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FRESHWATER ECOLOGICAL ASSESSMENT AS PART OF THE ENVIRONMENTAL AUTHORISATION AND WATER USE LICENCE APPLICATION PROCESS FOR THE PROPOSED DEVELOPMENT OF A NEW TAILINGS STORAGE FACILITY AND FUEL STORAGE AREAS AT THE DWARS RIVER CHROME MINE, LIMPOPO PROVINCE

Prepared for

Envirogistics (Pty) Ltd

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EXECUTIVE SUMMARY

Dwarsrivier Chrome Mine (DCM) near Steelpoort, Limpopo Province intends to undertake five new development projects to support their existing mining operations within their Mining Right Area (MRA). These projects include the construction of a new Tailings Storage Facility (TSF) and associated Return Water Dam (RWD), construction of diesel and emulsion batching areas, expansion of the existing parking area which service the mine's administrative offices, widening of an existing access road between the Main Offices and South Shaft, and the construction of a new access crossing between the Plant and North Mine, to minimise traffic on the Main Offices / South Shaft access road.

Two primary freshwater ecosystems were identified in association with the aforementioned project areas: the Dwars River, and the Springkaanspruit (a tributary of the Groot Dwars River). Both rivers have been subjected to various impacts relating to ongoing mining activities within the MRA and the greater catchment and are considered moderately modified (Present Ecological State category C). The Dwars River is deemed of very high Ecological Importance And Sensitivity (EIS) whilst the Spingkaanspruit is of High EIS.

No freshwater ecosystems were identified directly within the proposed footprint areas of the diesel and emulsion batching areas, although the headwaters of two small ephemeral drainage systems are located within 500 m thereof. Those ephemeral drainage systems were not deemed at risk from the proposed project and were therefore not assessed in detail, although it is strongly recommended that mitigation measures be implemented throughout all phases of the proposed batching areas to ensure that no risks or impacts are posed by edge effects.

The outcome of the DWS Risk Assessment applied to the proposed activities indicated that, provided a high level of mitigation takes place throughout all phases of each project, the risk significance associated with each is 'Low', largely due to the distances of most projects from the applicable watercourse. Nevertheless, this does not preclude the necessity for the implementation of well-developed, environmentally sound, site-specific mitigation measures.

Based on the outcome of the ecological assessment and risk assessment, provided that strict implementation of cogent, site-specific and general 'good practice' mitigation measures takes place throughout the life of all proposed projects, it is the specialist's opinion that the five projects may be considered for authorisation with the knowledge that the significance of risk to the receiving environment is limited.

MANAGEMENT SUMMARY

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

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

The purpose of this report is to define each of the proposed Project localities in terms of freshwater and aquatic ecology, by means of analysis of relevant datasets, prior studies conducted by SAS for DCM, and a brief site assessment of each proposed alternative. It is a further aim of this study to provide adequate relevant information to the Environmental Assessment Practitioner (EAP) and the proponent

to allow for informed decision-making in consideration of the principles of Integrated Environmental Management (IEM) and sustainable development as enshrined in Section 24 of the Constitution of South Africa.

The assessment took the following approach:

- A desktop study was conducted, in which possible wetlands/watercourses within each of the four proposed options for the new TSF were identified for on-site investigation. In addition, relevant national and provincial databases were consulted. The results of the desktop study are contained in Section 3 of this report;
- Various field assessments were undertaken between December 2018 to May 2021 for each of the different Projects:
  - The site assessment for the TSF was undertaken in May 2021;
  - Alternative sites for the diesel and emulsion batching areas were assessed in March 2020. The proposed footprints of the sites assessed in this report were not significantly different from those assessed in 2020 thus the data gathered in 2020 was deemed adequate for use in this study;
  - The freshwater ecosystems associated with Projects 3, 4 and 5 were previously assessed in 2017 and 2018. Since those Projects are within existing operational areas and the associated freshwater ecosystems are unlikely to have undergone significant modification since the original assessments, historical data was utilised to augment and inform this study;
- During the various site assessments, factors influencing the habitat integrity of the freshwater ecosystems were noted, and the functioning and the environmental and socio-cultural services provided by these systems were determined;
- Two primary freshwater ecosystems were identified in association with the five proposed projects:
  - The Dwars River is located within 500 m of the proposed TSF, but no watercourses were identified directly within the proposed TSF footprint; and
  - The Spingkaanspruit, a tributary of the Groot Dwars River, is associated with Projects 3, 4 and 5.
- No watercourses were identified within the diesel and emulsion batching areas, although the headwaters of two small tributaries are situated within 500 m thereof. These are not deemed at risk of the proposed activities and were therefore not assessed;
- The aforementioned freshwater ecosystems were classified according to the Classification System (Ollis *et. al.,* 2013). The results of this classification are presented in Section 4.1 of this report; and
- The characterisation of the watercourses is contained in Section 4.2 of this report and summarised in the table below.

Table A: Summary of the results of the ecological assessment of the watercourses associated with Projects 1 and 3.

Watercourse	Present Ecological State (PES)	Ecological Importance and Sensitivity (EIS)	Ecoservices
Dwars River	B/C	Very High	Moderately High to Low (indicator dependent)
Springkaanspruit	C/D	High	Moderately High to Very Low (indicator dependent)

Following the ecological assessment, the DWS Risk Assessment Matrix (2016) was applied to ascertain the risk significance of the various proposed activities on the receiving freshwater environment. The outcome of the risk assessment indicates that the majority of the proposed activities pose a 'low' risk to the associated watercourses, with the exception of the presence of a clean and dirty water separation system around the proposed TSF and RWD, which has the potential to result in a reduction in catchment yield. However, the precautionary principle was employed in the absence of detailed information when assessing the potential risk of this aspect, and the risk assessment would need to be refined to account for detailed information should it become available. 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 F.

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;
- The construction of sediment traps around the downgradient boundary of all construction areas is strongly recommended to minimise the volume of sediment transported in runoff from the construction site which would ultimately report to the Dwars River;
- The watercourses must be protected against erosion arising from the discharge of stormwater. In this regard, energy dissipating structures should be installed to prevent erosion. Water should also be distributed in a diffuse manner to prevent canalisation;
- With specific regards to the proposed TSF:
  - An Emergency Response Plan must be compiled, and must include the measures below:
    - In the case of failure, as much sediment as possible, contaminated by the spill, must be removed from the point of its source, following the spill path to the affected watercourse. Sediment must be removed until the natural in situ substrate is reached or until a clear change in the sediment colour is reached indicating that the natural soil level has been reached;
    - All silt removed should be returned to the TSF or disposed of at a suitably managed site;
    - Following the removal of the contaminated sediment, it must be ensured the slope of the excavated areas is in line with the natural topography – i.e. a low gradient no more than 1:3;
    - Edge effects must be strictly controlled – for example no removal of sediment must take place beyond the spill pathway;
    - Possible seepage and contamination of the groundwater resources is possible and should be monitored at suitable groundwater monitoring points;
    - Toxicological monitoring of the receiving environment and of the RWD must occur immediately following the first rain event after rehabilitation and again at the end of the wet season. A suitably qualified aquatic ecologist should make a recommendation concerning the necessity of future monitoring following the assessment.

