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FRESHWATER ECOLOGICAL ASSESSMENT AS PART OF THE ENVIRONMENTAL AND WATER USE AUTHORISATION PROCESSES FOR THE PROPOSED KUDUMANE MINE EXPANSION PROJECT NEAR HOTAZEL, NORTHERN CAPE

Prepared for

SRK Consulting (South Africa) (Pty) Ltd.

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EXECUTIVE SUMMARY

The results of the assessment indicate that the assessed reach of the Ga-Mogara River associated with the existing Kudumane Manganese Resources (KMR) mine near Hotazel in the Northern Cape, is in a largely modified ecological state, due to the authorised encroachment of mining activities within the 1:100 year floodline as well as upstream impacts mostly relating to mining. Upstream activities in particular have resulted in various impacts including loss of recharge to the system, causing further moisture stress to riparian vegetation. The episodic nature of the system (last recorded surface flow prior to January 2021 was in 1988) reduces human reliance on the watercourse, however, it is deemed an important component of the overall ecology of the focus area and greater region.

Several activities necessary for the expansion of operations are proposed, many of which are within 100 m of the delineated riparian zone associated with the Ga-Mogara River. In addition, several activities are proposed directly within the river, specifically, the construction of two attenuation dams, the expansion of the existing Hotazel and York pits into the active channel of the Ga-Mogara River, and the proposed Kipling pit. These will result in loss of habitat and hydraulic connectivity as no diversion structures to retain connectivity between the attenuation dams and downstream reaches of the river are proposed. In this regard, it is strongly recommended that the proponent engage with the Department of Water and Sanitation (DWS), as the custodians of water resources in South Africa, with regards to implementing appropriate management measures in line with the mitigation hierarchy which are deemed acceptable to both the competent authorities and the proponent.

The majority of anticipated impacts associated with activities such as the York Pollution Control Dam, various Waste Rock Dumps and the upgrade of the Lilliput WWTW are likely to be of medium to low significance, provided that strict implementation of mitigation measures takes place throughout the life of the project in order to ensure where possible, the prevention and as far as possible minimisation of direct impacts as well as ensuring that cumulative impacts on the larger drainage network are also minimised as far as possible. Provided that the mitigation measures supplied in this report are implemented in conjunction with those stipulated by other specialists, impact significance may be reduced for the majority of activities.

However, the proposed attenuation dams and expansion of open cast mining within the river have the potential to have high significance, irreversible latent impacts with long-term cumulative effects on the downstream reaches of the Ga-Mogara River. Careful consideration and planning of the rehabilitation and closure of the pits and the associated cost is deemed critical to ensure that the most cost-effective design and management solution is implemented, at the outset, for the operational phase of mining while ensuring that the long term (post closure) functionality and connectivity of the Ga-Mogara River is maintained and that the RMO of the system is achieved.

Taking the above into account, it is therefore the opinion of the specialist that consideration of the value of this landscape must be considered from a freshwater and terrestrial biodiversity resource management point of view and juxtaposed with the responsibility to comply with Regulation 23 of the Mining and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA) pertaining to the optimisation of the Mining Right as well as the socio-economic and socio-cultural impact the project will have and the decision should be made and aligned with the principles of sustainable development and Integrated Environmental Management.

MANAGEMENT SUMMARY

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater ecosystem delineation and assessment as part of the Integrated Environmental Authorisation (EA) and Water Use License Application (WULA) processes for the proposed Kudumane Manganese Resources (KMR) expansion activities, near Hotazel, Northern Cape. It is the intention of KMR to expand its existing operations and construct additional infrastructure to improve production capacity.

The purpose of this report is to provide detailed information to guide the activities associated with the proposed expansion activities, to ensure the ongoing functioning of the ecosystem in such a way as to support local and regional conservation requirements and water resource management initiatives and the provision of ecological services in the local area. The study also aimed to identify and quantify any impacts on the watercourse associated with the Mining Right Area (MRA) and project area (i.e. the Ga-Mogara River), and to present a set of mitigatory measures which could be employed to minimise impacts on the receiving freshwater environment.

The assessment took the following approach:

- A desktop study was conducted, and relevant national and provincial databases were consulted. The results of the desktop study are contained in Section 3 of this report;
- A field assessment took place in July 2021, to ground-truth pre-defined points of interest and delineate the reach of the Ga-Mogara River associated with the project area. During the site assessment, factors influencing the habitat integrity of the river were noted, and the functioning and the environmental and socio-cultural services provided by the river were determined;
- A single watercourse – the Ga-Mogara River – was identified in association with the various proposed activities and was classified according to the Classification System (Ollis *et. al.,* 2013). The results of this classification are presented in Section 4.1 of this report;
- The characterisation of the watercourse is contained in Section 4.2 of this report and is summarised in the table below.

Table A: Summary of the results of the field assessment.

Present Ecological State (PES) Category	Ecological function and service provision	Ecological Importance and Sensitivity (EIS)	Recommended Ecological Class (REC) / Recommended Management Objective (RMO) and Best Attainable State (BAS)
Instream IHI: B Riparian IHI / VEGRAI: C/D	Moderately low to very low	Low / Moderate	D Maintain C/D

Following the assessment of the watercourse, the SRK Consulting (South Africa) (Pty) Ltd impact assessment method and the Risk Assessment Matrix as defined in Appendix A of Regulation GN509 of 2016 as it applies to the National Water Act, 1998 (Act No. 36 of 1998) were applied to ascertain the significance of perceived impacts on the receiving environment, should the proposed expansion activities proceed. The results of the impact and risk assessments are contained in Section 5 of this report, and key mitigation measures are provided in Section 5 and general mitigation measures in Appendix G.

Mitigation measures were developed to aid in minimising potential direct, indirect, and cumulative impacts on the receiving freshwater environment. These measures are outlined in Section 5 of this report, however the key mitigation measures are summarised below:

- Sound environmental management practices, such as dust suppression, limiting disturbance footprints, alien vegetation management, erosion monitoring and soil management and continued monitoring of ground and surface water quality (amongst others) must be applied to all activities throughout the life of mine to minimise the impact significance of edge effects;

- Options to retain hydraulic connectivity of the Ga-Mogara River must be investigated, including alternatives such as approaching the mineral resource from the west of the river so as to prevent open cast mining through the river. Should it not be possible to avoid mining through the river, the proponent must engage with the DWS with regards to implementing appropriate management measures in line with the mitigation hierarchy which are deemed acceptable to both the competent authorities and the proponent;
- Pollution prevention through appropriate management and monitoring of pollution prevention systems, with specific mention of the management of clean and dirty water separation systems, in order to prevent, eliminate and/or control potential pollution of soil, groundwater and surface water must be implemented;
- Design of infrastructure should be environmentally and structurally sound and all possible precautions taken to prevent spillage or seepage to the groundwater resources present;
- Measures to contain and reuse as much water as possible within the mine process water system must be sought, and very strict control of water consumption must take place. Detailed monitoring must be maintained to ensure that all water usage is continuously optimised; and
- The attenuation dams will need to be desilted intermittently to ensure the storage capacity is maintained. During desilting, all silt within the dam basin should immediately be removed from site in order to prevent sedimentation of the downstream areas.

It is imperative that mitigation measures are implemented throughout the life of the project in order to ensure that not only are direct impacts prevented/minimised, but that cumulative impacts on the larger drainage network are also prevented. Provided that the mitigation measures supplied in this report are implemented in conjunction with those stipulated by other specialists, impact significance may be reduced for the majority of the proposed activities, excluding the attenuation dams and opencast mining within the river.

The proposed attenuation dams and expansion of open cast mining within the river have the potential to have high significance, irreversible latent impacts with long-term cumulative effects on the downstream reaches of the Ga-Mogara River.

Taking the above into account, it is therefore the opinion of the specialist that consideration of the value of this landscape must be considered from a freshwater and terrestrial biodiversity resource management point of view and juxtaposed with the responsibility to comply with Regulation 23 of the Mining and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA) pertaining to the optimisation of the Mining Right as well as the socio-economic and socio-cultural impact the project will have and the decision should be made and aligned with the principles of sustainable development and Integrated Environmental Management.

DOCUMENT GUIDE

No.	Requirement	Section in report
a)	Details of -	
(i)	The specialist who prepared the report	Appendix G
(ii)	The expertise of that specialist to compile a specialist report including a curriculum vitae	Appendix G
b)	A declaration that the specialist is independent	Appendix G
c)	An indication of the scope of, and the purpose for which, the report was prepared	Section 1.3
cA)	An indication of the quality and age of base data used for the specialist report	Section 2.1 and 3
cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 4 and 5
d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 2.1 and 4
e)	A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Appendix C
f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives	Section 4
g)	An identification of any areas to be avoided, including buffers	Section 4.3
h)	A map superimposing the activity including the associated structure and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers	Section 4.3
i)	A description of any assumption made and any uncertainties or gaps in knowledge	Section 1.4
j)	A description the findings and potential implication\s of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities	Section 4, 5, and 6
k)	Any mitigation measures for inclusion in the EMPr	Section 5.1
l)	Any conditions for inclusion in the environmental authorisation	Section 5
m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 5
n)	A reasoned opinion -	
(i)	As to whether the proposed activity, activities or portions thereof should be authorised	Section 6
(iA)	Regarding the acceptability of the proposed activity or activities	Section 6
(ii)	If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 6
o)	A description of any consultation process that was undertaken during the course of preparing the specialist report	N/A
p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
q)	Any other information requested by the competent authority	N/A

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GLOSSARY OF TERMS

Alien vegetation:	Plants that do not occur naturally within the area but have been introduced either intentionally or unintentionally. Vegetation species that originate from outside of the borders of the biome - usually international in origin.
Alluvial soil:	A deposit of sand, mud, etc. formed by flowing water, or the sedimentary matter deposited thus within recent times, especially in the valleys of large rivers.
Base flow:	Long-term flow in a river that continues after storm flow has passed.
Biodiversity:	The number and variety of living organisms on earth, the millions of plants, animals and micro-organisms, the genes they contain, the evolutionary history and potential they encompass and the ecosystems, ecological processes and landscape of which they are integral parts.
Buffer:	A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area.
Catchment:	The area where water is collected by the natural landscape, where all rain and run-off water ultimately flows into a river, wetland, lake, and ocean or contributes to the groundwater system.
Chroma:	The relative purity of the spectral colour which decreases with increasing greyness.
Delineation (of a wetland):	To determine the boundary of a wetland based on soil, vegetation and/or hydrological indicators.
Ecoregion:	An ecoregion is a "recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterise that region".
Ephemeral stream:	Ephemeral systems flow for less time than they are dry. Flow or flood for short periods of most years in a five-year period, in response to unpredictable high rainfall events. Support a series of pools in parts of the channel.
Episodic stream:	Highly flashy systems that flow or flood only in response to extreme rainfall events, usually high in their catchments. May not flow in a five-year period, or may flow only once in several years**.**
Facultative species:	Species usually found in wetlands (76%-99% of occurrences) but occasionally found in non-wetland areas.
Fluvial:	Resulting from water movement.
Gleying:	A soil process resulting from prolonged soil saturation which is manifested by the presence of neutral grey, bluish or greenish colours in the soil matrix.
Groundwater:	Subsurface water in the saturated zone below the water table.
Hydromorphic soil:	A soil that in its undrained condition is saturated or flooded long enough to develop anaerobic conditions favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic soils).
Hydrology:	The study of the occurrence, distribution and movement of water over, on and under the land surface.
Hydromorphy:	A process of gleying and mottling resulting from the intermittent or permanent presence of excess water in the soil profile.
Hydrophyte:	Any plant that grows in water or on a substratum that is at least periodically deficient of oxygen as a result of soil saturation or flooding; plants typically found in wet habitats.
Intermittent flow:	Flows only for short periods.
Indigenous vegetation:	Vegetation occurring naturally within a defined area.
Mottles:	Soils with variegated colour patterns are described as being mottled, with the "background colour" referred to as the matrix and the spots or blotches of colour referred to as mottles.
Obligate species:	Species almost always found in wetlands (>99% of occurrences).
Perched water table:	The upper limit of a zone of saturation that is perched on an unsaturated zone by an impermeable layer, hence separating it from the main body of groundwater.
Perennial:	Flows all year round.
RAMSAR:	The Ramsar Convention (The Convention on Wetlands of International Importance, especially as Waterfowl Habitat) is an international treaty for the conservation and sustainable utilisation of wetlands, i.e., to stem the progressive encroachment on and loss of wetlands now and in the future, recognising the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value. It is named after the city of Ramsar in Iran, where the Convention was signed in 1971.
RDL (Red Data listed) species:	Organisms that fall into the Extinct in the Wild (EW), critically endangered (CR), Endangered (EN), Vulnerable (VU) categories of ecological status.
Seasonal zone of wetness:	The zone of a wetland that lies between the Temporary and Permanent zones and is

	characterised by saturation from three to ten months of the year, within 50cm of the surface.
Temporary zone of wetness:	The outer zone of a wetland characterised by saturation within 50cm of the surface for less than three months of the year.
Watercourse:	In terms of the definition contained within the National Water Act, a watercourse means: • A river or spring; • A natural channel which water flows regularly or intermittently; • A wetland, dam or lake into which, or from which, water flows; and • Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse; • and a reference to a watercourse includes, where relevant, its bed and banks.
Wetland Vegetation (WetVeg) type:	Broad groupings of wetland vegetation, reflecting differences in regional context, such as geology, climate, and soils, which may in turn have an influence on the ecological characteristics and functioning of wetlands.

ACRONYMS

°C	Degrees Celsius.
BAR	Basic Assessment Report
BGIS	Biodiversity Geographic Information Systems
CBA	Critical Biodiversity Area
CSIR	Council of Scientific and Industrial Research
DD	Data Deficient
DEA	Department of Environmental Affairs
DMR	Department of Mineral Resources
DMRE	Department of Mineral Resources and Energy
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMPr	Environmental Management Program
EN	Endangered
ESA	Ecological Support Area
FEPA	Freshwater Ecosystem Priority Areas
GIS	Geographic Information System
GN	General Notice
GMP	Gold Mining Project
GPS	Global Positioning System
HGM	Hydrogeomorphic
IWUL	Integrated Water Use Licence
LC	Least Concern
m	Meter
MPRDA	Mineral and Petroleum Resources Development Act
NBA	National Biodiversity Assessment
N/A	Not Applicable
NAEHMP	National Aquatic Ecosystem Health Monitoring Programme
NEMA	National Environmental Management Act
NEM:WA	National Environmental Management: Waste Act
NFEPA	National Freshwater Ecosystem Priority Areas
NWA	National Water Act
PES	Present Ecological State
REC	Recommended Ecological Category
RHP	River Health Program
RQIS	Research Quality Information Services
SACNASP	South African Council for Natural Scientific Professions
SAIAB	South African Institute of Aquatic Biodiversity
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SAS	Scientific Aquatic Services
subWMA	Sub-Water Management Area
WetVeg Groups	Wetland Vegetation Groups
WMA	Water Management Areas
WML	Waste Management Licence
WRC	Water Research Commission

1 INTRODUCTION

1.1 Background

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater ecosystem delineation and assessment as part of the Integrated Environmental Authorisation (EA) and Water Use License Application (WULA) processes for the proposed Kudumane Manganese Resources (KMR) expansion activities, near Hotazel, Northern Cape. It is the intention of KMR to expand its existing operations and construct additional infrastructure to improve production capacity.

KMR is in the John Taolo Gaetsewe District Municipality in the Northern Cape, approximately three (3) km south-west of the town of Hotazel, approximately 60 km north of the town of Kathu, and approximately 45 km north of Sishen Airport. KMR currently holds two Mining Rights:

1. Mining Right NC/30/5/1/2/2/0268 MR: covering the farms York A 279 and Telele 312 (hereafter referred to as “York” and “Telele”, respectively); and
2. Mining Right NC/ 30/5/1/2/2/10053 MR: over the farms Devon 277, Hotazel 280 and Kipling 271 (hereafter referred to as “Devon”, “Hotazel”, and “Kipling”, respectively).

The mine is therefore managed under two Environmental Management Programmes (EMPrs), a Water Use Licence (WUL) and a WUL Amendment. The two Mining Rights will henceforth collectively be referred to as the “Mining Right Areas (MRAs)” (Figures 1 and 2) unless referring to an individual farm.

In order to identify all potential freshwater resources that may potentially be impacted by the proposed expansion activities, a 500m “zone of investigation” around the MRA, in accordance with Regulation 509 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998), was used as a guide in which to assess possible sensitivities of 67the receiving environment. This area – i.e. the 500m zone of investigation around the MRA – will henceforth be referred to as the “investigation area”. The study and investigation areas are depicted in Figures 1 to 3.

The purpose of this report is to provide detailed information to guide the activities associated with the proposed KMR expansion to ensure the ongoing functioning of the ecosystem in such a way as to support local and regional conservation requirements and the provision of

ecological services in the local area. The study also aimed to identify and quantify any impacts on the watercourse associated with the proposed expansion activities, and to present a set of mitigatory measures which could be employed to minimise impacts on the receiving freshwater environment.

1.2 Project Description

KMR is an established opencast manganese mine and intends to expand its current operations to extend the life of its operation and improve production capacity, through the inclusion of key mining related activities and infrastructure within their approved MRAs.

The infrastructure and activities associated with the proposed KMR Expansion Project requires a new Environmental Authorisation (EA), the amendment of the mine's existing EMPrs, a Waste Management Licence (WML) and a Water Use Licence Application (WULA) to authorise the below listed **key infrastructure**:

- A new Opencast Pit mine on Kipling;
- Expansion of the Hotazel and York Opencast Pits to allow for the mining of KMRs boundary pillar associated with each pit; and
- Two attenuation dams on the Ga-Mogara River, to allow for the expansion of the York and Hotazel Opencast Pits.

The above key infrastructure will have **secondary infrastructure** and activities associated with them, which includes:

- Establishment of an additional Water Storage Tank near the proposed Kipling Opencast Pit operation, including a Potable Water Pipeline for the transfer of water between the proposed Kipling potable water storage tank and the existing Hotazel and York potable water storage tanks;
- Development and expansion of Waste Rock Dumps (WRDs) at the proposed Kipling operation and the existing Hotazel operation;
- Establishment and expansion of ore stockpiles dumps at the proposed Kipling operation and the existing Hotazel and York operations;
- New haul road between the proposed Kipling operation and the existing Hotazel operation and upgrading of the existing haul roads between the Hotazel and York operations;
- Development and expansion of sewerage treatment plants at Kipling (new), Hotazel and York (Expansion);

- Supporting infrastructure such as admin offices ancillary infrastructure on the farm Kipling;
- Waste and fuel storage areas;
- Relocation and development of new Pollution Control Dams (PCDs) at York and Kipling operations;
- Upgrading the intersection along the R380 before the R31 – intersection used by KMR as haul truck transport entrance;
- Establishment of a Contractor's camp; and
- Extension of existing mine powerlines.

The above activities are depicted in Figures 1 to 5 as they are proposed to take place within each farm.

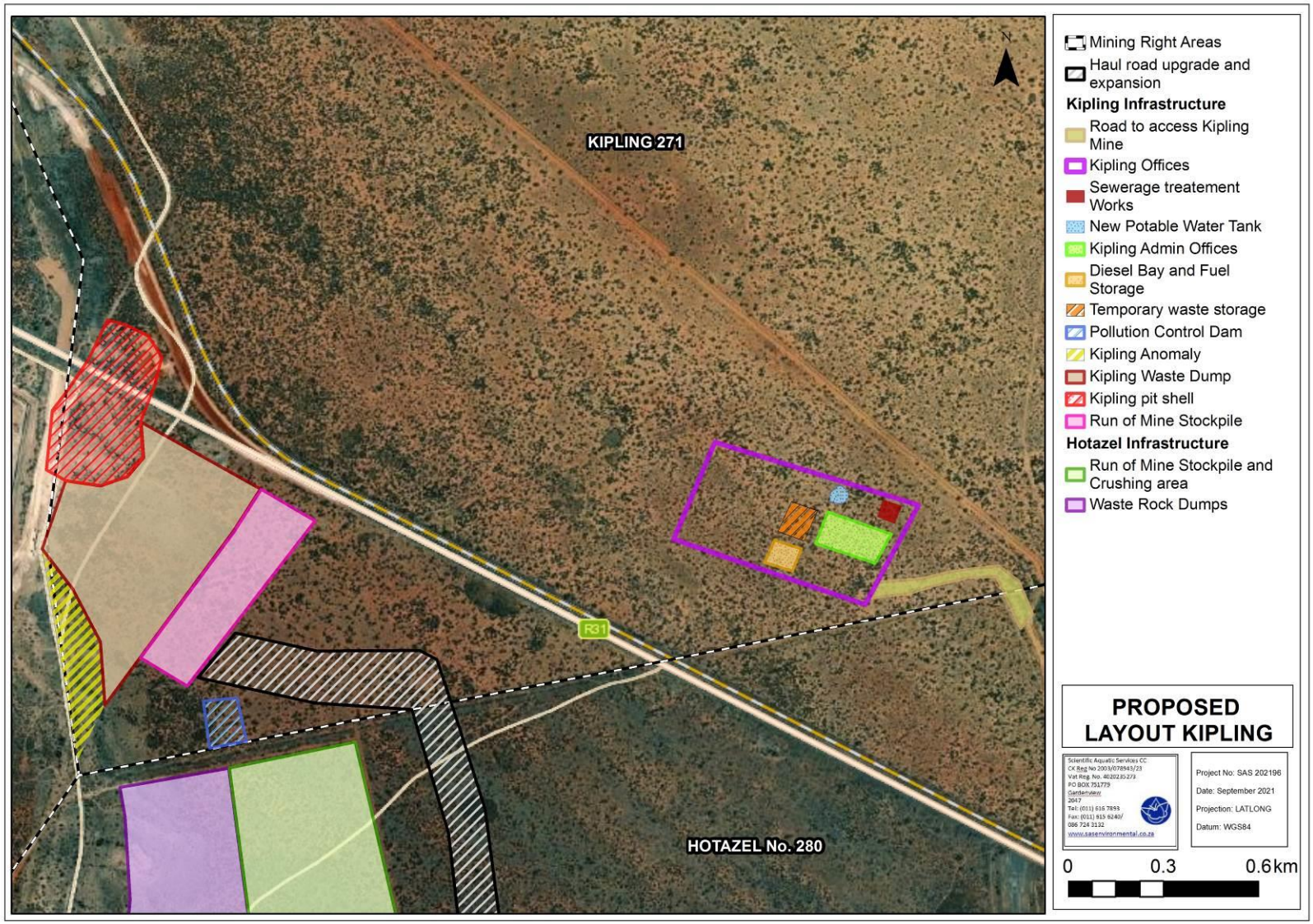


Figure 1: Digital satellite image depicting the location of the proposed expansion activities on Kipling and associated investigation areas in relation to surrounding areas.

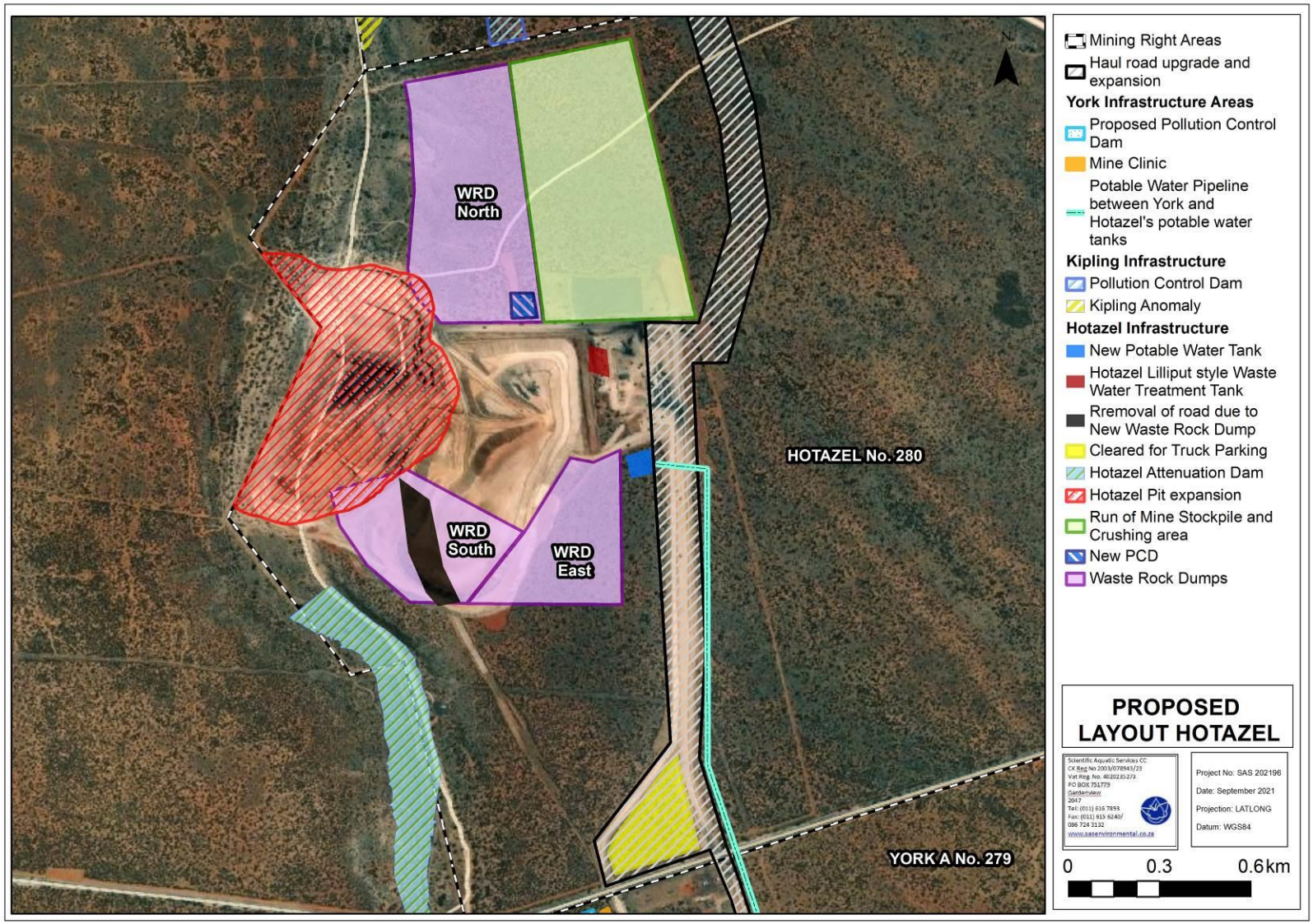


Figure 2: Digital satellite image depicting the location of proposed expansion activities on Hotazel and associated investigation areas in relation to surrounding areas.

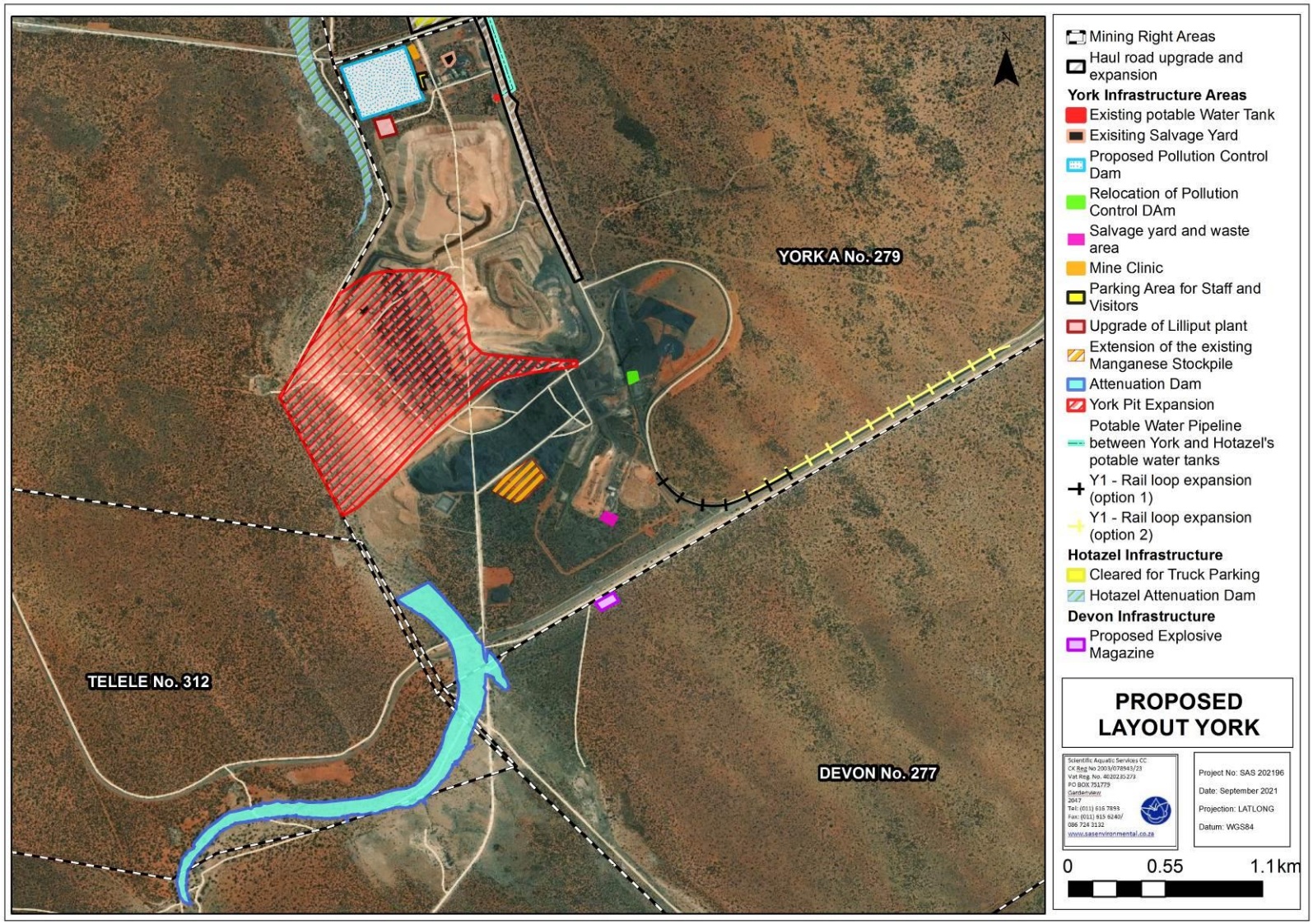


Figure 3: Digital satellite image depicting the location of proposed expansion activities on Hotazel and associated investigation areas in relation to surrounding areas.

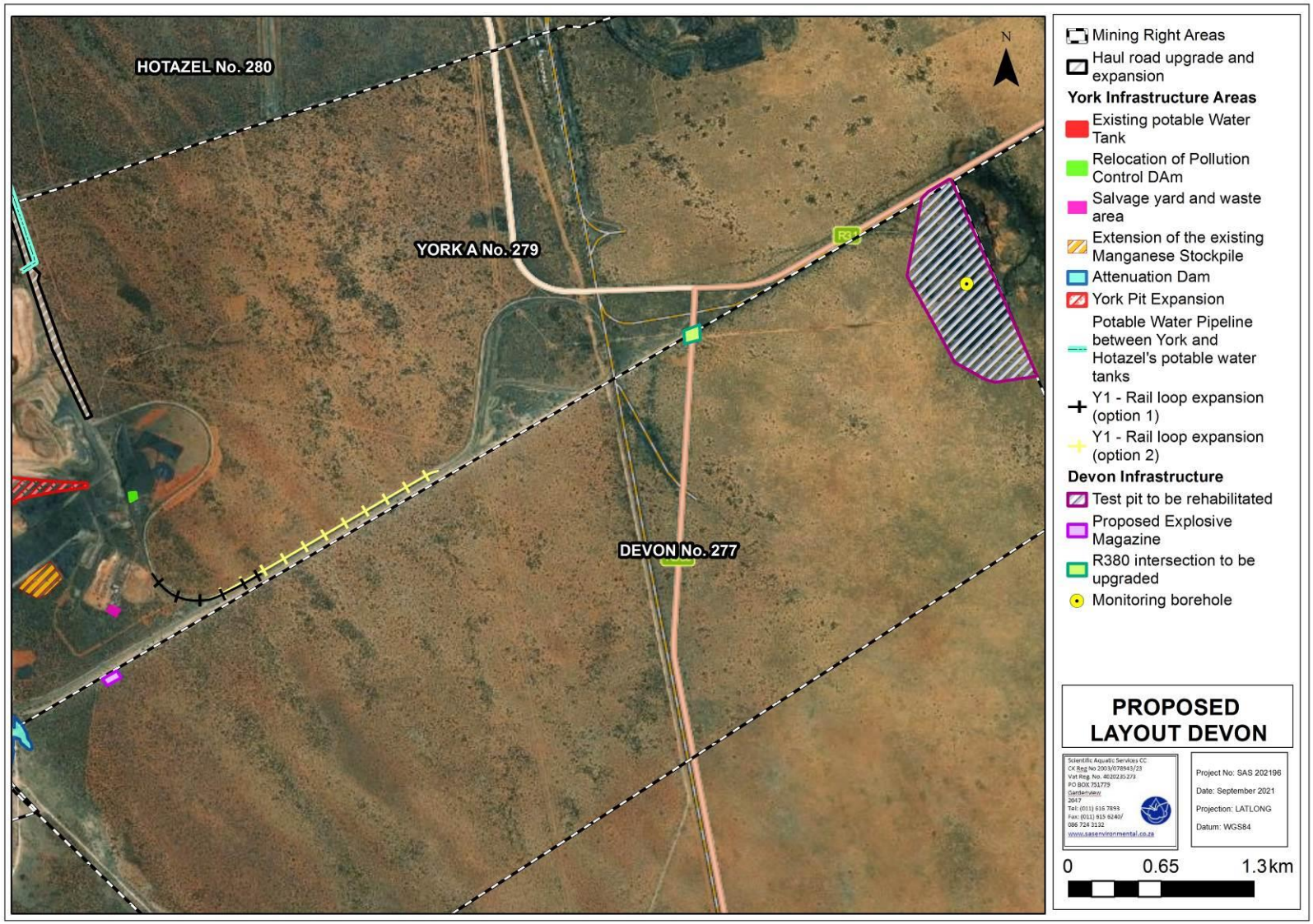


Figure 4: Digital satellite image depicting the location of proposed expansion activities on Devon and associated investigation areas in relation to surrounding areas.

