, Soils and Land capability;
- Geohydrology;
- Hydrology;
- Air quality;
- Climate Change;
- Palaeontology;
- Visual;
- Social;
- Traffic;
- Noise (compliance statement only);
- Health Risk and Radiological; and
- Closure Costing.

The following aspect will be disregarded at scoping:

- None.

11.3 ASPECTS TO BE ASSESSED BY SPECIALISTS

Table 39 below details the various aspects of the project to be addressed in the EIA phase through detailed specialist studies. It should be noted that many of the specialist studies have already been drafted and those that have been drafted already are appended to this Scoping Report, however further updates to certain reports will be required for the EIA phase of the project. All final updated specialist reports will be included as part of the EIA report for public review.

Table 39: Details of specialist input during the EIA phase.

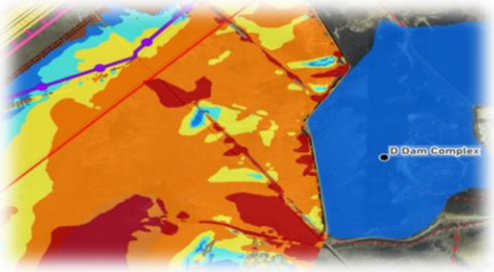
Aspect	Component	Company Responsible	Consultant	Scope of Work / Terms of Reference
Air quality 	Air Quality Impact Assessment	Airshed Planning Professionals	Hanlie Liebenberg-Enslin	The following will be undertaken as part of the EIA phase study: • Emissions Inventory (tailings wind erosion only); • Dispersion Modelling; • Inhalation Health Risk Screening, Compliance Assessment and information for radiological study; • Mitigation and management measures; and • Compilation of a comprehensive report.
Climate Change 	Climate Change Impact Assessment	Airshed Planning Professionals	Hanlie Liebenberg-Enslin	The following will be undertaken as part of the EIA phase study: • A study of legal requirements pertaining to GHG emissions – applicable national and international legal guidelines such as the International Finance Corporation (IFC). • GHG Emissions Statement and Climate Change Impact Assessment • Identification of the Transitional and Physical Risks associated with the project (as per the Task Force on Climate-related Financial Disclosures). • The information used in the Brand TSF CCIA is relevant and will be used. • The GHG emissions during the construction, operation and decommissioning of the project covering scope1, scope 2 and scope 3 emissions. These emissions will be compared to the global and national (if available) emission inventory; and compared to international benchmarks for the project. Calculated emissions will be compared to any guidelines provided by the IFC. • The robustness of the project in terms of forecasted climate change impacts to the area over the lifetime of the project.

Aspect	Component	Company Responsible	Consultant	Scope of Work / Terms of Reference
				• The vulnerability of communities in the immediate vicinity of the project to climate change. The specialist will compile a report that complies with the requirements of Appendix 6 of the EIA Regulations, 2014 (Government Notice (GN) R 982 of 2014, as amended); and/or The Department of Forestry, Fisheries and Environment (DFFE) "Protocols for the assessment and minimum report content requirements of environmental impacts" (GN 320 of 2020 and GN 1150 of 2020).
Visual 	Visual Impact Assessment	GYLA	Graham Young	The following will be undertaken as part of the EIA phase study: • Site visit; • Baseline Mapping; • Viewshed and Building of Computer Model and • Compilating of an impact assessment report.
Biodiversity (Terrestrial) 	Terrestrial Biodiversity Assessment	The Biodiversity Company	Andrew Husted	The following will be undertaken as part of the EIA phase study: • Desktop assessment to identify the relevant ecologically important geographical features within the project area; • Desktop assessment to compile an expected species list and possible threatened flora and fauna species that occur within the project area; • Field survey to ascertain the species composition of the present flora and fauna community within the project area; • Delineate and map the habitats and their respective sensitivities that occur within the project area;

