Renewal of the license in terms of Section 52 of the NWA, 1998

INTEGRATED WATER USE LICENSE RENEWAL APPLICATION (IWULA) IN TERMS OF SECTION 41 OF THE NATIONAL WATER ACT 36 OF 1998

AND

INTEGRATED WATER AND WASTE MANAGEMENT PLAN (IWWMP) FOR THE TGME UNDERGROUND MINES, PLANT AND TAILINGS DAM AREA (GREATER TGME): TGME LIMITED: PILGRIMS REST

FIRST DRAFT

November 2020

COMPILED FOR:
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PROJECT DETAILS

Document Title: **FIRST DRAFT** Integrated Water Use License Application (IWULA) in terms of Section 40 of the National Water Act 36 of 1998 and Integrated Water & Waste Management Plan (IWWMP) for the Greater TGME (MR83).

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Client: Transvaal Gold Mining Estate Limited (TGME)

Submission date: 04 November 2020

Revision: **1**

	Date	Description	Issued to	Issue Format
1	04/11/2020	Draft Report for review	NatashaThomas-Kasangana	Electronic
2				
3				
4				
5				
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Date: 03 November 2020

The author hereby declare that every effort was made to ensure that this Report was compiled as objectively as possible, making use of the latest available information, prescribed guidelines and methodologies and professional scientific judgment.

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List of Abbreviations

Acronym	Description
ABA	Acid Base Accounting
AMD	Acid Mine Drainage
ARD	Acid Rock Drainage
BEE	Black Economic Empowerment
BID	Background Information Document
BPG	Best Practice Guideline
BPEO	Best Practical Environmental Option
CBA	Critical Biodiversity Area
CE	Consulting Engineer
CRR	Comments and Response Report
CIL	Carbon In Leach
DMR	Department of Mineral Resources
DTM	Digital Terrain Model
DWA	Department of Water Affairs
DWS	Department Water and Sanitation
EDM	Ehlanzeni District Municipality
EI	Ecological Importance
EIA	Environmental Impact Assessment
ELU	Existing Lawful Use, as defined in section 32 of the NWA
EMP	Environmental Management Plan
EMPR	Environmental Management Programme Report
ELWU	Existing Lawful Water Use
EO	Environmental Officer
FEPA	Freshwater Ecosystem Priority Area
FSC	Full Supply Capacity
I&AP	Interested and Affected Party
GN	Government Notice
GN267	RSA, 2017 GN267. Regulations Regarding the Procedural Requirements for Water Use License Applications and Appeals
GN704	GN704 of 4 June 1999 i.t.o. section 26 of the NWA to prevent pollution by mining and related activities
GN509	GN509 of 2016 i.t.o. section 39 of the NWA for water uses as defined in section 21(c) & (i) (Zones of regulation)
GN466	RSA, 2016 GN466 in terms of the NWA. Classes and Resource Quality Objectives of Water Resources for the Olifants Catchment
GN632	RSA, 2015 GN632, in terms of s 69(1)(iA) as amended by GN242 of 2017 under s 19(2) read with s 19(10)(a), 72 & 74 of the National Environmental Management: Waste Act, 2008. Planning and

Acronym	Description
	management of residue stockpiles & residue deposits from a prospecting, mining, exploration or production operation
GN921	RSA, 2013 GN921 in terms of s 19(2) of the National Environmental Management: Waste Act, 2008. List of activities that have, or are likely to have, a detrimental effect on the environment
GN665	RSA, 2013 GN665 Revision of General Authorisation in terms of Section 39 of the NWA, 1998 (Revise the GA in section 3 of the Schedule to GN398 of 26 March 2004 (s 21 (e, f, g, h &j)
GN634	RSA, 2013 GN634 in terms of s 69 (1)(a, b, g, h, m ,q, r, s, dd & ee) of the National Environmental Management: Waste Act, 2008. Waste Classification & Management Regulations
GN635	RSA, 2013 GN635 in terms of s 7(1)(c) of the National Environmental Management: Waste Act, 2008.Waste Classification & Management Regulations. National Norms and Standards for the assessment of Waste for Landfill Disposal
GN636	RSA, 2013 GN636 in terms of s 7(1)(c) of the National Environmental Management: Waste Act, 2008. National Norms and Standards for Disposal of Waste To Landfill
GN538	RSA, 2016 GN538. Revision of General Authorisation for the Taking and Storing of Water
GVA	Gross Value Added
HDSA	Historically Disadvantaged South African
HLP	Heap Leach Pad
IWULA	Integrated Water Use License Application
IWRM	Integrated Water Resource Management
IWWMP	Integrated Waste and Water Management Plan
koz	Kilo ounces (1,000 oz)
ktpm	Kilo tons per month
KPA	Key Performance Area
LoM	Life of Mine
MAP	Mean Annual Precipitation
MAR	Mean Annual Run-off
Minxcon	Minxcon (Pty) LTD.
MPRDA	Mineral and Petroleum Resources Development Act, No 28. of 2002
MRD	Mine Residue Deposit
NAG	Net Acid Generating
NEMA	National Environmental Management Act (107 of 1998)
NEMBA	National Environmental Management Biodiversity Act, Act 10 of 2004
NEM:WA	National Environmental Management: Waste Act (Act 59 of 2008)
NFEPA	National Freshwater Ecosystem Priority Area 2011
NWA	National Water Act (Act 36 of 1998)
PCD	Pollution Control Dam
PES	Present Ecological State
PPD	Process Plant Dam
RWD	Return Water Dam
REC	Recommended Ecological Category
SBR	Sequencing Batch Reactor

Acronym	Description
SLP	Social and Labour Plan
STF	Standard Design Flood
STP	Sewage Treatment Plant
SWMP	Storm Water Management Plan
TCLM	Thaba Chweu Local Municipality
TGME	Transvaal Gold Mining Estates
tpa	Tonne per annum
TSF	Tailings Storage Facility
WB PCD	Wishbone Pollution Control Dam
WMA	Water Management Area
WMS	Water Management System
WRD	Waste Rock Dump
WQ	Water Quality
WQPLs	Water Quality Planning Limits
WTP	Wastewater Treatment Plant

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3	TGME no 1 Tailings Storage Facility Continuation Report, September 2020- Tailex
4	Water Quality Reports by OMI May to August 2020
5	Minutes and attendance register of meeting with DWS – 16 October 2020
6	Advertisement in newspapers and BID document
7	Dr. P Bentley Letter 20 August 2020

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EXECUTIVE SUMMARY

BACKGROUND TO TGME

Transvaal Gold Mining Estates Limited (TGME) is situated in the Sabie / Pilgrim's Rest goldfields of Mpumalanga. It is an existing mine which has been in operation since 1895, making it the oldest gold mining company in South Africa. TGME's underground mines, plant and slimes dam areas are situated in a 20 km radius from Pilgrims Rest in the Olifants River Water Management Area, -

Mining has taken place on the TGME properties since 1895. TGME is a strategic contributor to the economy of the region and is a source of employment for the local population.

TECHNICAL INFORMATION FOR THE IWWMP & IWULA

An Integrated Water Use Licence (IWUL) number 27/2/2/B60A/021 is approved in favour of TGME over the portion 42 of the farm Ponieskrans 543 KT, as well as the farms Morgenzon 525 KT and Frankfort 509 KT, incorporating water uses associated with the proposed mining operations as follows and subject to further conditions as stated in the IWUL:

- Taking of water from a water resource.
- Impeding or diverting the flow of water in a watercourse.
- Disposing of waste in a manner which may detrimentally impact on as water resource.
- Altering the bed, banks course or characteristics of a watercourse.
- Removing, discharging or disposing of water found underground.

The IWULA was approved on 29 March 2011 and is valid for a period of 10 years. TGME appointed Maleka Environmental Consulting to updated the current IWWMP & IWULA as part of the renewal application for the Water Use License (WUL) in terms of section 52 of the National Water Act, 1998 ("NWA").

This report is the technical information document in support of the Integrated Water Use License Application (hereafter referred to as the IWULA) in terms of Chapter 4 of the National Water Act, 1998 (Act 36 of 1998) (hereafter referred to as the NWA), for the relevant water uses under Section 21 of the NWA associated with the TGME underground mines (Clewer, Morgenson, Dukes Hill Lower and Frankfort, plant and slimes dam area , within the Mining Right 83MR perimeter. The 83MR right was granted, registered, and executed, and expires in October 2023. TGME intends to restart the underground mines. The gold mining operations forms part of the existing Greater TGME mining rights, and consist of:

- The plant, offices and tailings facility (MR83).
- Dukes Hill Upper and Lower.
- Clewer – Morgenzon Complex (MR83).

- Frankfort Mine (MR83).
- Beta Mine (MR83).

The creation of an Integrated Water and Waste Management Plan (IWWMP) is a process in which the essence is abstracted from all available information regarding water management and specialist studies, and consolidated into a single feasible, sustainable and measurable plan that could be implemented, audited and monitored by water users, government and Interested and Affected Parties (I&APs), and which can be updated and improved on a continual basis.

The purpose of this document is to formulate an IWWMP for the renewal of all water use activities as per the water use licence dated 11 March 2011, License number 24023343, based on the essential aspects that relate to the current status of all existing activities, institutional arrangements, water management programmes and specialist studies. The document will formulate management measures into an action plan for implementation with regard to water and waste management.

THE METHODOLOGY

The methodology to be followed for this project entails the following:

- Establish the existing status with regards to all water and waste management aspects, systems and processes and operations at the various mines, the plant area and the tailings storage facility, by reviewing all relevant and available information and documentation on its activities and the environment within which it is operated;
- Determine stakeholder expectations with regard to integrated water and waste management aspects by obtaining input from the environmental consultant, DWS, other authorities and relevant key stakeholders where applicable;
- Determine the gaps, backlog or shortfalls between the existing status and the desired end state and prioritise these gaps based on their potential impacts on the water resource or its users;
- Identify and evaluate alternatives that could be implemented to achieve the management objective;
- Determine the option that could be implemented as the best practicable environmental option (BPEO);
- Summarise the action required for implementation of the BPEO for each identified and prioritised gap into a draft IWWMP, preparing an action plan and an implementation schedule with monitoring measures and time frames;
- Discuss the draft IWWMP with TGME to determine acceptability and implementability;
- Prepare the Final IWWMP with comments received from stakeholders for submission to the DWS.

INFRASTRUCTURE LAYOUT

Each mine which forms part of the MR83 area has its own infrastructure. This does not address the specific water use activities such as dewatering and take of water for usage at the mine. Only

maintenance have been done for the past 5 years. TGME need to do some refurbishment on all structures before mining will start.

Table 1: List of infrastructure at each mine

Plant, offices and TSF area	Clewer underground mine (Morgenson Complex)	Frankfort mine	Dukes Hill mine	Beta Mine
Plant Spillage collection pond	WRD at Morgenson Office	Frankfort WRD	Dukes Hill Upper WRD	Beta WRD
Slime dam next to plant also referred to as the Tailings Storage Facility.	Morgenson Paddocks	Void underground	Dukes Lower WRD	
Lined Return water dam with two compartments (RWD)	Conservancy tank for sewage disposal at Morgenson Office.	Frankfort settling dam		
Conservancy tank for sewage disposal at Morgenson Office.		Conservancy tank for sewage disposal		

WATER USES

The current water use license expires end of March 2020 and TGME needs to renew the current license and water use activities. The following water uses will be licensed in terms of section 52 and 41 of the NWA, Act 58 1998

Section 21 (a) Taking water from a water resource:

- *Abstraction from Morgenson Paddocks;*
- *Abstraction from Molototse river at Frankfort mine;*
- *Taking water from the Frankfort void for usage;*

Section 21 (b) Storage of water:

- *Storage of water for domestic purposed at Frankford mine;*
- *Storage of water for domestic purposed at Beta mine;*
- *Storage of water for domestic purposed at Clewer mine;*
- *Storage of water for domestic purposed at Dukes Hill mine;*
- *Storage of water for domestic purposed at Morgenson mine.*

Section 21 (c) Impeding or diverting the flow of water in a watercourse:

- *Dukes Hill Upper diversion of tributary of Blyde river;*
- *Dukes Hill Upper diversion of another tributary of Blyde river.*

Section 21(g) Disposing of waste in a manner which may detrimentally impact on a water resource:

- *Underground mining void at Frankfort mine (referred to as Frankfort void);*
- *Waste rock dump at Frankfort mine (Frankfort WRD);*
- *Conservancy tank for sewage disposal at Frankfort mine.*
- *Waste rock dump at Morgenson offices (Morgenson WRD);*

- *Paddocks at Morgenson mine (referred to as Morgenson Paddocks);*
- *Conservancy tank for sewage disposal at Morgenson office;*
- *Settling dam at Frankfort mine;*
- *Waste rock dump at Beta mine (Beta WRD);*
- *Slimes dam Pilgrims rest plant (Referred to as Tailings Storage Facility – TSF);*
- *Return water dam with two compartments (RWD);*
- *The disposal of stormwater from the plant area via a sump to the Spillage collection pond 1&2 as part the stormwater management plan. (Sump and Spillage collection pond at plant);*
- *Dust suppression*

Section 21(i) Altering the bed, banks, course or characteristics of a watercourse:

- *Diversion canal around Dukes Hill Upper Waste rock dump;*
- *Diversion canal around Dukes Hill Upper Waste rock dump;*

Section 21(j) 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:

- *Excess groundwater removed from underground at Clewer No. 4 adit and disposed of into the Morgenson Paddocks;*
- *Disposal of groundwater at the Frankfort mine into either the Frankfort void or the Frankfort Settling dam;*
- *The removal of water found underground at Morgenson adit 5 in order to manage excess water for the efficient continuation of mining activity and for the safety of people.*

The water uses as listed above are illustrated in Figure 1 to Figure 4.

The NWA introduced the concept of Integrated Water Resource Management (IWRM) comprising all aspects of the water resource, including water quality, water quantity and the aquatic ecosystem quality. The IWRM approach provides for both resource-directed and source-directed measures. Resource directed measures aim to protect and manage the receiving environment; examples of resource directed action are the formulation of resource quality objectives. Source directed measures aim to control the impacts at source through the identification and implementation of pollution prevention after reuse and water treatment mechanisms.

The integration of resource and source directed measures forms the basis of the hierarchy of decision-taking aimed at protecting the resource from waste impacts. This hierarchy is based on a precautionary approach and the following order priority for wastewater managements applicable**:**

Step 1: Pollution prevention measures should be implemented at source.

Step 2: If the water/wastewater problems cannot be solved by pollution prevention, water/wastewater re-use and minimization strategies should be implemented.

Step 3: Discharge or disposal of waste and or wastewater (*polluter pays principle*). If the water/wastewater problems cannot be solved by pollution prevention and water/wastewater reuse and minimization strategies, then water/wastewater treatment strategies should be implemented.

An extensive water monitoring programme for surface water, groundwater, aquatics and sedimentation control will form part of the license application. This monitoring program will be implemented to monitor and control the effectiveness of the water management measures that will be implemented.

It is the purpose of this IWWMP and IWULA report to provide sufficient information to enable informed decision-making, to indicate existing lawful water uses and to apply for water uses requiring a water use license.

The administrative process with regards to a water use license application in terms of Chapter 4 of the NWA, 1998 for a water use under Section 21, requires that a technical document be prepared to provide the Department of Water and Sanitation with sufficient information to make an informed decision with regards to the required water use(s). References utilised:

- Procedural reference was made to the document: "Water Use Authorisation process (individual applications), Edition 1: Final draft for implementation and use, Revision 3" dated December 2000, published and distributed by the DWA.
- DWA, August 2010: Operational Guidelines: IWWMP for the preparation of the water quality management technical document to support the Application for Licenses for mining and industries in terms of the Requirements of the NWA (DWA IWWMP Guideline).
- The Best Practice Guidelines, 2008.

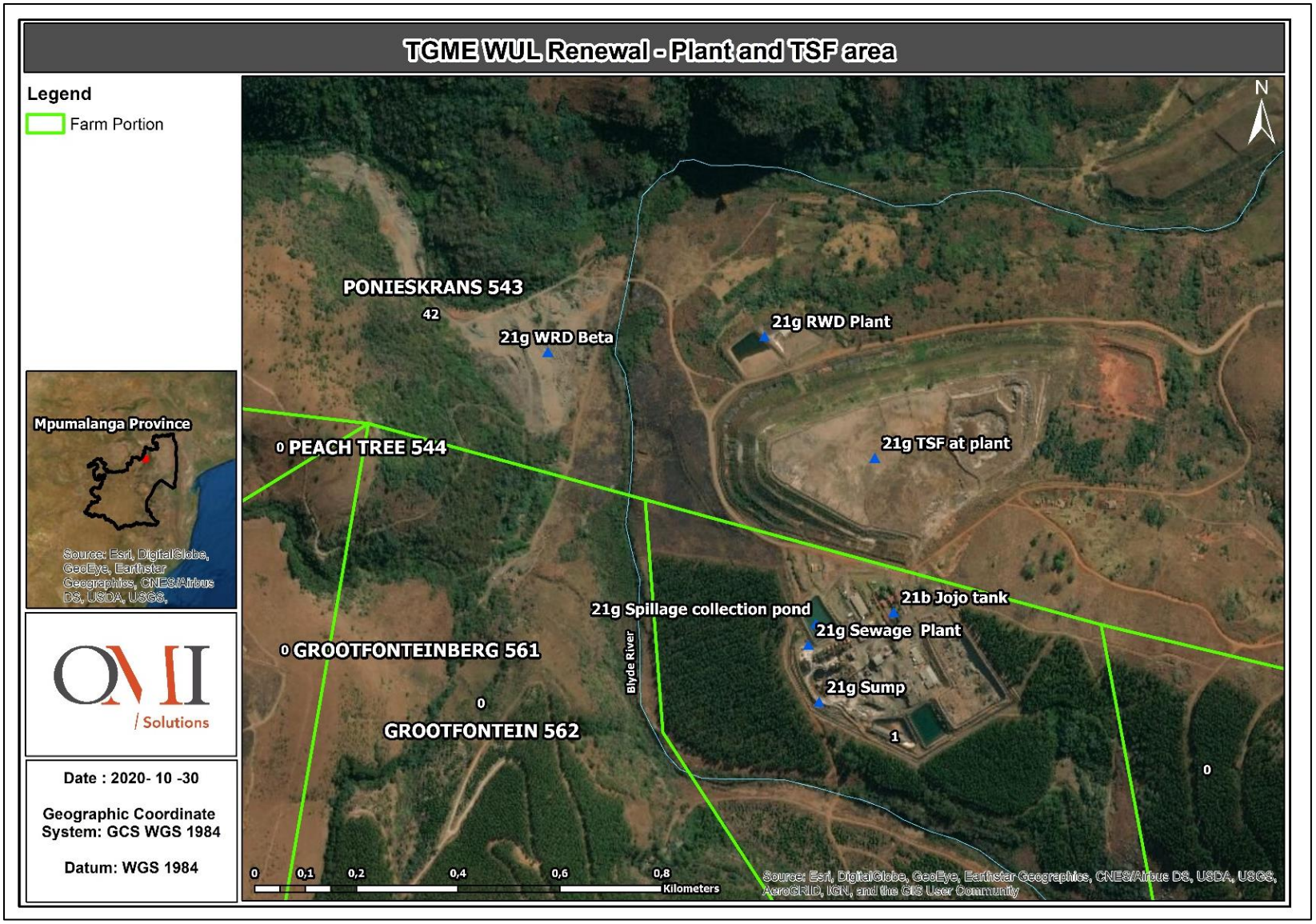

Figure 1: TGME Beta, Plant and TSF area -Water Uses Applicable to 83MR

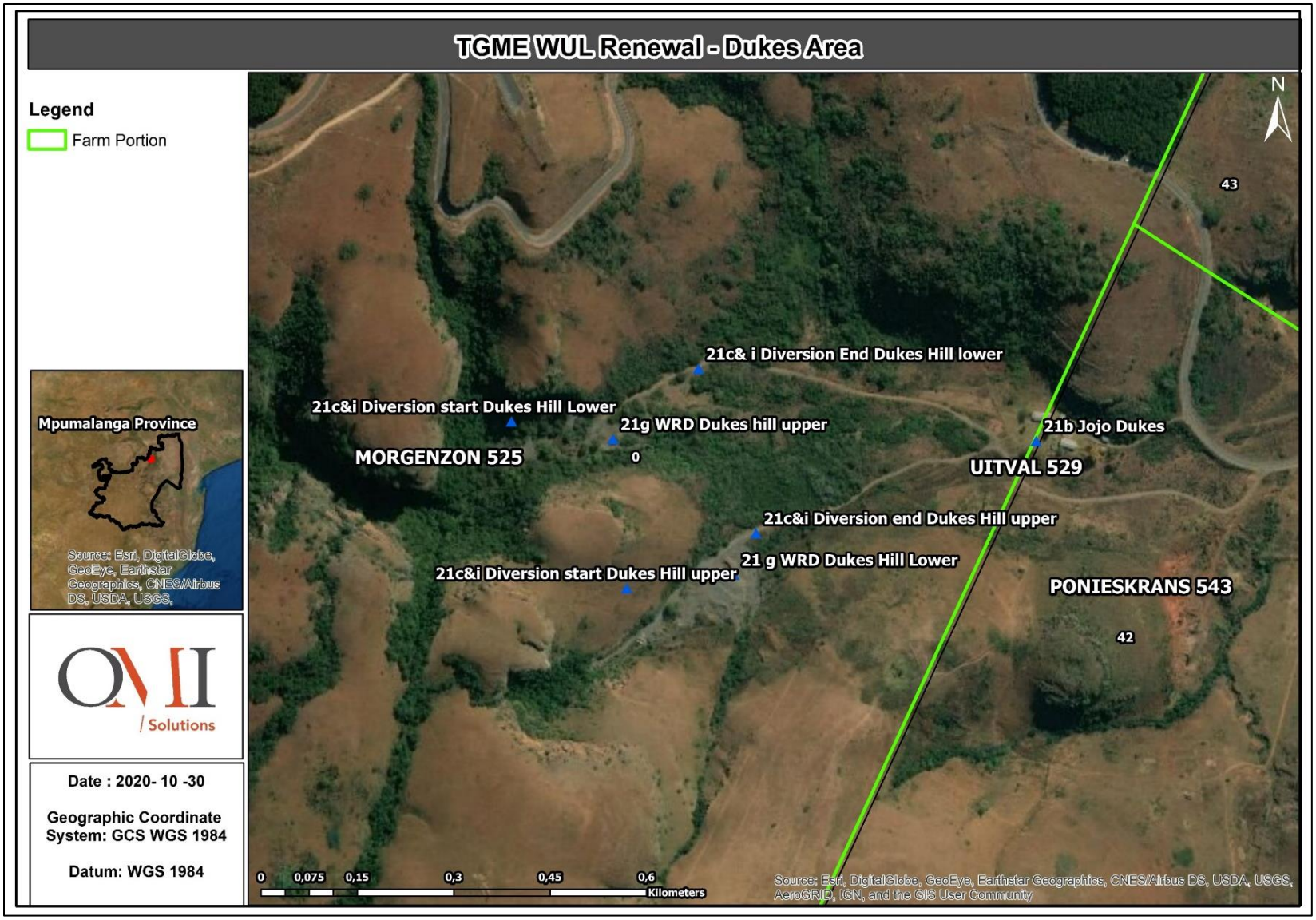

Figure 2: TGME:Dukes area-water uses applicable to 83MR

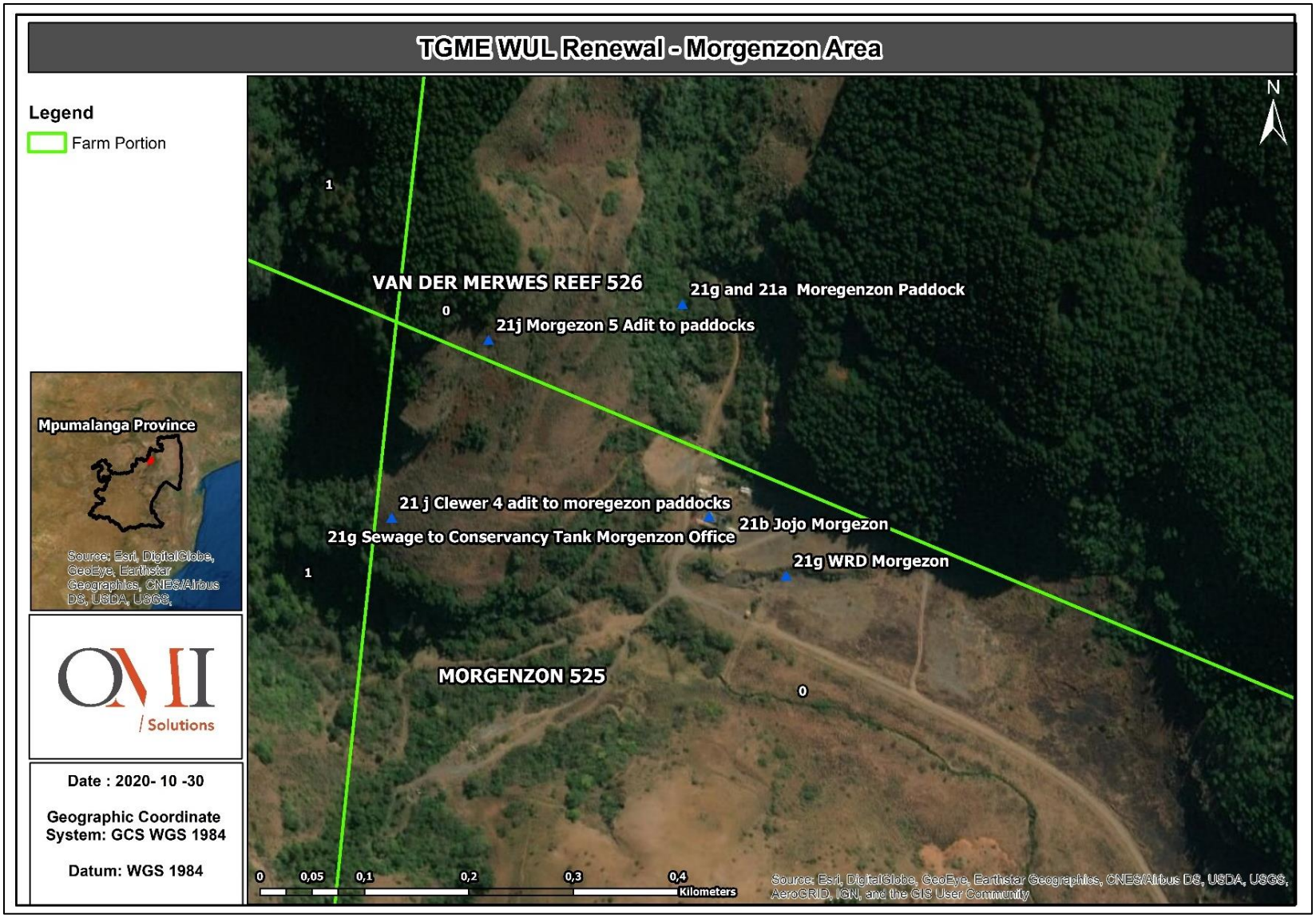

Figure 3: TGME: Morgenson area - water uses applicable to 83MR

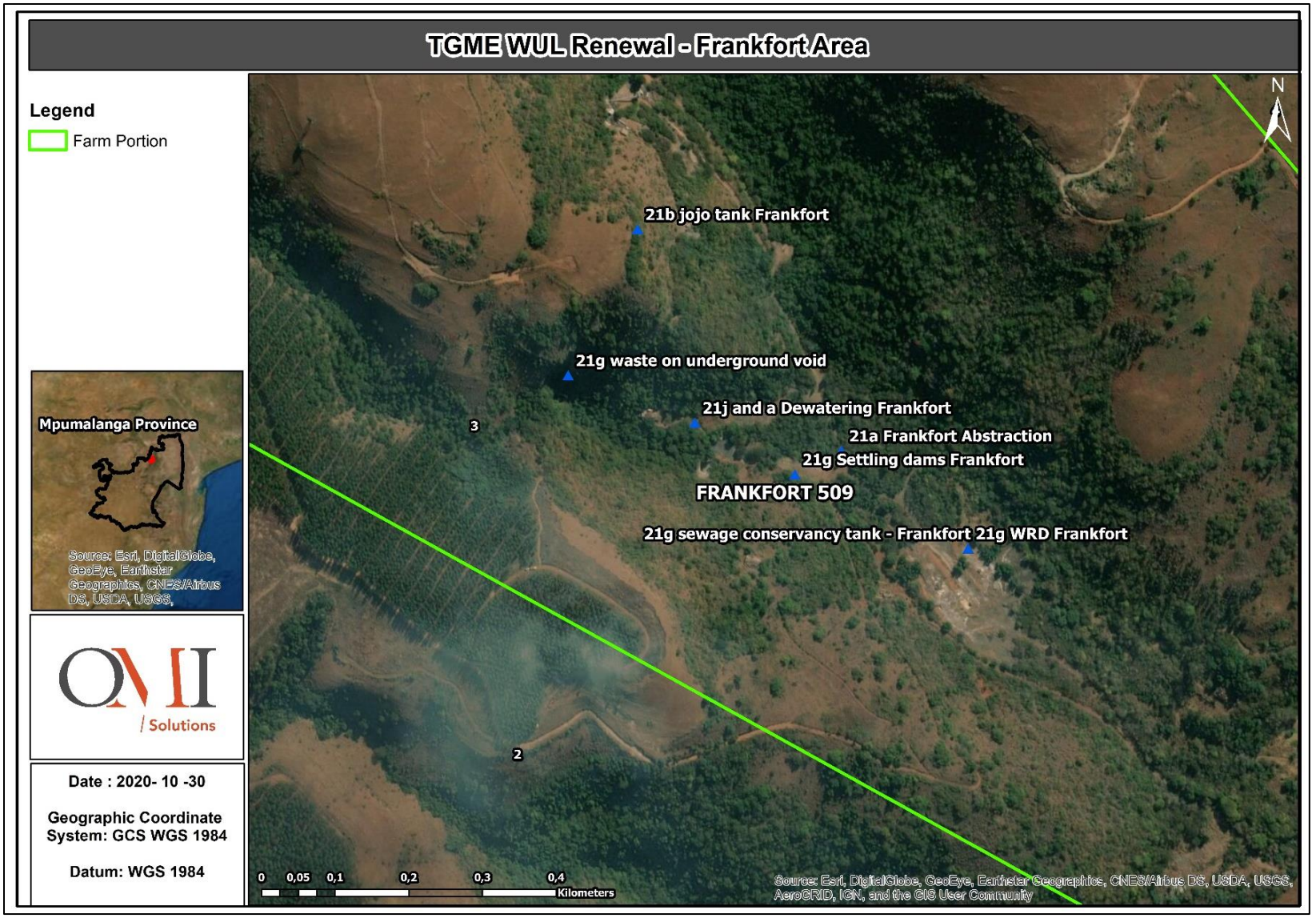

Figure 4: TGME: Frankfort area - water uses applicable to 83MR

FINDINGS

Freshwater Ecology

The status of the Upper Blyde River is Class I. This classification indicates high environmental protection and minimal utilisation (DWS, 2016). This river is considered unique on a national and international level based on its unique biodiversity.

The aquatic assemblages of the various rivers and streams assessed (i.e. the Blyde River, the Peach Tree Stream and the Pilgrims Creek) of the assessed sites were defined as being extremely sensitive to water quality changes as well as changes in flow regimes, with these two aspects also considered to be the most important ecological parameters in the Blyde River system (affected by both natural seasonal variation as well as existing anthropogenic impact) with more significant influence from the changes in flow regime. Two species of concern, the Treur River Barb (*Enteromius cf treurensis*) (Critically Endangered) and the Marico Barb (*Entromius motebensis*) (Near Threatened) were observed within and in the vicinity of the proposed project in the January 2020 assessment. Special mention is made of the Treur River Barb, which is isolated to a single population in the upper reaches of the Blyde River catchment. The temporal and spatial results of the aquatic ecological assessment indicate that the integrity of the Blyde River, while still largely classified overall as an Ecological Category B along the entire portion of the Blyde River assessed, has begun to decline in a downstream direction over time. This decline may be largely related to the surrounding land-use activities, including forestry, illegal artisanal mining activities, seepage and runoff from historical mining areas, increasing urbanization and proliferation of alien and invasive species (resulting in altered surface runoff into the river and changes to the stream bed characteristics), and the ingress of sewage related to the Pilgrims Rest WWTW. The illegal artisanal mining activities observed has resulted in severe sedimentation in some areas and may potentially have contributed to blanketing of benthos and algal proliferation, which has begun to compromise the habitat integrity and water clarity of the Blyde River in a downstream direction.

Management of Sedimentation

It is important to prevent sedimentation in the Blyde River Catchment. It is clear from Olifants River Catchment Classes and Water Resource Quality Objectives (GN466, 2016) that sedimentation needs to be managed.

Management of clean and dirty water

It is important to manage the separation of clean and dirty water on the mining sites in accordance with GN704 Regulations and DWS best practice guidelines

Management of the Water Balance

An annual water balance model was developed based on average annual climatic data and operating conditions to determine average annual inflow and outflow.

- Rainfall inflow (105 755 m^3/yr);
- Slurry Water (354 324 m^3/yr assuming a Relative Density of 1.37 with 43.2 solids);
- Plant storm water management in the spillage collection pond (21 428 m^3/yr);

- TSF side slope run-off (Assumed to be collected in the paddocks system and obtaining 80% loss in the paddocks system, 20% of the water collected from the side slopes will report to the return water dams (4069 m^3/yr);
- Total Inflow = 485 577 m^3/yr.

The water balance outflows include the following:

- Evaporation loss (83 898 m^3/yr);
- Seepage water due to unlined facility (10 233 m^3/yr);
- Interstitial storage (121 417 m^3/yr). Water is initially trapped in the pore spaces on the wet beach. This water is lost to desiccation in the long term;
- Combined Return to plant (255 904 m^3/yr);
- Storage Changes (Delta storage is the difference between the volumes at the start and end of the simulation) (-9 m^3/yr);
- GN 704 compliant spill (79 m^3/yr);
- Dust suppression over the haul roads (14 055 m^3/yr);
- Total outflow: 485 577 m^3/yr.

Hydrology and Stormwater Management

A conceptual Stormwater Management Plan (SWMP) was prepared for the plant and TSF areas to ensure that clean and dirty water are adequately separated, by diverting clean water away from dirty areas, and ensuring that dirty water is captured, contained and managed appropriately in accordance with GN704 Regulations and DWS best practice guidelines.

Geohydrological Setting

Karstic aquifers associated with the Malmani Dolomites are underlying the TGME Project mining sites. Karst is a topography formed from the dissolution of soluble rocks such as limestone, dolomite, and gypsum. It is characterized by underground drainage systems with sinkholes and caves. An area currently or formerly undergoing karstification, and thus characterized by karst landforms, is said to be karstified.

Based on the monitoring boreholes in the area the groundwater level varies between 1 224.43 – 1240.52 metres above mean sea level (mamsl). The water table in the dolomitic aquifer is generally a flat surface due to high aquifer parameters, and it is assumed that it is the same in the study area.

The dolomitic aquifer is an important aquifer and it is imperative that it is protected. The groundwater quality in this aquifer is currently very good, based on the current mine monitoring data as well as samples collected during this investigation. Water seeping from the mining areas, such as the Beta Adit, is generally also good. This is an indication that the buffering capacity of the host rock (dolomite) neutralises the acid generating potential of the reef horizon, which is generally pyritic in nature.

Recharge to the aquifer is in the region of 10% of the Mean Annual Precipitation (MAP).

Geohydrological Risks

There are essentially three potential primary risks associated with the proposed mining. These are:

1. Lowering of the regional groundwater level due to inflow of groundwater into the mine workings.
2. Impact on the regional groundwater quality because of seepage of contaminants from the mining operations.
3. Impact on the regional groundwater quality because of seepage of contaminants from the tailings facility (TSF).

In order to address these risks a waste classification, numerical groundwater and geochemical modelling were undertaken.

Geochemical Assessment

Geochemical Dynamic Systems (GeoDyn) undertook a geochemical, including an acid mine drainage (AMD), risk assessment for mineral waste material, specifically tailings, from the historic mining operations occurring on the TGME mine site.

Pyrite is contained in the Pilgrim's Rest gold ore (Boer, 1995, Meltz, 2015, Zietsman, 1967) and is unstable in the presence of oxygen contained in the Earth's atmosphere. Pyrite was thus added to the model as a kinetic reactant. Arsenopyrite is also associated with the ore material. However, arsenopyrite was not added to the model as a separate mineral phase, but arsenic was added to the model as a kinetic flux; as if arsenic is being released to the tailings pore water from the dissolution of a kinetic mineral phase. The minerals quartz and dolomite are ubiquitously associated with the gold ore. These minerals were also added to the model and allowed to equilibrate with the tailings pore water. In addition to arsenic, nickel, cobalt, manganese, iron and lead were also evaluated. These metals were added as kinetic fluxes.

The model results indicate that the tailings material does not pose a long-term environmental risk.

The geochemical risk assessment concluded the following:

- The current groundwater and surface water hydrochemistry indicates that AMD drainage conditions have not developed in response to the historic tailings facilities. The geochemical modelling indicates that this scenario is likely to perpetuate into the future.
- The hydrochemical data of the recent groundwater and surface water indicates that the historic tailings has not had an environmental impact in terms of the leaching of metals and metalloids. This geochemical model indicates that this scenario is likely to be perpetuated into the future.
- The current groundwater and surface water hydrochemical data indicates that the historic tailings has an insignificant impact on the local environmental in terms of sulphate concentrations. The geochemical modelling indicates that this scenario is likely to be perpetuated into the future.
- Nitrate concentrations of the historic tailings indicates that the tailings is not likely to have an environmental impact in the long-term, as the older tailings material are not associated elevated

nitrate and ammonia concentrations. This is due to the natural denitrification process which occurs due to the presence of denitrifying bacteria in the soil, groundwater and surface water.

The geochemical study concluded the following:

- The geochemical assessment shows that the historic tailings is not currently negatively impacting the local groundwater and surface water in terms of acid mine drainage and the geochemical modelling indicates that this scenario is likely to be perpetuated in the long-term.
- The historic tailings is not currently negatively impacting the local groundwater and surface water in terms of the leaching of hazardous metals and metalloids and the geochemical modelling indicates that this scenario is likely to be perpetuated in the long-term.
- The historic tailings is not currently negatively impacting the local groundwater and surface water in terms of the leaching of sulphate and the geochemical modelling indicates that this scenario is likely to be perpetuated in the long-term.
- The historic tailings is not currently negatively impacting the local groundwater and surface water in terms of the leaching of nitrate and the geochemical modelling indicates that this scenario is likely to be perpetuated in the long-term, as long as no fresh tailings material, containing process water with elevated nitrate concentrations, are deposited on these historic facilities.
- The results above are consistent with a geochemical model conducted on the Theta and Iota tailings material. This study (GeoDyn, 2019) showed that the likelihood of significant environmental impact is negligible, due to the geochemistry of the tailings as well as the high sorption capacity in the natural environment capable of immobilising metals and metalloids.

Numerical Groundwater Flow and Contaminant Modelling

The numerical groundwater modelling for this project was undertaken by Prof. Ingrid Dennis from the Northwest University.

The calibrated numerical model was used to assess the potential impacts from the Tailings Facility (TSF) on the groundwater and the potential impact on the Blyde River.

The numerical modelling concluded the following:

- The contaminant plume will not reach the Blyde River in 100 years.
- The concentrations that potentially exceed the current WUL limits (TDS and sulphate) will be restricted to the footprint of the TSF.
- No contamination is expected to impact on any down-gradient receptor, including the Blyde River.
- The modelling results do not take any rehabilitation of the TSF after closure into consideration.
- The modelling scenarios represents the worst-case scenario.

The historical mining intersected some water during its operations. The adits where water flows from the mine workings includes the following:

- Beta Adit: Estimated flow 350 m^3/day.

- Morgenzon Adit: Estimated flow 80 m^3/day.
- Clewer Adit: Unable to assess due to illegal mining activity.

The continuous inflow of groundwater into the mine may lead to an impact on the groundwater levels overlying the mine workings. The simulated groundwater level impacts (drawdown >0.1m), to account for the current inflow, however, indicated that the impacts are localised and not expected to be noticeable.

Waste Classification

Geochemical Dynamic Systems (GeoDyn) undertook a geochemical, including an acid mine drainage (AMD), risk assessment for mineral waste material, specifically tailings, from the historic mining operations occurring on the TGME mine site. Existing information on current tailings as well as historic information from studies on the gold ore material from the Sabie-Pilgrim's Rest goldfield is used in the study.

The geochemical assessment was conducted in two phases. The first was to determine the status quo of current environmental impacts by the tailings facilities. The second phase utilised numeric geochemical modelling to evaluate whether the status quo can be expected to be perpetuated in the long-term.

The first phases utilised historic information (Boer, 1995, Meltz, 2015, Zietsman, 1967) as well as information from a study on the current project tailings and waste rock at the TGME Theta and Iota mine sites (GeoDyn, 2019). This information was then used to develop numeric geochemical models to calculate the risk of the formation of AMD conditions from the historic tailings material as well as to assess the leachability and mobility of potential contaminants from specific source terms. The model results are correlated with existing surface water and groundwater quality data from and surrounding the site to determine which impacts, if any, are currently occurring and which can be potentially expected in the future.

Seepage

The biggest concern regarding the groundwater is the potential seepage of contaminants from the mining site, specifically the TSF, to the groundwater.

Due to the low risk posed by the waste material and the mining in general there are currently no additional management requirements, other than groundwater monitoring. The planned post-closure rehabilitation of the TSF will further protect the underlying groundwater resource.

A groundwater monitoring network is in place at the TGME Project, but it is recommended that the monitoring programme be upgraded and expanded.

1 INTRODUCTION

Transvaal Gold Mining Estates Limited (TGME) is situated in the Sabie / Pilgrim's Rest goldfields of Mpumalanga. It is an existing mine which has been in operation since 1895, making it the oldest gold mining company in South Africa. TGME's underground mines, plant and slimes dam area are situated in a 20 km radius from Pilgrims Rest in the Olifants River Water Management Area, specifically in the B60A and B quaternary catchments, in RU 121 of the Blyde river according to the Department of Water and Sanitation (DWS) Resource Quality Objectives for the Olifants Water Management Area. WNA 5. October 2014.

TGME falls within the Olifants Water Management Area (WMA). The major rivers within the WMA are the Wilge, Elands, Steelpoort and Olifants Rivers. TGME is located within the B60A quaternary drainage region, in the Blyde River catchment (B60A/B).

Mining, and in particular gold mining, has been a crucial part of the South African economy since the late 1800's and, as with most countries, it was mining that built the infrastructure and economy in South Africa. Mining remains a critical source of forex, tax revenues and employment within South Africa and forms a large part of the economy (TGME, December 2018).

The Pilgrims Rest gold field is considered to be the first official gold rush site in South Africa and TGME remains one of the oldest registered companies in South Africa. The Sabie goldfields were discovered shortly after the commencement of the gold rush in the area and both towns owe their existence to the discovery of gold in the area.

The Pilgrims Rest and Sabie goldfields have been mined since the late 1800's. Mining took place in over 40 different locations; however, the mines gradually closed down due to declining economics and in 1962 the last operational mine (Beta Gold Mine near Pilgrims Rest) was shut down in 1971. In the early 1980's, Rand Mines constructed a plant to reprocess old tailings dams in the area, in an attempt to revitalize the region. When these dams were depleted, the company added a crushing and milling section and reprocessed some of the old rock dumps. In the early 1990's, the mine was sold off to a privateer who carried out some underground mining in the Morgenzon and Frankfort Mines. The area required re-capitalisation to continue operating and a deal was done with Simmer and Jack to inject this capital. The Dukes/Clewer and Frankfort Mines were then mined for a number of years (1990's – 2008) before the mine was shut again due to the negative economics of the operation. Stonewall Mining took over the assets in the early 2010's and has owned the project since that time.

The following mining rights have been granted or are in the process of being granted (Minxcon, 2018):

- 83 MR – have been granted, registered and executed and are currently active.
- 340 MR – have been granted, registered and executed and are currently active.
- 330 MR – the application was accepted in July 2008. TGME has indicated that the right has been granted, but the grant letter as issued by the DMR is not available.

- 341 MR – granted in March 2012 but not yet executed.
- 10167 MR – conversion of prospecting rights to new order mining right.

An Integrated Water Use Licence (IWUL) number 24023343, (27/2/2/B60A/021) is approved in favour of TGME over the portion 42 of the farm Ponieskrans 543 KT, as well as the farms Morgenzon 525 KT and Frankfort 509 KT, incorporating water uses associated with the proposed mining operations as follows and subject to further conditions as stated in the IWUL:

- Taking of water from a water resource.
- Impeding or diverting the flow of water in a watercourse.
- Disposing of waste in a manner which may detrimentally impact on as water resource.
- Altering the bed, banks course or characteristics of a watercourse.
- Removing, discharging or disposing of water found underground.

The IWUL was approved on 29 March 2011 and is valid for a period of 10 years.

Following some small-scale re-mining of tailings and underground mining, the company scaled down its operations and subsequently reviewed its assets to evaluate its strategy for restarting full scale commercial operations at TGME and Sabie Mines.

Theta Gold Mines Limited is an Australian listed company that owns the gold assets of TGME and Sabie mines in the Pilgrims Rest and Sabie area, via its South African subsidiary Theta Gold SA (Pty) Ltd (Theta). TGME has an existing and approved mining right in the Pilgrim's Rest area, referred to as 83MR (Figure 5).

The intention and purpose of this IWWMP and IWULA is to update the IWWMP with new information from specialist studies. According to condition 12 it necessitate the annual updating of the IWWMP and to be submitted to the Dept. of Water and Sanitation. The IWWMP needs to support the renewal of the water use license (24023343).

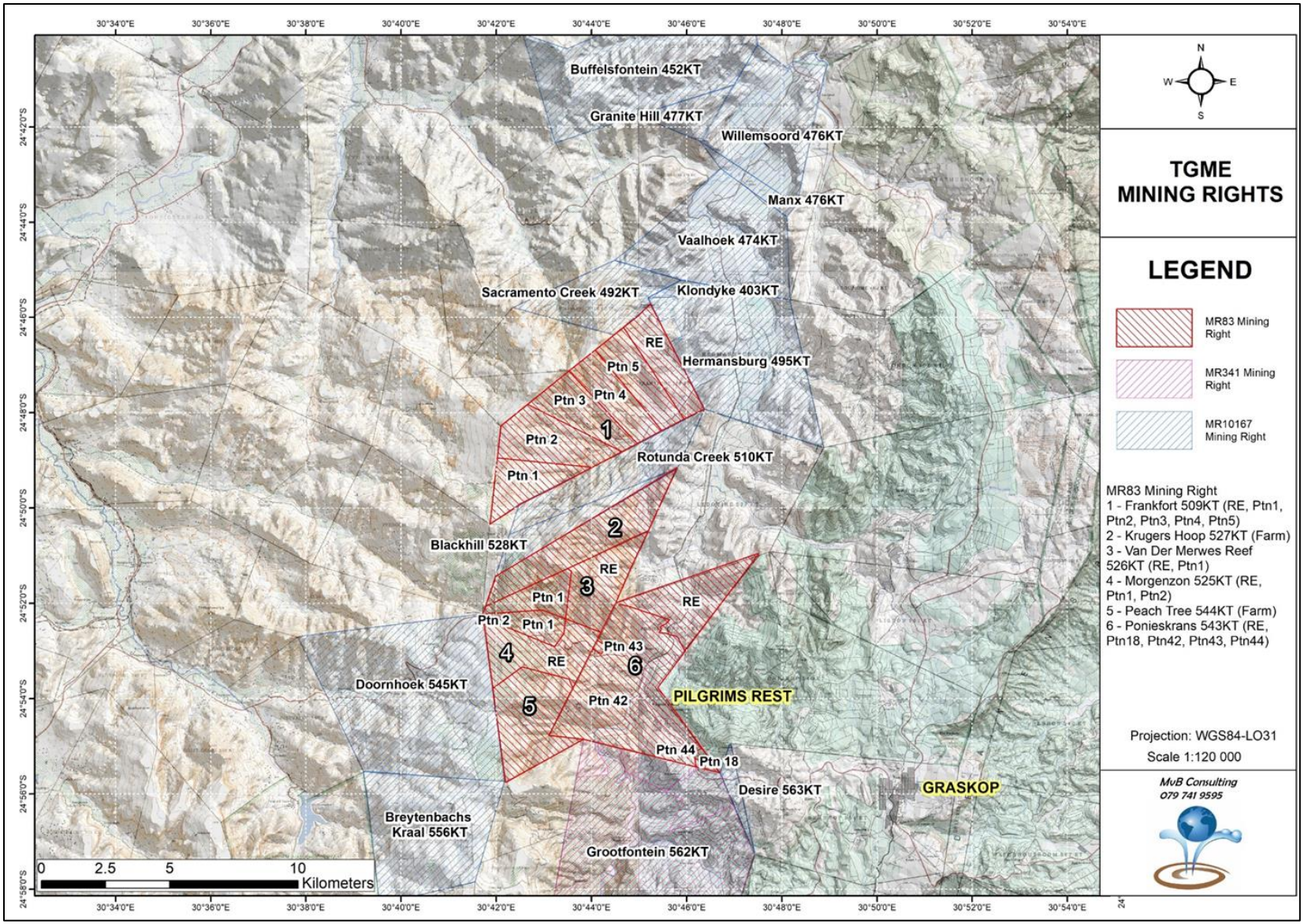

Figure 5: TGME Mining Rights MR 83

1.1 BACKGROUND INFORMATION

1.1.1 Contact names and numbers

Table 2: Contact Details

Name of Project	**Greater TGME – Renewal of the WUL**
Applicant	Transvaal Gold Mine Estate Limited.
Owner	Theta Gold SA (Pty) Ltd
Contact Person	Natasha Thomas-Kasangana
Postal Address	P.O. Box 21 Pilgrims Rest 1290
Telephone number	013-768 1271 or 076 242 3205 or 011-234 6216
Company no.	1895/000997/06
Email address:	natashak@tgme.co.za

1.1.2 Environmental Consultant

Table 3: Environmental Consultant

Name	**Maleka Environmental Consulting** **Althea van der Merwe *(Pr.Sci.Nat*)**
Postal Address	Post Net Unit #136 Private Bag X1288 Potchefstroom 2520
Telephone no	083 537 9986
E-mail	mec1@telkomsa.net

1.1.3 Magisterial District and Administrative Boundaries

Table 4: Administrative Boundaries

Magisterial District	**Mpumalanga**
District Municipality	**Ehlanzeni**
Local Municipality	**Thaba Chweu**

1.2 Regional Setting and Locality of Activity

TGME is situated in the Sabie / Pilgrim's Rest goldfields of Mpumalanga. TGME has been in operation since 1895, making it the oldest gold mining company in South Africa. TGME's offices and metallurgical plant are situated 2.5km southwest of the town of Pilgrim's Rest, 19km east of Graskop, 30km south east of Sabie and 58km south west of Mashishing (previously known as Lydenburg). The mine is located within the jurisdiction of the Ehlanzeni District Municipality and the local Municipality of Thaba Chweu.

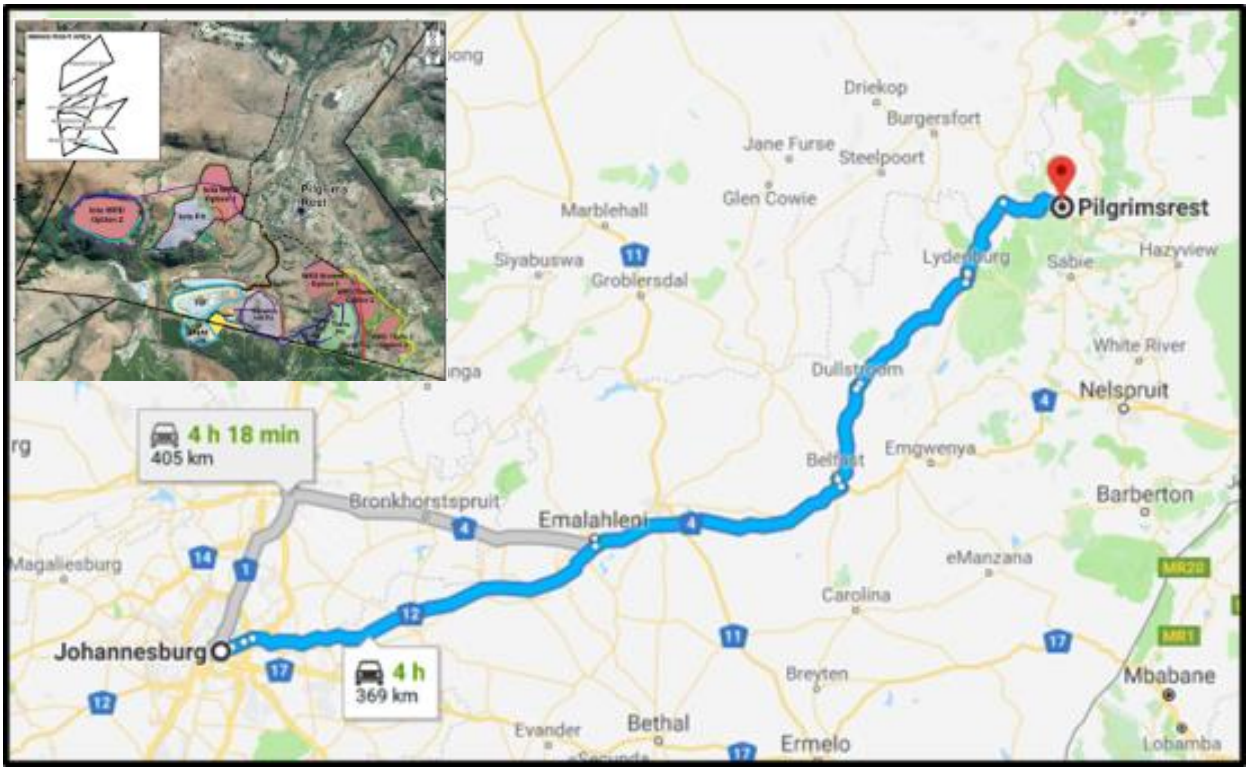

Figure 6: Location of Pilgrims Rest and TGME

1.3 Property Description

Mineral Rights in South Africa are issued by the Department of Mineral Resources (DMR) in accordance with the Mineral and Petroleum Resources Development Act, No. 28 of 2002 (MPRDA).