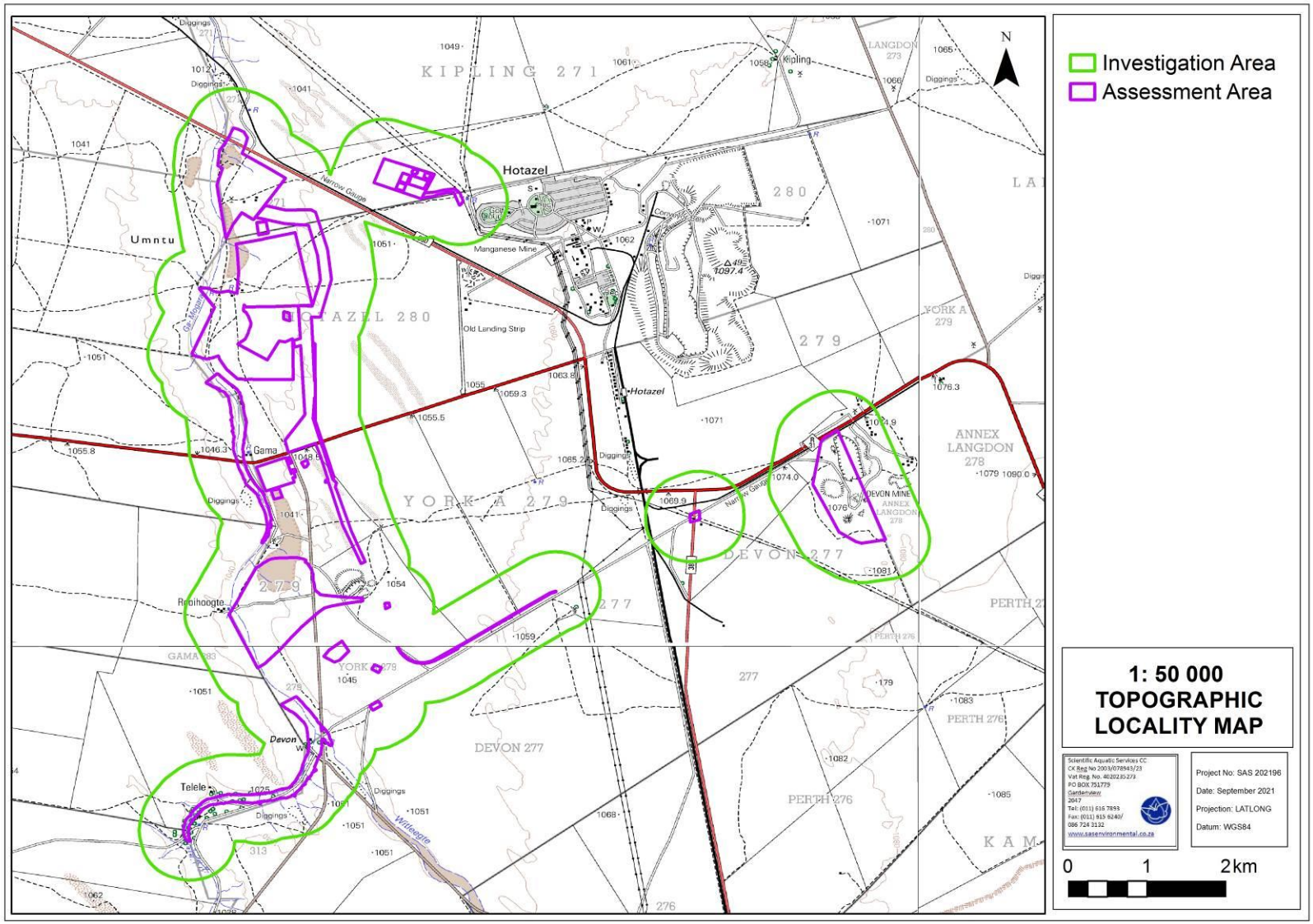


Figure 5: 1:50,000 topographic map depicting the location of proposed expansion activities within the MRA and associated investigation areas in relation to surrounding areas.

1.3 Project Scope

Specific outcomes in terms of this report are outlined below:

- A background study of relevant national, provincial and municipal datasets (such as National Freshwater Ecosystem Priority Areas [NFEPA] (2011), the National Biodiversity Assessment [NBA] (2018) database and the DWS RQS PES/EIS database) was undertaken to aid in defining the Ecological Importance and Sensitivity (EIS) of the watercourse;
- The watercourse was delineated according to "DWAF, 2008: A practical Guideline Procedure for the Identification and Delineation of Wetlands and Riparian Zones". Aspects such as soil morphological characteristics and vegetation indicators were used to delineate the riparian zone according to the guidelines. The applicable Zones of Regulation were then allocated to the watercourse;
- The classification assessment of the watercourse was undertaken according to the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems (Ollis *et al*., 2013);
- The EIS of the watercourse was determined according to the method described by DWAF (1999);
- The services provided by the watercourse were assessed according to the method of Kotze *et al* (2020) in which services to the ecology of the site as well as services to the people of the area were defined;
- The PES of the watercourse was assessed according to the resource directed measures guideline as advocated by Kleynhans *et al*., (2008);
- Watercourse areas were mapped in relation to the MRA. In addition to the watercourse boundaries, the applicable zones of regulation of in terms of both Government Notice 509 as published in the Government Gazette 40229 of 2016, and Government Notice 704 as published in the Government Gazette 20119 of 1999 as they relate to the National Water Act, 1998 (Act No. 36 of 1998), were depicted where applicable;
- The PES, EIS, and ecological service provision of the assessed reach of the watercourse were highlighted, and expected impacts on the system were assessed according to predefined impact and risk assessment methodologies; and
- Mitigation measures were presented in line with the impact mitigation hierarchy as advocated by the Department of Mineral Resources (DMR)[1], the Department of Environmental Affairs (DEA) and the Department of Water and Sanitation (DWS).

[1] The Department of Mineral Resources (DMR) is currently known as the Department of Mineral Resources and Energy (DMRE) and the Department of Environmental Affairs (DEA) is currently known as the Department of Environment, Forestry & Fisheries (DEFF). For the

1.4 Assumptions and Limitations

The following assumptions and limitations are applicable to this report:

- The watercourse assessment is confined to the MRA as illustrated in Figures 1 to 3 and does not include the neighbouring and surrounding properties outside of the focus area. The general surroundings and important catchment characteristics were, however, considered in the desktop assessment of the focus area;
- During the site assessment undertaken in July 2021, a single watercourse, identified as the Ga-Mogara River[2], was identified along the western boundary of the MRA. The Witleegte River, a small tributary of the Ga-Mogara River, was identified via desktop methods entering the south-eastern corner of York, where it confluences with the Ga-Mogara River. The Witleegte River and the reach of the Ga-Mogara River located within 500m of the MRA was delineated on a desktop basis using topographic maps and digital satellite imagery, in line with Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998). Only the reach of the Ga-Mogara River located within the MRA was assessed as part of this investigation;
- The MRA is situated within a semi-arid region, receiving an average annual rainfall of approximately 380mm per annum (SRK, 2020). The assessment was conducted during the dry winter season, and therefore identification of some floral species was not feasible due to the absence of inflorescences. However, due to the semi-arid climate in combination with the episodic characteristics of the Ga-Mogara River, it is not anticipated that the results of the assessment would greatly vary if the assessment was undertaken during the summer rainfall period;
- The application of aquatic assessment indices (such as the South African Scoring System version 5 [SASS5]) was not undertaken as conditions at the time assessment conducive to the application of such indices. Thus, instream conditions were inferred based on available databases, a visual assessment and professional experience of conditions in other reaches of the same watercourse. Therefore, although the instream Index of Habitat Integrity (IHI) (Kleynhans *et al*, 2008) was applied, it was undertaken with caution and a moderate degree of confidence, with the aim of providing a 'snapshot' of instream habitat conditions at the time of assessment;

purposes of referencing in this report, the name under which the Department was known during the time of publication of reference material, will be used.

[2] Please note that for the purposes of this report the spelling "Gamagara River" and the spelling "Ga-Mogara River" as used in the DWS RQIS database, is to be considered synonyms and may be used interchangeably.

- SAS previously undertook an ecological assessment of this reach of the Ga-Mogara River for SLR Consulting (Africa) (Pty) Ltd in 2017[3]. The method of assessment utilised in 2017 to ascertain the PES of the river differs from that used during this assessment with the latter method being developed specifically for riverine and instream habitats. Additionally, the method for ascertaining ecological and socio-cultural service provision has been refined by the authors with the updated tool being made available in late 2020. Thus, some discrepancy in the PES category and Ecoservices provision has occurred, however this is due to differences in the methodologies and not the result of inconsistencies in the application of the assessment methods;
- The watercourse delineation as presented in this report is regarded as the best estimate of the watercourse boundaries based on the site conditions present at the time of assessment and based on the level of field verification possible. However, some limitations in the accuracy of the delineation due to historical and ongoing anthropogenic disturbances, in particular the alteration of the vegetation community composition and topography as a result of historical and current mining practices with specific mention of the authorised encroachment of the open pits within the 1:100 year floodline of the river, is deemed possible, although every effort has been made to ensure accuracy of the delineation;
- Global Positioning System (GPS) technology is inherently inaccurate and some inaccuracies due to the use of handheld GPS instrumentation may occur. If more accurate assessments are required, the watercourse zones will need to be surveyed and pegged according to surveying principles;
- Aquatic, riparian and terrestrial areas form transitional areas where an ecotone is formed as vegetation species change from terrestrial species to facultative/riparian zone species. Additionally, due to the naturally arid characteristics of the MRA, many species found in the riparian zone occur in terrestrial areas, albeit in diminished abundance and/or structure (e.g. height of individual plants may be greater in the riparian zone than in the adjacent terrestrial areas). Within the transition zone some variation of opinion on the riparian zone boundary may occur, however if the DWAF 2008 method is followed, all assessors should get largely similar results;
- Both the DWS Risk Assessment Matrix (2016) and the impact assessment method supplied by SRK Consulting (South Africa) (Pty) Ltd were applied to the proposed activities and in relation to the identified watercourse. However, it is crucial to note

[3] Freshwater Resource Delineation and Ecological Assessment As Part Of The Proposed Expansion Of The Kudumane Mining Project; Northern Cape Province. Prepared for SLR Consulting (Africa) (Pty) Ltd. January 2017.

that although these two methods may present different scores and impact significance ratings for the same activity, this is due to differences in their methodologies (refer to Appendix C) and not due to inconsistencies in their application. Each should be judged individually for their specified purpose; i.e. the use of the SRK Consulting (South Africa) (Pty) Ltd Impact Assessment method for the purposes of applying for amendment to the Environmental Authorisation in terms of NEMA, and the use of the DWS Risk Assessment Matrix to inform the Water Use Licence Application (WULA);

- Although numerous proposed activities are included in the project description, those which are situated within or to the west of existing disturbances (for example, the proposed York haul road expansion and upgrade, relocation of the York PCD and rail loop expansion on York) were excluded from the impact and risk assessments as the quantum of risk posed by these activities is deemed very low to negligible. This is attributed to the distance of those activities from the watercourse, the relatively uniform topography of the MRA, and the barrier formed by existing activities between the watercourse and the proposed expansion activities;
- At the time of the assessment, details pertaining to the proposed or intended activities within the area labelled “Kipling Anomaly” were not available. Therefore it was not possible to assess potential risk / impact significance in that area beyond the possibility of vegetation clearing and site preparation; and
- A construction method statement for the proposed attenuation dams within the Ga-Mogara River was not available at the time of undertaking this study. Therefore, certain assumptions have been made when assessing the potential risk / impact significance of these, in particular during the construction phase. Should a detailed method statement be made available at a later stage the risk / impact assessments may need to be revised accordingly.

1.5 Legislative Requirements

The following legislative requirements were considered during the assessment:

- Constitution of the Republic of South Africa, 1996[4];
- The National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA);
- The National Water Act, 1998 (Act No. 36 of 1998) (NWA);
- Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998);
- Government Notice 704 as published in the Government Gazette 20119 of 1999 as it relates to the National Water Act, 1998 (Act No. 36 of 1998);
- The National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA);
- The National Environmental Management: Biodiversity Act, 2014 (Alien and Invasive Species Regulations, 2014); and
- The Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA).

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

2 ASSESSMENT APPROACH

2.1 Freshwater Site Selection and Field Verification

For the purposes of this investigation, the following definitions as per the National Water Act, 1998 (Act No. 36 of 1998) are of relevance:

A **watercourse** means:

(a) a river or spring;
(b) a natural channel in which water flows regularly or intermittently;
(c) a wetland, lake or dam into which, or from which, water flows; and
(d) any collection of water which the Minister may, by notice in the *Gazette,* declare a watercourse.

[4] Since 1996, the Constitution has been amended by seventeen amendments acts. The Constitution is formally entitled the 'Constitution of the Republic of South Africa, 19996". It was previously also numbered as if it were an Act of Parliament – Act No. 108 of 1996 – but since the passage of the Citation of Constitutional Laws Act, neither it nor the acts amending it are allocated act numbers.

Riparian habitat includes-

"The physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterized by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent areas".

Regulated Area of a Watercourse means -

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

(b) In the absence of a determined 1 in 100-year flood line or riparian area the area within 100m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or

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

Where the site characteristics had been significantly transformed (for example, complete loss of riparian vegetation in the vicinity of historical prospecting activities or road crossings) use was made of historical and current digital satellite imagery, topographic maps and available provincial and national databases to aid in the delineation of the watercourse following the field assessment. The following were taken into consideration when utilising the above desktop methods:

- Linear features: since water flows/moves through the landscape, watercourses often have a distinct linear element to their signature which makes them discernible on aerial photography or satellite imagery;
- Vegetation associated with watercourses: a distinct increase in density as well as shrub size near flow paths;
- Hue: water flow paths often show as white/grey or black and outcrops or bare soils displaying varying chroma created by varying vegetation cover, geology and soil conditions. Changes in the hue of vegetation with watercourse vegetation often indicated on black and white images as areas of darker hue (dark grey and black). In colour imagery these areas mostly show up as darker green and olive colours or brighter green colours in relation to adjacent areas where there is less soil moisture or surface water present; and
- Texture: with areas displaying various textures, created by varying vegetation cover and soil conditions.

A field assessment was undertaken in July 2021 to conduct a watercourse delineation and ecological assessment. The delineation of the identified watercourse took place, as far as possible, according to the method presented in the "Updated manual for the identification and delineation of wetland and riparian resources" (DWAF, 2008). The foundation of the method is based on the fact that watercourses have several distinguishing factors including the following:

- Landscape position;
- The presence of water at or near the ground surface;
- Distinctive hydromorphic soils;
- Vegetation adapted to saturated soils; and
- The presence of alluvial soils in stream systems.

In addition to the delineation process, a detailed assessment of the delineated watercourse was undertaken, at which time factors affecting the integrity of the watercourse were taken into consideration and aided in the determination of the functioning and the ecological and socio-cultural services provided by the watercourse. A detailed explanation of the methods of assessment undertaken is provided in Appendix C of this report.

2.2 Sensitivity Mapping

All the freshwater ecological resources of the MRA were considered, and sensitive areas were delineated with the use of a GPS. A Geographic Information System (GIS) was used to project the watercourse onto digital satellite imagery and topographic maps. The sensitivity map provided in Section 4.4 should guide the design and layout of the proposed prospecting activities.

2.3 Impact and Risk Assessments and recommendations

Following the completion of the assessment, a pre-defined impact assessment methodology provided by the EAP and the DWS Risk Assessment Matrix (2016) were applied (please refer to Appendix D for the methods of approach) and recommendations were developed to address and mitigate impacts associated with the proposed activities. These recommendations also include general management measures which apply to the proposed prospecting activities as a whole. Mitigation measures have been developed to address issues in all phases throughout the life of the proposed activities. The detailed mitigation measures are outlined in Section 5 of this report, whilst the general management measures

which are considered to be best practice mitigation applicable to a project of this nature, are outlined in Appendix F.

3 RESULTS OF THE DESKTOP ANALYSES

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

It is important to note that although all data sources used provide useful and often verifiable, high-quality data, the various databases used do not always provide an entirely accurate indication of the MRA’s actual site characteristics at the scale required to inform the Environmental Impact Assessment (EIA) process. Given these limitations, this information is considered useful as background information to the study. It must however be noted that site verification of key areas may potentially contradict the information contained in the relevant databases, in which case the site verified information must carry more weight in the decision-making process. Thus, this data was used as a guideline to inform the watercourse assessment and to focus on areas and aspects of increased conservation importance during the site assessment.

Table 1: Desktop data relating to the characteristics of the watercourse within the MRA and surrounding region.

Aquatic ecoregion and sub-regions in which the assessment area is located	
Ecoregion	Southern Kalahari
Catchment	Orange
Quaternary Catchment	D41K
WMA	Lower Vaal
subWMA	Molopo
Dominant characteristics of the Southern Kalahari (29.01) Aquatic Ecoregion Level 2 (Kleynhans *et al.*, 2007)	
Dominant primary terrain morphology	Plains; moderate relief, Closed Hills, mountains; moderate and high relief.
Dominant primary vegetation types	Karroid Kalahari Bushveld, Kalahari Mountain Bushveld, Kalahari Plateau Bushveld
Altitude (m a.m.s.l)	700 - 1500
MAP (mm)	0 - 500
The coefficient of Variation (% of the MAP)	30 - 40
Rainfall concentration index	60 - >65
Rainfall seasonality	Late Summer
Mean annual temp. (°C)	16 - 22
Winter temperature (July)	0 - 22
Summer temperature (Feb)	16 - >32
Median annual simulated runoff (mm)	<5 – 40
National Biodiversity Assessment (2018): South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (including the National Wetland Map 5 information)	
According to the NBA (2018): SAIIAE there is a natural seep wetland identified in the southern section of the assessment area. This wetland feature was classified as a channelled valley bottom wetland according to the NFEPA Database (2011). According to the NBA Dataset the Ga-Mogara River is moderately modified (Class C), it is currently not protected (Ecosystem Protection Level) and therefore critically endangered (Ecosystem Threat Status). At the time of the data collection for the NBA Dataset the Witleegte River did not have any surface water present therefore the PES could not be determined, rendering	

Detail of the assessment area in terms of the National Freshwater Ecosystem Priority Area (NFEPA, 2011) database	
FEPACODE	The ASSESSMENT AREA is situated within a SubWMA considered an **upstream management area**, required to prevent the downstream degradation of FEPAS and Fish Support Areas.
NFEPA Wetlands	According to the NFEPA database (2011) there are two natural channelled valley bottom wetland features associated with the assessment area, which is associated with the Ga-Mogara River. These channelled valley bottom wetland features are indicated by NFEPA to be in a natural or good ecological condition (Class AB). Based on digital satellite imagery, northern channelled valley bottom wetland indicated by the NFEPA database is a decommissioned borrow pit.
Wetland Vegetation Type	The majority of the assessment area (90%) is located within the Kalahari Duneveld (Least Threatened) Wetland Vegetation type, whilst the remaining portions are located within the Eastern Kalahari Bushveld Group 1 (Least Threatened) wetland vegetation type, according to Mbona *et al.* (2015).
NFEPA Rivers	The Ga-Mogara River runs parallel with the western border of the assessment area in a north south direction. The Witleegte River confluences with the Ga-Mogara River on the southern border of the assessment area. Both rivers are considered to be in a moderately modified ecological condition (RIVCON C), and both rivers are classified as upstream management rivers.
Detail of the assessment area in terms of the Northern Cape Critical Biodiversity Areas (2016)	
Ecological Support Area (ESA)	The western border of the assessment area which is associated with the Ga-Mogara River and the southern portion associated with the Witleegte River is classified as an **Ecological Support Area**. ESAs are areas which must retain their ecological processes in order to meet biodiversity targets for ecological processes that have not been met in CBAs or protected areas; meet biodiversity targets for representation of ecosystem types or Species of special concern when it's not possible to meet them in CBAs; support ecological functioning of protected areas or CBAs or a combination of these (SANBI, 2017).
Other Natural Area	The remaining portions of the assessment area falls within an area classified as "**Other Natural Areas (ONA)**". ONAs consist of all those areas in good or fair ecological condition that fall outside the protected area network and have not been identified as CBAs or ESAs (SANBI, 2017).
Detail of the assessment area in terms of the Mining and Biodiversity Guidelines (2013)	

the river being data deficient	
National Web Based Environmental Screening Tool (2020) (Figure 8)	According to the Mining and Biodiversity guidelines, the assessment area is not ranked as a priority area. Various areas considered to be of high biodiversity importance are 10 km or further to the north and east of the assessment area, while various moderate biodiversity important areas are located 13 km or more to the west of the assessment area.
The Screening Tool is intended to allow for pre-screening of sensitivities in the landscape to be assessed within the EA process. This assists with implementing the mitigation hierarchy by allowing developers to adjust their proposed development footprint to avoid sensitive areas.	
According to the screening tool the overall aquatic sensitivity of the assessment area is **very high,** due to a wetland feature in the southern portion of the assessment area. The majority (95%) of the assessment area does however have a **low aquatic sensitivity.**	

CBA = Critical Biodiversity Area; DWS = Department of Water and Sanitation; EI = Ecological Importance; ES = Ecological Sensitivity; ESA = Ecological Support Area; m.a.m.s.l = Metres Above Mean Sea Level; MAP = Mean Annual Precipitation; NBA = National Biodiversity Assessment; NFEPA = National Freshwater Ecosystem Priority Areas; PES = Present Ecological State; SAIIAE = South African Inventory of Inland Aquatic Ecosystems; WMA = Water Management Area.

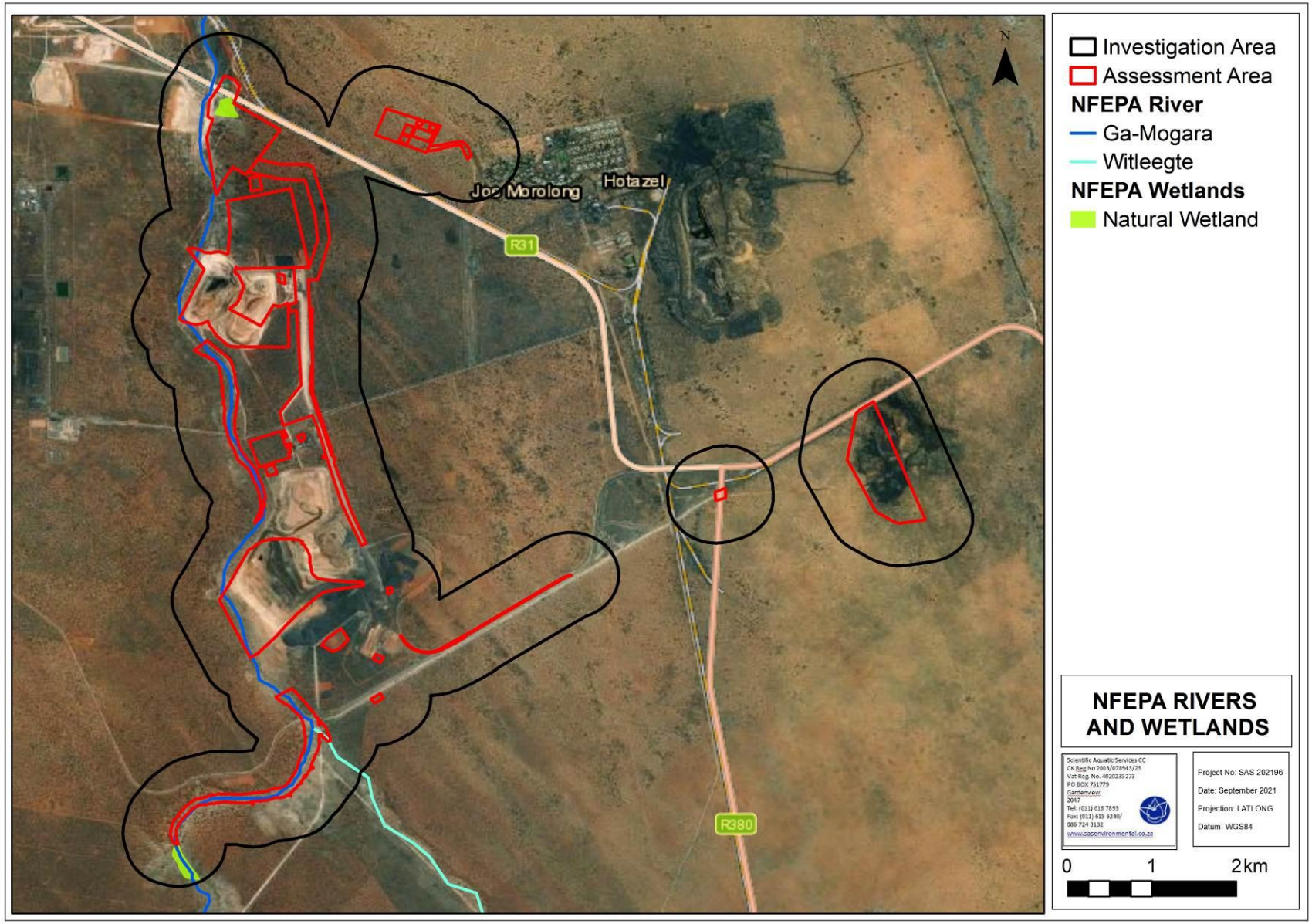


Figure 6: Rivers and wetlands associated with the MRA and investigation area, according to the NFEPA Database (2011).

Figure 7:Applicable Wetland Vegetation (WetVeg) types for the study and investigation areas.

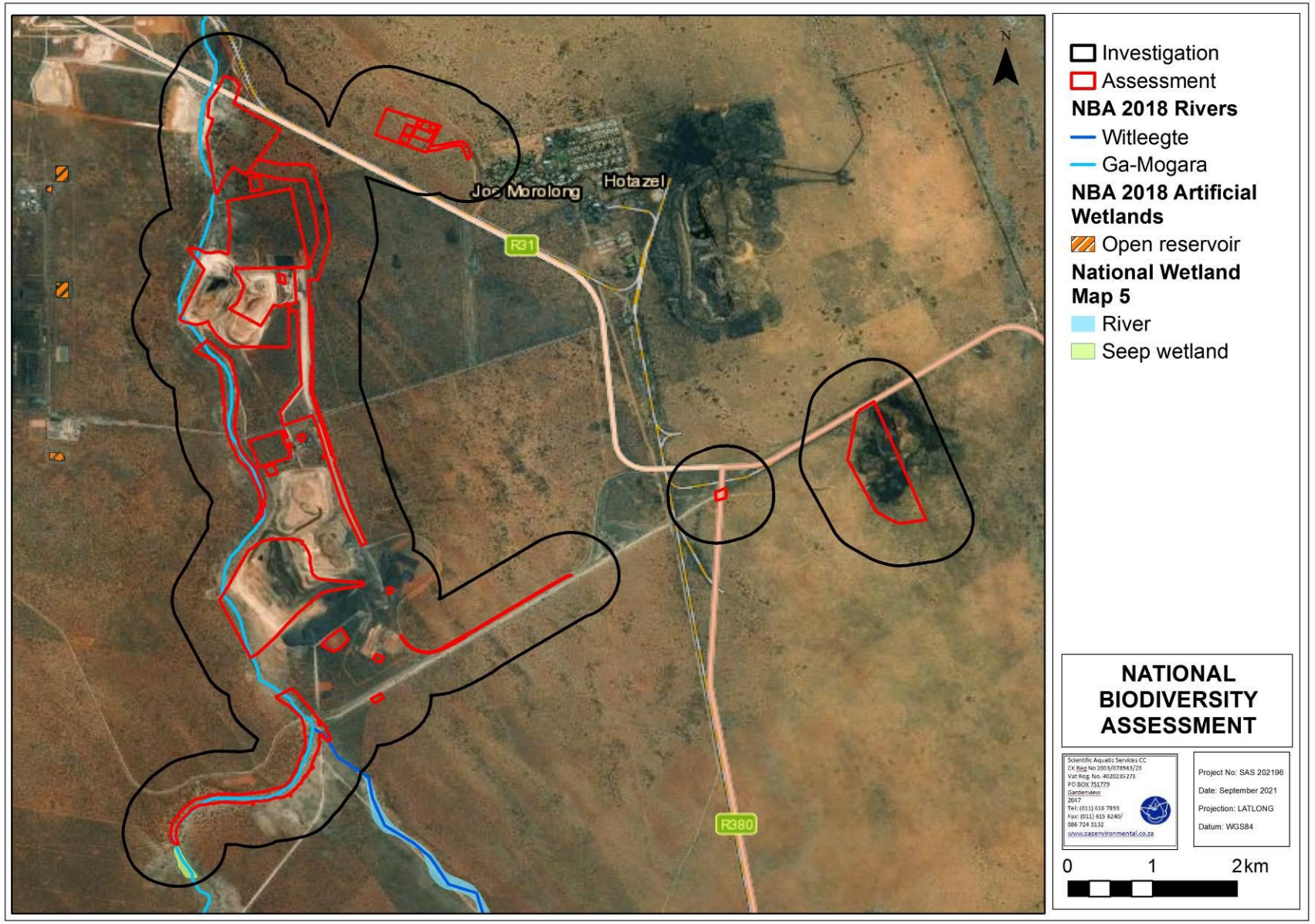


Figure 8: The watercourses (Ga-Mogara and Witleegte Rivers) associated with the MRA according to the National Biodiversity Assessment (2018).

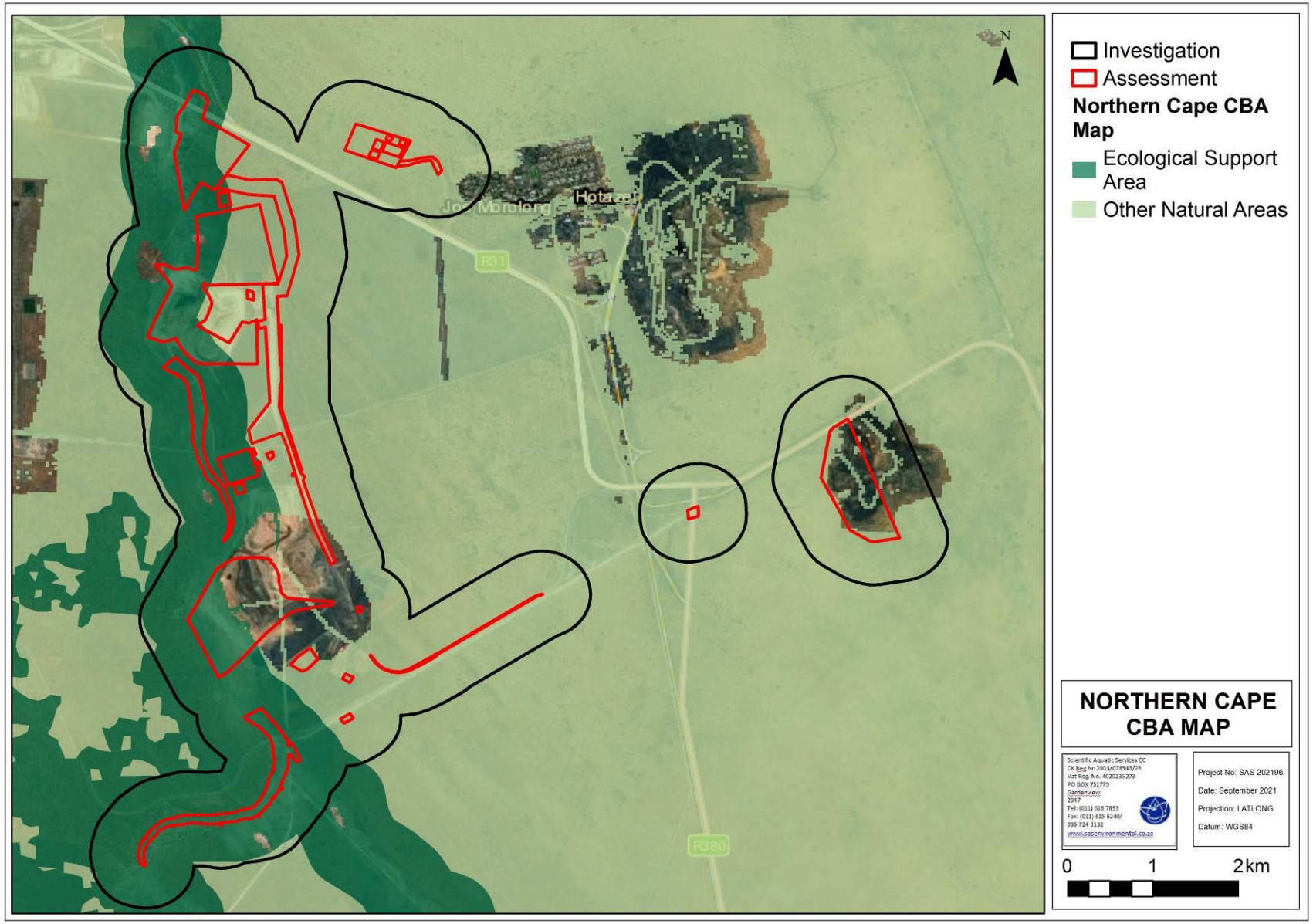


Figure 9: Ecological Support Areas (ESAs) and Other Natural Areas (ONAs) associated with the MRA and investigation area (NCCBA, 2016).