A summary of the DWS Risk Assessment is provided in Table B below:

Table B: Summary of the DWS Risk Assessment applied to the five proposed project activities.

Phases	Activity	Aspect	Impact	Risk Rating	Reversibility
Perceived Impacts: Construction of new Tailings Storage Facility (TSF) and Return Water Dam (RWD)					
Construction	Site preparation prior to construction activities of surface infrastructure, including placement of contractor laydown areas and storage facilities.	•Vehicular movement and access to the site; and •Removal of vegetation (terrestrial) and associated disturbances of soil.	•Exposure of soil, leading to increased runoff, erosion and stream incision, and thus potentially increased sedimentation of the Dwars River; •Increased sedimentation of the watercourse may lead to smothering of flora and benthic biota and potentially further alter surface water quality; •Decreased ecoservice provision; and *Further proliferation of alien vegetation or increased bush encroachment as a result of disturbances.	L	Partially reversible
	Construction of the proposed TSF and RWD	•Removal of vegetation and topsoil; •Ground-breaking and earthworks relating to foundations and trenches; •Mixing and casting of concrete	•Loss of catchment yield resulting from stormwater containment; •Increased flood peaks as a result of formalisation and concentration of surface runoff in clean water diversion structures; •Potential for erosion, leading to sedimentation of	L	

Phases	Activity	Aspect	Impact	Risk Rating	Reversibility
	Development of additional clean and dirty water separation systems, including the proposed diversion trench	for construction purposes; and •Miscellaneous activities by construction personnel.	the watercourse; •Reduction in volume of water entering the watercourse, leading to loss of recharge of the watercourse; and •Altered vegetation community structure and diversity due to moisture stress and changes to goods and service provision. •Disturbances of soil leading to increased alien vegetation proliferation or bush encroachment, and in turn to further alteration of surrounding watercourse and terrestrial habitat, with potential to affect the downgradient watercourse habitat; •Altered runoff patterns, leading to increased erosion and sedimentation of the downgradient watercourse; •Erosion of the exposed areas; •Potential impacts on the water quality of runoff which may potentially enter the downgradient watercourse and contamination of soils due to concrete being cast; and •Potential of backfill material to enter the downgradient watercourse, increasing the sediment load of the watercourse.	L	
Perceived Impacts: Diesel and Emulsion Batching Areas					
Construction	Site clearing prior to commencement of construction activities, including placement of contractor laydown areas.	•Vehicular movement and access to the site; •Removal of vegetation (terrestrial) for the access road, security offices, parking area, and tanks and associated disturbances (creation of rubble and litter) to soil upgradient of but further than 200 m from watercourse. •Increased risk of transportation of sediment from exposed soils and hydrocarbons from construction vehicles in storm water runoff into downgradient watercourses.	•Damage to and loss of vegetation, leading to exposed/compacted soil, in turn leading to potential for increased runoff from exposed areas, erosion of the downgradient watercourses and potential for increased sedimentation of the watercourses; •Increased sedimentation of the watercourses may lead to 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 from construction machinery and increased sediment availability; •Decreased ecoservice provision and biodiversity maintenance capacity; and •Proliferation of alien vegetation as a result of disturbances.	L	Partially reversible
	Removal of topsoil from project footprint and stockpiling thereof for rehabilitation.			L	
	Construction of 80 m access road to the diesel batching area from the existing access road, parking area and security offices.			L	
	Construction of diesel and emulsion tanks.			L	
Perceived impacts: Expansion of Parking at Main Offices					
Construction	Site clearing prior to commencement of construction activities, including vegetation clearing (approximately 280 m of riparian vegetation), removal of topsoil and stockpiling for use in rehabilitation, levelling of ground and placement of contractor laydown areas.	•Vehicular movement and access to the site; and •Removal of vegetation and associated disturbances to surrounding soil within the catchment of the Springkaanspruit. •Increased risk of transportation of sediment from exposed soils in storm water runoff.	•Damage to marginal and non-marginal vegetation, leading to exposed/compacted soil, in turn leading to potential for increased runoff from exposed areas, erosion of the watercourse and potential for increased sedimentation of the watercourse; •Increased sedimentation of the watercourse may lead to 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 from construction machinery; •Decreased ecoservice provision and biodiversity maintenance capacity; and •Proliferation of alien vegetation as a result of disturbances.	L	Partially reversible
	Potential indiscriminate disposal of hazardous and non-hazardous materials wastes within watercourse.	•Altered water quality; and •Possible changes to flow patterns as a result of blockages caused by solid waste/rubble.		L	
	Laying of tar and construction of steel roof parking bays.	•Increased risk of transportation of sediment from exposed soils in storm water runoff.		L	

Phases	Activity	Aspect	Impact	Risk Rating	Reversibility
		•Loss of surface roughness due to vegetation clearing, altering the pattern and timing of flow in the landscape if runoff does not report to the dirty water system.			
Perceived Impacts: Widening of Existing Access Road between South Shaft/Main Offices and Plant					
Construction	Site preparation prior to widening of roadway, including placement of contractor laydown areas and storage facilities.	•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 and instream habitat, leading to smothering of flora and benthic biota, alterations to the characteristics of the stream bed and potentially further altering surface water quality; •Decreased ecoservice provision; and •Further proliferation of alien vegetation or *Phragmites australis* as a result of disturbances.	**L**	Partially reversible
Perceived Impacts: Access Crossing between Plant and North Mine					
	Site preparation prior to widening of roadway, including placement of contractor laydown areas and storage facilities.	•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 and instream habitat, leading to smothering of flora and benthic biota, alterations to the characteristics of the stream bed and potentially further altering surface water quality; •Decreased ecoservice provision; and •Further proliferation of alien vegetation or *Phragmites australis* as a result of disturbances.	**L**	Fully reversible
OPERATIONAL PHASE IMPACTS					
Perceived Impacts: Operation of Tailings Storage Facility (TSF) and Return Water Dam (RWD)					
Operational	Operation and maintenance of the clean and dirty water separation system around the TSF and RWD.	•Containment/diversion of all runoff into the clean and dirty water system; •Discharge of clean water into the surrounding watercourse systems; and •Potential of malfunctioning of the dirty water system.	•Increased flood peaks into the watercourse 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 watercourse; •Reduction in volume of water entering the watercourse, leading to loss of recharge (and thus potential desiccation) of the watercourse systems; •Erosion and sedimentation of the watercourse at the outlet of the clean water trench; and •Altered vegetation communities due to moisture stress.	**M**	Partially reversible
	Potential Risk of failure of TSF or RWD leading to spill of tailings in the vicinity of watercourses leading to deposition in the aquatic environment.	•Sedimentation and increased turbidity of downgradient watercourse.	•Loss of aquatic habitat and refugia; •Silt deposition may lead to smothering of benthic layer.	L	
		•Reduced water quality with specific mention of increased dissolved salt concentrations and potentially introducing toxins into the system.	•Loss of aquatic biodiversity and loss of aquatic taxa; •Negative impact on aquatic biota community diversity and integrity due to deterioration of water quality.	L	
		•Temporary and momentary increased velocity and flow of downgradient watercourse.	•Potential loss of biodiversity, aquatic taxa, riparian habitat.	L	
Perceived Impacts: Diesel and Emulsion Batching Areas					