TGME has an existing and approved mining right over the area under application, with DMR reference 83MR. This right allows the mining of gold ore, silver ore, copper ore and stone aggregate. The total 83MR area encompasses the following farms and covers a total area of some 9,413.3366 ha:

- Frankfort 509KT: RE, Ptn 1, Ptn 2, Ptn 3, Ptn 4, Ptn 5;
- Krugers Hoop 527KT;
- Van der Merwes Reef 526KT: RE, Ptn 1;
- Morgenzon 525KT RE, Ptn 1, Ptn 2;
- Peach Tree 544KT;
- Ponieskrans 543KT: RE, Ptn 18, Ptn 42, Ptn 43, Ptn 44.

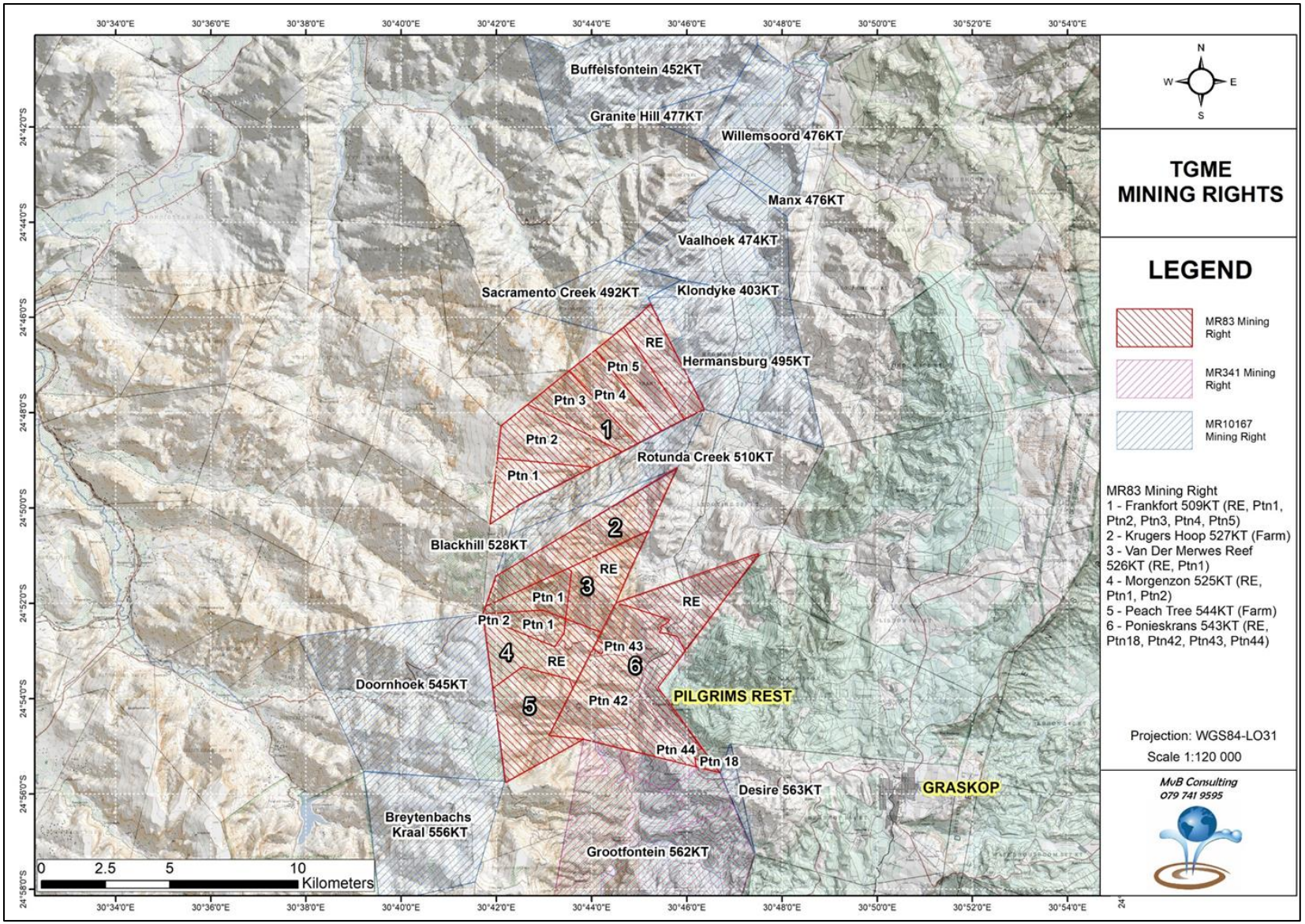

Figure 7: TGME M83 Mining Right Area with farm descriptions

Table 5: Property Description

Farm	Portion	Title deed	Surface Owner	Size (ha)
Frankfort 509KT	RE	T3313/2015	Maorabjang Communal Property Association	2,842.54
Frankfort 509KT	Ptn 3	T32393/1975	Republic of South Africa but leased by SAFCOL	
Frankfort 509KT	Ptn 4	T3313/2015	Maorabjang Communal Property Association	
Van der Merwes Reef 526KT	RE		(RSA) but leased by SAFCOL	856.53
Morgenzon 525KT	RE	T201/1906	Leased by SAFCOL	860.48
Morgenzon 525KT	Ptn 1		Unknown	NA
Peach Tree 544KT	Farm	T58018/2005	Republic of South Africa but leased by SAFCOL	NA
Ponieskrans 543KT	Ptn 42	T6421/1984	Republic of South Africa	NA
Grootfontein 562KT	RE	T127464/2007	York Timbers Pty LTD	NA
Grootfontein 562KT	Ptn 1	T127464/2007	York Timbers Pty LTD	NA

1.4 Land Use

The land use in the region is dominated by forestry activities. Secondary uses include mining, agriculture and residential. Large-scale forestation is found throughout the district with important areas around Mbombela, Pilgrim's Rest, Sabie and Graskop. There is some direct competition between forestry and agriculture, but in most cases the forested land is steep or rugged and not suitable for agriculture.[1]

1.5 Surrounding Land Use

The adjacent land is used for forestry, tourism, education (veld school) and recreation (golf course and trout fishing).

1.6 Soil and Land Capability

Agricultural potential is directly related to Land Capability and is measured on a scale of **I** to **VIII**. **Classes I to III** are classified as prime agricultural land that is well suited to cultivated crops, Class IV soils may be cultivated under certain circumstances and management practises, and Classes V to VIII soils are deemed not suitable for cultivation. Furthermore, during the assessment of land capability various attributes are considered in conjunction with the soil forms, such as climatic condition, terrain/ topography and land uses.

[1] Ehlanzeni District Municipality Final IDP and Budget Review 2016/17

1.7 Terrestrial Environment

The Montane Grassland habitat unit had a variety of species protected under the MNCA:

- All species falling within the Proteaceae family, of which the species recorded within this habitat unit included: *Protea gaguedi, Protea caffra* subsp*. caffra, Protea roupelliae* subsp*. roupelliae;*
- All species falling within the Orchidaceae family, of which the species recorded within this habitat unit included: *Brachycorythis ovata* subsp*. ovata*, *Disa patula* var. *transvaalensis*, *Eulophia foliosa*, *Habenaria falcicornis*, *Orthochilus aculeatus*, *Satyrium cristatum*, *Satyrium* sp.;
- All species of Pineapple flower, of which the species recorded within this habitat unit included: *Eucomis* sp.*;*
- All species of Aloes, of which the species recorded within this habitat unit included: *Aloe barbertoniae* and *Aloe dyeri;*
- All species of Gladioli, of which the species recorded within this habitat unit included: *Gladiolus ecklonii* and *Gladiolus longicollis*; and
- *Boophone disticha.*
- The overarching diversity of flora within this habitat unit is considered moderately high, with graminoids and herbaceous species best represented.
- The Montane Grasslands within the northern section of the focus area, occurring above the Blyde River, ranges from highly diverse to moderately diverse.
- Patches of undisturbed grasslands are most notably in the northern and eastern slopes of the proposed Browns Hill, where floral diversity, therefore, remains moderately high. The remainder of the grasslands associated with Browns Hill has been impacted on by mining activities, thus resulting in a moderate diversity of indigenous grassland flora.

Woody diversity: The woody layer mainly consisted of shrubs and small trees, with *Erica drakensbergensis*, *Parinari capensis* subsp. *capensis*, *Protea gaguedi*, *Senecio microglossus*, *Tenrhynea phylicifolia* and *Tetraselago wilmsii* most abundant.

Forb diversity: The forb layer was very species rich and these grasslands were well-represented by species of the genera *Crassula, Dicoma, Helichrysum, Ledebouria, Plectranthus* and *Senecio*, to name a few. Species such as *Alectra sessiliflora*, *Alepidea peduncularis*, *Berkheya echinacea*, *Euryops pedunculatus, Geigeria burkei Gladiolus ecklonii, Lopholaena disticha, Pearsonia sessilifolia* and *Plectranthus calycinus* were more common across the focus area.

Graminoid diversity: Graminoids included species representative of the various reference states with *Diheteropogon amplectens*, *Harpochloa falx*, *Hyparrhenia filipendula*, *Loudetia simplex*, *Monocymbium ceresiiforme*, *Panicum natalense* and *Tristachya leucothrix* most abundant.

Most of the Montane Grassland habitat unit remains relatively undisturbed, and ample habitat is available for floral SCC. Thus the list provided above is not expected to be a full representation of the floral SCC within this habitat unit. Species worth mentioninig that are of biogeographic importance (Mucina and Rutherford, 2006) recorded within this habitat unit include *Heteromorpha pubescens, Syncolostemon transvaalensis* (Northern sourveld endemic).

Table 6: Summary of the Vegetation Types Associated with the Project Footprint Area

Vegetation Type	GM 31 Long Tom Pass Montane Grassland	GM 22 Northern Escarpment Dolomite Grassland	GM 23 Northern Escarpment Quartzite Sourveld	FOz 4 Northern Mistbelt Forest
Altitude (m)	1,500m – 1,650m	1,000m – 1,320m	1,000m – 1,740m	1,050m -1,650m
Conservation	Not described	Endangered	Vulnerable	Least Threatened

1.8 Spatial Development Framework

The land is earmarked for mining purposes in terms of the Thaba Chweu Local Municipality Spatial Development Framework, 2016/17.

Land use in the Ehlanzeni area is dominated by agriculture, forestry and tourism; however, trade, community and financial services are the main economic contributors in the District.

Most of the province's minerals are produced in the Ehlanzeni district - mainly in the Barberton, Lydenburg and Pilgrim's Rest areas. Forestry dominates the land use in Ehlanzeni and is an important contributor to the economy. This is particularly true around Mbombela, Pilgrim's Rest, Sabie and Graskop. Whilst there is direct competition between forestry and agriculture, the forested land is generally steep or rugged and not suitable for agriculture.

The tourism sector is an important source of foreign revenue for the Ehlanzeni district. Tourism activities are concentrated around the beautiful areas of Pilgrim's Rest, Blyderivierspoort, Sabie and Graskop. Furthermore, large conservation areas dominate land use patterns in the east. These include the Kruger National Park and other provincial, community and private game reserves (*Ehlanzeni IDP, 2016/17).*

1.9 Purpose of the IWWMP

The purpose of the IWWMP is to:

- Serve as supporting document for the IWULA;
- Identify appropriate and effective action plans for the control and regulation of water (containing waste) and waste as sources of pollution;
- Implement a plan to manage water and waste in order to prevent pollution at source;
- Document all the relevant information in a manner that enables the Department of Water and Sanitation (DWS) to make informed decisions regarding the authorisation of the proposed water uses.

This document contains the background to the Greater TGME IWWMP and IWULA for the underground mines, plant and tailings storage facility within the 83MR mining right perimeter. The following is included:

- The current environmental and socio-economic setting, key activities, institutional arrangements, surface and groundwater monitoring networks and regulatory status of the water uses associated with these activities;

- Assessment of the risks and impacts;
- Determination of the Key Performance Areas (KPAs), objectives and management measures for water and waste management, all summarised into an IWWMP;
- Summary of the IWULA aspects, including the factors to be considered by the DWS in accordance with section 27 of the NWA.

KPAs to be addressed by this IWWMP are as follows:

- Facilitate improved water and waste governance, by ensuring that the water use area is appropriately authorised and that waste management activities are governed by the applicable requirements under the NEM:WA, and ensuring compliance to these statutes and relevant regulations;
- Facilitate improved management of risks and liabilities by ensuring that potential impacts on water resources are addressed through the implementation of appropriate management measures, both during the operation of the mine and after operations are discontinued;
- Facilitate improved water use efficiency by optimising the water balance, minimising water losses, optimising dust control, ensuring improved water re-use and recovery, and implementing a formalised storm water management system;
- Facilitate improved water usage and water quality monitoring and measurement and improved waste information systems;
- Ensure that appropriate capacity is provided to employees by means of resources, information, training and supervision;
- Facilitate the pro-active engagement of all stakeholders to ensure ongoing communication and agreements regarding impacts on water resources.

2 ENVIRONMENTAL SETTING AND SOCIO-ECONOMIC CONTEXT

2.1 Topography

The project area is located in the midst of the Drakensberg mountain range, with Pilgrims Rest at an elevation of 1,300 metres above mean sea level (mamsl) and the Lowveld stretching eastwards from the Great Escarpment with an elevation of below 750 mamsl. The project area is dissected by river erosion, with the Blyde River Canyon reaching a depth of over 770m (GCS, 2005).

The topography and slope of the project area are shown in Figure 8 (page 42). The general topography of the project area can be described as undulating and mountainous, with moderate to steep slopes. Flattish areas occur along the Blyde River floodplain.

2.2 Aquatic Ecology / Wetlands

The study area falls within the Olifants WMA. The major rivers within the water management area are the Wilge, Elands, Steelpoort and Olifants Rivers. TGME is located within the B60A quaternary drainage region, in the Blyde River catchment (B60A/B). The status of the Upper Blyde River is Class I. This classification indicates high environmental protection and minimal utilisation (DWS, 2016). This river is considered unique on a national and international level based on its unique biodiversity.

The aquatic assemblages of the various rivers and streams assessed (i.e. the Blyde River, the Peach Tree Stream and the Pilgrims Creek) of the assessed sites were defined as being extremely sensitive to water quality changes as well as changes in flow regimes, with these two aspects also considered to be the most important ecological parameters in the Blyde River system (affected by both natural seasonal variation as well as existing anthropogenic impact) with more significant influence from the changes in flow regime. Two species of concern, the Treur River Barb (*Enteromius cf treurensis*) (Critically Endangered) and the Marico Barb (*Entromius motebensis*) (Near Threatened) were observed within and in the vicinity of the proposed project in the January 2020 assessment. Special mention is made of the Treur River Barb, which is isolated to a single population in the upper reaches of the Blyde River catchment. The temporal and spatial results of the aquatic ecological assessment indicate that the integrity of the Blyde River, while still largely classified overall as an Ecological Category B along the entire portion of the Blyde River assessed, has begun to decline in a downstream direction over time. This decline may be largely related to the surrounding land-use activities, including forestry, illegal artisanal mining activities, seepage and runoff from historical mining areas, increasing urbanization and proliferation of alien and invasive species (resulting in altered surface runoff into the river and changes to the stream bed characteristics), and the ingress of sewage related to the Pilgrims Rest WWTW. The illegal artisanal mining activities observed has resulted in severe sedimentation in some areas and may potentially have contributed to blanketing of benthos and algal proliferation, which has begun to compromise the habitat integrity and water clarity of the Blyde River in a downstream direction. Climatic Conditions

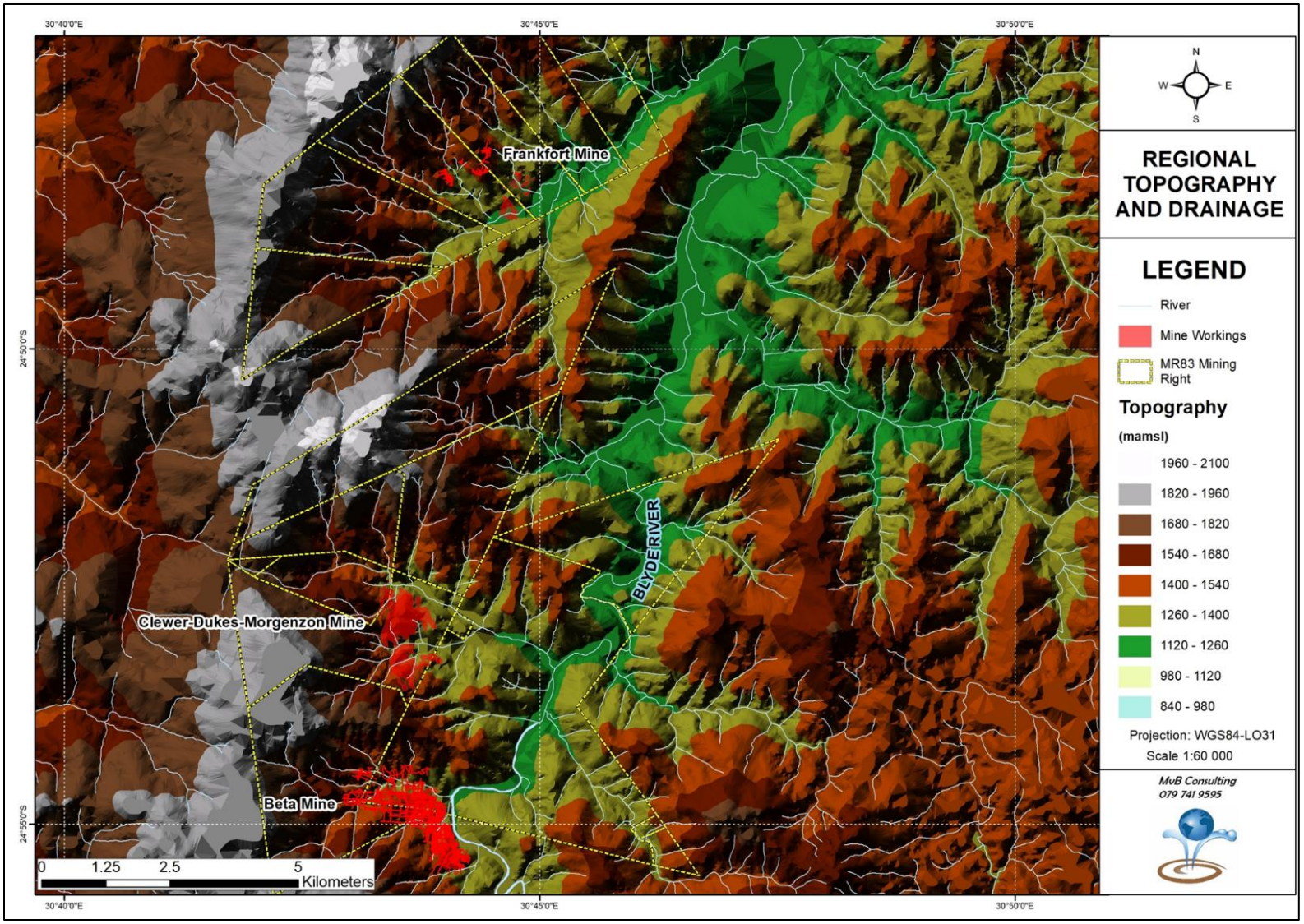

Figure 8: Site Specific Topography & Drainage

2.3 Climatic Conditions

The climatic conditions for this region are typical of that of the eastern Mpumalanga region, consisting of very hot summers and cool to cold winters. Rainfall occurs during summer, frequently as thunderstorms which are accompanied by lightning and occasional hail. Morning fog is common in summer but usually clears up by midday (GCS, 2009).

The Mean Annual Precipitation (MAP) for the region varies between 2,000 mm on the escarpment to around 600 mm in the Lowveld (GCS, 2009). Most of the rainfall occurs between November and March, in the form of tropical storms. The highest annual rainfall recorded occurred in the hydrological year 1987/88 where a depth of 1,283.3 mm was recorded. The lowest annual rainfall recorded occurred during the hydrological year 1991/92 where a depth of 560.5mm was recorded.

The local weather system yields a subtropical climate with hot, humid summers and mild, dry winters. Day temperatures of above 35° in summer are commonplace.[2] The yearly average maximum temperature is around 29°C, while the yearly average minimum is just below 16°C. The hottest months of the year are usually December, January and February, when temperatures routinely exceed 31°C. The coolest months are June and July where the average minimum and maximum are 9°C and 24.7°C respectively.

2.3.1 Mean Monthly and Annual Rainfall

According to the Hydrology Report[3] the rainfall stations with long-term rainfall data closest to the project are the Pilgrims Rest and Morgenzon stations. Monthly patched rainfall was downloaded from the WR2012 study website. A summary of the details from the stations is provided in Table 7, below.

Table 7: Rainfall Stations Closest to the Project

Station Name	Station Number	Distance & Direction from TGME Plant	Latitude*	Longitude*	Rainfall Record (years)	MAP (mm)
Pilgrims Rest	0594444 W	3.2 km East	-24.88°	30.72°	1903 – 1985	951
Morgenzon	0594383 W	4.5 km North-West	-24.92°	30.77°	1948 – 2019	948

**Decimal degrees*

Both stations have a similar MAP. Although located further away, the Morgenzon station has more recent rainfall data, and therefore data from this station was adopted to represent the rainfall for the study area.

The mean monthly rainfall is indicated in Figure 9. The project is located in a high rainfall area, with a MAP of 948 mm. Rainfall is highest during the summer months of October to March, with January and February being the wettest months. Rainfall is lowest from April to September, with June and July being the driest months.

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[2] Integrated Water Quality Management Plan for the Olifants River System, 2018: Water Quality Status Assessment and International Obligations with respect to Water Quality Report, WMA 04/B50/00/8916/3

[3] Draft Surface Water Hydrology Study for the Proposed Theta Mine Project, June 2020. Hydrospatial (Pty) LTD.

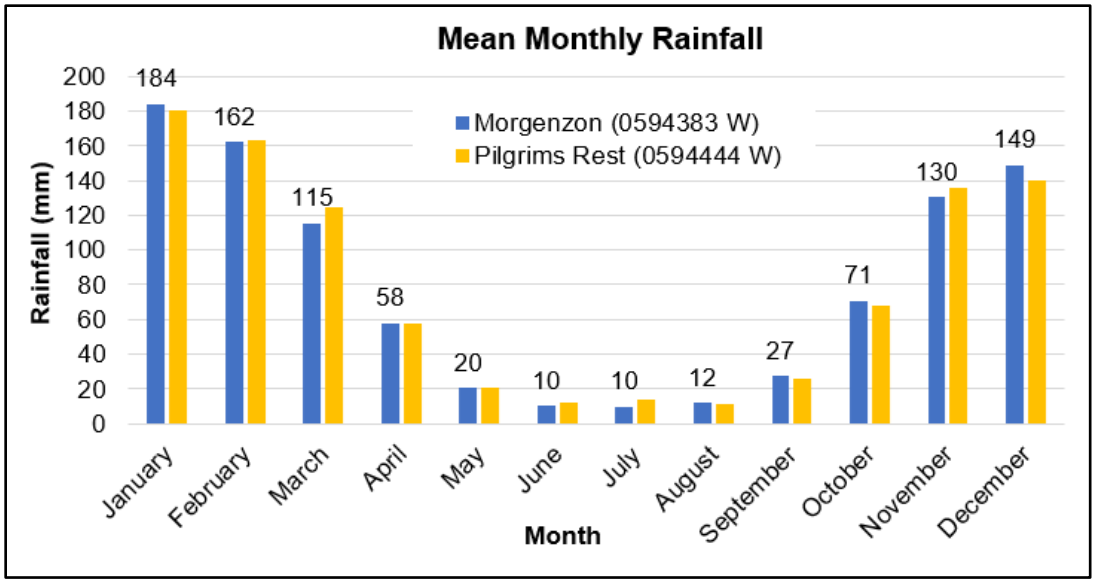

Figure 9: Monthly Rainfall for the Morgenzon Rainfall Station over the Period 1948 - 2010

Figure 10 indicates the monthly rainfall over the period of October 1948 to September 2010 (62 years). The wettest month occurred in January 2011, with a total of 475.3 mm of rainfall, whilst 0 mm of rainfall has occurred on a number of occasions over the dry months of May to September. Monthly rainfall in excess of 300 mm has occurred on 23 occasions.

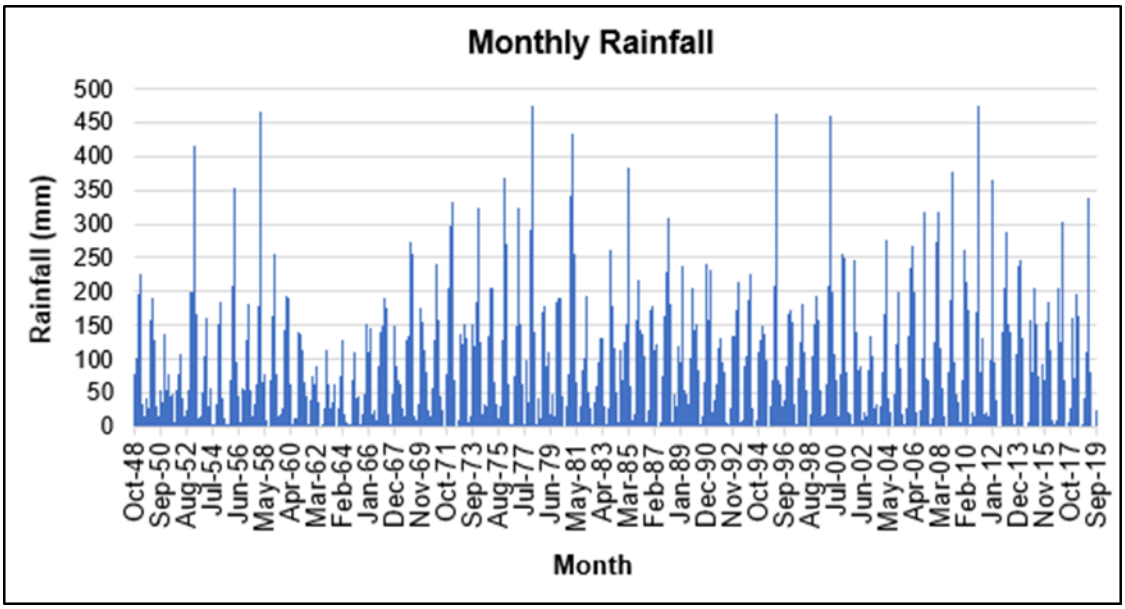

Figure 10: Monthly Rainfall Total for Morgenzon Rainfall Station

Figure 11 shows the annual rainfall totals in comparison to the MAP. The wettest year occurred in 2000, with 1,618 mm recorded, whilst the driest year occurred in 1962, when 384 mm was recorded. The 1960s was a particularly dry period where the yearly rainfall reached levels well below average, whilst the 1970s was a particularly wet period.

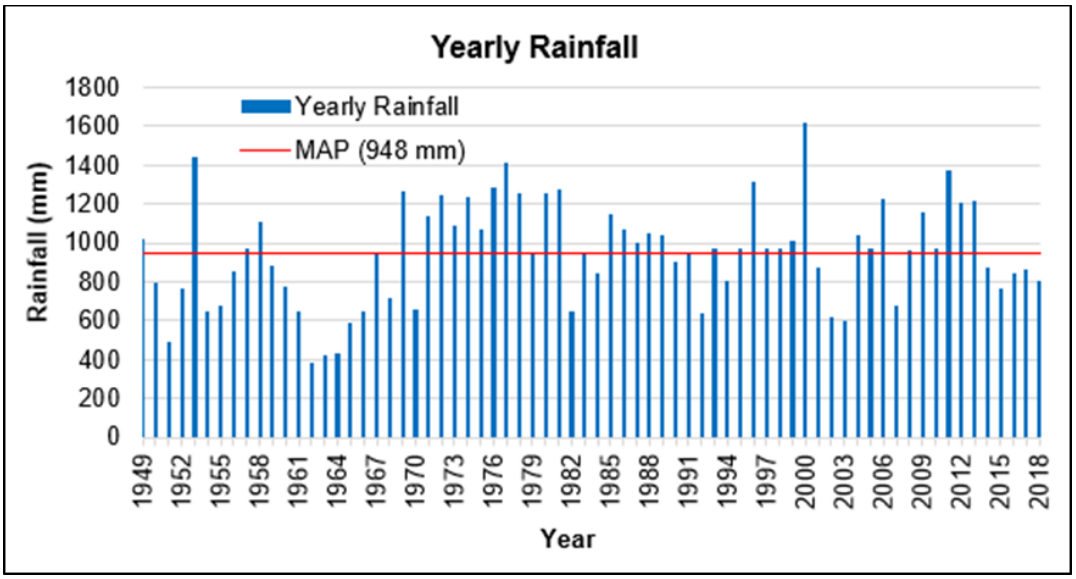

Figure 11: Yearly Rainfall Totals for Morgenzon Rainfall Station

2.3.2 Evaporation

Monthly Symon's Pan (S-Pan) evaporation was obtained from the WR2012 study for quaternary catchment B60A. S-Pan evaporation measurements are not a true reflection of evaporation from natural open water bodies, as the water temperatures in the S-Pan are higher, resulting in higher evaporation rates. In order to convert S-Pan measurements to open water evaporation, monthly open water evaporation conversion factors were used, which were obtained from the WR2012 study. The adopted monthly evaporation for the project is listed in Table 8. Evaporation is highest from October to March, and lowest during the cooler months of May to August.

Evaporation exceeds the rainfall in the region and average 1 179 mm/annum, compared to the average rainfall of 948 mm/annum. The adopted monthly evaporation for the project is presented in Table 8.

Table 8: Evaporation for the Project Area

Month	Symon's Pan Evaporation (mm)	Open Water Evaporation Factor	Open Water Evaporation (mm)
January	158	0.84	133
February	135	0.88	119
March	133	0.88	117
April	101	0.88	89
May	88	0.87	77
June	72	0.85	61
July	78	0.83	65
August	99	0.81	80
September	120	0.81	97
October	133	0.81	108
November	133	0.82	109

Month	Symon's Pan Evaporation (mm)	Open Water Evaporation Factor	Open Water Evaporation (mm)
December	151	0.83	125
Total	**1,401**	**N/A**	**1,179**

2.4 Water Resources

A number of specialist studies were undertaken to investigate the water resources occurring on the mining area of TGME, including a hydrological study (Hydrospatial, 2020)[4], a groundwater impact assessment (MvB, 2020)[5] and an aquatic report (SAS, 2020)[6]. The outcomes of these investigations are discussed below in the context of overall water management objectives and strategies.

2.4.1 Water Resource Management Area, Plans, Objectives and Institutions

TGME is located within the middle Olifants WMA in the B60A quaternary sub-catchment.

2.4.1.1 *Water Management Area*

The Olifants River originates in the Highveld of Mpumalanga. The river initially flows northwards before curving in an easterly direction through the Kruger National Park and into Mozambique. The Olifants River catchment falls within three provinces, namely Gauteng, Mpumalanga and Limpopo, and was designated as a WMA under GN R116 in GG2049 of 1 October 1999.

The Olifants River WMA has been divided into 4 sub water management areas, namely the Upper Olifants, Middle Olifants, Steelpoort and Lower Olifants sub area, as depicted in Figure 12 below[7]. The spatial extent of the study area is the Olifants WMA, also referred to as the Olifants River System that includes the Olifants River catchment (tertiary drainage regions B11, B12, B20, B31, B32, B41, B42, 52, B52, B60, B71, B72 and B73); the Letaba River catchment (tertiary drainage regions B81, B82 and B83); the Shingwedzi River catchment (tertiary drainage region B90).[8]

The Olifants WMA is an economically important area contributing 5% of South Africa's GDP. The continued growth in the economy will generate wealth for the country which will contribute to the eradication of poverty. The provision of water at an adequate assurance of supply and water quality is essential to sustain the projected economic growth.

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[4] Surface Water Hydrology Study for the Proposed Theta Mine Project and Water Balance - Hydrospatial, August 2020

[5] Final Report. TGME Geohydrological Study for the Theta Hill Project, Pilgrims Rest Region. June 2020 – MvB Consulting.

[6] Watercourse Ecological Assessment and Impact Assessment as part of the Water Environmental Authorisation and Environmental Impact Assessment (EIA) Process for the TGME Theta Project to include the Theta Hill, Brown Hill and Iota Hill near Pilgrim's Rest, Mpumalanga. Scientific Aquatic Services, July 2020

[7] DWAF, 2004 Olifants Water Management Area Internal Strategic Perspective.

[8] Integrated water Quality Management Plan for the Olifants River system, 2018: Water Quality Status Assessment and International Obligations with respect to Water Quality Report, P WMA 04/B50/00/8916/3.

2.4.1.2 *Water Management Plans*

It is the DWS' responsibility to operate the Olifants WMA to meet the water requirements at an adequate assurance of supply and to protect the water quality of the water resources. The Department has developed an Internal Strategic Perspective (ISP) document for the Olifants Water Management, 2004[9], which is subject to the approach set out in the National Water Resources Strategy (NWRS). The ISP details the approaches which the DWS is taking towards water management in the Olifants WMA and lists suggested actions towards achieving sustainable management of the water resource. The strategy includes a load reduction program to protect the water resources and improve the water quality so that the Resource Quality Objectives (RQO) can be met.

The DWS has identified the need to develop an Integrated Water Quality Management Plan (IWQMP) for the Olifants WMA in order to manage the water resources. This plan needs to take cognisance of and align to a number of studies and initiatives that have been completed to date, and needs to establish clear goals relating to the quality of the relevant water resource in order to facilitate a balance between protection and use of water resources.

The main objective of the plan would be to develop management measures to maintain and improve the water quality in the Olifants WMA (as per the National Water Resources Strategy, Second Edition, 2013) in a holistic and sustainable manner so as to ensure sustainable provision of water to local and international users. The management measures will be of an overarching nature and will deal with the broader Olifants WMA while taking the strategies and plans developed at the sub-catchment level into account.

The plan will detail feasible management options for implementation in the short term (next 5 years), assess the medium term strategies (10 years) at the pre-feasibility level and note longer term strategies at the reconnaissance level. A further important deliverable from the plan will be a set of integrated Water Quality Planning Limits (WQPLs) for the Olifants WMA and the individual sub-catchments that will include development of WQPLs, adjustments to the existing WQPLs and alignment to the RQOs.[10]

[9] DWAF, 2004. Olifants Water Management Area: Internal Perspective. P WMA 04/000/00/0304.

[10] Water Resource Planning System Series: Development of an Integrated Water Quality Management Plan for the Olifants River System. 2016, P WMA 04/B5000/8916/1

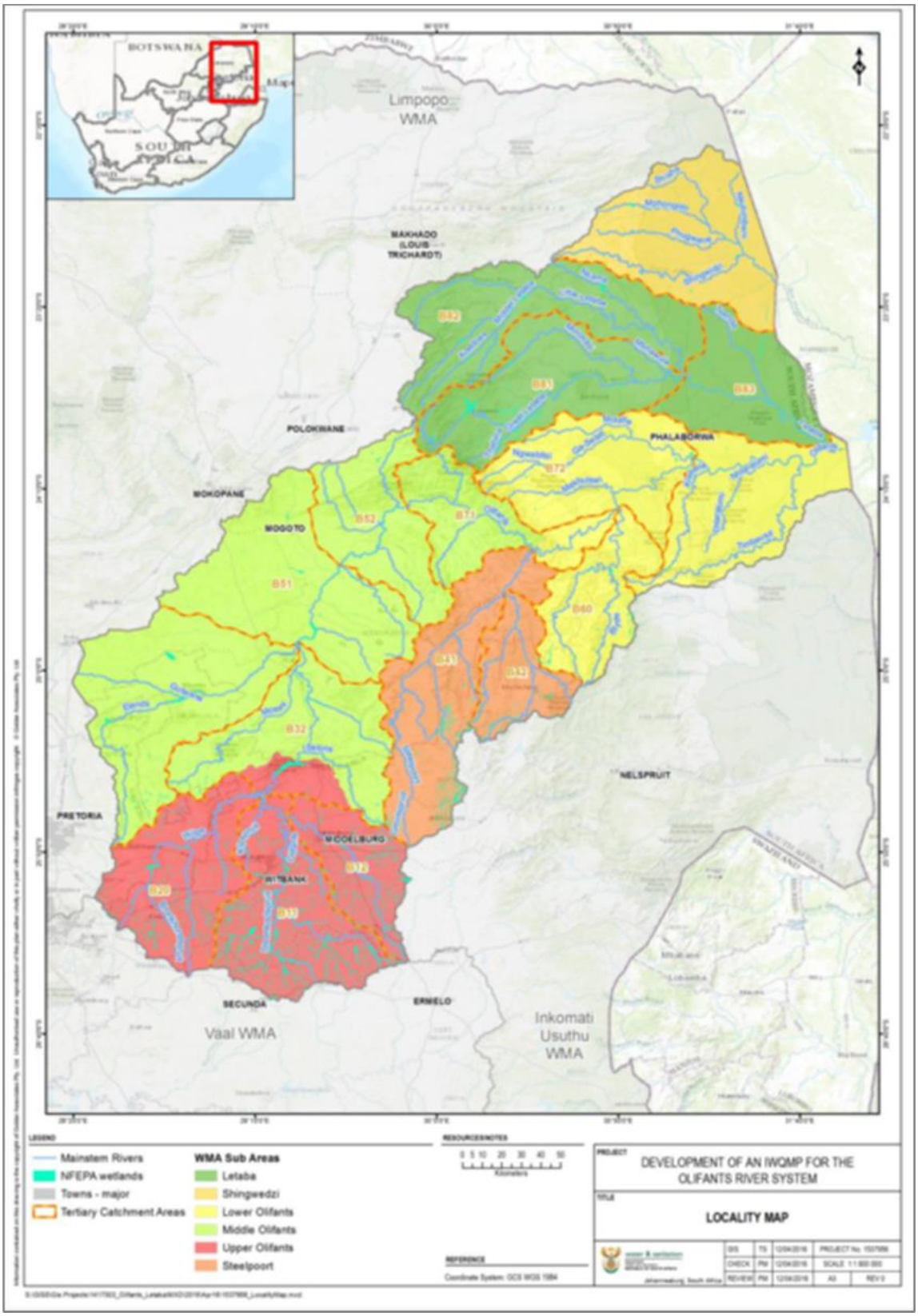

Figure 12: Olifants River Catchment

2.4.1.3 *Water Management Institutions*

In the absence of a CMA for this WMA, the Lydenburg Office of the DWS acts as the responsible water management authority for the Lower Olifants WMA. The local water services authority is Pilgrims Rest and the Thaba Chweu Local Municipality (TLCM). Other institutions that are important from a water management perspective in the Olifants WMA are:

- Water User Associations,
- Irrigation Boards,
- Olifants River Forum,
- Interim Catchment Management Committees, and
- Districts and Local Municipalities.

2.4.1.4 *Water Resource Management Objectives, Ecological Importance and Resource Class*

The NWA, 1998 specifies that water resources are to be managed by means of Resource Directed Measures (RDM) which entails the setting of a Reserve and the establishment of RQOs. The RQOs must indicate the level of use that is deemed acceptable and unlikely to damage a water resource beyond repair.

The Classes and RQOs of Water Resources for the Olifants River (Government Notice 466, 22 April 2016) (DWS, 2016), was consulted to obtain the RQOs for the Blyde River in the vicinity of the project. The ecological category and Ecological Water Requirements (EWRs) for the Blyde River up to its confluence with the Lisbon River, are indicated in Table 9.

Table 9: Ecological category and EWR applicable to the Blyde River in the vicinity of the project

Biophysical Node	Quaternary Catchment	River Reach	Ecological Category to be Maintained	Natural MAR (million m^3/a)	EWR as % of Natural MAR
HN117	B60A	Blyde River up to the confluence with the Lisbon River	C	87.1	18.73

In 2010, the Department of Water Affairs (DWA) identified the need to undertake the classification of significant water resources in the Olifants WMA in accordance with the Water Resource Classification System (WRCS). Classification of water resources aims to ensure that a balance is reached between the need to protect and sustain water resources on one hand and the need to develop and use them on the other.[11]

The proposed Management Class for the Lower Olifants is Class II and for the Blyde River catchment it is Class I.

[11] Management Classes of the Olifants Water Management Area Report, 2013. RDM/WMA04/00/CON/CLA/0213

Table 10: Management Classes for Water Resources

Management Class Descriptions	
Class I	***Minimally used*** *Water resource is one which is minimally used, and the overall condition of that water resource is minimally altered from its pre-development condition*
Class II	***Moderately used*** *Water resource is one which is moderately used, and the overall condition of that water resource is moderately altered from its pre-development condition*
Class III	***Heavily used*** *Water resource is one which is heavily used, and the overall condition of that water resource is significantly altered from its pre-development condition*

According to the study "Classification of Significant Water Resources in the Olifants (WMA 4) - WP 10383", 2013, the Olifants WMA would be divided into 13 Integrated Units of Analysis (IUA).

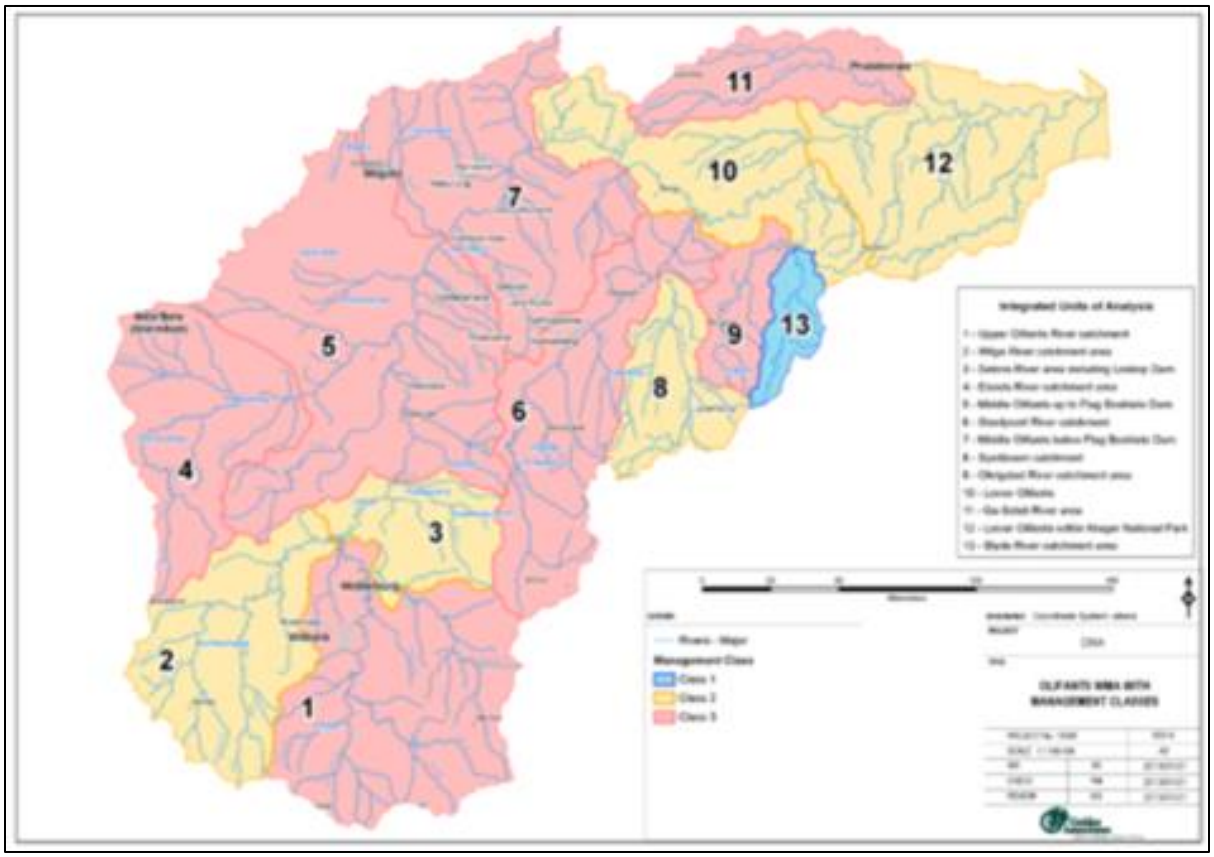

Figure 13: The Olifants WMA Indicating Proposed Integrated Units of Analysis Management Classes

IUA 13 incorporates the town Pilgrims Rest and contains the upper portions of the Blyde and Treur Rivers (Figure 13). This IUA is predominately rural in nature and is relatively undisturbed, with a small area of forestry in the upper reach of the Treur River.

According to the "State of the Rivers Report" the B60A quaternary catchment of the Blyde and Treur Rivers can be classified as sensitive and highly important i.t.o. ecological importance and sensitivity. The management objective is to maintain the current status as no improvement is necessary for systems of moderate importance, i.e. the RQO applicable for an Ecological Class B/C system.

The Table 11 below is a summary of the desktop assessment of the ecological importance of the B60A catchment, taken from the Aquatic Ecological Assessment Report (Scientific Aquatic Services, 2020)[12].

Table 11: Desktop Assessment of the Freshwater Resource Ecological Assessment

Catchment	Resource	EIS	PEMC	DEMC
B60A	Blyde River	Very High	Class C: Moderately Modified	A: Highly Sensitive System

The eco-classification and ecological water requirement, as a percentage of natural Mean Annual Runoff (MAR), is provided in Table 12. The Ecological Water Requirements (EWR) listed is based on maintenance low and drought flows only for the Present Ecological State (PES).

Table 12: IUA 13 Blyde River Catchment: Summary of Eco Classification & EWR

Node	Quaternary	Nodes	EI	ES	PES	Default REC	Natural MAR (mcm/a)	EWR as % of natural MAR	Recommended Class
HN 117	B60A	Blyde confluence with Lisbon	High	Very High	C	A	87.1	18.73	***Class I***
HN 119	B60B	Blyde outlet of quaternary	High	Very High	B	A	183.8	32.86	

The ecological importance of the water resources in this IUA is very high, with the present state of the Treur and upper Blyde being “almost natural”. A number of protected and conservation areas are present in the IUA.

The results of the freshwater resource ecological assessment indicate that the various freshwater resources associated with the study areas are riparian systems. No systems displaying wetland characteristics are identified. The watercourses are considered to be in a largely natural to moderately modified condition, although historical mining and agricultural activities have had some impact on all the assessed freshwater resources, particularly in the lower reaches of the systems. Modifiers to the lower reaches of the freshwater resources that were assessed include clearing of riparian vegetation in order to increase available arable land for forestry, stream bank incision and erosion, and the construction of flow-modifying structures (such as road crossings and associated culverts and bridge structures) within the active channel.

The assessed freshwater resources are deemed to provide moderately high to intermediate levels of ecological services and are thus considered to be of increased ecological importance and sensitivity. In addition to its moderately high eco-services provision and biodiversity support functions, the Blyde River contributes significantly to the overall tourism potential and value of the area. Thus, it is considered to be

[12] Watercourse Ecological Assessment and Impact Assessment as part of the Water Environmental Authorisation and Environmental Impact Assessment (EIA) Process for the TGME Theta Project to include the Theta Hill, Brown Hill and Iota Hill near Pilgrim’s Rest, Mpumalanga. Scientific Aquatic services, June 2020

important on a local and regional scale. The results of the freshwater resource assessments are summarised in Table 13. [13]

Table 13: Summary of Results of the Freshwater Resource Assessment

Freshwater Resource	PES	Eco Services	EIS	REC
Blyde River	B/C	Moderately high	High	B
Peach Tree Stream and associated tributaries	B/C	Intermediate	High	B/C
Unnamed tributaries of Blyde: Beta, Browns and Theta Hill study areas	B/C	Intermediate	Moderate	C
Unnamed tributaries of Blyde: Clewer-Dukes-Morgenzon study area	B	Moderately high	High	C

The Resource Water Quality Objective (RWQO) of South Africa (DWA, 2011) as defined for EC and pH is summarised in Table 14.(SAS, 2020)

Table 14: Resource Quality Objectives for the B60A

Constituent	Resource Quality Objective	Constituent	Resource Quality Objective
Electrical Conductivity (mS/m)		**pH**	
Ideal Range Limit	30mS/m	**Ideal Range Limit**	>6.5 - <8.0
Acceptable Range Limit	50mS/m	**Acceptable Range Limit**	8.0-8.4
Tolerable Range Limit	85mS/m	**Tolerable Range Limit**	No Range Limit
Unacceptable Range Limit	>85mS/m	**Unacceptable Range Limit**	<6.5 - >8.4

As the Blyde River falls within the Olifants River Catchment, the Olifants River Ecological Water Requirements Assessment (OREWRA)[14] recommendations were also consulted. For the Blyde River, Sections 1 to 8, the following is applicable to the month of October:

Table 15: Resource Quality Objective for the Blyde River (OREWRA, 2001)

Constituent	Range
TDS	<195mS/m
pH	Maintain between 7 and 8
EC	<30mS/m
Temperature	21°C +3°C
DO	Maintain at 80% saturation
Ecological Management Class	B/C

[13] Freshwater Resources & Aquatic Ecological Assessment as part of the Water Use Licensing Process for the proposed Stonewall Mining - TGME Mine Development Project (SAS – June 2020)

[14]Ecological Reserve Report: Olifants River Ecological Water Requirements Assessment (OREWRA), 2001

Table 16: Resource quality objectivers for river water quaity in the Olifants WMA (DWS, RQO & Numerical Limits Oct, 2014)

River	IUA	Component	RQO	Indicator / Measurement	Numerical Limit
Blyde River catchment area (EWR12)	IUA* 13	Instream Habitat	A healthy instream habitat is essential for this ecosystem and should be maintained.	Sate of instream habitat acceding to rapid habitat assessment Method (FHAM)	RHAM findings equate to ecosystem in a >B category. (equivalent to Eco Classification Score >80), and or maintenance of habitat for indicator species
	IUA 13		The sedimentation situation should be improved to support the protected status of this river.	Turbidity (NTUs)*	< 1 NTU
Olifants (EWR 11, confluence with Blyde)	D		Sedimentation concentrations should thus not reach levels where instream sedimentation excessively impacts on the ins stream habitat or where suspended sediments negatively impact on fitness for use for water institutions	Suspended solids*	<50.0mg/l

IUA: Integrated Unit Analysis
RU Resource Unit
EWR; Ecological Water Requirement

2.5 Surface Water

The study area falls within the B60A Quaternary Drainage Catchment, in the upper to middle parts of the Blyde River catchment. The Blyde River rises on the western slopes of the Drakensburg Mountains and flows northwards towards the Blydepoort Dam.

From the Blydepoort Dam, the Blyde River cascades down a steep series of rapids to its lower reaches, where the river again flows northwards to join the Olifants River north of the town of Hoedspruit.