3.1 Summary of historical freshwater ecological assessment

The previous study undertaken by SAS in 2017 (fieldwork conducted in November 2016) found that the assessed reach had been largely modified, primarily as a result of historical agricultural and mining practices, with specific mention of the loss of recharge caused by the formation of riverbed swallets upstream of KMR as a result of dewatering activities at Sishen Mine (refer to Section 4.2 of this report). The interception of flow by these swallets has exacerbated the pre-existing semi-arid conditions, causing further moisture stress and contributing to the transformation of the riparian vegetation community, which is characterised by terrestrial vegetation.

As a result of these modifiers, the assessed reach of the Ga-Mogara River was considered largely modified (PES category D), of moderate EIS, and likely to provide moderately low to intermediate levels of ecological service provision.

4 RESULTS: WATERCOURSE ASSESSMENT

4.1 Delineation

During the site assessment undertaken in May 2021, a single watercourse, specifically the Ga-Mogara River, was identified within the eastern portion of the MRA, and delineated according to the method described by DWAF (2008).

Due to the episodic[5] characteristics of the Ga-Mogara River, the primary indicators utilised to delineate the riparian zone were topography and vegetation. Although there is little difference in the species composition of the vegetation assemblage comprising the riparian zone and adjacent terrestrial areas, noticeable differences in the levels of greening and structure of the two vegetation assemblages provided a distinct guide in limited sections of the river. However, it must be noted that the majority of the MRA has been transformed, in particular by vegetation losses due to historical and current mining related activities, in particular various road crossings. In areas where vegetation was sparse, use was made of historical digital satellite imagery to refine the delineation. The delineations as presented in this report are nevertheless regarded as a best estimate of the riparian zone boundaries based on the site conditions present at the time of the assessment undertaken in May 2021.

[5] Episodic streams are highly flashy systems that flow or flood only in response to extreme rainfall events, usually high in their catchments. May not flow in a five-year period or may flow only once in several years.

Soil morphological characteristics (such as mottling and gleying), which are typically associated with a fluctuating water table, were not found during the site assessment, nor was soil wetness considered a reliable indicator due to the naturally arid conditions of the region and exacerbated by several years of drought conditions in the area.

4.2 Drainage System Characterisation

The Ga-Mogara River, an episodic river system, is situated along the western boundary of the MRA, draining in a northerly direction, and the Witleegte River (also episodic) enters the MRA in the south-eastern corner of York, confluencing with the Ga-Mogara River approximately 40 m from the farm boundary. Episodic systems generally only flow or flood once in several years in response to extreme rainfall events, usually within their catchment. Prior to January 2021, the last recorded flow in the Ga-Mogara River was in 1988 (SRK, 2020), however, following above-average rainfall in the region over December 2020 and January 2021, the Ga-Mogara River flowed, resulting in parts of the town of Deben (situated north of Sishen Mine and approximately 37 km south-west of KMR) experiencing flooding.

The MRA is located north, and therefore downstream of, the Sishen Iron Ore Mine. Sishen Mine started operations in 1953, and at that time it was assumed that little groundwater existed on the farm Sishen. Between the 1950's and mid-1970's groundwater was abstracted sporadically from boreholes near the Ga-Mogara River for mining and processing purposes. For water supply for the town of Sishen, today known as Dingleton, water was abstracted from boreholes near the Ga-Mogara River and the Khai Appel area. In 1970s it was recognized that systematic dewatering needed to be done to secure safe mining conditions.

However, since 2000, complaints from landowners in the area were received by Sishen, with claims of lowered water levels and a subsequent decline in the yield of their boreholes over a prior number of years, indicating that dewatering of the Ga-Mogara River within the relevant geological compartment is likely to be occurring, impacting on the natural hydrological regime of the system downstream of the Sishen operations with the impact considered regional. Between 2002 and 2007, Kumba Iron Ore commissioned external consultants to conduct geohydrological studies, which confirmed that a number of private landowners to the south of Sishen Mine had indeed been affected. Following heavy rainfall during February 2006, landowners in the vicinity of Sishen Mine informed Kumba that the flow of the Ga-Mogara River had been interrupted, at a point on the Kumba property, which

prevented further downstream flow. Investigations found that riverbed swallets (sinkholes) had formed, as a result of dewatering activities[6]. These swallets have subsequently intercepted surface flow, thus resulting in loss of recharge of the Ga-Mogara River downstream of Sishen Mine, which includes the portion of the river within the MRA. This has impacted negatively on the hydraulic regime and connectivity of the river downstream of the impact site, notwithstanding the flooding experienced in January 2021.

The Ga-Mogara and Witleegte Rivers (Figure 8) were classified according to the Classification System (outlined in Appendix C of this report) as Inland Systems falling within the Southern Kalahari Aquatic Ecoregion, and within the Eastern Kalahari Bushveld Group 3 and Kalahari Dunveld Wetland Vegetation Types, both considered 'Least Threatened' according to SANBI (2012) and Mbona *et al* (2015). The table below presents the classification of the watercourses at Levels 3 and 4 of the Classification System (Ollis *et al,* 2013).

Table 2: Characterisation of the watercourse associated with the focus area, according to the Classification System (Ollis *et al*., 2013).

Watercourse	Level 3: Landscape unit	Level 4: Hydrogeomorphic Unit
Ga-Mogara River **Witleegte River**	**Valley floor:** The base of a valley, situated between two distinct valley side-slopes.	**River:** a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water.

The locality and extent of the watercourses in relation to the MRA and investigation areas is depicted in the figure below. Although the Ga-Mogara and Witleegte Rivers extend beyond the boundary of the MRA, only the section of the Ga-Mogara River within the MRA was assessed. Nevertheless, the potential impacts of activities within the greater catchment such as mining, agriculture, construction of infrastructure within and adjacent to the river (particularly river diversion structures upstream of the MRA), transformed vegetation assemblages, clearing of natural vegetation and erosion were taken into consideration during the assessment. The Witleegte River is unlikely to be impacted by the proposed activities (the confluence with the Ga-Mogara River is approximately 515 m from the proposed attenuation dam wall thus construction thereof is unlikely to impact on the river), and was therefore excluded from further assessment.

[6] http://www.overendstudio.co.za/online_reports/kumba_ar2011/sustainability/sus_environmental.php retrieved 11 January 2017; reverified 2nd September 2021.

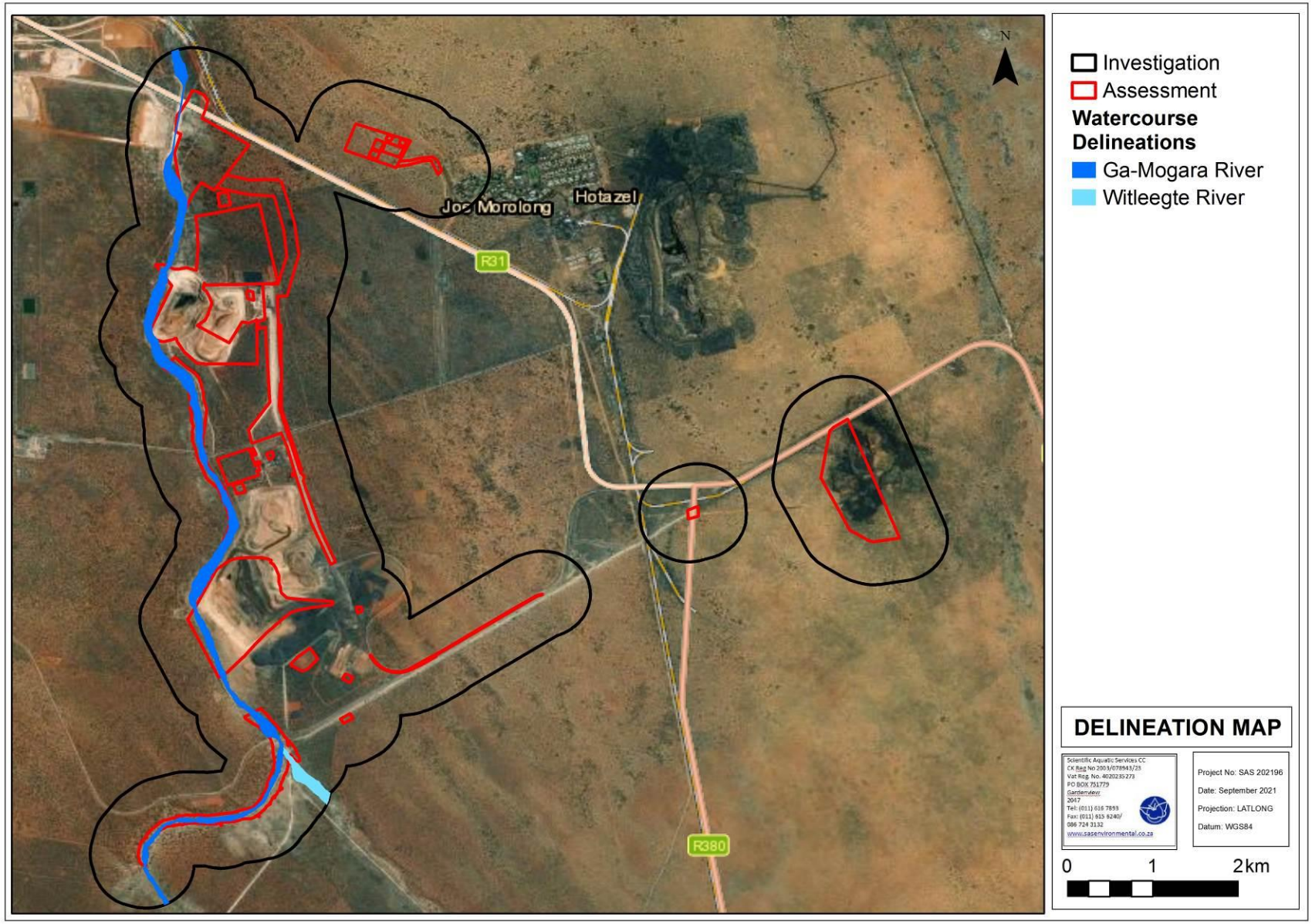


Figure 10: The reach of the Ga-Mogara and Witleegte Rivers associated with the MRA and investigation area.

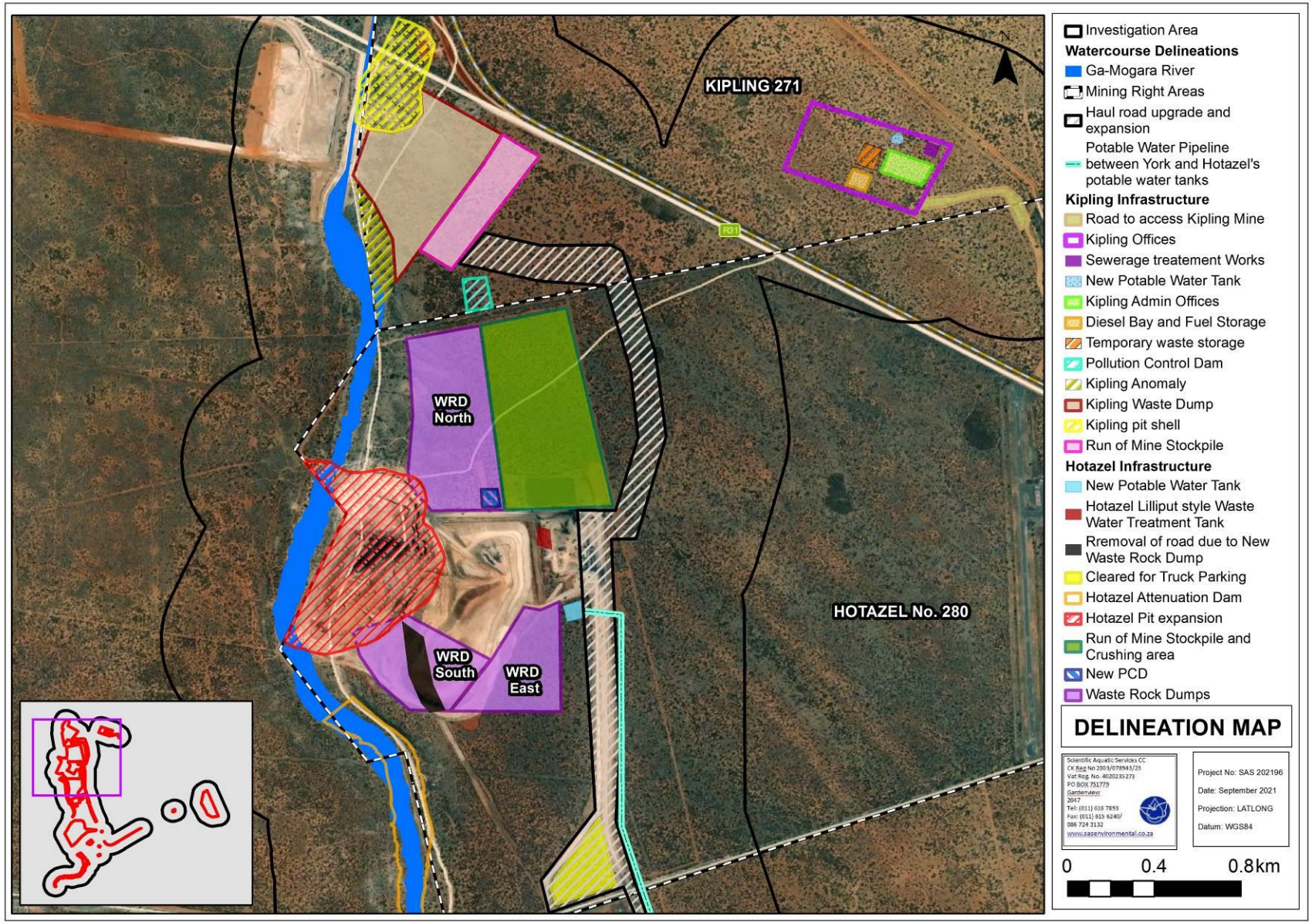


Figure 11: The reach of the Ga-Mogara River associated with the northern portion of the MRA and investigation area.

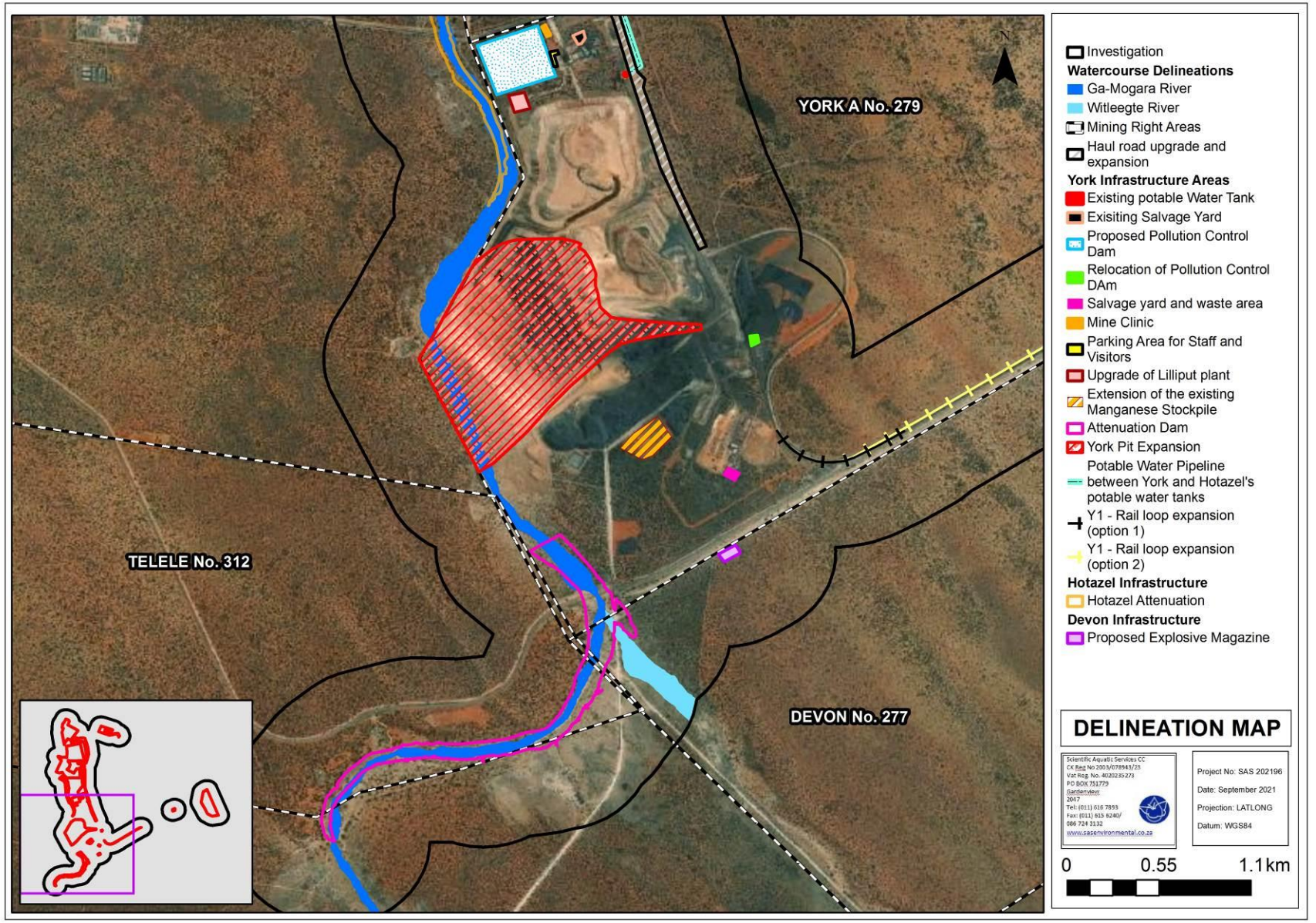


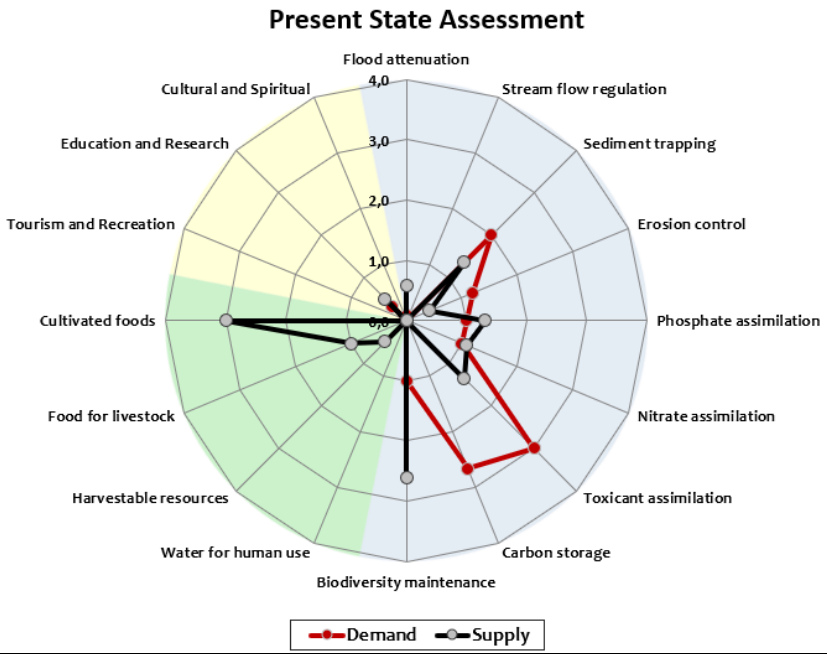
Figure 12: The reach of the Ga-Mogara and Witleegte Rivers associated with the southern portion of the MRA and investigation area.

4.3 Field Verification Results

The tables below summarise the findings of the field verification in terms of relevant aspects (hydrology, geomorphology and vegetation components) of freshwater ecology. The details pertaining to the method of assessment used to assess the watercourse are contained in Appendix C of this report. It should be noted that although water quality parameters are included in the method of assessment used, due to the episodic nature of the watercourse, testing of these parameters could not be undertaken. Given the surrounding landuses (predominantly agriculture though some mining occurs in the catchment) it is likely that when surface water is present, it is not likely to be impacted significantly by pollutants. Therefore, whilst the tables below include a discussion on water quality, information contained therein was based on information contained within available databases, as well as the anticipated impacts of the surrounding land uses within the catchment on water quality. The results of the assessments are presented in the table below.

Table 3: Summary of results of the assessment of the reach of the Ga-Mogara River within the MRA.

Ecological & socio-cultural service provision graph:



Photograph notes:	Representative photographs of the reach of the Ga-Mogara River associated with the MRA, illustrating the clearing of non-marginal riparian vegetation in the vicinity of the York open pit (left) and severe proliferation of the alien invasive *Prosopis sp.* within the active channel north of the York open pit (right).
PES discussion	**PES Category: C/D** **Instream IHI: B/C** **Riparian IHI: C/D** **VEGRAI: C/D** Major impacts to the reach of the Ga-Mogara River associated with the MRA are largely associated with the authorised expansion of the existing open pits on York and Hotazel into the non-marginal riparian zone, as well as various disturbances relating to historical exploration activities, and livestock husbandry activities upstream of KMR's existing operations. Additionally, impacts downstream of KMR, such as the diversion of the river through the Mokala Mine MRA have contributed to an overall decrease of the river's ecological integrity.

Watercourse drivers and receptors discussion (hydrology, geomorphology and topography, water quality and habitat and biota):

The Ga-Mogara River is a highly episodic system, flowing sporadically only when large volumes of rainfall are received in the region. The river most recently flowed in January 2021, flooding the town of Deben situated approximately 45 km south of the MRA, but apparently not reaching Mokala, according to KMR mine personnel as well as residents of the town of Deben (*Pers. Comm.* July 2021). Although hydraulic connectivity and impacts to the reach of the river associated with the MRA are limited in extent, although are severe where they have occurred, numerous upstream impacts have occurred, including various river diversions several kilometres south of the MRA and most notably, the formation of swallets in the active channel south of the Sishen Mine operations (due to dewatering of the aquifer). The episodic nature of the river means that the severity of most impacts to the hydrology are likely to be relatively low, although the swallet formation has negatively affected recharge of the reaches downstream thereof. Whilst the increasing extent of mining operations in the catchment and the MRA may contribute to increased runoff entering the river, again, due to the semi-arid climate the risk of this occurring is reduced.

The MRA is largely characterised by relatively flat, homogenous topography. Some bank incision was evident but was not considered to be extensive in extent nor severe. Geomorphological characteristics in the assessed reach have been altered as a result of the authorised encroachment of the open pits into the riparian zone thus disturbing soil and increasing sedimentation of the river, and in the upstream

<table>
<tr><td>Ecoservice provision</td><td>Moderately low to very low

Ecological service provision of the riparian zone associated with the assessed reach of the Ga-Mogara River is considered moderately low to very low, largely due to the absence of water although the reach immediately upstream of the MRA provides grazing for domestic livestock. The semi-arid climate means that vegetation cover is rarely as extensive as it was at the time of assessment, leading to a reduction in the capacity of the riparian zone to effectively provide services such as flood attenuation, sediment trapping and nutrient and toxicant assimilation. Nevertheless, the contribution made by the system to those services should not be overlooked on a larger scale.</td><td rowspan="2">reaches, various river diversions have contributed to altered geomorphological characteristics and processes. The proposed attenuation dams will further contribute to cumulative impacts to the geomorphological and hydraulic processes of the river.

Surface water was absent at the time of assessment and therefore, water quality parameters could not be assessed. Nevertheless, with the exception of possible contamination originating from mining activities in the catchment, surface water when present may be impacted by large volumes of iron-rich sediment thus increasing turbidity, as seen in January 2021.

Habitat diversity is low, as the weakly formed riparian zone is mostly characterised by graminoid species and a few low shrubs, as well as the alien invasive Prosopis sp. Historical agricultural and mining-related activities encroaching on the riparian habitat have contributed to altered floral assemblages, leading to increased occurrence of alien and encroacher species. However, due to above-average rainfall received in the preceding rainy season, vegetation cover was good and likely provides suitable habitat for a number of small mammals and reptiles. Although the episodic nature of the river is a notable limiting factor for instream biota, eg egg banks of some less sensitive aquatic macroinvertebrates such as Nepidae (water scorpion) may be present, hatching out when sufficient rainfall is received. The proximity of mining activities is likely to deter more sensitive fauna from utilising the river as a migratory corridor, however it is nevertheless likely to provide some cover and foraging habitat.</td></tr>
<tr><td>EIS discussion</td><td>EIS Category: Moderate to low

The ecological importance and sensitivity of the Ga-Mogara River is deemed moderate to low, largely due to the combined taxon / species richness of both instream and riparian biota which is minimal. Aspects such as habitat diversity, potential occurrence of populations of unique or threatened species and faunal utilisation of the riparian zone are only marginally important.</td></tr>
<tr><td>REC, RMO and BAS Categories</td><td>REC Category: C/D
BAS Category: C/D
RMO Category: Maintain

The Ga-Mogara River is under increasing pressure from expansion of mining activities in the catchment. It is imperative therefore that appropriate mitigation measures are implemented to avoid (preferable) or minimise perceived impacts which may arise as a result of the proposed KMR expansion activities, to maintain the ecostatus of the reach of the Ga-Mogara River associated with the MRA.</td><td>Business case, Impact Significance, Conclusion and Mitigation Requirements:
The majority of the proposed expansion activities can be adequately mitigated to minimise the significance of impacts; however, the proposed attenuation dams and open cast mining through the Ga-Mogara River will result in irreversible, long-term latent impacts on the system. A detailed impact and risk assessment along with activity-specific mitigation measures are provided in Section 5, however, key mitigation measures are summarised below:
➢ Sound environmental management practices, such as dust suppression, limiting disturbance footprints, alien vegetation management, erosion monitoring and soil management and continued monitoring of ground and surface water quality (amongst others) must be applied to all activities throughout the life of mine to minimise the impact significance of edge effects;
➢ Options to retain hydraulic connectivity of the Ga-Mogara River must be investigated, including alternatives such as inclusion of diversion berms in conjunction with the attenuation dams or approaching the mineral resource from the west of the river so as to prevent open cast mining through the river. Should it not be possible to avoid mining through the river, the proponent must engage with the DWS with regards to implementing appropriate management measures in line with the mitigation hierarchy which are deemed acceptable to both the competent authorities and the proponent;
➢ Design of infrastructure (WRDs, PCDs etc.) should be environmentally and structurally sound, compliant with GN704 regulations and all possible precautions taken to prevent spillage or seepage
➢ Measures to contain and reuse as much water as possible within the mine process water system must be sought, and very strict control of water consumption must take place. Detailed monitoring must be maintained to ensure that all water usage is continuously optimised; and
➢ The attenuation dams will need to be desilted intermittently to ensure the storage capacity is maintained. During desilting, all silt within the dam basin should immediately be removed from site in order to prevent sedimentation of the downstream areas.

Additionally, it was observed that the proposed pit at Kipling encroaches on the diverted reach of the river within the Mokala Mine MRA (SLR, 2021). Assuming that no agreement has been reached between KMR and Mokala Mine in this regard, it is recommended that the pit footprint be optimised to prevent encroachment or that the proponent engage with Mokala Mine to come to a mutual agreement regarding activities in that vicinity.</td></tr>
</table>

		Careful consideration and planning of the rehabilitation and closure of the pits and the associated cost is deemed critical to ensure that the most cost effective design and management solution is implemented, at the outset, for the operational phase of mining while ensuring that the long term (post closure) functionality and connectivity of the Gamagara River is maintained and that the RMO of the system is achieved.
Extent of modification anticipated:	**High**	The proposed attenuation dams, the further expansion of the open pits at York and Hotazel and the proposed new pit at Kipling into the delineated extent of the Ga-Mogara River will have a potentially irreversible impact on the affected reach of the river, since no diversion thereof is planned. The proposed activities will result in loss of hydraulic connectivity to the downstream reach of the river and therefore loss of recharge when there is flow.

4.4 Ecological Reserve Determination

4.4.1 Hydrological assessment

The natural flows at the EWR site (GaM_EWR1) was simulated using the WRSM2000 rainfall-runoff model and the WR2012 information for the Ga-Mogara River in quaternary catchments D41J and D41K. The Ga-Mogara River is a tributary of the Kuruman River and forms part of the Lower Orange Water Management Area. The EWR site was chosen at the outlet of D41J, downstream of the mining activities. No changes were made to the model parameters as there are no gauging weirs in close vicinity of the site to undertake calibration of the flows.

The Mean Annual Precipitation (MAP) is low for both the quaternaries, with a MAP of 358 mm and 344 mm for quaternary catchments D41J and D41K respectively. The Mean Annual Evaporation for the area is very high at 2 350 mm. As the river is dry for large periods (more than 50% of the time) and with no continuous baseflows, it can be classified as an ephemeral to episodic system. The natural Mean Annual Runoff (nMAR) at the EWR site for the period 1920 to 2009 was simulated as 13.783 x $10^6 m^3$. This flow time series was used as the base hydrology for the Desktop Reserve Model (DRM) to determine the Ecological Water Requirements (EWR).

Present day flows were not modelled as almost no water use from the river is present in the upper catchment due to its ephemeral nature. The mean and median monthly hydrographs for the natural flows at the EWR site is shown in the graph below.

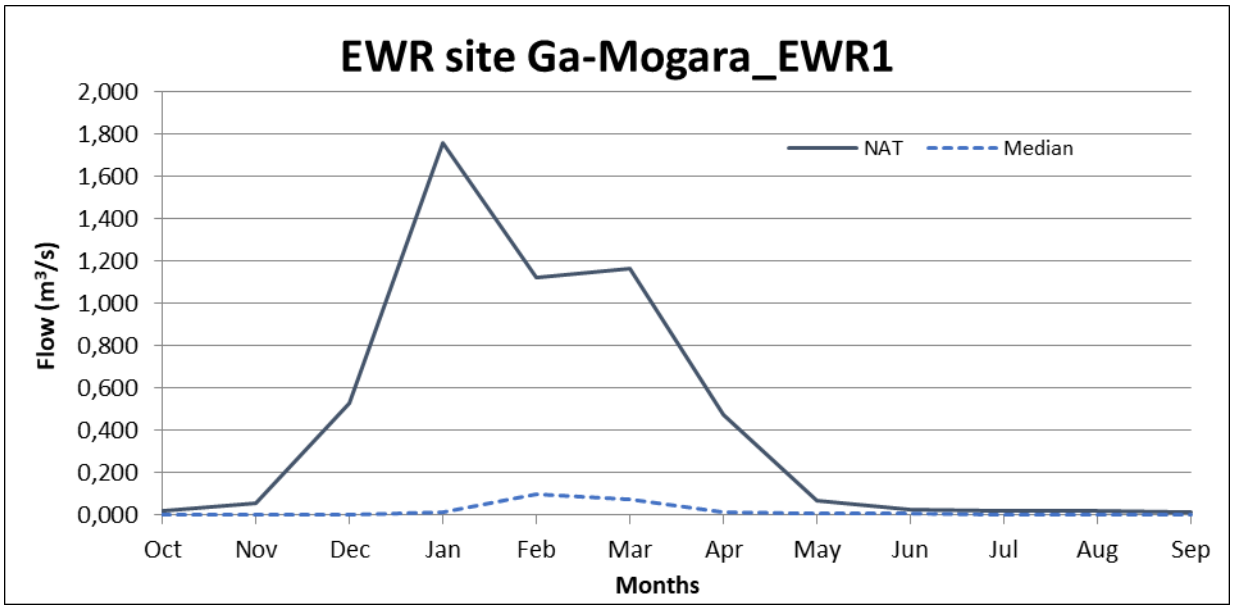


Figure 13: Monthly hydrograph for the Ga-Mogara River at EWR site (GaM_EWR1) in D41K

As can be seen in the graph, the monthly means show flows for all the months, but compared to the median monthly flows, it is clear that the system is flood driven and most dry most of the time.

4.5 Determination of Ecological Water Requirements

4.5.1 Integration of results and Recommended Ecological Category

No hydrological site surveys were undertaken for this river and the results from the Department of Water and Sanitation 2014 Desktop PES/EI/ES study was used to specify the PES and REC along with the findings of the freshwater ecological assessment. The desktop PES for reach D41K-02068 was determined as a C category (DWS, 2014) with the EI as moderate and ES as very low (DWS, 2014). Thus, an ecological category C was recommended to determine the EWR at the EWR site.

4.5.2 Ecological Water Requirements (quantity)

The Desktop Reserve Model (DRM) (SPATSIM, version 2.12) was used to calculate the Ecological Water Requirements for a REC of C for the Ga-Mogara River in quaternary catchment D41K at EWR site GaM_EWR1.