Aspect	Component	Company Responsible	Consultant	Scope of Work / Terms of Reference
				• Identify the manner that the proposed project impacts the flora and fauna community and habitat systems to evaluate the level of risk being posed. The prescription of mitigation measures and recommendations for identified risks. All sensitive areas, as described by the provincial and national legislation, will be identified. The locality and extent, as well as species composition of sensitive areas such as the wetlands or pans, streams, rivers and rocky outcrops will be conducted to identify and map all such sensitive areas present. Sensitive areas will be identified and delineated. A field survey will be undertaken for SCC. Based on the findings from this survey mitigation measures will be proposed to address this concern. This will include members from The Biodiversity Company and the Endangered Wildlife Trust. A terrestrial ecology assessment report will be written. This report will be compiled according to the necessary requirements and standards. A relocation and monitoring plan for the SCC will be drafted and included in the EIA report.
Biodiversity (Aquatic) 	Aquatic and Wetland Biodiversity Assessment	The Biodiversity Company	Andrew Husted	The areas will be traversed on foot to identify local freshwater resources. The following will be achieved to supplement the approach: • A desktop assessment of all available datasets; • GIS processing to preliminary identify water accumulation areas; and • The delineation of water resources in accordance with the DWAF (2005) guidelines, whereby the outer edges will be identified. • A functional and integrity assessment of the water resources. The "Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries" (Macfarlane, *et al*., 2014) will

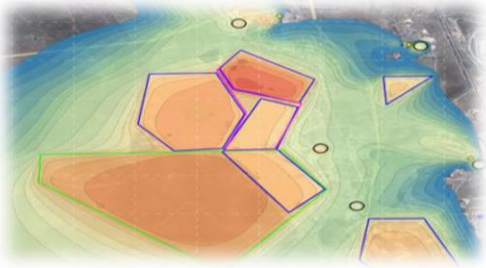
Aspect	Component	Company Responsible	Consultant	Scope of Work / Terms of Reference
				be used to determine the appropriate buffer zone for the proposed activity. The risk assessment will be completed in accordance with the requirements of the DWS General Authorisation (GA) in terms of Section 39 of the NWA for water uses as defined in Section 21(c) or Section 21(i) (GN 509 of 2016). An aquatics and wetlands assessment report will be written. This report will be compiled according to the necessary requirements and standards. <u>A level 2 hydropedology assessment will also be undertaken.</u>
Agriculture Potential, Soils and Land capability 	Soils and Agriculture Assessment	The Biodiversity Company	Andrew Husted	Land capability and agricultural potential is determined by a combination of soil, terrain and climate features. Land capability is defined by the most intensive long term sustainable use of land under rain-fed conditions. At the same time an indication is given about the permanent limitations associated with the different land use classes. Land capability is divided into eight classes and these may be divided into three capability groups. The land classes and groups are arranged in order of decreasing capability and ranges of use. The risk of use increases from class I to class VIII (Smith, 2006). The land potential classes are determined by combining the land capability results and the climate capability of a region. Land use will be identified using aerial imagery and then ground-truthed while out in the field. The land use categories are split into: • Cultivated; • Grazing; • Natural; • Mines; • Urban Built-Up; and • Waterbodies.

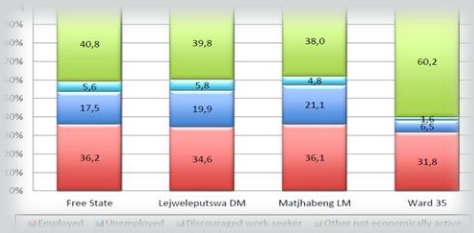
Aspect	Component	Company Responsible	Consultant	Scope of Work / Terms of Reference
				Compilation of a soils report including mitigation measures.
Heritage 	Heritage Impact Assessment	PGS Heritage	Wouter Fourie	The following will be included in the HIA for the EIA phase of the project: • Desktop Study An archaeological and historical desktop study will be undertaken by utilising the previous studies conducted. This will be augmented by an assessment of old topomaps and previous archaeological and heritage impact assessments undertaken for the study area and surroundings. • Fieldwork: An experienced fieldwork team from PGS will undertake an archaeological and heritage site survey to identify the heritage resources within the study area. Tracklogs will be recorded and the locations of all heritage resources identified during the fieldwork will be documented using a hand-held GPS. Furthermore, the documentation will reflect a brief qualitative description and statement of significance for each site and includes a photographic record of all the sites. • Report: A Heritage Impact Assessment will be written. This report will be compiled according to the necessary requirements and standards.
Palaeontology 	Palaeontology Impact Assessment	Banzai Environmental	Elize butler	The following is included in the PIA for the EIA phase of the project: • A PIA desktop study will be undertaken by utilising available data. • A site survey will be undertaken. • A Palaeontological Impact Assessment will be compiled according to the necessary requirements and standards.