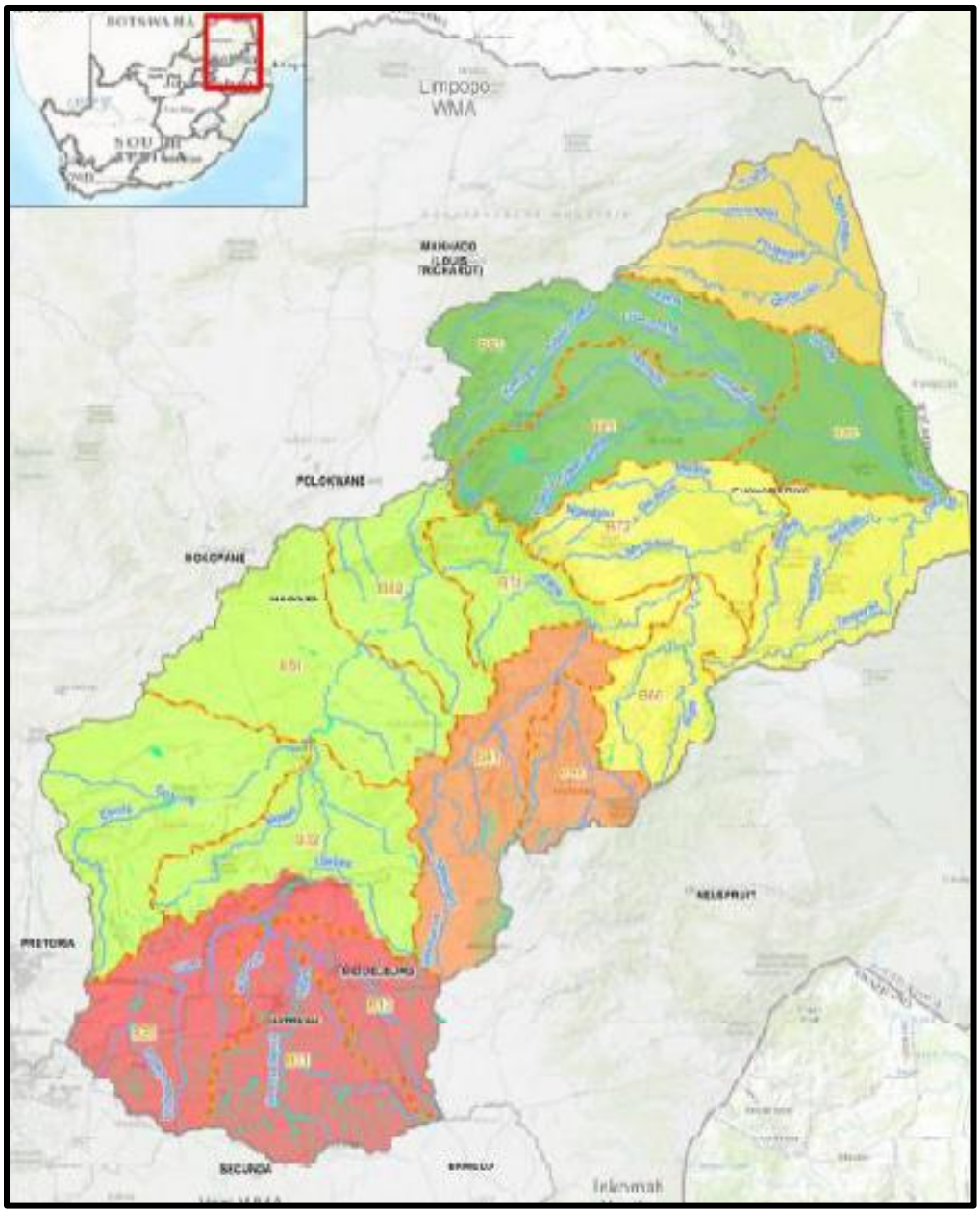

Figure 14: Quaternary Catchment within the Lower Olifants WMA

Table 17: Area of the Lower Olifants Sub Catchments

Sub-catchment areas (km^2)		
Lower Olifants	B60 A- J; B72 A – K; B71G, J and H; B73 A - J	12,612 km^2

The Blyde River Catchment is subjected to agricultural and mining activities. The present ecological state (PES) of the Blyde River is moderately modified which is a Class B/C. Flow patterns in the upper reaches of the Blyde River are relatively stable as this river drains an area that receives some of the highest rainfalls recorded in South Africa.

2.5.1 Surface Water Hydrology [15]

2.5.1.1 *Regional Catchments and Rivers*

The Lower Olifants catchment includes the B60, B72 and B73 tertiary catchments (Figure 14 above). The Theta Hill project falls in the B60A quaternary catchment of the Olifants MA, which is situated within the Drakensberg mountain range and varies between 900 – 1,650 mamsl.

The project area is drained by a number of non-perennial drainage lines, which are tributaries of the Blyde River. The Blyde River has its source approximately 20 km south-west of the project, flowing into the Blyderivierspoort Dam 40 km to the north-east of the project. From the Blyderivierspoort Dam, the Blyde River continues in a northerly direction for approximately 45 km, until its confluence with the Olifants River near the town of Hoedspruit.

2.5.2 Surface Water Quality

2.5.2.1 *Water Quality Management Objective*

The NWA specifies that water resources are to be managed by means of RDMs which entails the setting of a reserve and the establishment of RQOs. The Classes and RQOs of Water Resources for the Olifants River (GN466, 22 April 2016) (DWS, 2016) document was consulted to obtain the RQOs for the Blyde River in the vicinity of the project. The ecological category and EWR for the Blyde River up to its confluence with the Lisbon River are listed in Table 18.

Table 18: Ecological Category and EWR Applicable to the Blyde River in the Vicinity of the Project

Biophysical Node	Quaternary Catchment	River Reach	Ecological Category to be Maintained	Natural MAR (million m^3/a)	EWR as % of Natural MAR
HN117	B60A	Blyde River up to the confluence with the Lisbon River	C	87.1	18.73

The Resource Water Quality Objectives (DWA, 2011) as defined for Electrical Conductivity (EC) and pH is summarised in Table 14 (section 2.4.1.4 above) (SAS, 2019b)[16].

Furthermore, the EWR for the catchment is 18.73% of the natural MAR of 87.1 million cubic metres (mcm), which equates to 16.3 mcm per annum. It is an RQO that the sediment situation in the catchment must be improved to support the protected status of the river, and that the low and high flows must be suitable to maintain the river habitat and ecosystem condition (DWS, 2016).

The surface water quality was determined from data made available by the mine from January 2012 until August 2020. Variables of concern which were simples included Total dissolved solids (TDS_ and acidity (pH).

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[15] Surface Water Hydrology Study for the Proposed Theta Mine Project – Hydrospatial, July 2020.

[16] Watercourse Ecological Assessment and Impact Assessment as part of the Water Environmental Authorisation and Environmental Impact Assessment (EIA) Process for the TGME Theta Project to include the Theta Hill, Brown Hill and Iota Hill near Pilgrim's Rest, Mpumalanga. Scientific Aquatic services, July 2020

2.5.2.2 *Historic water analysis conclusions*

- Based on the analysis of pH there are no significant increases or fluctuations observed between S3, S5 and S6 for the monitoring period. It is expected that if there were historic mine impacts this would manifest as a drop in pH due to mine impacted ingress
- The analysis of results shows that there are also no significant increases or fluctuations between points S3 and S5 which includes the plant and old mine areas. This suggests that the mine has not impacted the river area here
- There is a noted increase between points S5 and S6 which include some historic mining footprints but also informal activities before the caravan park border
- The cause for this increase could be the result of some of the historic mine footprint activities, but washing of material into the river that is undertaken by the illegal miners with their activities would also result in the observed salt increase
- Since the mine was not operating during this period it is likely that other activities could have been the cause
- There was a factor of ten decrease in the total dissolved salts in the Blyde for all monitoring points from 2018 onwards which could have been the result of more dilution water being introduced upstream into the catchment of the Blyde river
- From 2018 forward the total dissolved salts in the Blyde river remained compliant within the WUL limit and met the SAWQ variation limits as well.

Water Quality results are discussed in section 3.7.3.

2.6 Archaeology and Cultural Heritage

An archaeology and cultural heritage study were done for the Theta Project. As Theta forms part of the MR 83 area, some of the information were abstracted and summarised in this IWWMP.

In terms of the National Heritage Resources Act, Act 25 of 1999 the Historic town of Pilgrims Rest is a Provincial Heritage Site.[17]

In terms of the National Heritage Resources Act, Act 25 of 1999 the Historic town of Pilgrims Rest is a Provincial Heritage Site.

The Heritage Assessment Report[18] notes the following:

- No known sites dating to the Stone Age in the immediate vicinity of the Theta Hill development – rock art is found in the larger region;
- No known sites dating to the Iron Age in the immediate vicinity of the development;
- Dating to the historic period and located inside and/or in the immediate vicinity of the Theta Hill development. Theta Hill is located on Ptn 42 of the Farm Ponieskrans 543KT which is adjacent to RE of Grootfontein 561 KT and Morgenson 525KT.

[17] Cultural Heritage assessment, J van Schalkwyk June 2020. (Done for the Theta Project)

[18] Cultural Heritage Assessment, J van Schalkwyk June 2020).

Table 19: Sites, features and objects of cultural significance

Name	Latitude	Longitude	Impact	Management
001 Fort	-24,91824	30,75706	Inside Theta Hill Pit	Avoid/Retain
002 Cemetery	-24,91814	30,74484	Outside development	Avoid/Retain
003 Burial site	-24,91806	30,74478	Outside development	Avoid/Retain
004 Burial site	-24,91792	30,74353	Outside development	Avoid/Retain
005 Graves	-24,91748	30,74682	Outside development	Avoid/Retain
019 Pump house	-24,90674	30,74701	Close to access road	Avoid/Retain
024 Cocopan bridge	-24,90787	30,74648	Integral part of remaining track	Avoid/Retain
025 Cocopan track (east)	-24,91013	30,74188	In proposed haul road	Document
026 Cocopan track (west)	-24,91006	30,73983	In proposed haul road	Document
032 Concrete structure	-24,91243	30,74408	Inside waste rock dump area	No further action
033 Foundations	-24,91222	30,74263	Inside waste rock dump area	No further action
034 Farmer's race	-24,91245	30,74267	Inside waste rock dump area	No further action
038 Foundations	-24,91383	30,73645	In proposed haul road	No further action
046 Informal settlement – dating to the late 1980s	-24,91581	30,74291	People to be relocated	No further action
047 Compound	-24,91712	30,74277	Abandoned 1972	No further action

2.7 Geology

This section summarises the geology of the area as detailed in the Geohydrological study for the Greater TGME (MR83) Project, October 2020. (MvB054/18/A048)

Theta Gold Mining Estates Limited (TGME), a subsidiary of Stonewall Mining (Pty) Ltd, intends to reopen some of the historical mines. The Sabie-Pilgrims Rest Projects lie in a historically prolific gold mining region. Mining in the area commenced in the late 19th century and continued into the mid-20th century and intermittently subsequent to this, with operations finally ceasing in 1971 at Beta Mine. Beta was the last operational mine of TGME. Intermittent mining has more recently occurred at locations such as at Clewer-Dukes Hill and Frankfort during the 1990's to 2008, but no mining activities are currently active (Minxcon, 2018).

The following mining rights have been granted or are in the process of being granted (Minxcon, 2018):

- 83 MR – have been granted, registered and executed and are currently active.
- 340 MR – have been granted, registered and executed and are currently active.
- 330 MR – the application was accepted in July 2008. TGME has indicated that the right has been granted, but the grant letter as issued by the DMR is not available.
- 341 MR – granted in March 2012 but not yet executed.
- 10167 MR – conversion of prospecting rights to new order mining right.

2.7.1 Regional Description

The Sabie-Pilgrims Rest goldfield is situated in eastern Mpumalanga, overlying the preserved eastern rim of the early Proterozoic Transvaal basin. This north-south trending, shallow westerly dipping, metallogenic province (goldfield) extending for approximately 140 km in a north-north-easterly direction, over a maximum width of 30 km along the Great Escarpment of Southern Africa (Figure 15Figure 15).

Gold mineralisation occurs on the eastern margins / rim of the early Proterozoic Transvaal Basin, marked by the Drakensburg escarpment. The mineralisation occurs within sedimentary host rocks of the late Archaean to early Proterozoic Transvaal Supergroup. The Sabie-Pilgrims Rest Goldfield stratigraphic succession, younging upwards, includes Achaean basement granite, as well as minor volcano-sedimentary succession of Godwan Group and Wolkberg Group clastic sediments that uncomformably overlie the basement rocks. The Transvaal Supergroup is separated from the Wolkberg Group by an angular unconformity (Figure 16).

The Pretoria Group overlies the Deutschland Subgroup, but the latter is not present in the Pilgrim's Rest area and here the Pretoria Group overlies the Malmani dolomites on a slight unconformity called the Bevett's unconformity. The Bevett's conglomerate rests on this unconformity and grades upwards into the dark coloured, fine-grained quartzite called the Rooihoogte Formation. This formation grades upwards into the Timeball Hill Formation comprising mainly shale and carbonaceous shale.

Numerous dykes and sills, principally of pre- and post-Bushveld Igneous Complex age have intruded into the Transvaal Supergroup. Some dykes that pre-date the Bushveld Complex were recognized, related to gold mineralisation. The last two units do not outcrop in the Pilgrim's Rest area.

Epigenetic gold mineralisation is present in three main types of orebody. Stratiform quartz-sulphide gold veins, termed flat reefs, are the dominant, most productive style of mineralisation in the goldfield. Steeply eastward-dipping, transgressive vertical reefs and smaller, sub-vertical to inclined lensoidal leader reefs are also present in the goldfield. The former originates in the Archaean granitoid basement beneath the shallowly dipping Transvaal Sequence and may pierce the overlying sedimentary pile, the latter frequently branch off flat reef lodes and are exclusively developed in the Transvaal sedimentary rocks.

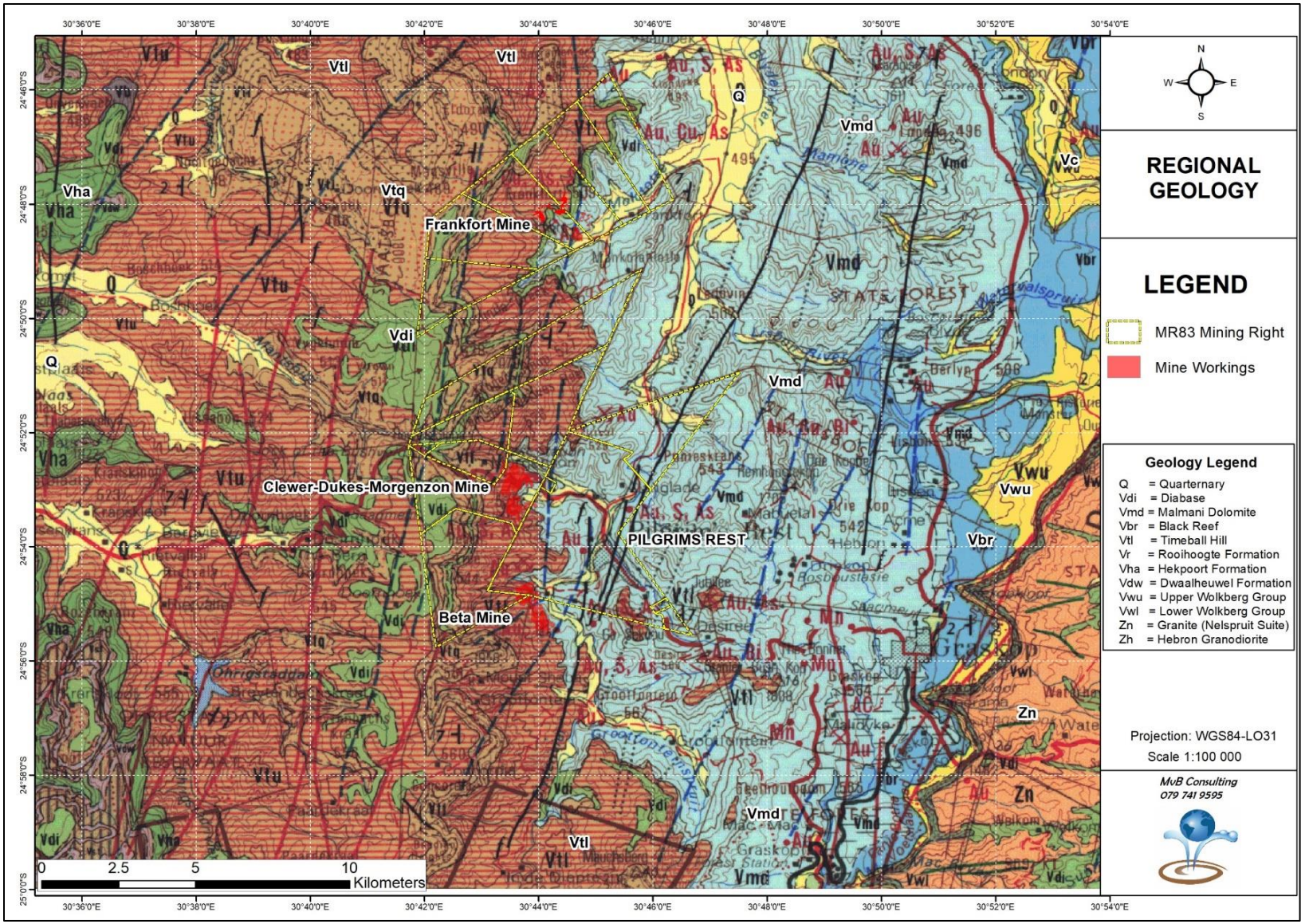


Figure 15: Regional surface geology – Pilgrims Rest region

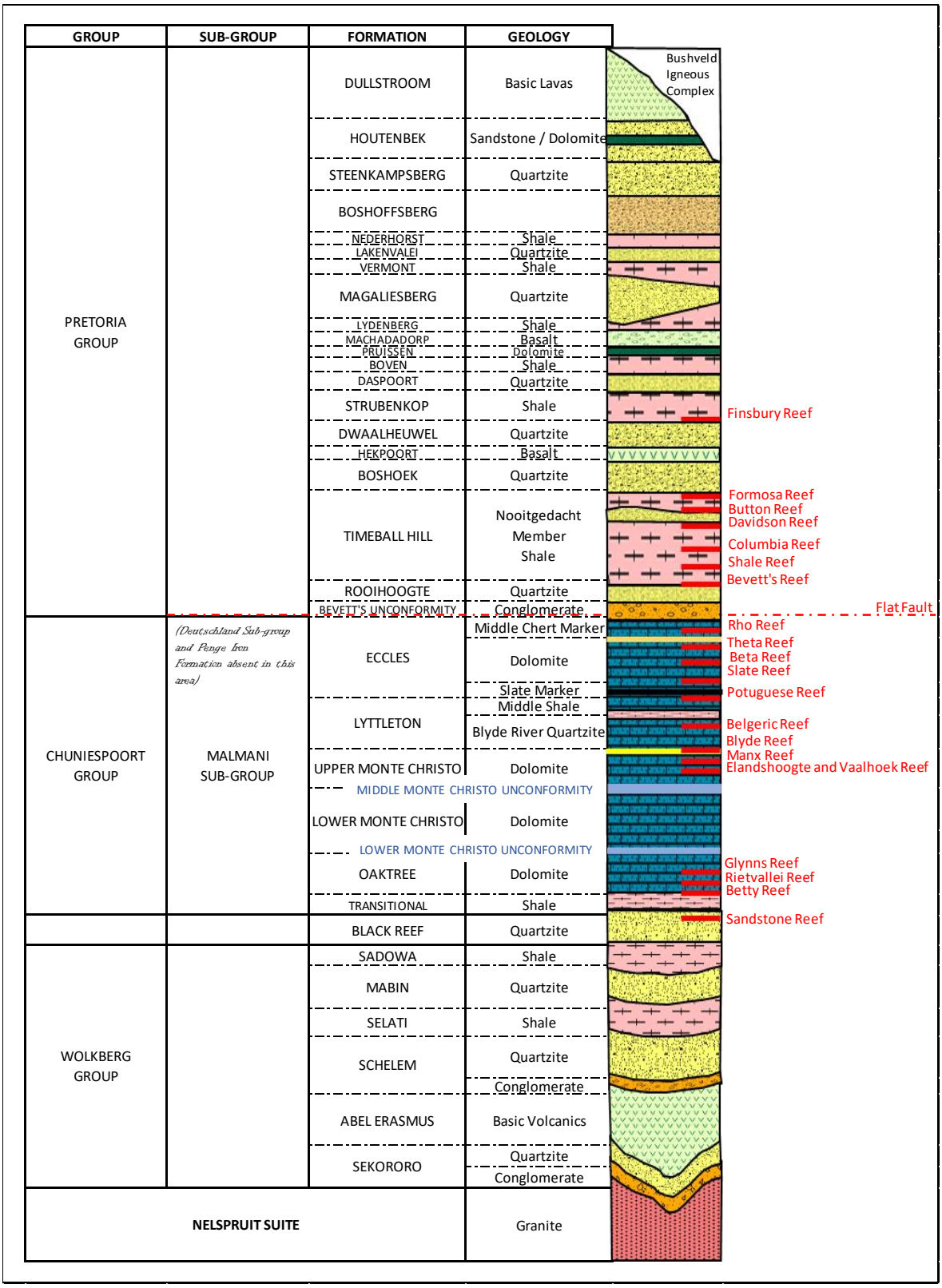


Figure 16: Stratigraphy in the Sabie – Pilgrims Rest goldfields

2.7.2 Local Geology

The stratigraphic succession in the study area, is similar to that of the Transvaal Supergroup, with the exclusion of the Deutschland Subgroup and Penge Iron Formation. Instead, the Pretoria Group is separated from the Malmani Subgroup by the Bevett's Unconformity.

Epigenetic gold mineralisation occurs as concordant and discordant veins in a variety of host rocks. The mineralisation in the area of interest is principally "flat" bedding parallel shears located mainly on shale partings within Malmani dolomite. However, there are other reefs located in the sediments apart from the dolomite. The ore bodies occur as narrow quartz carbonate veins (reefs), which occupy bedding parallel faults and shears, and generally conform to the shallow regional dip of the strata. Gold mineralisation is accompanied by various sulphides of iron (Fe), copper (Cu), arsenic (As) and bismuth (Bi).

Various discordant reefs, within the study area, are characterized by a variety of gold mineralisation styles. They are found throughout the Sabie-Pilgrims Rest Goldfield, and are commonly referred to as cross reefs, blows, veins, ore channels and leaders. These discordant bodies can be found sporadically throughout the stratigraphy as a varying assemblage of gold-quartz-sulphide mineralisation generally striking northeast. They vary greatly in terms of composition and depth.

The target orebodies are shear hosted quartz-carbonate vein mesothermal shallow dipping gold deposits (enriched with sulphide). The exception is the Bevetts lithologies which are thought to represent a later erosional surface which impinged on the other reefs and was intruded by the later mesothermal Bevetts Reef. It is thought that the mineralisation of the reefs occurred along pre-existing planes of weakness and is possibly associated with the intrusion of the Bushveld Igneous event in South Africa. Pressure and temperature estimates indicate that the ore fluids of the Sabie-Pilgrims Rest Goldfield were similar to other typical mesothermal gold deposits (Minxcon, 2018).

The stratigraphy of the study area, from top to bottom, includes the Timeball Hill Formation (shales), the Bevetts' Unconformity (a combination of quartzite and chert conglomerate in a quartzite matrix) and the interface between of the Big Chert Marker (chert) and underlying Malmani dolomites

The mineralisation the project area of interest is principally "flat" bedding parallel shears located mainly on shale partings within Malmani Dolomites. However, mineralisation also occurs in other formations of the Transvaal Supergroup. The orebodies occur as narrow quartz-carbonate veins (reefs), which occupy bedding parallel faults and shears, and generally conform to the shallow regional dip of the strata. Gold mineralisation is accompanied by various sulphides of Fe, Cu, As and Bi. Gold-bearing reefs that are present at the project area includes the following (Minxcon, 2019):

- Shale Reefs.
- Bevetts Reef.
- Upper Rho Reef.
- Lower Rho Reef.
- Upper Theta Reef.

- Lower Theta Reef.
- Beta Reef.

Recent drilling conducted has been concentrated to the northern sections of the project in the mining lease area of 83MR. The recent drilling programme consists of a total of 288 drillholes with the purpose of testing the geological model and to improve the confidence in the Mineral Resource estimation. A total of 536 drillholes for some 20 168 m was historically carried out on the project area during different phases (Minxcon, 2018).

The geological beds and accompanying parallel reefs generally display a north-south strike and a 4° to 6° dip to the west. Studies have shown the existence of very large regional scale open folding with slight variations in the north-south strike and 1º to 6º westerly dip. There is very little effect of this regional folding within the study area. Smaller scale folding, however, occurs in the existing underground workings and is evident from detailed mapping and structural measurements. Again, the folding is gentle and open with changes in dip and strike being no more than a degree or two (GCS, 2009).

Faulting in the main trends NNE to SSW and is normal and sub-vertical. Localized vertical displacement varies from 20cm to over 3m and the recent detailed mapping shows additional trends over and above the dominant NNE-SSW direction. In most cases, the dykes have occupied pre-existing faults evidenced by the fact that there is usually a very strongly faulted contact on one or both sides of the dyke. Faults and dyke contacts are often water-bearing (GCS, 2009).

Bedding plane thrusting is recognizable on discrete surfaces within the sedimentary pile. These planes occur along carbonaceous shale bands and are the result of brittle-ductile deformation. It is along these planes that the gold mineralization has been localized. Jointing follows the main NNE-SSW trend and is sub-vertical and occurs in zones on either side of the larger dykes (GCS, 2009).

2.7.3 Structural Geology

A number of major north to north-easterly trending lineaments are prevalent throughout the Sabie-Pilgrims Rest Goldfield and are broadly coincident with mineralisation patterns. These lineaments are represented by a series of near vertical faults and dykes. The period of northerly faulting is thought to postdates a period of east-west normal faulting.

To the north of the town of Pilgrims Rest, the north-northeast trending Vaalhoek Dyke forms the main regional structure that carries mineralisation. Younger north-east transverse dykes appear to be un-mineralised and post-date the Vaalhoek trend.

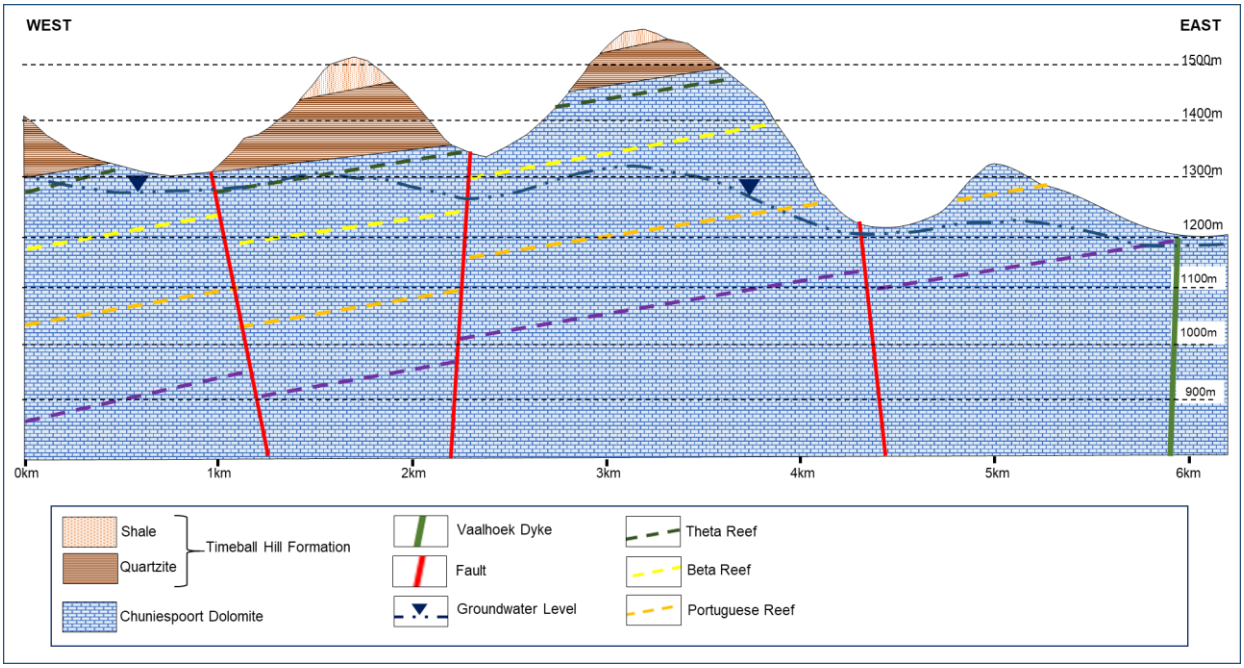


Figure 17: West-East geological section through the Pilgrim's Rest Goldfields

2.7.4 Uranium Detection

Gold mineralization predominantly manifests as quartz-carbonate veins that develop as sheeted orebodies locating on bedding plane thrusts on interbedded shale horizons within the Malmani Dolomite subgroup, as well as on rheological contacts of sills, quartzite-shale, quartzite - dolomite and shale-dolomite interfaces. Locally quartz stockworks and breccias develop. There are also subvertical veins hosted in Archean granite as well as adjacent to predominantly NNE trending dykes. The predominant dolomite host rock has a significant buffering effect on mine water drainage and general very pure ground water quality.

Historic documentation and ore mineralogy studies by researchers such as EGRU (University of the Witwatersrand) do not indicate any uraniferous minerals in the Goldfield. The mineralized horizons are largely pyritic quartz-carbonate veins with variable contents of copper, arsenic and bismuth.

It is emphasised that the geological setting of mineralisation (Proterozoic ~ 2.0 billion year old shear hosted quartz carbonate veins) with the main source of gold linked to the Bushveld Igneous Complex to the west of the Sabie-Pilgrims Rest Regional Geology) is not favourable for uranium deposition. Please refer to Appendix 7 for the letter from Dr Bentley pertaining to the detection of Uranium, within the study area. (I am looking for this letter. I have asked Robyn and Marius. No reply…)

The results of the Uranium analysis in July 2020 taken by OMI, were below detection limit for all monitoring points and is not related to any of the mining activities of the client in this area. The Uranium sampling was not repeated due to all points being below detection limit.

2.8 Groundwater

2.8.1 Boreholes

Groundwater boreholes in the region are scarce and mainly restricted to scattered mine investigative / monitoring boreholes. Boreholes drilled during previous investigations were consulted to form an understanding of the geohydrological regime of the study area. This understanding was supplemented by information obtained from exploration boreholes in the study area.

The localities of available boreholes are shown in Figure 18 and the geological boreholes information is summarised in Table 20.

Table 20: Borehole Information

Borehole ID	Locality	Coordinates			Depth	Groundwater Level	
		Longitude	Latitude	Collar (mamsl)	(m)	(mbs)	(mamsl)
BGW1	TGME Plant	30.7381	-24.9187	1,280.00	10	Dry	Dry
BGW2	TGME Plant	30.7381	-24.9187	1,280.00	Unknown	28.00	1,252.00
BGW3	TGME TSF	30.7364	-24.9120	1,260.00	Unknown	8.00	1,252.00
BGW4	TGME TSF	30.7364	-24.9120	1,260.00	Unknown	8.00	1,252.00
BGW5	Brown Hill	30.7448	-24.9153	1,314.57	Unknown	Dry	Dry
BGW6	TGME TST SE	30.7441	-24.9125	1,279.10	Unknown	46.00	1,233.10
BGW7	TGME TSF NE	30.7438	-24.9119	1,268.84	38	35.00	1,233.84
BGW9	Clewer Main	30.7258	-24.8749	1,320.00	Unknown	5.00	1,315.00
BGW10	Morgenzon Main	30.7245	-24.8747	1,320.00	Unknown	5.00	1,315.00
BGW16	Frankfort	30.7430	-24.8097	1,260.00	Unknown	6.52	1,253.48
TG2	TGME Plant	30.7401	-24.9198	1,286.84	30	25.57	1,261.27
TG1	TGME Plant	30.7363	-24.9124	1,262.05	30	8.70	1,253.35
TG1-SM	TGME Plant	30.7361	-24.9125	1,260.80	10	8.85	1,251.95
HMB1	Hermansburg	30.7455	-24.7750	1,654.36	117	73.00	1,581.36
HMB2	Hermansburg	30.7515	-24.7789	1,580.00	60	Dry	Dry
HMB3	Hermansburg	30.7641	-24.7737	1,480.90	133	117.00	1,363.90
BH3	TGME TSF	30.7400	-24.9128	1,279.95	Unknown	Dry	Dry
DG1-BH1	Trend deposits	30.7660	-24.9238	1,465.51	Unknown	Dry	Dry
DG2-BH1	Trend deposits	30.7660	-24.9238	1,465.51	Unknown	Dry	Dry
BH North	Bourke's Luck	30.8084	-24.6819	1,152.25	Unknown	45.00	1,107.25
Vaalhoek 2#	Vaalhoek Shaft	30.7681	-24.7599	1,263.26	Unknown	137.00	1,126.26
Frankfort BH	Frankfort	30.7432	-24.8096	1,260.00	Unknown	6.52	1,253.48
Fountain	Vaalhoek	30.7718	-24.7501	1,307.86	Unknown	0.00	1,307.86
Forestry BH	Golf Course	30.7447	-24.8856	1,269.05	Unknown	Locked	Locked

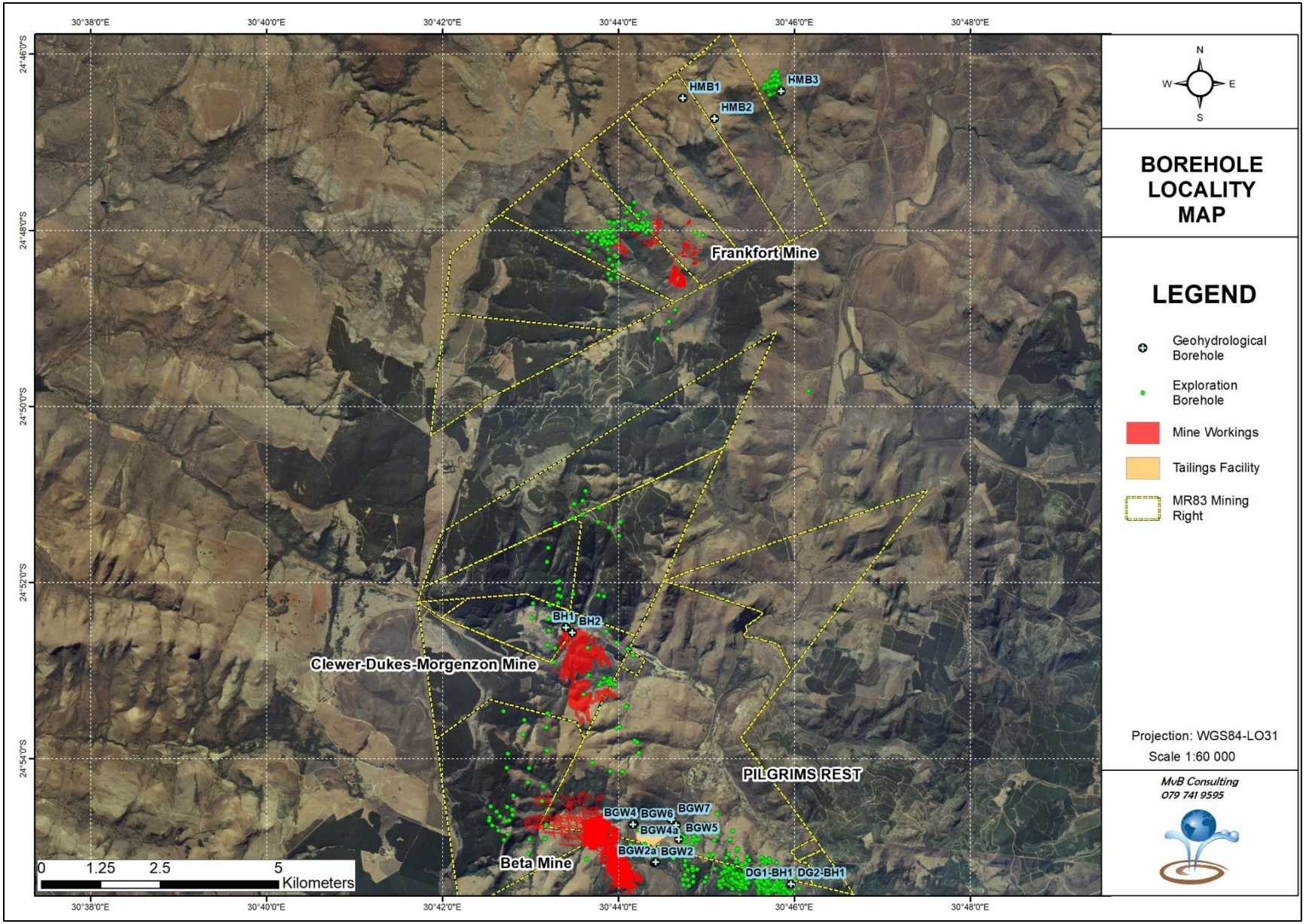


Figure 18: Regional borehole locality plan

2.8.2 Aquifer Type

Groundwater occurrences in the study area are predominantly restricted to the following types of terrain:

- Primary aquifers consisting of the quaternary sediments which are restricted to the river valleys.
- Weathered and fractured rock aquifer in the Timeball Hill formations.
- Dolomitic and Karst Aquifers.

A brief description of each aquifer is included in the Geohydrological report Section 4.3 on page22, attached as **Appendix 2.**

2.8.3 Aquifer Parameters

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 (K*): 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 (T):* 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 (S):* 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.

Groundwater Consulting Services (GCS, 2009) conducted aquifer testing in the Pilgrims Rest region. Aquifer testing was performed on several boreholes to determine the aquifers' response to abstraction and to determine the aquifer parameters. The test results are shown in Table 21.

Table 21: Aquifer Parameters (GCS, 2005 & 2009)

Borehole ID	Borehole Depth (mbs)	Pump Inlet (mbs)	Groundwater Level (mbs)	Available Drawdown (m)	Test Duration (min)	Test Rate (ℓ/sec)	Transmissivity (m2/day)
BH1	-	-	4.76	-	-	-	68.00
BH2	-	-	5.07	-	-	-	157.00

The dolomite or karst aquifer may have transmissivity values of up to 1 000 m^2/day in exceptional instances such as boreholes into cavities. The boreholes in the Pilgrims Rest region are lower but considered representative of the dolomite aquifer.

2.8.4 Groundwater 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. Groundwater recharge (R) for the study area was calculated using the chloride method (Bredenkamp et al, 1995) and is expressed as a percentage of the Mean Annual Precipitation (MAP). The method is based on the following equation:

$$R = \frac{\text{Chloride concentration in rainfall}}{\text{Harmonic mean of Cl concentration in ground water}} \times 100$$

The average chloride in rainfall for areas inland is approximately 0.5 mg/ℓ and the harmonic mean of the chloride concentration values in groundwater samples obtained from the mining area is 4.85 mg/ℓ.

$$R = \frac{0.5}{4.85} \times 100 = 10.3\%$$

The calculated recharge percentage is relatively high, but in line with dolomite aquifers.

2.8.5 Groundwater Gradients and Flow

The first important aspect when evaluating the geohydrological regime and groundwater flow mechanisms is the groundwater gradients. Groundwater gradients, taking into consideration fluid pressure, are used to determine the hydraulic head which is the driving force behind groundwater flow. The flow also governs the migration of contaminants and an assessment of the flow was required to determine sub-surface flow directions from the potential contaminant sources.

Groundwater levels were measured during the hydro census, but only limited measurements could be taken. The groundwater levels that were used are shown in Table 22 (below).

Table 22: Groundwater Levels

Borehole ID	Locality	Coordinates			Depth	Groundwater Level	
		Longitude	Latitude	Collar (mamsl)	(m)	(mbs)	(mamsl)
BGW2	TGME Plant	30.7381	-24.9187	1,280.00	Unknown	28.00	1,252.00
BGW3	TGME TSF	30.7364	-24.9120	1,260.00	Unknown	8.00	1,252.00
BGW4	TGME TSF	30.7364	-24.9120	1,260.00	Unknown	8.00	1,252.00
BGW6	TGME TST SE	30.7441	-24.9125	1,279.10	Unknown	46.00	1,233.10
BGW7	TGME TSF NE	30.7438	-24.9119	1,268.84	38	35.00	1,233.84
BGW9	Clewer Main	30.7258	-24.8749	1,320.00	Unknown	5.00	1,315.00
BGW10	Morgenzon Main	30.7245	-24.8747	1,320.00	Unknown	5.00	1,315.00
BGW16	Frankfort	30.7430	-24.8097	1,260.00	Unknown	6.52	1,253.48
TG2	TGME Plant	30.7401	-24.9198	1,286.84	30	25.57	1,261.27
TG1	TGME Plant	30.7363	-24.9124	1,262.05	30	8.70	1,253.35
TG1-SM	TGME Plant	30.7361	-24.9125	1,260.80	10	8.85	1,251.95
HMB1	Hermansburg	30.7455	-24.7750	1,654.36	117	73.00	1,581.36
HMB3	Hermansburg	30.7641	-24.7737	1,480.90	133	117.00	1,363.90

Borehole ID	Locality	Coordinates			Depth	Groundwater Level	
		Longitude	Latitude	Collar (mamsl)	(m)	(mbs)	(mamsl)
BH North	Bourke's Luck	30.8084	-24.6819	1,152.25	Unknown	45.00	1,107.25
Vaalhoek 2#	Vaalhoek Shaft	30.7681	-24.7599	1,263.26	Unknown	137.00	1,126.26
Frankfort BH	Frankfort	30.7432	-24.8096	1,260.00	Unknown	6.52	1,253.48
Fountain	Vaalhoek	30.7718	-24.7501	1,307.86	Unknown	0.00	1,307.86

In most geological terrains, the groundwater mimics the topography. To test if this is the case within the study area, the available groundwater levels were plotted against the topography (represented by the borehole collar elevations). The result of this assessment is presented in Figure 19 below.

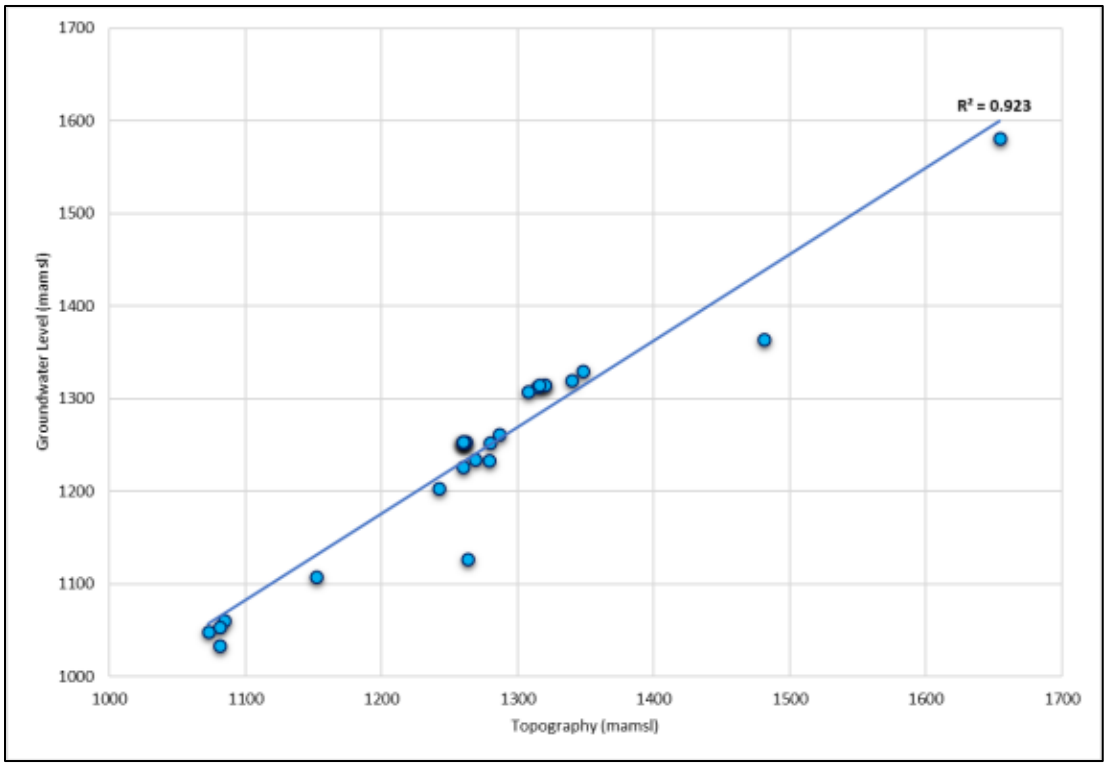


Figure 19: Correlation between Topography and Groundwater Level

The graph indicates a good correlation (92%) between the topography and the groundwater level. This is an indication that the groundwater flow follows the topographical gradient.

The groundwater in dolomite aquifers do not typically follow this trend, due to the high transmissivity that is found in dolomite aquifers. The apparent relationship between the topography and groundwater levels in the Sabie-Pilgrims Rest dolomite aquifer may indicate that this aquifer approximates a typical fractured aquifer, that the dolomite is not extensively karstified and that the high water yielding dolomite aquifer is not well developed. This is not to say that the dolomite in this region is a minor aquifer; it is

likely a reflection on the distribution of the current boreholes that may not have specifically targeted karst areas. Karst zones with a potential for high yielding boreholes do in all likelihood exist.

This relationship between topography and groundwater level is known as the Bayesian relationship, and where this exists, the regional topography can be used to interpolate (Bayesian interpolation) a regional groundwater gradient map. In the absence of an evenly distributed borehole network it is assumed that, for most of the study area, the groundwater mimics the topography. Figure 20 depicts the groundwater level elevations, based on the Bayesian interpolation. Groundwater flow is perpendicular to the groundwater contours and is predominantly towards the surface streams.

According to GCS (2009) a hydrogeological study was conducted for a proposed Heap Leach Pad. Drilling of new boreholes and aquifer testing was conducted. A pump and recovery test could only be conducted on a single borehole (BTB-1) as BTB-2 and BTB-3 did not encounter water strikes and aquifer tests could not be performed.

The depth of borehole BTB-1 was recorded at approximately 38 m, while the static water level is this borehole was measured at 29.59 m below ground level. The evaluation of the aquifer test indicated a saturated transmissivity of 24.4 m/day.

According to GCS (2009) it is reasonable to assume that the groundwater flow is from surface streams to the lithology (negative base-flow) considering that the groundwater level in the area is lower than the surface water elevation. Another confirmation is the difference in the groundwater level in a borehole pair represented by boreholes TG1-SM and TG1 (Table 4-3). Borehole TG 1-SM is a shallow borehole, drilled to a depth of 10m, while borehole TG 1 was drilled to a depth of 30 m. These boreholes are approximately 8 m apart but the groundwater level in borehole TG 1-SM is higher than in Borehole TG1. The higher groundwater level in the shallower borehole indicates infiltration of the surface water into the groundwater system.

The difference between elevations of the groundwater and surface water decreases as one moves along the Blyde River in a downstream direction. The observation suggests that negative baseflow may be localised in certain areas along the river (GCS, 2009).

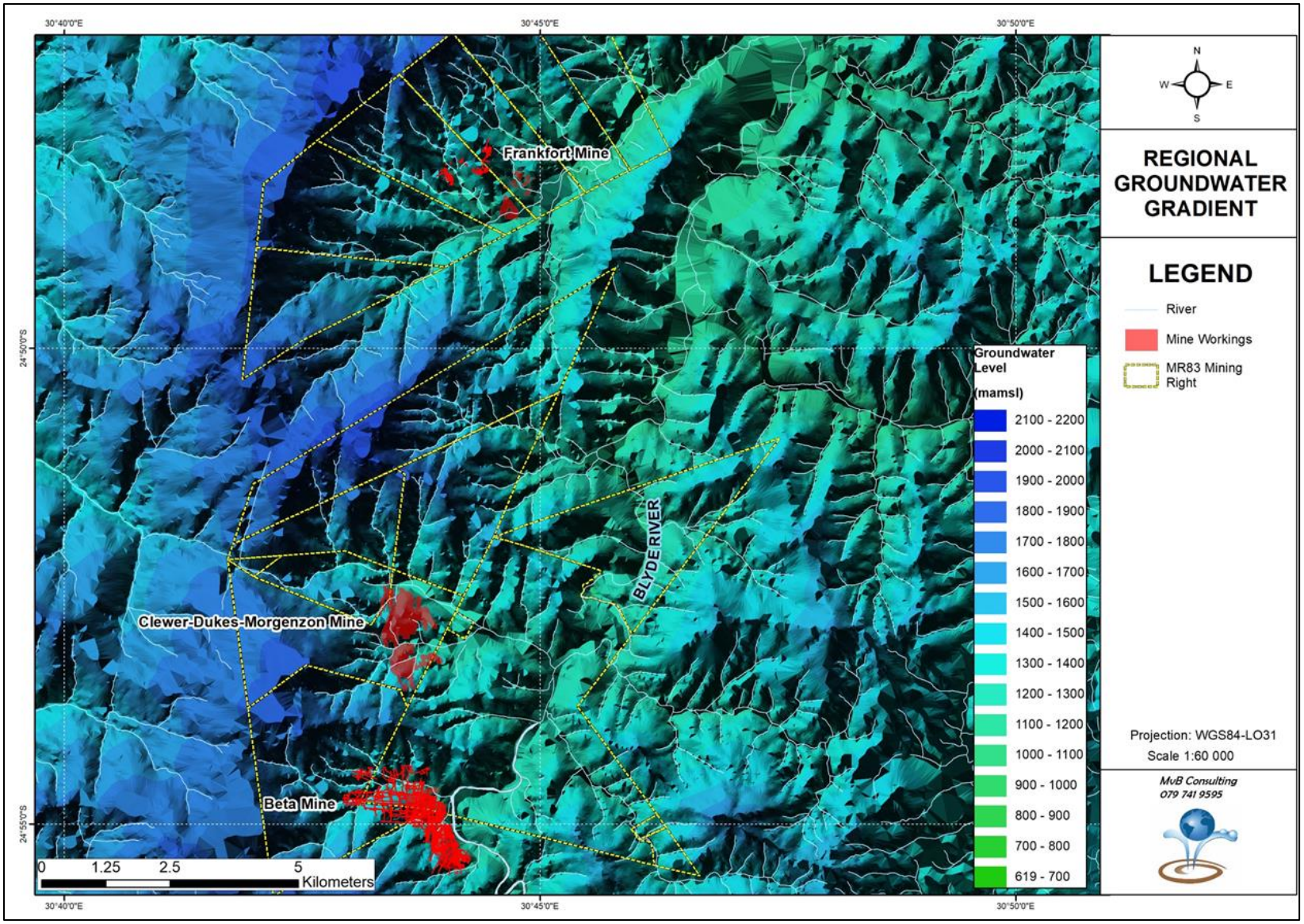


Figure 20: Interpolated Groundwater Gradients – Pilgrims Rest Region

A hydrocensus was conducted by MVB Consulting which focused on the area around the existing plant and tailings facility located on the farm Ponieskrans 543 KT and Grootfontein 526 KT. This provides insight to the hydrogeological environment on a more local scale. The groundwater level underlying the TGME existing plant and TSF area project is deep (110m – 380m). None of the exploration boreholes intersected any water, and no water levels could be measured in any of these holes several weeks after they were drilled. Based on the monitoring boreholes in the area the groundwater level varies between 1 224.43 – 1240.52 mamsl (Table 23)

Table 23: Groundwater levels at the existing Plant & TSF

ID	Locality	Coordinates			Depth	Casing Height	Groundwater Level	
		X	Y	Z	(mbs)	(m)	(mbs)	(mamsl)
BGW2	TGME Plant (Deep)	30.7401	-24.9198	1272.57	20.10	0.53	Dry	-
BGW2a	TGME Plant (shallow)	30.7404	-24.9196	1272.57	9.57	0.30	Dry	-
BGW4	TGME TSF (Deep)	30.7363	-24.9124	1253.29	29.60	0.74	29.60	1224.43
BGW4a	TGME TSF (Shallow)	30.7361	-24.9125	1253.71	10.00	0.00	Dry	-
BGW5	Browns Hill	30.7448	-24.9153	1318.00	40.00	0.00	Dry	-
BGW6	TGME TST SE	30.7442	-24.9127	1275.62	43.00	0.50	36.13	1239.99
BGW7	TGME TSF NE	30.7433	-24.9116	1270.63	38.00	0.45	30.56	1240.52
BGW15	Beta decant	30.7319	-24.9122	1280.00	0.00	0.00	0.00	1280.00

Regionally a good correlation exists between the topography and the groundwater level (see Figure 19), suggesting that the groundwater level mimics the topography. On a local scale, however, this does not appear to be the case. Only a 56% correlation is noticeable (Figure 21).

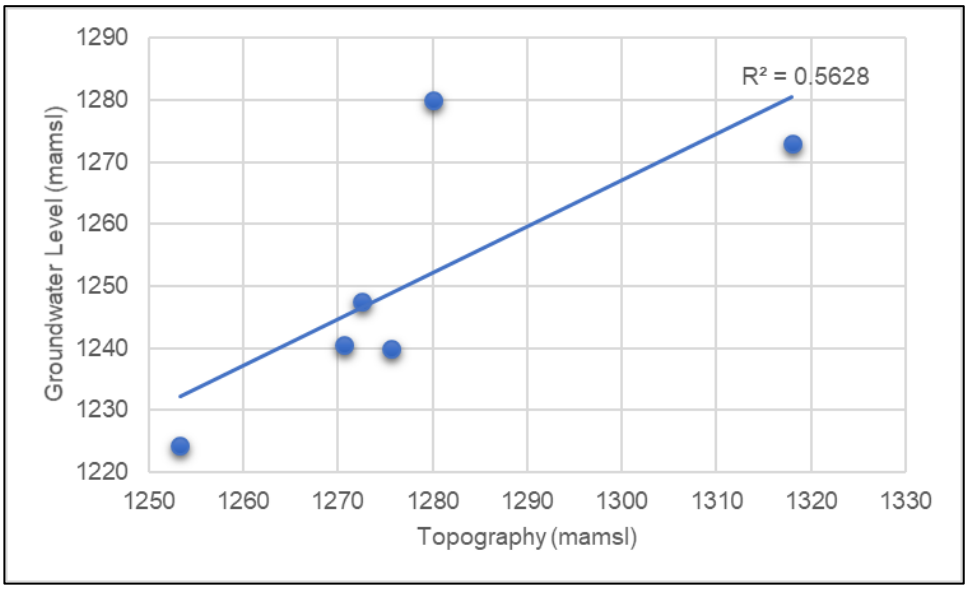


Figure 21: Correlation between topography and groundwater level – Plant and TSF

The water table in the dolomitic aquifer is generally a flat surface due to high aquifer parameters, and it is assumed that it is the same in this area.

2.8.6 Hydrochemistry

Groundwater quality results were obtained from the OMI Solutions (Pty) Ltd water quality reports (Appendix 4). A three-month water monitoring exercise was conducted in order to confirm whether any changes should be made to the frequency of the parameters not specified in the WUL. Where samples have not been indicated the boreholes were dry or could not be accessed due to illegal mining. According to OMI (July 2020) the borehole water quality analysis was not conclusive due to the large number of the boreholes being dry or unable to gain samples during the three-month monitoring period. Seasonal fluctuations affect the ground water levels, so monitoring of the ground water over a longer period of time, such as through quarterly sampling, should give a better indication of the ground water qualities.