As no hydraulic cross-section was surveyed or discharges measured at the site, the EWR flow data could not be converted to hydraulic conditions (i.e., depths and flow velocities at discharges measured in m^3/s) using a hydraulic model. The final EWR for the Ga-Mogara River at site GaM_EWR1 in D41K is shown in the seasonal distribution graph and summarised in the table below**.**

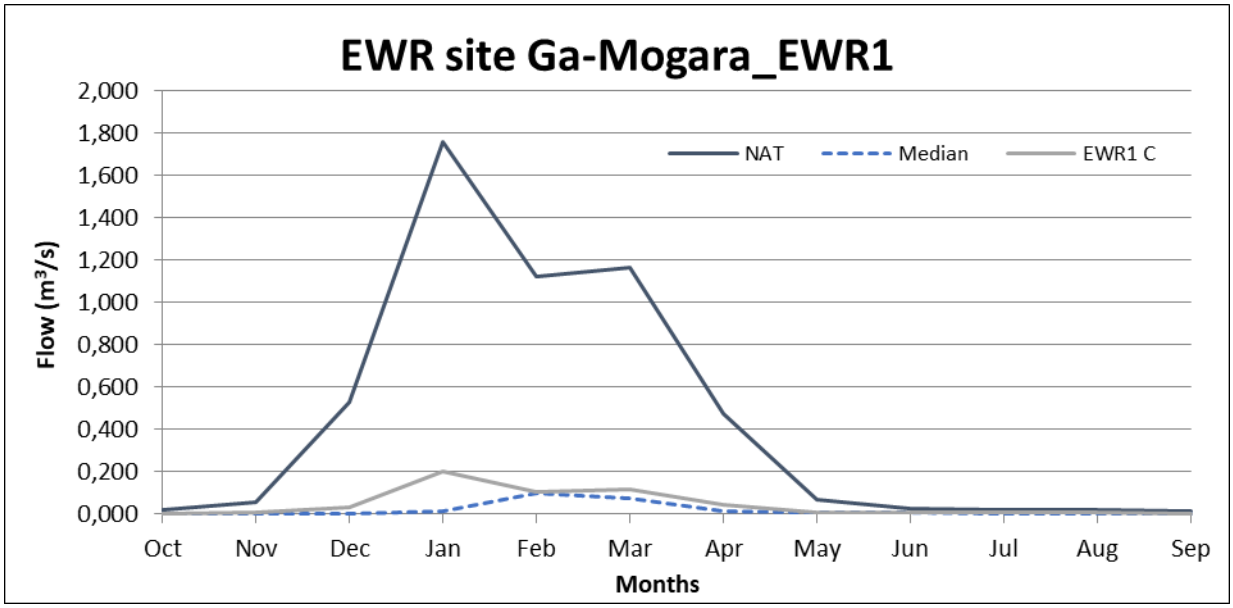


Figure 14: Seasonal distribution graph of the EWR at GaM_EWR1 (Ga-Mogara River)

These EWR results are used to produce the final ecological reserve quantity results in the format of an assurance table or EWR rule curves. These curves specify the frequency of occurrence relationships of the defined maintenance and drought flow requirements for each month of the year. The tables thus specify the percentage of time that defined flows should equal or exceed the flow regime required to satisfy the ecological Reserve. The detailed EWR and assurance tables are provided in **Appendix F**.

Table 4: Summary of the final EWR results at GaM_EWR1 (flows in million m³ per annum)

Quaternary Catchment	D41K
River	Ga-Mogara
Recommended Ecological Category	C
NMAR at EWR site	13.783
Total EWR	2.394 (17.37 %MAR)
Maintenance Low flows	0.664 (4.82 %MAR)
Drought Low flows	0.000 (0.00 %MAR)
Maintenance High flows	1.730 (12.55 %MAR)
Overall confidence	Very low

4.5.3 Ecological Water Reserve Conclusions and conditions

The Ga-Mogara River is an ephemeral to episodic system with long periods of no flows and infrequent large floods. No groundwater contribution is present in the system as the depth to groundwater in the vicinity of the project area is estimated at 20 – 30 meters below ground level (DeltaH, 2021).

The final EWR as specified for the months of May to December is between 0.004 m^3/s to 0.020 m^3/s. These requirements are based on the average flows in the system for the period 1920 to 2010. If one considers the median flows, it is clear that naturally the system is dry most of the time, with no flows for the vast majority of the time above the 50th percentile (see table below). Thus, it is important that these large floods are not impeded to ensure the movement of sediments through the system.

Table 5: Natural flow distribution of the Ga-Mogara River at GaM_EWR1 (flows in million m^3/s)

Percentiles	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
0.1	0.576	1.331	26.809	66.618	26.133	27.051	9.334	1.412	0.513	0.463	0.429	0.333
1	0.381	0.951	10.298	24.750	15.277	25.983	8.892	1.182	0.340	0.325	0.295	0.240
5	0.048	0.302	0.778	8.385	5.583	3.209	2.462	0.290	0.092	0.062	0.051	0.041
10	0.019	0.123	0.451	1.134	2.515	2.134	0.760	0.153	0.055	0.034	0.034	0.024
15	0.007	0.050	0.285	0.601	1.252	1.402	0.444	0.062	0.037	0.025	0.021	0.014
20	0.007	0.012	0.149	0.340	0.869	0.937	0.274	0.039	0.027	0.019	0.015	0.008
30	0.001	0.001	0.027	0.209	0.369	0.459	0.150	0.020	0.015	0.009	0.007	0.005
40	0.000	0.000	0.004	0.092	0.180	0.195	0.048	0.009	0.008	0.007	0.000	0.000
50 (median)	0.000	0.000	0.000	0.011	0.094	0.071	0.012	0.007	0.004	0.000	0.000	0.000
60	0.000	0.000	0.000	0.004	0.025	0.026	0.008	0.000	0.000	0.000	0.000	0.000
70	0.000	0.000	0.000	0.000	0.000	0.011	0.000	0.000	0.000	0.000	0.000	0.000
80	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
85	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
90	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
95	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
99	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
99.9	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

The proposed attenuation dams in the river will have little to no impact on the larger flood flows in the system due to their small size (maybe add height of weirs), if these floods should occur during the lifespan of the mine. Small flood events might be impeded by the attenuation dams. However, due to the sandy nature of the system and the high evaporation, the impact will be limited.

The process of dewatering of the opencast pit in the event of a large flood will need to be undertaken in such a way to minimise the impact on the river downstream from a flow as well as sediment balance perspective.

4.6 Sensitivity Mapping

4.6.1 Legislative requirements and national guidelines pertaining to the application of buffer zones

According to Macfarlane *et al.* (2015) the definition of a buffer zone is variable, depending on the purpose of the buffer zone, however in summary, it is considered to be "a strip of land with a use, function or zoning specifically designed to protect one area of land against impacts from another". Buffer zones are considered to be important to provide protection of basic ecosystem processes (in this case, the protection of wetland ecological services), reduce impacts on water resources arising from upstream activities (e.g. by removing or filtering sediment and pollutants), provision of habitat for aquatic and wetland species as well as for certain terrestrial species, and a range of ancillary societal benefits (Macfarlane *et. al,* 2015). It should be noted however that buffer zones are not considered effective mitigation against impacts such as hydrological changes arising from stream flow reduction, impoundments or abstraction, nor are they considered to be effective in the management of point-source discharges or contamination of groundwater, both of which require site-specific mitigation measures (Macfarlane *et. al,* 2015). Therefore, it is highly recommended that a specialist hydrologist be appointed (if a study has not already been undertaken) to determine the risk of contamination of groundwater which could in turn manifest as surface water impacts. Mitigation measures contained in such an assessment must then be implemented.

Legislative requirements were taken into consideration when determining a suitable buffer zone for the watercourse. The definition and motivation for a regulated zone of activity as well as buffer zone for the protection of the watercourse can be summarised as follows:

Table 6: Articles of Legislation and the relevant zones of regulation applicable to each article.

Regulatory authorisation required	Zone of applicability
Water Use License Application in terms of the National Water Act, 1998 (Act No. 36 of 1998).	**General Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act 36 of 1998)** In accordance with GN509 of 2016 as it relates to the National Water Act, 1998 (Act 36 of 1998), a regulated area of a watercourse in terms of water uses as listed in Section 21c and 21i is defined as: • the **outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance**, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; • in the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or • a 500m radius from the delineated boundary (extent) of any wetland or pan in terms of this regulation, as well as General Notice no. 509 of 2016 as it relates to the NWA.

Regulatory authorisation required	Zone of applicability
	Government Notice 704 Regulations as published in the Government Gazette 20119 of 1999 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) regarding the use of water for mining and related activities aimed at the protection of water resources. These Regulations were put in place in order to prevent the pollution of water resources and protect water resources in areas where mining activity is taking place from impacts generally associated with mining. It is recommended that the proposed project complies with Regulation GN 704 of the National Water Act**,** 1998 (Act No. 36 of 1998) which contains regulations on use of water for mining and related activities aimed at the protection of water resources. GN 704 states that: *No person in control of a mine or activity may:* *(a) locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year floodline or within a horizontal distance of 100 metres from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on waterlogged ground, or on ground likely to become waterlogged, undermined, unstable or cracked;* According to the above, the activity footprint must fall outside of the 1:100 year floodline of the aquatic resource or 100m from the edge of the resource, whichever distance is the greatest.
Listed activities in terms of the National Environmental Management Act, 1998 (Act 107 of 1998) EIA Regulations (2014).	**Activity 12** of Listing Notice 1 (GN 327) of the National Environmental Management Act, 1998 (Act 107 of 1998) EIA regulations, 2014 (as amended) states that: *The development of:* *(xii) Infrastructure or structures with a physical footprint of 100 square meters or more;* *Where such development occurs—* *a) Within a watercourse;* *b) In front of a development setback; or* *c) If no development setback has been adopted, within **32 meters of a watercourse**, measured from the edge of a watercourse.*

The Ga-Mogara River and the applicable zones of regulation as summarised above are conceptually depicted in the figures below.

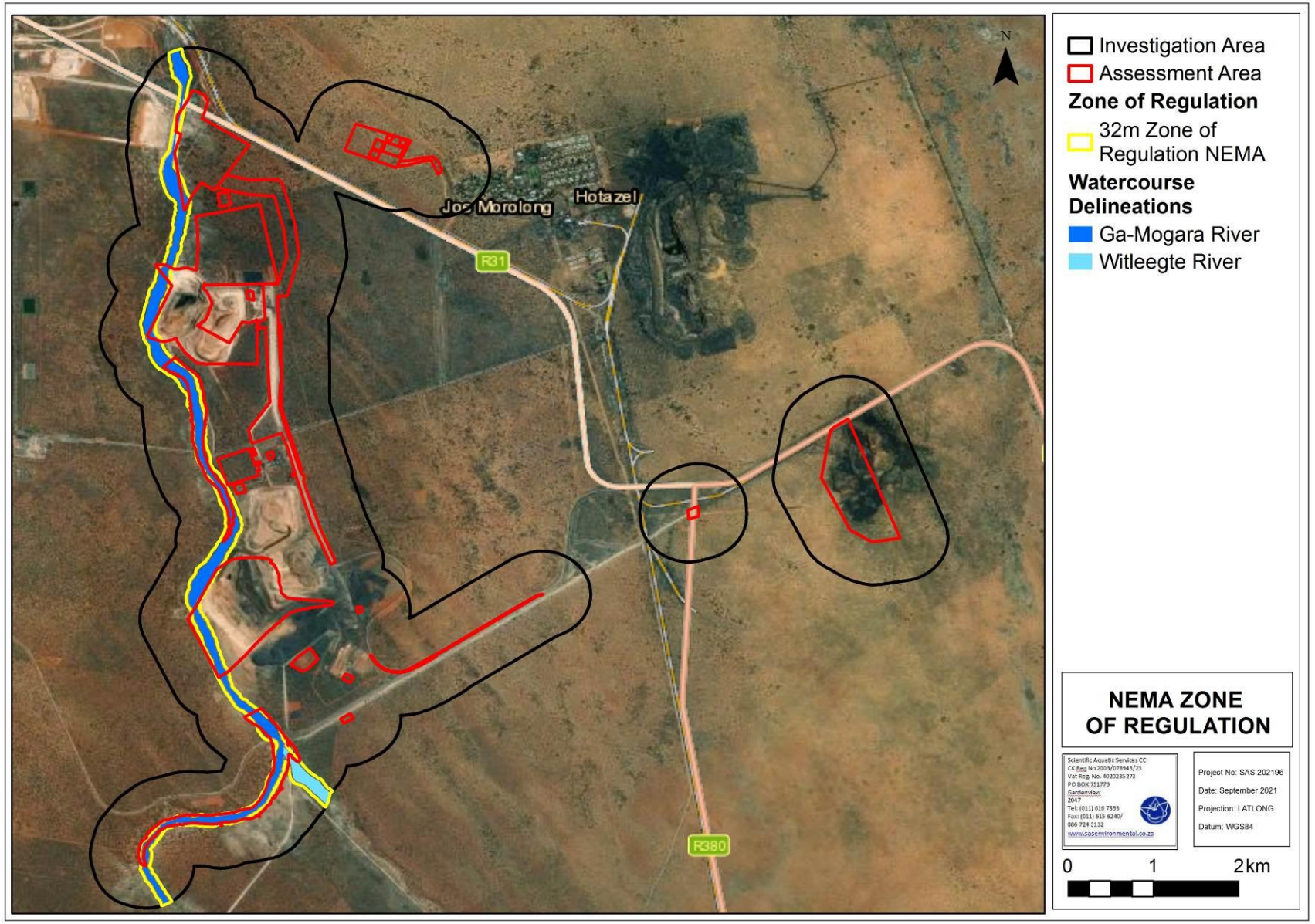


Figure 15: Conceptual presentation of the watercourse within the MRA and investigation areas and the applicable zones of regulation in terms of NEMA.

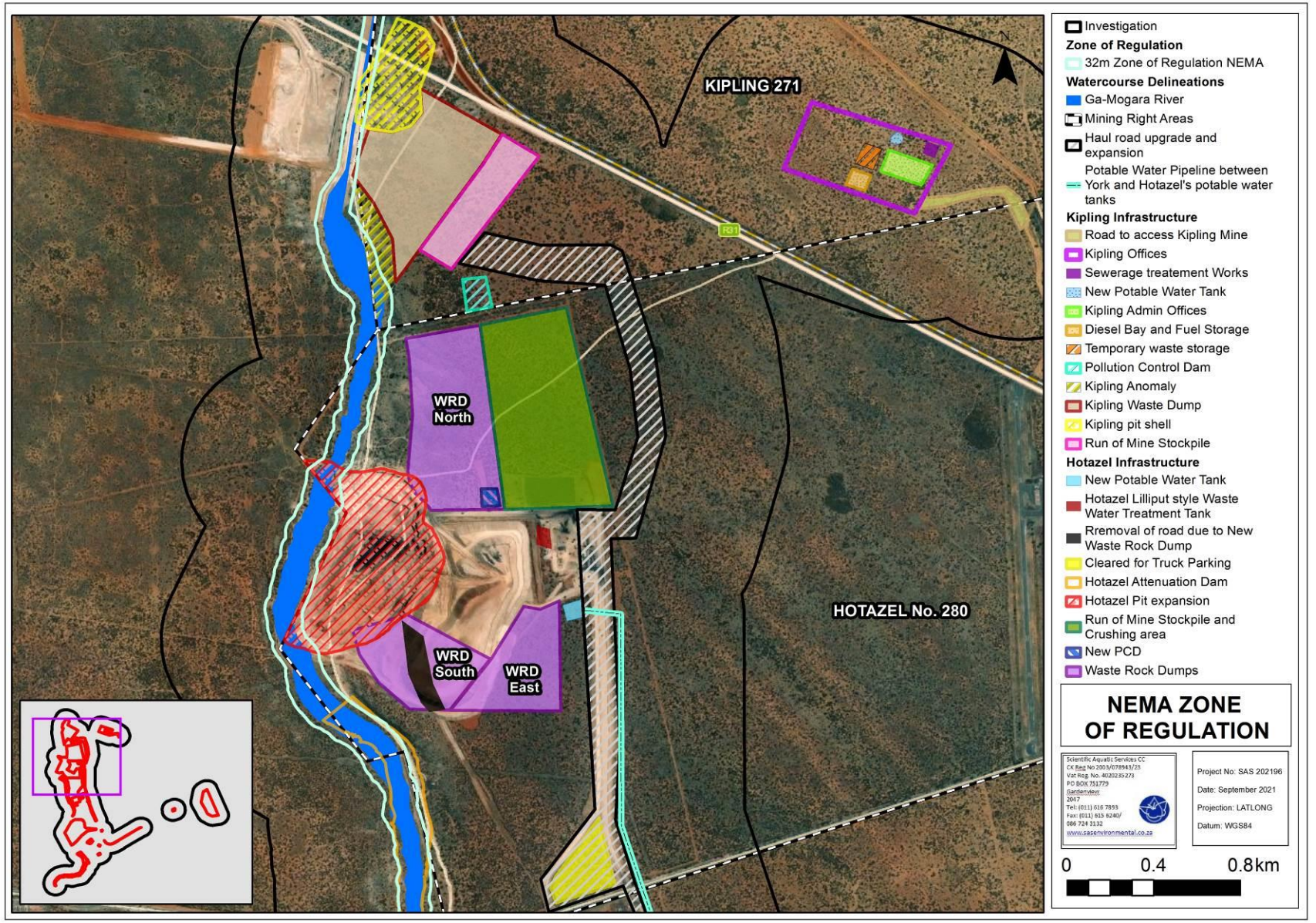


Figure 16: Conceptual presentation of the watercourse within the northern portion of the MRA and investigation area and the applicable zones of regulation in terms of NEMA.

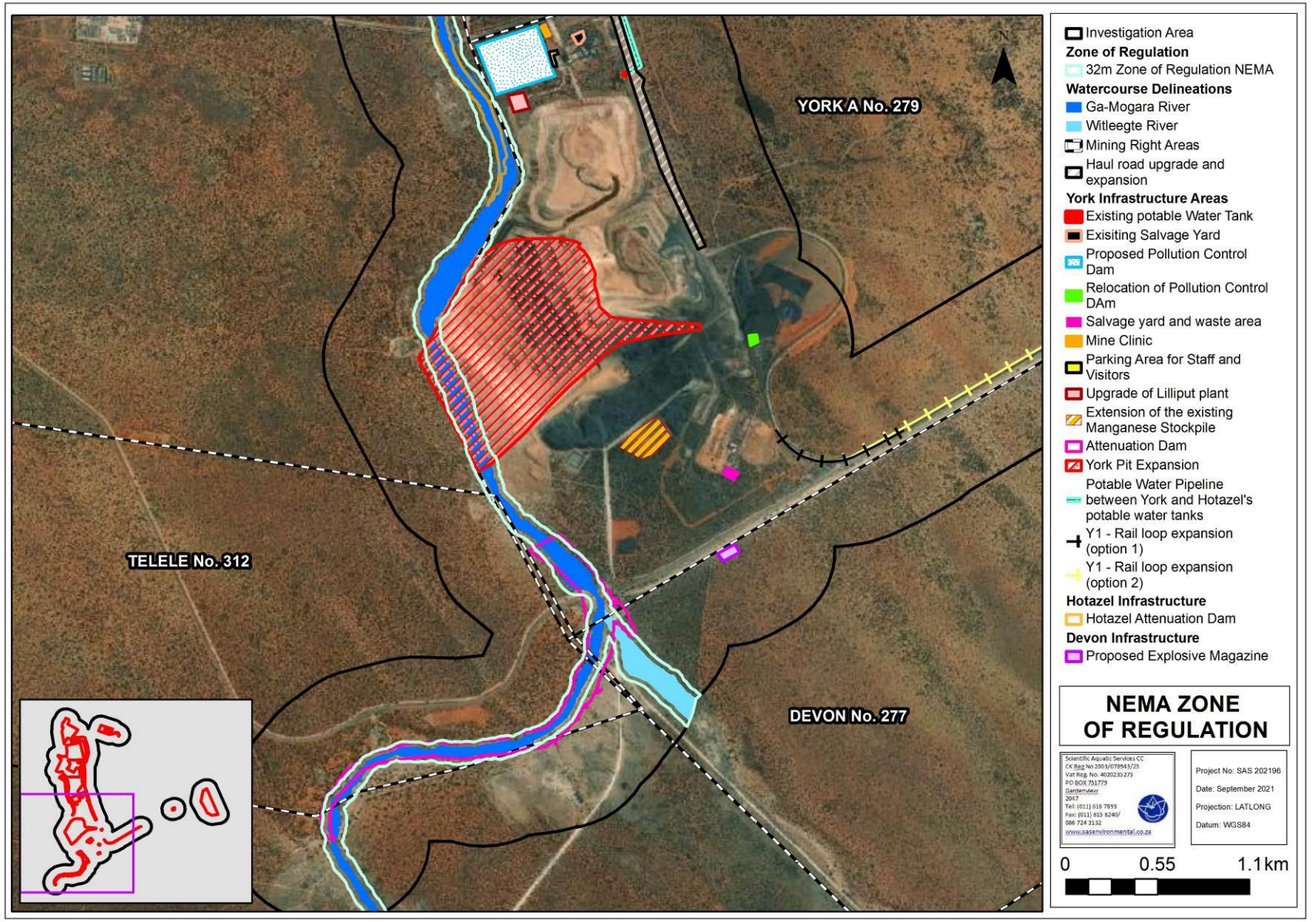


Figure 17: Conceptual presentation of the watercourses within the southern portion of the MRA and investigation area and the applicable zones of regulation in terms of NEMA.

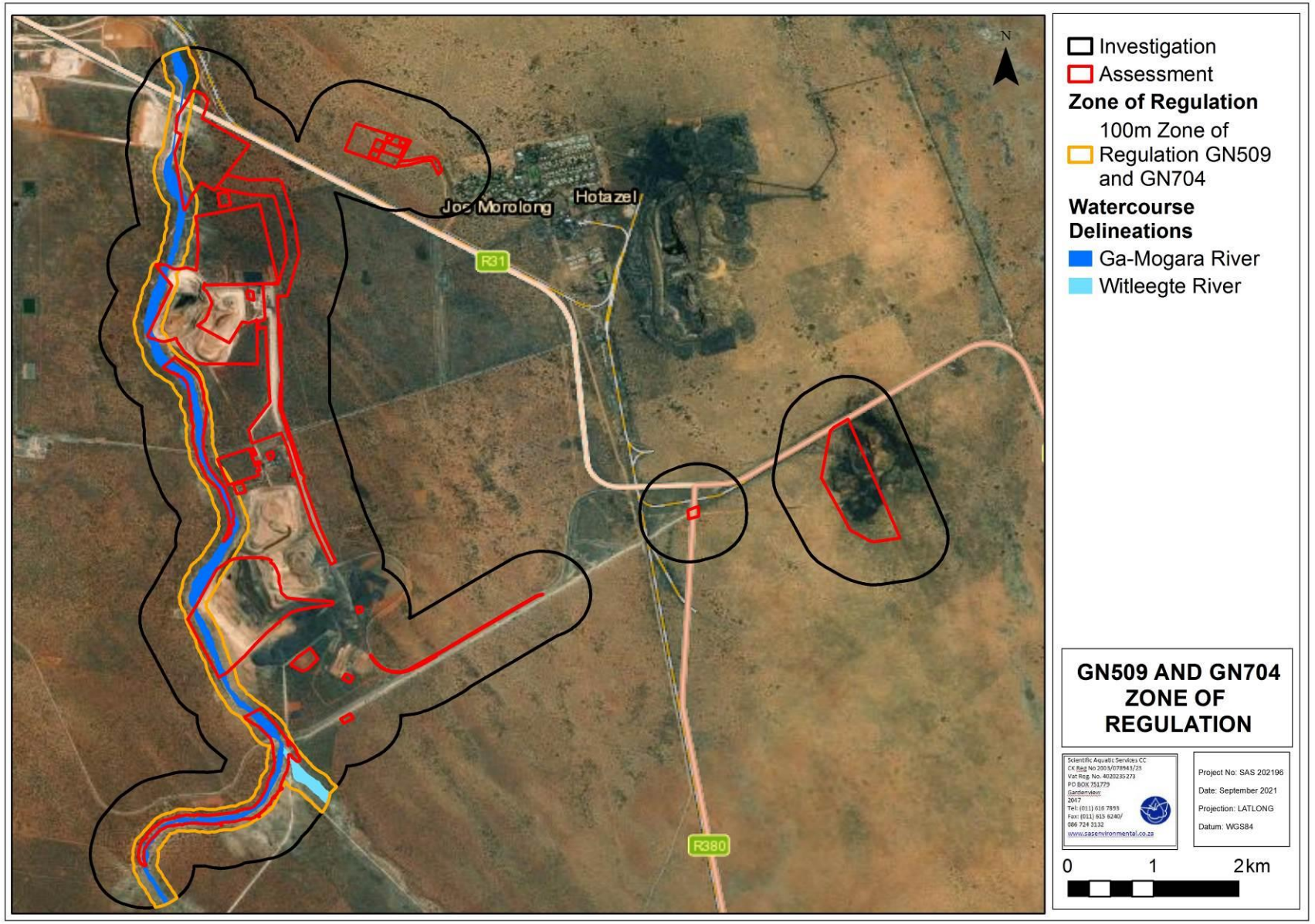


Figure 18: Conceptual presentation of the watercourses within the MRA and investigation area and the applicable zones of regulation in terms of GN509 and 704 as they relate to the NWA.

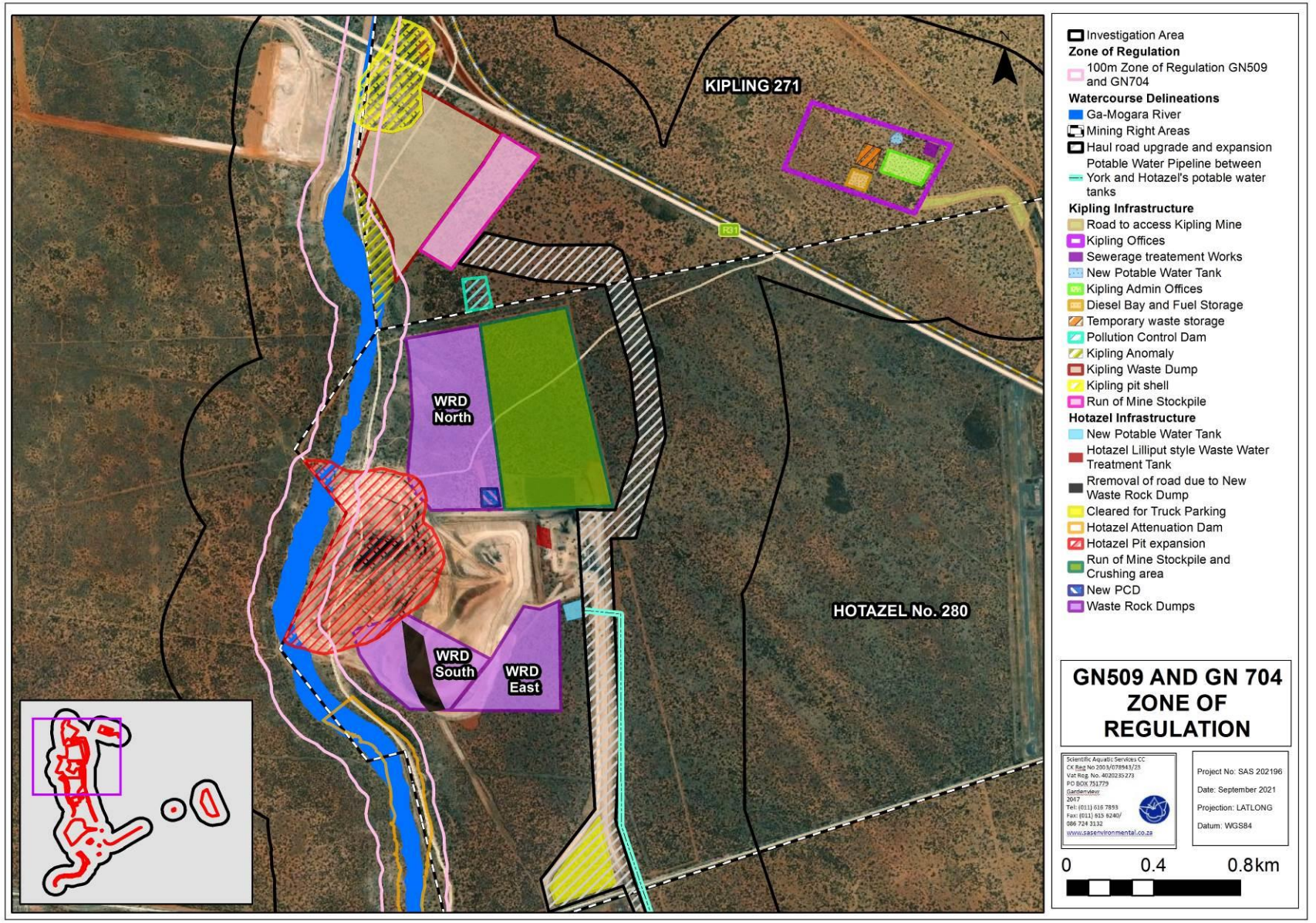


Figure 19: Conceptual presentation of the watercourse within the northern portion of the MRA and investigation area and the applicable zones of regulation in terms of GN509 and 704 as they relate to the NWA.

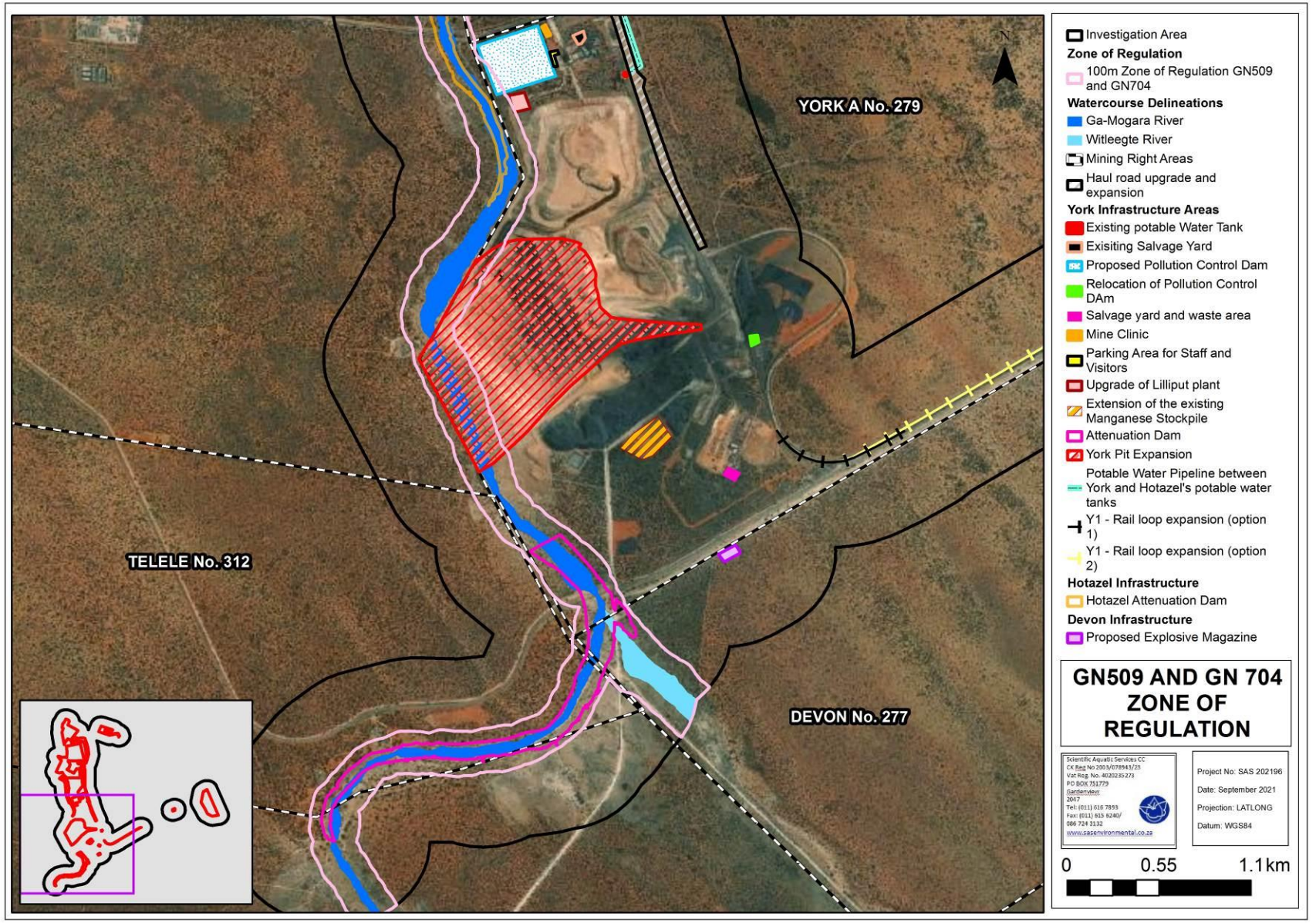


Figure 20: Conceptual presentation of the watercourse within the northern portion of the MRA and investigation area and the applicable zones of regulation in terms of GN509 and 704 as they relate to the NWA.

5 IMPACT AND RISK ASSESSMENTS

This section presents the significance of potential impacts on the ecology of the reach of the Ga-Mogara River associated with the proposed KMR expansion activities. In addition, it indicates the required mitigatory measures needed to minimise the perceived impacts of the proposed activities and presents an assessment of the significance of the impacts taking into consideration the available mitigatory measures and assuming that they are fully implemented. The impact significances were determined using the method provided by the Environmental Assessment Practitioner (EAP) (SRK Consulting (Pty) Ltd) and the DWS Risk Assessment Matrix (2016).

The results of the application of the impact assessment method applied by SRK Consulting (South Africa) (Pty) Ltd as presented in this section will be utilised in the Environmental Authorisation process, whilst the results of the DWS Risk Assessment Matrix will be utilised in the Water Use Licence (WUL) amendment in consultation with the relevant competent authority. Thus, although the two methods may present different scores for the same activity, this is due to differences in their methodologies (refer to Appendix D) and not due to inconsistencies in their application, and each will be judged individually for their specified purpose as discussed above.