Aspect	Component	Company Responsible	Consultant	Scope of Work / Terms of Reference
Geohydrology 	Geohydrological Assessment	MvB Consulting	Marius van Biljoen	The aim of the geohydrological study is to assess the following: • Assessment of the geohydrological environment in terms of aquifer development, aquifer hydraulics, groundwater flow and groundwater chemistry. • Assessment of the potential short and long-term impact from the TSF on the groundwater environment. • Recommended management measures to mitigate potential impacts. The study will include the following: • Desktop study of existing information. Conceptual model of the groundwater system. • Numerical groundwater flow and mass transport model. • Risk assessment and reporting.
Hydrology 	Hydrological Assessment	Hydrologic	Mark Bollaert	• A 2D approach to hydraulic modelling will be utilised to maximise the benefit to flood modelling, with regards to the available terrain data. • The relevant floods event will be modelled to produce respective flood-lines for the current (baseline) scenario only. • A potential deliverable of a rain-on-grid model which considers the accumulation of surface water (and thereby demonstrates surface water flooding and not only river (fluvial) flooding is included as an optional extra. This result would assist in planning the design of berms to divert clean water around the facility. It will also identify preferential flow paths that are not defined by the 1:50,000 topographical river. This deliverable is

Aspect	Component	Company Responsible	Consultant	Scope of Work / Terms of Reference
				recommended given the environmental significance of the proposed TSF. HEC-RAS 6.3.1 is expected to be used for this study. A specialist surface water reports to inform and contribute towards the application in terms of NEMA will be produced. This report will meet the requirements of Appendix 6 of GN.R982 (as amended) of NEMA. A detailed evaluation of the predicted impacts of the project on the receiving environment, or of the receiving environment on the project as per the methodology that uses the criteria of extent, duration and intensity to quantify the significance of the potential impact. The evaluation of impacts will include: • An assessment of impacts during the construction, operation phases and decommissioning phases; • An assessment of the probability of each impact occurring, the reversibility of each impact and the level of confidence in each potential impact; • An assessment of the significance of each impact before and after mitigation; • The identification of any residual risks that will remain after implementation of any mitigation of an impact; and • The cumulative impact in terms of the current and proposed activities in the area. Recommendations to avoid negative impacts or where this will not be possible, then practical mitigation, management and/or monitoring options to reduce negative impacts and enhance positive impacts. Recommendations on the preferred placement of infrastructure will be provided if any watercourses intersect sensitive infrastructure (as determined by river buffers or flood-lines if available). An outline of recommended measures to manage residual impacts will be provided where necessary (i.e. impacts that remain after optimisation of design and planning) for the construction, operation and decommissioning phases.

Aspect	Component	Company Responsible	Consultant	Scope of Work / Terms of Reference
				Where required, a surface water monitoring plan will be included with an indication of the following: • Aspects to be measured; • Responsible person/body; • Frequency of monitoring actions; • Standards to be met; and • Reporting requirements. • The conditions, in respect of the surface water environment, for inclusion in the Environmental Authorisation. A sensitivity map will be produced outlining area of increased surface water sensitivity (low, medium and high).
Noise 	Noise Compliance Statement	Airshed Planning Professionals	Hanlie Liebenberg-Enslin	A noise impact statement will be compiled for the potential impact of noise from the construction and operation of the TSF and associated infrastructure.