The water chemistry is compared to the limits specified in the TGME Water Use Licence (Licence No: 24023343, 2011) as well as the SANS 241 (2015). The WUL guideline limits refer to the in-stream or resource quality limits, but in the absence of specific groundwater quality limits, these are used.

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 chemistry of the groundwater quality in the currently available monitoring boreholes is further discussed in Section3.6.4 of the IWWMP.

2.8.7 Numerical Groundwater Model [19]

2.8.7.1 *Introduction*

The numerical modelling for this project was undertaken by Prof. Ingrid Dennis from the Northwest University. The basic steps involved in modelling can be summarised as:

- *Collecting and interpreting field data:* Field data is essential to understand the natural system and to specify the investigated groundwater problem. The numerical model develops into a site-specific groundwater model when real field parameters are assigned. The quality of the simulations depends largely on the quality of the input data.
- *Calibration & validation:* Model calibration and validation are required to overcome the lack of input data, but they also accommodate the simplification of the natural system in the model. In model calibration, simulated values like potentiometric surface or concentrations are compared with field measurements. Model validation is required to demonstrate that the model can be reliably used to make predictions. A common practice in validation is the comparison of the model

[19] Taken from Chapter 5 of the Geohydrological Report.

with a data set not used in model calibration. Calibration and validation are accomplished if all known and available groundwater scenarios are reproduced by the model without varying the material properties or aquifer characteristics supplied to the model.

- *Modelling scenarios:* Alternative scenarios for a given area may be assessed efficiently. When applying numerical models in a predictive sense, limits exist in model application. Predictions of a relative nature are often more useful than those of an absolute nature.

2.8.7.2 *Assumptions and Limitations*

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;
- The available geological/geohydrological data was used to describe the different aquifers, on the assumption that this data is 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. In this case, the following assumptions were made:

- The system is initially in equilibrium and therefore in steady state, even though natural conditions have been disturbed;
- 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 limited capability of numerical methods to describe natural physical processes.

2.8.7.3 *Model Set-up*

In order to investigate the behaviour of aquifer systems in time and space, it is necessary to employ a mathematical model. MODFLOW, a modular three-dimensional finite difference groundwater flow model

which was developed by U.S. Geological Survey, was used for this investigation. It is an internationally accepted modelling package, which calculates the solution of the groundwater flow equation using the finite difference approach.

The modelling area was selected based on a combination of topographical and drainage control and covers an area of approximately 1,243 km^2.

The mesh constructed for the site consists of 311 x 600 cells in the x and y directions respectively – shown schematically in Figure 22. Each of the cells is 100 x 100m. The coordinates for the modelled area are -39 000, -2 774 000 (lower left corner) to -7 900, -2 714 000 (upper right corner).

The model network extends over a larger area than the area under investigation to ensure that the model boundaries will not affect simulated results.

Once the network has been set up, all initial and boundary conditions, sources, sinks, and aquifer parameters are entered. A steady state calibration is then conducted to ensure the flow model shows the same behaviour as the actual system under investigation.

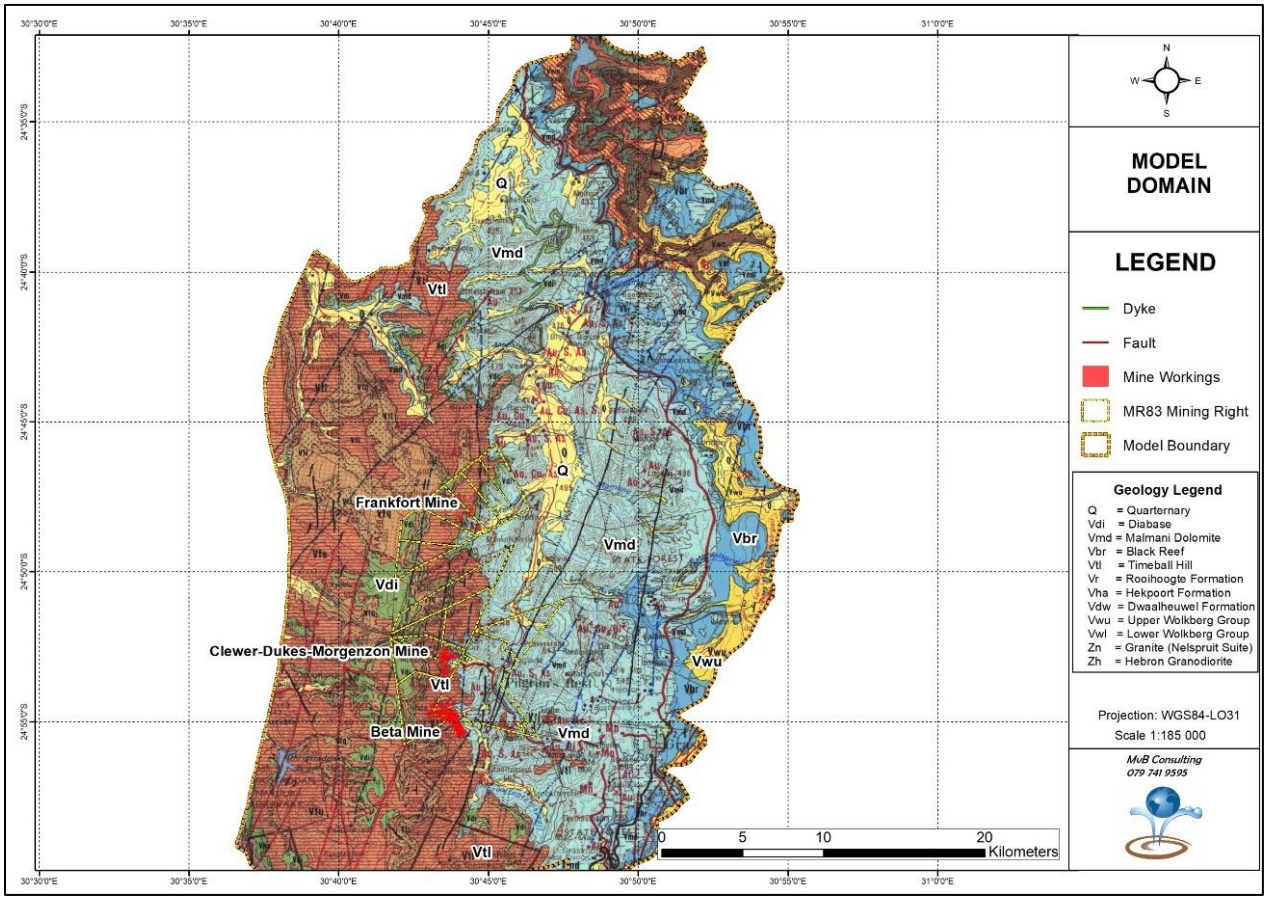


Figure 22: Model Domain

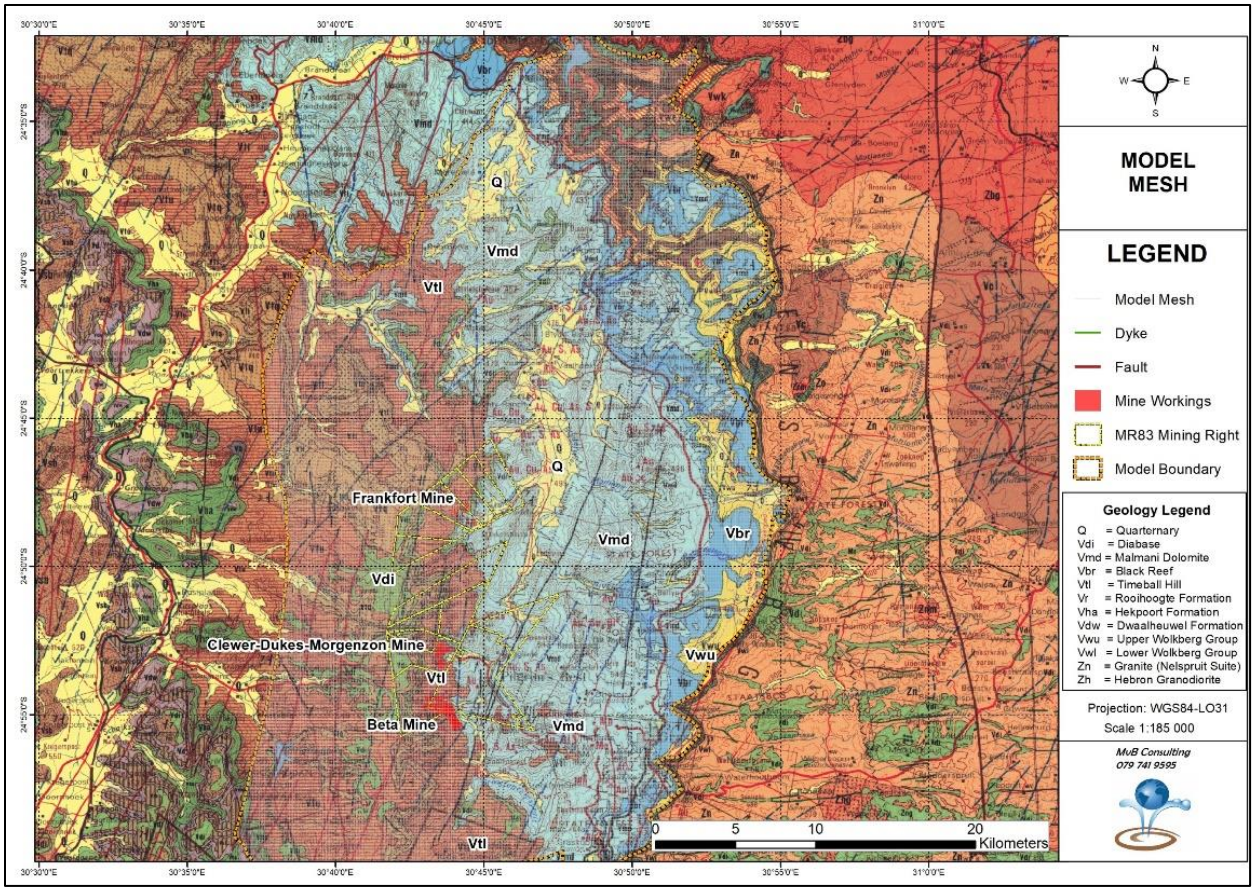


Figure 23: Model Mesh

2.8.7.4 *Model Boundary Conditions*

One of the first and most demanding tasks in groundwater modelling is that of identifying the model area and its boundaries. The model's boundary is the interface between the model area and the surrounding environment. Conditions on the boundaries must be specified. Boundaries occur at the edges of the model area and at locations inside the model area where external influences are represented, such as rivers, wells, and leaky impoundments.

Criteria for selecting hydraulic boundary conditions are primarily topography, hydrology and geology. The topography and/or geology may yield boundaries such as impermeable strata or potentiometric surface controlled by surface water, and recharge/discharge areas such as inflow boundaries along mountain ranges. The flow system allows the specification of boundaries in situations where natural boundaries are a great distance away.

Boundary conditions must be specified for the entire boundary and may vary with time. At a given boundary section just one type of boundary condition can be assigned. As a simple example, it is not possible to specify groundwater flux ad groundwater head at an identical boundary section.

Boundaries in groundwater models can be specified as:

- Dirichlet (also known as constant head or constant concentration) boundary conditions;
- Neuman (or specified flux) boundary conditions;
- Cauchy (or a combination of Dirichlet and Neuman) boundary conditions.

The main rivers (including the Blyde River) within the study area were set as constant heads. The northern, north-eastern and southern boundaries coincide with the boundaries of the quaternary catchments and they were set as no-flow boundaries.

2.8.7.5 *Initial Conditions*

Initial conditions are vital for modelling flow problems and should be specified for the entire area. Generally, the initial groundwater level / head distribution acts as the starting distribution for the numerical calculation. The groundwater levels shown in Figure 20 in section 2.8.5 were used as initial conditions for the model.

2.8.7.6 *Sources and Sinks*

Sources and sinks can be defined as recharge and abstraction sources in the aquifer. Sources can be precipitation and inflow from surface water and recharging boreholes. Sinks can be abstraction boreholes, springs, evapotranspiration and outflow to surface water.

Initially only recharge due to precipitation was included in the model. According to GCS (2009), the recharge is approximately 4.5%. The GRA recharge values for the quaternary catchments within the study area are summarised in Table 24.

Table 24: Recharge Values

Quaternary catchment	Rainfall (mm/a)	Recharge as a % of rainfall
B60A	1,193.1	9.5
B60B	1,026.3	8.2
B60C	1,229.2	8.2
B60D	1,003.9	7.3
B60E	1,026.9	10.3
B60F	766.5	8.0
B60G	681.4	6.4

2.8.7.7 *Aquifer Parameters*

Water in a fractured rock aquifer flows along fractures, faults, joints and bedding planes within the rock matrix. Two aquifer parameters are required for numerical modelling, namely:

- Transmissivity is a measure of the ease with which groundwater flows in the subsurface. Transmissivity is related to hydraulic conductivity (K):
  - $T = Kd$
  - Where d is the saturated thickness of the aquifer.
- Storativity (S) is a volume of water per volume of aquifer released as a result of a change in head.

The aquifer parameters discussed in section 2.8.3 were initially used in the numerical model. The model is calibrated using the groundwater level elevations which are a function of the product of the saturated aquifer thickness, the hydraulic conductivity and the effective aquifer recharge. Should the average aquifer thickness therefore be under/overestimated, this can be compensated for by adjustment of the hydraulic conductivity values during model calibration.

The simulated groundwater level distribution is compared to the measured head distribution, and the hydraulic conductivity or recharge values can be altered until an acceptable correlation between measured and simulated heads is obtained. The calibration process was done by adjusting the model parameters for hydraulic conductivity (K) and recharge within a narrow range compatible with the test results and hydrogeological situation.

The final calibrated aquifer parameters are shown in Table 25.

Table 25: Aquifer Parameters

Geology	Transmissivity (m^2/d)
Dykes	1
Shale	5
Dolomites	50
Black reef	5
Faults	100

2.8.7.8 *Mathematical Flow Model*

A steady state groundwater flow model for the study area was constructed to simulate undisturbed groundwater flow conditions. These conditions serve as starting heads for the transient simulations of groundwater flow where the effect of, for example, the discard dumps is considered.

The simulation model (MODFLOW) used in this modelling study is based on three-dimensional groundwater flow and may be described by the following equation:

$$\frac{\partial}{\partial x}\left(K_x \frac{\partial h}{\partial x}\right)+\frac{\partial}{\partial y}\left(K_y \frac{\partial h}{\partial y}\right)+\frac{\partial}{\partial z}\left(K_z \frac{\partial h}{\partial z}\right)\pm W = S\frac{\partial h}{\partial t} \qquad (1)$$

where

h = hydraulic head [L]

K_x, K_y, K_z = Hydraulic Conductivity [L/T]

S = storage coefficient

t = time [T]

W = source (recharge) or sink (pumping) per unit area [L/T]

x, y, z = spatial co-ordinates [L]

For steady state conditions, the groundwater flow Equation (1) reduces to the following equation:

$$\frac{\partial}{\partial x}(K_x \frac{\partial h}{\partial x}) + \frac{\partial}{\partial y}(K_y \frac{\partial h}{\partial y}) + \frac{\partial}{\partial z}(K_z \frac{\partial h}{\partial z}) \pm W = 0 \quad (2)$$

2.8.8 Calibration of the Steady State Model

The steady state head distribution is dependent upon the recharge, transmissivity, sources, sinks and boundary conditions specified. For a given recharge component and set of boundary conditions, the head distribution across the aquifer under steady-state conditions can be obtained for a specific transmissivity value. The simulated head distribution can then be compared to the measured head distribution and the transmissivity or recharge values can be altered until an acceptable correspondence between measured and simulated heads is obtained. An advantage of a steady state model is that the parameter for storativity is not required to solve the groundwater flow equation therefore, there are less unknown parameters to determine.

The calibration process was conducted by changing the model parameters for transmissivity and recharge. Nine boreholes were used to calibrate the steady state groundwater flow model (Figure 24). The calibration objective was reached when an acceptable correlation was obtained between the observed and simulated piezometric heads. A correlation of 96% was achieved (Figure 25). It is important to note that only a steady state calibration was performed, and this is not ideal. The confidence in the model would be increased if the model was calibrated with time series data and more boreholes.

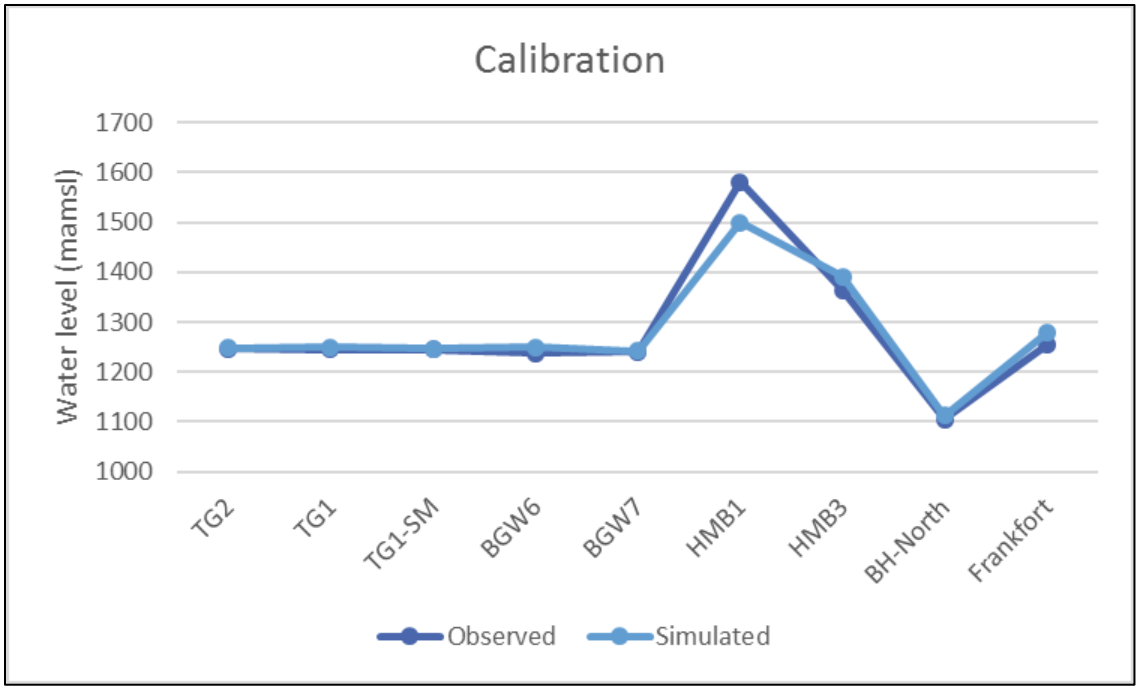


Figure 24: Correlation between simulated and observed groundwater levels

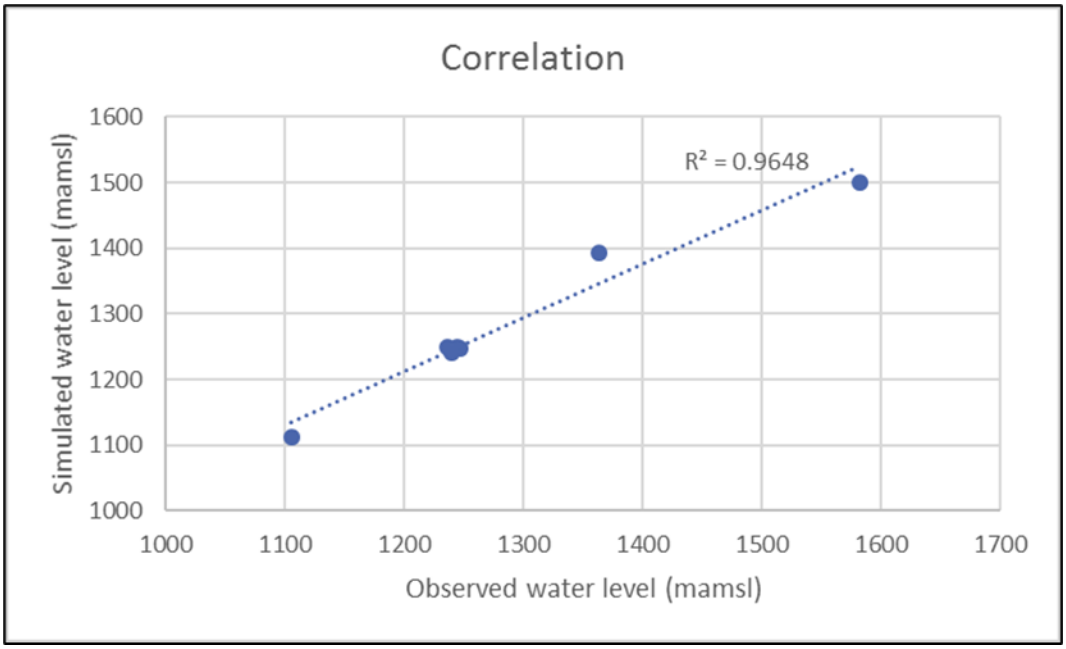


Figure 25: Calibration result

2.8.8.1 *Numerical Groundwater Mass Transport Model*

Mass transport modelling in this situation refers to the simulation of water contamination or pollution due to deteriorating water quality in response to man's disturbance of the natural environment (for example residue deposits). Transport through a medium is mainly controlled by the following two processes:

- Advection is the component of contaminant movement described by Darcy's Law. If uniform flow at a velocity V takes place in the aquifer, Darcy's law calculates the distance (x) over which a labelled water particle migrates over a time period t as x = Vt.
- Hydrodynamic dispersion comprises two processes:
    - Mechanical dispersion is the process whereby the initially close group of labelled particles is spread in a longitudinal as well as in a transverse direction because of the velocity distribution (as a result of varying microscopic streamlines) that develops at the microscopic level of flow around the grain particles of the porous medium. Although this spreading is both in the longitudinal and transversal direction of flow, it is primarily in the former direction. Very little spreading can be caused in the transversal direction by velocity variations alone.
    - Molecular diffusion mainly causes transversal spreading by the random movement of the molecules in the fluid from higher contaminant concentrations to lower ones. It is thus clear that if V = 0, the contaminant is transported by molecular diffusion only. In other words, the higher the velocity of the groundwater, the lower the relative effect of molecular diffusion on the transportation of a labelled particle.

In addition to advection, mechanical dispersion and molecular diffusion, several other phenomena may affect the concentration distribution of a contaminant as it moves through a medium. The contaminant may interact with the solid surface of the porous matrix in the form of adsorption of contaminant particles on the solid surface, deposition, solution of the solid matrix and ion exchange. All these phenomena cause changes in the concentration of a contaminant in a flowing fluid.

The MT3D software was used to provide numerical solutions for the concentration values in the aquifer in time and space. The required input into the model includes:

- Input concentrations of contaminants;
- Transmissivity values;
- Porosity values;
- Longitudinal dispersivities;
- Transversal dispersivities;
- Hydraulic heads/water levels in the aquifer over time.

Input concentrations in the model were specified at cells over the areas where contamination is expected. The input concentrations were specified as average concentrations (mg/ℓ).

Transmissivities for the aquifer were specified according to the values obtained during the scenario of the steady state water level calibration.

One of the biggest uncertainties encountered during transport modelling of pollutants is the kinematic porosity of the aquifer. Porosities were determined from laboratory experiments. These porosity values are documented in

Table 26 below, and are assumed to represent the porosities in the field.

Table 26: Porosity Values

Geology	Porosity as a %
Dykes	0.1
Shale	5
Dolomites	15
Black reef	10
Faults	20

A longitudinal dispersivity value of 100 m was selected for the simulations (see Table D.3 – Field-Scale Dispersivities in Spitz and Moreno, 1996). Bear and Verruijt (1992) estimated the average transversal dispersivity to be 10 to 20 times smaller than the longitudinal dispersivity. An average value of 10m was selected for this parameter during the simulations.

The hydraulic head values as calculated during the steady state simulations were used in the model.

2.8.9 Groundwater Model Simulations

2.8.9.1 *Groundwater Quality*

The calibrated numerical model was used to assess the potential impacts from the Tailings Facility (TSF) on the groundwater and the potential impact on the Blyde River.

The current impact is illustrated in Figure 26 and the estimated plume in 100 years is shown in Figure 27 .

With reference to the above figures it is important to note that the “contaminant plumes” are simulated as a percentage of the source concentration. Although a plume is indicated the actual concentrations are expected to be below the guideline limits. Selected individual chemical parameters, that may be indicative of mining impact, are shown in Table 27. The source concentration is based on the geochemical modelling (see

Table 37). It is evident from the geochemical study that the quality of the leachate does not pose a risk to the groundwater. The source concentrations for TDS and sulphate exceeds the WUL limits, but not the SANS 241 Drinking water limits.

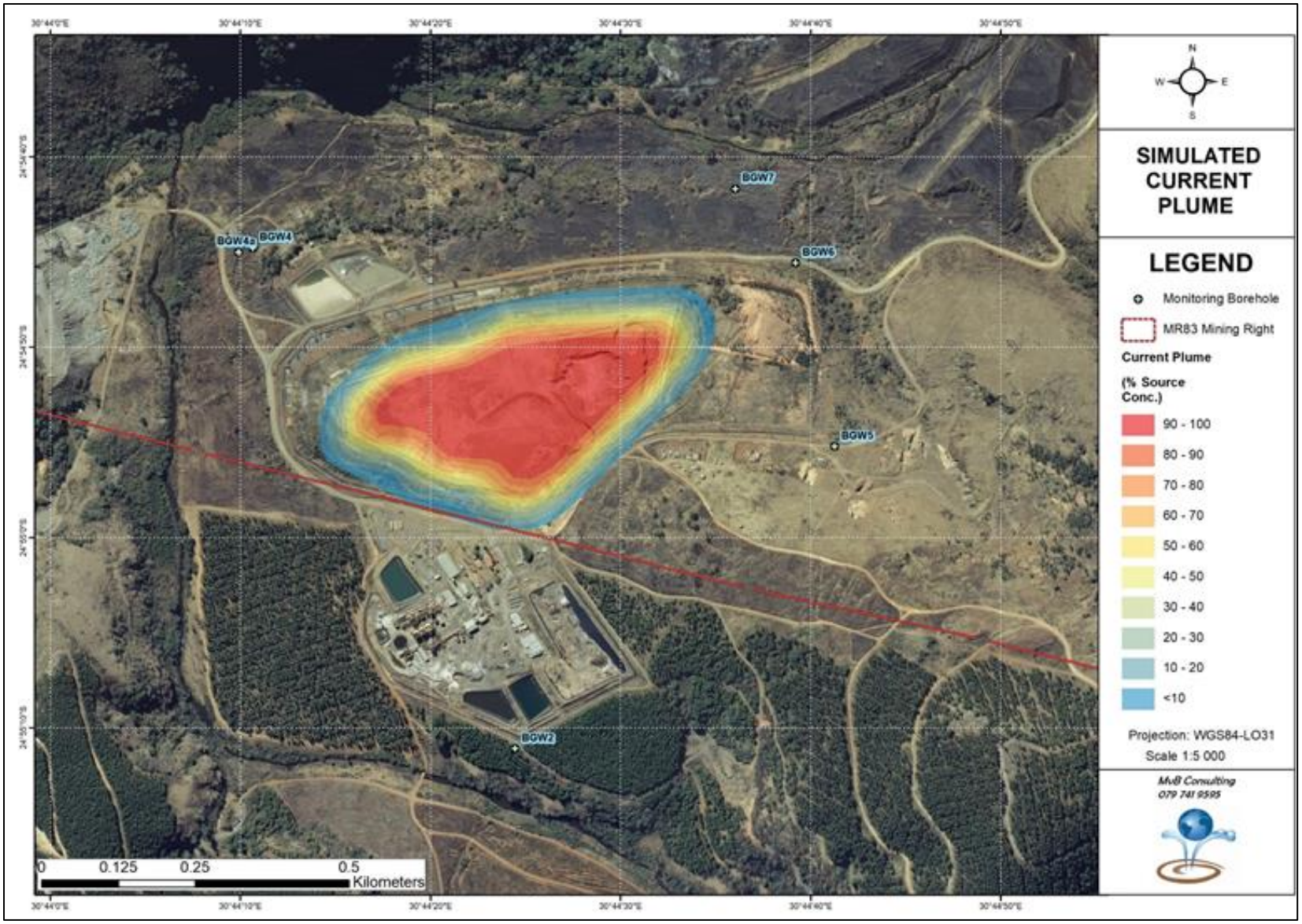


Figure 26: Simulated current impact from the TSF

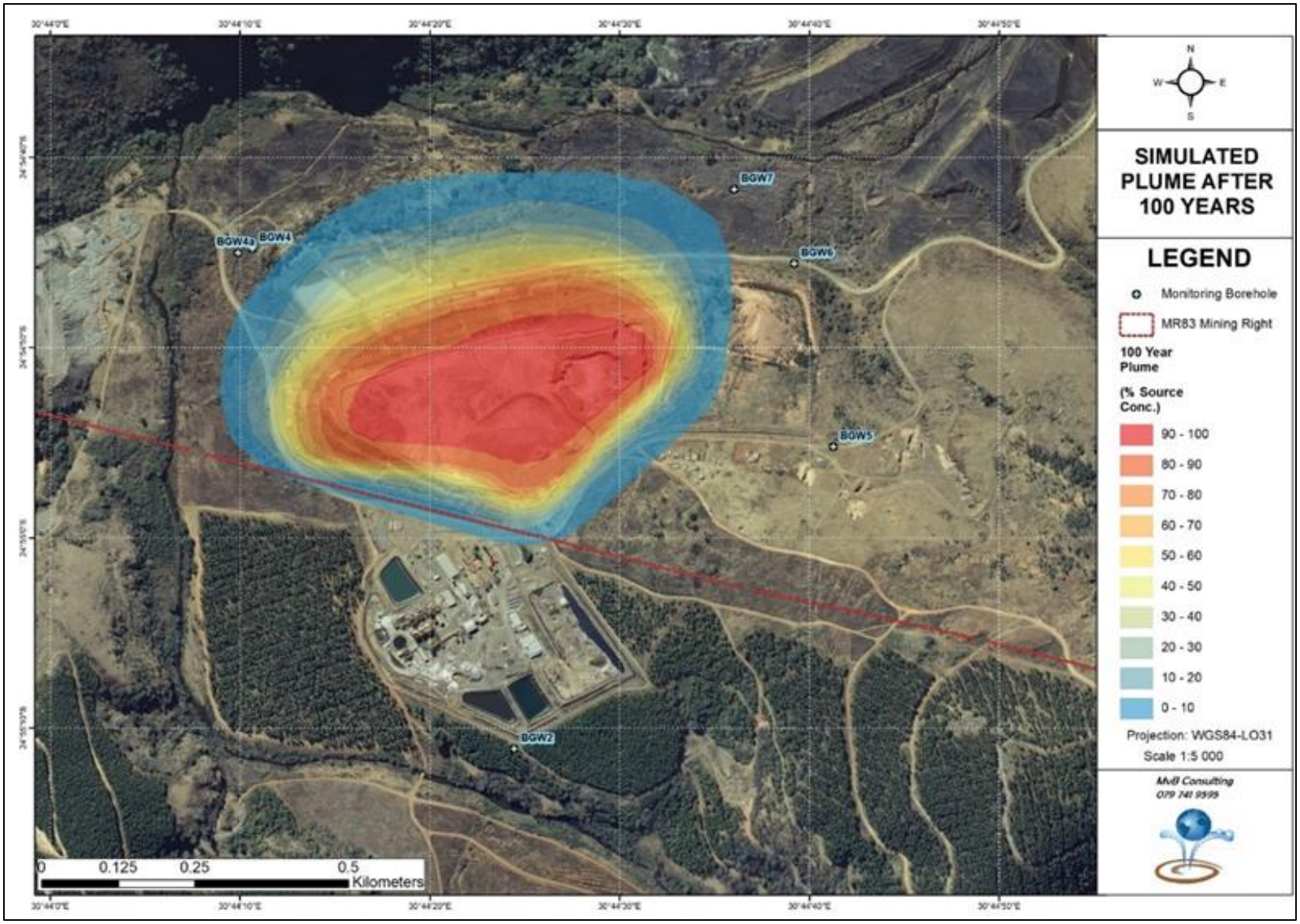


Figure 27: Simualted impact of the TSF in 100 years

Table 27: Source term concentrations – operational phae

Parameter (All mg/ℓ)	Source Concentration (mg/ℓ)	Guideline Limits		Percentage of Source Concentration (mg/ℓ)				
		SANS 241	WUL	100	80	60	40	20
Total Dissolved Solids (TDS)	862	1200	385	862	690	517	345	172
Sulphate (SO_4)	333	500	70	333	266	200	133	67
Arsenic (As)	0	0.01	-	0	0	0	0	0
Iron (Fe)	0	2	-	0	0	0	0	0
Manganese (Mn)	0	0.4	-	0	0	0	0	0
Cobalt (Co)	0.001	-	-	0.001	0.0008	0.0006	0.0004	0.0002
Chromium (Cr)	0.04	0.05	-	0.040	0.032	0.024	0.016	0.0008
Copper (Cu)	0	2	-	0	0	0	0	0
Mercury (Hg)	0.002	0.006	-	0.002	0.0016	0.0012	0.0008	0.0004
Aluminium (Al)	0.005	0.3	-	0.005	0.004	0.003	0.002	0.001
Nickel (Ni)	0.046	0.07	-	0.046	0.0368	0.0276	0.0184	0.0092
Zinc (Zn)	0.27	5	-	0.27	0.216	0.162	0.108	0.054

With reference to Figure 26and Figure 27 the following can be concluded:

- The contaminant plume will not reach the Blyde River in 100 years.
- The concentrations that potentially exceed the current WUL limits (TDS and sulphate) will be restricted to the footprint of the TSF.

2.9 Socio-Economic Aspects

2.9.1 Ehlanzeni District Municipality

The Ehlanzeni District Municipality (EDM) is one of the three districts in Mpumalanga Province and is located in the North-eastern part of Mpumalanga. EDM covers an area of 27,895.47km^2. It is bordered by Mozambique in the east and Swaziland in the south. EDM comprises four local municipalities namely Bushbuckridge, City of Mbombela, Nkomazi and Thaba Chweu Local Municipalities. [20]

The Ehlanzeni District has experienced changes in the leading industries driving the economy, notably from agriculture being the dominant sector in terms of gross value added (GVA) to community services, trade and finance. This situation indicates a shift from a primary activity-based economy. Skills development and training would thus remain a critical factor in ensuring economic growth and stability.

The limited availability of skills in the district will require that agriculture, construction, mining and tourism must be further developed to provide employment opportunities for unskilled labourers. The tourism

[20] Ehlanzeni District Municipality Final IDP and Budget review 2016/17

industry contributes 12.2% of the district's GDP. The industry has the ability to provide employment to both skilled and unskilled labour and has the ability to attract investment into the district.

Figure 28: Ehlanzeni District

2.9.2 Thaba Chweu Local Municipality

Thaba Chweu Local Municipality (TCLM) is located in the North Western section of Mpumalanga and is one of the major tourist attractions in South Africa. The escarpment divides the district into eastern and western halves. The western half (Lydenburg district) is characterised by agricultural and mining activities. The eastern half (Sabie/Graskop) is characterised by forestry.

The municipality shares its boundaries with the Bushbuckridge Local Municipality (east), the City of Mbombela Local Municipality (south), the Emakhazeni Local Municipality (west) and the Greater Tubatse Local Municipality (north). Emakhazeni and Tubatse fall within the Limpopo Province.

The main economic sectors in the Thaba Chweu municipal area are mining, forestry, agriculture, business services and tourism. Within the study area, forestry dominates the land-use and is an important contributor to the economy.

2.9.3 Study Area: Ward 13

The affected ward within the study area for the project is Ward 13 of TLCM. Ward 13 includes an area from north of Simile (near Sabie) to Pilgrim's Rest. The main town in the area is Pilgrim's Rest. Other areas falling in this ward include the Ohrighstad Dam area, Spekboom and Boomplaats.

Pilgrim's Rest was sold to government as a living national museum village in 1971 when mining activities in the town closed down. The town was declared a National Monument and became a provincial heritage site in 1986. The Mpumalanga Department of Public Works, Roads and Transport (DPWRT) is currently custodian of the town on behalf of the government and is responsible for the maintenance and restoration of Pilgrim's Rest. The TCLM is responsible for basic service provision while the other provincial departments (e.g. health, education) are responsible for their respective mandates in Pilgrim's Rest.

Main tourism attractions in and close to Pilgrim's Rest include the historic town itself, gold panning tours, Pilgrim's Rest Ghost Tours, Crystal Springs Mountain Lodge, Mount Sheba Resort, hiking tours and mountain bike trails throughout the area as well as bird watching tours and trails. Several recreation facilities are available, such as gold panning, golf, fishing, soccer, horse-riding and hiking.

According to local sources international tourists (mainly from Europe) dominates the tourism industry of Pilgrim's Rest, accounting for 85% to 90% of tourists visiting the town. There are conflicting opinions concerning trends in domestic tourism to the local area. Some sources believe the domestic tourism market is stagnant while other business owners experience an increase in local tourists to the town, especially tourists from historically disadvantaged communities. Local tourism to the town increases substantially during the holiday seasons in April and December.

The reliance of the economy on the tourist industry is evident from the type of businesses present within the local economy namely accommodation establishments, formal arts and craft shops, informal craft staffs, restaurants/deli's, retail/wholesalers, an education centre and a recreation facility. Both formal businesses and informal crafts stalls operate in the two distinct geographic areas of the historic town of Pilgrim's rest, informally named 'uptown' and 'downtown'. Both areas serve the same market and there is little real distinction between them. In addition to the businesses in the historic town, there are restaurants/taverns and a general dealer in Newtown.

Apart from tourism, the main employers in Ward 13 are TGME, Mpumalanga Government and forestry (Komatiland & York). The Mpumalanga Department of Public Works, Roads and Transport (DPWRT) is currently custodian of the town on behalf of the government and is responsible for the maintenance and restoration of Pilgrim's Rest. Many of the town's businesses lease premises from DPWRT.

2.9.4 Population density, growth and location

The total population in TCLM were 98,387 individuals in 2011 and 101,895 in 2016, an increase of 3.4%. In 2016, there were 33,352 households with an average household size of 2.7.

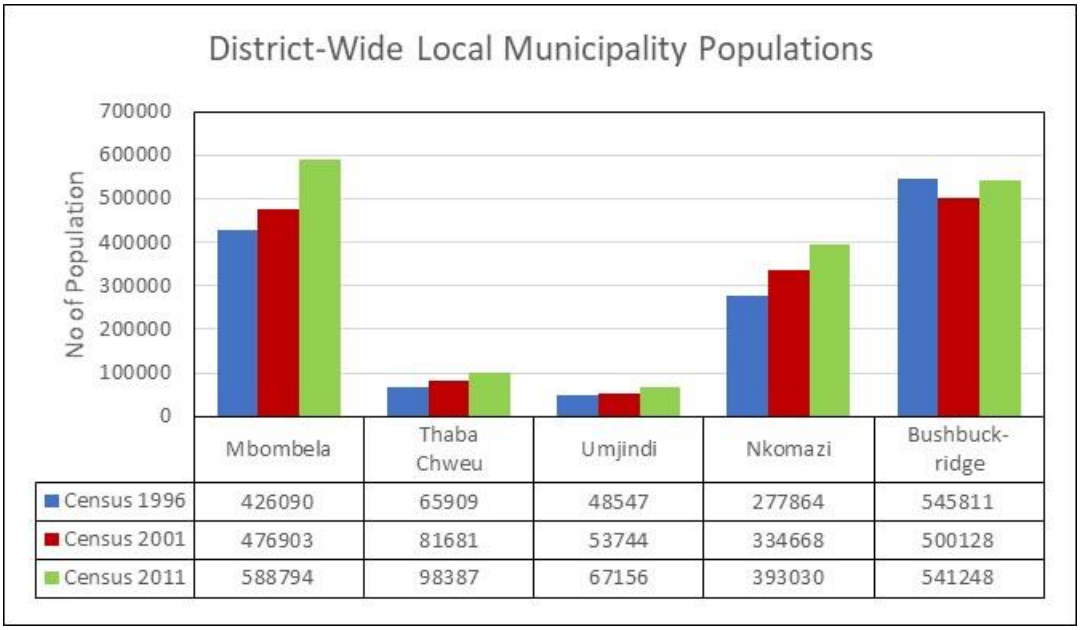
The population growth of the municipality as a whole exceeded national population growth rate. This indicates in-migration into TCLM, mainly due to increased mining activities in the Lydenburg, Burgersfort and Steelpoort areas since 2011 (Figure 29).

Ward 13 is a typical rural area without large settlements, which represents less than 3% of the total TCLM population (2,584 in 2011). According to Statistics South Africa, 1,721 individuals lived in the town of

Pilgrim's Rest in 2011 - 66% of Ward 13's population; this translates into 68 persons/km^2, 630 households and an average household size of 2.6.

According to local sources the current (2019) population could the between 1,700 to 2,500 people – around 200-300 people live in the old historic part of town, and the remainder live in the adjacent new townships Newtown/Schoonplaas and Darks Gully. These sources also indicate that the population could have stayed relatively stable with limited nett in/out migration after 2011. In the past, influx to Newtown/Schoonplaas happened sporadically and on an ad-hoc basis when labourers on short term construction works remained behind in the area.

There is also a perception that young people leave Pilgrim's Rest for better job opportunities elsewhere while illegal miners move into Pilgrim's Rest from areas as far afield as Free State, Lesotho and Mozambique. From discussions with local representatives of TGME and residents of Pilgrim's Rest, the in-migration of illegal miners has substantially increased in the last year. Illegal miners operating in the area around Pilgrim's Rest are sub-letting from residents in Newtown/Schoonplaas and Darks Gully.



	Mbombela	Thaba Chweu	Umjindi	Nkomazi	Bushbuck-ridge
Census 1996	426090	65909	48547	277864	545811
Census 2001	476903	81681	53744	334668	500128
Census 2011	588794	98387	67156	393030	541248

Figure 29: Local Municipality Population size from 1996, 2001 & 2011

2.9.5 Economic Activities and Performance in Ehlanzeni and Thaba Chweu

The main economic sectors in the Thaba Chweu municipal area are mining, forestry, agriculture, business services and tourism. Within the study area, forestry dominates the land-use and is an important contributor to the economy. The main employers are TGME, governmental departments, tourism, forestry (Komatiland & York) and the tourist shops.

In 2016 the total gross value added (GVA) of the Thaba Chweu municipal economy was estimated at R15bn (current prices) contributing close to 5% of the GVA produced in Mpumalanga province and 18% of the

GVA of Ehlanzeni District. The formal economy created between 25,000 and 30,000 jobs in 2016, representing around 12% of formal jobs in the district and 4% in the Province.

Between 1996 and 2013 the growth of the Mpumalanga economy was below the national economy at 2.3% per annum compared to the national growth of 3.1% (Stats SA, 2016). The Ehlanzeni district grew at rates slightly higher than the provincial rate (2.4%) during this period with Thaba Chweu recording an average annual growth rate of 3.9% for this period.

Between 2013 and 2016 the national economy grew at a lower rate of 1.2% per annum. The growth in the Mpumalanga economy once again lagged behind the national economy at 0.9%. The Ehlanzeni District is estimated to have grown at a slightly higher rate of 1.3% per annum during this period.

Thaba Chweu includes a large part of the Eastern Limb of South Africa's Platinum Belt, with more than 20 smelters and 30 mines operating in the Lydenburg and Steelpoort areas, producing mainly platinum and chrome concentrates. The mines include Glencore's Eastern Chrome Mines, Anglo Platinum's Mototolo and Modikwa mines, Marula Platinum, Two Rivers Platinum, Dwarsrivier Chrome and Booysendal Platinum. There are also a number of junior miners and quarries in the area. The mining sector is the single largest sector in the local economy, contributing almost a quarter (24%) to total job opportunities created in the local area. The contribution towards economic output could be significantly higher and is estimated to be between 45% and 50% of total economic production in 2013.

While the primary sector (agriculture, forestry and mining) dominates the local economy there is limited downstream beneficiation of these products and most products are exported in a raw form and processed elsewhere. This situation is reflected in the relatively low contribution of the manufacturing sector to the local economy (Figure 30).

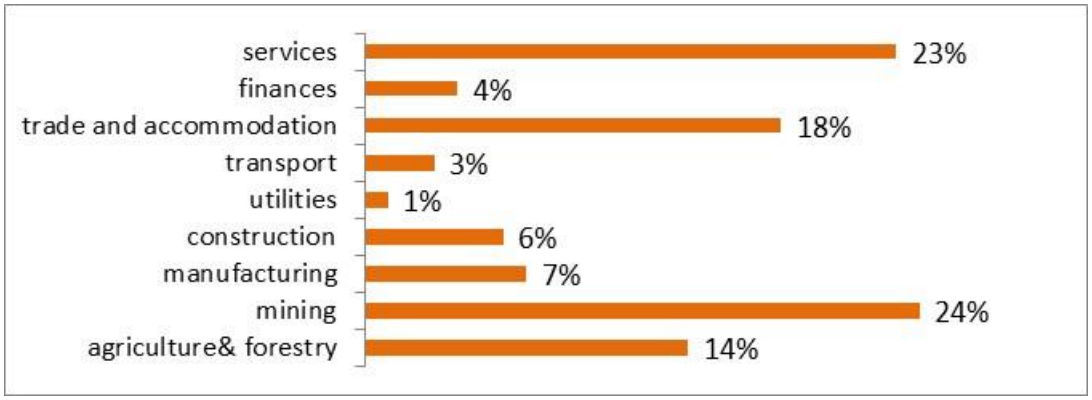


Figure 30: The Sector Distribution of Employment, Thaba Chweu, 2011

2.9.6 Employment, Occupations and Industry – Pilgrim's Rest

Analysis of the situation in Ward 13 suggests that local employment is dominated by informal craft and arts trade; this sector accounts for 43% of total employment, but only for 11% of total income. The Royal Hotel is the single largest employer in formal economy of Pilgrim's Rest and dominates the

accommodation sector, providing more than 60 jobs in 2019. Figure 31 demonstrates the distribution of employment vs contribution to GVA.

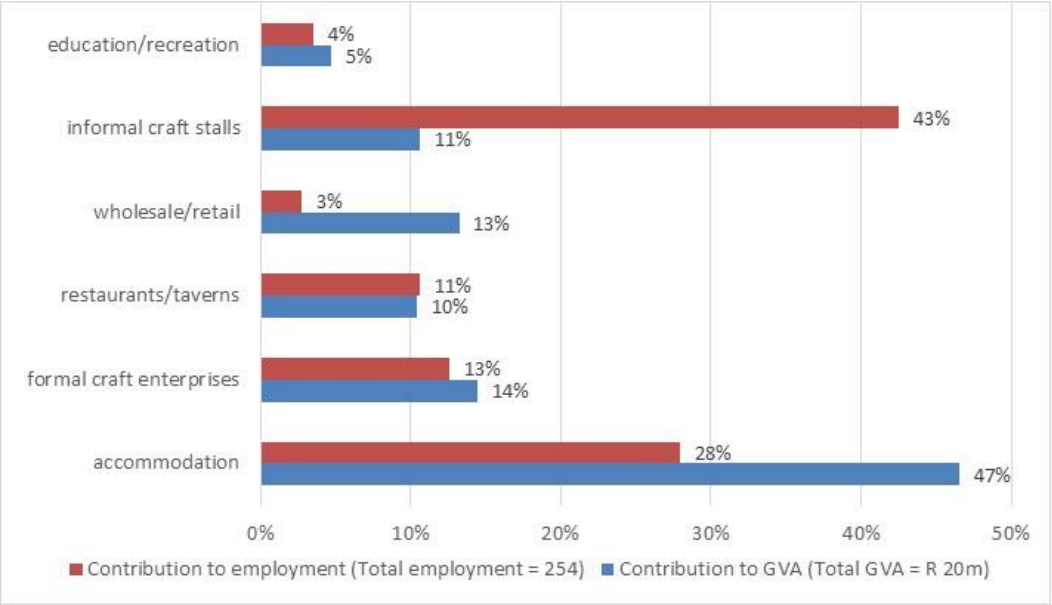


Figure 31: The Sector Distribution of Output and Employment, Pilgrim's Rest 2019

Recent unemployment statistics for South Africa show that the national unemployment rate (official rate) has risen to close to 26% at the end of 2018. Mpumalanga Province had the third highest unemployment rate in South Africa in 2018 namely 34% (official/narrow unemployment) and 43% expanded definition – up from 30% (official rate) in 2011. The official TCLM unemployment rate was much lower than the provincial or national rate in 2011, at 21%.

Based on the population and employment figures in the sections above, the current (expanded) unemployment rate in Pilgrim's rest could be as high as 75% in 2019. below shows high level estimates of Pilgrim's Rest labour force in 2016 and 2019 based on current employment estimates, 2011 population figures, provincial population growth rates since 2011 as well as Ward 13-based labour force participation rates. The table also shows that formal jobs could have accounted for slightly more than 50% of total employment in 2019 compared to 55% in 2016.

Table 28: Analysis of Pilgrim's Rest's Labour Force

Pilgrim's Rest labour force	2016	2019
Population	1,900	2,016
Population in economic active years (15-64)	1,330	1,411
Labour force participation rate (narrow)	71%	71%
Total labour force (narrow)	944	1,002
Formal employment (including management)	141	130
Informal employment	114	124
Unemployment	689	748

Unemployment rate	73%	75%

2.9.7 Tourism and Pilgrim's Rest

In 2015, Mpumalanga Province made the fifth highest contribution (9%) to the total 25 million domestic tourist trips in the country after Limpopo, KwaZulu Natal, Gauteng and the Eastern Cape. Mpumalanga Province's share of foreign tourist arrivals on the other hand is the third highest of all provinces, i.e. representing 11% or 8.6 million of the total 81 million bed-nights spent by international tourists in 2015.

The Ehlanzeni District Municipality (EDM) plays a dominant role in tourism in Mpumalanga hosting popular tourist destinations including the Kruger National Park (KNP) in Bushbuckridge Local Municipality and Pilgrim's Rest, God's Window, Blyde Canyon, Three Rondavels, Bourke's Luck and Mac Falls in Thaba Chweu Local Municipality. Thaba Chweu furthermore hosts numerous events throughout the year that attracts both local residents and visitors to the area including the Long Tom Marathon, Subaru/Ashburton Sabie Classic Mountain Bike race and Sabie Forest Fair.

In 2013, tourism spending in Thaba Chweu LM made the second highest contribution (16%) towards GVA after Nkomazi LM within the Ehlanzeni district (Mpumalanga Province, 2015). While there are indications of the growth of visitor numbers to Thaba Chweu municipality, not all tourist destinations share in the tourism growth to the area.

For example, visitor numbers to God's Window grew from 106,000 in 2013 to 133,000 in 2015, but the historic town of Pilgrim's Rest faces a deteriorating tourism industry due to deteriorating safety and hygiene conditions. Local business sources agree that the economy of Pilgrim's Rest experienced a sharp decline since its peak in the early 1990's.

The factors mentioned as the main reasons behind this decline include the deteriorating road infrastructure and concerns around general safety, especially related to the sharp increase in civil protest actions. Other factors include an increase in illegal mining activities, increased vagrancy due to poverty and unemployment and lack of public facilities and municipal functions such as street cleaning.

According to local business sources, in addition to the challenges above, the public tender process to fill the public-owned business premises in town created challenges in terms of unsustainable business enterprises and the non-payment of rentals. In 2014 the Public Protector released a report related to the negative impacts of alleged irregular tender processes in Pilgrim's Rest.

In the past decade an estimated 17 business premises in Pilgrim's Rest became vacant, resulting in the loss of close to 40 direct formal jobs. This included the local Caravan Park (300 stands), Bank and ATM. The decline in activities has had further negative effects on the remaining business establishments in town.

There has been some positive movement in the local economy in the past year, as a number of the vacant premises became occupied again, including the Clewer general dealer and the re-opening of the garage. After some mass community action in 2018, the provincial Department of Public Works also appear to have placed the town higher on its agenda. There is however no consensus in the business community

whether these actions imply the possible revival of the town. According to one respondent "for each step the town takes forward it moves a pace back". The low growth in the provincial and national tourism sector is also an ongoing concern for the town.

2.10 Services in Thaba Chweu Local Municipality

2.10.1 Roads

The TLCM does not have a road maintenance plan in place. However, various municipal roads within the towns of Sabie, Simile, Graskop and the Harmony Hill area have been identified as being in need of refurbishment, patching and/or reconstruction. Small sections of new municipal roads would also be required within these urban areas. Within the study area, sections of the provincial and national routes must also be upgraded. These routes are frequently used by tourists.

2.10.2 Electricity

3,535 households in the TCLM were not connected to the electrical infrastructural grid in 2016 - this constitutes 9.5% of all households in the area. Although this figure had decreased from 15.23% in 2011, there remain various challenges with regards to the provision of electricity, including development in Mashishing (Lydenburg) that requires electricity. Many households still make use of gas, paraffin and candles for lighting.

2.10.3 Water and Sanitation

Mashishing (Lydenburg) makes use of surface water resource whilst Sabie and Graskop are served by underground water (boreholes). The quality of the raw water in all three of these major towns is good. With regard to the provision of water, Graskop and Sabie only face challenges with regard to infrastructure, whilst Mashishing also faces a source challenge.