Phases	Activity	Aspect	Impact	Risk Rating	Reversibility
Operational	Operation of the diesel and emulsion batching areas	•Increased vehicular activity and impermeable surfaces in the catchment of the ephemeral drainage lines.	•Potential contamination of stormwater runoff from hard surfaces by hydrocarbons from vehicles, leading to potential contamination of surface water, groundwater and soil; •Increased volume of stormwater runoff entering the ephemeral drainage lines as a result of increased catchment hardening.	L	Partially reversible
Perceived impacts: Expansion of Parking at Main Offices					
Operational	Operation of the parking area at the Main Offices	•Increased vehicular activity and impermeable surfaces in the catchment of the Springkaanspruit.	•Potential contamination of stormwater runoff from hard surfaces by hydrocarbons from vehicles, leading to potential contamination of surface water, groundwater and soil; •Increased volume of stormwater runoff entering the episodic drainage line as a result of increased catchment hardening.	L	Partially reversible
Perceived Impacts: Widening of Existing Access Road between South Shaft/Main Offices and Plant					
Operational	Operation of the existing access road	•Increased vehicular activity and impermeable surfaces in the catchment of the Springkaanspruit.	•Potential contamination of stormwater runoff from hard surfaces by hydrocarbons from vehicles, leading to potential contamination of surface water, groundwater and soil; •Increased volume of stormwater runoff entering the episodic drainage line as a result of increased catchment hardening.	L	Partially reversible
Perceived Impacts: Access Crossing between Plant and North Mine					
Operational	Operation of the existing access road	•Increased vehicular activity and impermeable surfaces in the catchment of the Springkaanspruit.	•Potential contamination of stormwater runoff from hard surfaces by hydrocarbons from vehicles, leading to potential contamination of surface water, groundwater and soil; •Increased volume of stormwater runoff entering the episodic drainage line as a result of increased catchment hardening.	L	Partially reversible

Based on the outcome of the ecological assessment and risk assessment, provided that strict implementation of cogent, site-specific and general 'good practice' mitigation measures takes place throughout the life of all proposed projects, it is the specialist's opinion that the five projects may be considered for authorisation with the knowledge that the significance of risk to the receiving environment is limited.

DOCUMENT GUIDE

No.	Requirement	Section in report
a)	Details of -	
(i)	The specialist who prepared the report	Appendix C
(ii)	The expertise of that specialist to compile a specialist report including a curriculum vitae	Appendix
b)	A declaration that the specialist is independent	Appendix c
c)	An indication of the scope of, and the purpose for which, the report was prepared	Section 1.2
cA)	An indication of the quality and age of base data used for the specialist report	Section 2.1 and 3.1
cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 4
d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 2.1
e)	A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 1
f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives	Section 4
g)	An identification of any areas to be avoided, including buffers	Section 4.3
h)	A map superimposing the activity including the associated structure and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers	Section 5
i)	A description of any assumption made and any uncertainties or gaps in knowledge	Section 1.3
j)	A description the findings and potential implication\s of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities	Section 4
k)	Any mitigation measures for inclusion in the EMPr	Section 6
l)	Any conditions for inclusion in the environmental authorisation	N/A
m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	N/A
n)	A reasoned opinion -	
(i)	As to whether the proposed activity, activities or portions thereof should be authorised	N/A
(iA)	Regarding the acceptability of the proposed activity or activities	N/A
(ii)	If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	N/A
o)	A description of any consultation process that was undertaken during the course of preparing the specialist report	N/A
p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
q)	Any other information requested by the competent authority	N/A

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

GLOSSARY OF TERMS

Alien vegetation:	Plants that do not occur naturally within the area but have been introduced either intentionally or unintentionally. Vegetation species that originate from outside of the borders of the biome -usually international in origin.
Alluvial soil:	A deposit of sand, mud, etc. formed by flowing water, or the sedimentary matter deposited thus within recent times, especially in the valleys of large rivers.
Average Score Per Taxon	The average sensitivity of the aquatic community obtained by determining the sum of the sensitivity scores for each aquatic macro-invertebrate family observed and then dividing by the number of families present.
Base flow:	Long-term flow in a river that continues after storm flow has passed.
Biodiversity:	The number and variety of living organisms on earth, the millions of plants, animans and micro-organisms, the genes they contain, the evolutionary history and potential they encompass and the ecosystems, ecological processes and landscape of which they are integral parts.
Buffer:	A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area.
Catchment:	The area where water is collected by the natural landscape, where all rain and run-off water ultimately flows into a river, wetland, lake, and ocean or contributes to the groundwater system.
Chroma:	The relative purity of the spectral colour which decreases with increasing greyness.
Direct Estimation of Ecological Effect Potential	DEEEP proposes a battery of tests to directly assess effluent oxygen demand, lethal (acute) and sublethal (chronic) toxicity, bioaccumulation, mutagenicity and persistence potential of effluents, using test organisms from a range of trophic levels.
Delineation (of a wetland):	To determine the boundary of a wetland based on soil, vegetation and/or hydrological indicators.
Dissolved Oxygen	Dissolved Oxygen is the amount of oxygen that is present in the water. It is measured in milligrams per litre (mg/L).
Dissolved Oxygen Saturation	In aquatic environments, oxygen saturation is a ratio of the concentration of dissolved oxygen in the water to the maximum amount of oxygen that will dissolve in the water at that temperature and pressure under stable equilibrium.
Ecoregion:	An ecoregion is a "recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterise that region".
Electrical Conductivity	Electrical conductivity (EC) is a measure of the ability of water to conduct an electrical current. This ability is a result of the presence in water of ions such as carbonate, bicarbonate, chloride, sulphate, nitrate, sodium, potassium, calcium and magnesium, all of which carry an electrical charge
Ecological Importance and Sensitivity	Ecological importance refers to the diversity, rarity or uniqueness of the habitats and biota. Ecological sensitivity refers to the ability of the ecosystem to tolerate disturbances and to recover from certain impacts.
Environmental Management Plan	An EMP is a site-specific plan developed to ensure that all necessary measures are identified and implemented in order to protect the environment and comply with environmental legislation.
Ecological Water Requirements	The flow patterns (magnitude, timing and duration) and water quality needed to maintain a riverine ecosystem in a particular condition. This term is used to refer to both the quantity and quality components.
Ephemeral stream:	Ephemeral systems flow for less time than they are dry. Flow or flood for short periods of most years in a five-year period, in response to unpredictable high rainfall events. Support a series of pools in parts of the channel.
Episodic stream:	Highly flashy systems that flow or flood only in response to extreme rainfall events, usually high in their catchments. May not flow in a five-year period, or may flow only once in several years**.**
Facultative species:	Species usually found in wetlands (76%-99% of occurrences) but occasionally found in non-wetland areas
Fluvial:	Resulting from water movement.
Gleying:	A soil process resulting from prolonged soil saturation which is manifested by the presence of neutral grey, bluish or greenish colours in the soil matrix.
Groundwater:	Subsurface water in the saturated zone below the water table.
Hydromorphic soil:	A soil that in its undrained condition is saturated or flooded long enough to develop anaerobic conditions favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic soils).