Aspect	Component	Company Responsible	Consultant	Scope of Work / Terms of Reference
Health Risk and Radiological 	Health Risk and Radiological Assessment	AquiSim Consulting	Japie van Blerk	The overall framework within which the radiological public safety and impact assessment will be consistent with international practice (e.g., IAEA ISAM Safety Assessment Methodology), the following logical elements will be included in the scope of the assessment: • Definition of the assessment context: High-level definition of what will be included and excluded in the assessment, and justification for the choices made. This will include a definition of the regulatory framework within which the assessment will be performed based on international guidelines and requirements. • High-level description of the system: The system as used here refers to the mining operation and associated activities, the potentially affected environment, as well as the public habits and behavioural conditions that might determine their potential levels of radiological exposure. • Definition of exposure conditions: During this step, assessment context and system description information will be used to define a limited number of credible public exposure conditions associated with the mining operations. • Development of conceptual and mathematical models: The development of conceptual and mathematical models for each exposure condition will be done systematically and transparently to increase general confidence in the assessment results. Parameter values will be assigned using site-specific conditions, or if not available, will be justified using literature values. • Consequence analysis: During this step, the mathematical models will be used to evaluate the radiological consequences of each exposure condition defined for the workers and public, both for the operational and post-operational periods.

Aspect	Component	Company Responsible	Consultant	Scope of Work / Terms of Reference
				• Interpretation of the results: During this step, the results will be interpreted in terms of the assessment context defined in the first step.
Social 	Social Impact Assessment	Equispectives	Dr Ilse Aucamp	The following activities will form part of the SIA: • Fieldwork will be conducted to obtain additional information and communicate with key stakeholders. Key stakeholders are likely to include: o Authorities: local municipalities that fall in the project area. o Affected parties: communities and individuals that will be affected by the project. o Interested parties: local business in the area, community-based organisations and non-governmental organisations within the affected communities, trade unions, and political groups. • Methodologies will include in-depth interviews, participatory rural appraisal, in-the-moment discussion groups, focus groups and immersions. Field notes will be kept of all interviews and focus groups. Initial meetings have been conducted. • An interview schedule might be utilised instead of formal questionnaires. An interview schedule consists of a list of topics to be covered, but it is not as structured as an interview. It provides respondents with more freedom to elaborate on their views. • The final report will focus on current conditions, providing baseline data. Each category will discuss the current state of affairs, but also investigate the possible impacts that might occur in future. The impacts identified in the scoping report will be revisited and rated accordingly. New impacts that have not been identified

Aspect	Component	Company Responsible	Consultant	Scope of Work / Terms of Reference
				will be added to the report. Recommendations for mitigation will be made at the end of the report. • The SIA process will have a participatory focus. This implies that the SIA process will focus strongly on including the local community and key stakeholders. The public consultation process needs to feed into the SIA. • Impacts will be rated according to significance (severity), probability, duration, spatial extent, and stakeholder sensitivity. • Information obtained through the public processes will inform the writing of the final SIA and associated documents.
Traffic 	Traffic Impact Assessment	LD&S Engineers	LD&S Engineers	The TIA will determine the impact of construction traffic on nearby roads and road users and will include: • Desktop study and site visit. • Traffic Counts. • Traffic analysis and modelling. • Report compilation including drawings.
Closure and Rehabilitation 	Closure Costing	MineLock Environmental Engineers	Johann Le Roux	A closure cost estimate in support of the TSF application will be undertaken. This report will address the closure measures that will be implemented and provides the cost of environmental rehabilitation at closure.

11.4 PROPOSED METHOD OF ASSESSING ENVIRONMENTAL ASPECTS

The same method of assessing impact significance as was used during the Scoping phase will be applied during the EIA phase. This methodology is described in detail in Section 9.1 of this report.

11.5 PROPOSED METHOD FOR ASSESSING DURATION AND SIGNIFICANCE

The significance of environmental impacts will be rated before and after the implementation of mitigation measures. These mitigation measures may be existing measures or additional measures that may arise from the impact assessment and specialist input. The impact rating system considers the confidence level that can be placed on the successful implementation of the mitigation. The proposed method for the assessment of environmental issues is set out in the Section 9.1. This assessment methodology enables the assessment of environmental issues including: the severity of impacts (including the nature of impacts and the degree to which impacts may cause irreplaceable loss of resources), the extent of the impacts, the duration and reversibility of impacts, the probability of the impact occurring, and the degree to which the impacts can be mitigated.