Pilgrim's Rest rural area basically has two water supply schemes, the Matibidi scheme and the Pilgrim's Rest scheme. Only two surface water resources are currently being utilized for primary water use in the Pilgrim's Rest area. One source is called the Moremela spring that feeds the Moremela stream. Water is withdrawn from the spring. Detailed investigations are required to augment supply to the Matibidi scheme.

The Blyde River, which passes south east of Moremela, is not currently utilized as a bulk water source. Various options such as a bulk water pipeline, water treatment plant and reservoirs, as well as the refurbishment of the current reservoirs and reticulation lines are being investigated.

In terms of sanitation, the number of households without toilets decreased from 980 in 2011 to 326 in 2016. Some sanitation infrastructural upgrades (refurbishment of wastewater treatment plant) would be required in Lydenburg (Mashishing), Sabie and Graskop to accommodate the population growth in those areas.

The growing population, however, continues to place a huge demand on the municipality to continue to provide basic services and infrastructure.

3 CONTEXTUALISATION OF ACTIVITY

This section outlines the status of on-site activities, describing the facilities and processes at the TGME underground mines, plant and TSF da area, including infrastructure, waste management facilities and storm water management as well as potential impacts, engineering controls and management measures of these activities.

3.1 Description of Mining Operation

TGME has an existing and approved mining right over the area under application, with DMR reference 83MR. This right allows the mining of gold ore, silver ore, copper ore and stone aggregate. The total 83MR area covers a total area of some 9,413.3366ha.[21]

The gold mining operations that form part of the Greater TGME mining rights consist of:

- The plant, offices and tailings facility (MR83).
- Dukes Hill Upper and Lower.
- Clewer – Morgenzon Complex (MR83).
- Frankfort Mine (MR83).
- Beta Mine (MR83)

3.1.1 Morgenson Complex mining method

For the Morgenson – Clewer and Dukes Hill lower mining area, stopes with a mining system incorporating systematic pillar will be used. Stoping will be fairly scattered with a stope width o <1m in general. This will invariable be confined to a higher grade top RHO reef horizon. The top and bottom reefs may come together in some places. A conventional narrow tabular full cut method will be used with breast panels generally advancing away from dip-orientate winzes. Strike gullies are spaced 15- 25m apart. Face, gully and internal support are by means of 150mm mine poles (2x2m) with pre-stressed packs in critical areas. The maximum inter-pillar span will be 50m and the minimum rib pilar width being 5m an maximum extraction rate 91%.

3.1.2 Beta, Dukes and Frankfort mining method

The proposed mining layout for Beta, Dukes hill Upper and Frankfort is “on-reef” to provide the least amount of waste development and the best grade to the plant. The mining layout consist of declines on dip with strike reef derives equipped with strike conveyors feeding onto a main trunk line conveyor to surface. Stoping would be a breast -mining layout (with the exception of Frankfort), which would provide a fast ramp up in stope production with the least dilution. The breast mining method would produce at a

[21] Mining Work Programme, Minxcon, July 2020

better grade by maintaining a low stope width of approximately 80cm in the narrow channel width area and mining at the full channel width when this exceeds 80cm.

The room and pillar method is to be used at Frankfort due to thicker than expected reef, therefor a breast mining method would not be sufficient.

3.1.3 Plant and Tailings Facility

The TGME No. 1 TSF is located less than 2 kilometers south west of the town of Pilgrims Rest located in the Mpumalanga Province of South Africa. It is found in a cluster of historical mining facilities of various ages and operational status. It was operational until August 2016 after which production was ceased without a formal care and maintenance plan. The facility as it stands is in need of attention and cannot be left unattended any longer. The recommissioning of the facility will allow the new owners to give attention to a better solution to closure of the site than currently allows. The endeavor of Stonewall Resources to recommission the facility will allow for a period of active management where the facility can be methodically repaired and ultimately closed responsibly and can be seen as a major positive aspect to the project.

The Tailings Storage Facility (TSF), as well as a lined return water dam with two compartments are located on ptn 42 of the farm Ponieskrans 543 KT.

The primary crushing circuit consist of a primary jaw crusher including a vibrating grizzly feeder (“VGF”) and crushing feed bin including a static grizzly on top. The undersize from the VGF will bypass the crusher, discharging onto a conveyor reporting to a single deck screen. The primary crusher discharge product, combined with the VGF undersize, on the conveyor and reports to the single deck screen. The screen undersize (-20 mm) proceeds to the mill feed stockpile, with the screen oversize sent to the secondary cone crusher with the product recycled back onto the screen feed (in closed circuit).

The mill feed stockpile has been designed for an 8-hour live capacity. A precast concrete tunnel beneath the stockpile will house extraction pan feeders. The stockpile extraction feeders will control feed onto the mill feed conveyor (via weightometer) and will feed the milling circuit.

The milling circuit will consist of a ball mill, classification cyclone and gravity concentration circuit. The mill discharge will report to the cyclone, with the cyclone underflow to be treated in the gravity circuit. Cyclone overflow (80% passing 75 µm) will exit the milling circuit and proceed to the preleach thickener. Cyclone underflow will first pass through the gravity concentrator, with tailings recycled back to the mill feed. Concentrate from the gravity concentrator proceeds to a shaking table located in the wet section of the gold room.

The shaking table will have a dedicated feed tank with pump based on the fact that this is a batch operation. The tailings from the shaking table will be pumped back to the mill discharge sump. Gold accounting of the gravity gold will be separate from the bonded gold for the plant.

The mill cyclone overflow will pass over a trash screen to prevent any carbonaceous material entering the CIL circuit. The pre-leach thickener (18 m diameter) underflow at 50% solids will be pumped to the CIL conditioning tank. The thickener overflow will return to the process water tank to be re-used in the plant.

The CIL circuit will consist of the agitated conditioning tank and 8 agitated CIL tanks. Lime will be added at the pre-leach thickener and conditioning tank to control the pH of the slurry at ±10.5. Cyanide for gold dissolution is added in tank 1 and 2 and topped-up, if required, in tank 5 and 6. A residual cyanide concentration of 400 - 500 ppm in the leach tailings is desired to ensure excess cyanide in the CIL to ensure all bonded gold is dissolved.

To increase leach efficiency, optimise oxygen dissolution and reduce reagent consumption, a shear reactor has been allowed for at the conditioning tank.

Regenerated carbon will be added in either tank 7 or 8 and pumped upstream to tank 1. Dissolved gold is loaded onto the carbon as the carbon moves upstream. A total leach residence time of 24 hrs has been allowed for, pending test work results. The addition of the shear reactor is anticipated to reduce the overall leach time require.

Loaded carbon is then pumped from either tank 1 or 2 to the elution circuit where it will be stripped, and the carbon regenerated for re-use in the CIL circuit. Slurry moves downstream from tank 1 to 8 and is pumped by interstage up-pumper screens from one tank to the next.

CIL tailings pass over a carbon catchment screen to recover any gold bearing fine carbon before the tailings is disposed of. The tailings undergo a cyanide detoxification process by chemical means before being pumped to the tailings storage facility (“TSF”) for deposition. The design of the tailings dewatering and deposition, including the return water system has been excluded in this report as it falls within Tailex scope.

The elution process followed will be the ZADRA circuit, which is a continuous circulation of eluate through the elution column and electrowinning cells via the heat exchangers and eluate tank. The gold sludge cathodes will proceed to the calcine and smelting furnace to produce doré gold bars.

Apart from the planned upgrade to the plant area, TGME plans to extend the existing tailings facility towards the east. The future TSF extensions are not included in the current study and IWULA.

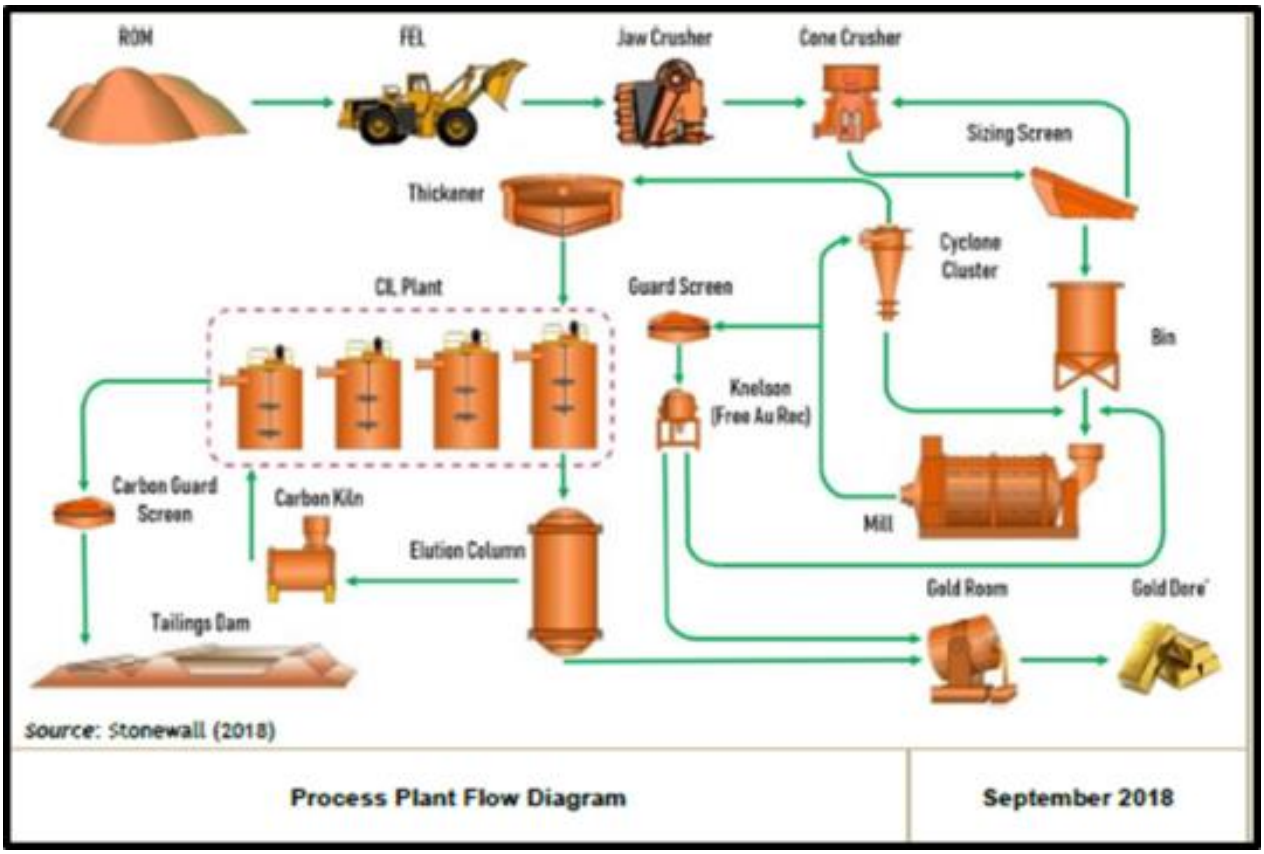


Figure 32: Process Plant Diagram

3.1.3.1 *Plant and Tailings Facility*

The existing TGME Processing Plant as well as TGME's offices are situated on portion 1 of the farm Grootfontein 526 KT. The Tailings Facility (TSF), as well as the lined return water dam are located on Ptn 42 of the farm Ponieskrans 543 KT.

3.1.3.2 *Dukes Hill Upper and Lower*

The Dukes Hill Upper and Lower site is located on the RE of the farm Morgenzon 525 KT. Approved activities include a waste rock dump at Dukes Hill Lower and Dukes Hill Upper, an explosive magazine, compressor station and a settling pond at Dukes Hill Lower.

3.1.3.3 *Morgenzon and Clewer*

The area known as Morgenzon is located on the RE of the farm Morgenzon 525 KT. The Clewer area borders on the RE of the farms Van Der Merwes Reef 526 KT and Morgenzon 525 KT. Approved activities include mine offices, staff facilities, explosive magazine, compressor station, three settling dams (capacities 392 m^3, 510m^3, 395 m^3), a waste rock dump and water tanks.

3.1.3.4 *Frankfort*

The area known as Frankfort has existing remnants of previous mining activities. The existing infrastructure includes access roads, waste rock dumps, accommodation facilities, two portals and a settling pond.

3.1.3.5 *Beta Mine*

The Beta site has existing access roads which leads to an existing adit as well as an existing waste rock dump known as "Beta waste rock dump" which belongs to the Department of Public Works (GCS, 2005).

3.2 Extent of Activity

The 83MR falls within the B60A quaternary catchment of the Olifants Water Management Area. The total 83MR area encompasses the farms as depicted in Table 29. These farms cover a total area of some 9,413.3366 hectares.

Table 29: Extent of the Mining Activity

FARMS	FARM PORTIONS
Frankfort 509 KT	RE, Ptn 1,2,3,4 &5
Krugers Hoop 527 KT	Farm
Van der Merwes Reef 526 KT	RE and Ptn 1
Morgenzon 525 KT	RE, Ptn 1 & 2
Peach Tree 544 KT	Farm
Ponieskrans 543 KT	RE, Ptn 18, 42, 43 & 44

3.2.1 Location

The projects presented are located within the existing mining rights area, referred to as the Greater TGME (DMR reference MP 30/5/1/2/2/83MR).

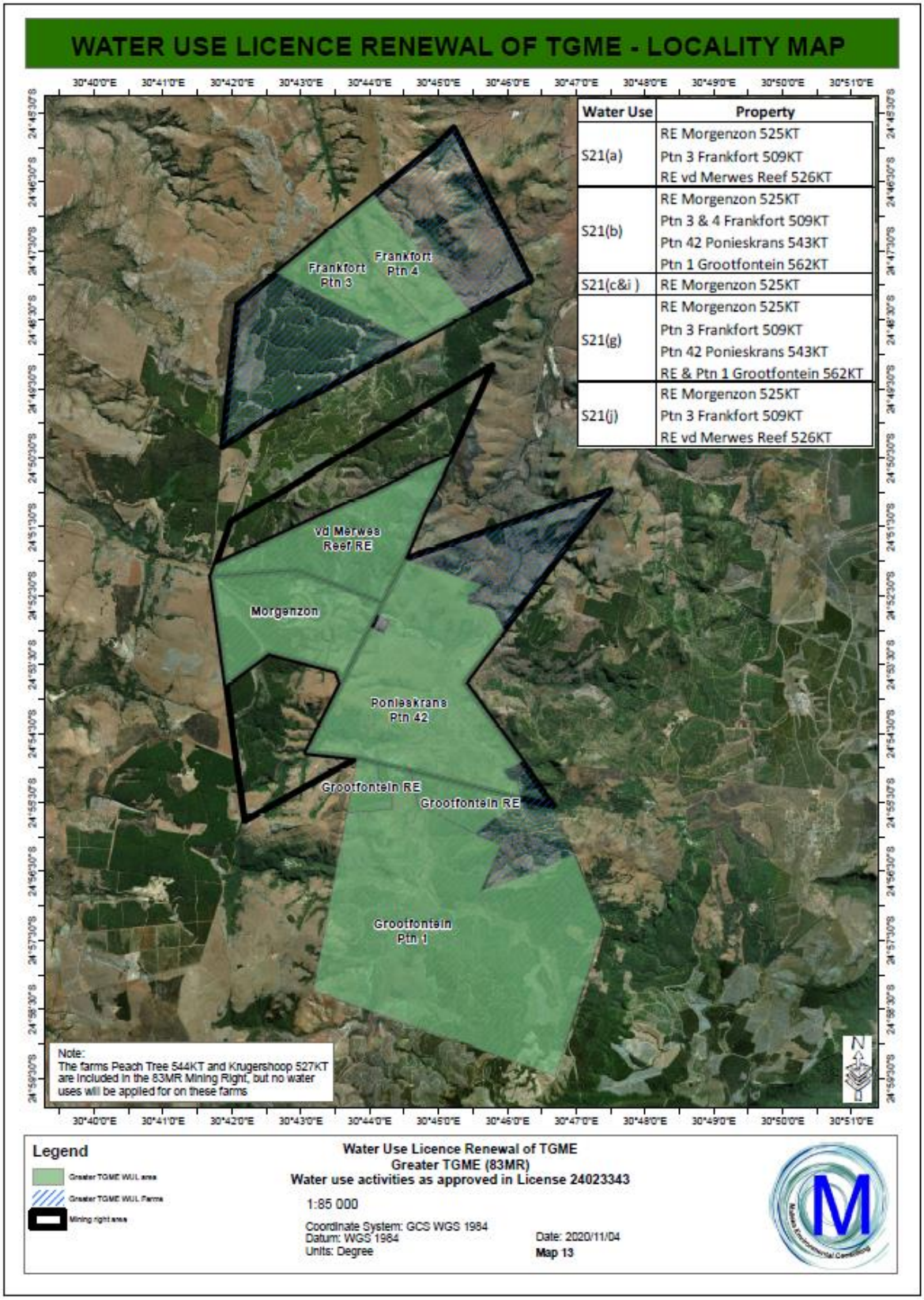


Figure 33: Existing Greater TGME MR 83 area and farm description and locations

TGME has an existing and approved mining right over the area under application, with DMR reference 83MR. This right allows the mining of gold ore, silver ore, copper ore and stone aggregate. The total 83MR area encompasses the following farms and covers a total area of some 9,413.3366 ha.:

- Frankfort 509KT: RE, Ptn 1, Ptn 2, Ptn 3, Ptn 4, Ptn 5;
- Krugers Hoop 527KT;
- Van der Merwes Reef 526KT: RE, Ptn 1;
- Morgenzon 525KT RE, Ptn 1, Ptn 2;
- Peach Tree 544KT and
- Ponieskrans 543KT: RE, Ptn 18, Ptn 42, Ptn 43, Ptn 44.

3.2.2 Water Supply

Domestic water supply is obtained from the Blyde River and is pumped into a closed reservoir (JoJo tank with a storage capacity of 10,000 liters) for usage at the office complex and the change house. The estimated use is 35m^3/day, 1,038m^3/month, 378,870m^3/annum *(*Water Balance, Hydrospatial, July 2020*).*

Water supply for operations can be sourced from the Blyde River[22], from water boreholes, from the plant return water dam. The mine will implement all measures not to use Blyde River water for make-up or process water.

3.2.3 Process Water at the Plant

TGME will continue to make use of the current permit authorising the use of 469,025 m^3/annum (1,0m^3/d) of water from the Blyde River (Permit No. 1351N). Water consumption by the process plant is approximately 1.407 m^3/day (514m^3/a). Water from the return water dam will be re-used in the plant.

3.3 Mine surface infrastructure

3.3.1 Morgenson -Clewer

Underground minim was conducted through three adits, .nl Clewer no 4 adit, Morgenson no 5 adit and Morgenson No 10 adit situated in the mountain. The Clewer stream originates in the mountain through water falls and flows pass the Morgenson office.

At Morgenson there is one WRD and the Morgenson Paddocks.

3.3.2 Dukes Hill

A tributary of the Blyde River originated through a waterfall in the mountain. It is a non-perennial stream and only flow during rain events. The Dukes Hill Upper and Lower adit has a WRD. The water from the waterfall is diverted with a stormwater trench around the adit and WRD.

[22] Permit 1351N allows 1,250m^3/d from the Blyde River

3.3.3 Beta mine

There is one WRD at Beta mine.

3.3.4 Frankford mine

Excess water found underground at Frankfort is either disposed of in a void underground or the Settling ponds above ground.

3.4 Waste Management Activities and Facilities

Waste generated at the mine can be grouped based on their physical characteristics. Waste management activities include the handling of domestic solid waste, industrial, hazardous waste, stockpiles and waste rock areas.

Wastewater management facilities include the Frankford settling dams, Morgenson Paddocks and at the area the Spillage collection pond 1 and 2 which forms part of the stormwater management at the plant. Waste management activities and facilities are discussed below, while wastewater management is discussed in 3.5.

Domestic waste will comprise all waste material generated by the day-to-day running of offices, change houses and canteens. This will include food, paper, cardboard, plastic wrappers, tin cans and plastic bottles, amongst others.

Industrial waste is expected to be generated from the workshops, especially from machine maintenance. Hazardous waste will include all discarded fuels, oils, lubricants, paints solvents and other chemicals. It will not be possible to dispose of these items on-site; it will have to be removed from site to a licenced waste handling facility.

3.4.1 Waste Sorting and Salvage Yards

The mine operation will have waste sorting and salvage yards. These areas will be utilised to sort all generated waste into the above-mentioned groups/categories.

These areas will have concrete slabs and bunded areas to ensure no soil contamination can occur. Dedicated compartments will be equipped with colour-coded waste collection bins to assist with the waste sorting process. The hazardous waste compartment will be bunded and equipped with a roof. This will minimise the risk of run-off rainwater being contaminated. Medical waste will be containerised in enclosed bins.

Subsequent to sorting, waste will be collected by an appointed contractor and disposed of at a suitable facility in the area.

3.4.2 Waste Rock Dump Facilities [23]

3.4.2.1 *Morgenson Complex*

There is a WRD at the Morgenson office. This WRD is located outside the 1:50 year and 1:100 year floodline of the Clewer Stream. The waste rock originates from the blasting process underground and contains no gold bearing material and pyrite oxidizing material.

Acid base accounting tests indicated that the waste rock dump is not expected to have an acid-generating potential as the sulphide content of the waste rock is generally less than 0.1%. (TGME EIA/EMP October 2005, GCS)

3.4.2.2 *Frankfort WRD*

Historically there were three WRD's as well as two slimes dumps (Heap leach) at this mining area. Waste rock generated will be disposed of on the existing footprint area. In the 2005 IWULA it was indicated that there would have been a slimes dam and plant at Frankfort, however this was never carried out. The ore was taken to the Pilgrims Rest plant and disposed of on the TSF.

3.4.2.3 *Dukes Hill*

Upper: This is an existing WRD. This is an existing WRD, however the ore was sent to the processing plant and thus did not generate waste material. A tributary of the Blyde River originates through a water fall in the mountain. This non-perennial stream flow in rain events. The water from the waterfall's diverted with a stormwater trench around the adit and WRD.

Lower: This is an existing WRD, however the ore was sent to the processing plant and thus did not generate waste material. A tributary of the Blyde River originates through a water fall in the mountain. This non-perennial stream flow in rain events. The water from the waterfall's diverted with a stormwater trench around the adit and WRD.

3.4.2.4 *Beta Mine WRD*

Beta underground mine is situated on the opposite side of the Blyde River from the Plant area. There is one WRD.

3.4.2.5 *Tailings Storage Facility*

The TSF 1 was the recipient of a steady stream of tailings until it was decommissioned in August 2016 and placed on care and maintenance. Stonewall Resources wishes to utilise the remaining storage space, estimated to be 2.5 million tons, for the depositing of tailings in the near future.

The TSF is currently dormant and stable and has good overall slope stability. Average side slope construction angles are 1:2.7 (V:H) on average.

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[23] Environmental Impact assessment and management report i.t.o the Mineral and Petroleum Resources Development Act, no 28 of 2002 for Simmer & Jack Mines Limited. GCS Pty LTD. October 2005

There are localized slope erosion sites related to historical berms which are concerning, as well as slope specific inter-slope, slope angles, that will require attention as part of the recommissioning plan and long-term closure planning.

The original decant system appears to be lost or discontinued and has been replaced with two substandard decant pipes that will have to be replaced. This was part of the recent historical combined deposition/remining system that was being practiced on the TSF pre the care and maintenance phase. The old original outfall pipe has been located by Tailex and must be plugged prior to recommissioning to prevent an unwanted failure of the outfall pipe.

There are erosion gulley's present on some of the slopes and berms, these can be repaired using mechanical means, not all erosion gulley's present a problem and an action needs to be implemented to address the deeper ones by backfilling and reprofiling, but must be accompanied by a reprofiling of the berms, replacements of the down chutes and installation of a bund wall. A detailed berm erosion repair program will be developed prior to recommissioning.

At NGL the catchment paddock walls are intact but will require some remedial work to regain capacity for containing runoff water. The paddock bases have been fitted with an HDPE liner which was badly installed. This must be removed as soon as possible as it is creating localized pooling of water and possible ingress into the foundations.

The anticipated future storage capacity of the existing basin is estimated to be in the region of 1.1Million tons, at a proposed monthly deposition rate of no more than 22,500 tons per month. The TSF has adequate capacity to deposit tonnage onto the basin at a rate of 22,500tons per month for approximately 48 months. Thereafter the rate of rise is deemed too high for safe operation at that rate of deposition and will increase exponentially rendering the safe deposition, operationally impossible.

As part of a closure solution for the landform it is planned to convert the tailings deposition method from a hydraulic deposition method to a dry stack type operation. This will involve a second phase (a and b) where the hydraulic deposition will be ceased and will be replaced with a filter press operation. The concentrator plant will install mechanical filter press machines which will allow the tailings to be stacked on the outer slopes as part of a closure plan, to address the inter-slope steepness and all of the erosion gulley's and allow a suitable diverse grass cover to be established.

Current and future extrapolated slope stability factors are within acceptable norms, although specific phreatic levels cannot be ascertained, as the piezometer infrastructure has been destroyed and no historical data is available. In the absence of alternative information some assumptions were made (see appendix A). No signs of seepage are evident on any of the existing side slopes, nor in the geotechnical inspection trenches (5m below NGL), indicating a low to zero phreatic level that would typically be associated with a period of dormancy and the underlying geology.

The return water dam appears to be in good condition save for the removal of the pumping station and some localized damage to the geomembrane barrier system. Capacity of the return water dam is adequate for the recommissioning of the TSF and appears to have been initially correctly sized for the original

footprint of the facility. The return water dam is currently fitted with a bitumen liner. It is advisable and planned to install a new 2mm HDPE Liner as replacement for the old worn bitumen liner to prevent ground water infiltration over time and adhere to modern requirements and standards.

Piping infrastructure is virtually non-existent and that that is on site is wholly unsuitable, so will have to be replaced and sized accordingly. This will include new distribution piping and cyclone machines for slurry delivery. Slurry deposition will be by means of upstream cyclone wall construction to enable a spit of 75% of solids reporting to the overflow discharge port being below 75 micron in size and 25% of solids being above 75 micron in size fraction and reporting to the spigot discharge end, to be utilized for upstream wall building.

A new tailings starter wall at current tailings crest height is envisaged to be installed prior to commissioning and an elevated drain will be installed on the top of this starter wall (see cross section drawing detailed in report). This will control seepage on the interface between the old day wall discharge beach and the new cyclone underflow wall, improving both old and new outer wall stability.

Capacity calculations show that the basin area can accommodate a total stored tonnage of 1.1M (dry) tons. Rate of rise constraints begin to limit development at 48mnths at a rate of rise of 5m per year, with a maximum deposition rate of 22500 tons per month. It is therefore planned to reduce the deposition rate at month 48 to 11,250 tons per month for a further 12 months (Phase 2a) bringing the total available deposition capacity to 1,215 000 tons over a period of 60 months.

Under the above stated conditions, rate of rise will peak at 5 meters per year and the crest will reach a planned height of 1321 mamsl at that point. Thereafter (Phase 2B) the hydraulic deposition rate will be reduced by 50% to 11250 tons per month for a further 12mnths, rate of rise is expected to drop to 2.5m per year at that stage and continue for a further 12mnths and then stop at a final heigh of 1323.5mamsl. At month 48 the remaining 50% of the tailings stream will be directed to a mechanical filter press machine which will produce a dry filter cake with maximum 18% water content at time of stacking. This will then be dry stacked against the side slopes using trucks. After month 60 an additional filter press machine will be installed allowing 100% (22500 tons) to be processed and dewatered. This too will be dry stacked against the outer side slopes of the TSF. No further deposition will take place in the basin. The capacity, in regard to the availability for dry stacked material is an additional 1.3 Million tons, bringing the total available capacity of the TSF to 2.5million tons.

3.5 Water and Wastewater Management Activities and Facilities

3.5.1 Stormwater Management

TGME's water- and waste management philosophy is based on the water resource and waste management hierarchy of reduce, re-use, recycle and responsible disposal. As outlined in the DWA Best Practice Guidelines, the precautionary approach is followed, which entails the prevention of pollution as highest priority, followed by the implementation of water use efficiency measures such as re-use, water conservation and demand management as far as possible and, if necessary, the treatment of wastewater

to acceptable standards. The philosophy of "concentrate and contain" has also been adopted, which implies keeping dirty areas on a small footprint as safely possible, in order to reduce the volumes of dirty water that will require management. This also reduces overall production cost.

In simple terms the clean water (storm water) is to be separated from the contaminated water (dirty water) into two separate systems by diverting clean water away from dirty areas and ensuring that dirty water is captured, contained and managed appropriately in accordance with GN704 Regulations and DWA Best Practice Guidelines. A summary of the plan follows.

The Stormwater Management Plan (SWMP) has been developed in accordance with the following guidelines, which should at least meet the legal requirements:

- Best Practice Guideline – G1: (BPG-G1) Storm Water Management;
- Best Practice Guideline – H3: (BPG-H3) Water Reuse and Reclamation.

As explained above, the following four general principles outlined in BPG-G1 have been considered and used in developing this SWMP, as necessary:

- **Principle 1**: Keep clean water clean;
- **Principle 2**: Collect and contain dirty water for treatment;
- **Principle 3**: Sustainability over mining life cycle;
- **Principle 4:** Consideration of Regulations and Stakeholders.

The following design philosophy was adopted to guide the development of the SWMP, and is based on GN704 Regulations and the DWS' Best Practice Guideline (BPG) G1: Storm Water Management:

- Confine or divert any unpolluted water to a clean water system, away from a dirty area;
- Runoff from dirty areas must be captured, contained and managed appropriately;
- Clean and dirty water systems must be designed and constructed to prevent cross contamination;
- Dirty water must, as far as possible, be recycled and reused;
- Clean and dirty water systems must convey/contain runoff from the 50 year storm event, and should not lie within the 100 year floodline or within a horizontal distance of 100 m from any watercourse, whichever is the greater of the two;
- Appropriate maintenance and management of stormwater related infrastructure should always be ensured.

MineLock Environmental Engineers is responsible for the design of the Stormwater Management Plans (SWMPs).

3.5.1.1 *Plant area and TSF*

Process water from the process plant will equal 485,577m³ per annum of which an estimated 30% will remain in lock-up inside the TSF as moisture content of the insitu tailings body. Remaining water that is not lost due to evaporation and "lock-up" will be recycled and re-used.

Runoff from a reduced plant area will be gravity fed via the storm water sump directly into the RWD and on an average year this will equate to an estimated 18,077 m³. An estimated 354,7324 m³ of water will be recovered on an annual basis from the TSF and the runoff from the reduced plant area, this includes the process water being fed into the TSF system as well as accumulated rainwater. It can therefore be assumed on an annualized basis and provided that sufficient storage is available that the TSF and plant system.

3.5.1.2 *Morgenson Complex*

At Morgenson there are the Morgenson Paddocks constructed below the Clewer and Morgenson adit. Water found underground from Clewer adit 4 and Morgenson adit 5 are disposed of onto the Morgenson Paddocks.

3.5.1.3 *Frankfort Mine*

There is currently a lined settling dam at Frankfort. Water found underground is either disposed onto the Frankfort void or the Frankfort settling dams. Most of the water needed for the underground mining process is obtained from the underground reticulation system through recycling.

3.5.2 Water Balance

3.5.2.1 *Plant and TSF*

The water balance inflows include the following:

- Rainfall inflow (105 755 m^3/a);
- Slurry Water (354 324 m^3/a assuming a Relative Density of 1.37 with 43.2 Solids)
- Plant storm water management in the spillage collection pond (21 428 m^3/a)
- TSF side slope run-off (Assumed to be collected in the paddocks system and obtaining 80% loss in the paddocks system, 20% of the water collected from the side slopes will report to the return water dams (4069 m^3/a)
  Total Inflow = 485 577 m^3/a

T**he water balance outflows include the following:**

- Evaporation loss (83 898 m^3/a)
- Seepage water due to unlined facility (10 233 m^3/a)
- Interstitial storage (121 417 m^3/a). Water is initially trapped in the pore spaces on the wet beach. This water is lost to desiccation in the long term.
- Combined Return to plant (255 904 m^3/a)
- Storage Changes (Delta storage is the difference between the volumes at the start and end of the simulation) (-9 m^3/a)
- GN 704 compliant spill (79 m^3/a)
- Dust suppression over the haul roads (14 055 m^3/a)

  Total outflow: 485 577 m^3/a

3.9.3 Key Water Uses

Currently TGME has a permit for the abstraction of water from the Blyde River as well as water contained in the material reclaimed form the old tailings dumps (1351N permit).

There is also a water use licence for water uses on RE of the Farm Morgenzon 525 KT, Ptn 3 & 4 of the Farm Frankfort 509 KT and Ptn 42 of the Farm Ponieskrans 543 KT. Licence number 24023343 dated 23 March 2011 is valid for 10 years. Section 32 of the NWA defines “existing lawful water use” (ELU) as water use which has taken place in the two years preceding the commencement of the NWA, i.e. between 1 October 1996 and 30 September 1998. In accordance with section 34 of the NWA, a person, successor-in-title, may continue with an existing lawful water use, subject to any existing conditions or obligations attaching to that use; its replacement by a license in terms of this Act, or any other limitation or prohibition by or under this Act.

TGME has been carrying out maintenance on the mine under the conditions set in the above-mentioned water use licence. All water use is in terms of this licence and is regarded as existing water uses.

These water uses were identified and are summarised in Table 30.

Table 30: Summary of Water Uses at the GreaterTGME (Existing and lawful)

Water Uses	Status of use (New or ELU)	Description	Volume / Capacity	Coordinates		Property Description
				South	East	
Permit 1351N – B33/260/14 i.t.o. Water Act, Act 54 of 1956 for the Greater TGME						
Section 21(a)	ELU	Public water from the Blyde River	1,250m³/day	24°55'12.82"S	30°44'19.97"E	Ptn 42 Farm Ponieskrans 543 KT
	ELU	Private water contained in the material reclaimed form the old tailings dumps	35m³/d	Not available		Ptn 42 Farm Ponieskrans 543 KT
Summary of Water Uses as per WUL 24023343 - 27/2/2/B60A/021 (Existing water uses)						
Section 21(a)	(2011-2021)	Abstraction of water from the Molototse River	6022m³/a	NA		Morgenzon 525 KT, Ptn 3&4 Farm Frankfort 509 KT, Ptn 42 Ponieskrans 526 KT
Section 21(a)	(2011-2021	Water from the Morgenzon Paddocks for domestic use at Clewer an Morgenzon	183m³/a	NA		RE of the Farm van der Merwes Reef 525 KT
Section (21c&i)	(2011-2021	Diversion of a stream around Dukes Hill Upper and	NA	Start: 24°53'13.80"S End 24°53'11.30"S ”	Start 30°43'35.70"E” End 30°43'42.20"E	RE of the Farm Morgenzon 525 KT
		Dukes Lower Adit and waste rock dump	NA	Start 24°53'06.20"S End 24°53'03.80"S	Start 30°43'29.90"E End 30°43'39.30"E ”	RE of the Farm Morgenzon 525 KT
Section 21(g)	(2011-2021)	Disposal waste on underground mining void to manage excess groundwater removed to mine safely	37 000m³	24º48’9.65”S	30º44’2.71”	Ptn 3 Farm Frankfort 506 KT
	(2011-2021)	Disposal of waste rock on dump at Frankfort mine	9000 tonnes	24.73821.	30.80747	Ptn 3 Farm Frankfort 509 KT
	(2011-2021)	Disposal of sewage effluent into a conservancy tank at Frankfort Mine	629m³/a	24.73821.	30.80747	Ptn 3 Farm Frankfort 509 KT
	(2011-2021)	Disposal of waste rock on dump at Morgenzon offices	82 230 tonnes	24º52’26.63”S	30º43’39.21” E	RE of the Farm Morgenzon 525 KT
	(2011-2021)	Disposal of excess groundwater from Clewer 4 Adit onto the Morgenson paddocks	533m³/day	24º52’25”	30º43’27”	RE of the Farm Morgenzon 525 KT
	(2011-2021)	Disposal of waste on a settling dam at Morgenzon 5 Adit to manage seepage from Morgenzon No 5 Adit	1825m³/day	24º52’20”	30º43’30”	RE of the Farm Morgenzon 525 KT
		Disposal of sewage effluent a conservancy tank at Morgenzon office	634m³	24.52412	30.43634	RE of the Farm Morgenzon 525 KT

Water Uses	Status of use (New or ELU)	Description	Volume / Capacity	Coordinates		Property Description
				South	East	
		Disposal of waste rock on dump at Dukes Hill lower	60 695 tonnes	24°52'07"S	30°43'41.09" E	RE of the Farm Morgenzon 525 KT
	(2011-2021)	Disposal of waste rock dump at Beta Mine	25 998 tonnes	24°54'46.90"S	30°44'1.23"E	Ptn 42 Farm Ponieskrans 543 KT
	(2011-2021)	Disposal of slimes in slimes dam at Pilgrims Rest Plant area (also refer to as the *Plant TSF*)	36 000m^{3}month	24°54'53"S	30°44'22"E	Ptn 42 Farm Ponieskrans 543 KT
	(2011-2021)	Disposal of effluent and storm water from the TSF to the return water dam with two compartments	23 360m^3	24°54'46"S	30°44'15"E	Ptn 42 Farm Ponieskrans 543 KT
	(2011-2021)	Disposal of storm water from plant area at the Spillage Collection Pond at plant (SCP)	39 730m^3	24°55'2.55"S	30°44'18.26" E	Ptn 1 Farm Grootfontein 562 KT
	(2011-2021)	Disposal of sewage waste onto Conservancy tank at the Plant	620m^3/a	24°55'76"S	30°17'79"E	Ptn 1 Farm Grootfontein 562 KT
Section 21(j)	(2011-2021)	The licensee is authorised to either dispose of the groundwater at Frankfort mine into the Frankfort void or Frankfort Settling dams on the ptn 3 of the Farm Frankfort 509 KT	37,000m^3	24°48'20"S	30°44'00"E	Ptn 3 of the Farm Frankfort 509 KT
	(2011-2021)	The disposal of water from Clewer 4 into the Morgenson Paddocks shall take place at the following location: RE of the farm Morgenson 525 KT	194,545m^3/a	24°55'5.54"S	30°44'17.45"E	RE of the farm Morgenson 525 KT
	(2011-2021)	The quantity of the water authorise to be removed and disposed of into the Morgenson Paddocks in terms of this license may not be exceeded without prior authorisation by the Minister.	1626m^3	24°52'5.25"S	30°430'27"E	

3.6 Organisational Structure of TGME; Business and Corporate Policies Related to the Environment

3.6.1 Organisational Structure

The organisational structure for the mining operation is shown in Figure 34 (below).

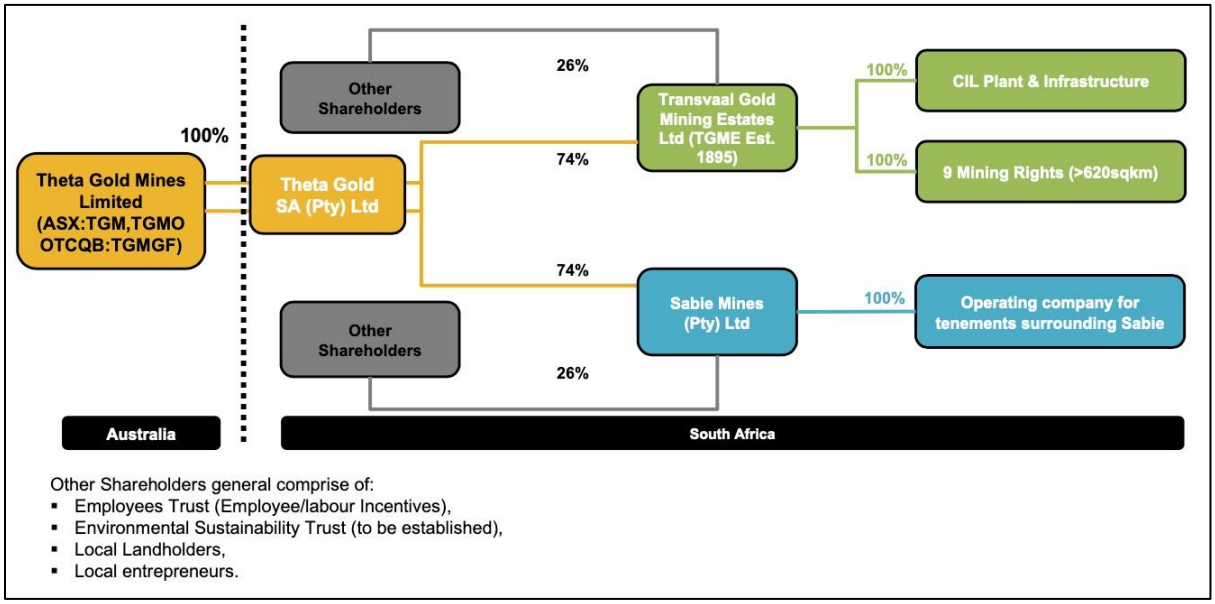

Figure 34: Theta Gold Corporate Structure 2020

TGME's management system is consistent with international and organisational standards, legislation and other relevant requirements. They undertake to ensure that their management system is developed, documented, implemented and maintained in a manner that is both understood and effective at all levels in the business, to enable them to:

- Identify, assess and manage risks to employees, contractors, the environment and communities;
- Strive to achieve leading industry practice and recognition;
- Meet and, where appropriate, exceed applicable legislation;
- Define SHEQ objectives and targets (including reducing and preventing pollution) and continually measure and monitor activities and progress against these objectives;
- Lead and develop their people and provide resources to achieve targets;
- Support the fundamental human rights of employees, contractors and communities in which TGME operates and safeguard them from exposure to unacceptable risk;
- Respect the rights of indigenous people and value cultural heritage;
- Minimise the impact of operations on the environment through control of pollution, waste, hazardous materials and the conservation of natural resources;
- Design and implement processes that ensure cost effective and quality product provision.

TGME is committed to seeking opportunities to share their success by developing partnerships that focus on creating sustainable value for all stakeholders. In this, they will work with communities to contribute to social infrastructure needs through the development and use of appropriate skills and technologies.

3.6.2 Environmental Policy

As a dynamic gold producing company, geared for shared prosperity for all, TGME is committed to the management of its core business in a manner whereby the environment is perceived and acknowledged as vital for social and economic growth and stability.

TGME will conduct its operations responsibly and with due care and regard to the impact on the environment.

It is the policy of TGME to strive to eliminate the adverse environmental effects of all its activities and take an active role in raising the environmental awareness and responsibility of their employees, suppliers, contractors and customers.

To achieve and surpass this objective, the company endeavours to:

- Conduct all its activities in an environmentally responsible manner;
- Conform to all relevant legislation as a minimum standard;
- Ensure that all its operations have appropriate policies, procedures and facilities so that such standards can be met;
- Promote environmental Awareness by continuous training, motivation and leading by example;
- Implement effective Environmental Management and reporting systems which encompass auditing, monitoring and decisive intervention at all operations;
- Conduct regular reviews of conformance to requirements and achievement of objectives at Board level;
- Use raw materials and recoup prudently;
- Promote the recycling of used and waste material;
- Apply the principles of continuous improvement to environmental performance;
- Develop and maintain positive relationships to environmental performance;
- Participate in environmental governance.

3.6.3 Training and Awareness

Regular formal training and informal mentoring of employees address environmental management aspects and responsibilities towards water management, including water conservation and demand management aspects. TGME also has awareness programmes aimed at educating its stakeholders regarding the activities undertaken at the mine, potential impacts of these activities on the environment, and management measures implemented to mitigate these impacts.

3.6.4 Stakeholder Communication

TGME is committed to implement a consistent communication process that strives for participation by employees, mine management, community representatives, government authorities, local business, as well as structures of society, where applicable. The following components form part of this communication protocol:

- Consultation with employees will take place;
- TGME community forum (if required) will be established with the local community to serve as a two-way communication mechanism with the Mine;
- An electronic database of all the participants in the SLP will be used for implementing stakeholder consultation;
- TGME will ensure that key stakeholders are kept informed through an open and transparent participation process;
- Regular community feedback meetings will be held with I&APs;
- A complaint book for the public will be established.

TGME will regularly review their progress and communicate results with all stakeholders in order to enable a relationship based on honesty, openness and mutual trust. In engaging them, they will share with their stakeholders the responsibility for meeting the requirements of this policy.

3.6.5 Water and Waste Management Philosophy

TGME's water and waste management philosophy is based on the water resource and waste management hierarchy of reduce, re-use, recycle and responsible disposal. As outlined in the DWS' Best Practice Guidelines, the precautionary approach is followed, which entails the prevention of pollution as highest priority, followed by the implementation of water use efficiency measures such as re-use, water conservation and demand management as far as possible, and if necessary, the treatment of wastewater to potable standards. The philosophy of "concentrate and contain" has also been adopted, which implies keeping dirty areas safely on as small a footprint as possible, in order to reduce the volumes of dirty water that will require management. This also reduces overall production costs.

3.7 Associated Impacts on Water Resources

A Geohydrology study was done by MvB Consulting in order to investigate and quantify the impact of the mining activities on the groundwater. TGME has a surface water monitoring program in place and takes samples on a monthly basis at various surface locations in order to quantify the possible impact on the Blyde river. OMI Solutions took surface water samples from May – August 2020 in order to form a strong reference point. This monitoring schedule also aimed to meet the current WUL requirements and to provide additional information to mitigate perceived future risks to water quality in the area. The outcome of these investigation is discussed below in the context of overall water management objectives and strategies.

3.7.1 Potential Impact on Groundwater

The calibrated numerical model was used to assess the potential impacts from the Tailings Facility (TSF) on the groundwater and the potential impact on the Blyde River.

The current impact is illustrated in Figure 35and the estimated plume in 100 years is shown in Figure 36With reference to the above figures it is important to note that the "contaminant plumes" are simulated as a percentage of the source concentration. Although a plume is indicated the actual concentrations are expected to be below the guideline limits. Selected individual chemical parameters, that may be indicative of mining impact, are shown in Table 42. The source concentration is based on the geochemical modelling. It is evident from the geochemical study that the quality of the leachate does not pose a risk to the groundwater. The source concentrations for TDS and sulphate exceeds the WUL limits, but not the SANS 241 Drinking water limits.

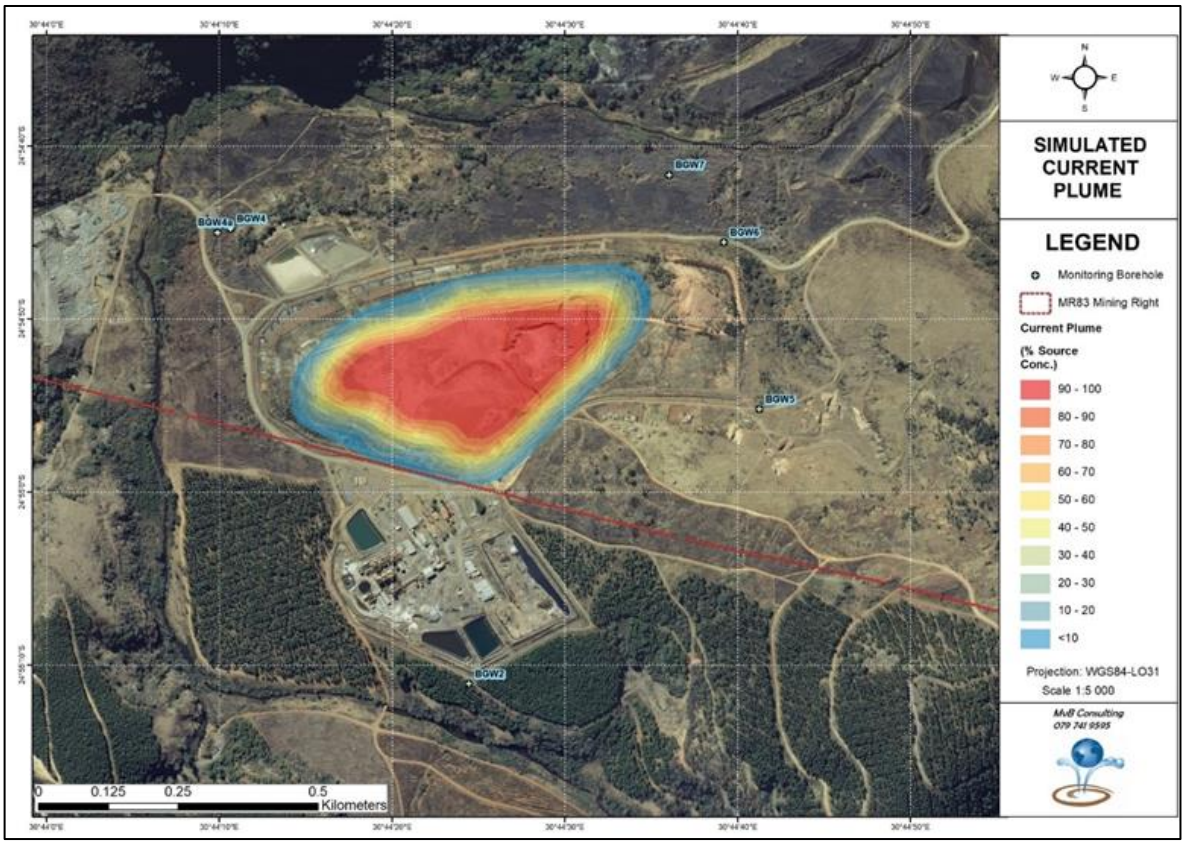

Figure 35: Simulated impact from the TSF

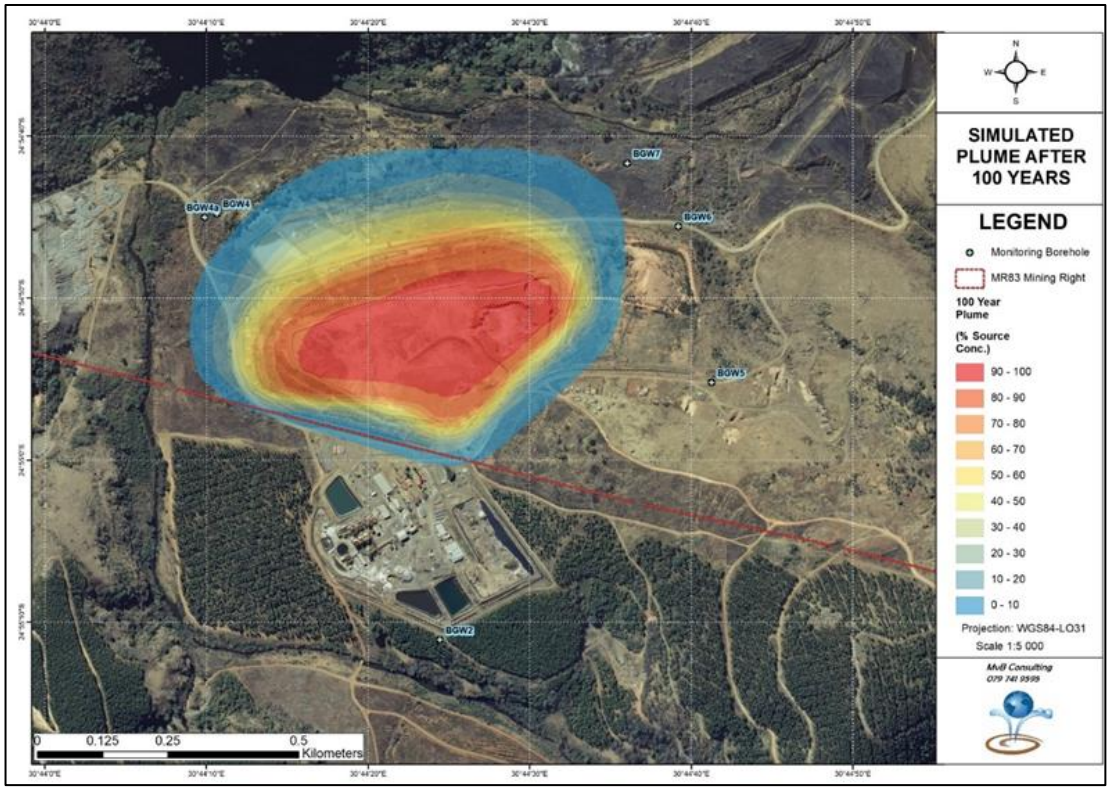

Figure 36: Simulated impact from the TSF in 100 years

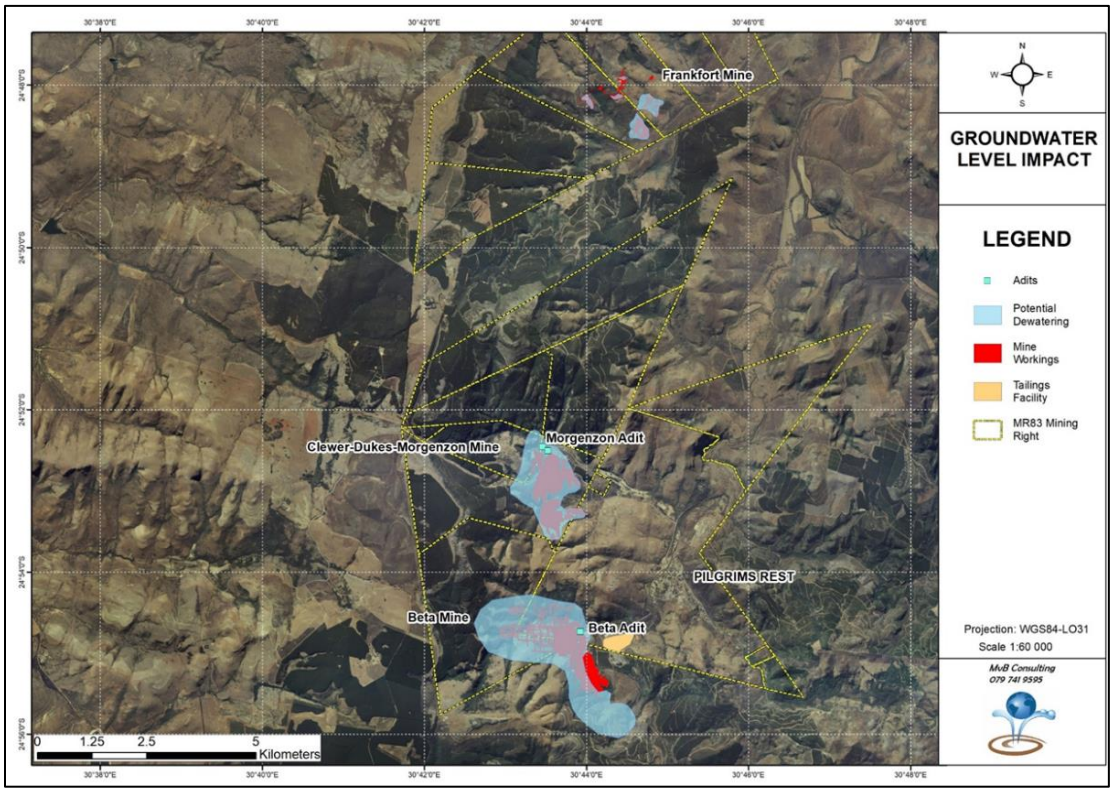

Figure 37: Estimated groundwater level impact area

3.7.2 Impact on Surface Water

3.7.2.1 *Blyde River Run-off*

No river flow gauging stations are present along the Blyde River in the vicinity of the project. Therefore, simulated monthly runoff for the Blyde River at the outlet of quaternary catchment B60A, was obtained from the WRSM/Pitman model, which has been set up as part of the WR2012 study for the period 1920 – 2010. The monthly runoff from October 1990 to September 2010 (20 years) was used to calculate both the mean monthly runoff and the mean annual runoff, as no significant changes in the catchment have occurred since then.