5.1 Impact Analyses

5.1.1 Mitigation hierarchy and considerations given to application of mitigation measures

The impact and risk assessments were based on a description of the proposed expansion activities and the layout provided by the proponent (refer to Section 1.2). The points below summarise the considerations undertaken:

- Only the activities which are situated immediately upgradient of or within 100 m of the Ga-Mogara River were assessed. Activities located further than 100 m or to the east of existing infrastructure which would form a barrier between the activity and the river, were excluded from assessment as there is a negligible quantum of risk associated with those activities;
- The DWS Risk Assessment Matrix was applied assuming that a high level of mitigation is implemented, thus the results of the DWS Risk Assessment as presented in this report are *post-mitigation*. The impact assessment was undertaken considering both pre- and post-mitigation scenarios, and is presented accordingly;

- In applying the impact and risk assessments, it was assumed that the mitigation hierarchy as advocated by the DEA *et al* (2013) would be followed, i.e. the impacts would first be avoided, minimised if avoidance is not feasible, rehabilitated as necessary and offset if required;
- The perceived impacts of the various activities on the watercourse ecology took into consideration the chronological order in which the activities will occur. Thus, for example, the impact intensity pertaining to habitat loss during the construction phase is considered “high” (without mitigation) but is deemed “medium” in terms of the operational or decommissioning phases, as the habitat will have already been affected during construction;
- At the time of undertaking the risk and impact assessments, no details were available pertaining to the intended activities within the area demarcated as “Kipling Anomaly”, thus is was not assessed in detail. Should further information be made available at a later stage the risk and impact assessments would need to be updated accordingly;
- Similarly, no construction method statement was available for the proposed attenuation dams within the Ga-Mogara River, and therefore certain assumptions were made pertaining to the construction and operation of these. Furthermore, at the time that this assessment was conducted, no potential diversion channels to link the dams with downstream reaches of the river were planned, therefore the risk and impact assessments were undertaken considering a “worst case” scenario. Should additional information become available in due course, the risk and impact assessments would need to be amended accordingly to allow for due consideration of the information;
- The potential impact of possible changes to the baseflow of the Ga-Mogara River as a result of groundwater drawdown associated with the proposed expansion of the open pits was not assessed, as according to Delta H (2021), although drawdown into the pits occurs, the depth of groundwater (between 12 mbgl and 37 mbgl) precludes it from contributing to baseflow of the river. Thus, the baseflow of the Ga-Mogara River is very unlikely to be affected by the drawdown associated with the open pits; and
- Similarly, due to the ratio of precipitation to evaporation, decant from the open pits is highly unlikely to occur and was therefore not assessed.

Watercourse impact discussion

Four aspects of freshwater ecology are considered when assessing the impacts of the proposed mining related activities:

- Loss of habitat and ecological structure (including alien plant invasion);

- Changes to ecological and sociocultural service provision;
- Hydrological function and sediment balance; and
- Impacts on water quality (when surface water is present).

The assessed reach of the Ga-Mogara River has been modified as a result of various historical agricultural practices and current (authorised) mining activities, and although capacity to provide specific ecological and socio-cultural services is restricted by the episodic nature of the system, it nevertheless forms part of the continuum of ecological processes within the focus area, immediate surrounds, and downstream areas.

Although the Ga-Mogara River is a highly episodic system, flowing once every few decades, riverine systems and particularly ephemeral / episodic riverine systems or river systems that have very low flows as part of their annual hydrological cycles are particularly susceptible to changes in habitat condition, and changing climatic conditions and rainfall patterns may result in changes to the hydraulic regime of the system. As experienced in January 2021, flooding of the Ga-Mogara River can have economically and ecologically devastating effects.

A summary of the DWS Risk Assessment Matrix (2016) is presented in Table 6 below, whilst the results of the SRK impact assessment are provided in Tables 7 to 15.

Table 7: Summary of the impact assessment conducted for the proposed mining expansion activities (in accordance with the DWS Assessment Matrix).

No.	Phases	Activity	Aspect	Impact	Significance	Risk Rating	Confidence level	Control Measures
Perceived Impacts: Kipling Anomaly								
1	**Construction**	Site preparation prior to intended activities (not confirmed at the time of this assessment) including potential vegetation clearing, placement of contractor laydown areas and storage facilities and possible road or bridge crossings across the river, and associated disturbances to soil.	•Vehicular transport and access to the site, site clearing; •Removal of vegetation and associated disturbances to soils; •Miscellaneous activities by construction personnel.	•Exposure of soil, leading to increased runoff, erosion and stream incision, and thus increased sedimentation of the watercourse; •Increased sedimentation of already transformed riparian habitat, leading to smothering of flora and benthic biota and potentially altering surface water quality; •Decreased ecoservice provision; and •Proliferation of alien vegetation as a result of disturbances.	**54**	**L**	80	•Contractor laydown areas, and material storage facilities to remain outside of the delineated riparian zone and associated 32m NEMA zone of regulation; •All vehicle re-fuelling is to take place outside of the delineated riparian zone and associated 32m NEMA zone of regulation; •All Clean and Dirty Water separation areas are to be developed first prior to any other major earthworks to reduce risk of erosion and sedimentation; •All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is absolutely essential; •Retain as much indigenous vegetation (riparian and terrestrial) as possible; •It should be feasible to utilise existing roads to gain access to the site, and crossing the river in areas where no existing crossing is apparent should be unnecessary, but if it is essential crossings should be made at right angles; •Areas where bank failure is observed as a result of such watercourse crossings should be immediately repaired; and •The watercourse areas beyond the proposed footprint of development and the NEMA zone of regulation (32m) should be clearly demarcated with danger tape and areas in which no activities are proposed should be marked as a no-go areas.
Perceived impacts: Kipling Pit shell (partially encroaches on diverted reach of Ga-Mogara River)								
2	**Construction**	Site clearing prior to commencement of construction activities related to the proposed open pit, including placement of contractor laydown areas and storage facilities.	•Vehicular movement and access to the site; and •Removal of vegetation (terrestrial and riparian) and associated disturbances (rubble and litter) to soil and potential indirect disturbances of the river.	•Damage to marginal and non-marginal vegetation, leading to exposure and compaction of soil, in turn leading to potentially increased runoff and erosion; •Exposure of soil, leading to increased runoff from cleared areas and potential erosion of affected reach of the river, and thus increased	**48**	**L**	**70**	•The footprint provided to the specialist in August 2021 indicates that the Kipling pit shell will extend into a diverted reach of the Ga-Mogara River, within the Mokala Mine MRA (SLR, 2021). It is strongly recommended that the footprint be optimised to avoid encroaching on the river any further as this will contribute to the cumulative impacts to the river posed by the proposed expansion activities; •Notwithstanding the above, no unauthorised activity may be permitted within the Ga-Mogara River, including vehicular

No.	Phases	Activity	Aspect	Impact	Significance	Risk Rating	Confidence level	Control Measures
3		Removal of topsoil from open pit footprint, and stockpiling thereof for rehabilitation.	•Increased risk of transportation of sediment from exposed soil via wind or potentially in stormwater.	potential for further sedimentation of the river particularly within the diverted reach thereof; •Increased sedimentation of the river may lead to changes in instream habitat, potentially altered surface water quality when present and smothering of vegetation and/or altered vegetation composition; •Decreased ecoservice provision; •Further decreased ability to support biodiversity, specifically downstream of the MRA; and •Increased proliferation of alien vegetation as a result of disturbances.	**72**	**M**		movement, indiscriminate disposal of waste material, or removal of vegetation; •During construction, the topsoil should be removed up to a depth of 150mm and be carefully stockpiled, for use during rehabilitation, outside of the freshwater resource and its 32m NEMA Zone of Regulation; •Excavated materials should not be contaminated and it should be ensured that the minimum surface area is taken up. The stockpiles may not exceed 2m in height or the height recommended by the Soil and Land Capability study (ZRC, 2021); •All exposed soils must be protected for the duration of the construction phase in order to prevent erosion and further sedimentation of the reach of the watercourse proximal to these stockpiles; and •Mitigation measures as outlined for Activity 1 above.
4		Potential indiscriminate disposal of hazardous and non-hazardous materials waste in the Ga-Mogara River.	•Altered surface water quality (when present); and •Possible changes to flow patterns as a result of blockages caused by overburden and waste rock that is spilled.		**48**	**L**	**70**	
5		Surface impact during blasting and initial removal of overburden.	•Contamination of river with chemicals and hydrocarbons in runoff (decreased water quality); and •Altered sediment balance of the river and erosion resulting from altered run-off patterns may have a negative impact on riparian and in-stream habitat and/or biota.		**48**	**L**	**80**	
Perceived impacts: Kipling Pit Waste Rock Dump (WRD) within 20 m of diverted reach of Ga-Mogara River								
6	**Construction**	Construction of clean and dirty water separation systems / stormwater management systems around the downgradient boundaries of the WRD that direct clean stormwater run-off around and away from the WRD.	•Clearing of vegetation / levelling of soil; •Earthworks, creating potential sources of sediment, which may be transported to the watercourse by stormwater runoff; •Disposal of construction-related waste; *Transportation of construction materials, resulting in disturbances to soil, and increased risk of sedimentation/erosion.	•Temporarily exposed soils, leading to increased risk of transportation of sediment to the watercourse. •Increased sedimentation of the watercourse may lead to altered water quality, smothering of vegetation and/or altered vegetation composition; •Exposed soils may result in increased stormwater runoff, leading to sheet erosion, as well as increased water inputs to the watercourse, in turn potentially leading to an altered vegetation composition.	**52**	**L**	**70**	As per Activity 1, and: •The stockpiles may not exceed 2m in height or the height recommended by the Soil and Land Capability study (ZRC, 2021); •All exposed soils must be protected for the duration of the construction phase in order to prevent erosion and further sedimentation of the reach of the watercourse proximal to these stockpiles.

No.	Phases	Activity	Aspect	Impact	Significance	Risk Rating	Confidence level	Control Measures
7		Removal of topsoil from project footprint, and stockpiling thereof for rehabilitation	Topsoil removal Creation of temporary stockpiles	Increased risk of transportation of sediment from exposed soil in stormwater runoff, leading to increased turbidity of surface water, sedimentation of watercourse, smothering of vegetation and/or altered vegetation composition.	**48**	**L**	**70**	
Perceived Impacts: Expansion of open pits (York and Hotazel)								
8	**Construction**	Site clearing prior to commencement of construction activities related to the open pit expansion area, including placement of contractor laydown areas and storage facilities.	•Vehicular movement and access to the site; and •Removal of vegetation (terrestrial and riparian) and associated disturbances (rubble and litter) to soil and potential indirect disturbances of the river.	•Damage to marginal and non-marginal vegetation, leading to exposure and compaction of soil, in turn leading to further increased runoff and erosion; •Exposure of soil, leading to increased runoff from cleared areas and further erosion of the river, and thus increased potential for further sedimentation of the river; •Changes to the sediment balance of the river may lead to changes in instream habitat, potentially altered surface water quality when present and smothering of vegetation and/or altered vegetation composition; •Decreased ecoservice provision; •Further decreased ability to support biodiversity, specifically downstream of the MRA; and •Increased proliferation of alien vegetation as a result of disturbances.	**78**	**M**	70	•Alternative options to avoid mining through the Ga-Mogara River should be sought, such as accessing the mineral resource from the western side of the river. •Notwithstanding the above, no unauthorised activity may be permitted within the Ga-Mogara River, including vehicular movement, indiscriminate disposal of waste material, or removal of vegetation; •During construction, the topsoil should be removed up to a depth of 150mm and be carefully stockpiled, for use during rehabilitation, outside of the freshwater resource and its 32m NEMA Zone of Regulation; •Excavated materials should not be contaminated and it should be ensured that the minimum surface area is taken up. The stockpiles may not exceed 2m in height or the height recommended by the Soil and Land Capability study (ZRC, 2021); •All exposed soils must be protected for the duration of the construction phase in order to prevent erosion and further sedimentation of the reach of the watercourse proximal to these stockpiles; and •Mitigation measures as outlined for Activity 1 above.
9		Removal of topsoil from open pit footprint, and stockpiling thereof for rehabilitation.	•Increased risk of transportation of sediment from exposed soil via wind or potentially in stormwater.		**78**	**M**	70	
10		Potential indiscriminate disposal of hazardous and non-hazardous materials waste in the Ga-Mogara River.	•Altered surface water quality (when present); and •Possible changes to flow patterns as a result of blockages caused by overburden and waste rock that is spilled..		**48**	**L**	**70**	

No.	Phases	Activity	Aspect	Impact	Significance	Risk Rating	Confidence level	Control Measures
11		Surface impact during blasting and initial removal of overburden.	•Loss of instream and riparian habitat; •Contamination of river with chemicals and hydrocarbons in runoff (decreased water quality); and •Increased sedimentation and erosion resulting from altered run-off patterns may have a negative impact on riparian and in-stream habitat and/or biota.		**165**	**M**	**70**	
Perceived Impacts: WRD North and South (Hotazel) within 120 m and 150 m respectively of the Ga-Mogara River								
12	Construction	•Clearing and levelling of land for the WRDs within 120 m and 150 m (north and south WRDs respectively) of the Ga-Mogara River. •Removal of topsoil from WRD footprint areas, and stockpiling thereof for rehabilitation.	•Clearing of vegetation / levelling of soil, and creation of temporary topsoil stockpiles. •Earthworks, creating potential sources of sediment, which may be transported via wind to the river. •Altered topography, leading to changes in pattern, quantum of flow and timing of water in the landscape.. *Potential loss of catchment yield (*considered very low risk due to semi-arid climate) and the extent of the catchment.	•Exposure of soil, leading to increased runoff, erosion and wind-blown sediment, and thus potential increased sedimentation of the river; •Increased sedimentation of riparian and/or instream habitat, leading to smothering of flora and benthic biota and potentially altering surface water quality when water is present; •Decreased ecoservice provision; and •Proliferation of alien vegetation or encroacher species as a result of disturbances.	**40**	**L**	70	As per Activities 6 and 7.
13		•Construction of stormwater trenches / berms around the downgradient boundaries of the respective WRDs to direct clean stormwater run-off around and away from the WRD.			**40**	**L**	70	
Perceived Impacts: York Pollution Control Dam (PCD) within 85 m of Ga-Mogara River								
14	Construction	Site preparation prior to construction activities related to the construction of Pollution Control Dam (PCD) including placement of contractor	•Vehicular movement and access to the site; and •Removal of vegetation and associated disturbances (rubble and litter) to soil.	•Loss of vegetation, leading to exposed/compacted soils, in turn leading to potential increased runoff and erosion; •Exposure of soil, leading to	**36**	**L**	70	•Ensure that sound environmental management is in place during the planning phase - refer to Activity 1; •Design of infrastructure should be environmentally and structurally sound and all possible precautions taken to prevent spillage or seepage;

No.	Phases	Activity	Aspect	Impact	Significance	Risk Rating	Confidence level	Control Measures
15		laydown areas and storage facilities.	•Possible indiscriminate movement of construction equipment through the river; •Potential contamination of river by stormwater runoff containing hydrocarbons/sediment.	increased runoff from cleared areas and potential erosion of the river, and thus increased potential for further sedimentation of the river; •Changes to the sediment balance of the river may lead to further changes in instream habitat, potentially altered surface water quality particularly in the downstream reaches of the system, and smothering of vegetation and/or altered vegetation composition; •Potential impacts on water quality due to leaks and spills; •Further decreased ecoservice provision; •Further decreased ability to support biodiversity; and •Further proliferation of alien vegetation as a result of disturbances.			70	•It must be ensured that the design and construction of all infrastructure prevents failure.
16		Removal of topsoil from project footprint, and stockpiling thereof for rehabilitation.	•Increased risk of transportation of sediment from exposed soils in storm water runoff.				70	
17		Potential indiscriminate disposal of hazardous and non-hazardous waste within the river.	•Altered water quality; and •Possible changes to flow patterns as a result of blockages caused by overburden and waste rock that is spilled.				70	
18		Construction of Pollution Control Dam (PCD).	•Ground breaking and earthworks; •Possible excavation activities leading to the stockpiling of soil; and •Removal and stockpiling of topsoil.				70	
Perceived Impacts: Upgrade of Lilliput Waste Water Treatment Works (WWTW) (York) within 102 m of the river								
19	Construction	•Site preparation prior to construction activities related to the expansion of the WWTW including placement of contractor laydown areas and storage facilities. •Removal of topsoil from project footprint, and stockpiling thereof for rehabilitation. •Potential indiscriminate disposal of hazardous and non-hazardous waste within the river.	•Vehicular movement and access to the site; •Removal of vegetation and associated disturbances (rubble and litter) to soil; •Increased risk of transportation of sediment from exposed soils in storm water runoff; •Altered water quality; and •Possible changes to flow patterns as a result of blockages caused by	•Loss of vegetation, leading to exposed/compacted soil, in turn leading to potential increased runoff and erosion; •Exposure of soil, leading to increased runoff from cleared areas and potential erosion of the river, and thus increased potential for further sedimentation of the river; •Changes to the sediment balance of the river may lead to further changes in instream habitat, potentially altered surface water quality particularly in	**24**	**L**	70	As per Activity 1.

No.	Phases	Activity	Aspect	Impact	Significance	Risk Rating	Confidence level	Control Measures
			construction rubble / spilled waste rock or overburden within the river.	the downstream reaches of the system, and smothering of vegetation and/or altered vegetation composition; •Potential impacts on water quality due to leaks and spills; •Further decreased ecoservice provision; •Further decreased ability to support biodiversity; and •Further proliferation of alien vegetation as a result of disturbances.				
20		Construction activities relating to the expansion of the WWTW.	•Ground breaking and earthworks; •Possible excavation activities leading to the stockpiling of soil; and •Removal and stockpiling of topsoil.					
Perceived Impacts: Attenuation dams downstream of York and Hotazel pits								
21	Construction	•Site preparation prior to construction activities related to the construction of the dam wall, including placement of contractor laydown areas and storage facilities. •Removal of topsoil from project footprint, and stockpiling thereof for rehabilitation. •Potential indiscriminate disposal of hazardous and non-hazardous waste within the river.	•Vehicular movement and access to the site; •Removal of vegetation and associated disturbances to soil; •Increased risk of transportation of sediment from exposed soils in storm water runoff; •Altered water quality; and •Possible changes to flow patterns as a result of blockages caused by spilled waste rock or overburden.	•Loss of vegetation, leading to exposed/compacted soil, in turn leading to potential increased runoff and erosion; •Exposure of soil, leading to increased runoff from cleared areas and potential erosion of the river, and thus increased potential for further alteration to the sediment balance of the river; •Increased sedimentation of the river may lead to further changes in instream habitat, potentially altered surface water quality particularly in the downstream reaches of the system, and smothering of vegetation and/or altered vegetation composition; •Potential impacts on water quality due to leaks and spills; •Further decreased ecoservice provision; •Further decreased ability to support biodiversity; and •Further proliferation of alien	**84,5**	**M**	70	As per Activity 1
22		Construction activities relating to the construction of the dam wall.	•Ground breaking and earthworks; •Possible excavation activities leading to the stockpiling of soil; and •Removal and stockpiling of topsoil.				**70**	

No.	Phases	Activity	Aspect	Impact	Significance	Risk Rating	Confidence level	Control Measures
				vegetation as a result of disturbances.				
OPERATIONAL PHASE IMPACTS								
Perceived Impacts: Kipling Anomaly								
23	Operational	Not assessed due to insufficient information pertaining to the intended activity in the 'Kipling anomaly' area at the time of assessment.						
Perceived impacts: Kipling Pit shell								
24	Operational	Operation of open pit on Kipling; encroaching on diverted portion of Ga-Mogara River.	•Removal of topsoil and overburden and stockpiling thereof, potentially within 32 m of the river; •Extraction and subsequent transport of manganese from pits.	•Further loss of hydraulic and instream connectivity; •Increased risk of pollution of surface water when present, which may affect the downstream reaches of the river, leading to impaired water quality and salination of soil within the river; •Increased risk of sediment transport via wind and/or surface runoff from the overburden stockpile into the river, potentially leading to altered water quality, further altered channel competency and further altered vegetation community composition; and *Increased risk of erosion, leading to further altered topography/geomorphological processes, in turn resulting in altered runoff patterns and formation of preferential flow paths.	**192**	**H**	**70**	In applying the risk assessment, it was assumed that the mitigation hierarchy as advocated by the DEA et al. (2013) would be followed, i.e. impacts would first be avoided. As the proposed expansion of both the York and Hotazel pits are located within the Ga-Mogara river, causing irreversible localised impacts and contributing to the cumulative impacts on the downstream reach as a result, this is not feasible. Notwithstanding the above the following mitigation measures apply: •Pollution prevention through appropriate management and monitoring of pollution prevention systems, with specific mention of the management of clean and dirty water separation systems, in order to prevent, eliminate and/or control potential pollution of soil, groundwater and surface water must be implemented; •Implement a monitoring programme to detect and prevent the pollution of soil, surface water and groundwater; and •If possible, the overburden stockpiles should be located in an area where they will not impact on any hydrological features of increased importance within the greater MRA, and outside the 100m GN704 Zone of Regulation associated with either the Ga-Mogara River or Witleegte River within the MRA. *Reduce airborne dust during blasting activities through: - Damping dust generation areas with water (although not in sufficient quantities to generate runoff); and - Use of hessian or brush barrier fences. •Measures to contain and reuse as much water as possible within the mine process water system must be sought, and very strict control of water consumption must take place. Detailed monitoring must be implemented and maintained to ensure that all water usage is continuously optimised;
25			•Blasting/mining activities in order to remove overburden and to extract the manganese; •Removal of manganese and overburden from the open cast pits.		**160**	**M**	**70**	

No.	Phases	Activity	Aspect	Impact	Significance	Risk Rating	Confidence level	Control Measures
Perceived impacts: Kipling Pit Waste Rock Dump (WRD) within 20 m of diverted reach of Ga-Mogara River								
26	Operational	Potential risk of failure if structure is not stable.	•Possible loss of riparian habitat.	•Loss of riparian habitat, leading to loss of biodiversity; •Risk of ponding should diverted portion of river become blocked as a result of failure; •Formation of preferential surface flow paths leading to potential for erosion of terrestrial habitat and sedimentation of downgradient river.	**24**	**L**	**70**	•The structure must be stabilised to prevent failure, and must be regularly inspected to proactively manage any perceived risk of failure. •Should failure occur, and the diverted portion of the river become blocked as a result, the waste rock must be removed immediately and stockpiled in another appropriate WRD to ensure continued hydraulic connectivity of the channel.
27		Seepage and runoff from WRD.	•Increased risk of pollution of surface water which may potentially reach the Ga-Mogara River, leading to salinisation and pollution by specific contaminants of concern; •Increased risk of sediment transport in surface runoff from the WRD to river leading to altered water quality and sedimentation of river.	•Possible contamination of surface water, leading to impaired water quality and salination of soil within the watercourse; and •Alteration to the sediment balance of the river could lead to altered water quality, altered channel competency and altered vegetation community composition.	**30**	**L**	70	•Additional water inputs to watercourse via groundwater are anticipated to be highly unlikely due to depth of groundwater table (between 12 m to 37 m according to 2018/19 hydro census) and groundwater does not contribute to baseflow of river. •Notwithstanding the above, water to be collected by means of stormwater trenches/berms, and recycled and utilised within the KMR water circuit, or pumped to a Pollution Control facility for evaporation; •Pollution prevention through infrastructure design, in order to prevent, eliminate and/or control the potential groundwater pollution plume, as determined by a suitably qualified specialist; •Implement monitoring programme to detect and determine the formation and/or extent of any potential groundwater pollution plume as per the groundwater management plan, if one has been developed.
28		Presence of clean and dirty separation infrastructure around downgradient areas of WRD, preventing stormwater runoff from reaching watercourse	Loss of catchment yield due to stormwater containment.	•Altered flood peaks as a result of formalisation and concentration of surface runoff; •Potential for erosion of terrestrial areas as a result of the formation of preferential flow paths, leading to sedimentation of the river; •Further reduction in volume of water entering the river, leading to further loss of recharge (and thus increased desiccation) of downstream system; •Altered vegetation communities due to increased moisture stress.	**40**	**L**	70	•Loss of catchment yield to be determined by a suitably qualified specialist (although this is not perceived to be a significant risk due to the relatively small extent of the mine's dirty water containment system, the river's catchment size and the semi-arid climate); •Clean and dirty water systems must be kept separate in line with Regulation GN704;• •The clean water diversion structures must be designed to accommodate the peak flow expected for a minimum 1:50 year flood event; •Clean water may be discharged into the watercourse, however the discharge outlet must be equipped with energy dissipating structures (such as Armorflex or reno mattresses) to attenuate the velocity of water inflow into the watercourse and to control erosion

No.	Phases	Activity	Aspect	Impact	Significance	Risk Rating	Confidence level	Control Measures
								and incision; *Runoff from areas within the dirty water management area should be captured in a sump and pumped to a PCD that is lined with an appropriate liner, before being re-used as process water of the mine.
Perceived Impacts: Expansion of open pits (York and Hotazel)								
29	Operational	Operation of expanded open pits on Hotazel and York, both through the active channel of the Ga-Mogara River.	•Removal of topsoil and overburden and stockpiling thereof, potentially within 32 m of the river; •Extraction and subsequent transport of manganese from pits.	•Loss of instream and riparian habitat (approximately 1,4 ha [Hotazel pit] and 5,1 ha [York pit]); •Increased risk of pollution of surface water when present, which may affect the downstream reaches of the river, leading to impaired water quality and salination of soil within the river; •Increased risk of sediment transport via wind and/or surface runoff from the overburden stockpile into the river, potentially leading to altered water quality, further altered channel competency and further altered vegetation community composition; and *Increased risk of erosion, leading to further altered topography/geomorphological processes, in turn resulting in altered runoff patterns and formation of preferential flow paths.	**192**	**H**	**70**	As per Activities 24 and 25.
30			•Blasting/mining activities in order to remove overburden and to extract the manganese; •Removal of manganese and overburden from the open cast pits.		**165**	**M**	**70**	
Perceived Impacts: WRD North and South (Hotazel) within 120 m and 150 m respectively of the Ga-Mogara River								
31	Operational	Potential risk of failure if structure is not stable.	•Possible loss of riparian habitat.	•Loss of riparian habitat, leading to loss of biodiversity; •Risk of ponding should diverted	**18**	**L**	70	As per Activities 26 to 28.

No.	Phases	Activity	Aspect	Impact	Significance	Risk Rating	Confidence level	Control Measures
				portion of river become blocked as a result of failure; •Formation of preferential surface flow paths leading to potential for erosion of terrestrial habitat and sedimentation of downgradient river.				
32		Seepage and runoff from WRD.	•Increased risk of pollution of surface water, potentially affecting the water quality within the river; •Increased risk of sediment transport in surface runoff from the WRD to river leading to altered water quality and sedimentation of river.	•Possible contamination of surface and ground water, leading to impaired water quality and salination and contamination of soil within the watercourse; and •Sedimentation of watercourse could lead to altered water quality, altered channel competency and altered vegetation community composition.	**18**	**L**	70	
Perceived Impacts: York Pollution Control Dam (PCD) within 85 m of Ga-Mogara River								
33	**Operational**	Operation of Pollution Control Dam (PCD)	•Disposal of water containing waste ('dirty water') into the PCD.	•Potential failure of the PCD infrastructure may result in leakages or discharges and possible contamination of surface water, increased flow into the river or back into the open pit, and lowered water quality (increase in salts and specific contaminants of concern) within the river.	**40**	**L**	70	Measures needed to mitigate risk of increased runoff and seepage, surface disturbance and increased risk of sedimentation and erosion. See Appendix G in report, and specifically: •Capacity of the PCD must be in line with GN704 regulations; •Regular monitoring of possible seepage must be undertaken and proactive measures to prevent seepage (lining of storage facilities) implemented; •Potential runoff in areas with steep slopes should be slowed down by the strategic placement of berms; •Clean and dirty water management must take place in order to prevent contaminated runoff from the ROM stockpiles and potentially from PCDs creating preferential flow paths which may reach the watercourses; •Monitoring of erosion must take place throughout the life of mine (after every rainstorm and / flood greater than 5 mm and on a monthly basis during the wet season) in order to prevent the formation of erosion gullies as a result of altered flow paths, and the possible sedimentation of the river; and •Ensure that an emergency response plan is in place to deal with any spillages in accordance with Appendix C of GN509 as it relates to the NWA.

No.	Phases	Activity	Aspect	Impact	Significance	Risk Rating	Confidence level	Control Measures
Perceived Impacts: Upgrade of Lilliput Waste Water Treatment Works (WWTW) (York) within 102 m of the river								
34	Operational	Continued operation (increased capacity) of Lilliput WWTW	•Treatment of sewage effluent and pumping thereof into municipal sewage system; •Potential failure of infrastructure, resulting in blockages or leakages and possible contamination of surface and ground water	•Potential contamination of surface and groundwater in the event of spills (including burst pipes).	**21**	**L**		•Treatment and discharge of effluent must comply with GN665 of 2013 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) both in terms of volume of discharge and chemical values; •WWTW infrastructure must be regularly inspected for failure or leaks, to avoid accidental discharge into the receiving environment; •All sewer outfall pipelines must be encased in concrete along the entire length, and pressure tested for integrity upon the completion of construction; •It is recommended that the integrity of the pipeline(s) be inspected at least once every five years or more often should there be any sign or reports of a leak; •Should a blockage occur all possible steps are to be taken to prevent the pollution of the receiving environment during repair, including the placement of sheeting around the manhole used for access as well as containment barrels for any effluent withdrawn;
35			•Unblocking or repair of pipelines if required (accessed via manholes).	•Vehicular access to the affected pipeline resulting in: - Soil compaction - Vegetation degradation - Soil and stormwater contamination from oils and hydrocarbons •Potential contamination of surface and groundwater with sewage effluent resulting in: - Increased concentration of salts, nitrate and toxic ammonia concentrations, as well as counts of *Escheria coli.* - Potential contamination of receiving environment, leading to biodiversity simplification and the excess production of hydrogen sulphide gas as well as increased alien and invasive species encroachment.	**16**	**L**	70	
36			Operation of the WWTW and associated pipelines	•Latent impacts: The infrastructure may pose an increased risk over time in terms of the pipeline weakening and cracking leading to leakages of sewage. This may result in inputs of sewage effluent entering the receiving environment, and the following impacts:	**15**	**L**	70	

No.	Phases	Activity	Aspect	Impact	Significance	Risk Rating	Confidence level	Control Measures
				- Increased concentration of salts, nitrate and toxic ammonia concentrations, as well as counts of *Escheria coli.* - Potential contamination of receiving environment.				
Perceived Impacts: Attenuation dams								
37	**Operational**	Operation of attenuation dams.	•Inundation footprint will result in the direct loss of approximately 16 ha (dam on Telele) and approximately 18 ha (dam between York and Hotazel pits) of riparian habitat. Additional loss due to increased moisture stress as a result of loss of recharge is possible in the reaches downstream of the dams; •Loss of hydraulic connectivity and recharge to downstream reaches of the Ga-Mogara River. •Overflow of water over the spillway when the dam is at full capacity.	•Prolonged inundation of the upstream reach of the dam wall, leading to potential changes to hydroperiod and associated alterations to biodiversity aspects including floral community composition and structure and increased faunal utilisation; •Potential accumulation of sediment within the dams, leading to altered vegetation assemblages, and possible reduction in dam capacity.	**156**	**M**	80	•The dams and any outlet structures should regularly be inspected for erosion, especially after heavy rainfall events when potential for erosion is greatest. If erosion is noted, this should be rectified, preferably through the reinstatement of vegetation in the eroded areas. If erosion is pronounced, erosion control devices such as reno mattresses should be considered, in consultation with a freshwater ecological specialist; •Outlet structures should be maintained free of any debris and silt/sediment; •Alien Invasive Plants (AIPs) must be managed, and annual removal/chemical treatment must be undertaken. An AIP control plan must consider clearing and management of AIPs for at least 7 years post construction of the dams; •The dams will need to be desilted intermittently to ensure the storage capacity is maintained. During desilting, all silt within the dam basin should immediately be removed from site in order to prevent sedimentation of the downstream areas. Additionally, during desilting a temporary silt trap should be installed at the outlet structure. This should be emptied on a regular basis during the desilting process to prevent any excess silt being transported into the downstream areas; •Maintenance vehicles must be confined to designated roadways and the indiscriminate movement of vehicles across the dam wall, any remaining portions of the Ga-Mogara River and through the Witleegte River must be strictly prohibited.

Table 8: Summary of the SRK Consulting (South Africa) (Pty) Ltd Impact Assessment applied to the Kipling Anomaly.

Nature of the impact		Significance of potential impact BEFORE mitigation							Mitigation Measures	Significance of potential impact AFTER mitigation							Degree of mitigation (%)
		P	D	E	M	LoR	Significance			P	D	E	M	LoR	Significance		
ACTIVITY: Kipling Anomaly																	
Pre-Construction Phase																	
Site preparation prior to intended activities (not confirmed at the time of this assessment) including potential vegetation clearing, placement of contractor laydown areas and storage facilities and associated disturbances to soil. Activities include but not limited to: *•Vehicular transport and access to the site including possible road crossings over the river, site clearing;* *•Removal of vegetation and associated disturbances to soils;* *•Miscellaneous activities by construction personnel.* ***Potential impacts include:*** *•Exposure of soil, leading to increased runoff, erosion and stream incision, and thus increased sedimentation of the watercourse;* *•Increased sedimentation of already transformed riparian habitat, leading to smothering of flora and benthic biota and potentially altering surface water quality;* *•Decreased ecoservice provision; and* *•Proliferation of alien vegetation as a result of disturbances.*	-	4	2	1	4	3	**28**	**Low**	*•Contractor laydown areas, and material storage facilities to remain outside of the delineated riparian zone and associated 32m NEMA zone of regulation;* *•All vehicle re-fuelling is to take place outside of the delineated riparian zone and associated 32m NEMA zone of regulation;* *•All Clean and Dirty Water spearation areas are to be developed first prior to any other major earthworks to reduce risk of erosion and sedimentation;* *•All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is absolutely essential;* *•Retain as much indigenous vegetation (riparian and terrestrial) as possible;* *•It should be feasible to utilise existing roads to gain access to the site, and crossing the river in areas where no existing crossing is apparent should be unnecessary, but if it is essential crossings should be made at right angles;* *•Areas where bank failure is observed as a result of such watercourse crossings should be immediately repaired; and* *•The watercourse areas beyond the proposed footprint of development and the NEMA zone of regulation (32m) should be clearly demarcated with danger tape and areas in which no activities are proposed should be marked as a no-go areas.*	2	2	1	2	2	**10**	**Low**	64,3
Construction Phase																	
Not assessed due to insufficient information pertaining to the intended activity in the 'Kipling anomaly' area at the time of assessment.	-						**0**	**#N/A**							**0**	**#N/A**	#DIV/0!
Operational Phase																	

Not assessed due to insufficient information pertaining to the intended activity in the 'Kipling anomaly' area at the time of assessment.	-						0	#N/A								0	#N/A	#DIV/0!
Closure/Rehabilitation Phase																		
Not assessed due to insufficient information pertaining to the intended activity in the 'Kipling anomaly' area at the time of assessment.	-						0	#N/A								0	#N/A	#DIV/0!
Cumulative Impacts																		
Not assessed due to insufficient information pertaining to the intended activity in the 'Kipling anomaly' area at the time of assessment.	-						0	#N/A								0	#N/A	#DIV/0!