Hydrology:	The study of the occurrence, distribution and movement of water over, on and under the land surface.
Hydromorphy:	A process of gleying and mottling resulting from the intermittent or permanent presence of excess water in the soil profile.
Hydrophyte:	Any plant that grows in water or on a substratum that is at least periodically deficient of oxygen as a result of soil saturation or flooding; plants typically found in wet habitats.
Intermediate Habitat Integrity Assessment	The habitat integrity assessment is based on two perspectives of the river, the riparian zone and the instream channel. Assessments are made separately for both aspects, but data for the riparian zone are primarily interpreted in terms of the potential impact on the instream component.
Intermittent flow:	Flows only for short periods.
Indigenous vegetation:	As defined within the NEMA EIA Regulations Listing Notice 3 of 2014 (amended 2017) "indigenous vegetation" refers to vegetation consisting of indigenous plant species occurring naturally in an area, regardless of the level of alien infestation and where the topsoil has not been lawfully disturbed during the preceding ten years. Vegetation occurring naturally within a defined area.
Invertebrate Habitat Assessment System	An assessment index to determine the suitability of the habitat at any assessment point for colonisation by aquatic macro-invertebrates.
Macro-Invertebrate Response Assessment Index	MIRAI integrates the ecological requirements of the invertebrate taxa in a community or assemblage to their response to modified habitat conditions.
Mottles:	Soils with variegated colour patterns are described as being mottled, with the "background colour" referred to as the matrix and the spots or blotches of colour referred to as mottles.
Obligate species:	Species almost always found in wetlands (>99% of occurences).
Olifants River Ecological Water Requirement Assessment	A comprehensive determination of the Reserve was conducted with the aim of quantifying the environmental requirements of the resource in order to protect the aquatic ecosystem and secure ecologically sustainable development and use of the resource. The outcome of this determination was recommended flow and water quality objectives that should be achieved in order that the aquatic ecosystem can be afforded the level of protection as required by the Ecological Class.
Perched water table:	The upper limit of a zone of saturation that is perched on an unsaturated zone by an impermeable layer, hence separating it from the main body of groundwater
Perennial:	Flows all year round.
Present Ecological State	The current state or condition of a water resource in terms of its biophysical components (drivers) such as hydrology, geomorphology and water quality and biological responses viz. fish, invertebrates, riparian vegetation). The degree to which ecological conditions of an area have been modified from natural (reference) conditions.
RAMSAR:	The Ramsar Convention (The Convention on Wetlands of International Importance, especially as Waterfowl Habitat) is an international treaty for the conservation and sustainable utilisation of wetlands, i.e., to stem the progressive encroachment on and loss of wetlands now and in the future, recognising the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value. It is named after the city of Ramsar in Iran, where the Convention was signed in 1971.
RDL (Red Data listed) species:	Organisms that fall into the Extinct in the Wild (EW), critically endangered (CR), Endangered (EN), Vulnerable (VU) categories of ecological status
Resource Quality Information Services	RQIS provides national water resource managers with aquatic resource data, technical information, guidelines and procedures that support the strategic and operational requirements for assessment and protection of water resource quality.
Resource Quality Objectives	Classes and resource quality objectives of water resources for the Olifants catchment from Government Gazette number 39943, 22 April 2016, Department of Water and Sanitation (DWS 2016).
Seasonal zone of wetness:	The zone of a wetland that lies between the Temporary and Permanent zones and is characterised by saturation from three to ten months of the year, within 50cm of the surface
South African River Health Programme	The RHP serves as a source of information regarding the overall ecological status of river ecosystems in South Africa. For this reason, the RHP primarily makes use of in-stream and riparian biological communities (e.g. fish, invertebrates, vegetation) to characterise the response of the aquatic environment to multiple disturbances.
South African Scoring System	An index to determine the integrity of the aquatic macro-invertebrate community at any given assessment point.
Sub-quaternary Reach	A finer subdivision of the quaternary catchments (the catchment areas of tributaries of main stem rivers in quaternary catchments).

Target Water Quality Requirement	*Guidelines set by the South African Department of Water and Sanitation (DWS), formerly the Department of Water Affairs and Forestry (DWAF), for various physico-chemical and biological parameters for various uses as well as ecosystem functioning.
Temporary zone of wetness:	the outer zone of a wetland characterised by saturation within 50cm of the surface for less than three months of the year
Watercourse:	In terms of the definition contained within the National Water Act, a watercourse means: • A river or spring; • A natural channel which water flows regularly or intermittently; • A wetland, dam or lake into which, or from which, water flows; and • Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse; • and a reference to a watercourse includes, where relevant, its bed and banks
Whole Effluent Toxicity	Whole Effluent Toxicity refers to the aggregate toxic effect to aquatic organisms from all pollutants contained in a facility's wastewater (effluent).
Wetland Vegetation (WetVeg) type:	Broad groupings of wetland vegetation, reflecting differences in regional context, such as geology, climate, and soils, which may in turn have an influence on the ecological characteristics and functioning of wetlands.
Water Management System	WMS is a suite of computer programmes developed for the Department of Water and Sanitation to provide information for water resource monitoring and management in South Africa.
Water Use License	The National Water Act (Act 36 of 1998) gives the Department of Water and Sanitation the tools to gather the information that we need for the optimal management of our water resources. The registration of water use is one of these tools.