The simulated monthly runoff for quaternary catchment B60A is shown in Figure 38. A maximum monthly runoff of 75.3 million m^3 (mcm) occurred in March 2000. This coincides with heavy rains which fell over the north-eastern parts of South Africa over that period, which resulted in disastrous flooding. A minimum monthly runoff of 1 mcm occurred in August 1992.

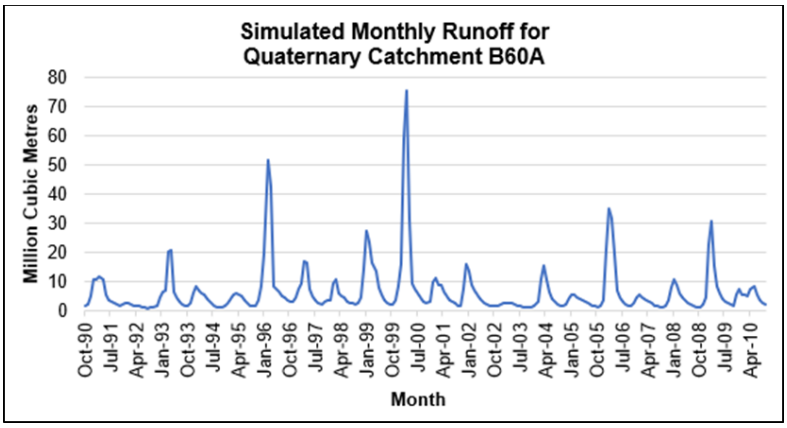

Figure 38: Simulated monthly runoff for quaternary catchment B60A (October 1990 to September 2010)

3.7.3 Guideline Limits

There are a number of existing standards and guidelines for water quality which have been published for different circumstances.

These standards and guidelines include the following:

- Background water quality at the current TGME;
- The South African Drinking Water Standard (SANS) 241:2015;
- Water Quality Guidelines' Receiving Water Quality Objectives;
- Special Limit Values under the General Authorisations;
- RQOs and Resource Water Quality Limits for the Olifants River and the surface water reserve for the Pilgrims Rest area.

The Blyde River water is used for agriculture, industrial and domestic purposes.

- Immediately downstream of the Blydepoort Dam, the large Blyderivierspoort Irrigation Scheme is a major water user. The Blydepoort Dam was built in 1974 by DWAF. The Lower Blyde River Water Users Association was originally established in 1912 as a River Board, co-ordinating the water use of the riparian land owners. It became a more formalised Irrigation Board in 1952, accommodating the Water Act of 1956. The Blyde River Water Control Area was declared in 1957 (Proclamation 276) and the Irrigation District was declared in 1960 (Proclamation 353). The Lower Blyde Water User Association was established in 2002.
- Water from the Blydepoort Dam is released on demand to flow downstream to the Phalaborwa Barrage on the Olifants River, where it is used to supplement the declining Olifants River flows that are available to water users in the urban-industrial complex at the town of Phalaborwa. Recent estimates suggest that the water from the Blydepoort Dam may account for some 30% of the total water used by Phalaborwa.
- Some agricultural activity is taking place in the lower Blyde River (approximately 400 km^2).
- Adjacent to the irrigation district are extensive black communities where there are pockets of relative wealth with good infrastructure and areas suffering poverty and having basic infrastructure.
- The Blyde River Canyon is located within the upper catchment areas and is the third largest canyon in the world and attracts a significant number of tourists every year.
- The booming sectors of (eco) tourism, game farms and nature conservation (Kruger National park and the International Biosphere Kruger to Canyon), have a growing interest in the development of the Blyde River.
- The Olifants River is an international river, entering Mozambique after leaving the Kruger Park. Mozambique has built a huge dam not far across the border (Masinguri Dam). Mozambique is to a large extent dependent on proper water management on the South African side to prevent floods and to make irrigated agriculture possible.

Each of these standards and guidelines are briefly discussed below.

3.7.3.1 *Background Water Quality*

Although the use of background water quality is not legally prescribed, it could provide useful guidance to determine regulatory requirements, especially for groundwater quality, which is often influenced by the host rock, and which differs on a site-specific basis.

3.7.3.2 *South African Drinking Water Standard*

The South African National Standards (SANS) 241:2015 Drinking Water Quality. This standard is generally used for comparison purposes, albeit providing stringent limits that are required for drinking water purposes. The limits provided in the SANS 241:2015 Drinking Water Quality standards are separated into the following risks:

- **Acute health**: Parameter that poses immediate unacceptable health risk if consumed with water at concentration values exceeding the specified limit;

- **Aesthetic**: Parameter that taints water with respect to taste, odour and colour, and that does not pose an unacceptable health risk if present at concentration values exceeding the specified limit;
- **Chronic health**: Parameter that poses an unacceptable health risk if ingested over an extended period if present at concentration values exceeding the specified limit;
- **Operationa**l: Parameter that is essential for assessing the efficient operation of treatment systems and risks to infrastructure.

3.7.3.3 *Water Quality Guidelines' Receiving Water Quality Objectives*

RWQOs are established based on the water quality guidelines for different users, contained in a set of documents first published by DWAF in 1993, and revised in 1996[24]. These documents are collectively known as the "South African Water Quality Guidelines" (SAWQG) and contain guidelines for specific types of water uses, namely:

- SAWQG Volume 1: Domestic Water Use
- SAWQG Volume 2: Recreational Water Use
- SAWQG Volume 3: Industrial Water Use
- SAWQG Volume 4: Agricultural Water Use: Irrigation
- SAWQG Volume 5: Agricultural Water Use: Livestock Watering
- SAWQG Volume 6: Agricultural Water Use: Aquaculture
- SAWQG Volume 7: Aquatic Ecosystems

These guidelines provide useful information on the effects of various chemical substances on water resource quality, and establish objectives for the management of the water resource based on the requirements of the users of the water resource. For each constituent, different ranges are specified, including the No Effect range (Target Water Quality Guideline), Acceptable range, and Intolerable levels.

The SAWQGs can be quite useful in determining regulatory criteria for the characterisation of risks to the water resource. A two-step approach is followed in using these guidelines: firstly, the possible users of the water resource is established to determine which guideline to use (assuming that the water quality guideline for Aquatic ecosystems have been used in the setting of RQOs); secondly, the applicable variables for those users are selected, and the applicable ranges to these variables are used as regulatory criteria.

3.7.3.4 *Special Limit Values under the General Authorisation*

Water use is defined in terms of the NWA to include taking water from a water resource; discharging waste or water containing waste into a water resource; 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. Section 22 of the NWA provides

[24] DWAF, 1996: South African Water Quality Guidelines, Volumes 1 - 7

that water use requires a licence unless it is permissible under Schedule 1; permissible as a continuation of an existing lawful use; or permissible in terms of a General Authorisation issued under s39.

The aim of the General Authorisations is to set a cut-off point below which strict regulatory control under a water use license is not necessary. Several general authorisations have been promulgated[25], including a general authorisation that applies to the discharge of water into water resources, provided that the discharge complies with the **General and Special Limit Values** set out in the regulations. Although these general authorisations are not applicable to Category A mines, which includes gold mines, the discharge limits specified in the general authorisations can provide some guidance towards establishing regulatory criteria for water quality for TGME's activities on 83MR.

Table 31: Special Limit Values under the General Authorisation

SUBSTANCE/PARAMETER	SPECIAL LIMIT
Faecal Coliforms (per 100 ml)	0
Chemical Oxygen Demand (mg/l)	30*
pH	5.5 – 7.5
Ammonia (ionised and un-ionised) as Nitrogen (mg/l)	2
Nitrate/Nitrite as Nitrogen (mg/l)	1.5
Chlorine as Free Chlorine (mg/l)	0
Suspended Solids (mg/l)	10
Electrical Conductivity (mS/m)	50 mS/m above background receiving water, to a maximum of 100 mS/m
Ortho-Phosphate as phosphorous (mg/l)	1 (median) and 2,5 (maximum)
Fluoride (mg/l)	1
Soap, oil or grease (mg/l)	0
Dissolved Arsenic (mg/l)	0.01
Dissolved Cadmium (mg/l)	0.001
Dissolved Chromium (VI) (mg/l)	0.02
Dissolved Copper (mg/l)	0.002
Dissolved Cyanide (mg/l)	0.01
Dissolved Iron (mg/l)	0,3
Dissolved Lead (mg/l)	0.006
Dissolved Manganese (mg/l)	0.1
Mercury and its compounds (mg/l)	0.001
Dissolved Selenium (mg/l)	0.02
Dissolved Zinc (mg/l)	0.04
Boron (mg/l)	0.5

3.7.3.5 *Resource Water Quality Objectives*

The NWA specifies that water resources are to be managed by means of RDMs which entails the setting of a reserve and the establishment of RQOs. The RQOs must indicate the level of use that is deemed acceptable, and unlikely to damage a water resource beyond repair, and is usually established based on the water quality guidelines for aquatic ecosystems.

[25] GN 665 of 06 September 2013.

The Classes and RQOs of Water Resources for the Olifants River (Government Notice 466, 22 April 2016) (DWS, 2016), was consulted to obtain the RQOs for the Blyde River in the vicinity of the project. The ecological category and EWR for the Blyde River up to its confluence with the Lisbon River are indicated in Table 32.

Table 32: Ecological Category EWR Applicable to the Blyde River in the vicinity of the project

Biophysical Node	Quaternary Catchment	River Reach	Ecological Category to be Maintained	Natural MAR (million m^3/a)	EWR as % of Natural MAR
HN117	B60A	Blyde River up to the confluence with the Lisbon River	C	87.1	18.73

The Resource Water Quality Objectives (DWA, 2011) as defined for Electrical Conductivity (EC) and pH is summarised in Table 33 (SAS, 2019b)[26].

Table 33: Resource Water Quality Objectives for Quaternary Catchment B60A

Electrical Conductivity (mS/m)		pH	
Ideal Range Limit	30 mS/m	**Ideal Range Limit**	>6.5 and <8.0
Acceptable Range Limit	50 mS/m	**Acceptable Range Limit**	8.0 - 8.4
Tolerable Range Limit	85 mS/m	**Tolerable Range Limit**	No Range Limit
Unacceptable Range Limit	>85 mS/m	**Unacceptable Range Limit**	<6.5 and >8.4

The RQOs specified for the whole Blyde River, implies that TGME must ensure the concentrations of EC in the Blyde River do not exceed 50 mS/m, and that the pH remains between >6.5 and <8.4. This might not be applicable to the non-perennial drainage lines and other tributaries to the Blyde River.

Further to the above, it is mentioned that the sediment situation within the Blyde River catchment area must be improved, to support the protected status of the river, and that the low and high flows must be suitable to maintain the river habitat and ecosystem condition (DWS, 2016).[27]

3.7.4 Surface Water Quality

3.7.4.1 *Data Sources*

Surface water quality data was obtained from the following sources:

- Monitoring undertaken by TGME;
- Geohydrological Study for the project (van Biljon, 2019)[28];
- DWS National Water Management System database (DWS, 2018).
- OMI Water Quality Monitoring Reports, May, June, July and August 2020.

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[26] Watercourse Ecological Assessment and Impact Assessment as part of the Water Environmental Authorisation and Environmental Impact Assessment (EIA) Process for the TGME Theta Project to include the Theta Hill, Brown Hill and Iota Hill near Pilgrim's Rest, Mpumalanga. Scientific Aquatic services, July 2020.

[27] RSA, 2016 GN 466 in terms of the National Water Act, 1998. Classes and Resource Quality Objectives of Water Resources for the Olifants Catchment.

[28] Final Report. TGME Geohydrological Study for the Theta Hill Project, Pilgrims Rest Region. June 2020 – MvB Consulting.

3.7.4.2 *Monitoring/Sampling Locations*

A number of monitoring points exist for both surface and ground water sampling. These are spread across the 83MR area. The surface samples taken by OMI in the 2020 sampling campaign are listed in Table 34. This list includes a number of samples over and above the WUL points, to examine the need for future sampling.

Table 34: Surface Water Samples

Location	Sample Name	Description
Metallurgical Plant Area	S3	Point in Blyde River upstream of Plant
	S5	Point in Blyde River downstream of plant
	S6	Sampling point downstream of historic mine dumps inside the Caravan Park
	S19	Surface water monitoring point between slimes dam and old historical tailings dumps
	S20	Surface water monitoring point upstream of Beta mine waste rock dump in tributary of Blyde river
	TGME 1	Point in Blyde River furthest upstream of the mining activities to indicate base river conditions
	TGME 2	Downstream of the new proposed bridge crossing, plant and TSF
Morgenson	S1 /S17	Point upstream of infrastructure at Morgenson mine
	S2	Downstream of Morgenson and Clewer Mine
	BSW13	Morgenson adit decant at Wilgerboom
Frankfort	S12	Point in tributary of Molototse river upstream of Frankfort mine (Molototsi Waterfall)
	S13	Downstream point in tributary of Molototse near Vaalhoek road
	S14	Point in Molototse river downstream of Frankfort mine
	S15	Point in Molototse spruit upstream of point S14
	S16	Point in tributary of Molototse river
	FR Security	Point in stream by old Frankfort security gate

3.7.4.3 *Surface Water Quality Results*

Plant Area

It was not possible to access all sampling points every month, due to inaccessibility and/or safety concerns at the time of sampling due to illegal mining activities. The average main water quality parameters for August were within the expected variance and did not show any exceedances of concern. BGW 15 the flooded adit showed the consistent raised salt content, with the Calcium and Sulphate concentrations exceeding the WUL limits. This water quality is characteristic of mine impacted waters in contact with dolomitic material which neutralizes the pH, but dissolves additional calcium and magnesium in the process. The overall salt content for this point remains stable for the monitoring period and suggests that the source remains unchanged, and should there be no new activities it is expected that the water quality will remain the same.

Point S20 is the upstream reference point for the tributary and is referred to as the Peach tree sample point that requires a 4X4 capable vehicle to access, as well as an armed security escort due to the presence of illegal miners. This point aims to test the water quality of the tributary upstream of the mining activities, however multiple sources feeding into this point emanate from old mine adits from the underground workings which is also expected to be contributing towards the low pH observed here, even though the high metal and sulphate content that usually corresponds to acid mine drainage is not present. This point is not completely unaffected as the security escort indicated that there is a large presence of illegal mining activities further upward in the hills, of which the evidence was observed on site. Multiple washing tables as well as material that is being washed were observed on site as seen in the pictures below. The water running in the tributary changed from clear to turbid while the sampling personnel were on site indicating that these activities are taking place nearby without fear of any sort of prosecution. These illegal miners are known to be armed and pose a threat to the sampling personnel as well as the obvious pollution impact they are having on the environment.

The in-stream points in the Blyde River showed good qualities throughout, with no exceedances barring fluctuations in the pH, which is natural expected fluctuations in a water course. The water quality from BGW remains impacted and exceeding the WUL limits however the quality is stable and does not show any indications of increasing in salt load which is what is expected from a historically impacted site. All points in the Plant area where the mine could have potential impacts showed extremely clear water with turbidity values below 5 NTU. This is despite the high turbidity of the Peach tree creek tributary that flows into the river.

Throughout the monitoring periods there was no detection of total Cyanide, free Cyanide or Mercury in any of the monitoring points throughout the Plant Surface Area. The current activities of the client are not contributing any of these elements to the environment, and should subsequent sampling indicate the presence of these elements it should immediately be investigated

Morgenson Area

S17 shows the water quality from the Morgenson Adit which was historically mined and is now continuously discharging water. The Adit is flooded and and seeps a small amount of water that runs into the tributary which is sampled at S1. This point is characterised by high salt content, with raised Calcium, Magnesium and Sulphates as well as trace amounts of Ni, similar to the BGW15 mine water decant which is expected as they are both historically impacted. S17 had slightly lower TDS concentrations which was reflected in a small deterioration of the sulphates with the Calcium and Magnesium concentrations staying at the same average values. This could be attributed to the fact that there is lower seepage volumes as it is deep into the dryer season thus there is less groundwater ingress to the adit areas and less contamination taking place.

While the S17 water indicates mining contamination the downstream point S2 shows good quality which has been consistent for the entire monitoring period, which confirms that the water flow from the old Adit is very small in comparison with the tributary. All further points show compliance to the WUL limits, and it is important to note that both boreholes BGW10 and G1 show that the ground water conditions

are good quality and qualities with metal content below detection limit. This suggests the water emanating from the adits are following the flow path of the old mine tunnels and not seeping into the surrounding ground water which can be more effectively managed should future mining activities take place.

Frankfort Mining Area

During August the water points measured around the Frankfort mine meet the WUL requirements with the exception of the FR Security sample taken at the Frankfort Security Gate and Calcium exceeding the limit at S13. FR Security sample is between S16, S14 and S13 which are all compliant, however the FR Security point first exceeded sulphates in June and again in August. During July there was Manganese present, with low sulphate concentrations, whereas in June there was high Sulphates but Manganese was below detection limit. The operational staff indicated that there is known illegal mining activity in this area, and since no mine activities are taking place in this area, the fluctuations in water quality would be explained by irregular activities taking place in the area.

There is one borehole at the old hostel area, which is called Frankfort Hostel Borehole, which is an indication of the groundwater quality downstream of the mine. The water quality is compliant with the WUL limits, with an elevated pH which could be the result of alkaline material in the underground formations. There are low concentrations of manganese present in the borehole water, but the two results did not vary significantly so there is not an indication of apparent contamination increase. It should be noted that more results are required to make conclusive results on the current groundwater quality.

Table 35: Regulator Criteria for Water Quality at TGME

Variable	Unit	SAWQG Agriculture			RQO for B60A[29]	WUL WRQ limits[30]	GA Special Limits	SANS 241:2015		Background	
		Livestock	Irrigation	Aquatic				Standard Limit	Risk	S0 Surface water 06/12/2018	BGW6 Groundwater
		TWQ	TWQ	TWQ							
pH	mS/m	NS	6.5 - 8.4		>6.5 - <8.0	6.5 – 8.0	5.5 - 7.5	>5.0 - <9.5	Operational	8.1	7.9
EC	mg/l	NS	NS		30	NS	50mS/m *	170	Aesthetic	9	60
TDS	mg/l	1000	NS		NS	<385	NS	1200	Aesthetic	58	402
SO_4	mg/l	1000	NS		NS	<70	NS	250 500	Aesthetic Acute Health	<0.141	0.64
SS	mg/l	NS	NS		NS	NS	10	NS	NS	NS	NS
NO_3 as N	mg/l	100	NS		NS	6	1.5	11	Acute Health	0.291	9.83
T Alk	mg/l	NS	NS		NS	NS	NS	NS		47	414
Ca	mg/l	1000	NS		24	<32	NS	150	Aesthetic	9.61	74.90
Mg	mg/l	500	NS		NS	<27	NS	70	Aesthetic	5.81	46.2
K	mg/l	NS	NS		NS	NS	NS	50	Health	0.24	5.47
Na	mg/l	2000	70		NS	<6	NS	200	Aesthetic	1.51	9.83
Cl	mg/l	1500	100 NS		NS	<200	0	300	Aesthetic	1.15	23.9
F	mg/l	2	2.0		NS	NS	1	1.5	Chronic Health	<0.263	0.78
Al	mg/l	5	5		NS	NS	NS	NS		0.013	0.228
Fe	mg/l	10	5		NS	NS	0.3	2		0.128	1.76
Mn	mg/l	10	0.02		NS	NS	0.1	0.4		0.012	0.967
Zn	mg/l	20	0 – 1.0		NS	NS	0.04	5		<0.002	<0.002
Hg	Mg/l				NS	NS	0.001	6	Chronic Health	NS	NS
As	ug/L				NS	NS	0.01	10	Chronic Health	NS	NS
CN	mg/L				NS	NS	0.01	200	Acute Health Chemical	NS	NS

"NS"= Not Specified

"NM" = Not Measured

*mS/m - above background receiving water, to maximum of 30mS/m

[29] GN 466; 22 April 2016. Olifants River Resource Quality Objectives

[30] Licence no: 24023343: File number: 27/2/2/B60A/021

3.8 Status of Arsenic and Cyanide

TGME took surface water quality sample and it was analysed specifically for arsenic and free cyanide. These samples were taken during May and August 2019 at the sampling locations S3, S5 and TGME 6. The results are summarised in Table 36. OMI undertook to take samples (May – August 2020) in order to confirm whether any changes should be made to the frequency of any of the parameters not specified in the current WUL. The purpose of the 3 months is to form a strong reference point.

One primary finding of the monitoring results taken in May 2020 to August 2020 indicated no traced of cyanide or mercury pollution in any of the monitoring points.

The Arsenic and Cyanide concentration were measured against the SANS drinking water quality limits and the concentration was below this standard. Arsenic and Cyanide concentration were also measured against the Special wastewater limits and the SAWQG for Aquatic ecosystems; however, these limits are applicable to the quality of wastewater to be discharged to a listed river.[31]The Arsenic and Free Cyanide concentration exceeded the Special limits for wastewater.

The sample run from May to August 2020 confirmed that none of the points indicated any cyanide or mercury concentration as it was consistently below detection limits. This indicates that there is no contribution of the mining activities to the spread of these elements, and they were not measured at any point.[32]

[31] RSA, 2013 GN 665 Revision of General Authorisation in terms of Section 39 of the NWA, 1998 (Revise the GA in section 3 of the Schedule to GN 398 of 26 March 2004 (s21 (e, f, g, h &j)

[32] Water Quality Monitoring Reports May – August 2020, OMI Solutions

Table 36: Summary or Arsenic and Cyanide tested at three locations

Location	Variable	GA Special Limits	STD limit SANS 241:015	SAWQG Aquatic ecosystems	May 2019	August 2019	May 2020	June 2020	July 2020	August 2020
S3	***Arsenic as***	**0.01**	**10**		<0.5	0.2	0.041	0.006	0.006	<0.001
S5	***As***	**0.01**	**10**		1.8	0.3	0.01	0.005	0.006	<0.001
TGME 6 above the STP discharge	***As***	**0.01**	**10**		3	1.1	0.008	-NS	0.008	<0.001
S3	***Free Cyanide***	**0.01**	**100**		<.05	<.05	0.008	0.008	0.008	0.008
S5	***Free Cyanide***	**0.01**	**100**		<0.5	<0.5	0.008	0.008	0.008	0.008
TGME 6 above the STP discharge	***Free Cyanide***	**0.01**	**100**		<0.5	<0.5	0.008	0.008	NS-	0.008
S3	***Suspended Solids (SS)***	**10**	**34**		NS	NS	9	25	4.5	<1.0
S5	***SS***	**10**	**34**		NS	NS	4.5	25	4.5	<1.0
TGME 6 above the STP discharge	***SS***	**10**	**34**		NS	NS	40	0	6	34
S3	***Mercury (Hg)***				NS	NS	0.004	0.004	0.004	0.004
S5	***Hg***				NS	NS	0.004	0.004	0.004	0.004
TGME 6 above the STP discharge	***Hg***				NS	NS	0.004	-NS	0.004	0.004

*NS: Not sampled

4 CURRENT REGULATORY STATUS & REQUIREMENTS FOR WATER AND WASTE RELATED AUTHORISATIONS

This section addresses the current regulatory status of activities and aspects requiring authorisation under different statutes that relate to water and waste management, and assesses the effectiveness of current management measures implemented to be address these regulatory requirements and the identified impacts on water sources.

It is intended to provide the DWS with sufficient information regarding water and waste in terms of both the NWA and National Environmental Management: Waste Act, Act 59 of 2008 (NEM:WA), in order to make a decision on how the waste streams should be authorised. The DWS could either recommend the National Department of Environmental Affairs to license the activities i.t.o. of NEM:WA by dispensing the activities in terms of section 22(3) of the NWA, or the department could authorise the activities or some of the activities i.t.o. the NWA, 1998.

4.1 LEGAL REQUIREMENTS

4.1.1 Constitution 1996, (Act 108 of 1996)

The Bill of Rights contained in the Constitution of the Republic of South Africa, 1996 (Act 108 of 1996) states that everyone has a right -

(a) to an environment that is not harmful to their health or wellbeing;
(b) to have the environment protected for the benefit of the present and future generations through reasonable legislative and other measures that:
    i. prevent pollution and ecological degradation;
    ii. promote conservation;
    iii. secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

4.1.2 The National Water Act 1998 (Act 36 of 1998) - NWA

The NWA gives effect to the rights enshrined in the Constitution of the RSA in that, it provides for the protection, usage, development, conservation, management and control of the country's water resources in an integrated manner. The Act provides the legal basis upon which to develop tools and means to affect the said activities. One of these tools is the authorisation of a water use as defined in Chapter 4 of the NWA.

Section 21 of the NWA lists the following 11 water uses which can only be legitimately undertaken through the water use authorisation issued by the DWS:

(a) taking water from a water resource;

(b) storing water;
(c) impeding or diverting the flow of water in a watercourse;
(d) engaging in a stream flow reduction activity contemplated in section 36;
(e) engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1);
(f) discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduits;
(g) disposing of waste [33]in a manner which may detrimentally impact on a water resource;
(h) disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process;
(i) altering the bed, banks, course or characteristics of a watercourse;
(j) 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;
(k) using water for recreational purposes

The Act stipulates that a water use authorisation must be obtained before construction of a mine residue deposit (MRD) or any tailings complex facility.

TGME must apply for the following Section 21 water uses:

- Section 21 (a): The taking of water from the Blyde River;
- Section 21 (b): Storing water;
- Section 21 (c): Impeding or diverting the flow of water in a watercourse,
- Section 21 (g): Disposing of waste in a manner which may detrimentally impact on a water resource;
- Section 21 (i): Altering the bed, banks, course or characteristics of a watercourse,
- Section (j): Removing, discharging or disposing of water found underground.

4.1.2.1 *Government Notice 704*

Furthermore, Government Notice 704, NWA contains specific regulations dealing with aspects on the use of water for mining and related activities aimed at the protection of water resources. Specific attention is drawn to the following regulations, which are applicable to all activities within a watercourse or within 100 m radius of a watercourse.

- **Regulation 2**: Information and notification;
- **Regulation 4:** Restriction on locality;
- **Regulation 5:** Restriction on the use of material;
- **Regulation 6:** Capacity requirements of clean and dirty water systems;

[33] Definition of waste i.t.o. the NWA, 1998. "**waste''** includes any solid material or material that is suspended, dissolved or transported in water (including sediment) and which is spilled or deposited on land or into a water resource in such volume, composition or manner as to cause, or to be reasonably likely to cause, the water resource to be pollute.

- **Regulation 7:** Protection of water resources;
- **Regulation 8:** Security and additional measures;
- **Regulation 9:** Temporary and permanent cessation of the mine.

4.1.2.2 *Government Notice 905*

In accordance of GN905 of 2016 as it relates to the NWA, 1998, "a regulated area of a watercourse" for section 21(c) and (i) of the NWA is defined as:

(a) The outer edge of the 1 in 100 year floodline and/or delineated riparian habitat whichever is the greatest distance measured from the middle of the watercourse of a river, spring, natural , channel, lake or dam.

(b) In the absence of a determined 1 in 100 year floodline or riparian area it is the area within 100m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench (*subject to compliance to section 144 of the Act);* or

(c) A 500m radius from the delineated boundary (*extent*) of any wetland or pan in terms of the regulation.

4.1.2.3 *Dam Safety Regulations*

The Dam Safety Regulations (published in Government Notice R1560 of 5 July 1986) requires that every dam with a safety risk shall be classified in accordance with Regulation 2.4 on the basis of its size and hazard potential. An authorisation is required from the dam safety regulator before construction of a dam commences.

4.1.3 National Environmental Management Act (Act 107 of 1998) - NEMA

NEMA requires that an EIA must be carried out before construction of a new residue deposit. Application in terms of the:

- National Environmental Management Act of 1998 (Act No. 107 of 1998), as amended;
- 2014 Environmental Impact Assessment Regulations, as amended;
- An Amendment in terms of Section 102 of the Mineral and Petroleum Resources Development Act (Act 28 of 2002): Section 23 (A), (B) and (C) read together with Regulation 11(1) (G);
- National Water Act, Act 36 of 1998 (NWA) terms of section 40;
- National Environmental Management: Waste Act, Listed Activities (GNR 921);
- National Environmental Management: Air Quality Act, Act 39 of 2004 (NEMAQA) and associated listed activities;
- The National Heritage Resources Act (No. 25 of 1999.

The application for the Integrated Mining and Environmental Authorisation for the proposed project is undertaken in terms of sections 11(2), 24 and 24D of the NEMA, as read with the EIA Regulations of GNR R327, GNR 325 and GNR 324 of April 2017. A Scoping and Environmental Impact Reporting Process integrated with a Mining Right Amendment Application are required to be undertaken for the proposed project.

4.1.3.1 *Listed Activities in terms of the NEMA, 1998 EIA regulation, 2014 listed activities*

The listed activities in terms of the EIA regulations of 2014 as amended GN983 dated 04 December 2014: the zone of applicability is stipulated as 32m from the edge of a watercourse.

4.1.4 The National Freshwater Ecosystem Priority Area (NFEPA) Implementation Manual

There are buffer guidelines according to the National Freshwater Ecosystem Priority Area (NFEPA) Implementation Manual and the Mpumalanga Biodiversity Sector Plan (MBSP) Handbook, 2014. Although there are no legislated zones of regulation the recommended buffer for the Blyde River in accordance with both guidelines is 1,000m.

4.1.5 Water Uses and Waste Management Activities Requiring Authorisation under the NWA & the NEM:WA

The primary legislative requirements that applies to the management of water and waste at TGME and thus to this IWWMP relate to authorisations for water use in terms of the NWA, and for waste management activities identified under the NEM:WA, Regulation 632, dated 2015 and as amended by GN990 dated 21 September 2018, regarding the planning and management of residue stockpiles and residue deposits from a prospecting , mining, exploration or production operation.

Regulation 921, dated 29 November 2013 and as amended, makes provision for lists of waste management activities that have, or are likely to have, a detrimental effect on the environment.

These statutes overlap for a number of water uses and waste management activities, and since cooperative governance arrangements in both these laws aim to prevent duplication in authorisation, it is crucial to determine the most appropriate applicable legislation for the relevant activities.

Due to the fact that the NEM:WA contains a more restrictive definition of “waste”, and has limited applicability, the activities that will certainly resort under this statute are identified first, followed by a discussion of water uses and activities that will be best governed under the NWA.

4.1.5.1 *Applicability of the Requirements under the NEM:WA, 2008*

This current TSF was constructed and operated prior to the NEWMA changes to legislation (NEWMA). It is assumed that no new permissions are required to re-commission the facility, but this should be confirmed with the authorities. The disposal of mine waste now falls under the NEM:WA legislation and all waste facilities are required to be licensed and approved in terms of the National Water Act and specifically GN704 which calls in this case for a Class C barrier system (*based on the waste type*) to prevent any changes to the natural water systems. (Tailex, September 2020)

It is understood that the water use license for the operation is still active and in place, therefore there would be no need to immediately provide a barrier in the return water dam from a legal point of view

however it is advised to do so as the existing liner has been exposed to the elements for a long period of time and is deemed inadequate to prevent ingress of solutions into the groundwater.[34]

In terms of the NEM:WA, "waste" has been defined as "any substance, whether or not that substance can be reduced, re-used, recycled and recovered –

(a) that is surplus, unwanted, rejected, discarded, abandoned or disposed of;

(b) which the generator had no further use of for the purpose of production;

(c) that must be treated or disposed of; or

(d) that is identified as a waste by the Minister by notice in the Gazette, and includes waste generated by the mining, medical or other sector;

but

(i) a by-product is not considered waste, and

(ii) any portion of waste, once re-used, recycled and recovered, ceases to be waste".

Definition of "**residue deposit"** in terms of GN704 includes any debris, discard, tailings, slimes, screening, slurry, waste rock, foundry sand, beneficiation plant waste, ash and any other waste product derived from an incidental to the operation of a mine or activity and which is stock piled, stored or accumulated for potential re-use or recycling or which is disposed of.

In terms of section 4 of the NEM:WA, 2008; this act does not apply to *residue deposits and residue stockpiles* that are regulated under the MPRDA.

In terms of section 69(1)(A) of NEM:WA, GN632 dated 24 July 2015 was promulgated regarding the planning and management of residue stockpiles and residue deposits from a prospecting, mining, exploration or production operation as previously mentioned. The purpose of these regulations is to regulate the planning and management of the residue stockpiles and residue deposits. In the case of TGME there are waste rock which was classified a Type 3 waste which need to be stockpiled as a waste rock dump (WRD).

GN990, regulation 3(5) dated 21 September 2018: specific attention is drawn to the following regulations:

- **Regulation 3(5):** 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 Regulation 4 & 5.
- **Regulation 5(2):** A risk analysis must be conducted and documented on all residue stockpiles and residue deposits to be established;
- **Regulation 5(2A):** The risk analysis contemplated in sub regulation (2) must be undertaken by a competent person;

[34] TGME No 1 TSF – Continuation Report, Tailex September 2020.

- **Regulation 7(1):** The design of a residue stockpile and residue deposit must be undertaken by a registered Professional civil or mining engineer, registered under the Engineering Profession of South Africa Act, Act 114 of 1990.

This implies that the rock to be disposed of to waste rock dumps and/or re-used for the construction of berms are not subject to the NEM:WA.

All other waste management activities are subject to the GN921[35] promulgated under section 19 of the NEM:WA, which identifies waste management activities that requires a waste management activity license in terms of Chapter 5 of the NEM:WA. The Regulation distinguishes between two main Categories of waste management activities: *Category A* activities require a Basic Assessment in support of the application for a waste management facility license, while *Category B* activities require a full EIA in support of the application for a waste management facility license.

4.2 Waste Classification of Rock Material

4.2.1 Introduction

Geochemical Dynamic Systems (GeoDyn) undertook a geochemical, including an acid mine drainage (AMD), risk assessment for mineral waste material, specifically tailings, from the historic mining operations occurring on the TGME mine site. Existing information on current tailings as well as historic information from studies on the gold ore material from the Sabie-Pilgrim's Rest goldfield is used in the study.

The geochemical assessment was conducted in two phases. The first was to determine the status quo of current environmental impacts by the tailings facilities. The second phase utilised numeric geochemical modelling to evaluate whether the status quo can be expected to be perpetuated in the long-term.

The first phases utilised historic information (Boer, 1995, Meltz, 2015, Zietsman, 1967) as well as information from a study on the current project tailings and waste rock at the TGME Theta and Iota mine sites (GeoDyn, 2019). This information was then used to develop numeric geochemical models to calculate the risk of the formation of AMD conditions from the historic tailings material as well as to assess the leachability and mobility of potential contaminants from specific source terms. The model results are correlated with existing surface water and groundwater quality data from and surrounding the site to determine which impacts, if any, are currently occurring and which can be potentially expected in the future.

The full report is attached as Appendix C of the Geohydrological Report (Appendix 2) and summarised below.

[35] GN 921 of 29 November 2013; List of Waste Management Activities that has, or is likely to have, a Detrimental Effect on the Environment.

4.2.2 Geochemical Modelling

Pyrite is contained in the Pilgrim's Rest gold ore (Boer, 1995, Meltz, 2015, Zietsman, 1967) and is unstable in the presence of oxygen contained in the Earth's atmosphere. Pyrite was thus added to the model as a kinetic reactant. Arsenopyrite is also associated with the ore material. However, arsenopyrite was not added to the model as a separate mineral phase, but arsenic was added to the model as a kinetic flux; as if arsenic is being released to the tailings pore water from the dissolution of a kinetic mineral phase. The minerals quartz and dolomite are ubiquitously associated with the gold ore. These minerals were also added to the model and allowed to equilibrate with the tailings pore water. In addition to arsenic, nickel, cobalt, manganese, iron and lead were also evaluated. These metals were added as kinetic fluxes.

The model results, together with the median groundwater and surface water monitoring data values are shown in the tables below. The model results indicate that the tailings material does not pose a long-term environmental risk. This is further substantiated when the model results are compared to the median groundwater and surface water hydrochemical data, indicating that none of the parameters modelled and analysed for exceeds regulatory guideline values, even if the SANS drinking water guideline values are used for comparison.

Table 37: Geochemical modelling results – Operational source term

Parameter	Abbreviation	*Unit*	Model results
Physical parameters			
pH	pH	*pH units*	7.39
Total Dissolved Solids	TDS	*mg/L*	862
Major cations			
Calcium	Ca	*mg/L*	44
Potassium	K	*mg/L*	0.074
Magnesium	Mg	*mg/L*	128
Sodium	Na	*mg/L*	1
Anions			
Sulphate	SO_4	*mg/L*	333
Chloride	Cl	*mg/L*	63
Bicarbonate	HCO_3	*mg/L*	299
Minor components			
Aluminium	Al	*mg/L*	0.005
Arsenic	As	*mg/L*	<0.001
Barium	Ba	*mg/L*	<0.001
Cobalt	Co	*mg/L*	0.001
Chromium	Cr	*mg/L*	0.04
Copper	Cu	*mg/L*	<0.001
Iron	Fe	*mg/L*	0.706
Manganese	Mn	*mg/L*	<0.001
Nickel	Ni	*mg/L*	0.046
Mercury	Hg	*mg/L*	0.002
Zinc	Zn	*mg/L*	0.27

Table 38: Geochemical modelling result – Post closure source term

Parameter	Abbreviation	*Unit*	Model results
Physical parameters			
pH	pH	*pH units*	7.39
Total Dissolved Solids	TDS	*mg/L*	862
Major cations			
Calcium	Ca	*mg/L*	44
Potassium	K	*mg/L*	0.074
Magnesium	Mg	*mg/L*	128
Sodium	Na	*mg/L*	1
Anions			
Sulphate	SO_4	*mg/L*	333
Chloride	Cl	*mg/L*	63
Bicarbonate	HCO_3	*mg/L*	299
Minor components			
Aluminium	Al	*mg/L*	0.005
Arsenic	As	*mg/L*	<0.001
Barium	Ba	*mg/L*	<0.001
Cobalt	Co	*mg/L*	0.001
Chromium	Cr	*mg/L*	0.04
Copper	Cu	*mg/L*	<0.001
Iron	Fe	*mg/L*	0.706
Manganese	Mn	*mg/L*	<0.001
Nickel	Ni	*mg/L*	0.046
Mercury	Hg	*mg/L*	0.002
Zinc	Zn	*mg/L*	0.27

4.2.3 Geochemical Risk Assessment

A geochemical risk assessment was conducted as part of this study on the historic tailings material. The risk assessment is based on the assessment of current groundwater and surface water hydrochemical data to determine the current, or status quo, impacts. Numeric geochemical modelling is used to evaluate the long-term scenario in terms of the impacts. The potential environmental impacts assessed during this study for the operational and post-operational phases are:

- The potential of the mineral waste material types to generate acid mine drainage conditions.
- The potential of the mineral waste material types to leach metals and metalloids to the mineral waste substrate and groundwater.
- The potential of the mineral waste material types to leach sulphate to the mineral waste substrate and groundwater.

- The potential of the mineral waste material types to leach nitrate to the mineral waste substrate and groundwater.

4.2.3.1 ***Status Quo***

Acid Mine Drainage

The current groundwater and surface water hydrochemistry indicates that AMD drainage conditions have not developed in response to the historic tailings facilities. The geochemical modelling indicates that this scenario is likely to perpetuate into the future.

Leaching of Metals and Metalloids

The hydrochemical data of the recent groundwater and surface water indicates that the historic tailings has not had an environmental impact in terms of the leaching of metals and metalloids. This geochemical model indicates that this scenario is likely to be perpetuated into the future.

Leaching of Sulphate

The current groundwater and surface water hydrochemical data indicates that the historic tailings has an insignificant impact on the local environmental in terms of sulphate concentrations. The geochemical modelling indicates that this scenario is likely to be perpetuated into the future.

Leaching of Nitrate

Nitrate concentrations of the historic tailings indicates that the tailings is not likely to have an environmental impact in the long-term, as the older tailings material are not associated elevated nitrate and ammonia concentrations. This is due to the natural denitrification process which occurs due to the presence of denitrifying bacteria in the soil, groundwater and surface water.

4.2.3.2 **Operational and Post-Operational Phases**

Acid Mine Drainage

The historic tailings currently do not pose a risk in terms of the formation of AMD conditions and the geochemical modelling has shown that this scenario is likely to continue in the long-term. Therefore, the tailings material is unlikely to pose an environmental risk in the operational and post-operational phases of the mining project.

Leaching of Metals and Metalloids

The historic tailings currently do not pose a risk in terms of the leaching of metals and metalloids and the geochemical modelling has shown that this scenario is likely to continue in the long-term. Therefore, the tailings material is unlikely to pose an environmental risk in the operational and post-operational phases of the mining project.

Leaching of Sulphate

The historic tailings currently do not pose a risk in terms of the leaching of sulphate and the geochemical modelling has shown that this scenario is likely to continue in the long-term. Therefore, the tailings material is unlikely to pose an environmental risk in the operational and post-operational phases of the mining project.

Leaching of Nitrate

The historic tailings currently do not pose a risk in terms of the leaching of nitrate and the geochemical modelling has shown that this scenario is likely to continue in the long-term. Therefore, the tailings material is unlikely to pose an environmental risk in the operational and post-operational phases of the mining project, assuming that no fresh tailings material is deposited on these historic facilities

4.2.4 Geochemical Study Conclusions

The study showed that:

- The geochemical assessment shows that the historic tailings is not currently negatively impacting the local groundwater and surface water in terms of acid mine drainage and the geochemical modelling indicates that this scenario is likely to be perpetuated in the long-term.
- The historic tailings is not currently negatively impacting the local groundwater and surface water in terms of the leaching of hazardous metals and metalloids and the geochemical modelling indicates that this scenario is likely to be perpetuated in the long-term.
- The historic tailings is not currently negatively impacting the local groundwater and surface water in terms of the leaching of sulphate and the geochemical modelling indicates that this scenario is likely to be perpetuated in the long-term.
- The historic tailings is not currently negatively impacting the local groundwater and surface water in terms of the leaching of nitrate and the geochemical modelling indicates that this scenario is likely to be perpetuated in the long-term, as long as no fresh tailings material, containing process water with elevated nitrate concentrations, are deposited on these historic facilities.
- The results above are consistent with a geochemical model conducted on the Theta and Iota tailings material. This study (GeoDyn, 2019) showed that the likelihood of significant environmental impact is negligible, due to the geochemistry of the tailings as well as the high sorption capacity in the natural environment capable of immobilising metals and metalloids.

The waste management activities as listed under NEM:WA that are associated with the key activities at the TGME underground mines, plant and TSF area , within the Mining Right 83MR perimeter include the following:

- The establishment or reclamation of a residue stockpile or residue deposit resulting from activities which require a mining right i.t.o. the Minerals and Petroleum Resource Development Act, 2002 Act No. 28 of 2002

4.2.5 Applicability of the Requirements in terms of the NWA for the Water Uses at TGME Operations

The promulgation of the NWA changed the manner in which the consumptive and non-consumptive use of water is being authorised. Water uses have been defined under section 21 of the NWA, (under Chapter 4, entitled "Use of Water") to include, inter alia.-

WATER USES

The following water uses will be licensed in terms of section 40 of the NWA.

Section 21 (a) Taking water from a water resource:

- *Abstraction from Morgenson Paddocks;*
- *Abstraction from Molototse river at Frankfort mine;*
- *Taking water from the Frankfort void for usage;*

Section 21 (b) Storage of water:

- *Storage of water for domestic purposed at Frankford mine;*
- *Storage of water for domestic purposed at Beta mine;*
- *Storage of water for domestic purposed at Clewer mine;*
- *Storage of water for domestic purposed at Dukes Hill mine;*
- *Storage of water for domestic purposed at Morgenson mine.*

Section 21 (c) Impeding or diverting the flow of water in a watercourse:

- *Dukes Hill Upper diversion of tributary of Blyde river;*
- *Dukes Hill Upper diversion of another tributary of Blyde river.*

Section 21(g) Disposing of waste in a manner which may detrimentally impact on a water resource:

- *Underground mining void at Frankfort mine (referred to as Frankfort void);*
- *Waste rock dump at Frankfort mine (Frankfort WRD);*
- *Conservancy tank for sewage disposal at Frankfort mine.*
- *Waste rock dump at Morgenson offices (Morgenson WRD);*
- *Paddocks at Morgenson mine (referred to as Morgenson Paddocks);*
- *Conservancy tank for sewage disposal at Morgenson office;*
- *Settling dam at Frankfort mine;*
- *Waste rock dump at Beta mine (Beta WRD);*
- *Slimes dam Pilgrims rest plant (Referred to as Tailings Storage Facility – TSF);*
- *Return water dam with two compartments (RWD);*
- *The disposal of stormwater from the plant area via a sump to the Spillage collection pond as part the stormwater management plan. (Sump and Spillage collection pond at plant);*
- *Dust suppression.*

Section 21(i) Altering the bed, banks, course or characteristics of a watercourse:

- *Diversion canal around Dukes Hill Upper Waste rock dump;*
- *Diversion canal around Dukes Hill Upper Waste rock dump;*

Section 21(j) 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

- Excess groundwater removed from underground at Clewer No. 4 adit and disposed of into the Morgenson Paddocks;
- Disposal of groundwater at the Frankfort mine into either the Frankfort void or the Frankfort Settling dam;
- The removal of water found underground at Morgenson adit 5 in order to manage excess water for the efficient continuation of mining activity and for the safety of people

The NWA provides a tiered authorisation system to regulate the use of water. In terms of section 22(1) of the NWA, a person may only use water -

- if that water use is permissible under Schedule 1;
- if that water use is permissible as a continuation of an existing lawful use; or
- if that water use is permissible in terms of a general authorisation issued under section 39;
- if the water use is authorised by a license under this Act; or
  if the responsible authority has dispensed with a license requirement under subsection 22(3).

All the above-mentioned water uses are illustrated in Figure 39 to Figure 42.