Table 9: Summary of the SRK Consulting (South Africa) (Pty) Ltd Impact Assessment applied to the Kipling Pit Shell

Nature of the impact		Significance of potential impact BEFORE mitigation							Mitigation Measures	Significance of potential impact AFTER mitigation							Degree of mitigation (%)
		P	D	E	M	LoR	Significance			P	D	E	M	LoR	Significance		
ACTIVITY: Kipling Pit Shell (partially encroaches on diverted reach of Ga-Mogara River)																	
Pre-Construction Phase																	
Site clearing prior to commencement of construction activities related to the proposed open pit, including placement of contractor laydown areas and storage facilities, including: *•Vehicular transport and access to the site, site clearing;* *•Removal of vegetation and associated disturbances to soils;* *•Miscellaneous activities by construction personnel.*	-	4	2	1	6	3	**36**	**Moderate**	*•The footprint provided to the specialist in August 2021 indicates that the Kipling pit shell will extend into a diverted reach of the Ga-Mogara River, within the Mokala Mine MRA (SLR, 2021). It is strongly recommended that the footprint be optimised to avoid encroaching on the river any further as this will contribute to the cumulative impacts to the river posed by the proposed expansion activities; Notwithstanding the above, the following mitigation measures apply:* *•Contractor laydown areas, and material storage facilities to remain outside of the delineated riparian zone (or diverted reach of the river) and associated 32m NEMA zone of regulation;* *•All vehicle re-fuelling is to take place outside of the delineated riparian zone and associated 32m NEMA zone of regulation;* *•All Clean and Dirty Water separation areas are to be developed first prior to any other major earthworks to reduce risk of erosion and sedimentation;* *•All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is absolutely essential;* *•Retain as much indigenous vegetation (riparian and terrestrial) as possible;* *•It should be feasible to utilise existing roads to gain access to the site, and crossing the river in areas where no existing crossing is apparent should be unnecessary, but if it is essential crossings should be made at right angles;* *•Areas where bank failure is observed as a result of such watercourse crossings should be immediately repaired; and*	3	2	1	4	3	**21**	**Low**	41,7

									•The watercourse areas beyond the proposed footprint of development and the NEMA zone of regulation (32m) should be clearly demarcated with danger tape and areas in which no activities are proposed should be marked as a no-go areas.								
Construction Phase																		
•Removal of topsoil from open pit footprint, and stockpiling thereof for rehabilitation. •Potential indiscriminate disposal of hazardous and non-hazardous materials waste in the Ga-Mogara River. •Surface impact during blasting and initial removal of overburden. Impacts include: •Damage to marginal and non-marginal vegetation, leading to exposure and compaction of soil, in turn leading to potentially increased runoff and erosion; •Exposure of soil, leading to increased runoff from cleared areas and potential erosion of affected reach of the river, and thus increased potential for further alteration of the sediment balance of the river particularly within the diverted reach thereof; •Altered sediment balance of the river may lead to changes in instream habitat, potentially altered surface water quality when present and smothering of vegetation and/or altered vegetation composition; •Decreased ecoservice provision; •Further decreased ability to support biodiversity, specifically downstream of the MRA; and •Increased proliferation of alien vegetation as a result of disturbances.	-	5	3	1	8	4	60	High	•The footprint provided to the specialist in August 2021 indicates that the Kipling pit shell will extend into a diverted reach of the Ga-Mogara River, within the Mokala Mine MRA (SLR, 2021). It is strongly recommended that the footprint be optimised to avoid encroaching on the river any further as this will contribute to the cumulative impacts to the river posed by the proposed expansion activities; •Notwithstanding the above, no unauthorised activity may be permitted within the Ga-Mogara River, including vehicular movement, indiscriminate disposal of waste material, or removal of vegetation; •During construction, the topsoil should be removed up to a depth of 150mm and be carefully stockpiled, for use during rehabilitation, outside of the freshwater resource and its 32m NEMA Zone of Regulation; •Excavated materials should not be contaminated and it should be ensured that the minimum surface area is taken up. The stockpiles may not exceed 2m in height or the height recommended by the Soil and Land Capability study (ZRC, 2021); •All exposed soils must be protected for the duration of the construction phase in order to prevent erosion and further sedimentation of the reach of the watercourse proximal to these stockpiles; and •Mitigation measures as outlined for Activity 1 above.	4	3	1	6	3	40	Moderate	-50,0
Operational Phase																		

Operation of open pit on Kipling; encroaching on diverted portion of Ga-Mogara River including: *•Removal of topsoil and overburden and stockpiling thereof, potentially within 32 m of the river;* *•Blasting/mining activities in order to remove overburden and to extract the manganese;* *•Removal of manganese and overburden from the open cast pits and subsequent transportation thereof.* ***Potential impacts include:*** *•Further loss of hydraulic and instream connectivity;* *•Increased risk of pollution of surface water when present, which may affect the downstream reaches of the river, leading to impaired water quality and salination of soil within the river;* *•Increased risk of sediment transport via wind and/or surface runoff from the overburden stockpile into the river, potentially leading to altered water quality, further altered channel competency and further altered vegetation community composition;* **Increased risk of erosion, leading to further altered topography/geomorphological processes, in turn resulting in altered pattern, quantum of flow and timing of water in the landscape.*	-	5	5	2	8	5	**75**	**High**	*In applying the risk assessment, it was assumed that the mitigation hierarchy as advocated by the DEA et al. (2013) would be followed, i.e. impacts would first be avoided. As the proposed expansion of both the York and Hotazel pits are located within the Ga-Mogara river, causing irreversible localised impacts and contributing to the cumulative impacts on the downstream reach as a result, this is not feasible.* *Notwithstanding the above the following mitigation measures apply:* *•Pollution prevention through appropriate management and monitoring of pollution prevention systems, with specific mention of the management of clean and dirty water separation systems, in order to prevent, eliminate and/or control potential pollution of soil, groundwater and surface water must be implemented;* *•Implement a monitoring programme to detect and prevent the pollution of soil, surface water and groundwater; and* *•If possible, the overburden stockpiles should be located in an area where they will not impact on any hydrological features of increased importance within the greater MRA, and outside the 100m GN704 Zone of Regulation associated with either the Ga-Mogara River or Witleegte River within the MRA.* **Reduce airborne dust during blasting activities through:* *- Damping dust generation areas with water (although not in sufficient quantities to generate runoff); and* *- Use of hessian or brush barrier fences.* *•Measures to contain and reuse as much water as possible within the mine process water system must be sought, and very strict control of water consumption must take place. Detailed monitoring must be implemented and maintained to ensure that all water usage is continuously optimised.*	4	5	1	6	4	**48**	**Moderate**	36,0
Closure/Rehabilitation Phase																		

•Demolition of related surface infrastructure; *•Backfilling of pit.*	-	5	2	1	4	1	**35**	**Moderate**	*•As per the pre-construction and construction phase mitigation measures; and* *•The topography of the backfilled pit must be levelled and tie-in with the surrounding landscape to ensure that there is no formation of preferential flow paths which may lead to erosion over time, or unnatural accumulation of surface water when present, which could over time lead to changes in vegetation profiles.*	3	2	1	2	1	**15**	**Low**	57,1
Cumulative Impacts																		
•Residual loss of affected reach of Ga-Mogara River, contributing to cumulative impacts of loss of recharge such as increase moisture stress and transformation of floral community composition and structure.	-	5	5	3	8	5	**80**	**High**	*•Cumulative impacts can only be avoided by preventing impacts during the Life of Mine on the river, however, it is strongly recommended that should mining through the river be authorised, the proponent engage with the DWS as the custodians of South Africa's water resources, with regards to implementing appropriate management measures in line with the mitigation hierarchy which are deemed acceptable to both the competent authorities and the proponent.*	4	5	1	8	4	**56**	**Moderate**	30,0

Table 10: Summary of the SRK Consulting (South Africa) (Pty) Ltd Impact Assessment applied to the Kipling WRD

Nature of the impact		Significance of potential impact BEFORE mitigation							Mitigation Measures	Significance of potential impact AFTER mitigation							Degree of mitigation (%)
		P	D	E	M	LoR	Significance			P	D	E	M	LoR	Significance		
ACTIVITY: Kipling Waste Rock Dump within 20 m of diverted reach of Ga-Mogara River																	
Pre-Construction Phase																	
•Removal of topsoil from project footprint, and stockpiling thereof for rehabilitation. *•Clearing of vegetation / levelling of soil.* *•Earthworks, creating potential sources of sediment, which may be transported to the watercourse by stormwater runoff.* ***Potential impacts include:*** *•Increased risk of transportation of sediment from exposed soil in stormwater runoff, leading to increased turbidity of surface water, sedimentation of watercourse, smothering of vegetation and/or altered vegetation composition.*	-	4	2	1	6	2	36	Moderate	*•Contractor laydown areas, and material storage facilities to remain outside of the delineated riparian zone and associated 32m NEMA zone of regulation;* *•All vehicle re-fuelling is to take place outside of the delineated riparian zone and associated 32m NEMA zone of regulation;* *•All Clean and Dirty Water separation areas are to be developed first prior to any other major earthworks to reduce risk of erosion and sedimentation;* *•All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is absolutely essential;* *•Retain as much indigenous vegetation (riparian and terrestrial) as possible;* *•It should be feasible to utilise existing roads to gain access to the site, and crossing the river in areas where no existing crossing is apparent should be unnecessary, but if it is essential crossings should be made at right angles;* *•Areas where bank failure is observed as a result of such watercourse crossings should be immediately repaired;* *•The watercourse areas beyond the proposed footprint of development and the NEMA zone of regulation (32m) should be clearly demarcated with danger tape and areas in which no activities are proposed should be marked as a no-go areas.* *•The stockpiles may not exceed 2m in height or the height recommended by the Soil and Land Capability study (ZRC, 2021);* *•All exposed soils must be protected for the duration of the construction phase in order to prevent erosion and further sedimentation of the reach of the watercourse proximal to these stockpiles.*	3	2	1	4	2	21	Low	41,7

Construction Phase																		
Construction of clean and dirty water separation systems / stormwater management systems around the downgradient boundaries of the WRD that direct clean stormwater run-off around and away from the WRD. ***Potential impacts include:*** *•Temporarily exposed soils, leading to increased risk of transportation of sediment to the watercourse.* *•Increased sedimentation of the watercourse may lead to altered water quality, smothering of vegetation and/or altered vegetation composition;* *•Exposed soils may result in increased stormwater runoff, leading to sheet erosion, as well as increased water inputs to the watercourse, in turn potentially leading to an altered vegetation composition.*	-	4	2	1	6	2	**36**	**Moderate**	*As per pre-construction activities.*	3	2	1	4	1	**21**	**Low**	-71,4
Operational Phase																		
•Potential risk of failure if structure is not stable. *•Seepage and runoff from WRD* *•Presence of clean and dirty separation infrastructure around downgradient areas of WRD, preventing stormwater runoff from reaching watercourse.* ***Potential impacts include:*** *•Loss of riparian habitat, leading to loss of biodiversity;* *•Risk of ponding should diverted portion of river become blocked as a result of failure;* *•Formation of preferential surface flow paths leading to potential for erosion of terrestrial habitat and sedimentation of downgradient river.* *•Possible contamination of surface and ground water, leading to impaired water quality and salination of soil within the watercourse;* *•Alteration of sediment balance of watercourse could lead to altered water quality, altered channel competency and altered vegetation community composition;*	-	4	5	2	6	2	**52**	**Moderate**	*•The structure must be stabilised to prevent failure, and must be regularly inspected to proactively manage any perceived risk of failure;* *•Should failure occur, any waste rock within the diverted reach of the river must be removed to another appropriate storage facility to ensure hydraulic connectivity is maintained.* *•Additional water inputs to watercourse via groundwater are anticipated to be highly unlikely due to depth of groundwater table (between 12 m to 37 m according to 2018/19 hydro census) and groundwater does not contribute to baseflow of river.* *•Notwithstanding the above, water to be collected by means of stormwater trenches/berms, and recycled and utilised within the KMR water circuit, or pumped to a Pollution Control facility for evaporation;* *•Pollution prevention through infrastructure design, in order to prevent, eliminate and/or control the potential groundwater pollution plume, as determined by a suitably qualified specialist;*	3	4	2	4	2	**30**	**Moderate**	42,3

•Altered flood peaks as a result of formalisation and concentration of surface runoff; *•Potential for erosion of terrestrial areas as a result of the formation of preferential flow paths, leading to sedimentation of the river;* *•Further reduction in volume of water entering the river, leading to further loss of recharge (and thus increased desiccation) of downstream system;* *•Altered vegetation communities due to increased moisture stress.*									*•Implement monitoring programme to detect and determine the formation and/or extent of any potential groundwater pollution plume as per the groundwater management plan, if one has been developed;* *•Loss of catchment yield to be determined by a suitably qualified specialist (although this is not perceived to be a significant risk due to the semi-arid climate);* *•Clean and dirty water systems must be kept separate in line with Regulation GN704;•* *•The clean water diversion structures must be designed to accommodate the peak flow expected for a minimum 1:50 year flood event;* *•Clean water may be discharged into the watercourse, however the discharge outlet must be constructed from energy dissipating structures (such as Armorflex or reno mattresses) to slow down the velocity of water inflow into the watercourse;* **Runoff from areas within the dirty water channel should be captured in a sump and pumped to a PCD that is lined with an appropriate liner, before being re-used as process water of the mine.*								
Closure/Rehabilitation Phase																		
•Capping, sloping and revegetation of WRD. ***Potential impacts include:*** *•Increased risk of transportation of sediment from exposed soil in stormwater runoff, leading to increased turbidity of surface water, sedimentation of watercourse, smothering of vegetation and/or altered vegetation composition.*	-	4	5	2	6	2	**52**	**Moderate**	*Mitigation Measures as per pre-construction and construction*	3	5	2	4	2	**33**	**Moderate**	36,5
Cumulative Impacts																		
•Possible failure, seepage and runoff from WRD post-closure. ***Potential impacts as per operational phase.***	-	5	5	2	8	2	**75**	**High**	*•Ensure that rehabilitation during closure does not allow for possible failure of the WRD or seepage.* *•Implement monitoring plan in line with the recommendations of the Rehabilitation Plan (Shangoni, 2021)*	3	5	2	4	2	**33**	**Moderate**	56,0

Table 11: Summary of the SRK Consulting (South Africa) (Pty) Ltd Impact Assessment applied to the expansion of the open pits on York and Hotazel.

Nature of the impact		Significance of potential impact BEFORE mitigation							Mitigation Measures	Significance of potential impact AFTER mitigation							Degree of mitigation (%)
		P	D	E	M	LoR	Significance			P	D	E	M	LoR	Significance		
ACTIVITY: Expansion of open pits (York and Hotazel)																	
Pre-Construction Phase																	
•Site clearing prior to commencement of construction activities related to the open pit expansion area, including placement of contractor laydown areas and storage facilities. *•Removal of topsoil from open pit footprint, and stockpiling thereof for rehabilitation.* ***Potential impacts include:*** *•Damage to marginal and non-marginal vegetation, leading to exposure and compaction of soil, in turn leading to further increased runoff and erosion;* *•Exposure of soil, leading to increased runoff from cleared areas and further erosion of the river, and thus increased potential for further sedimentation of the river;* *•Changes to the sediment balance of the river may lead to changes in instream habitat, potentially altered surface water quality when present and smothering of vegetation and/or altered vegetation composition;* *•Decreased ecoservice provision;* *•Further decreased ability to support biodiversity, specifically downstream of the MRA; and* *•Increased proliferation of alien vegetation as a result of disturbances.*	-	5	2	1	6	3	45	Moderate	*••Alternative options to avoid mining through the Ga-Mogara River should be sought, such as accessing the mineral resource from the western side of the river.* *•Notwithstanding the above, no unauthorised activity may be permitted within the Ga-Mogara River, including vehicular movement, indiscriminate disposal of waste material, or removal of vegetation;* *Notwithstanding the above, the following mitigation measures apply:* *•Contractor laydown areas, and material storage facilities to remain outside of the delineated riparian zone (or diverted reach of the river) and associated 32m NEMA zone of regulation;* *•All vehicle re-fuelling is to take place outside of the delineated riparian zone and associated 32m NEMA zone of regulation;* *•All Clean and Dirty Water separation areas are to be developed first prior to any other major earthworks to reduce risk of erosion and sedimentation;* *•All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is absolutely essential;* *•Retain as much indigenous vegetation (riparian and terrestrial) as possible;* *•It should be feasible to utilise existing roads to gain access to the site, and crossing the river in areas where no existing crossing is apparent should be unnecessary, but if it is essential crossings should be made at right angles;* *•Areas where bank failure is observed as a result of such watercourse crossings should be immediately repaired; and* *•The watercourse areas beyond the proposed*	4	2	1	4	2	28	Low	37,8

									footprint of development and the NEMA zone of regulation (32m) should be clearly demarcated with danger tape and areas in which no activities are proposed should be marked as a no-go areas.								
Construction Phase																		
•Surface impact during blasting and initial removal of overburden. *•Potential indiscriminate disposal of hazardous and non-hazardous materials waste in the Ga-Mogara River.* ***Potential impacts: as per pre-construction phase activities**.*	-	5	4	2	8	4	70	High	*Mitigation measures as per pre-construction phase.*	4	4	2	6	4	48	Moderate	-45,8
Operational Phase																		
•Removal of topsoil and overburden and stockpiling thereof, potentially within 32 m of the river; *•Blasting/mining activities in order to remove overburden and to extract the manganese;* *•Removal of manganese and overburden from the open cast pits and subsequent transportation thereof.* ***Potential impacts include:*** *•Loss of instream and riparian habitat (approximately 1,4 ha [Hotazel pit] and 5,1 ha [York pit]);* *•Increased risk of pollution of surface water when present, which may affect the downstream reaches of the river, leading to impaired water quality and salination of soil within the river;* *•Increased risk of sediment transport via wind and/or surface runoff from the overburden stockpile into the river, potentially leading to altered water quality, further altered channel competency and further altered vegetation community composition;* **Increased risk of erosion, leading to further altered topography/geomorphological processes, in turn resulting in changes to pattern, quantum of flow and timing of water in the landscape.*	-	5	5	2	10	5	85	High	*In applying the risk assessment, it was assumed that the mitigation hierarchy as advocated by the DEA et al. (2013) would be followed, i.e. impacts would first be avoided. As the proposed expansion of both the York and Hotazel pits are located within the Ga-Mogara river, causing irreversible localised impacts and contributing to the cumulative impacts on the downstream reach as a result, this is not feasible.* *Notwithstanding the above the following mitigation measures apply:* *•Pollution prevention through appropriate management and monitoring of pollution prevention systems, with specific mention of the management of clean and dirty water separation systems, in order to prevent, eliminate and/or control potential pollution of soil, groundwater and surface water must be implemented;* *•Implement a monitoring programme to detect and prevent the pollution of soil, surface water and groundwater; and* *•If possible, the overburden stockpiles should be located in an area where they will not impact on any hydrological features of increased importance within the greater MRA, and outside the 100m GN704 Zone of Regulation associated with either the Ga-Mogara River or Witleegte River within the MRA.* **Reduce airborne dust during blasting activities through:*	5	4	2	8	5	70	High	17,6

									- Damping dust generation areas with water (although not in sufficient quantities to generate runoff); and *- Use of hessian or brush barrier fences.* *•Measures to contain and reuse as much water as possible within the mine process water system must be sought, and very strict control of water consumption must take place. Detailed monitoring must be implemented and maintained to ensure that all water usage is continuously optimised;.*								
Closure/Rehabilitation Phase																		
•Backfilling of pits and reinstatement of pre-mining topography. Presumed no re-creation of riverine habitat. ***Impacts to Ga-Mogara River will have occurred during construction and operational phase. Backfilling of pits will not reverse construction / operational phase impacts thus extent, magnitude and loss of resource deemed relatively low.***	-	5	5	1	4	1	**50**	**Moderate**	*•As per the pre-construction and construction phase mitigation measures; and* *•The topography of the backfilled pit must be levelled and tie-in with the surrounding landscape to ensure that there is no formation of preferential flow paths which may lead to erosion over time, or unnatural accumulation of surface water when present, which could over time lead to changes in vegetation profiles.*	3	5	1	2	1	**24**	**Low**	52,0
Cumulative Impacts																		
•Long term loss of recharge to downstream reaches, leading to irreversible alteration of instream and riparian habitat and total transformation of downstream reach of Ga-Mogara River.	-	5	5	3	10	5	**90**	**High**	*•Cumulative impacts can only be avoided by preventing impacts during the Life of Mine on the river, however, it is strongly recommended that should mining through the river be authorised, the proponent engage with the DWS as the custodians of South Africa's water resources, with regards to implementing appropriate management measures in line with the mitigation hierarchy which are deemed acceptable to both the competent authorities and the proponent.*	5	5	3	8	5	**80**	**High**	11,1

Table 12: Summary of the SRK Consulting (South Africa) (Pty) Ltd Impact Assessment applied to the North and South WRDs on Hotazel.

Nature of the impact		Significance of potential impact BEFORE mitigation							Mitigation Measures	Significance of potential impact AFTER mitigation							Degree of mitigation (%)
		P	D	E	M	LoR	Significance			P	D	E	M	LoR	Significance		
ACTIVITY: WRD North and South (Hotazel) within 120 m and 150 m respectively of the Ga-Mogara River																	
Pre-Construction Phase																	
•Clearing and levelling of land for the WRDs within 120 m and 150 m (north and south WRDs respectively) of the Ga-Mogara River. *•Removal of topsoil from WRD footprint areas, and stockpiling thereof for rehabilitation.* ***Potential impacts include:*** *•Exposure of soil, leading to increased runoff, erosion and wind-blown sediment, and thus potential increased sedimentation of the river;* *•Alteration of sediment balance of the river leading to changes in riparian and/or instream habitat, leading to smothering of flora and benthic biota and potentially altering surface water quality when water is present;* *•Decreased ecoservice provision; and* *•Proliferation of alien vegetation or encroacher species as a result of disturbances.*	-	4	2	1	6	1	**36**	**Moderate**	*•Contractor laydown areas, and material storage facilities to remain outside of the delineated riparian zone and associated 32m NEMA zone of regulation;* *•All vehicle re-fuelling is to take place outside of the delineated riparian zone and associated 32m NEMA zone of regulation;* *•All Clean and Dirty Water separation areas are to be developed first prior to any other major earthworks to reduce risk of erosion and sedimentation;* *•All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is absolutely essential;* *•Retain as much indigenous vegetation (riparian and terrestrial) as possible;* *•It should be feasible to utilise existing roads to gain access to the site, and crossing the river in areas where no existing crossing is apparent should be unnecessary, but if it is essential crossings should be made at right angles;* *•Areas where bank failure is observed as a result of such watercourse crossings should be immediately repaired; and* *•The watercourse areas beyond the proposed footprint of development and the NEMA zone of regulation (32m) should be clearly demarcated with danger tape and areas in which no activities are proposed should be marked as a no-go areas.* *•The stockpiles may not exceed 2m in height or the height recommended by the Soil and Land Capability study (ZRC, 2021);* *•All exposed soils must be protected for the duration of the construction phase in order to prevent erosion and further sedimentation of the reach of the watercourse proximal to these stockpiles.*	3	2	1	2	1	**15**	**Low**	58,3
Construction Phase																	

Construction of stormwater trenches / berms around the downgradient boundaries of the respective WRDs to direct clean stormwater run-off around and away from the WRD. ***Potential impacts as per pre-construction phase, and:*** ***Potential loss of catchment yield (*considered very low risk doe the semi-arid climate) and the extent of the catchment.***	-	4	2	1	6	1	**36**	**Moderate**	*As per pre-construction activities.*	2	2	1	2	1	**10**	**Low**	-260,0
Operational Phase																		
•Potential risk of failure if structure is not stable, *•Seepage and runoff from WRD.* ***Potential impacts include:*** *•Loss of riparian habitat, leading to loss of biodiversity;* *•Formation of preferential surface flow paths leading to potential for erosion of terrestrial habitat and sedimentation of downgradient river;* *•Alteration to topography, leading to changes in pattern, quantum of flow and timing of water in the landscape;* *•Possible contamination of surface and ground water, leading to impaired water quality and salination of soil within the watercourse;* *•Alteration to the sediment balance of watercourse could lead to altered water quality, altered channel competency and altered vegetation community composition; and* *•Potential loss of catchment yield (considered very low risk due to the relatively small extent of the mine's dirty water management systems, size of the river's catchment and the semi-arid environment) and reduction in the size of the catchment.*	-	4	2	2	6	3	**40**	**Moderate**	*•The structure must be stabilised to prevent failure, and must be regularly inspected to proactively manage any perceived risk of failure;* *•Additional water inputs to watercourse via groundwater are anticipated to be highly unlikely due to depth of groundwater table (between 12 m to 37 m according to 2018/19 hydro census) and groundwater does not contribute to baseflow of river.* *•Notwithstanding the above, water to be collected by means of stormwater trenches/berms, and recycled and utilised within the KMR water circuit, or pumped to a Pollution Control facility for evaporation;* *•Pollution prevention through infrastructure design, in order to prevent, eliminate and/or control the potential groundwater pollution plume, as determined by a suitably qualified specialist;* *•Implement monitoring programme to detect and determine the formation and/or extent of any potential groundwater pollution plume as per the groundwater management plan, if one has been developed;* *•Loss of catchment yield to be determined by a suitably qualified specialist (although this is not perceived to be a significant risk due to the semi-arid climate);* *•Clean and dirty water systems must be kept separate in line with Regulation GN704;•* *•The clean water diversion structures must be designed to accommodate the peak flow expected for a minimum 1:50 year flood event;*	2	2	1	2	1	**10**	**Low**	75,0

									•Clean water may be discharged into the watercourse, however the discharge outlet must be constructed from energy dissipating structures (such as Armorflex or reno mattresses) to slow down the velocity of water inflow into the watercourse; **Runoff from areas within the dirty water channel should be captured in a sump and pumped to a PCD that is lined with an appropriate liner, before being re-used as process water of the mine.*								
Closure/Rehabilitation Phase																		
•Capping, sloping and revegetation of WRD. ***Potential impacts include:*** *•Increased risk of transportation of sediment from exposed soil in stormwater runoff, leading to increased turbidity of surface water, sedimentation of watercourse, smothering of vegetation and/or altered vegetation composition.*	-	4	5	2	6	2	**52**	**Moderate**	*Mitigation measures as per pre-construction and construction*	3	5	2	4	2	**33**	**Moderate**	36,5
Cumulative Impacts																		
•Possible failure, seepage and runoff from WRD post-closure. ***Potential impacts as per operational phase.***	-	5	5	2	6	1	**65**	**High**	*•Ensure that rehabilitation during closure does not allow for possible failure of the WRD or seepage.* *•Implement monitoring plan in line with the recommendations of the Rehabilitation Plan (Shangoni, 2021)*	3	5	2	4	2	**33**	**Moderate**	49,2

Table 13: Summary of the SRK Consulting (South Africa) (Pty) Ltd Impact Assessment applied to the proposed York PCD.

Nature of the impact	Significance of potential impact BEFORE mitigation							Mitigation Measures	Significance of potential impact AFTER mitigation							Degree of mitigation (%)
	P	D	E	M	LoR	Significance			P	D	E	M	LoR	Significance		
ACTIVITY: York Pollution Control Dam (PCD) within 85 m of Ga-Mogara River																
Pre-Construction Phase																
•Site preparation prior to construction activities related to the construction of Pollution Control Dam (PCD) including placement of contractor laydown areas and storage facilities. *•Removal of topsoil from project footprint, and stockpiling thereof for rehabilitation.* *•Potential indiscriminate disposal of hazardous and non-hazardous waste within the river.* ***Potential impacts include:*** *•Loss of vegetation, leading to exposed/compacted soils, in turn leading to potential increased runoff and erosion;* *•Exposure of soil, leading to increased runoff from cleared areas and potential erosion of the river, and thus increased potential for further sedimentation of the river;* *•Altered sediment balance of the river may lead to further changes in instream habitat, potentially altered surface water quality particularly in the downstream reaches of the system, and smothering of vegetation and/or altered vegetation composition;* *•Potential impacts on water quality due to leaks and spills;* *•Further decreased ecoservice provision;* *•Further decreased ability to support biodiversity; and* *•Further proliferation of alien vegetation as a result of disturbances.*	-	4	2	1	4	1	**28**	**Low**	*•Design of infrastructure should be environmentally and structurally sound, adhere to GN704 regulations and all possible precautions taken to prevent spillage or seepage;* *•It must be ensured that the design and construction of all infrastructure prevents failure;* *•Contractor laydown areas, and material storage facilities to remain outside of the delineated riparian zone and associated 32m NEMA zone of regulation;* *•All vehicle re-fuelling is to take place outside of the delineated riparian zone and associated 32m NEMA zone of regulation;* *•All Clean and Dirty Water separation areas are to be developed first prior to any other major earthworks to reduce risk of erosion and sedimentation;* *•All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is absolutely essential;* *•Retain as much indigenous vegetation (riparian and terrestrial) as possible;* *•It should be feasible to utilise existing roads to gain access to the site, and crossing the river in areas where no existing crossing is apparent should be unnecessary, but if it is essential crossings should be made at right angles;* *•Areas where bank failure is observed as a result of such watercourse crossings should be immediately repaired; and* *•The watercourse areas beyond the proposed footprint of development and the NEMA zone of regulation (32m) should be clearly demarcated with danger tape and areas in which no activities are proposed should be marked as a no-go areas.*	3	2	1	2	1	**15**	**Low**	46,4
Construction Phase																

Construction of Pollution Control Dam (PCD), including •Groundbreaking and earthworks; *•Possible excavation activities leading to the stockpiling of soil; and* *•Removal and stockpiling of topsoil.* ***Potential impacts as per pre-construction phase***	-	4	2	1	4	1	**28**	**Low**	*As per pre-construction phase.*	3	2	1	2	1	**15**	**Low**	-86,7
Operational Phase																		
•Disposal of water containing waste ('dirty water') into the PCD. ***Potential impacts include:*** *•Potential failure of the PCD infrastructure may result in leakages or discharges and possible contamination of surface water, increased flow into the river or back into the open pit, and lowered water quality (increase in salts and specific contaminants of concern) within the river.*	-	4	2	2	6	3	**40**	**Moderate**	*General 'best practice' measures needed to mitigate risk of increased runoff and seepage, surface disturbance and increased risk of sedimentation and erosion. See Appendix G in report, and specifically:* *•The capacity of the PCD must be in line with GN704 regulations;* *•Regular monitoring of possible seepage must be undertaken and proactive measures to prevent seepage (lining of storage facilities) implemented;* *•Potential runoff in areas with steep slopes should be slowed down by the strategic placement of berms;* *•Clean and dirty water management must take place in order to prevent contaminated runoff from the ROM stockpiles and potentially from PCDs creating preferential flow paths which may reach the watercourses;* *•Monitoring of erosion must take place throughout the life of mine (after every rainstorm and / flood greater than 5 mm and on a monthly basis during the wet season) in order to prevent the formation of erosion gullies as a result of altered flow paths, and the possible sedimentation of the river; and* *•Ensure that an emergency response plan is in place to deal with any spillages in accordance with Appendix C of GN509 as it relates to the NWA.*	3	2	1	4	1	**21**	**Low**	47,5
Closure/Rehabilitation Phase																		
•Rehabilitation, ripping, seeding of PCD. ***Potential impacts as per pre-construction and construction phases.***	-	5	2	1	6	1	**45**	**Moderate**	*Mitigation measures as per pre-construction and construction*	3	2	1	2	1	**15**	**Low**	66,7
Cumulative Impacts																		

•Ineffective rehabilitation and post-closure monitoring may potentially lead to ongoing seepage or leaching of salts and potential chemical pollutants.	-	5	5	3	6	1	70	High	•Ensure that rehabilitation during closure does not allow for possible failure of or seepage from the PCD. •Implement monitoring plan in line with the recommendations of the Rehabilitation Plan (Shangoni, 2021)	3	2	1	2	1	15	Low	78,6

Table 14: Summary of the SRK Consulting (South Africa) (Pty) Ltd Impact Assessment applied to the expansion and upgrade of the Lilliput WWTW.