ACRONYMS

% DO sat	Dissolved Oxygen Saturation
°C	Degrees Celsius.
ASPT	Average Score Per Taxon
BAR	Basic Assessment Report
BGIS	Biodiversity Geographic Information Systems
CBA	Critical Biodiversity Area
CSIR	Council of Scientific and Industrial Research
CR	Critically Endangered
DCM	Dwarsrivier Chrome Mine
DEA	Department of Environmental Affairs
DEMC	Desired Ecological Management Class
DO	Dissolved Oxygen
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EC	Ecological Class or Electrical Conductivity (use to be defined in relevant sections)
EI	Ecological Important
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
ES	Ecological Sensitivity
ESA	Ecological Support Area
EWR	Ecological Water Requirements
FEPA	Freshwater Ecosystem Priority Areas
FRAI	Fish Response Assessment Index
GIS	Geographic Information System
GN	General Notice
GPS	Global Positioning System
HGM	Hydrogeomorphic
IHAS	Invertebrate Habitat Assessment System
IEM	Integrated Environmental Management
IHI	Index of Habitat Integrity
LEMA	Limpopo Environmental Management Act
mm	Millimetre
m.a.m.s.l	Metres above Mean Sea Level
MAP	Mean Annual Precipitation
NEMA	National Environmental Management Act
NFEPA	National Freshwater Ecosystem Priority Areas
NWA	National Water Act
OREWRA	Olifants River Ecological Water Requirements Assessment
PEMC	Present Ecological Management Class
PES	Present Ecological State
REC	Recommended Ecological Category
RHP	River Health Program
RQIS	Research Quality Information Services
RWQO	** Resource Water Quality Objectives
SA RHP	South African River Health Programme
SACNASP	South African Council for Natural Scientific Professions
SAIAB	South African Institute of Aquatic Biodiversity
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SAS	Scientific Aquatic Services
SASS5	South African Scoring System
SQR	Sub-Quaternary Reach

subWMA	Sub-Water Management Area
TWQR	* Target Water Quality Requirement
WET	Whole Effluent Toxicity
WetVeg Groups	Wetland Vegetation Groups
WMA	Water Management Areas
WMS	Water Management System
WRC	Water Research Commission
WULA	Water Use License Application

1 INTRODUCTION

1.1 Background

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

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

Further detail regarding the above projects is provided in Section 1.2 of this report.

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

In order to identify all watercourses that may potentially be impacted by the proposed projects described above, a 500m "zone of investigation" around each project area, in accordance with Government Notice (GN) 509 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) (NWA), was used as a guide in which to assess possible sensitivities of the receiving watercourse environment. These areas – i.e. the 500m zone of investigation around the project areas - will henceforth be referred to as the "investigation area".

The purpose of this report is to, by means of analysis of relevant datasets, prior studies conducted by SAS for DCM, and a brief site assessment of the proposed projects, define those areas deemed to be of increased Ecological Importance and Sensitivity (EIS), and to define the Present Ecological State (PES) of the watercourses associated with the proposed project areas. Furthermore, this report aims to define the socio-cultural and ecological service provision of these watercourses, and the Recommended Management Objectives (RMO) and Recommended Ecological Category (REC) thereof. It is a further objective of this study to

provide detailed information when considering the proposed project activities in the vicinity of the watercourses, to ensure the ongoing functioning of the ecosystems, such that local and regional conservation requirements and the provision of ecological services in the local area are supported while considering the need for sustainable economic development.

1.2 Project description

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

Project 1: Tailings Storage Facility

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

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

The areas are as follows:

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

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

As part of the pre-feasibility studies, SAS undertook an alternatives analysis of the four proposed options (SAS, 2021). This analysis concluded that Option B was the preferred option from a freshwater management perspective as the placement does not pose any direct threat to watercourses (refer to summary below, taken from SAS, 2021):

Table 1:Partial summary of the results of the investigation and comparison of TSF option B (SAS, 2021).

TSF Alternative	Freshwater ecology of site	Business Case	Preferred Site (from a freshwater ecology perspective)
Option B	No watercourses were identified within Option B. The site is located upgradient and approximately 230 m east of the Dwars River. The site is also located approximately 350 m south and downgradient of an ephemeral, unnamed tributary of the Dwars River.	The construction of the proposed TSF in this location does not pose any direct threat to any watercourses. However, indirect impacts could potentially occur during construction such as contaminated stormwater runoff reaching the Dwars River. Similarly, no direct impacts are envisaged during the operational phase should the proposed TSF be placed in this site; however, in the event of failure of the TSF, significant impacts to the Dwars River could occur, particularly without appropriate mitigation.	Preferred, since the placement poses no direct threat to any watercourses. Strict mitigation, including ensuring that the design and operation of the TSF does not lead to failure thereof, will be necessary to prevent any possible indirect impacts on the Dwars River.

Project 2: Diesel and Emulsion Batching

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

The project will include:

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

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

Project 3: Main Parking Extension

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

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

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

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

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

Project 5: Access Crossing between Plant and North Mine

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

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

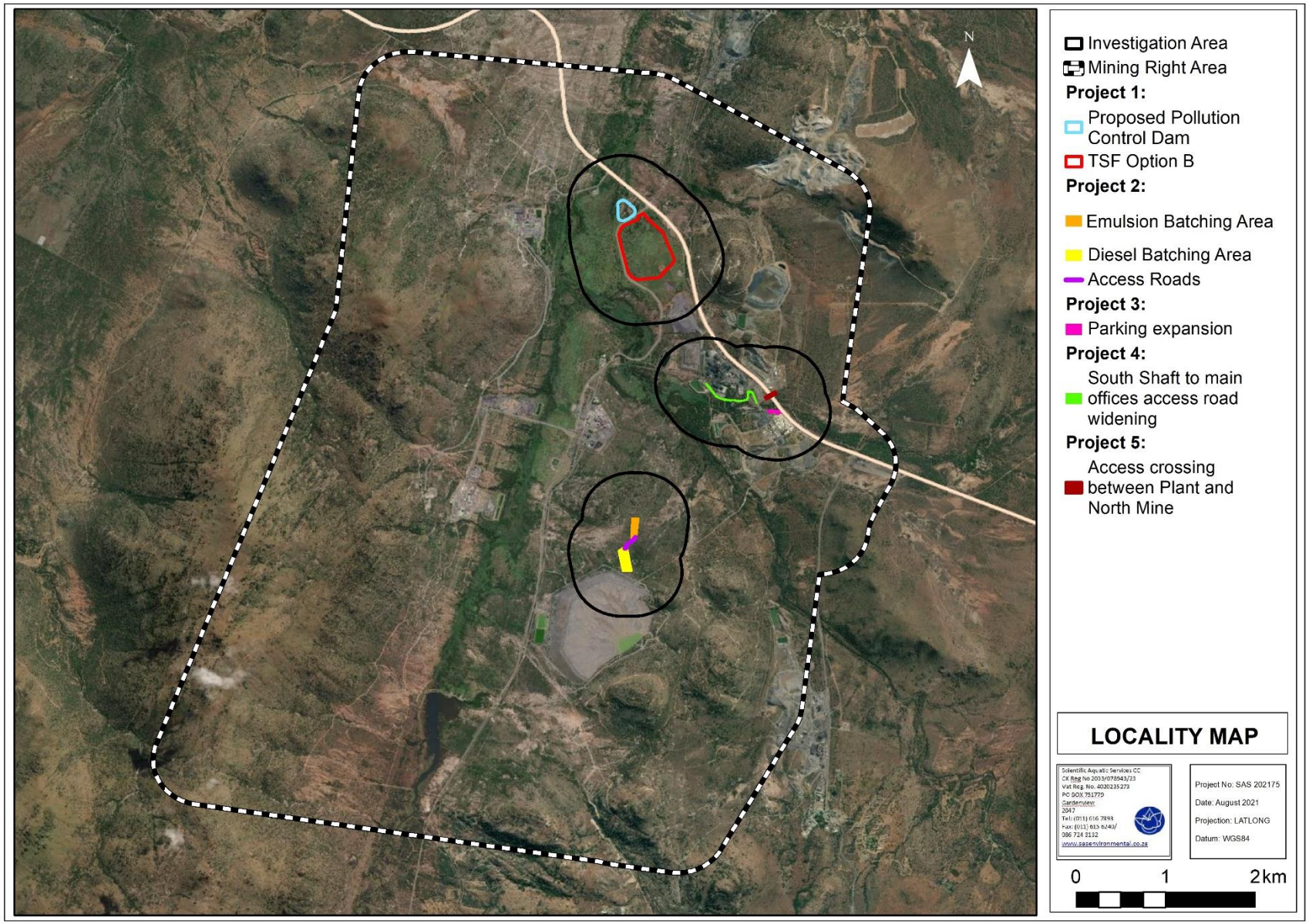


Figure 1: A digital satellite image depicting the location of the MRA and the five proposed projects.

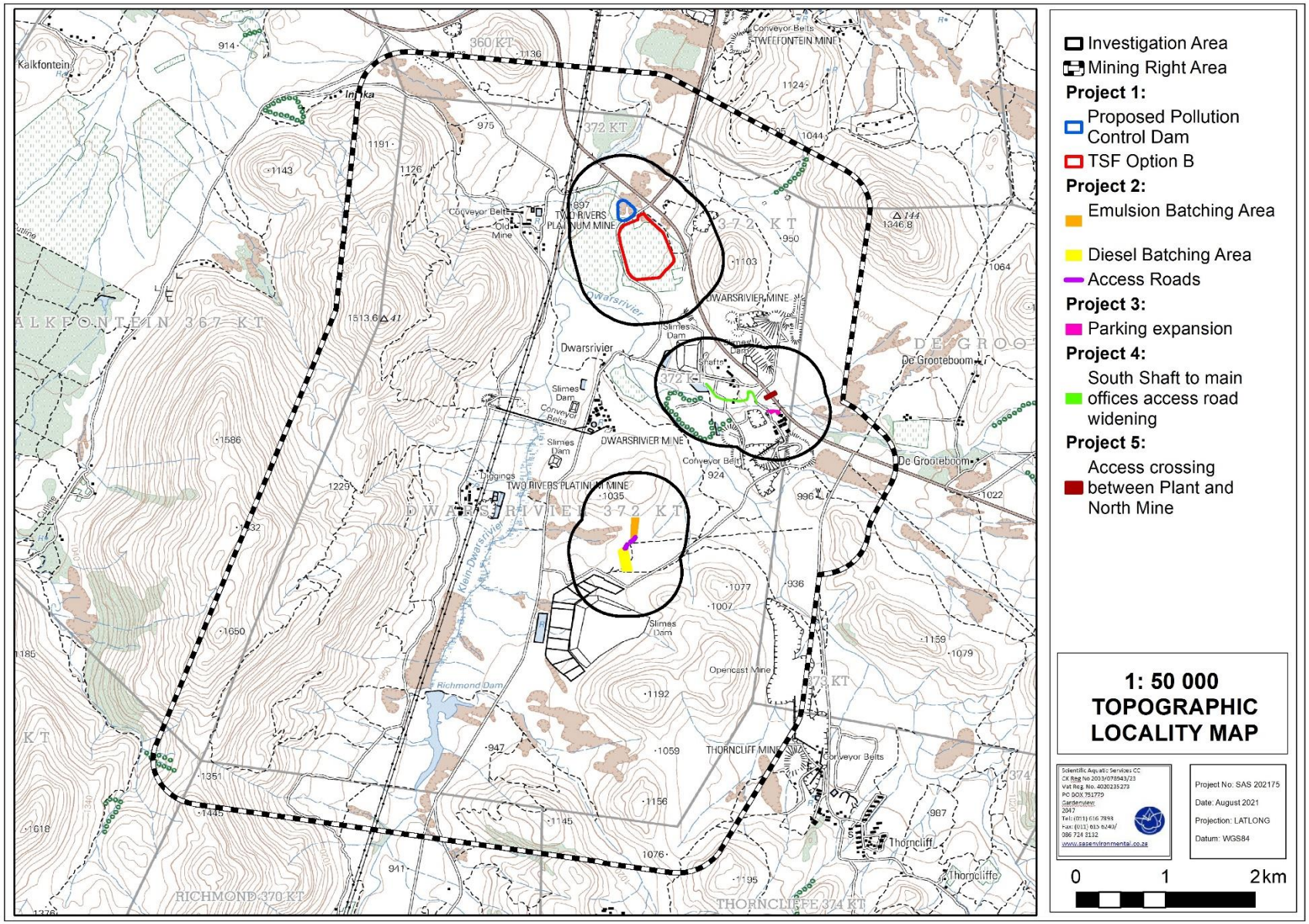


Figure 2: The five proposed projects depicted on a 1:50 000 topographical map, in relation to the surroundings.