The specialist studies will recommend practicable mitigation measures or management actions that effectively minimise or eliminate negative impacts, enhance beneficial impacts, and assist project design. If appropriate, the studies will differentiate between essential mitigation measures, which must be implemented and optional mitigation measures, which are recommended.

11.6 STAGES AT WHICH COMPETENT AUTHORITIES WILL BE CONSULTED

Competent authorities have been and will be consulted during the initial notification period, the scoping phase as well as during the EIA phase.

11.7 DESCRIPTION OF TASKS THAT WILL BE UNDERTAKEN DURING THE EIA PROCESS

The plan of study detailed in the above sections and is summarised below. The following tasks will be undertaken as part of the EIA phase of the project:

- EIA-phase specialist studies.
- Public consultation:
    - Notification of the availability of the EIA Report for review and comment to all registered I&AP's;
    - Public and focus group meetings.
- Authority consultation:
    - Consultation with DMPR, DESTEA, DWS and the various commenting authorities; and
    - Authority consultation (including meetings where necessary) to provide authorities with project related information and obtain their feedback.
- Document compilation:
    - The EIA and EMPr will be compiled in line with the requirements of Appendix 3 and 4 of the NEMA EIA Regulations.
    - The EIA and EMPr will be made available for public comment for a period of 30 days.
    - The EIA and EMPr will be finalised and submitted to the DMPR for adjudication and decision making.

11.8 PROPOSED METHOD OF EIA PHASE PUBLIC PARTICIPATION

The proposed public participation process to be followed for the EIA phase is provided below.

- The commenting periods that will be provided to the I&AP's (and the competent authorities) will be 30 days as per the relevant legislative requirements.
- The dates of the review and commenting period for the EIA/EMPr will be determined at a later date and communicated to all registered I&AP's through faxes, emails, SMS's and/or registered letters.
- The location at which the hard copy of the EIA report will be made available is at the same public places in the project area that the Scoping Report was made available (refer to Section 7.1.3), sent electronically to stakeholders who request a copy, and placed on the EIMS website: www.eims.co.za.
- The public participation will be undertaken in compliance with NEMA GNR 982 (Chapter 6).
- A public meeting will be held during the review period for the EIA report. Focus group meetings will also be held with key stakeholders as and where necessary.
- All comments and issues raised during the comment periods will be incorporated into the final EIA Report.

11.9 MEASURES TO AVOID, REVERSE, MITIGATE, OR MANAGE IMPACTS

All comments received from I&APs during the Scoping Report review will be taken into consideration and where applicable inform the high-level mitigation measures. Detailed mitigation measures will be further developed as part of the EIA phase. The potential impacts will further be assessed in terms of the mitigation potential, taking into consideration the following:

- Reversibility of impact:
    - Reversible.
    - Partially reversible.
    - Irreversible.
- Irreplaceable loss of resources:
    - Replaceable.
    - Partially replaceable.
    - Irreplaceable.
- Potential of impacts to be mitigated:
    - High.
    - Medium.
    - Low.

This information for each identified impact will be provided in the EIA and EMPr.

12 ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations relating to this scoping phase assessment should be noted:

- In determining the significance of impacts, with mitigation, it is assumed that mitigation measures proposed in the report are correctly and effectively implemented and managed throughout the life of the project.
- Identified impact significance ratings and mitigation measures will be further refined based on specialist input during the EIA phase.
- Detailed Assumptions and Limitations for each specialist study completed to date are presented in Table 40. This table will be updated in the EIA report once additional specialist reports and specialist report updates are completed.