Nature of the impact	Significance of potential impact BEFORE mitigation						Mitigation Measures	Significance of potential impact AFTER mitigation						Degree of mitigation (%)
	P	D	E	M	LoR	Significance		P	D	E	M	LoR	Significance	
ACTIVITY: Upgrade of Lilliput Waste Water Treatment Works (WWTW) (York) within 102 m of the river														
Pre-Construction Phase														
•Site preparation prior to construction activities related to the expansion of the WWTW including placement of contractor laydown areas and storage facilities. •Removal of topsoil from project footprint, and stockpiling thereof for rehabilitation. •Potential indiscriminate disposal of hazardous and non-hazardous materials within the river. ***Potential impacts include:*** •Loss of vegetation, leading to exposed/compacted soil, in turn leading to potential increased runoff and erosion; •Exposure of soil, leading to increased runoff from cleared areas and potential erosion of the river, and thus increased potential for further sedimentation of the river; •Increased sedimentation of the river may lead to further changes in instream habitat, potentially altered surface water quality particularly in the downstream reaches of the system, and smothering of vegetation and/or altered vegetation composition; •Potential impacts on water quality due to leaks and spills; •Further decreased ecoservice provision; •Further decreased ability to support biodiversity; and •Further proliferation of alien vegetation as a result of disturbances.	-	4	2	1	4	1	28	Low	•Contractor laydown areas, and material storage facilities to remain outside of the delineated riparian zone and associated 32m NEMA zone of regulation; •All vehicle re-fuelling is to take place outside of the delineated riparian zone and associated 32m NEMA zone of regulation; •All Clean and Dirty Water separation areas are to be developed first prior to any other major earthworks to reduce risk of erosion and sedimentation; •All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is absolutely essential; •Retain as much indigenous vegetation (riparian and terrestrial) as possible; •It should be feasible to utilise existing roads to gain access to the site, and crossing the river in areas where no existing crossing is apparent should be unnecessary, but if it is essential crossings should be made at right angles; •Areas where bank failure is observed as a result of such watercourse crossings should be immediately repaired; and •The watercourse areas beyond the proposed footprint of development and the NEMA zone of regulation (32m) should be clearly demarcated with danger tape and areas in which no activities are proposed should be marked as a no-go areas.	2	2	1	2	1	10	Low	64,3

Construction Phase																		
Construction activities relating to the expansion of the WWTW: *•Groundbreaking and earthworks;* *•Possible excavation activities leading to the stockpiling of soil; and* *•Removal and stockpiling of topsoil.* ***Potential impacts as per pre-construction phase***	-	4	2	1	4	1	**28**	**Low**	*As per pre-construction phase.*	2	2	1	2	1	**10**	**Low**	-180,0
Operational Phase																		
Continued operation (increased capacity) of Lilliput WWTW: *•Treatment of sewage effluent and pumping thereof into municipal sewage system;* *•Potential failure of infrastructure, resulting in blockages or leakages and possible contamination of surface and ground water* *•Unblocking or repair of pipelines if required (accessed via manholes).* ***Potential impacts include:*** *•Potential contamination of surface and groundwater in the event of spills (including burst pipes);* *•Vehicular access to the affected pipeline resulting in:* *- Soil compaction* *- Vegetation degradation* *- Soil and stormwater contamination from oils and hydrocarbons* *•Potential contamination of surface and groundwater with sewage effluent resulting in:* *- Increased concentration of salts, nitrate and toxic ammonia concentrations, as well as counts of Escheria coli.* *- Potential contamination of receiving environment, leading to biodiversity simplification and the excess production of hydrogen sulphide gas as well as increased alien and invasive species encroachment.*	-	4	2	2	4	2	**32**	**Moderate**	*•Treatment and discharge of effluent must comply with GN665 of 2013 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) both in terms of volume of discharge and chemical values;* *•WWTW infrastructure must be regularly inspected for failure or leaks, to avoid accidental discharge into the receiving environment;* *•All sewer outfall pipelines must be encased in concrete along the entire length, and pressure tested for integrity upon the completion of construction;* *•It is recommended that the integrity of the pipeline(s) be inspected at least once every five years or more often should there be any sign or reports of a leak;* *•Should a blockage occur all possible steps are to be taken to prevent the pollution of the receiving environment during repair, including the placement of sheeting around the manhole used for access as well as containment barrels for any effluent withdrawn;*	2	2	1	2	1	**10**	**Low**	68,8
Closure/Rehabilitation Phase																		
•Decommissioning and demolition of WWTW. ***Potential impacts as per pre-construction phase.***	-	5	2	1	4	1	**35**	**Moderate**	*Mitigation measures as per pre-construction and construction phases.*	2	2	1	2	1	**10**	**Low**	71,4
Cumulative Impacts																		

None anticipated, provided that appropriate measures are taken during decommissioning phase.	-						0	#N/A								0	#N/A	#DIV/0!

Table 15: Summary of the SRK Consulting (South Africa) (Pty) Ltd Impact Assessment applied to the attenuation dams within the Ga-Mogara River.

Nature of the impact		Significance of potential impact BEFORE mitigation							Mitigation Measures	Significance of potential impact AFTER mitigation							Degree of mitigation (%)
		P	D	E	M	LoR	Significance			P	D	E	M	LoR	Significance		
ACTIVITY: Site clearing of vegetation																	
Pre-Construction Phase																	
•Site preparation prior to construction activities related to the construction of the dam wall, including placement of contractor laydown areas and storage facilities. *•Removal of topsoil from project footprint, and stockpiling thereof for rehabilitation.* *•Potential indiscriminate disposal of hazardous and non-hazardous waste within the river.* ***Potential impacts include:*** *•Loss of vegetation, leading to exposed/compacted soil, in turn leading to potential increased runoff and erosion;* *•Exposure of soil, leading to increased runoff from cleared areas and potential erosion of the river, and thus increased potential for further alteration to the sediment balance of the river;* *•Alteration of the sediment balance of the river may lead to further changes in instream habitat, potentially altered surface water quality particularly in the downstream reaches of the system, and smothering of vegetation and/or altered vegetation composition;* *•Potential impacts on water quality due to leaks and spills;*	-	5	2	1	8	2	55	Moderate	*•Contractor laydown areas, and material storage facilities to remain outside of the delineated riparian zone and associated 32m NEMA zone of regulation;* *•All vehicle re-fuelling is to take place outside of the delineated riparian zone and associated 32m NEMA zone of regulation;* *•All Clean and Dirty Water separation areas are to be developed first prior to any other major earthworks to reduce risk of erosion and sedimentation;* *•All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is absolutely essential;* *•Retain as much indigenous vegetation (riparian and terrestrial) as possible;* *•It should be feasible to utilise existing roads to gain access to the site, and crossing the river in areas where no existing crossing is apparent should be unnecessary, but if it is essential crossings should be made at right angles;* *•Areas where bank failure is observed as a result of such watercourse crossings should be immediately repaired; and* *•The watercourse areas beyond the proposed footprint of development and the NEMA zone of regulation (32m) should be clearly demarcated with danger tape and areas in which no activities are proposed should be marked as a no-go areas.*	4	2	1	6	1	36	Moderate	34,5

•Further decreased ecoservice provision; *•Further decreased ability to support biodiversity; and* *•Further proliferation of alien vegetation as a result of disturbances.*																		
Construction Phase																		
Construction activities relating to the construction of the dam wall: *•Groundbreaking and earthworks;* *•Possible excavation activities leading to the stockpiling of soil; and* *•Removal and stockpiling of topsoil.* ***Potential impacts as per pre-construction phase.***	-	5	2	1	10	3	65	High	*As per pre-construction phase.*	5	2	1	6	2	45	Moderate	-44,4
Operational Phase																		
•Inundation footprint will result in the direct loss of approximately 16 ha (dam on Telele) and approximately 18 ha (dam between York and Hotazel pits) of riparian habitat. Additional loss due to increased moisture stress as a result of loss of recharge is possible in the reaches downstream of the dams; *•Loss of hydraulic connectivity and recharge to downstream reaches of the Ga-Mogara River.* *•Overflow of water over the spillway when the dam is at full capacity.* ***Potential impacts include:*** *•Prolonged inundation of the upstream reach of the dam wall, leading to potential changes to hydroperiod and associated alterations to biodiversity aspects including floral community composition and structure and increased faunal utilisation;* *•Potential accumulation of sediment within the dams, leading to altered vegetation assemblages, and possible reduction in dam capacity.*	-	5	2	3	10	5	75	High	*•The dams and any outlet structures should regularly be inspected for erosion, especially after heavy rainfall events when potential for erosion is greatest. If erosion is noted, this should be rectified, preferably through the reinstatement of vegetation in the eroded areas. If erosion is pronounced, erosion control devices such as reno mattresses should be considered, in consultation with a freshwater ecological specialist;* *•Outlet structures should be maintained free of any debris and silt/sediment;* *•Alien Invasive Plants (AIPs) must be managed, and annual removal/chemical treatment must be undertaken. An AIP control plan must consider clearing and management of AIPs for at least 7 years post construction of the dams;* *•The dams will need to be desilted intermittently to ensure the storage capacity is maintained. During desilting, all silt within the dam basin should immediately be removed from site in order to prevent sedimentation of the downstream areas. Additionally, during desilting a temporary silt trap should be installed at the outlet structure. This should be emptied on a regular basis during the desilting process to prevent any excess silt being transported into the downstream areas;* *•Maintenance vehicles must be confined to designated roadways and the indiscriminate movement of*	5	2	2	8	5	60	High	20,0

									vehicles across the dam wall, any remaining portions of the Ga-Mogara River and through the Witleegte River must be strictly prohibited.								
Closure/Rehabilitation Phase																		
•Demolition of dam walls. ***Potential impacts as per pre-construction and construction phases.***	-	5	2	1	4	1	**35**	**Moderate**	*As per pre-construction and construction phases.*	3	2	1	2	1	**15**	**Low**	57,1
Cumulative Impacts																		
•Long term loss of recharge to downstream reaches, leading to irreversible alteration of instream and riparian habitat and total transformation of downstream reach of Ga-Mogara River.	-	5	5	3	10	5	**90**	**High**	*•Cumulative impacts can only be avoided by preventing impacts during the Life of Mine on the river, however, it is strongly recommended that should mining through the river be authorised, the proponent engage with the DWS as the custodians of South Africa's water resources, with regards to implementing appropriate management measures in line with the mitigation hierarchy which are deemed acceptable to both the competent authorities and the proponent.*	5	5	3	8	5	**80**	**High**	11,1

5.2 Cumulative Impact Statement

Cumulative impacts are activities and their associated impacts on the past, present and foreseeable future, both spatially and temporally, considered together with the impacts identified above.

The assessed reach of the Ga-Mogara River associated with KMR has already been influenced by impacts which have occurred upstream of the mine, including the formation of swallets (refer to Section 4.2), upstream river diversion structures and encroachment of various mining activities on portions of the river. These impacts have most likely had an effect on the ecological functioning of downstream reaches, and the proposed and existing activities at KMR are likely to contribute to further impacts downstream of the mine. In particular, the proposed attenuation dams will result in further loss of hydraulic connectivity within the system thus further reducing the possibility of flow reaching the downstream Kuruman River. It is likely that the downstream reaches of the river (between KMR and the Kuruman River) will undergo further transformation from a freshwater ecosystem to a more episodic ecosystem as a result of the cumulative impacts of the various flow-impeding structures within the Ga-Mogara River.

6 CONCLUSION

The results of the ecological assessment indicate that the assessed reach of the Ga-Mogara River is in a largely modified ecological state (PES C/D) largely due to (authorised) encroachment of mining activities within the 1:100 year floodline and the edge effects thereof such as vegetation losses and increased sediment inputs. Erosion, albeit minor at the time of assessment, was observed in portions of the active channel, and this was attributed to the various anthropogenic activities in the area, mostly mining-related. Although the Ga-Mogara River is an episodic system and is therefore not necessarily a valuable resource from an anthropocentric perspective, it forms a crucial component of the overall ecology of the area, being a key contributor to biodiversity maintenance as well as providing valuable breeding and foraging habitat and connectivity to surrounding natural areas.

Although surface flow in the river occurs sporadically (every few decades), changing climate patterns (including rainfall patterns) may change the frequency of flow periods. The devastating impact of the flooding which occurred in January 2021 (albeit mostly localised around the town of Deben, upstream of KMR) speaks to the importance of maintaining

hydraulic connectivity and ensuring that potential impacts to water quality are minimised. Thus, whilst the likelihood of impacts on aspects such as hydrological patterns and water quality arising from the proposed expansion activities may be low, the impact significance may potentially be 'high' in the event that such a flood event occurs during the ongoing mining activities, particularly as no hydraulic connectivity between the proposed attenuation dams and the downstream reaches of the river is proposed.

The risk of an extreme flood event aside, activities adjacent to or within the Ga-Mogara River and associated riparian zone will nevertheless lead to loss of, or changes to, the watercourse habitat, ecological structure, and the associated ability of the system to provide various ecological and socio-cultural benefits.

Based on the findings of this study, it is the opinion of the ecologists that the project is regarded as having potentially medium to high impact significance *without* mitigation, although the results of the impact and risk assessments indicate that the post-mitigation impact significance is largely of medium to low levels with the exception of the perceived cumulative impact of the attenuation dams and opencast mining within the river on the long-term ecological state of the system. With suitable management and strict implementation of mitigation measures, impact significance of most activities can be adequately reduced. It is imperative, however, that mitigation measures are implemented throughout the life of the project in order to ensure that not only are direct impacts prevented/minimised, but that further cumulative impacts on the larger drainage network are also prevented.

However, the proposed attenuation dams and expansion of open cast mining within the river have the potential to have high significance, irreversible latent impacts with long-term cumulative effects on the downstream reaches of the Ga-Mogara River. Careful consideration and planning of the rehabilitation and closure of the pits and the associated cost is deemed critical to ensure that the most cost-effective design and management solution is implemented, at the outset, for the operational phase of mining while ensuring that the long term (post closure) functionality and connectivity of the Ga-Mogara River is maintained and that the RMO of the system is achieved.

Taking the above into account, it is therefore the opinion of the specialist that consideration of the value of this landscape must be considered from a freshwater and terrestrial biodiversity resource management point of view and juxtaposed with the responsibility to comply with Regulation 23 of the Mining and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA) pertaining to the optimisation of the Mining Right as well as

the socio-economic and socio-cultural impact the project will have, and the decision should be made and aligned with the principles of sustainable development and Integrated Environmental Management.

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APPENDIX A – Indemnity and Terms of Use

INDEMNITY AND TERMS OF USE OF THIS REPORT

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

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APPENDIX B - Legislation

LEGISLATIVE REQUIREMENTS

The Constitution of the Republic of South Africa, 1996	The environment and the health and well-being of people are safeguarded under the Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996) by way of section 24. Section 24(a) guarantees a right to an environment that is not harmful to human health or well-being and to environmental protection for the benefit of present and future generations. Section 24(b) directs the state to take reasonable legislative and other measures to prevent pollution, promote conservation, and secure the ecologically sustainable development and use of natural resources (including water and mineral resources) while promoting justifiable economic and social development. Section 27 guarantees every person the right of access to sufficient water, and the state is obliged to take reasonable legislative and other measures within its available resources to achieve the progressive realisation of this right. Section 27 is defined as a socio-economic right and not an environmental right. However, read with section 24 it requires of the state to ensure that water is conserved and protected and that sufficient access to the resource is provided. Water regulation in South Africa places a great emphasis on protecting the resource and on providing access to water for everyone.
National Environmental Management Act (Act No. 107 of 1998) (NEMA)	The National Environmental Management Act (NEMA) (Act 107 of 1998) and the associated Regulations as amended in 2017, states that prior to any development taking place within a wetland or riparian area, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment Report (BAR) process or the Environmental Impact Assessment (EIA) process depending on the scale of the impact. Provincial regulations must also be considered.
National Environmental Management: Biodiversity Act (2004) (Act 10 of 2004) (NEMBA)	**Ecosystems that are threatened or in need of protection** (1) (a) The Minister may, by notice in the Gazette, publish a national list of ecosystems that are threatened and in need of protection. *(b)* An MEC for environmental affairs in a province may, by notice in *the Gazette,* publish a provincial list of ecosystems in the province that are threatened and in need of protection. (2) The following categories of ecosystems may be listed in terms of subsection (1): *(a)* critically endangered ecosystems, being ecosystems that have undergone severe degradation of ecological structure, function or composition as a result of human intervention and are subject to an extremely high risk of irreversible transformation; *(b)* endangered ecosystems, being ecosystems that have undergone degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems; (c) vulnerable ecosystems, being ecosystems that have a high risk of undergoing significant degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems or endangered ecosystems; and *(d)* protected ecosystems, being ecosystems that are of high conservation value or of high national or provincial importance, although they are not listed in terms of paragraphs *(a), (b)* or (c).
The National Water Act 1998 (Act No. 36 of 1998) (NWA)	The National Water Act (NWA) (Act 36 of 1998) recognises that the entire ecosystem and not just the water itself in any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the Department of Water and Sanitation (DWS). Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DWS in terms of Section 21 (c) & (i).
Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act 36 of 1998)	In accordance with Regulation GN509 of 2016, a regulated area of a watercourse for section 21c and 21i of the NWA, 1998 is defined as: a) The outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; b) In the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or c) A 500 m radius from the delineated boundary (extent) of any wetland or pan. This notice **replaces GN1199** and may be exercised as follows: i) Exercise the water use activities in terms of Section 21(c) and (i) of the Act as set out in the table below, subject to the conditions of this authorisation; ii) Use water in terms of section 21(c) or (i) of the Act if it has a low risk class as determines

	through the Risk Matrix; iii) Do maintenance with their existing lawful water use in terms of section 21(c) or (i) of the Act that has a LOW risk class as determined through the Risk Matrix; iv) Conduct river and stormwater management activities as contained in a river management plan; v) Conduct rehabilitation of wetlands or rivers where such rehabilitation activities has a LOW risk class as determined through the Risk Matrix; and vi) Conduct emergency work arising from an emergency situation or incident associated with the persons' existing lawful water use, provided that all work is executed and reported in the manner prescribed in the Emergency protocol. A General Authorisation (GA) issued as per this notice will require the proponent to adhere with specific conditions, rehabilitation criteria and monitoring and reporting programme. Furthermore, the water user must ensure that there is a sufficient budget to complete, rehabilitate and maintain the water use as set out in this GA. Upon completion of the registration, the responsible authority will provide a certificate of registration to the water user within 30 working days of the submission. On written receipt of a registration certificate from the Department, the person will be regarded as a registered water user and can commence within the water use as contemplated in the GA.
Government Notice 704 Regulations as published in the Government Gazette 20119 of 1999 as it relates to the National Water Act, 1998 (Act No. 36 of 1998)	These Regulations were put in place in order to prevent the pollution of water resources and protect water resources in areas where mining activity is taking place from impacts generally associated with mining. It is recommended that the proposed project complies with Regulation GN 704 of the NWA which contains regulations on the use of water for mining and related activities aimed at the protection of water resources. GN 704 states that: *No person in control of a mine or activity may:* *(b) locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year floodline or within a horizontal distance of 100 metres from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on waterlogged ground, or on ground likely to become waterlogged, undermined, unstable or cracked;* According to the above, the activity footprint must fall outside of the 1:100 year floodline of the aquatic resource or 100m from the edge of the resource, whichever distance is the greatest.
Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA)	The obtaining of a New Order Mining Right (NOMR) is governed by the MPRDA. The MPRDA requires the applicant to apply to the DMR for a NOMR which triggers a process of compliance with the various applicable sections of the MPRDA. The NOMR process requires environmental authorisation in terms of the MPRDA Regulations and specifically requires the preparation of a Scoping Report, an EIA, an Environmental Management Programme (EMP), and a Public Participation Process (PPP).

APPENDIX C – Method of Assessment

WATERCOURSE ASSESSMENT APPROACH

1. Literature Review

A desktop study was compiled with all relevant information as presented by the South African National Biodiversity Institutes (SANBI's) Biodiversity Geographic Information Systems (BGIS) website (http://bgis.sanbi.org). Wetland specific information resources taken into consideration during the desktop assessment of the subject property included:

- National Freshwater Ecosystem Priority Areas (NFEPAs, 2011)
  - NFEPA water management area (WMA)
  - FEPA (sub)WMA % area
  - Sub water catchment area FEPAs
  - Water management area FEPAs
  - Fish sanctuaries
  - Wetland ecosystem types
- Limpopo Conservation Plan V2, 2013
- Mining and Biodiversity Guidelines, 2013.

1.1 National Freshwater Ecosystem Priority Areas (NFEPA; 2011)

The NFEPA project is a multi-partner project between the Council of Scientific and Industrial Research (CSIR), Water Research Commission (WRC), South African National Biodiversity Institute (SANBI), Department of Water Affairs (DWA), South African Institute of Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks). The project responds to the reported degradation of freshwater ecosystem condition and associated biodiversity, both globally and in South Africa. It uses systematic conservation planning to provide strategic spatial priorities of conserving South Africa's freshwater biodiversity, within the context of equitable social and economic development.
The NFEPA project aims to identify a national network of freshwater conservation areas and to explore institutional mechanisms for their implementation. Freshwater ecosystems provide a valuable, natural resource with economic, aesthetic, spiritual, cultural and recreational value. However, the integrity of freshwater ecosystems in South Africa is declining at an alarming rate, largely as a consequence of a variety of challenges that are practical (managing vast areas of land to maintain connectivity between freshwater ecosystems), socio-economic (competition between stakeholders for utilisation) and institutional (building appropriate governance and co-management mechanisms).
The NFEPA database was searched for information in terms of conservation status of rivers, wetland habitat and wetland resources present within the subject property.

2. Classification System for Wetlands and other Aquatic Ecosystems in South Africa (2013)

All wetland or riparian resources encountered within the focus area were assessed using the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems, hereafter referred to as the "Classification System" (Ollis *et. al*., 2013). A summary on Levels 1 to 4 of the classification system are presented in the tables below.

Table C1: Classification System for Inland Systems, up to Level 3.

WETLAND / AQUATIC ECOSYSTEM CONTEXT		
LEVEL 1: SYSTEM	LEVEL 2: REGIONAL SETTING	LEVEL 3: LANDSCAPE UNIT
Inland Systems	DWA Level 1 Ecoregions OR NFEPA WetVeg Groups OR Other special framework	Valley Floor
		Slope
		Plain
		Bench (Hilltop / Saddle / Shelf)

Table C2: Hydrogeomorphic (HGM) Units for the Inland System, showing the primary HGM Types at Level 4A and the subcategories at Level 4B to 4C.

FUNCTIONAL UNIT		
LEVEL 4: HYDROGEOMORPHIC (HGM) UNIT		
HGM type	Longitudinal zonation/ Landform / Outflow drainage	Landform / Inflow drainage
A	**B**	**C**
River	Mountain headwater stream	Active channel
		Riparian zone
	Mountain stream	Active channel
		Riparian zone
	Transitional	Active channel
		Riparian zone
	Upper foothills	Active channel
		Riparian zone
	Lower foothills	Active channel
		Riparian zone
	Lowland river	Active channel
		Riparian zone
	Rejuvenated bedrock fall	Active channel
		Riparian zone
	Rejuvenated foothills	Active channel
		Riparian zone
	Upland floodplain	Active channel
		Riparian zone
Channelled valley-bottom wetland	(not applicable)	(not applicable)
Unchannelled valley-bottom wetland	(not applicable)	(not applicable)
Floodplain wetland	Floodplain depression	(not applicable)
	Floodplain flat	(not applicable)
Depression	Exorheic	With channelled inflow
		Without channelled inflow
	Endorheic	With channelled inflow
		Without channelled inflow
	Dammed	With channelled inflow
		Without channelled inflow
Seep	With channelled outflow	(not applicable)
	Without channelled outflow	(not applicable)
Wetland flat	(not applicable)	(not applicable)

Level 1: Inland systems
From the classification system, Inland Systems are defined as **aquatic ecosystems that have no existing connection to the ocean**[7] (i.e. characterised by the complete absence of marine exchange and/or tidal influence) but **which are inundated or saturated with water, either permanently or periodically.** It is important to bear in mind, however, that certain Inland Systems may have had a historical connection to the ocean, which in some cases may have been relatively recent.

Level 2: Ecoregions & NFEPA Wetland Vegetation Groups
For Inland Systems, the regional spatial framework that has been included in Level 2 of the classification system is that of the DWA's Level 1 Ecoregions for aquatic ecosystems (Kleynhans *et. al.,* 2005). There is a total of 31 Ecoregions across South Africa, including Lesotho and Swaziland. DWA Ecoregions have most commonly been used to categorise the regional setting for national and regional water resource management applications, especially in relation to rivers.
The Vegetation Map of South Africa, Swaziland and Lesotho (Mucina & Rutherford, 2006) groups' vegetation types across the country, according to Biomes, which are then divided into Bioregions. To categorise the regional setting for the wetland component of the NFEPA project, wetland vegetation groups (referred to as WetVeg Groups) were derived by further splitting Bioregions into smaller groups through expert input (Nel *et al*., 2011). There are currently 133 NFEPA WetVeg Groups. It is envisaged that these groups could be used as a special framework for the classification of wetlands in national- and regional-scale conservation planning and wetland management initiatives.

Level 3: Landscape Setting
At Level 3 of the classification system for Inland Systems, a distinction is made between four Landscape Units (Table C1) on the basis of the landscape setting (i.e. topographical position) within which an HGM Unit is situated, as follows (Ollis *et. al.,* 2013):

- **Slope:** an included stretch of ground that is not part of a valley floor, which is typically located on the side of a mountain, hill or valley;
- **Valley floor:** The base of a valley, situated between two distinct valley side-slopes;
- **Plain:** an extensive area of low relief characterised by relatively level, gently undulating or uniformly sloping land; and
- **Bench (hilltop/saddle/shelf):** an area of mostly level or nearly level high ground (relative to the broad surroundings), including hilltops/crests (areas at the top of a mountain or hill flanked by down-slopes in all directions), saddles (relatively high-lying areas flanked by down-slopes on two sides in one direction and up-slopes on two sides in an approximately perpendicular direction), and shelves/terraces/ledges (relatively high-lying, localised flat areas along a slope, representing a break in slope with an up-slope one side and a down-slope on the other side in the same direction).

Level 4: Hydrogeomorphic Units
Seven primary HGM Types are recognised for Inland Systems at Level 4A of the classification system (Table C2), on the basis of hydrology and geomorphology (Ollis *et. al*., 2013), namely:

- **River:** a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water;
- **Channelled valley-bottom wetland:** a valley-bottom wetland with a river channel running through it;
- **Unchannelled valley-bottom wetland:** a valley-bottom wetland without a river channel running through it;
- **Floodplain wetland:** the mostly flat or gently sloping land adjacent to and formed by an alluvial river channel, under its present climate and sediment load, which is subject to periodic inundation by over-topping of the channel bank;
- **Depression:** a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates;
- **Wetland Flat:** a level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench. Closed elevation contours are not evident around the edge of a wetland flat; and

[7] Most rivers are indirectly connected to the ocean via an estuary at the downstream end, but where marine exchange (i.e. the presence of seawater) or tidal fluctuations are detectable in a river channel that is permanently or periodically connected to the ocean, it is defined as part of the estuary.

- **Seep:** a wetland area located on (gently to steeply) sloping land, which is dominated by the colluvial (i.e. gravity-driven), unidirectional movement of material down-slope. Seeps are often located on the side-slopes of a valley but they do not, typically, extend into a valley floor.

The above terms have been used for the primary HGM Units in the classification system to try and ensure consistency with the wetland classification terms currently in common usage in South Africa. Similar terminology (but excluding categories for "channel", "flat" and "valleyhead seep") is used, for example, in the recently developed tools produced as part of the Wetland Management Series including WET-Health (Macfarlane *et. al*., 2008), WET-IHI (DWAF, 2007) and WET-EcoServices (Kotze *et. al*., 2009).

3. Watercourse Function Assessment

"The importance of a water resource, in ecological social or economic terms, acts as a modifying or motivating determinant in the selection of the management class".[8] The assessment of the ecosystem services supplied by the identified freshwater features was conducted according to the guidelines as described by Kotze *et al.* (2020). An assessment was undertaken that examines and rates 16 different ecosystem services, selected for their specific relevance to the South African situation, as follows:

- Flood attenuation;
- Stream flow regulation;
- Sediment trapping;
- Phosphate assimilation;
- Nitrate assimilation;
- Toxicant assimilation;
- Erosion control;
- Carbon storage;
- Biodiversity maintenance;
- Provision of water for human use;
- Provision of harvestable resources;
- Food for livestock;
- Provision of cultivated foods;
- Cultural and spiritual experience;
- Tourism and recreation; and
- Education and research.

For each ecosystem service, indicator scores are combined automatically in an algorithm given in the spreadsheet that has been designed to reflect the relative importance and interactions of the attributes represented by the indicators to arrive at an overall supply score. In addition, the demand for the ecosystem service is assessed based on the wetland's catchment context (e.g. toxicant sources upstream), the number of beneficiaries and their level of dependency, which are also all rated on a five-point scale. Again, an algorithm automatically combines the indicator scores relevant to demand to generate a demand score.

*It is important to note that when assessing riparian zones associated with riverine habitats, the contribution of the riparian zone to streamflow regulation is omitted, owing to a lack of relevant studies (Kotze *et al*, 2020).

[8] Department of Water Affairs and Forestry, South Africa Version 1.0 of Resource Directed Measures for Protection of Water Resources, 1999

Table C3: Integrating scores for supply and demand to obtain and overall importance score

Integrating scores for supply & demand to obtain an overall importance score						
		Supply				
		Very Low	Low	Moderate	High	Very High
Demand		0	1	2	3	4
Very Low	0	0,0	0,0	0,5	1,5	2,5
Low	1	0,0	0,0	1,0	2,0	3,0
Moderate	2	0,0	0,5	1,5	2,5	3,5
High	3	0,0	1,0	2,0	3,0	4,0
Very High	4	0,5	1,5	2,5	3,5	4,0

A single overall importance score is generated for each ecosystem service by combining the supply and demand scores. This aggregation therefore places somewhat more emphasis on supply than demand, with the supply score acting as the starting score for a “moderate” demand scenario. The importance score is, however, adjusted by up to one class up where demand is “very high” and by up to one class down where demand is “very low”. The overall importance score can then be used to derive an importance category for reporting purposes.

Table C4: Classes for determining the likely extent to which a benefit is being supplied.

Importance Category		Description
Very Low	0-0.79	The importance of services supplied is very low relative to that supplied by other wetlands.
Low	0.8 – 1.29	The importance of services supplied is low relative to that supplied by other wetlands.
Moderately-Low	1.3 – 1.69	The importance of services supplied is moderately-low relative to that supplied by other wetlands.
Moderate	1.7 – 2.29	The importance of services supplied is moderate relative to that supplied by other wetlands.
Moderately-High	2.3 – 2.69	The importance of services supplied is moderately-high relative to that supplied by other wetlands.
High	2.7 – 3.19	The importance of services supplied is high relative to that supplied by other wetlands.
Very High	3.2 - 4.0	The importance of services supplied is very high relative to that supplied by other wetlands.

4. Index of Habitat Integrity

The general habitat integrity of each site was discussed based on the application of the Index of Habitat Integrity (Kleynhans et al. 2008). It is important to assess the habitat at each site in order to aid in the interpretation of the results of the community integrity assessments, by taking habitat conditions and impacts into consideration. This method describes the Present Ecological State (PES) of both the in-stream and riparian habitat at each site. The method classifies habitat integrity into one of six classes, ranging from unmodified/natural (Class A) to critically modified (Class F), as indicated in Table C3 below.

5. Table C5: Classification of Present State Classes in terms of Habitat Integrity [Kleynhans et al. 2008]

Class	Description	Score (% of total)
A	Unmodified, natural.	90 - 100
B	Largely natural with few modifications. The flow regime has been only slightly modified and pollution is limited to sediment. A small change in natural habitats may have taken place. However, the ecosystem functions are essentially unchanged.	80 - 89
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60 - 79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40 – 59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20 – 39
F	Critically / Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	0 - 19

5. Aquatic Ecological Importance and Sensitivity (EIS) Method of assessment (DWAF, 1999)

The EIS method considers a number of biotic and habitat determinants surmised to indicate either importance or sensitivity. The determinants are rated according to a four-point scale (Table C10). The median of the resultant score is calculated to derive the EIS category (Table C11).

Table C6: Definition of the four-point scale used to assess biotic and habitat determinants presumed to indicate either importance or sensitivity

Four point scale	Definition
1	One species/taxon judged as rare or endangered at a local scale.
2	More than one species/taxon judged to be rare or endangered on a local scale.
3	One or more species/taxon judged to be rare or endangered on a Provincial/regional scale.
4	One or more species/taxon judged as rare or endangered on a National scale (i.e. SA Red Data Books)

Table C7: Ecological importance and sensitivity categories (DWAF, 1999)

EISC	General Description	Range of median
Very high	Quaternaries/delineations that are considered to be unique on a national and international level based on unique biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually very sensitive to flow modifications and have no or only a small capacity for use.	>3-4
High	Quaternaries/delineations that are considered to be unique on a national scale based on their biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) may be sensitive to flow modifications but in some cases may have substantial capacity for use.	>2-≤3

Moderate	Quaternaries/delineations that are considered to be unique on a provincial or local scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are not usually very sensitive to flow modifications and often have substantial capacity for use.	>1-≤2
Low/ marginal	Quaternaries/delineations that are not unique on any scale. These rivers (in terms of biota and habitat) are generally not very sensitive to flow modifications and usually have substantial capacity for use.	≤1

6. Recommended Management Objective (RMO) and Recommended Ecological Category (REC) Determination

"A high management class relates to the flow that will ensure a high degree of sustainability and a low risk of ecosystem failure. A low management class will ensure marginal maintenance of sustainability but carries a higher risk of ecosystem failure" (DWA, 1999).

The RMO (table below) was determined based on the results obtained from the PES, reference conditions and EIS of the freshwater resource (sections above), with the objective of either maintaining, or improving the ecological integrity of the freshwater resource in order to ensure continued ecological functionality.

Table C8: Recommended management objectives (RMO) for water resources based on PES & EIS scores.