1.3 Scope of Work

Specific outcomes in terms of this report are outlined below:

- Compile a background study of relevant national, provincial and municipal datasets (such as the National Freshwater Ecosystem Priority Areas [NFEPA] 2011 database, the National Biodiversity Assessment (2018), the Department of Water and Sanitation Research Quality Information Services [DWS RQIS PES/EIS] 2014 database) and the Limpopo Conservation Plan Version 2 (2013) to aid in defining the PES and EIS of the freshwater and aquatic resources;
- Delineation of watercourses according to "Department of Water Affairs and Forestry (DWAF[1], 2008): A practical Guideline Procedure for the Identification and Delineation of Wetlands and Riparian Zones". Aspects such as soil morphological characteristics, vegetation types and wetness were used to delineate the freshwater resources;
- To define, through visual observations and utilisation of existing information, the freshwater and aquatic ecological integrity, importance and sensitivity associated with each project (Projects 1 to 5) including:
  - Define the PES according to the resource directed measures guidelines as advocated by Kleynhans *et al*. (2008), i.e., the Index of Habitat Integrity (IHI);
  - Define the EIS according to the method described by Rountree & Kotze, (2013);
  - Determine ecological service provision according to the resource-directed measures advocated by Macfarlane *et al*, 2020;
  - Allocate a suitable Recommended Ecological Category (REC) and Recommended Management Objective (RMO) to the watercourses based on the results obtained from the PES, EIS and ecoservices assessments;
- The DWS Risk Assessment Matrix (2016) was applied to identify potential impacts that may affect the watercourses as a result of the proposed airport development activities, and to aim to quantify the significance thereof; and
- To present management and mitigation measures which should be implemented during the various development phases to assist in minimising the impact on the receiving watercourse environment.

1.4 Assumptions and Limitations

The following assumptions and limitations are applicable to this report:

[1] The Department of Water Affairs and Forestry (DWAF) was formerly known as the Department of Water Affairs (DWA). At present, the Department is known as the Department of Water and Sanitation (DWS). For the purposes of referencing in this report, the name under which the Department was known during the time of publication of reference material, will be used.

- The determination of the watercourse boundaries and the assessment thereof, is confined to the footprint areas of each of the five proposed projects as provided by the proponent. The general surroundings were, however, considered in the desktop assessment of each area;
- The delineation of watercourses within 500m (in compliance with Regulation GN509 of 2016 as it relates to the National Water Act, 1998 (Act 36 of 1998)) of each of the five proposed projects ere delineated using various desktop methods including topographic maps, 5 m contours, historical and current digital satellite imagery, aerial photographs. The general surroundings were, however, considered in the desktop assessment of the MRA and investigation area;
- Previous studies undertaken by SAS in 2017 and 2018 provided the basis of this assessment, with limited field verification of key watercourses undertaken during 2018, 2020 and 2021;
- The footprint areas of the proposed emulsion batching area (Project 2), main parking extension (Project 3), widening of access road (Project 4) and access crossing between the Plant and North Mine (Project 5) were not ground-truthed specifically as part of this investigation. However, ground-truthing data obtained in these areas by SAS between March 2017 and March 2020 was utilised to inform the watercourse delineations and characterisation of the freshwater ecology of those areas where required;
- The delineations as presented in this report are thus regarded as a best estimate of the riparian zones associated with ephemeral drainage lines and the river systems based on the site conditions present at the time of assessment;
- Global Positioning System (GPS) technology is inherently inaccurate and some inaccuracies due to the use of handheld GPS instrumentation may occur, however, the delineations provided in this report are deemed accurate enough to inform future decision-making and planning processes. If more accurate assessments are required the watercourses will need to be surveyed and pegged according to surveying principles and with survey equipment;
- Wetland, riparian and terrestrial zones create transitional areas where an ecotone is formed as vegetation species change from terrestrial to obligate/facultative species. Within this transition zone, some variation of opinion on the watercourse boundary may occur. However, if the DWAF (2008) method is followed, all assessors should get largely similar results; and
- With ecology being dynamic and complex, certain aspects (some of which may be important) may have been overlooked. However, it is expected that the proposed development activities have been accurately assessed and considered, based on the

field observations and the consideration of existing studies and monitoring data in terms of riparian and wetland ecology.

1.5 Legislative Requirements and Provincial Guidelines

The following legislative requirements and relevant provincial guidelines were taken into consideration during the assessment. A detailed description of these legislative requirements is presented in Appendix B:

- The Constitution of the Republic of South Africa, 1996[2];
- National Environmental Management Act, 1998, (Act No. 107 of 1998) (NEMA);
- National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) (NEMBA)
- National Water Act, 1998, (Act No. 36 of 1998) (NWA);
- General Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the NWA;
- Government Notice 704 Regulations as published in the Government Gazette 20119 of 1999 as it relates to the National Water Act, 1998 (Act 36 of 1998) regarding the use of water for mining and related activities aimed at the protection of water resources;
- Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002) (MPRDA)*;* and
- Limpopo Environmental Management Act, 2003, (Act 7 of 2003) (LEMA).

2 ASSESSMENT APPROACH

2.1 Watercourse Field Verification

For the purposes of this investigation, the definition of watercourses, wetland and riparian systems was taken as per that in the National Water Act, 1998 (Act 36 of 1998). The definitions are as follows:

A **watercourse** means:
(a) a river or spring;
(b) a natural channel in which water flows regularly or intermittently;
(c) a wetland, lake or dam into which, or from which, water flows; and

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

(d) any collection of water which the Minister may, by notice in the *Gazette,* declare to be a watercourse,
and a reference to a watercourse includes, where relevant, its bed and banks.

Wetland habitat is “land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.”

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

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

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

A field assessment of the proposed TSF alternatives was undertaken in early December 2018 in mid-summer, and of the proposed fuel storage area alternatives in March 2020 in late summer, during which the presence of any riparian or wetland characteristics as defined by DWAF (2008) and by the NWA, were noted within each of the TSF alternative options. In addition, each alternative option was assessed in terms of freshwater and aquatic ecological integrity.

2.2 Sensitivity Mapping

All freshwater resources associated with each of the TSF and alternative options and Projects 2 to 5 were delineated with the use of a GPS. Geographic Information System (GIS) was used to project these features onto digital satellite imagery and topographic maps. The sensitivity map presented in Section 4.3 should guide the design and layout of the development.