Table 40: Assumptions and limitations from completed specialist studies

Study	Assumptions and Limitations
Biodiversity (Terrestrial)	The following assumptions and limitations are applicable to this assessment: • The assessment area was based on the spatial data provided by the client and any alterations to the route and/or missing GIS information pertaining to the assessment area would have affected the area surveyed; • For the purposes of this assessment, the results from the desktop evaluation and field survey considered the entire PAOI; • Whilst every effort was made to cover as much of the site as possible, it is possible that some flora and fauna species that are present on site were not recorded during the field survey, especially secretive or rare species; • The assessment area was only surveyed during a single season site visit and therefore, this assessment does not consider temporal trends, however sufficient to derive meaningful baseline; • The second survey that was undertaken in collaboration with the Endangered Wildlife Trust (EWT) focused primarily on the location of Sensitive Species 15; • The GPS used in the assessment has an accuracy of 5 m and consequently any spatial features may be offset by 5 m.
Agriculture Potential, Soils and Land capability	The following assumptions and limitations are applicable to this assessment: • The information contained in this report is based on auger points taken and observations on site. There may be variations in terms of the delineation of the soil forms across the area. • The GPS used for delineations is accurate to within five meters. Therefore, the delineation plotted digitally may be offset by at least five meters to either side. • Soil fertility analysis was not conducted on-sites for this report.
Geohydrology	The following conditions typically need to be described in a model: • Geological and geohydrological features. • Boundary conditions of the study area (based on the geology and geohydrology). • Initial groundwater levels of the study area. • The processes governing groundwater flow. • Assumptions for the selection of the most appropriate numerical code. Field data is essential in solving the conditions listed above and developing the numerical model into a site-specific groundwater model. Specific assumptions related to the available field data include: • The top of the aquifer is represented by the generated groundwater heads.

Study	Assumptions and Limitations
	• The available geological / geohydrological information was used to describe the different aquifers. The available information on the geology and field tests is considered as correct. • Many aquifer parameters have not been determined in the field and therefore have to be estimated. In order to develop a model of an aquifer system, certain assumptions have to be made. The following assumptions were made: • No abstraction boreholes were included in the initial model. • The boundary conditions assigned to the model are considered correct. • The impacts of other activities (e.g. agriculture) have not been considered. It is important to note that a numerical groundwater model is a representation of the real system. It is therefore at most an approximation, and the level of accuracy depends on the quality of the data that is available. This implies that there are always errors associated with groundwater models due to uncertainty in the data and the capability of numerical methods to describe natural physical processes.
Aquatics and Wetlands	The following assumptions and limitations are applicable for this assessment: • The focus area was based on the spatial files provided by the client and any alterations to the area and/or missing GIS information would have affected the area surveyed; • Only the outline area of the proposed TSF site and infrastructure was provided to the specialist at the time of survey; • Wetlands within the extended 500 m radius were delineated and assed via desktop wherever they were inaccessible on field; • Several artificial features were noted within the project are and are attributed to the predominant mining land use in the area. Artificial features do not form of the assessment, however the main and observable features were delineated to provide context for the receiving environment; and • The GPS used for the survey has a 5 m accuracy and therefore any spatial features may be offset by 5 m.
Air quality	The main assumptions, exclusions and limitations are summarized below: • Use was made of measured Welkom meteorological data and this is regarded representative of the project area. • The quantification of sources of emission was restricted to the project activities and baseline Harmony operations within the study domain only. Although other background sources were identified, such sources were not quantified. • Information required for the calculation of emissions from fugitive dust sources for the project operations was taken from a previous study for Harmony Welkom (Grobler and Liebenberg-Enslin, 2017). The assumption was made that this information was accurate and correct. • Routine emissions from the operations were estimated and modelled. Atmospheric releases occurring as a result of accidents were not accounted for.
Socio-Economic	The following assumptions and limitations were relevant:

Study	Assumptions and Limitations
	• Not every individual in the community could be interviewed therefore only key people in the community were approached for discussion. These key people include the directly affected landowners and ward councillors. Additional information was obtained using existing data. • The social environment constantly changes and adapts to change, and external factors outside the scope of the project can offset social changes, for example changes in local political leadership, droughts or economic conditions. It is therefore difficult to predict all impacts to a high level of accuracy, although care has been taken to identify and address the most likely impacts in the most appropriate way for the current local context within the limitations. In addition, it is also important to manage social impacts for the life of the project, especially in the light of the changing social environment. • Social impacts can be felt on an actual or perceptual level, and therefore it is not always straightforward to measure the impacts in a quantitative manner. • Social impacts commence when the project enters the public domain. Some of these impacts will occur irrespective of whether the project continues or not, and other impacts have already started. These impacts are difficult to mitigate and some would require immediate action to minimise the risk. • There are different groups with different interests in the community, and what one group may experience as a positive social impact, another group may experience as a negative impact. This duality will be pointed out in the impact assessment phase of the report. • Social impacts are not site-specific but take place in the communities surrounding the proposed development.
Hydrology	Various assumptions were required in the development of the hydraulic model with resultant limitations in the accuracy of the modelled flooding. They included the following: • PCSWMM model parameterisation – Design hydrographs estimated using PCSWMM are accurate given the potential for large deviations in their estimation to significantly influence resulting flooding. • Rainfall depth – the probable maximum rainfall depths are correct – as defined by SANRAL (2013). The 20% increase assumed for the PMF (plus climate change) is also assumed a representative increase in the potential increase in rainfall intensity in the future. • Rainfall distribution – the rainfall distribution used is hypothetical, with a symmetrical S-curve approach adopted (centred at the 12-hour mark). Rainfall may occur differently from this. • Accuracy of terrain datasets – the 1m DTM was assumed accurate while the 2m DSM was likewise assumed accurate (following a vertical shift to align with the 1m DTM). • Terrain representation - The terrain can only be expected to represent the terrain at the time of data capture. Change in terrain, including change in the morphology of any flow paths or river channel morphology can alter the results of this assessment. • Catchment delineation – a containing catchment has been used for modelling. This catchment has been defined using geoprocessing of the available terrain data. This geoprocessing is based upon an 8-point pour model with the lowest neighbouring cell assumed to receive all the flow from the cell upstream of it. As such, there is not consideration of the flow rate and the potential for the upstream cell to feed into more than one downstream cell. This has potential implications on the final containing catchment extent.

Study	Assumptions and Limitations
	• Culverts – no culverts were modelled since no survey was available while upstream channel detail was absent (in the 2m DSM). There is a culvert immediately upstream of the flood model boundary that would affect flood model results. • Equivalence in recurrence interval – the design rainfall event applied to the flood model is assumed to result in the equivalent design flood event (i.e. the 1:100 RI storm, produces the 1:100 RI flood). • Potential error in the parameterisation of the model – this included the soils and land-cover classification used which may not accurately represent the site and surrounding area. Infiltration losses are highly significant to this study. These losses have only been considered using a generalised approach to infiltration and are not based on measured data. • Mesh detail – the default mesh utilised a 10m mesh size. While one of HEC-RAS's major strengths is the use of a subgrid, the obstructing or routing influence of linear features that are smaller than the mesh resolution will not be well defined. • Breaklines – to compensate for mesh detail, linear features (and ridges in particular) were digitised as breaklines and then applied to the model mesh. The application of these breaklines is assumed correct/sufficient. • Roughness values – the selected Manning's 'n' values were representative of the areas they covered, including being representative regardless of the depth of flooding. • Model calibration – no calibration of the model was undertaken as there is no observed data for calibration purposes. • Software Performance - the software and methods utilised are assumed accurate with regards to their utilisation of input data and the processes they simulate. • Climate Change – the influence of climate change has not been considered.
Heritage	Not detracting in any way from the comprehensiveness of the fieldwork undertaken, it is necessary to realise that the heritage resources located during the fieldwork do not necessarily represent all the possible heritage resources present within the area. Various factors account for this, including the subterranean nature of some archaeological sites and existing vegetation cover. Therefore, should any heritage features and/or objects be located or observed outside the identified heritage sensitive areas during the construction activities, a heritage specialist must be contacted immediately. Such observed or located heritage features and/or objects may not be disturbed or removed in any way until such time that the heritage specialist has been able to make an assessment as to the significance of the site (or material) in question. This applies to graves and cemeteries as well. If any graves or burial places are located during the development, the procedures and requirements pertaining to graves and burials will apply. The study area boundaries and development footprints depicted in this report were provided by the client. As a result, these were the areas assessed during the fieldwork. Should any additional development footprints located outside of these study area boundaries be required, such additional areas will have to be assessed in the field by an experienced archaeologist/heritage specialist long before construction starts.
Palaeontology	The geology of the area is the focal point of geological maps, and the sheet explanations of the Geological Maps were not intended to focus on palaeontological heritage. Many inaccessible areas of South Africa have never been examined by palaeontologists, and data is typically dependent solely on aerial pictures. Locality and geological information in museums and university databases is out of date, and data acquired in the past is not always adequately documented. Comparable Assemblage Zones in other places are also used to provide information on the existence of fossils in areas that have not before been recorded. When similar Assemblage Zones and geological formations are used for desktop studies, it is commonly assumed that exposed fossil exists within the footprint.
Visual	The following assumptions limitations have been made in the study:

Study	Assumptions and Limitations
	• The description of project components is derived from the Background Information Document for the Project. • The project site is the only site under consideration i.e. no alternative sites have been assessed.
Health Risk and Radiological	The following are assumed for the Residential Area Exposure Condition: • The exposure groups consist of members of the public from all age groups. • The exposure group maintain a small household garden consisting of fruits, vegetables (leafy and root) and cereal (mealies), which fulfil 50% of their annual requirement of fruit, vegetables, and cereal. • The exposure group keep animals in the form of chickens, goats, and cattle. These serve as a source of protein in the form of eggs, milk, and meat. For the assessment, it is conservatively assumed that it contributes to 50 % of their daily rate of protein consumption. • Food preparation (e.g., peeling, boiling) may contribute to a reduction in radioactivity concentrations in fruits and vegetables. However, for this assessment, it is assumed that radionuclide concentrations in any food produced in the area remain the same irrespective of preparation methods used. • Consistent with RG-002 guidelines (NNR, 2013a), Table 4.1 in the attached study lists the age group-specific indoor and outdoor occupancy factors assumed for the assessment. • As a conservative assumption, the rate of incidental soil ingestion is maintained at 100% of the value published in RG-002 (NNR, 2013a). The following are assumed for the Commercial Agricultural Exposure Condition: • The exposure groups (farmers and farm workers) consist of members of the public from all age groups. • The exposure group maintain a commercial farm system consisting of fruits, vegetables, and cereal (mealies). It is conservatively assumed that the farm contributes 100% to its annual consumption rate. • The exposure group keep animals in the form of chickens, sheep, and cattle. These serve as a source of protein in the form of eggs, milk, and meat. For the assessment, it is conservatively assumed that it contributed 100% to their annual consumption rate. • Food preparation (e.g., peeling, boiling) may contribute to a reduction in radioactivity concentrations in fruits and vegetables. However, for this assessment, it is assumed that radionuclide concentrations in any food produced in the area remain the same irrespective of preparation methods used. • Consistent with RG-002 guidelines. Table 4.1 in the attached study lists the age group-specific indoor and outdoor occupancy factors assumed for the assessment.

13 UNDERTAKING REGARDING CORRECTNESS OF INFORMATION AND LEVEL OF AGREEMENT

I **John von Mayer** herewith undertake that the information provided in the foregoing report is correct to the best of my knowledge, and that the comments and inputs and the level of agreement from stakeholders and Interested and Affected Parties has been correctly recorded in the report where applicable.

Signature of the EAP

Date: 2025/12/10

14 REFERENCES

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Appendix A: Copy of Application Form

Appendix B: EAP CV

Appendix C: Public Participation

Appendix D: Specialist Reports

Appendix E: Impact Assessment Matrix

Appendix F: DFFE Screening Tool Reports and Site Sensitivity Verification Report

Appendix G: Previous Site Selection Summary Report and Mitigation Hierarchy Report

Appendix H: Preliminary Design Report