			Ecological and Importance Sensitivity (EIS)			
			Very High	High	Moderate	Low
PES	A	Pristine	A Maintain	A Maintain	A Maintain	A Maintain
	B	Natural	A Improve	A/B Improve	B Maintain	B Maintain
	C	Good	A Improve	B/C Improve	C Maintain	C Maintain
	D	Fair	C Improve	C/D Improve	D Maintain	D Maintain
	E/F	Poor	D* Improve	E/F* Improve	E/F* Maintain	E/F* Maintain

***PES Categories E and F are considered ecologically unacceptable (Malan and Day, 2012) and therefore, should a freshwater resource fall into one of these PES categories, a REC class D is allocated by default, as the minimum acceptable PES category.**

A freshwater resource may receive the same class for the REC as the PES if the freshwater resource is deemed in good condition, and therefore must stay in good condition. Otherwise, an appropriate REC should be assigned in order to prevent any further degradation as well as enhance the PES of the freshwater resource.

Table C9: Description of Recommended Ecological Category (REC) classes.

Class	Description
A	Unmodified, natural
B	Largely natural with few modifications
C	Moderately modified
D	Largely modified

7. Watercourse Delineation

The freshwater resource delineation took place according to the method presented in the “Updated manual for the identification and delineation of wetland and riparian resources” published by DWAF in 2008. The foundation of the method is based on the fact that wetlands and riparian zones have several distinguishing factors including the following:

- The presence of water at or near the ground surface;
- Distinctive hydromorphic soils;
- Vegetation adapted to saturated soils; and
- The presence of alluvial soils in stream systems.

According to the DWA (2005) like wetlands, riparian areas have their own unique set of indicators. It is possible to delineate riparian areas by checking for the presence of these indicators. Some areas may display both wetland and riparian indicators, and can accordingly be classified as both. If you are adjacent to a watercourse, it is important to check for the presence of the riparian indicators described below, in addition to checking for wetland indicators, to detect riparian areas that do not qualify as wetlands. The delineation process requires that the following be taken into account:

- topography associated with the watercourse;
- vegetation; and
- alluvial soils and deposited material.

By observing the evidence of these features in the form of indicators, wetlands and riparian zones can be delineated and identified. If the use of these indicators and the interpretation of the findings are applied correctly, then the resulting delineation can be considered accurate (DWA, 2005).

APPENDIX D – Impact Assessment Methodology

DWS RISK ASSESSMENT MATRIX (2016)

In order for the EAP to allow for sufficient consideration of all environmental impacts, impacts were assessed using a common, defensible method of assessing significance that will enable comparisons to be made between risks/impacts and will enable authorities, stakeholders and the client to understand the process and rationale upon which risks/impacts have been assessed. The method to be used for assessing risks/impacts is outlined in the sections below.

The first stage of risk/impact assessment is the identification of environmental activities, aspects and impacts. This is supported by the identification of receptors and resources, which allows for an understanding of the impact pathway and an assessment of the sensitivity to change. The definitions used in the impact assessment are presented below.

- An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that are possessed by an organisation.
- An **environmental aspect** is an 'element of an organizations activities, products and services which can interact with the environment'[9]. The interaction of an aspect with the environment may result in an impact.
- **Environmental risks/impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or well-being, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is.
- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as wetlands, flora and riverine systems.
- **Resources** include components of the biophysical environment.
- **Frequency of activity** refers to how often the proposed activity will take place.
- **Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor.
- **Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.
- **Spatial extent** refers to the geographical scale of the impact.
- **Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.

The significance of the impact is then assessed by rating each variable numerically according to the defined criteria. Refer to the table below. The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity, spatial scope and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 15. The frequency of the activity and the frequency of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 10. The values for likelihood and consequence of the impact are then read off a significance rating matrix and are used to determine whether mitigation is necessary[10].

[9] The definition has been aligned with that used in the ISO 14001 Standard.
[10] Some risks/impacts that have low significance will however still require mitigation

The assessment of significance is undertaken twice. Initial, significance is based on only natural and existing mitigation measures (including built-in engineering designs). The subsequent assessment takes into account the recommended management measures required to mitigate the impacts. Measures such as demolishing infrastructure, and reinstatement and rehabilitation of land, are considered post-mitigation.

The model outcome of the impacts was then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in line with South Africa's National Environmental Management Act (No. 108 of 1997) in instances of uncertainty or lack of information, by increasing assigned ratings or adjusting final model outcomes. In certain instances where a variable or outcome requires rational adjustment due to model limitations, the model outcomes have been adjusted.

Table D1: Criteria for assessing significance of impacts.

"RISK ASSESSMENT KEY" (Based on DWS 2015 publication: Section 21 c and i water use Risk Assessment Protocol)

Table D1: Severity (How severe does the aspects impact on the resource quality (flow regime, water quality, geomorphology, biota, habitat)

Insignificant / non-harmful	1
Small / potentially harmful	2
Significant / slightly harmful	3
Great / harmful	4
Disastrous / extremely harmful and/or wetland(s) involved	5
Where "or wetland(s) are involved" it means that the activity is located within the delineated boundary of any wetland. The score of 5 is only compulsory for the significance rating.	

Table D2: Spatial Scale (How big is the area that the aspect is impacting on)

Area specific (at impact site)	1
Whole site (entire surface right)	2
Regional / neighbouring areas (downstream within quaternary catchment)	3
National (impacting beyond secondary catchment or provinces)	4
Global (impacting beyond SA boundary)	5

Table D3: Duration (How long does the aspect impact on the resource quality)

One day to one month, PES, EIS and/or REC not impacted	1
One month to one year, PES, EIS and/or REC impacted but no change in status	2
One year to 10 years, PES, EIS and/or REC impacted to a lower status but can be improved over this period through mitigation	3
Life of the activity, PES, EIS and/or REC permanently lowered	4
More than life of the organisation/facility, PES and EIS scores, an E or F	5
PES and EIS (sensitivity) must be considered.	

Table D4: Frequency of the activity (How often do you do the specific activity)

Annually or less	1
6 monthly	2
Monthly	3
Weekly	4
Daily	5

Table D5: The frequency of the incident or impact (How often does the activity impact on the resource quality)

Almost never / almost impossible / >20%	1
Very seldom / highly unlikely / >40%	2
Infrequent / unlikely / seldom / >60%	3
Often / regularly / likely / possible / >80%	4
Daily / highly likely / definitely / >100%	5

Table D6: Legal issues (How is the activity governed by legislation)

No legislation	1
Fully covered by legislation (wetlands are legally governed)	5
Located within the regulated areas	

Table D7: Detection (How quickly or easily can the impacts/risks of the activity be observed on the resource quality, people and resource)

Immediately	1
Without much effort	2
Need some effort	3
Remote and difficult to observe	4
Covered	5

Table D8: Rating Classes

RATING	CLASS	MANAGEMENT DESCRIPTION
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated.
56 – 169	M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and require specialist input. Licence required.
170 – 300	(H) High Risk	Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve. Licence required.

A low risk class must be obtained for all activities to be considered for a GA

Table D9: Calculations

Consequence = Severity + Spatial Scale + Duration
Likelihood = Frequency of Activity + Frequency of Incident + Legal Issues + Detection
Significance\Risk = Consequence X Likelihood

The following points were considered when undertaking the assessment:

- Risks and impacts were analysed in the context of the *project's area of influence* encompassing:
  - Primary project site and related facilities that the client and its contractors develop or controls;
  - Areas potentially impacted by cumulative impacts for further planned development of the project, any existing project or condition and other project-related developments; and
  - Areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location.
- Risks/Impacts were assessed for construction phase and operational phase; and
  - Individuals or groups who may be differentially or disproportionately affected by the project because of their disadvantaged or vulnerable status were assessed.

Control Measure Development

The following points presents the key concepts considered in the development of mitigation measures for the proposed construction:

- Mitigation and performance improvement measures and actions that address the risks and impacts[11] are identified and described in as much detail as possible. Mitigating measures are investigated according to the impact minimisation hierarchy as follows:
  - Avoidance or prevention of impact;
  - Minimisation of impact;
  - Rehabilitation; and
  - Offsetting.
- Measures and actions to address negative impacts will favour avoidance and prevention over minimisation, mitigation or compensation; and
- Desired outcomes are defined and have been developed in such a way as to be measurable events with performance indicators, targets and acceptable criteria that can be tracked over defined periods, wherever possible.

Recommendations

Recommendations were developed to address and mitigate potential impacts on the freshwater ecology of the resources in traversed by or in close proximity of the proposed infrastructure.

[11] Mitigation measures should address both positive and negative impacts

SRK CONSULTING (SOUTH AFRICA) (PTY) LTD IMPACT ASSESSMENT METHODOLOGY

All specialists are required to assess each proposed activity/aspect of the KMR Expansion Project in relation to the construction, operational, closure and decommissioning phases to identify the potential impacts that may be associated with such activity and to develop appropriate mitigation measures that can be implemented to reduce or eliminate the potential impacts identified.

The specialist will assess the potential impact identified according to the Impact Assessment Methodology described below. This Impact Assessment Methodology has been formalised by SRK to comply the EIA Regulations of 2014 (as amended) promulgated under NEMA, which states the following:

- *An environmental impact assessment report must contain all information that is necessary for the competent authority to consider the application and to reach a decision, and must include – an assessment of each identified potentially significant impact, including –*
  - *i. cumulative impacts;*
  - *ii. the nature, significance and consequence of the impact and risk;*
  - *iii. the extent and duration of the impact and risk;*
  - *iv. the probability of the impact and risk occurring;*
  - *v. the degree to which the impact and risk can be reversed;*
  - *vi. the degree to which the impact and risk may cause irreplaceable loss of resources; and*
  - *vii. the degree to which the impact and risk can be mitigated.*

Based on the above, the Impact Assessment Methodology requires that each potential impact identified is clearly described (providing the nature of the impact) and be assessed in terms of the following factors (see Table C1):

- **extent** (spatial scale) - *will the impact affect the national, regional or local environment, or only that of the site?*;
- **duration** (temporal scale) - *how long will the impact last?;*
- **magnitude** (severity) - *will the impact be of high, moderate or low severity?;* and
- **probability** (likelihood of occurring) - *how likely is it that the impact may occur?*

To enable a scientific approach for the determination of the environmental significance (importance) of each identified potential impact, a numerical value has been linked to each factor. The following ranking scales are applicable:

Table C1: Risk matrix

Occurrence	**Duration (D):**	**Probability (P):**
	5 – Permanent	5 – Definite/don't know
	4 - Long-term (ceases with the operational life)	4 – Highly probable
	3 - Medium-term (5-15 years)	3 – Medium probability
	2 - Short-term (0-5 years)	2 – Low probability
	1 – Immediate	1 – Improbable
		0 – None
Severity	**Extent/scale (E):**	**Magnitude (M):**
	5 – International	10 - Very high/uncertain
	4 – National	8 – High
	3 – Regional	6 – Moderate
	2 – Local	4 – Low
	1 – Site only	2 – Minor
	0 – None	

Once the above factors had been ranked for each identified potential impact, the environmental significance of each impact can be calculated using the following formula:

- *Significance = (duration + extend + magnitude) x probability*

The maximum value that can be calculated for the environmental significance of any impact is 100. The environmental significance of any identified potential impact is then rated as either: high, moderate, or low on the following basis:

- More than 60 significance value indicates a **high (H)** environmental significance impact;
- Between 30 and 60 significance value indicates a **moderate (M)** environmental significance impact; and
- Less than 30 significance value indicates a **low (L)** environmental significance impact.

In order to assess the degree to which the potential impact can be reversed and be mitigated, each identified potential impact will need to be assessed twice:

- Firstly, the potential impact will be assessed and rated prior to implementing any mitigation and management measures; and
- Secondly, the potential impact will be assessed and rated after the proposed mitigation and management measures have been implemented.

The purpose of this dual rating of the impact before and after mitigation is to indicate that the significance rating of the initial impact is and should be higher in relation to the significance of the impact after mitigation measures have been implemented.

In order to assess the degree to which the potential impact can cause irreplaceable loss of resources, the following classes (%) will be used and will need to select based on the specialist informed decision and discretion:

- 5 100% - Permanent loss
- 4 75% - 99% - Significant loss
- 3 50% - 74% - Moderate loss
- 2 25% - 49% - Minor loss
- 1 0% - 24% - Limited loss

Please note that the Loss of Resources aspect will not affect the overall significance rating of the impact.

In terms of assessing the cumulative impacts, specialists are required to address this in a sentence/paragraph fashion as the spatial extent of the cumulative impacts will vary from project to project. Cumulative impact, in relation to an activity, means the impact of an activity that in itself may not be significant, but may become significant when added to the existing or potential impacts eventuating from similar or diverse activities or undertakings in the area.

Results

The impact assessment results will be presented in a table format as provided by the EAP for the planning, construction, operational and maintenance phases of the project.

APPENDIX E – Results of the Field Investigation

PRESENT ECOLOGICAL STATE (PES), ECOSERVICES AND ECOLOGICAL IMPORTANCE AND SENSITIVITY (EIS) RESULTS

Table E1: Presentation of the results of the Index of Habitat Integrity (IHI) applied to the assessed reach of the Ga-Mogara River.

INSTREAM IHI	
Base Flows	0,0
Zero Flows	0,0
Floods	0,0
HYDROLOGY RATING	**0,0**
pH	1,0
Salts	1,0
Nutrients	1,0
Water Temperature	1,0
Water clarity	1,0
Oxygen	1,0
Toxics	1,0
PC RATING	**1,0**
Sediment	2,0
Benthic Growth	0,0
BED RATING	**1,2**
Marginal	3,0
Non-marginal	2,0
BANK RATING	**2,6**
Longitudinal Connectivity	1,0
Lateral Connectivity	1,0
CONNECTIVITY RATING	**1,0**
INSTREAM IHI %	**80,6**
INSTREAM IHI EC	**B/C**
INSTREAM CONFIDENCE	**3,0**

RIPARIAN IHI	
Base Flows	0,0
Zero Flows	0,0
Moderate Floods	0,0
Large Floods	0,0
HYDROLOGY RATING	**0,0**
Substrate Exposure (marginal)	1,0
Substrate Exposure (non-marginal)	1,0
Invasive Alien Vegetation (marginal)	4,0
Invasive Alien Vegetation (non-marginal)	2,0
Erosion (marginal)	2,0
Erosion (non-marginal)	1,0
Physico-Chemical (marginal)	0,5
Physico-Chemical (non-marginal)	0,5
Marginal	4,0
Non-marginal	2,0
BANK STRUCTURE RATING	**3,6**
Longitudinal Connectivity	2,0
Lateral Connectivity	2,0
CONNECTIVITY RATING	**2,0**
RIPARIAN IHI %	**59,1**
RIPARIAN IHI EC	**C/D**
RIPARIAN CONFIDENCE	**3,3**

Table E2: Presentation of the results of the VEGRAI assessment applied to the assessed reach of the Ga-Mogara River within the MRA.

METRIC GROUP	CALCULATED RATING	WEIGHTED RATING	CONFIDENCE	RANK	% WEIGHT
MARGINAL	56,3	35,2	2,5	1,0	100,0
NON MARGINAL	63,3	23,8	0,0	2,0	60,0
	2,0				160,0
LEVEL 3 VEGRAI (%)				58,9	
VEGRAI EC				**C/D**	
AVERAGE CONFIDENCE				1,3	

Table E3: Presentation of the results of the Ecoservices assessments applied to the assessed portion of the Ga-Mogara River in the MRA.

ECOSYSTEM SERVICE		Present State			
		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0,6	0,1	0,0	Very Low
	Stream flow regulation	-	-	#VALUE!	#VALUE!
	Sediment trapping	1,4	2,0	0,9	Low
	Erosion control	0,4	1,2	0,0	Very Low
	Phosphate assimilation	1,3	1,0	0,3	Very Low
	Nitrate assimilation	1,1	1,0	0,1	Very Low
	Toxicant assimilation	1,4	3,0	1,4	Moderately Low
	Carbon storage	0,0	2,7	0,0	Very Low
	Biodiversity maintenance	2,6	1,0	1,6	Moderately Low
PROVISIONING SERVICES	Water for human use	0,0	0,0	0,0	Very Low
	Harvestable resources	0,5	0,0	0,0	Very Low
	Food for livestock	1,0	0,0	0,0	Very Low
	Cultivated foods	3,0	0,0	1,5	Moderately Low
CULTURAL SERVICES	Tourism and Recreation	0,0	0,0	0,0	Very Low
	Education and Research	0,5	0,3	0,0	Very Low
	Cultural and Spiritual	0,0	0,0	0,0	Very Low

***Streamflow regulation is excluded from the suite of services assessed for riparian areas owing to a lack of relevant studies (Kotze *et al*, 2020)**

Table E4: Presentation of the results of the EIS assessment (DWAF 1999) applied to the assessed reach of the Ga-Mogara River within the MRA.

PRIMARY DETERMINANTS	SCORE	CONFIDENCE
Biotic Determinants		
Rare & Endangered Species	0	4
Populations of unique species	1	4
Intolerant biota	0	4
Species / taxon richness	2	4
Aquatic Habitat Determinants		
Diversity of aquatic habitat types or features	1	4
Refuge value of habitat type	1	4
Sensitivity of habitat to flow changes	0	4
Sensitivity of flow-related water quality changes	1	4
Migration route/corridor for instream and riparian biota	1	4
Nature Reserves, Natural Heritage sites, Natural areas, PNEs	1	4
TOTAL	**8**	**40**
MEAN	**0,8**	**4**
OVERALL EIS	**Low/Marginal**	

APPENDIX F – Summary of Ecological Water Reserve (EWR) estimates and rules

Table F1: Summary of EWR estimates – Ga-Mogara River at GaM_EWR1 in D41K

Desktop Version 2, Printed on 2021/07/30
Summary of IFR estimate for: GaM_EWR1
Determination based on site specific parameters from SPATSIM database.

Annual Flows (Mill. cu. m or index values):

MAR	=	13.783*
S.Dev.	=	43.005
CV	=	3.120
Q75	=	0.000
Q75/MMF	=	0.000
BFI Index	=	0.141
CV(JJA+JFM) Index	=	6.847

ERC = C

Total IFR	=	2.394 (17.37 %MAR)
Maint. Lowflow	=	0.664 (4.82 %MAR)
Drought Lowflow	=	0.000 (0.00 %MAR)
Maint. Highflow	=	1.730 (12.55 %MAR)

Monthly Distributions (cu.m./s)
Distribution Type : Lowveld

Month	Natural Flows			Modified Flows (IFR)			
				Low flows		High Flows	Total Flows
	Mean	SD	CV	Maint.	Drought	Maint.	Maint.
Oct	0.019	0.078	1.576	0.004	0.000	0.001	0.005
Nov	0.056	0.196	1.342	0.004	0.000	0.007	0.011
Dec	0.527	3.132	2.217	0.020	0.000	0.040	0.060
Jan	1.755	8.081	1.719	0.064	0.000	0.326	0.389
Feb	1.134	3.483	1.270	0.047	0.000	0.089	0.136
Mar	1.165	4.034	1.293	0.050	0.000	0.148	0.199
Apr	0.475	1.519	1.235	0.029	0.000	0.045	0.074
May	0.068	0.211	1.158	0.011	0.000	0.000	0.011
Jun	0.026	0.072	1.078	0.008	0.000	0.000	0.008
Jul	0.020	0.064	1.175	0.007	0.000	0.000	0.007
Aug	0.017	0.057	1.293	0.006	0.000	0.000	0.006
Sep	0.012	0.045	1.413	0.005	0.000	0.000	0.005

* Natural MAR at EWR site based on updated WR2012 hydrology for the period 1920-2009

Table F2: Summary of EWR rules – Ga-Mogara River at GaM_EWR1 in D41K

Desktop Version 2, Printed on 2021/07/30
Summary of IFR rule curves for : GaM_EWR1
Determination based on site specific parameters from SPATSIM database.
Regional Type : Lowveld

ERC = C

Data are given in m^3/s mean monthly flow

	% Points									
Month	10%	20%	30%	40%	50%	60%	70%	80%	90%	99%
Oct	0.007	0.007	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Nov	0.015	0.012	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Dec	0.130	0.104	0.030	0.004	0.000	0.000	0.000	0.000	0.000	0.000
Jan	0.865	0.355	0.217	0.101	0.011	0.004	0.000	0.000	0.000	0.000
Feb	0.292	0.236	0.184	0.131	0.066	0.029	0.000	0.000	0.000	0.000
Mar	0.264	0.252	0.225	0.180	0.075	0.026	0.011	0.000	0.000	0.000
Apr	0.103	0.097	0.085	0.050	0.012	0.008	0.000	0.000	0.000	0.000
May	0.017	0.016	0.013	0.010	0.006	0.000	0.000	0.000	0.000	0.000
Jun	0.013	0.013	0.011	0.008	0.004	0.000	0.000	0.000	0.000	0.000
Jul	0.011	0.011	0.009	0.007	0.000	0.000	0.000	0.000	0.000	0.000
Aug	0.009	0.009	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Sep	0.007	0.007	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Reserve flows without High Flows										
Oct	0.006	0.005	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Nov	0.006	0.006	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Dec	0.030	0.028	0.025	0.004	0.000	0.000	0.000	0.000	0.000	0.000
Jan	0.095	0.090	0.080	0.063	0.011	0.004	0.000	0.000	0.000	0.000
Feb	0.071	0.067	0.058	0.044	0.027	0.013	0.000	0.000	0.000	0.000
Mar	0.077	0.073	0.065	0.051	0.034	0.018	0.007	0.000	0.000	0.000
Apr	0.045	0.042	0.037	0.028	0.012	0.008	0.000	0.000	0.000	0.000
May	0.017	0.016	0.013	0.010	0.006	0.000	0.000	0.000	0.000	0.000
Jun	0.013	0.013	0.011	0.008	0.004	0.000	0.000	0.000	0.000	0.000
Jul	0.011	0.011	0.009	0.007	0.000	0.000	0.000	0.000	0.000	0.000
Aug	0.009	0.009	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Sep	0.007	0.007	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural Duration curves*										
Oct	0.022	0.007	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Nov	0.123	0.012	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Dec	0.482	0.164	0.030	0.004	0.000	0.000	0.000	0.000	0.000	0.000
Jan	2.401	0.355	0.217	0.101	0.011	0.004	0.000	0.000	0.000	0.000
Feb	3.390	0.893	0.393	0.182	0.095	0.029	0.000	0.000	0.000	0.000
Mar	2.319	1.012	0.467	0.224	0.075	0.026	0.011	0.000	0.000	0.000
Apr	0.826	0.305	0.150	0.050	0.012	0.008	0.000	0.000	0.000	0.000
May	0.183	0.045	0.022	0.011	0.007	0.000	0.000	0.000	0.000	0.000
Jun	0.062	0.027	0.015	0.008	0.004	0.000	0.000	0.000	0.000	0.000
Jul	0.034	0.019	0.011	0.007	0.000	0.000	0.000	0.000	0.000	0.000
Aug	0.041	0.015	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Sep	0.027	0.008	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000

* Natural MAR at EWR site based on updated WR2012 hydrology for the period 1920-2009

APPENDIX G – Impact Analysis and Mitigation

IMPACT ANALYSIS AND MITIGATION MEASURES

1. General management and good housekeeping practices

The following essential mitigation measures are considered to be standard best practice measures applicable to development of this nature and must be implemented during all phases of the proposed prospecting activities, in conjunction with those stipulated in Section 5 of this report which define the mitigatory measures specific to the minimisation of impacts on the Ga-Mogara River.

Development and operational footprint

- Sensitivity maps have been developed for the focus area, indicating the watercourse, and relevant regulatory zones in accordance with NEMA, Regulation GN509 and Regulation GN704, as shown in Figure 9 (Section 4.4.1). It is recommended that this sensitivity map be considered during all phases of the development and with special mention of the planning of any future infrastructure layout, to aid in the conservation of the watercourse habitat within the MRA;
- All future prospecting or development footprint areas should remain as small as possible and should not encroach onto surrounding, more sensitive areas. Prospecting must only take place in the demarcated areas. If prospecting or development is to occur within the watercourse, strict regulation of activities therein must take place, and non-prospecting areas are to be considered off-limits to personnel and vehicles;
- The boundaries of footprint areas are to be clearly defined and it should be ensured that all activities remain within defined footprint areas;
- Planning of temporary roads and access routes should take the site sensitivity plan into consideration, and wherever possible, existing roads should be utilised. If additional roads are required, then wherever feasible such roads should be constructed a distance from the watercourse areas and not directly adjacent thereto. If crossings are required they should cross the system at right angles, as far as possible to minimise impacts in the receiving environment, and any areas where bank failure is observed due to the effects of such crossings should be immediately repaired by reducing the gradient of the banks to a 1:3 slope and where needed necessary, installing support structures. This should only be necessary if existing access roads are not utilised;
- All areas of increased ecological sensitivity should be marked as such and be off limits to all unauthorised construction and maintenance vehicles and personnel;
- Appropriate sanitary facilities must be provided for the life of the proposed project and all waste removed to an appropriate waste facility;
- All hazardous chemicals should be stored on bunded surfaces and no storage of such chemicals should be permitted within the freshwater buffer zones;
- No informal fires should be permitted in or near the construction areas;
- Ensuring that an adequate number of rubbish and “spill” bins are provided will also prevent litter and ensure the proper disposal of waste and spills; and
- Edge effects of activities, particularly erosion and alien/weed control need to be strictly managed.

Vehicle access

- All areas of increased ecological sensitivity should be marked as such and kept off limits to all unauthorised construction and maintenance vehicles as well as personnel;
- It must be ensured that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage. All vehicles must be regularly inspected for leaks. Re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into topsoil; and
- All spills, should they occur, should be immediately cleaned up and treated accordingly.

Alien plant species

- Proliferation of alien and invasive species is expected within any disturbed areas. These species should be eradicated and controlled to prevent their spread beyond the project footprint. Alien plant seed dispersal within the top layers of the soil within footprint areas, that will have an impact on future rehabilitation, has to be controlled;
- Removal of the alien and weed species encountered on the property must take place in order to comply with existing legislation (amendments to the regulations under the Conservation of Agricultural Resources Act, 1983 and Section 28 of the National Environmental Management Act, 1998). Removal of species should take place throughout the construction, operational, closure/decommissioning and rehabilitation/ maintenance phases; and
- Species specific and area specific eradication recommendations:
  - Care should be taken with the choice of herbicide to ensure that no additional impact and loss of indigenous plant species occurs due to the herbicide used;
  - Footprint areas should be kept as small as possible when removing alien plant species*;*
  - No vehicles should be allowed to drive through designated sensitive watercourse areas during the eradication of alien and weed species.

Freshwater habitat

- Ensure that as far as possible all infrastructure is placed outside of watercourse areas and applicable regulatory zones. A minimum buffer of 100m around all watercourse/freshwater systems should be maintained in line with the requirements of regulation GN704 of the NWA for all non-resource dependent infrastructure. If these measures cannot be adhered to, strict mitigation measures will be required to minimize the impact on the receiving watercourses. Such measures include those stipulated in Section 5 of this report, in addition to the following:
  - Ensuring that measures are implemented to prevent dirty runoff water entering the watercourse habitat; and
  - Ensuring that where necessary, exposed soils in the vicinity of watercourse habitat are protected from erosion by means of reinstating natural vegetation following construction,
- Permit only essential personnel within 100m of the watercourse habitat, if absolutely necessary that they enter the regulatory zone;
- Limit the footprint area of the construction activities to what is absolutely essential in order to minimise environmental damage;
- During prospecting, no vehicles should be allowed to indiscriminately drive through the freshwater areas;
- All waste materials generated during any phase of the proposed activities must be prevented from entering the watercourses; and
- Implement effective waste management in order to prevent construction related waste from entering the watercourse environments.

Soils

- To prevent the erosion of soils, management measures may be determined by the site engineer at their discretion and may include mechanisms such as temporary silt traps or hessian curtains. Revegetation with indigenous graminoid species is however recommended for long-term protection of soils and it is suggested that such revegetation of disturbed areas is undertaken concurrently with prospecting;
- Maintain topsoil stockpiles below 5 meters in height;
- As far as possible, all construction activities should occur in the low flow season, during the drier winter months;
- All soils compacted as a result of construction activities falling outside of project footprint areas should be ripped and profiled. Special attention should be paid to alien and invasive control within these areas; and
- Monitor all areas for erosion and incision. Any areas where erosion is occurring excessively quickly should be rehabilitated as quickly as possible.

Rehabilitation

- All soils compacted as a result of construction activities falling outside of project footprint areas should be ripped and profiled. Special attention should be paid to alien and invasive control within these areas. Alien and invasive vegetation control should take place throughout all construction and rehabilitation phases to prevent loss of floral habitat;
- Edge effects of activities including erosion and alien/ weed control need to be strictly managed in these areas;

- As far as possible, all rehabilitation activities should occur in the low flow season, during the drier winter months.
- As much vegetation growth (of indigenous/endemic floral species) as possible should be promoted within the proposed development area in order to protect soils;
- All alien vegetation in the watercourse areas should be removed from rehabilitated areas and reseeded with indigenous grasses as specified by a suitably qualified specialist (ecologist);
- All areas affected by prospecting activities should be rehabilitated upon completion of the activities.

APPENDIX G – Specialist CVs and Declaration

DETAILS, EXPERTISE AND CURRICULUM VITAE OF SPECIALISTS

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

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

Amanda Mileson Advanced Diploma: Nature Conservation (UNISA)

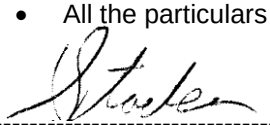
1.(a).(ii) The expertise of that specialist to compile a specialist report including a curriculum vitae

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

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

I, Stephen van Staden, declare that -

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



Signature of the Specialist

SAS ENVIRONMENTAL GROUP OF COMPANIES –

SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

Position in Company	Group CEO, Water Resource Discipline Lead, Managing Member, Ecologist, Aquatic Ecologist
Joined SAS Environmental Group of Companies	2003 (year of establishment)

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP)

Accredited River Health Practitioner by the South African River Health Program (RHP)

Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum

Member of the Gauteng Wetland Forum

Member of International Association of Impact Assessors (IAIA) South Africa;

Member of the Land Rehabilitation Society of South Africa (LaRSSA)

EDUCATION

Qualifications

MSc Environmental Management (University of Johannesburg)	2003
BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg)	2001
BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)	2000

Short Courses

Integrated Water Resource Management, the National Water Act, and Water Use Authorisations, focusing on WULAs and IWWMPs	2017
Tools for Wetland Assessment (Rhodes University)	2017
Legal liability training course (Legricon Pty Ltd)	2018
Hazard identification and risk assessment training course (Legricon Pty Ltd)	2018
Wetland Management: Introduction and Delineation (WLID1502S) (University of the Free State)	2018
Hydropedology and Wetland Functioning (TerraSoil Science and Water Business Academy)	2018

AREAS OF WORK EXPERIENCE

South Africa – All Provinces
Southern Africa – Lesotho, Botswana, Mozambique, Zimbabwe Zambia

Eastern Africa – Tanzania Mauritius

West Africa – Ghana, Liberia, Angola, Guinea Bissau, Nigeria, Sierra Leona

Central Africa – Democratic Republic of the Congo

DEVELOPMENT SECTORS OF EXPERIENCE

1. Mining: Coal, chrome, Platinum Group Metals (PGMs), mineral sands, gold, phosphate, river sand, clay, fluorspar
2. Linear developments (energy transmission, telecommunication, pipelines, roads)
3. Minerals beneficiation
4. Renewable energy (Hydro, wind and solar)
5. Commercial development
6. Residential development
7. Agriculture
8. Industrial/chemical

KEY SPECIALIST DISCIPLINES

Legislative Requirements, Processes and Assessments

- Water Use Applications (Water Use Licence Applications / General Authorisations)
- Environmental and Water Use Audits
- Freshwater Resource Management and Monitoring as part of EMPR and WUL conditions

Freshwater Assessments

- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Maintenance and Management Plans
- Plant Species and Landscape Plans
- Freshwater Offset Plans
- Hydropedological Assessment
- Pit Closure Analysis

Aquatic Ecological Assessment and Water Quality Studies

- Habitat Assessment Indices (IHAS, HRC, IHIA & RHAM)
- Aquatic Macro-Invertebrates (SASS5 & MIRAI)
- Fish Assemblage Integrity Index (FRAI)
- Fish Health Assessments
- Riparian Vegetation Integrity (VEGRAI)
- Toxicological Analysis
- Water quality Monitoring
- Screening Test
- Riverine Rehabilitation Plans

Biodiversity Assessments

- Floral Assessments
- Biodiversity Actions Plan (BAP)
- Biodiversity Management Plan (BMP)
- Alien and Invasive Control Plan (AICP)
- Ecological Scan
- Terrestrial Monitoring
- Biodiversity Offset Plan

Soil and Land Capability Assessment

- Soil and Land Capability Assessment
- Hydropedological Assessment

Visual Impact Assessment

- Visual Baseline and Impact Assessments
- Visual Impact Peer Review Assessments

SAS ENVIRONMENTAL GROUP OF COMPANIES –

SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF AMANDA MILESON

PERSONAL DETAILS

Position in Company	Senior Ecologist: Wetland Ecology
Joined SAS Environmental Group of Companies	2013

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Member of the South African Wetland Society (SAWS)
Member of the Gauteng Wetland Forum (GWF)

EDUCATION

Qualifications

N. Dip Nature Conservation (UNISA)	2017
Advanced Diploma Nature Conservation (UNISA)	2020
Post Graduate Diploma Nature Conservation (UNISA)	In progress

Short Courses

Wetland Management: Introduction and Delineation (University of the Free State)	2018
Tools for Wetland Assessment (Rhodes University)	2017
Wetland Rehabilitation (University of the Free State)	2015

AREAS OF WORK EXPERIENCE

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

KEY SPECIALIST DISCIPLINES

Freshwater Assessments

- Desktop Freshwater Delineation
- Freshwater Verification Assessment
- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater EcoService and Status Determination
- Rehabilitation Assessment / Planning
- Maintenance and Management Plans
- Plant Species Plans
- Freshwater Offset Plans

Biodiversity Assessments

- Ecological Scans
- Biodiversity Offset Plans