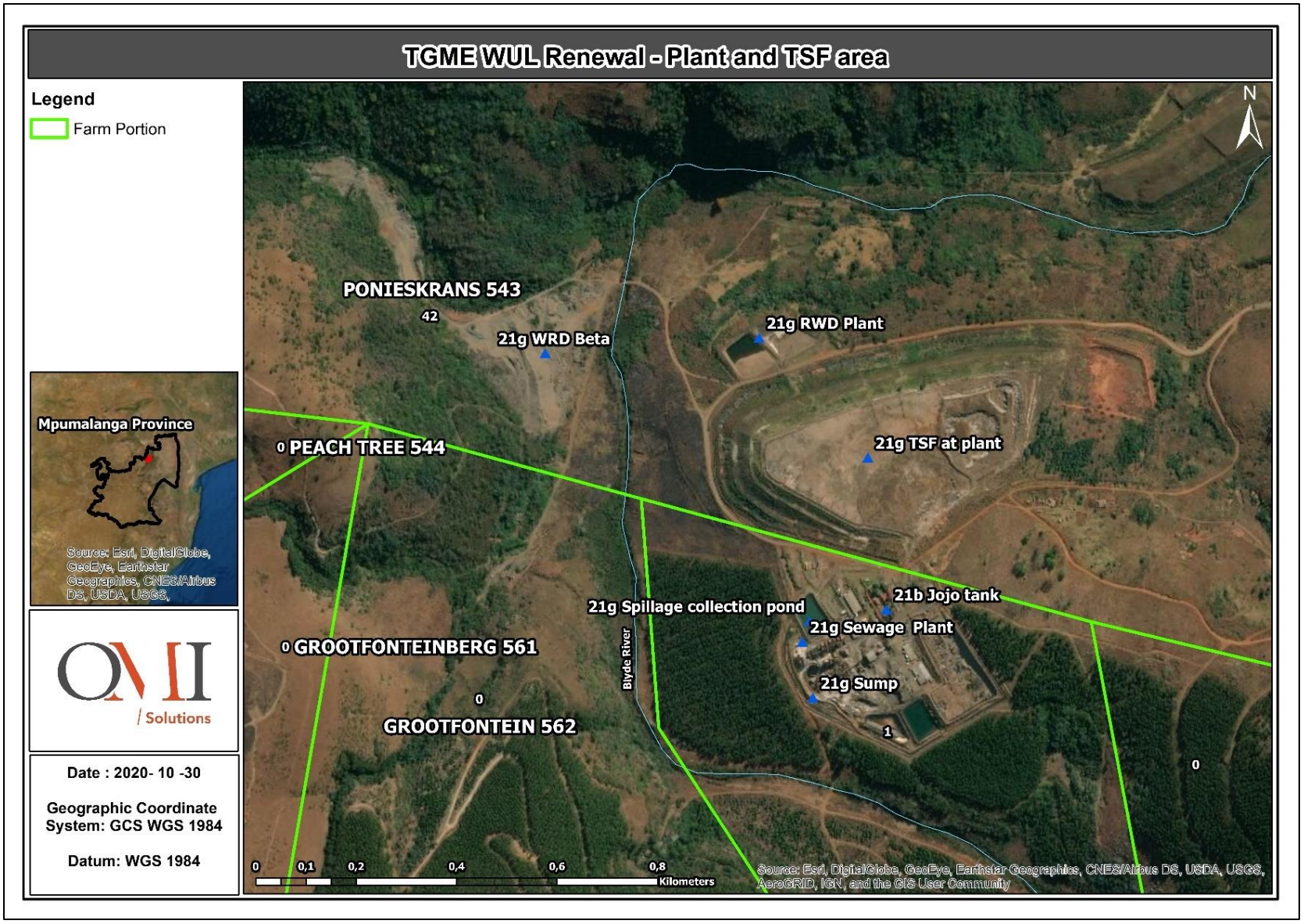


Figure 39: Water Uses at Beta Mine, the Plant Area and TSF

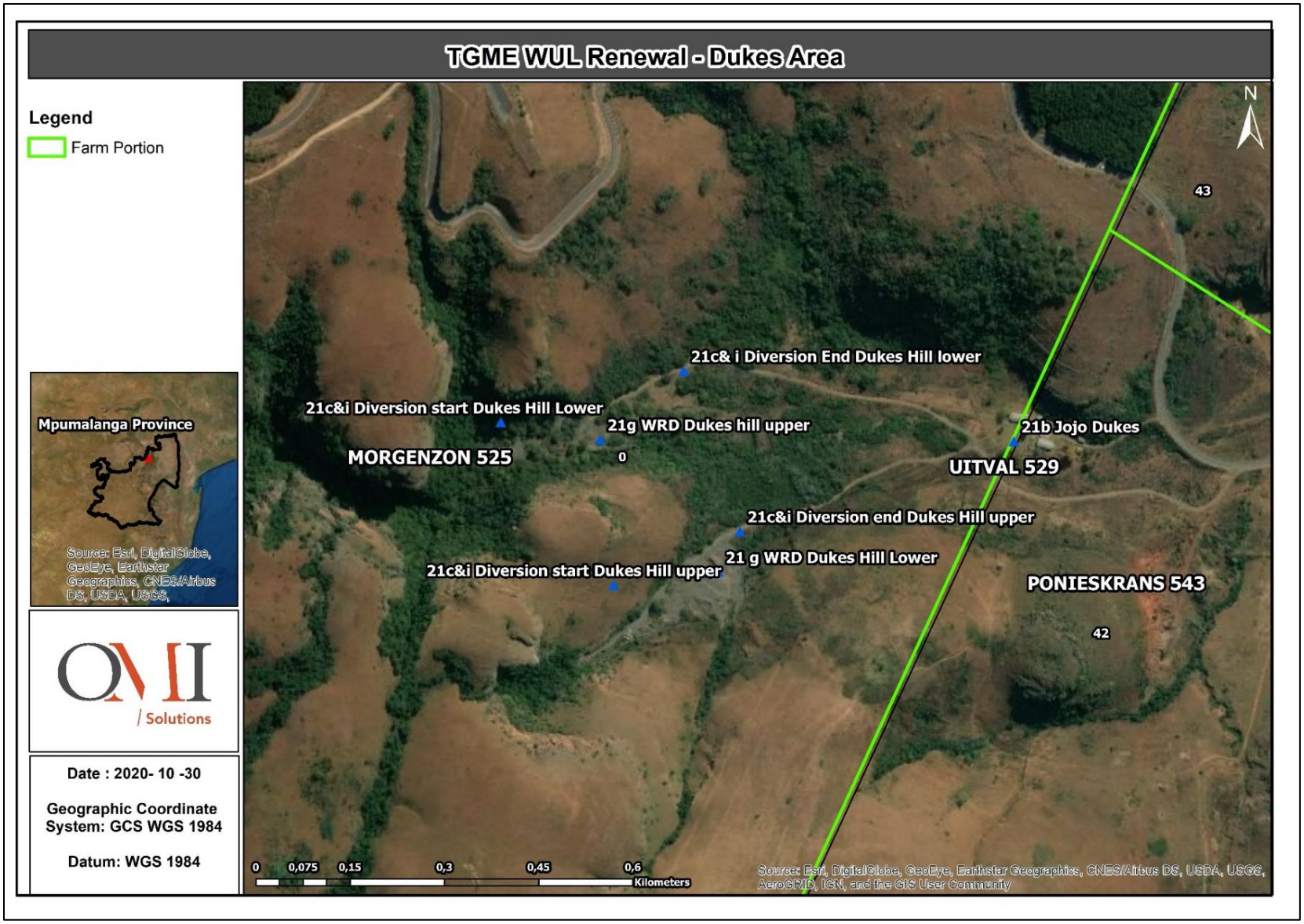


Figure 40: Water uses at Duke Hill

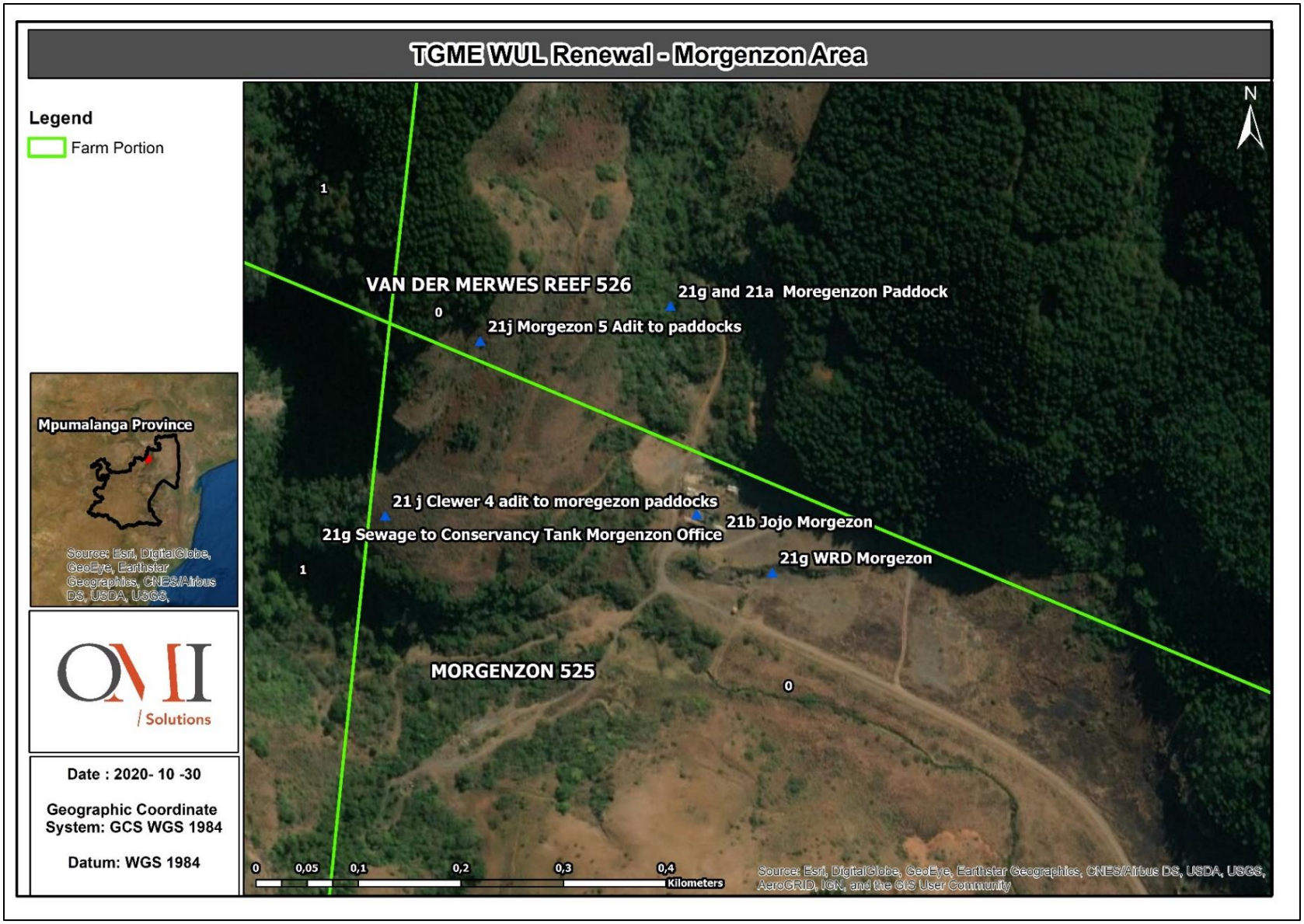


Figure 41: Water uses at the Morgenson Complex

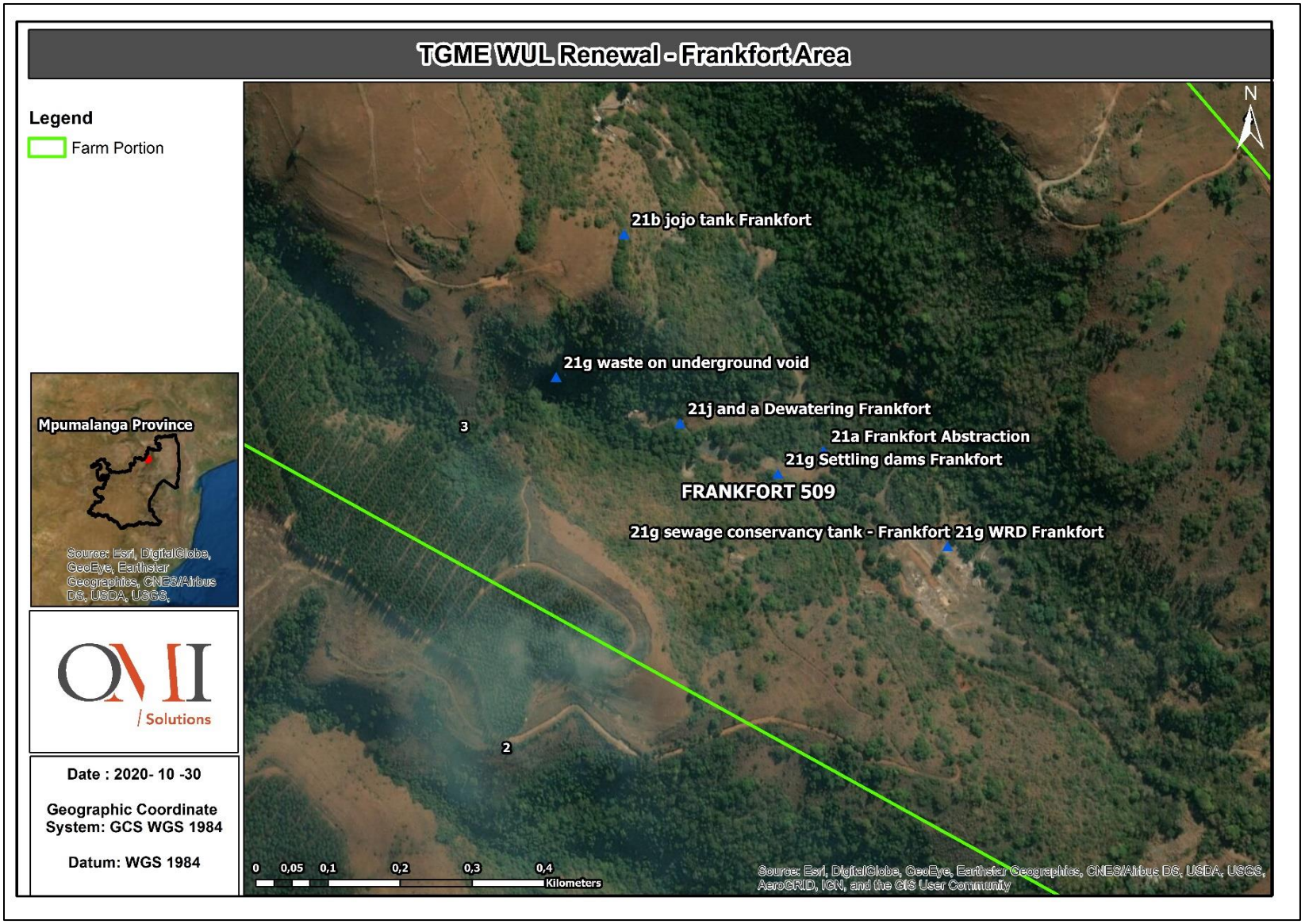


Figure 42: Water uses at Frankfort Mine

Schedule 1 to the NWA authorizes a number of water uses, for example reasonable domestic use, small non-commercial gardening or the use of water for emergencies such as fire-fighting.

General Authorisation (*GN665 of 6 September 2013)* has been promulgated for a number of water uses, including taking and storing of water, and disposal of wastewater, in terms of paragraph 3.7 of the GA's, a person may store up to 5000m^3 of domestic and or biodegradable industrial wastewater **for the purpose of re-use**, if the storing of the wastewater:

(a) does not impact on a water resource or on any other person's water use, property or land;

(b) is not detrimental to the health and safety of the public in the vicinity of the activity.

In terms of paragraph 3.8 of the GA's, a person may store of domestic and or biodegradable industrial wastewater for **the purposes of disposal**:

(a) up to 10,000m^3 per property or land;

(b) up to 50,000m^3 in wastewater pond system per property or land if the storing of the wastewater;

(c) does not impact on a water resource or on any other person's water use, property or land;

(d) is not detrimental to the health and safety of the public in the vicinity of the activity.

An assessment has been undertaken to determine the water uses as defined in the NWA that are associated with the key activities at the various mining sites as described in paragraph

4.2.6 Applicability of Requirements of Relevant Regulations under the NWA

4.2.6.1 *GN704: Regulation on the Use of Water for Mining Related Activities aimed at the Protection of Water Resources.*

In terms of GN267[36] promulgated on 24 March 2017 all water containing waste related applications are subject to a GN704 motivation that is aimed at the protection of water resources. The GN704 Regulations are applicable for mining related activities.

Various section 21(g) water uses are applicable to TGME and in this instance the Regulations on restriction of locality, restrictions on the use of material, capacity requirements as well as protection of water resources.

[36] GN 267. 24 March 2017. Dept. Water and Sanitation. Regulation regarding the procedural requirements for water use license applications and appeals.

4.3 Current Regulatory Status: Authorisation of Water and Waste Management Activities at the Greater TGME

4.3.1 Other Authorisations & Regulations (EIAs, EMPs, RODs)

GCS (Pty) LTD ("GCS") an independent environmental company was appointed by TGME in 2005 to undertake the 83 MR EIA process. The mining right application was submitted for the farms: Frankfort 509KT; Krugers Hoop 527KT; Morgenzon 525KT; Peach Tree 544KT; Ponieskrans 543KT; Van Der Merwes Reef 526KT. The Mining Right Application (MRA) was accepted by the Department of Minerals and Energy (DME), and as part of the process of approval an EIA and an EMPR were required to incorporate all current and proposed operations.

The EMPR / EMP done by GCS, October 2005 application was approved by the DMR on 16 October 2013. The authorisation is valid for 10 years.

Table 39: Summary of IWULA Status for TGME

Water Use Licence	Area	Property description	Date Approved	Valid (years)
05/X31A/a,c,g,l,j/2405	Glynn's Lydenburg	RE, Ptn 5 & Ptn 141 Grootfontein 196 JT RE Olifantsgeraamte 198 JT	11 January 2015	12
05/X31B/a,c,g,l,j/1634	Rietfontein	Ptn 4 Farm Rietfontein 193 JT Farm Spitskop 195 JT	11 January 2015	9
27/2/2/B60A/021	Greater TGME	RE Farm Morgenzon 525 KT Farm Frankfort 509 KT Ptn 42 Farm Ponieskrans 543 KT	29 March 2011	10
24083180	Elandsdrift	Ptn 1 & 2 Farm Elandsdrift 220 JT	02 October 2008	3

5 WATER AND WASTE MANAGEMENT MEASURES: MONITORING

This section describes the status of water and waste management measures at the TGME underground mines, plant and TSF area within the Mining Right 83MR perimeter, including the current status of surface and groundwater quality monitoring networks and the proposed water balance for the open cut operation.

The water and waste management philosophy for the IWWMP is based upon DWS principles and guidelines for water and waste management (BPG H1: Integrated Mine Water Management; BPG H3 Water Reuse and Reclamation and BPG 2: Water and Salt Balance).

Best Practice Guidelines (BPG) has been provided by the DWS for the management of water within the mining sector based on international guidelines for the sustainable use of water. The principles contained in the Constitution of South Africa (Act No. 108 of 1996) govern the BPG, these principles aim at achieving the right to equitable water access, sustainable water use as well as effective and efficient water use for ideal social and economic development. Furthermore, the National Water Policy and National Water Resource Strategy guide the principles and guidelines contained in the BPG. The BPG is a series that currently consists of three separate sections made up of the following groupings: water management hierarchy, general water management strategies and specific water management activities and aspects. The guidelines are based on the precautionary principle aiming at first preventing pollution and/or water use, then minimising water use and/or impacts and finally if the first two cannot be achieved the use, discharge and disposal of waste and/or wastewater. The Integrated Water Resource Management Strategy was introduced in the NWA to ensure that all aspects of the water resource is maintained in a sustainable manner. This includes the use of both resource and source directed methods. These strategies aid as a guideline for the planning of the EMP and WUL, the development and implementation of the IWWMP as well as the post mining closure strategy. Any water use and/or pollution must take into consideration the RQOs, site-specific, regional and national impacts.

5.1 Water Balance

Tailex[37] drafted a continuation report to outline the main features and characteristics related and reliant, on the potential for the Tailings Storage Facility (TSF), known as TGME No 1 Tailings storage facility (No. 1 TSF), to be recommissioned and able to receive a continuous steady stream of tailings from the proposed upgrades to the TGME gold processing plant. The purpose of this report is to outline the main features and characteristics pertinent to the facilities herein mentioned, to serve the function for which they have been constructed. This is often referred to as a continuation or continuity report. This type of report is required where some information for a facility or structure may be required post construction as a means to place on record, the layout, engineering drawings, operating methodology and confirmation of functionality for the purpose that they were constructed. In terms of section 10.4.4.4 of the SANS 10286.

[37] TGME No 1 Tailings Storage Facility Continuation Report – TMS/TGME/TSF1/02. September 2020

MineLock Environmental Engineers[38] used the information in the Tailex Continuation Report and did detail modelling in order to design the stormwater management plant for the plant and TSF. Here follows a summary of the water balance at the plant area:

The water balance inflows include the following:

- Rainfall inflow (105 755 m^3/a);
- Slurry Water (354 324 m^3/a assuming a Relative Density of 1.37 with 43.2 Solids)
- Plant storm water management in the spillage collection pond (21 428 m^3/a)
- TSF side slope run-off (Assumed to be collected in the paddocks system and obtaining 80% loss in the paddocks system, 20% of the water collected from the side slopes will report to the return water dams (4069 m^3/a)
  Total Inflow = 485 577 m^3/a

T**he water balance outflows include the following:**

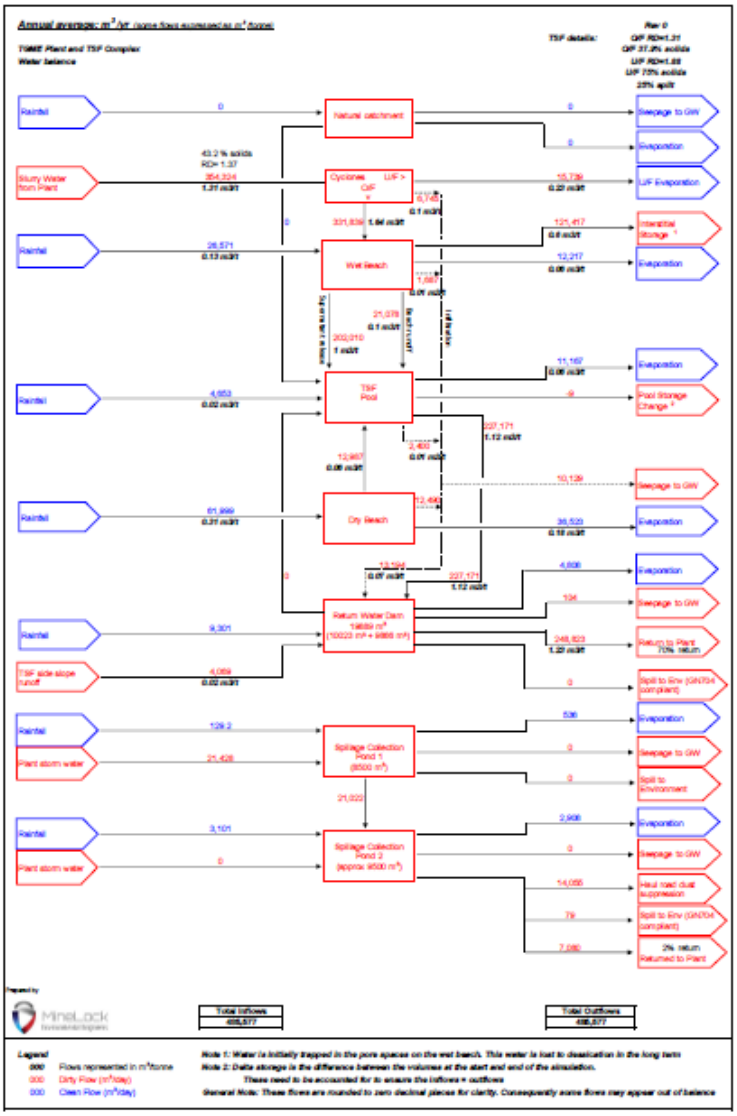
- Evaporation loss (83 898 m^3/a)
- Seepage water due to unlined facility (10 233 m^3/a)
- Interstitial storage (121 417 m^3/a). Water is initially trapped in the pore spaces on the wet beach. This water is lost to desiccation in the long term.
- Combined Return to plant (255 904 m^3/a)
- Storage Changes (Delta storage is the difference between the volumes at the start and end of the simulation) (-9 m^3/a)
- GN 704 compliant spill (79 m^3/a)
- Dust suppression over the haul roads (14 055 m^3/a)

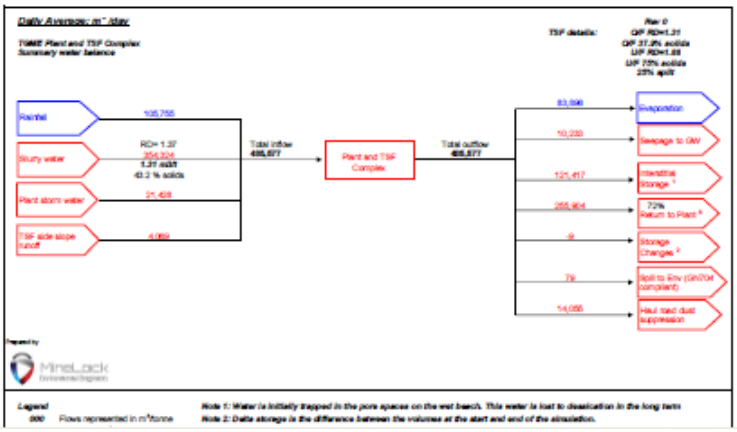
  Total outflow: 485 577 m^3/a

The daily average and annual flow diagram calculated and modelled by Minelock Environmental Engineers is attached to Appendix 1.

[38] TGME Conceptual Engineering Design for Storm Water Management Plan of Plant. MineLock. October 2020

5.2 Process Flow Description (Daily Average)





5.3 Monitoring Requirements at MR83

5.4 Water Resources Monitoring

A surface water quality monitoring programme is essential as a management tool to detect negative water quality impacts as they arise and to ensure that the necessary mitigation measures are implemented. The proposed monitoring programme is discussed below.

5.4.1 Surface Water Quality Monitoring

Surface water quality data was obtained from the following sources:

- Monitoring undertaken by TGME;
- Geohydrological Study for the project (van Biljon, 2020)[39];
- Additional monitoring by OMI. (May-August 2020)

The data provided by TGME was evaluated for the purpose of this Report, in order to determine the current situation with regard to the impact of the mining activities on water quality.

TGME has had a surface water monitoring programme in place since 2012 under the current ownership of Theta Gold SA (previously Stonewall Mining). Prior to Theta, samples were taken by Simmer and Jack (2003-2008). There are three areas of monitoring, namely around the central TGME plant area, the Frankfort area and the Morgenson area.

TGME is currently taking surface water samples as per the legal requirements of the existing water use licence (WUL 24023343) and as part of the care and maintenance program on site.

The surface water locations in the current water use licence need to be amended as some of the location descriptions have changed, ID numbers have changed and some location's coordinates were wrongly captured. Table 40 Indicates the original description as well as the proposed amended description of the monitoring locations.

[39] Final Report. TGME Geohydrological Study for the Theta Hill Project, Pilgrims Rest Region. June 2020 – MvB Consulting.

Table 40: Surface water monitoring locations as per WUL

Original Clause				**Amendment Proposed**				**Comments/Justification**
Site ID	**Name used by TGME**	**Co-ordinates**	**Description**	**Site ID**	**Name used by TGME**	**Co-ordinates**	**Description**	
Existing Sites								Heading "Existing site" can be removed, as all sites in the amended table exist and are sampled
S3	Plant causeway	*30.73877 24.92018*	Point in Blyde River upstream of Plant	S3	Plant causeway	**-24.920173 30.738801**	Point in Blyde River upstream of Plant	Coordinates to be amended
S4	*Beta Peachtree*	*30.73482 24.91165*	Point in tributary of Blyde River downstream of Beta	S4	**Beta/Peachtree confluence**	**-24.911948 30.735136**	Point in tributary of Blyde River downstream of Beta	Coordinates to be amended The name of the monitoring site has changed
S5	Beta causeway	*30.73509 24.91190*	Point in Blyde River downstream of plant	S5	Beta causeway	**-24.911658 30.734271**	Point in Blyde River downstream of plant	Coordinates to be amended
S6	Reclamation site	*30.74501 24.90501*	Point in Blyde river downstream of slimes dam and old historical tailings dumps	S6	Caravan Park	**-24.90574 30.745933**	Sampling point downstream of historic mine dumps inside the Caravan Park	Coordinates to be amended
S12	*Lisbon Creek*	*30.73662 24.80639*	Point in tributary of Molototse river upstream of Frankfort mine	S12	**Molototsi waterfall**	**-24.801455 30.733983**	Point in tributary of Molototse river upstream of Frankfort mine	Name and coordinates to be amended
S14	Hostel	*30.74328 24.81004*	Point in Molototse river downstream of Frankfort mine	S14	Hostel	**-24.810108 30.743515**	Point in Molototse river downstream of Frankfort mine	Coordinates to be amended
S13	*Bevets stream*	*30.74196 24.81097*	Point in Molototse spruit downstream of point S14	S13	**Vaalhoek**	**-24.789272 30.774027**	Downstream point in tributary of Molototse near Vaalhoek road	Name and coordinates changed
S1	Morgenson	30.72430 24.87478	*Water quality in tributary*	S1	Morgenson	-24.87478 30.72430	**Point upstream of infrastructure at Morgenson mine**	Description to be amended
S2	Lower Clewer	30.72618 24.87453	Downstream of Morgenson and Clewer Mine	S2	Lower Clewer	-24.87453 30.72618	Downstream of Morgenson and Clewer Mine	No changes

Original Clause				Amendment Proposed				Comments/Justification
Site ID	**Name used by TGME**	**Co-ordinates**	**Description**	**Site ID**	**Name used by TGME**	**Co-ordinates**	**Description**	
New Sites								Heading "New sites" can be removed as all sites in the amended table exist and are sampled
S15		-	*Further upstream point of S14*	S15	**Bevetts stream**	**-24.811176 30.741912**	**Point in Molototse spruit upstream of point S14**	Name and coordinates to be added. Description to be amended
S16		-	Downstream point in tributary of Molototse	S16	**Theta stream**	**-24.806142 30.736448**	**Point in tributary of Molototse river**	Name and coordinates to be added. Description to be amended.
S17		-	*Upstream point of infrastructure at Morgenson mine*					**Point S17 to be removed from table – is same as S1**
S18		-	*Separate upstream and downstream points at Dukes Hill Upper and Lower mines*	**BSW27**	**Dukes Upper**	**-24.885944 30.724999**	**Point at Dukes Upper mine**	Site ID and description to be amended. Name and coordinates to be added
				BSW30	**Dukes Lower**	**-24.885401 30.731297**	**Point at Dukes Lower mine**	Site ID and description to be amended. Name and coordinates to be added
S19		-	Surface water monitoring point between slimes dam and old historical tailings dumps	S19	**Historic Mine Dump**	**-24.910300 30.738175**	Surface water monitoring point between slimes dam and old historical tailings dumps	Name and coordinates to be added
S20		-	Surface water monitoring point upstream of Beta mine waste rock dump in tributary of Blyde river	S20	**Peach Tree**	**-24.910081 30.730078**	Surface water monitoring point upstream of Beta mine waste rock dump in tributary of Blyde river	Name and coordinates to be added
G3	*Morgenson*		*Borehole downgradient of Beta mine*	**BSW13**	**Morgenzon Adit**	**-24.8743 30.7244**	**Morgenson adit decant at Wilgerboom**	Point to be added to this table (moved from groundwater table) as it is not a borehole. Decant water = surface water

5.4.3.3 Chemical Parameters:

Table 41: List of variables for groundwater and surface water as listed in the current water use licence

Table 41: Original clause in theWUL for both ground and surface water variables

Original Clause		
Variable	**Variable**	**Variable**
pH – Value at 25°C	Electrical Conductivity at 25°C	Total Dissolved Solids (mg/l)
Chloride (mg/l)	Sulphate (mg/l)	Magnesium (mg/l)
Calcium (mg/l)	Potassium (mg/l)	Aluminium (mg/l)
Manganese (mg/l)	Iron (mg/l)	Suspended Solids (mg/l)
Ammonium (mg/l)	Orthophosphate (mg/l)	Nitrate (mg/l)
Free Cyanide (mg/l)	Total Cyanide (mg/l)	Arsenic (mg/l)

All samples were analysed for cyanide and mercury to establish base line conditions before mining operations commence.

This table should be amended and the following parameters should be included in the monitoring of the site as per Table 42.

Table 42: The following variable shall be analysed for surface water monitoring

Amendment Proposed		
Variable	**Variable**	**Variable**
pH – Value at 25°C	Electrical Conductivity at 25°C	Total Dissolved Solids (mg/l)
Chloride (mg/l)	Sulphate (mg/l)	Magnesium (mg/l)
Calcium (mg/l)	Potassium (mg/l)	Aluminium (mg/l)
Manganese (mg/l)	Iron (mg/l)	Suspended Solids (mg/l)
Ammonium (mg/l)	Orthphosphate (mg/l)	Nitrate (NO3) (mg/l)
Free Cyanide (mg/l)	Total Cyanide (mg/l)	Nitrite (NO2) (mg/l)
Arsenic (mg/l)	Sodium (mg/l)	Zinc (mg/l)
Total Alkalinity (mg/l)	Copper (mg/l)	Mercury (mg/l)
Turbidity (NTU)	Lead (mg/l)	Nickel (mg/l)
Fluoride (mg/l)		

5.4.1.1 *Frequency of sampling*

Monthly samples need to be taken of all surface water monitoring locations. The mine takes weekly readings at each monitoring location using probes/field instruments. The readings taken are pH, temperature, and EC. Data from 2012 to October 2019 was provided for each surface water location around the TGME plant area.

The mine collects surface water samples on a monthly basis, which in the past were sent to DD Science Environmental for analysis. DD Science is an independent commercial laboratory located in Randfontein. They provide support and advisory service to customers in the areas of water and wastewater quality and

general environmental and analytical chemistry. DD Science is a SANAS Accredited Laboratory and meets the requirements of ISO/IEC 17025. In the future TGME will make use of Regen water

OMI took samples from May 2020 – August 2020. These samples were taken to Waterlab and Aquatico laboratory. Water lab is a SANAS accredited laboratory T0391. Aquatico is also a SANAS ISO17025:2017 accredited testing laboratory.

5.4.2 Recommendation regarding surface water monitoring

Analyses of the surface water qualities showed that the in-stream water quality remain consistent throughout the monitoring area, the exception being S3 which had a massive spike in salt content. This spike was localised and not reflected in the downstream points which suggests it was an irregular event and the sample was taken shortly after the activity event. The remainder of the water quality remained within the average ranges throughout the three-month period. For the elements that were not detected throughout the entire monitoring period it may be concluded that these elements do not pose a risk as a result of the mining activities. It would therefore not be necessary to test for these monthly, analyses would only be required if there is probable cause of mining contamination taking place in the future, to determine if the risk factor for these elements has changed.

Water monitoring strategies are in place to ensure that the mining activities are not negatively impacting the surrounding environment, and that should always be the primary outcome. Where sampling shows that there is a potential impact, it is important to investigate the possible source and adjust the monitoring programme to be more effective in managing and mitigating these impacts.

5.4.3 Groundwater monitoring

A groundwater monitoring network is currently in place, but it is recommended that the monitoring programme be upgraded and expanded. shows the recommended monitoring borehole locality plan.

The groundwater monitoring locations as per the current licence is described in Table 43

Table 43: Groundwater Monitoring Locations – Greater TGME

Original Clause				**Amendment Proposed**				**Comments/Justification**
Site ID	**Name used by TGME**	**Co-ordinates**	**Description**	**Site ID**	**Name used by TGME**	**Co-ordinates**	**Description**	
Existing Sites				Existing Sites				
G4	*BH1 at return water dam*		Borehole downgradient of return water dam and slimes dam·	**BGW4**	**TGME TSF BH4**	**-24.9120 30.7364**	Borehole downgradient of return water dam and slimes dam·	Site ID and name to be amended. Coordinates to be added
G5	*BH1 at return water dam*		Second borehole downgradient of return water dam and slimes dam	**BGW4a**	**TGME TSF BH4a**	**-24.9123 30.73598**	Second borehole downgradient of return water dam and slimes dam	Site ID and name to be amended. Coordinates to be added
G6	TG2 5m		Borehole downgradient of plant	**BGW2**	TG2 5m	**-24.9187 30.7381**	Borehole downgradient of plant	Site ID to be amended. Coordinates to be added
G7	TG2-30m		Second borehole downgradient of plant	**BGW2a**	TG2-30m	**-24.9189 30.73832**	Second borehole downgradient of plant	Site ID to be amended. Coordinates to be added
G1	*Borehole Clewer*		Borehole downgradient of Clewer Adit	**BGW9**	**Clewer Main**	**-24.8749 30.7258**	Borehole downgradient of Clewer Adit	Site ID and name to be amended. Coordinates to be added
G2	*Morgenson*		*Second Borehole downgradient of Clewer Adit*	**BGW10**	**Morgenzon Main**	**-24.8747 30.7245**	**Borehole downgradient of Morgenson Mine**	Site ID, name and description to be amended. Coordinates to be added
G3	*Morgenson*		*Borehole downgradient of Beta mine*					**Point moved to surface water monitoring table as actual point is not a borehole, it is decanted water on surface**
Beta mine	*BH3*		*Borehole downgradient of Beta mine*					**Point to be removed, borehole does not exist anymore**
				BGW5	**TSF East**	**-24.9152 30.74446**	**Borehole east of TSF**	Existing point to be added to WUL
				BGW6	**TSF East Road Side**	**-24.9126 30.74426**	**Borehole east of TSF towards river**	Existing point to be added to WUL
				BGW7	**TSF East River Side**	**-24.9114 30.74384**	**Borehole below TSF towards river**	Existing point to be added to WUL
				Hostel BH	**Fankfort Old Hostel**	**-24.8105 30.74161**	**Borehole by old hostel/Frankfort security gate**	Existing point to be added to WUL

5.4.3.1 *Monitoring Parameters*

The identification of the monitoring parameters is crucial and depends on the chemistry of possible pollution sources. They comprise a set of physical and/or chemical parameters (e.g. groundwater levels and predetermined organic and inorganic chemical constituents). Once a contaminant indicator has been identified it can be used as a substitute to full analysis and therefore save costs. The use of pollution indicators should be validated on a regular basis in the different sampling positions. The parameters should be revised after each sampling event; some metals may be added to the analyses during the operational phase, especially if the pH drops.

5.4.3.2 *Physical Parameters:*

- Groundwater levels.
- In-field measurements of Temp, EC, TDS and pH.

5.4.3.3 *Chemical Parameters:*

The list of variables as in the water use licence for ground and surface water. (Table 44)

Table 44: List of variable for groundwater and surface water as listed in the current water use licence

Original Clause		
Variable	**Variable**	**Variable**
pH – Value at 25°C	Electrical Conductivity at 25°C	Total Dissolved Solids (mg/l)
Chloride (mg/l)	Sulphate (mg/l)	Magnesium (mg/l)
Calcium (mg/l)	Potassium (mg/l)	Aluminium (mg/l)
Manganese (mg/l)	Iron (mg/l)	Suspended Solids (mg/l)
Ammonium (mg/l)	Orthphosphate (mg/l)	Nitrate (mg/l)
Free Cyanide (mg/l)	Total Cyanide (mg/l)	Arsenic (mg/l)

This table should be amended and the following parameters should be included in the monitoring of the site as per Table 45.

Table 45: The following variables shall be analysed for ground water monitoring

Amendment Proposed		
Variable	**Variable**	**Variable**
pH – Value at 25°C	Electrical Conductivity at 25°C	Total Dissolved Solids (mg/l)
Chloride (mg/l)	Sulphate (mg/l)	Magnesium (mg/l)
Calcium (mg/l)	Potassium (mg/l)	Alkalinity as CaCO3 (mg/l)
Manganese (mg/l)	Iron (mg/l)	Barium as Ba (mg/l)
Ammonium (mg/l)	Orthophosphate (mg/l)	Nitrate (mg/l)
Boron as B (mg/l)	Chemical Oxygen Demand	Arsenic (mg/l)
Cadmium as Cd (mg/l)	Copper as Cu (mg/l)	Mercury as Hg (mg/l)

Boron as B (mg/l)	Fluoride as F (mg/l)	Sodium as Na (mg/l)
Cadmium as Cd (mg/l)	Lead as Pb (mg/l)	Total chromium as Cr (mg/l)

5.4.3.4 *Monitoring Frequency*

In the operational phase and closure phase, biannual monitoring of groundwater quality and groundwater levels is recommended. Quality monitoring should take place during the wet and dry seasons, i.e. during June and December. It is important to note that a groundwater-monitoring network should also be dynamic. This means that the network should be extended over time to accommodate the migration of potential contaminants through the aquifer as well as the expansion of infrastructure and/or addition of possible pollution sources.

5.4.4 Recommendation regarding groundwater monitoring

- The current groundwater and surface water hydrochemistry indicates that AMD drainage conditions have not developed in response to the historic tailings facilities. The geochemical modelling indicates that this scenario is likely to perpetuate into the future.
- The hydrochemical data of the recent groundwater and surface water indicates that the historic tailings have not had an environmental impact in terms of the leaching of metals and metalloids. This geochemical model indicates that this scenario is likely to be perpetuated into the future.
- The current groundwater and surface water hydrochemical data indicates that the historic tailings have an insignificant impact on the local environmental in terms of sulphate concentrations. The geochemical modelling indicates that this scenario is likely to be perpetuated into the future.
- Nitrate concentrations of the historic tailings indicates that the tailings is not likely to have an environmental impact in the long-term, as the older tailings material are not associated elevated nitrate and ammonia concentrations. This is due to the natural denitrification process which occurs due to the presence of denitrifying bacteria in the soil, groundwater and surface water.

5.5 Bio-monitoring

Mining, especially the open cut mining for gold ore, can have detrimental effects on the health of freshwater ecosystems which are often not indicated through chemical analysis alone. Stressors such as habitat disturbance, increased or decreased flow, resulting either from the discharge of clean storm water or the abstraction of water, can affect the health of the freshwater ecosystem.

Aquatic bio-monitoring is the science of inferring the ecological conditions of rivers, lakes, streams and wetlands by examining the organisms that live there. A bio-survey is a class of bio-monitoring in which an entire community of organisms is sampled, to see what types of invertebrates, algae, macrophytes (aquatic plants), fish or amphibians remain. The method is based on the principle that different aquatic organisms have different tolerances to pollutants, and that certain organisms will appear under conditions or pollution, while others will disappear. The assessment of biota in freshwater ecosystems is a widely recognised means of determining the condition or health of the ecosystem.

The South African Scoring System version 5 (SASS5)[40], which has been accredited to ISO standards, is the biological index used for assessing aquatic invertebrate fauna. This index is based on the presence of families of aquatic invertebrates and their perceived sensibility to water quality changes.

In order to directly measure, assess and report on the current health status and long-term trends of the state of the aquatic ecosystem associated with the activities assessed in the study area, the establishment of an aquatic monitoring programme is recommended. [41]

The purpose for such a monitoring strategy will be to examine the long-term environmental trends of the aquatic resources associated with the activities related to the proposed open cut operation in a practical and achievable manner.

Aquatic macro-invertebrates must be sampled using the latest SASS method.

The following recognised bio-parameters and methods must be used.

- Aquatic invertebrates (South African Scoring System version 5 — SASS5). In addition to using this method the operators (or their appointed consultant) must be accredited SASS5 practitioners.
- Aquatic macro-invertebrate habitat availability: Invertebrate Habitat Assessment System (IHAS Version 2) and HQI (Habitat Quality Index). Used in conjunction with the SASS5 protocol.

The frequency for such a monitoring programme should be bi-annual during the construction and operation phase of the project. Thereafter, any non-compliance with the RQOs should be identified and mitigated accordingly.

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[40] Watercourse Ecological Assessment and Impact Assessment as part of the Water Environmental Authorisation and Environmental Impact Assessment (EIA) Process for the TGME Theta Project to include the Theta Hill, Brown Hill and Iota Hill near Pilgrim's Rest, Mpumalanga. Scientific Aquatic services, July 2020.

[41] Same Report as Footnote 54

The aquatic ecological assessments were performed at four sites along the Blyde River during October 2018, March 2019 and January 2020, namely:

- **BUS**: Upstream of the study area;
- **BMS 1:** Within the study area;
- **BMS 2:** Within the study area;
- **BDS:** Downstream of the study area and
- **PTS:** An unnamed tributary of the Blyde River locally known as Peach Tree Stream.
- **BRN1:** Between Iota Pit & Browns Opencast Pit;
- **BRN2:** Adjacent to the Pit WRD
- **BRN3:** Downstream of the study area and the Pilgrims Rest town and WWTP (sewage)
- **PCN1:** Upstream of the Theta North Mall Pit
- **PCN2:** Down gradient of the Theta North Small Pit, the Theta Main Pit & Browns Pit;
- **BRO1:** Located at selected points on the Blyde;
- **BRO2:** Located at selected points on the Blyde;
- **GOP:** Located at selected points on the Blyde;
- **PCO1:** Located at selected points on the Pilgrim's Creek;
- **PCO2**: Located at selected points on the Pilgrim's Creek.

During the January 2020 assessment an additional three sites were assessed on the Blyde River (**BRN1, BRN2 and BRN3**), and an additional two sites were assessed on another tributary of the Blyde River known as the Pilgrim's Creek. Assessment of points on the PTS, the Blyde River and the Pilgrim's Creek included the following:

- assessment of the *in-situ* water quality;
- a survey of habitat conditions for aquatic macro-invertebrates;
- aquatic macro-invertebrate community integrity; and
- fish community integrity.

The protocols of applying the indices were strictly adhered to, and all work was carried out by a South African River Health Program (SA RHP) accredited assessor. An impact assessment based on the findings of both the desktop and field assessments is provided. Table 46 contains geographic information for each of the biomonitoring assessment points.

Table 46: Co-ordinates of the bio monitoring sampling points on the Blyde river & associated tributaries

Site*	Study Area	Description	GPS co-ordinates	
			South	East
BUS	Between Theta Pit and Browns Pit Opencast	Upstream site situated in the upper reaches of the Blyde River, upstream from the town of Pilgrims Rest and the active mining area. Site serves as a reference site for the sites further downstream as well as for future monitoring.	24°55'36.69"	30°44'37.69"
BMS1	Between Iota Pit and Browns Pit Opencast	Located downstream of the BUS site, below the mine's site office on the Blyde River adjacent to the Iota Hill study area.	24°54'43.43"	30°44'06.58"
BMS2		Located downstream of the BMS1 site, downstream of the confluence of the Peach Tree Stream flowing adjacent to Iota Hill Opencast study area.	24°54'37.93"	30°44'19.96"
BDS	Downstream of Iota Pit Opencast	Downstream site situated in the lower reaches of the Blyde River, downstream of Pilgrim's Caravan Park and Iota Hill Opencast study area.	24°53'53.69"	30°45'01.49"
PTS	Adjacent to Iota Pit Opencast	Located on an unnamed tributary, locally known as Peach Tree Stream (PTS) of the Blyde River adjacent to the Iota Hill Opencast study area.	24°54'34.74"	30°43'25.38"
BRN1	Between Iota Pit and Browns Pit Opencast	Located in the upper reaches of the Blyde River, downstream of the BUS site, but upstream of the BMS1 site and mine's site office.	24°55'12.99"	30°44'19.50"
BRN2	Adjacent to the Iota Pit WRD	Located downstream of site BMS2 and downstream of various small-scale artisanal mining operations. Located upstream of the Pilgrim's Caravan Park.	24°54'18.09"	30°44'45.42"
BRN3	Downstream of the study area and the Pilgrims Rest town and WWTW	Located at the historical River Health Programme (RHP) monitoring site, downstream of the Pilgrim's Rest town and downstream of the Pilgrim's Rest WWTW facility.	24°52'40.05"	30°45'39.65"
PCN1	Upstream of the Theta North Small Pit	Located on the Pilgrim's Creek upstream of the historical town of Pilgrims Rest and the proposed mining operations.	24°55'10.21"	30°46'4.30"
PCN2	Downgradient of the Theta North Small Pit, the Theta Main Pit and the Browns Pit	Located on the Pilgrim's Creek downstream of the historical town of Pilgrims Rest and the proposed mining operations prior to its confluence with the Blyde River	24°53'53.97"	30°45'6.73"
BRO1	Visual observation points within and in the vicinity of the proposed project area	Located at selected points on the Blyde River	24°54'30.16"	30°44'50.53"
BRO2			24°54'21.91"	30°44'44.34"
GOP			24°53'53.70"	30°45'2.48"
PCO1		Located at selected points on the Pilgrims Creek	24°54'23.20"	30°45'26.45"
PCO2			24°54'1.15"	30°45'11.77"

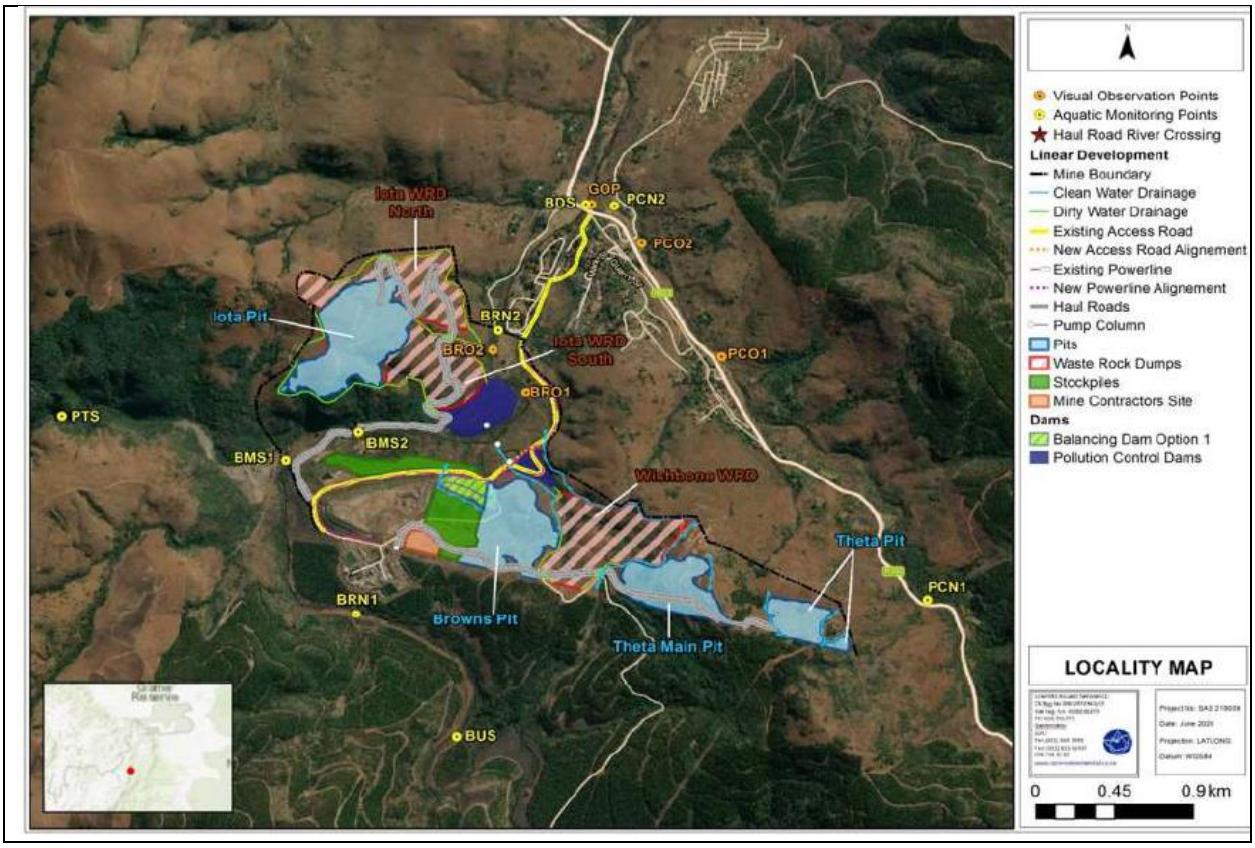

Figure 43: Aquatic Ecological Assessment points around the TGME plant area

5.6 Waste Monitoring

The objective of waste monitoring is to ensure and check that all waste is managed sufficiently. It is also to monitor and ensure that there is minimal risk to the environment. Thus the following objectives have been developed:

- Avoid and minimise the generation of waste;
- Reduce, recycle and recovering of waste;
- Minimise the consumption of natural resources;
- Meet regulatory requirements;
- Prevent pollution and ecological degradation.

Waste should be separated into the different waste types and disposed of in designated waste skips and bins. Domestic waste will be removed and disposed of at a suitable facility in the area.

Hazardous waste will also be disposed of in suitable containers and taken to an appropriate disposal site. Contractors are responsible for the removal of these waste skips. Skips should be emptied regularly (once a month or when full) or removed and replaced with empty skips.

The contractors should keep record of the volumes of waste removed from TGME. These volumes should be reported to the mine. All waste figures will be assessed 6-monthly and will be reported with the EMP performance assessment.

5.6.1 Waste Rock

The overburden or waste material will be removed with a combination of excavators and trucks, with breaking of ground being done by dozers or eccentric rippers. Material requiring no breaking will be free dig and will be removed with a truck and shovel combination.

The planned mining strategy is to utilise space in the mined-out areas for backfilling with waste/overburden, which will ultimately reduce the waste rock dump footprint.

The volume of waste rock moved will be recorded on a monthly basis. This information will then be included in the annual performance assessment.

5.6.2 Data Management and Reporting

The mine should have internal databases in place in order to correctly report all relevant information. This database(s) will ease the process of auditing, since all the information will be together.

Databases need to be established for the following monitoring data:

- Water;
- Dust;
- Waste rock;
- Incidents.

Data can then be extracted from the databases and compiled (using tabular and graphical formats) for submission as part of the annual EMP performance assessment.

5.7 Incident recording

All environmental incidents/accidents or disasters will be reported immediately or during the shift to the responsible manager or immediate supervisor. Contractors and employees will be trained in environmental awareness to assist in identifying such events. The immediate action will be to contain/stop the incident/accident or disaster and the next steps will depend on the nature and magnitude of the event. These steps may include (in no particular order):

- Stop the spill;
- Investigate the incidents or accident;
- Clean contaminated areas;
- Pump and store affected water;
- Construct emergency water management structures;
- Treat contaminated natural resources;
- Rehabilitation of the affected environment;

- Notify the relevant I&APs (including the DWS and DME), of moderate, major and critical indents. Incidents or accidents that fall within those ranges may have an impact on the affected downstream users, the regional users and the national users and it is therefore essential that it be reported to authorities and I&APs. Low and minor incidents however may have an impact on the natural and physical environment on site and it is therefore required to mitigate and rehabilitate the effect of the incident to reach the objectives set in the Environmental Management Program. Notification will be done by the fastest possible means and the following information will be supplied:
    - The date and time of the incident;
    - A description of the incident;
    - The source of the pollution or potential pollution;
    - The impact or potential impact on the water resource and the relevant water users;
    - Remedial action taken or to be taken or activity to remedy the effects of the incident.

Within 14 days after the date of the incident or accident or disaster a written report must be forwarded to the relevant government department stating what measures will be taken to correct and prevent a recurrence of the event.

5.8 Areas for Management Intervention

The DWA, 2010 IWWMP Guideline states that the level of management intervention and regulatory control depends on the severity of the threat posed by a potential pollution source to the receiving water resource.

Some specific aspects that require intervention:

- Stormwater management on the entire mining site is very important.
- Increased risk of sediment transport in surface runoff from surface infrastructure to watercourses, leading to altered water quality and sedimentation of freshwater systems. The management of sedimentation post closure is important. Energy dissipation measures are implemented at steep sections as well as at the exits of the proposed channels.
- Storage areas will be lined and bunded.
- According to the DWS' policies (Best Practice Guideline G1 and H3, GN704), there should be a separation of clean and dirty storm water on site. The storm water management plan should illustrate clean and dirty storm water separation. Recommendations made in the Civil engineer are as follows:
    - Confine or divert any unpolluted water to a clean water system, away from a dirty area;
    - Runoff from dirty areas must be captured, contained and managed appropriately;
    - Clean and dirty water systems must be designed and constructed to prevent cross contamination;
    - Dirty water must, as far as possible, be recycled and reused;

- Clean and dirty water systems must convey/contain runoff from the 50 year storm event, and should preferably not lie within the 100 year floodline;
- Appropriate maintenance and management of stormwater related infrastructure should always be ensured.

5.9 Monitoring of Infrastructure

Stormwater infrastructure (channels, berms, culverts, sump and dirty water dam (Example RWD, Spillage collection ponds, Frankfort settling dam and Morgenson Paddocks) must be monitored on a monthly basis during the dry season, and on a weekly basis during the wet season. The freeboard of all dirty water dams must be inspected daily. It should further be monitored immediately after every large storm event. Should blockages, silted up structures or breaches occur, immediate action should be taken to remove debris and repair breaches. Monitoring should be undertaken by the onsite Environmental Control Officer (ECO) or maintenance manager. Inspections must be recorded and should include the following:

- Date of inspection;
- Rainfall amount received in a 24-hour period prior to inspection;
- Photographs of blockages, silted up structures or breaches witnessed;
- What action was taken to fix issues, and the amount of time taken to address issues;
- Photographs post action taken.

Inspection reports should be prepared on a monthly basis and should be kept ready and supplied to the DWS when requested, and as part of the WUL conditions.

6 DEVELOPMENT OF THE IWWMP

This section describes the process that was followed with the IWWMP development from determining the existing status and establishing the expectations of stakeholders in order to determine the desired end state for formulating SMART (Specific, Measurable, Accountable, Resourced, Time-framed) management objectives, to prioritising the gaps identified, evaluating options to address the gaps and identifying preferred options for implementation.

6.1 Status Quo Assessment

The outcome of the Status Quo Assessment is documented in Chapters 2-5 above, which clearly describes the status of water and waste management at the mine.

6.2 Key Issues requiring attention as identified during the Status Quo Assessment

The **key issues** relating to water and waste management that have been identified during this Status Quo Assessment can be grouped as follows:

- The Blyde River is a highly sensitive system. These systems are thus considered to be of increased ecological importance and sensitivity. In addition to their moderately high eco-services provision and biodiversity support functions, the Blyde River and associated tributaries contribute significantly to the overall tourism potential and value of the area. Thus, it is considered to be important on a local and regional scale. This river is considered unique on a national and international level based on unique biodiversity.
- The storm water management systems need to ensure compliance to GN704[42]:
    - Ensure that clean and dirty run-off is separated. Clean storm water should be discharged to the environment and dirty storm water should be contained and recycled and re-used;
    - Preventing the risks of flooding through ensuring that the storm water diversion channels are correctly sized, and properly maintained, to enable the effective routing of storm water during flooding;
    - TGME must confirm the capacity requirements of clean and dirty water systems such that it is not likely to spill more than once in 50 years;
    - Design, construct, maintain and operate any dam that forms part of a dirty water system to have a minimum freeboard of 0.8 meters above full supply level.
- The **water quality and quantity monitoring** network requires continuous monitoring;
    - Additional Suspended Solids, Arsenic and Cyanide were added to variables monitored.
    - The sample run from May to August 2020 confirmed that none of the points indicated any cyanide or mercury concentration as it was consistently below detection limits. This

[42] GN 704 of 4 June 1999 i.t.o. section 26 of the NWA, 1998, to prevent pollution by mining and related activities aimed at the protection of water resources (Regulation 704).

indicates that there is no contribution of the mining activities to the spread of these elements, and they were not measured at any point.

- **Illegal mining** takes place and that these activities will cause environmental pollution of elements characteristic with mining activities.
- **Dust** needs to be controlled at all times in order to prevent potential health risk exposure of especially residents of Pilgrims Rest.
    - Ensure the correct application rate of watering on dirt roads, and include this water use need in the optimised water balance (average of 39m^3/day) is required as a minimum;
    - Ensure prevention of siltation.
- The **proposed water balance** needs optimisation during the construction and operation phase in order to improve water use efficiency:
    - Ensure that all water and waste streams are metered;
    - Determine how much water is lost in the process and where;
    - A water quality and quantity monitoring network, including bio-monitoring and water and waste management information management systems need to be implemented;
    - It will be necessary to implement a surface water monitoring programme,
    - Bio-monitoring should be implemented;
    - Instruments used for monitoring should be regularly calibrated

6.3 Desired End State: Management Objectives

The Desired End State with regard to water and waste management was determined by establishing the needs of the DWS, other authorities, key stakeholders and the applicant.

6.3.1 Stakeholder Input

I&APs were consulted during the renewal process of the water use licence. There was a 60 day comment period from 05 November 2020 to 25 January 2021.

Notification of the intention of TGME to apply for the renewal of the license has been advertised in the following newspapers:

Table 47: Advertisement in Local and Provincial News Papers

Newspaper	Date	Local or Provincial paper
Lowvelder	05 November 2020	Provincial
Steelburger	05 November 2020	Local
Phalaborwa Herald	November 2020	Local
GPS	13 November 2020	Local

The review period will be for 60 days starting on the 5 November until the 25 of January 2021.

The Draft WULA Report (hard copies) was also available at the following locations:

- Office of the local ward councillor, Mr. Mandla Mokoena (Pilgrim's Rest); and

- Offices of TGME near Pilgrim's Rest.
- Electronic copies were available to be downloaded from the Batho Earth website: www.bathoearth.co.za.

6.3.2 Distribution of BID

A Background Information Document (BID) was compiled. This document was distributed with a locality map to I&APs from the 05 November 2020.

6.3.3 Site Notices

Site notice boards (English) notifying stakeholders and I&APs of the proposed activity were placed at conspicuous places in the project area on 05 November 2020. These areas of placement were determined according to the number of potential I&APs that may pass by.

There should be ongoing consultation with the directly affected parties throughout the construction and operation phases of the projects. Active consultation must be initiated and maintained by TGME.

6.3.4 Meetings

During the review period a meeting is planned with the landowners. Additional focus group meetings will be held. I&APs will be requested to indicate their need for any additional or further meetings to the public participation consultant.

Suitable dates and platforms will then be communicated and arranged for such meetings.

6.3.5 Stakeholder Input

I&APs that will be included as part of the stakeholder database and that will receive information with regards to the WUL Renewal inter alia include the following:

- Government Departments:
  - Mpumalanga Department of Economic Development and Tourism (MDEDT);
  - Department of Water and Sanitation (DWS);
  - Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs (MDARDLEA);
  - Mpumalanga Department of Public Works, Roads and Transport (MDPWRT)
  - Mpumalanga Tourism and Parks Agency (MTPA)
  - Department of Environment, Forestry and Fisheries (DEFF)
- Representatives of the Thaba Chweu Local Municipality
- Representatives of the Ehlanzeni District Municipality;
- Ward Councillors;
- Non-governmental organisations;
- Community based organisations;
- South Africa Heritage Resource Agency (SAHRA);

- Representatives of Pilgrim's Rest Museum;
- Landowners and adjacent landowners;
- Parastatals / Service providers;
- General Public

I&APs that register during the process (e.g. from responses to the advertisements and site notices) will be included on the database and will receive project related information.

The I&APs register will be maintained for the duration of the study where the details of stakeholders are captured and automatically updated upon communication with the public participation office. The identification, registration, and comments from I&APs will be an ongoing activity.

6.3.6 Liaison with Dept. Water & Sanitation

A meeting and site visit with the officials of the department was held on the 16 of October 2020. The minutes and attendance register are attached to Appendix 6.

6.4 Management Options

Based on the risk assessment, it is possible to identify different option to achieve the management objectives namely to:

- Separate clean and dirty storm water;
- Ensure that all infrastructure comply with GN 704;
- The design of any dirty water impoundment according to GN704;
- Meter all waste streams;
- Control sedimentation at all times;
- If there might be a need to discharge any effluent, it must be treated before discharge;
- Consider options aimed at conservation and demand management.

6.5 Draft IWWMP

On the basis of the Key Issues identified, as well as the Management Objectives determined with stakeholder input, an IWWMP has been developed for the Greater TGME project.

The IWWMP is an Action Plan outlining the KPAs, Objectives, Targets, Roles and Responsibilities (R&R), Timeframes, Monitoring Measures and Review Periods.

This IWWMP was submitted to TGME in a draft format, and after comment by responsible parties, it has been finalised for submission to the DWS and implementation at TGME.

Table 48: Propsoed Integrated water and waste managmen palnf ro the Greate TGME unground mining porject

KPAs	Objectives	Targets & management Measures	Timeframes
Governance	Ensure that legislative requirements are addressed, especially those relating to water and waste activities.	• Ensure that IWULA is submitted to DWS in order to allow the Department to evaluate the updated IWWMP & IWULA in order to be renew the existing license; • Address all comments received in the 60 day review period.	End January 2021
Risk and liabilities impact on water resources	Ensure the implementation of a formalised dirty water and storm water management system	• Ensure sufficient storm water & pollution control measures and related infrastructure are improved and optimized to comply with GN704; • Ensure that storm water diversion channels are correctly sized, and properly maintained, including culverts, to enable effective routing of storm water during flooding at the plant area; • Ensure that there is an engineering designs for the stormwater management plan at the plant; • Ensure that engineering solutions devised for the separation of clean and dirty water are designed to withstand long-term natural water erosion; • Confirm that capacity requirements for storage of the 1:50 year flood event in all dirty water impoundments is designed and ensure that operational levels do not compromise storage capacities; • Ensure that all dirty water impoundments are properly lined;	March 2021
Water use efficiency	Ensure improved water use efficiency by optimizing the mine water balance, eliminating water losses and optimising dust control and ensuring improved water re-use and recovery.	• Update plant water balance and optimise water use efficiency; • Investigate mechanisms which will result in better water recovery that will reduce the use of water, for example: o Increase the recovery of water from the tailings dam, o Increase the re-use of contaminated water in the process water circuit.	Ongoing
Monitoring	Ensure that water quality and quantity monitoring network, water and waste information systems	• Maintain existing flow meter devices in order to facilitate the monitoring of water abstraction and consumption patterns, keep record of all measurements; • Ensure that calibrated instrumentation is used;	Ongoing

KPAs	Objectives	Targets & management Measures	Timeframes
	are improved and updated; Ensure bio-monitoring; Management of sedimentation and erosion.	• Determine the volumes of hazardous waste generated, sorted and removed by contractors, as well as the volumes of oil recycled, and determine the current level of compliance with the applicable national standards; • Determine the volumes of wastewater stored, recycled & re-used. • Determine the current level of compliance with the applicable national standards;	
Stakeholder engagement	Ensure pro-active engagement of all stakeholders to facilitate communication and agreements regarding water impacts and possible shared water responsibilities.	• Establish communication with the State - as owners of the farm Ponieskrans - to discuss shared responsibilities • Establish stakeholder forum with regular meetings (minimum annually); • Continue with ongoing liaison with external stakeholders	Ongoing

7 CONCLUSION, RECOMMENDATION AND COMMITMENT

7.1 Conclusion

Every effort has been made to source the latest information in the compilation of this IWWMP and IWULA.

All the principles contained in the Best Practice Guidelines will be utilised for al designs and management practices.

As the IWWMP is a long-term commitment, specialist studies as well as the implementation of management measures, can often take months to complete. Requirement for review is recommended to be every 2 years, but with annual audit to determine suitability and adherence to the commitments made in the IWWMP.

It is trusted that the implementation of this IWWMP will facilitate the continual improvement of water management at TGME and specific the Theta Hill operation.

7.2 Recommendations

7.2.1 Surface water monitoring

The sample run from May to August 2020 confirmed that none of the points indicated any cyanide or mercury concentration as it was consistently below detection limits. This indicates that there is no contribution of the mining activities to the spread of these elements, and they were not measured at any point. It is important to note that there was proof of illegal mining activities taking place during sampling process, and that these activities will cause environmental pollution of elements characteristic with mining activities. It will be important to take that into consideration should there be future exceedances, to determine the cause of the environmental impact. The difference in the observed water quality between TGME 02, the last point in the plant area, and at S6 which is the entrance to the caravan park shows severe illegal mining impacts due to mined material being washed into the Blyde River. Safety during sampling is of increased concern, especially regarding monitoring points S20 and BGW15 where illegal miners are present in increased frequency.

The water quality at BFW04 shows stable results that consistently meet the WUL requirements, but the other borehole results require more data to be able to make suitable conclusions. Seasonal fluctuations affect the ground water levels, so monitoring of the ground water over a longer period of time, such as through quarterly sampling, should give a better indication of the ground water qualities.

During the 4 month monitoring period there was only the one exceedance for S3 during June 2020 which was a massive salt content exceedance, that was not observed at any other points downstream and is expected to be an isolated incident or laboratory error. The remainder of the water quality remained within the average ranges over the entire period. For the elements that were not detected throughout the entire monitoring period it may be concluded that these elements do not pose a risk as a result of the mining activities, and do not have to be analysed for every month, and should only be analysed for if there

is probable cause of mining contamination taking place to determine if the risk factor for these elements has changed.

Water monitoring strategies are in place to ensure that the mining activities are not negatively impacting the surrounding environment, and that should always be the primary outcome. Where sampling shows that there is a potential impact, it is important to investigate the possible source and adjust the monitoring programme to be more effective in managing and mitigating these impacts.

7.2.2 Groundwater

The biggest concern regarding the groundwater is the potential seepage of contaminants from the mining site, specifically the TSF, to the groundwater.

Due to the low risk posed by the waste material and the mining in general there are currently no additional management requirements, other than groundwater monitoring. The planned post-closure rehabilitation of the TSF will further protect the underlying groundwater resource.

A groundwater monitoring network is in place at the TGME Project, but it is recommended that the monitoring programme be upgraded and expanded.

In the operational phase and closure phase, quarterly monitoring of groundwater quality and groundwater levels is recommended. It is important to note that a groundwater-monitoring network should also be dynamic. This means that the network should be extended over time to accommodate the migration of potential contaminants through the aquifer as well as the expansion of infrastructure and/or addition of possible pollution sources.

New mining ventures seldom have detailed, closely spaced, site-specific information and several assumptions must be made during these assessments. The TGME Project, however, is different and the closely spaced exploration drilling provided valuable information on the geology that allowed for a thorough geohydrological conceptual model to be developed. The historical mining in the region and recent studies in the existing mining areas provided valuable information that was incorporated into the assessment. This increases the confidence in the conclusions that were reached.

As mining and groundwater monitoring continues the conceptual and numerical modelling can be verified and adjusted if necessary.

7.3 Commitments

TGME is committed to the implementation of this IWWMP and compliance with all commitments made.

TGME is committed to a water management system that is guided by the requirements of applicable legislation such as the Best Practice Guidelines, The NWA, and the Regulation GN704, dated 1999 under the NWA, amongst others.

As previously indicated the water management at TGME is built on the four-step hierarchy of a water management strategy as promoted by the DWS, which can be summarised as follows:

- Dirty water catchments will be minimised and kept separate from clean catchments and all water contained here shall be re-used;
- Water utilisation will be optimised by the reuse and reclamation of contaminated storm water;
- The treated sewage effluent will be disposed of in a septic tank for re-use at the plant;
- Affected stormwater will be stored in the PCDs to be used for dust suppression.

8 IWULA AND SECTION 27 i.t.o. THE NWA, 1998 MOTIVATION

Water resources in South Africa belong to the people of South Africa and are regulated under the NWA (Act 36 of 1998). The Minister of Water and Sanitation is the custodian of all water resources in South Africa on behalf of the people of South Africa.

It must be noted that, in terms of the NWA, it is an offence to pollute any water resources to render it unfit for the propagation of fish and aquatic life, including rainwater, seawater, and subterranean water.

TGME hereby applies for an IWULA for the following Section 21 water uses as per Section 40 of the NWA:

WATER USES

The following water uses need to be renewed and licensed in terms of section 40 of the NWA.

Section 21 (a) Taking water from a water resource:

- Abstraction from Morgenson Paddocks;
- Abstraction from Molototse river at Frankfort mine;
- Taking water from the Frankfort void for usage;

Section 21 (b) Storage of water:

- *Storage of water for domestic purposed at Frankford mine;*
- *Storage of water for domestic purposed at Beta mine;*
- *Storage of water for domestic purposed at Clewer mine;*
- *Storage of water for domestic purposed at Dukes Hill mine;*
- *Storage of water for domestic purposed at Morgenson mine.*

Section 21 (c) Impeding or diverting the flow of water in a watercourse:

- Dukes Hill Upper diversion of tributary of Blyde river;
- Dukes Hill Upper diversion of another tributary of Blyde river.

Section 21(g) Disposing of waste in a manner which may detrimentally impact on a water resource:

- Underground mining void at Frankfort mine (referred to as Frankfort void);
- Waste rock dump at Frankfort mine (Frankfort WRD);
- Conservancy tank for sewage disposal at Frankfort mine.
- Waste rock dump at Morgenson offices (Morgenson WRD);
- Paddocks at Morgenson mine (referred to as Morgenson Paddocks);
- Conservancy tank for sewage disposal at Morgenson office;
- Settling dam at Frankfort mine;
- Waste rock dump at Beta mine (Beta WRD);

- Slimes dam Pilgrims rest plant (Referred to as Tailings Storage Facility – TSF);
- Return water dam with two compartments (RWD);
- The disposal of stormwater from the plant area via a sump to the Spillage collection pond as part the stormwater management plan. (Sump and Spillage collection pond at plant);
- Dust suppression.

Section 21(i) Altering the bed, banks, course or characteristics of a watercourse:

- Diversion canal around Dukes Hill Upper Waste rock dump;
- Diversion canal around Dukes Hill Upper Waste rock dump;

Section 21(j) 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

- Excess groundwater removed from underground at Clewer No. 4 adit and disposed of into the Morgenson Paddocks;
- Disposal of groundwater at the Frankfort mine into either the Frankfort void or the Frankfort Settling dam;
- The removal of water found underground at Morgenson adit 5 in order to manage excess water for the efficient continuation of mining activity and for the safety of people.

8.1 Need and desirability of the proposed activities

Theta Gold Mines Limited (Theta Gold) (previously Stonewall Resources Limited), which is listed on the Australian Securities Exchange (ASX:TGM), is an advanced gold developer with over 6Moz of gold mineral resources (JORC 2012), targeting high margin open-cut mining from 2020. Through its wholly owned South African subsidiary Theta Gold SA (Pty) Ltd (Theta), it has a 74% holding in Transvaal Gold Mining Estates Limited (TGME) as well as a 74% holding in Sabie Mines (Pty) Ltd (Sabie Mines). These two subsidiaries hold extensive rights to gold deposits in the Sabie-Pilgrims Rest goldfield.

Gold mining activities around Pilgrims Rest commenced in 1873 and it is considered to be the first official gold rush area in South Africa. An estimated 6.7 million ounces has been mined in the last 146 years of mining history. The towns of Pilgrims Rest and Sabie both owe their existence to gold mining. Furthermore, it was the mining companies that established the timber industry in the area to provide timber for underground mining and other uses such as housing.

During the past 146 years, the area has suffered some environmental degradation, both as a direct result of the mining activities and from the associated impacts of forestry, human settlement, and farming. In recent years, the socio-economic landscape has deteriorated as a result of the mine no longer being in operation. Other contributing factors to this degradation include the general reduction in tourism

revenues as a result of the closure of many businesses over time. The current unemployment rate for Pilgrims Rest and surrounds is estimated at 75%, which is more than double the national average.

The project is expected to provide benefits in the following spheres:

- Environmental remediation;
- Improvement in local socio-economic environment;
- Contribution to improving Pilgrims Rest infrastructure;
- Contribution to the national economy;
- Reduction of local and national unemployment rates.

The largest positive impacts of the project at a local level will be in the creation of jobs in the Pilgrims Rest area as well as a significant economic injection through increased expenditure on goods and services by employees and service providers. It has been clearly demonstrated that the local, and regional economy, benefits from an operational mine and this is expected to be the case.

8.2 Broad Base Black Economic Empowerment Status (BBBEE)

Theta has a 74% shareholding in both TGME and Sabie Mines (Pty) Ltd (Sabie Mines). TGME and Sabie Mines both carry out gold mining operations in South Africa. The balance of shareholding is held by Black Economic Empowerment ("BEE") entities. The South African Mining Charter requires a minimum of 26% meaningful economic participation by the historically disadvantaged South Africans (HDSAs). The BEE shareholding of Stonewall comprises a combination of local community trusts, an employees' trust and a strategic entrepreneurial partner.[43]

Theta Gold SA (Pty) Ltd is incorporated in South Africa, while its holding company, Theta Gold Limited is incorporated in Australia. The corporate structure for Theta Gold is presented in the figure below.

[43] Independent Competent Person's Report on the Sabie-Pilgrims Rest Projects, Mineral Resources Report, by Minxcon, 2019.

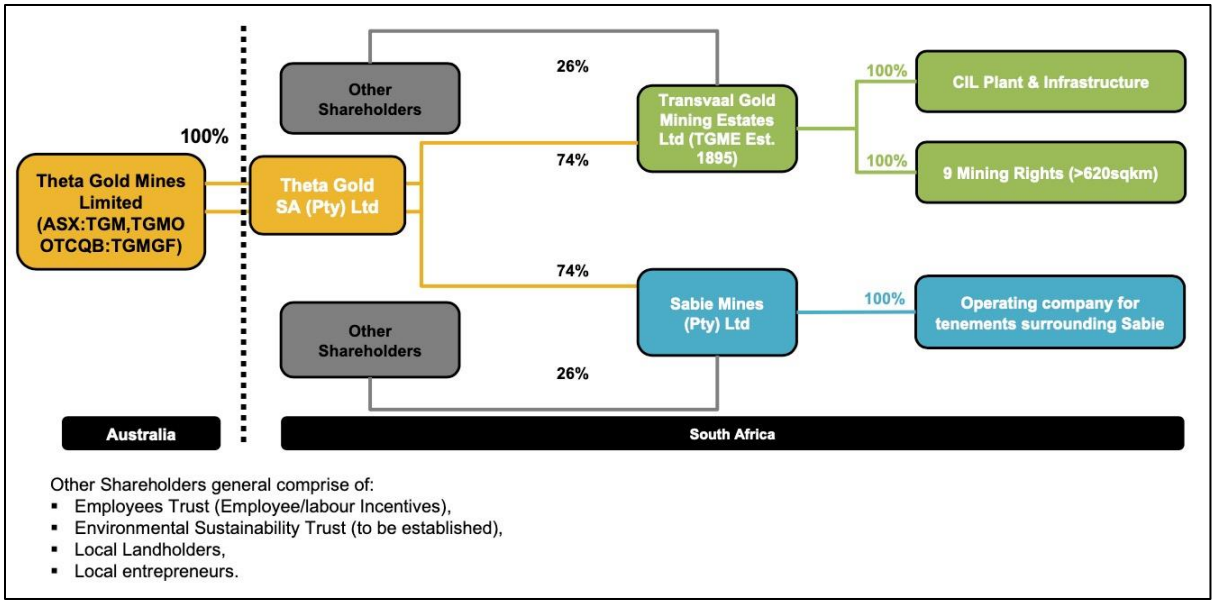

Figure 44: Theta Gold Corporate Structure 2020

8.3 Existing Lawful Water Use

TGME has a water use license, License Number 24080138 for section 21(a, c, g, i and j) water uses, dated 29 March 2011. This license expires in 2021.

TGME has a permit to abstract 469,025m^3/a (1250m^3/day) from the Blyde River. This permit also allows the mine to use 35m^3/day private water reclaimed from the old tailings dumps.

8.4 Redress of Past Racial and Gender Discrimination

Almost half of the sub-catchment (47%) does not actively take part in the economy (Figure 45). Only 27% are employed, mostly in the formal sector (66%). The two leading income groups per household are earnings of R9,601 to R19,600 and of R19,601 to R38,200 per month, accounting for 23% and 20% of households respectively (Figure 46). 14% of households have no income and 7% earn less than R4,800 per month.

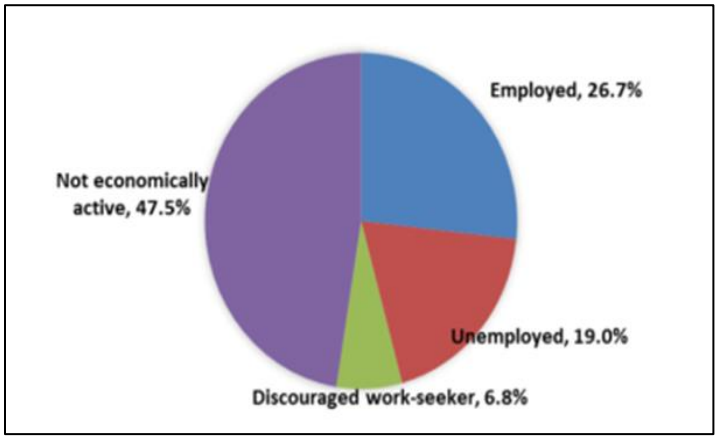

Figure 45: Employment Status (Age 15-64) Demographics in the Lower-Olifants Sub-Catchment (Census 2011)

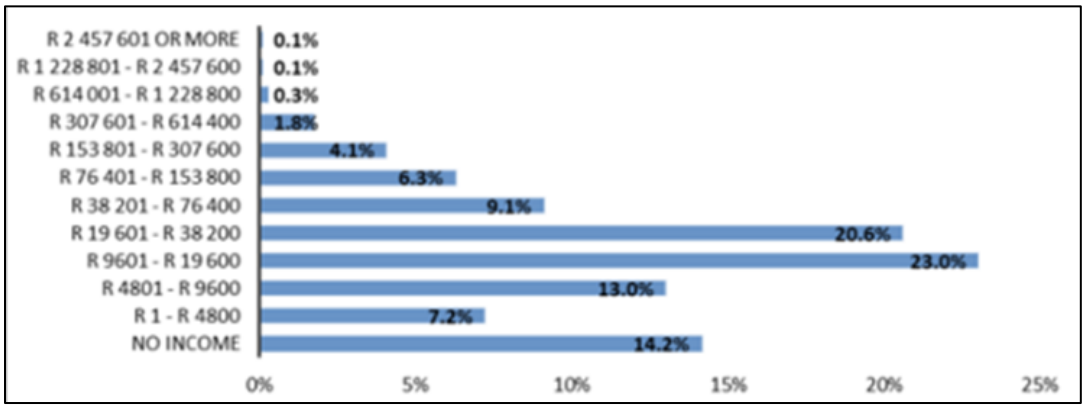

Figure 46: Income group per households in the Lower-Olifants Sub-Catchment (Census 2011)

The unemployment averages in the Pilgrims Rest and Sabie areas is above the national average of 27.5% and there is a critical need for employment in the area. In addition, it is well recognised that for every direct job created within the mining industry, a further two indirect jobs are created.

The mining industry is of great importance to the South African economy, with South Africa having one of the world's largest gold reserves.

The proposed mine is expected to have a positive socio-economic benefit through employment of locals. Recruitment of labour will be guided by TGME's recruitment policies which are expected to promote the employment of local labour by the mine as well as by any appointed contractors. A local employment procedure and recruitment process will be developed in consultation with local authorities and their representatives. Theta Gold Mine will ensure that a transparent process of employment will be followed to limit opportunities for conflict that may arise.

Theta Mine will use recruitment to meet the targets as set forth in the Social Labour Plan (SLP)[44]. Positions will be reserved and earmarked for both HDSAs and women in mining to ensure that the targets of 10% of women in mining and 40% of HDSA in all management levels are met. A total of 426 employees are envisaged to be employed during the first year of mine commissioning. Although specialist and skilled labour will be recruited outside the local boundaries due to the skills scarcity, local residents will benefit through on-the-job training for unskilled and semi-skilled labour, where possible.

The assessment of the current economic state in Thaba Chweu LM and Ehlanzeni District Municipality, the profile of the zone of influence, and the project itself revealed that the proposed mining activity will create numerous positive impacts and will likely stimulate the local economy. The stimulation of the national economy will occur as a result of the investment into the mine and proceeding increase in

[44] Social and Labour Plan. 2017-2021. MP 30/5/1/2/2/83 MR. February 2020

production. The subsequent benefits are employment creation, a rise in consumption levels, new business sales, and a contribution to Gross Domestic Product (GDP).

8.5 Efficient and Beneficial User of the Water

In terms of the NWA, no activity involving the use of water may commence without an approved water use authorisation. Thus, approval of these proposed water uses will indirectly contribute to the socio-economic development of the local region. Responsible management of the water use and adhering to the principles of water conservation and demand management will benefit the community in terms of employment.

All contaminated effluent will be isolated so as not to impact on the clean catchment area.

Monitoring of water resources will be implemented to detect any impacts in early stages and to mitigate these accordingly.

Mining activities have been taking place in the Pilgrims Rest area for the last 146 years, and as a result the area has seen some environmental degradation. In particular, the introduction of timber plantations to support early mining activities has replaced vast tracts of native vegetation. Additionally, the introduction of invasive species, such as wattle, has resulted in these species proliferating and altering the environment. In recent years the mining industry as a whole has seen a significant increase in illegal mining activities. Since the cessation of mining by TGME in early 2015, there has been an explosion of illegal mining activities in the Blyde Valley and surrounds. All these activities have resulted in a degradation of the immediate area surrounding Pilgrims Rest and the specialists have observed a degradation of the environment over the last 12 months of them visiting the project area, especially as a result of illegal mining.

8.6 Socio-Economic Impact

Pilgrims Rest has two main pillars for its economy and employment, tourism and mining.

Tourism in the area has seen a significant decline over time and in 2012 the town took a significant hit when businesses were forced to close. Since then the town has not seen the volume of tourists, particularly local tourists, as in previous years. The recent global Covid 19 Pandemic has also had a significant negative impact on tourism which is not expected to re-open until September 2020, and perhaps even later depending on local and global approaches to containing the pandemic.

Mining has always been the largest employer in Pilgrims Rest and with the mine ceasing operations in early 2015, the town's economy has declined, and the unemployment rate has increased significantly. Unfortunately, incidents of criminal activities rise with rising unemployment and Pilgrims Rest has not been spared this trend.

Given the 146 years of mining history of the Pilgrims Rest area, most of the local population are generational miners with some being up to sixth generation miners. Pilgrims Rest was built by mining and the town and immediate surrounds have co-existed with mining for many years, with the positive effects of an operational mining company clearly demonstrated through multiple mining periods.

There has been a significant increase in illegal mining activities in the area since the mine ceased operations in May 2015. This has led to secondary crime in the area which is directly impacting the local community. While the mine was operational, a specialist team was contracted to deal with illegal miners, and they had successfully eradicated the illegal mining gangs and syndicates. Since the mine's closure and the departure of this team, an estimated 30 illegal smelters have been established in the local communities. As part of the planned Theta Project there is a budget which includes the re-engagement of a specialist team to remove the illegal miners in the area. The Greater TGME mines will also benefit from this strategy.

The applicants corporate and social responsibility activities are well documented including:

- sponsoring 3 teachers and an assistant at a local school
- company providing printing facilities at the local schools
- renovation activities at the schools
- partnering in a feeding scheme for junior school children
- various local event sponsorships including annual National Gold Panning Championships

A revenue generating project will allow ongoing support for these activities and will also enable TGME to expand its SLP and CSR initiatives, particularly with a view to completing projects that can continue beyond the mine's life. These projects are expected to focus on ultimately supporting the tourism and agricultural industries.

8.6.1 Employment Equity

TGME believes that its competitiveness and ability to realise its vision depend on the competency and commitment of its employees. It therefore has an approach to HRD management, as well as a variety of HRD Programmes, aimed at enhancing the contributions made by all its employees.

At the same time the company recognizes the need to redress the imbalances of the past in line with the objectives of both MC2018 and the Employment Equity Act. To this end, transformation measures will be put in place to ensure that HDP's begin to enjoy equitable access to employment opportunities.

This will have the effect that all employees with potential and the necessary motivation will have an equal opportunity to be appointed, trained and promoted into skilled, supervisory and managerial positions as such vacancies arise. It is envisaged that addressing the equality until such time as the demographics of the work force reflects that of the country.

The Company has developed an EE Plan for TGME based on the following principles:

- The Company believes that the potential contribution of all its employees to EE should be fully exploited for the successful long-term achievement of Company objectives.
- The Company is committed to the promotion of EE as well as the elimination of any and all forms of unfair discrimination with regards to the spectrum of people, policies and practices within the Company, as envisaged by the EE Act.
- The Company confirms its commitment to the EE Act and will implement an EE Programme in line with the requirements of the Act.

- Fundamental to the Programme are the following underlying principles:
- The Company's human resources are to be optimally developed and applied within the framework of available resources;
- Selection and promotion from within the company, based on the required skills and competency. External candidates will only be considered in the case where no suitable candidates are available internally.

The Company will develop an EE Policy in consultation with any representatives, trade union, or in absence of a recognized trade union, with employees or their nominees, on conducting of the analysis to identify employment barriers, preparation of EE plan, and report on its implementation.

Having identified the gaps in the EE profile through, the skills development, Learnerships, career development pathway, and mentorship plan will be linked to the EE plan, to ensure that the current historically disadvantaged employees are given the opportunity to be promoted. If not possible to fill posts from within the mine, HDPs will be prioritised for recruitment externally.

TGME will introduce and implement the following strategies and actions:

- The responsibility for the implementation of the EE Plan and progress towards the set targets resonate with the EE Manager, or responsible person in consultation with all the relevant stakeholders. The EE Manager will be appointed in terms of Section 24 of the Employment Equity Act, 1998.
- Quarterly Progress reports will be submitted to the EE Committee and the Board for review on a bi-monthly basis.
- The annual report will be submitted to the Department of Labour on the 1st of October each year as required by law.
- All employees have a right to work in an environment that is free from any form of unfair and unlawful discrimination. The mine shall therefore ensure that there are channels for employees to raise allegations of discrimination which will then be addressed by Management.
- The achievements of targets and time-frames for the appointment of HDPs to management positions will be based on the planned complements, possible labour turnover trends, skills retention, operational requirements and the mine's Business Plan.
- The HRD Strategy and the WSP will be submitted to the MQA and will form a key component of the EE Policy and Plans.
- TGME will develop and support training and development programmes that lead to improved technical and management skills for all its employees. The number of trainees on such programmes should be at least 70% HDPs.

- Identification of high potential internal HDP candidates for inclusion into a talent pool, the fast tracking of these candidates through the relevant career paths and support for the requirement of further qualifications through the provision of support mechanisms such as granting of study leave.
- TGME will concentrate on the development of its employees but it will also recruit HDPs from external sources (local community) when appropriate.
- TGME will implement fair and effective selection processes to identify and assess the ability and potential of future and existing employees, in particular, HDPs for appointment in management positions; and
- TGME will identify those positions where HDP skill shortages are most acute and then develop a targeted strategy to recruit candidates or to develop potential candidates.

8.6.2 Skills Development

In the spirit of transformation, TGME commits to develop its workforce to meet the operational requirements of the mine, to address career aspirations of employees, to advance HDP employees to increasingly senior levels and to encourage the participation of more women in its operations.

A skills database will be kept to monitor the performance, personal attributes and abilities of its employees in order to give each employee the opportunity to advance in their career development path and to ensure that future staffing needs are filled internally wherever possible.

8.6.3 Preferential Procurement

Indirect employment/entrepreneurship opportunities must be enhanced. TGME and the contractor must support local entrepreneurs as far as possible. It must be acknowledged that there will be local entrepreneurs trying to sell their goods to the construction force. Unless managed carefully this may lead to squatter camps near the construction camps. The contractor should provide a designated area where such services can be provided – the area should ideally form part of the construction camp and be cleared and fenced. No open fires must be allowed. Food should rather be prepared off-site and transported in, or people can be encouraged to sell food parcels. The vendors must also travel in and out of the area and should not be allowed in the construction area outside the designated area. The social monitor must assist in managing this process.

This strategy is crucial in assisting with the high percentage of unemployment within the Pilgrim's Rest area.

8.6.4 Enterprise Development

An in-depth economic review of the TGME and Sabie Mines rights areas has clearly shown the only way to re-establish sustainable operations within the area is to have multiple mining operations running and to process the material through a central processing facility.

Within the application and rights areas, it was determined that each mine on a stand-alone basis cannot sustain the capital and operating costs required to produce gold; however, multiple operations allow for a sustainable overall project.

The model of having multiple mines operating together and processing ore through a central processing facility is not unusual and in addition to the fact that this was how the area was operated historically, most goldfields around the world and in South Africa are moving towards this model. This is primarily driven by the fact that individual mines are becoming more difficult to operate due to increasing costs and operational complexities such as difficult geological conditions and decreasing grades.

In order to ensure that there is a sufficiently large asset base to have a sustainable operational plan to support fund raising activities, TGME and Sabie Mines have lodged applications for new Mining rights MR10167 (TGME) and MR10161 (Sabie Mines) which are consolidations of several prospecting rights in the area.

The South African economy has been on a steady downward trajectory for the last several years. On 27 March 2020, rating agency Moody's cut South Africa's sovereign credit rating to sub investment grade, meaning the country now has a junk rating from all three major international rating agencies. The downgrade comes on the same day that South Africa entered a 21-day national lockdown in an effort to slow the spread of the coronavirus pandemic. The result of these two significant events is that the country's economy is in a very vulnerable position and is expected to significantly contract which will result in a large increase in the unemployment rate.

The company currently has a total resource base in the area of over 6.0 million ounces, which is almost the equivalent of all the gold that had been mined in the area over the last 146 years. The resource value equates to US$10.2 billion at 1,700 USD/oz, which is R172.9 billion at 16.95 ZAR/USD. This is a significant asset which, when exploited, would contribute significantly to the country's economy. The company also expects to expand the current resource base through the application of modern exploration techniques, and this would further add to the value of the area towards the economy.

The current national unemployment rate is 29.0% and the local unemployment rate in Pilgrims rest is estimated at 75%. The country is currently in the grip of the global Covid19 pandemic and coupled with a downgrade of the country's sovereign credit rating to sub investment grade unemployment is expected to rise significantly in 2020.

Treasury forecasts that the impact of the virus, and resulting lockdown period, could lead to job losses of between 690,000 and 1.79 million with a worst-case scenario being presented that unemployment could rise to over 50%.

8.6.5 Multiplier effect

Mining has a multiplier effect of 3 to 4 in the area. In other words, for every person employed in mining, 3 to 4 jobs are created in support industries. TGME has a positive socio-economic impact on the local, regional and national economy, with initiatives including the following:

- Current employment of 3 teachers and an assistant at the local Primary and High School;
- Provision of printer and copier to local school including payment of printing costs;
- Partnering with a feeding scheme for primary school children in Sabie;
- Various donations to government sponsored events such as the Department of Heritage support for the National Gold Panning tournament in Pilgrims Rest.

The company is currently spending around R800,000 per annum on these initiatives despite not being in production (*Information provided by the TGME, December 2018).*

Due to the general degradation of the socio-economic environment and the increase in unemployment, the town has seen a significant increase in criminal activities. Theft is the biggest contributor to damage and loss of infrastructure. Illegal mining activities have caused significant damage to the historical reduction works. Significant damage and loss has also occurred at:

- Historical hydroelectric plant;
- Caravan park;
- Buildings and structures in the town;
- Historical graveyard.

The company is in the process of securing the caravan park, golf course and an old house in the village with a view to improving the overall condition of these facilities and re-establishing the caravan park as an operational facility. The company has placed security at the caravan park to limit further losses in the interim.

These initiatives, however, require significant capital which will only be realised should the project become operational.

Pilgrims Rest currently suffers from a lack of government funding to maintain the overall condition of the town. A profitable gold mining operation will enable the company to assist the local town management with various maintenance and improvement initiatives, which will in turn create a more attractive tourism venue and improve the general socio-economic environment.

8.7 Catchment Management Strategy

DWS is responsible for the National Water Resource Strategy for South Africa. According to the NWA (1998), a Catchment Management Agency (CMA) should be established for each water management area. The CMA will then be responsible for the Catchment Management Strategy for each water management area.

The sourced water will be used as efficiently and as sparingly as possible and negative impacts to the water resources will be minimised by implementing monitoring of both surface and groundwater.

All water-related infrastructure will also be constructed in line with Best Practice Guidelines and will be fully compliant with all legislative requirements.

8.8 Effect on the Water Resources and Other Users

TGME is committed to adhering to the license conditions and to implement monitoring and management measures to limit any potential pollution from the site.

8.9 Class and Resource Objectives of the Water Resource

The Minister of Water and Sanitation is required to establish a classification system, and to determine the class and resource quality objectives for all or part of the resources considered to be significant. The B60A quaternary catchment is a **Class I** highly sensitive system.

Table 49 and Table 50 summarise the quantity component for the Upper Blyde River (Olifants-BLY1) which include the Ecological Water Requirement (EWR) and Basic Human Need (BHN) for the Priority areas (*DWS 2018*).

Table 49: Summary of the Quantity Component for the Upper Blyde (Olifants-BLY1)

Quaternary Catchment	Water Resource	PES	EI-ES	TES[1]	Ecological Reserve[2] (%NMAR)	BHN Reserve[3] (%NMAR)	Total Reserve[4] (NMAR)	NMAR[5] (MCM)
B60B	Upper Blyde Olifants-BLY1	C	High	B	43.08	0.005	46.085	164.45

Table 50: Summary of the Quantity Component for the Upper Blyde (Blyde – Confluence with Lisbon River)

Quaternary Catchment	Water Resource	PES	EI	ES	REC	Ecological Reserve (%NMAR)	BHN Reserve (%NMAR)	Total Reserve (NMAR)	NMAR (MCM)
B60A	Blyde (confluence with Lisbon)	C	High	Very High	C	18.73	0.015	18.745	87.10

[1] Target Ecological Category (TEC): The ultimate target to achieve a sustainable system both ecologically and economically taking into account the PES and REC.

[2] Represents the percentage of BHN.

[3] This amount represents the long-term mean based on the NMAR. If the NMAR changes, this volume will also change.

[4] The total Reserve amount accounts for both the Ecological Reserve and the Basic Human Needs Reserve (BHN).

Of particular importance is the prevention of sedimentation of the river, since the aquatic biota associated with the system are considered very sensitive to changes in habitat conditions which may be altered if excess sediment enters the system.

The objectives listed in Table 51 will be used to manage the water quality in the study area. Thus, as part of the baseline water quality assessment, the current water quality status will be benchmarked against these objectives and the water quality management will be in line with these objectives.

Water quality monitoring will also be implemented as a management tool in order to detect any negative quality impacts as a result of the proposed mining project. Where impacts are detected, mitigation measures will be implemented to reduce and prevent further impacts.

Table 51: Resource Quality Objectives for River In-stream & Biota in the Olifants Catchment (adapted from DWA, 2016)

IUA	Class[1]	River	RU	REC	RQO	Numeric Limits
13: Blyde River catchment area	I	Blyde	117	B	***In-stream habitat*** must be in a close to natural condition. ***In-stream biological assemblages*** must be in a moderately modified or better condition. The habitat requirements of species of special ecological importance must be provided for to ensure viable and sustainable populations. ***Low and high flows*** must be suitable to maintain the river habitat and ecosystem condition. ***Water quality:*** The sediment situation must be improved to support the protected status of this river	In-stream Habitat Integrity category: ≥ B (≥ 82) Fish ecological category: ≥ B (≥ 82) Macro-invertebrate ecological category: ≥ B (≥ 82) In-stream EcoStatus category: ≥ B (≥ 82) Hydrological category: ≥ B (≥ 82) Water Quality category: ≥ B (≥ 82)

[1.] Integrated Units of Analysis (IUA) are classified in terms of their extent of permissible utilization and protection as the **Class I:** indicating high environmental protection and minimal utilization; or Class II indicating moderate protection and moderate utilization; Class Ill indicating sustainable minimal protection and high utilization.

8.10 Strategic Importance of the Water Use

The proposed project will have positive social and economic benefits that will be experienced on local, regional, provincial and national scales including:

- Security of employment and subsequent contribution to stabilising the economic activity in the area;
- An increased use of existing infrastructure;
- Production and supply of a necessary resource.

8.11 Quality of the Water Resource, the Reserve and International Obligations

Section 16 of the NWA requires that the Minister and Director of DWS determine the Reserve for all or part of any significant water resource before any license can be issued. The Reserve consists of two parts: the basic human needs and the ecological reserve.

The Reserve is basically a specification of the amount of water that must be present in water resources as well as the quality of the water for the water resource to remain ecologically healthy and to be able to provide water for basic human needs.

The water uses applied for here would not impact negatively on the quantity of the water resource or on international obligations. The management measures in place will ensure that the clean water run-off is

separated from the dirty water run-off and that no polluted water will reach the natural streams, thereby meeting the quality requirements.

8.12 Duration

Authorisation for this water use is applied for, for a period of 10 years based on the estimated Life of Mine (LOM) of 25 to 30 years from the date of approval of this license, with at least an annual review process.

8.13 Major Benefits

The project is expected to provide benefits in the following spheres:

- Environmental remediation;
- Improvement in local socio-economic environment;
- Contribution to improving Pilgrims Rest infrastructure;
- Contribution to the national economy;
- Reduction of local and national unemployment rates.

Mining activities have been taking place in the Pilgrims Rest area for the last 146 years, and as a result the area has seen some environmental degradation. In particular, the introduction of timber plantations to support early mining activities has replaced vast tracts of native vegetation. Additionally, the introduction of invasive species, such as wattle, has resulted in these species proliferating and altering the environment. In recent years the mining industry as a whole has seen a significant increase in illegal mining activities. Since the cessation of mining by TGME in early 2015, there has been an explosion of illegal mining activities in the Blyde Valley and surrounds. All these activities have resulted in a degradation of the immediate area surrounding pilgrims Rest and the specialists have observed a degradation of the environment over the last 12 months of them visiting the project area, especially as a result of illegal mining.

The local socio-economic landscape will see a significant improvement once the applicant becomes operational again. Some of the improvements include, but are not limited to:

- Significant reduction in unemployment numbers through direct and indirect employment;
- Significant local, and to a lesser degree regional, economic injection through increased expenditure on goods and services by employees and service providers;
- Injection into the local and regional economy through direct purchases of goods and services by an operational mine;
- Reduction in secondary crime in Pilgrims Rest through the active removal of illegal miners;
- Opportunity to establish new SMME’s within Pilgrims Rest;
- Implementation of the applicants Social and Labour Plan will result in the delivery on community projects within the Thaba Chweu Municipality Integrated Development Plan;

- Reduction in secondary crime resulting from illegal miners as the company rolls out its specialist illegal mining teams.

There has been a significant increase in illegal mining activities in the area since the mine ceased operations in May 2015. This has led to secondary crime in the area which is directly impacting the local community. While the mine was operational, a specialist team was contracted to deal with illegal miners, and they had successfully eradicated the illegal mining gangs and syndicates. Since the mine's closure and the departure of this team, an estimated 30 illegal smelters have been established in the local communities.

The applicant's corporate and social responsibility activities are well documented including:

- Employment of 3 teachers and an assistant at the local Primary and High School;
- Provision of printer and copier to local school including payment of printing costs;
- Partnering with a feeding scheme for primary school children in Sabie;
- Various donations to government sponsored events such as the Department of Heritage support for the National Gold Panning tournament in Pilgrims Rest.

The company is currently spending around R800,000-00 per annum on these initiatives despite not being in production.

A revenue generating project will allow ongoing support for these activities and will also enable TGME to expand its SLP and CSR initiatives, particularly with a view to completing projects that can continue beyond the mine's life. These projects are expected to focus on ultimately supporting the tourism and agricultural industries.

8.14 Proposed License Conditions

For the renewal of the current license all conditions will stay as is. All volumes, capacities and footprints will stay the same, although the applicant have notified the Department that there are various errors in the current licence regarding wrong coordinates, wrong farm portions and incorrect wording of water uses. A section 158 in terms of the National Water Act has been submitted to the Department in order to amend these these conditions.

9 REFERENCES

LEGISLATION

Republic of South Africa (RSA), 2008. *National Environmental Management: Waste Act, 59 of 2008*

RSA, 2019 ***GN535*** *hereby under regulation 6(3) of the waste Exclusion Regulation, 2018 read with s72 & 73 of the National Environmental Management: Waste Act, 2008*

RSA, 2018 ***GN990*** *in terms of s69(1)(iA) read with s 71(2)(a),72 & 73 of the National Environmental Management: Waste Act, 2008. Planning and Management of Residue Stockpiles and Residue Deposits.*

RSA, 2018 ***GN715*** *terms of s69(1)(dd) read with s1 (definition of waste) of the National Environmental Management: Waste Act, 2008. The Exclusion of a waste stream or a portion of a waste stream from the definition of waste.*

*RSA, 2017 GN2****67****. Regulations Regarding the Procedural Requirements for Water Use License Applications and Appeals*

RSA, 2016 ***GN509.*** *General Authorisation in terms of Section 39 of The National Water Act, 1998 (Act No. 36 Of 1998) For Water Uses as Defined in Section 21(c) of Section 21(i)*

RSA, 2016 ***GN538****. Revision of General Authorisation for the Taking and Storing of Water*

RSA, 2016 ***GN466*** *in terms of the National Water Act, 1998. Classes and Resource Quality Objectives of Water Resources for the Olifants Catchment.*

RSA, 2015 ***GN632,*** *in terms of s69(1)(iA) as amended by GN242 of 2017 under s 19(2) read with s19(10)(a), 72 & 74 of the National Environmental Management: Waste Act, 2008. Planning and management of residue stockpiles & residue deposits from a prospecting, mining, exploration or production operation.*

RSA, 2013 ***GN921*** *in terms of s19(2) of the National Environmental Management: Waste Act, 2008. List of activities that have, or are likely to have, a detrimental effect on the environment.*

RSA, 2013 ***GN665*** *Revision of General Authorisation in terms of Section 39 of the NWA, 1998 (Revise the GA in section 3 of the Schedule to GN398 of 26 March 2004s21 (e, f, g, h &j).*

RSA, 2013 ***GN634*** *in terms of s69(1)(a, b, g, h, m ,q, r, s, dd & ee) of the National Environmental Management: Waste Act, 2008.Waste Classification & Management Regulations.*

RSA, 2013 ***GN635*** *in terms of s7(1)(c) of the National Environmental Management: Waste Act, 2008.Waste Classification & Management Regulations. National Norms and Standards for the assessment of Waste for Landfill Disposal.*

RSA, 2013 ***GN636*** *in terms of s7(1)(c) of the National Environmental Management: Waste Act, 2008. National Norms and Standards for Disposal of Waste Tot Landfill.*

RSA, 2008.National Environmental Management: Waste Act (Act 59 of 2008).

RSA, 2004. *Mineral and Petroleum Resources Development Regulations (R527 in GG 26275 of 23 April 2004).*

RSA, 2004 **GN399**, as extended by NN417 of 13 May 2011. *General Authorisation in terms of Section 39 of the NWA.*

RSA, 2002. Mineral and Petroleum Resources Development Act, 28 of 2002.

RSA, 1999. **GN704** *Regulations on Use of Water for Mining and Related Activities aimed at the Protection of Water Resources (GN704, in GG 4 June 1999).*

RSA, 1998. *National Water Act, 1998 (Act 36 of 1998).*

SABS 0286:1998 *(Later SANS 10286) The standard referred to as SABS 0286:1998 (later renamed to SANS 10286) contains fundamental objectives, the principles and minimum requirements for best practice, all aimed at ensuring that no unavoidable risks, problems and/or legacies are left to future generations (Kilani 1998).*

STANDARDS AND GUIDELINES

Dept. of Water and Sanitation, 2019. **Technical Advisory Note**: Specialist Reports on Civil Design in support of Water Use, Waste Management and/or Mining License Applications.

Integrated Water Quality Management Plan for the Olifants River System, 2018: Water Quality Status Assessment and International Obligations with respect to Water Quality Report, P WMA 04/B50/00/8916

Dept. of Water & Sanitation, 2016. Integrated Quality Management Plan for the Olifants River System. Inception Report. P WMA 04/B50/00/8916/1.

Dept. of Water & Sanitation, 2016. Integrated Quality Management Plan for the Olifants River System. Water Quality Status Assessment and International Obligations with respect to Water Quality Report. P WMA 04/B50/00/8916/3

Dept. of Environmental Affairs, 2015. NEM:WA GN633. Amendments to the list of waste management activities that have, or are likely to have, a detrimental effect on the environment

Dept. Water Affairs and Sanitation (DWS). 2014. Determination of Resource Quality Objectives in the Olifants Water Management Area (WMA4): Resource Quality Objectives and numerical limits report. report no.: RDM/WMA04/00/CON/RQO/0214.

Dept. of Water & Sanitation, 2013. Classification of Significant Water Resources in the Olifants Water Management Area: (WMA 4) WP 10383. Management Classes of the Olifants Water Management Area Report. RDM/WMA04/00/CON/CLA/0213

DWA, 2010. Operational Guideline: Integrated Water and Waste Management Plan for the preparation of the Water Quality Management Plan. Technical Document to support the Application for Licenses for

Mining and Industries in terms of the requirements of the National Water Act, 1998 ("DWA IWWMP guideline").

WRC TT147/01/2009. State of the Rivers Report, Crocodile, Sabie-Sand & Olifants River Systems.

DWAF, 2007. Best Practice Guidelines for the Protection of Water Resources in the South African Mining Industry.

DWAF, 2007. Water Use Authorisation: External and Internal Guidelines

Dept. of Water & Sanitation, 2004. Olifants Water Management Area Internal Strategic Perspective. WMA 04/000/00/0304

DWAF, 2004 Olifants Water Management Area Internal Strategic Perspective (ISP)

DWAF.2003. Water Quality Management Series Operational Guideline No U2.1. Aide Memoire for the preparation of a Water Quality Management Report to Support the Application for Licenses for Sewage Treatment Works in terms of the requirements of the NWA, Act 38 of 1998.

Dept. of Water & Sanitation, 2001. Olifants River Ecological Water Requirements Assessment; Ecological Reserve

DWAF, 2000. *Water Use Authorisation process (Individual Applications). Edition 1: Final draft for implementation and use, Rev 3.*

Ecological Reserve Report: Olifants River Ecological Water Requirements Assessment (OREWRA), 2001

Department of Water Affairs (and Forestry) *(1998). Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste, Second Edition.*

DWAF, 1996. *South African Water Quality Guidelines, Volumes 1 to 7.*

TGME REPORTS AND SPECIALIST STUDIES

MvB Consulting. October 2020. Final Report. *TGME Geohydrological Study for the Greater TGME (MR83) Project: Pilgrims Rest Region.* Report no: MVB054/18/A048.

J.A van Schalkwyk. June 2020*. Phase 1 Cultural Heritage Assessment. 2019/JvS/042 Revision 3*

TGME. February 2020. *Social and Labour Plan 2017 – 2021. MP 30/1/2/2/83 MR.*

Scientific Aquatic Services. June 2020. *Freshwater Resource and Aquatic Ecological Assessment as part of the Water Use Licensing Process for the Proposed Stonewall Mining TGME Mine Development Project, near Pilgrims Rest. SAS 219038*

GCS (Pty) LTD. 2009. *Pilgrim's Rest Trend Deposits – DG1 and DG2. Revised Environmental Impact Assessment and Environmental Management Programme Version 2, Reference 30/5/1/2/2/341.*

GCS (Pty) LTD. 2005. *Motivation Report for water Use Authorisations in terms of Section 40 of the National Water Act (Act 36 of 1998) for Simmer and Jack Mines LTD. Report 05.01.039.*

OTHER PUBLICATIONS AND SOURCES

Ehlanzeni District Municipality, 2016/17 *Final Integrated Development Plan and Budget Review.*

SDF Spatial Development Framework, 2016/17

Appendix I

Conceptual Engineering designs for the Stormwater Management Plan at the plant by Minelock (Pty) LTD. 29 October 2020

Appendix 2

Geohydrological study for the Greater TGME (MR83 Project – MVB consulting, 27 October 2020

Appendix 3

TGME no 1 Tailings Storage Facility Continuation report, September 2020 by Tailex

Appendix 4

Water quality reports by OMI – May – August 2020

Appendix 5

Minutes and attendance registry for a meeting & Site visit held with DWS – 15 October 2020

Appendix 6

Advertisement in newspapers

05 and 06 November 2020