2.3 Risk Assessment and Recommendations

Following the completion of the freshwater resource and aquatic assessment, a risk assessment (please refer to Appendix D for the method of approach) and recommendations were developed to address and mitigate impacts associated with the proposed mining activities.

3 RESULTS OF THE DESKTOP ANALYSIS

3.1 Conservation Characteristics of the five proposed project areas

The following section contains data accessed as part of the desktop assessment and are presented as a “dashboard” style report below (Table 1). For the purposes of providing context, the background data was accessed for the entire MRA, and where necessary, specifics pertaining to the specific proposed projects are emboldened where considered relevant.

The dashboard report aims to present concise summaries of the data on as few pages as possible to allow for integration of results by the reader to take place. Where required, further discussion and interpretation is provided, and information that was considered of particular importance was emboldened. It is important to note that although all data sources used provide useful and often verifiable, high quality data, the various databases used do not always provide an entirely accurate indication of the study area’s actual site characteristics at the scale required to inform the environmental authorisation and/or water use licencing processes. Given these limitations, this information is considered useful as background information to the study. It must however be noted that site verification of key areas may potentially contradict the information contained in the relevant databases, in which case the site verified information must carry more weight in the decision-making process. Thus, this data was used as a guideline to inform the watercourse scoping assessment and to focus on areas and aspects of increased conservation importance during the site assessment.

Table 2: Desktop data relating to the character of freshwater resources associated with the five proposed projects.

Aquatic ecoregion and sub-regions in which the five proposed projects are located			Detail of the five proposed projects in terms of the National Freshwater Ecosystem Priority Area (NFEPA) (2011) database	
Ecoregion	Eastern Bankenveld		FEPACODE (Figure 5)	Projects 2 to 5 and the majority of TSF Option B fall within an area defined as a **FEPA catchment**, with the remaining northern portion of TSF Option B located within an area considered a **Fish Support Area (FSA)**. **River Freshwater Ecosystem Priority Areas (FEPA)** achieve biodiversity targets for river ecosystems and threatened fish species and were identified in rivers that are currently in a good condition (A or B ecological category). Although the FEPA status applies to the actual river reach, the surrounding land and smaller stream network needs to be managed in a way that maintains the good condition of the river reach. Remaining fish sanctuaries in lower than an A or B ecological condition were identified as **Fish Support Areas**. Furthermore, the Fish Support Areas include sub-quaternary catchments important for migration of threatened fish species.
Catchment	Olifants North			
Quaternary Catchment (Figure 3)	Projects 2 to 5 and the majority of TSF Option B fall within B41G, with the remaining northern portion of TSF Option B within B41H.			
WMA	Olifants			
subWMA	Steelpoort			
Dominant characteristics of the Eastern Bankenveld Ecoregion Level II (9.03) (Kleynhans *et al.*, 2007a)				
Dominant primary terrain morphology	Closed hills, Mountains; Moderate and high relief, low mountains		NFEPA Wetlands and Rivers (Figure 6 & 7)	➢ **No wetlands or rivers are indicated by the NFEPA database within any of the five proposed projects.** ➢ The database indicates three small artificial unchannelled valley bottom wetlands located within the investigation area of the proposed Project 4. These wetlands are considered to be heavily to critically modified (Class Z3). Analysis of digital satellite imagery indicates that these are various mine process water dams. ➢ The Dwars River is located within the western portion of the TSF Option B's investigation area. The river is a designated FSA and is currently in a moderately modified ecological condition (Class C). ➢ The Groot-Dwars River traverses the south western portion of the TSF Option B's investigation area. This river is considered largely natural (Class B) and is a designated FEPA River.
Dominant primary vegetation types	Mixed Bushveld			
Altitude (m a.m.s.l)	500 to 2300			
MAP (mm)	400 to 700			
Coefficient of Variation (% of MAP)	20 to 34			
Rainfall concentration index	55 to 64			
Rainfall seasonality	Early summer			
Mean annual temp. (°C)	14 to 22			
Winter temperature (July)	2 to 20 °C			
Summer temperature (Feb)	12 – 30 °C			
Median annual simulated runoff (mm)	20 to 150			
Ecological Status of the most proximal sub-quaternary reach (DWS, 2014) (Figure 4)			Wetland vegetation Type	The five proposed projects fall within the Central Bushveld Group 1 Wetland Vegetation Type, considered critically endangered (CR) (Mbona *et al*, 2015).
Sub-quaternary reach	B41G – 00674 (Groot Dwars River)	B41H – 00640 (Dwars River)		
Assessed by expert?	Yes	Yes		
PES Category Median	**Class D (Largely Modified)**		Detail of the five proposed projects in terms of the Limpopo Conservation Plan Version 2 (2013) (Figure 8)	
Stream Order	2	2	Critical Biodiversity Area (CBA) 1	Projects 1, 2 3 and 5 and the majority of Project 4 fall within areas defined as **Category 1 CBAs.** These are "Irreplaceable" areas, which are required to meet biodiversity pattern and/or ecological processes targets; and with no alternative sites available to meet targets.
Mean Ecological Importance (EI) Class	**High**	**High**		
Mean Ecological Sensitivity (ES) Class	**Very High**	**High**	Ecological Support Area (ESA) 2	A small portion of Project 4 falls within an area defined as a **Category 2 ESA**. These are areas where no natural habitat remains, but that are still important for meeting ecological processes.
Default Ecological Class (based on median PES and highest EI or ES mean)	Class A (Very High)	Class B (High)		
Importance of the five proposed projects according to the Mining and Biodiversity Guidelines (2013)			National Biodiversity Assessment (2018): South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (Figure 9)	
The five proposed projects fall within an area considered to be of **Highest Biodiversity Importance**. Highest Biodiversity Importance areas include areas where mining is not legally prohibited, but where there is a very high risk that due to their potential biodiversity significance and importance to ecosystem services (e.g., water flow regulation and water provisioning) that mining projects will be significantly constrained or may not receive the necessary authorisations.			According to the NBA (2018):SAIIAE the artificial features identified by the NFEPA Database (2011) to be located within the investigation area, are classified as dams. The Dwars and Groot-Dwars Rivers are largely modified according to the NBA 2018 Dataset. The Ecosystem Protection Level (EPL) of the rivers are poorly protected and therefore the rivers are critically endangered (Ecosystem Threat Status (ETS)).	

National Web-based Screening Tool (2020)		
The screening tool is intended to allow for pre-screening of sensitivities in the landscape to be assessed within the EA process. this assists with implementing the mitigation hierarchy by allowing developers to adjust their proposed development footprint to avoid sensitive areas.		
For the aquatic biodiversity theme, the five proposed projects, with the exception of a portion of the TSF Option B, are considered to have an overall **aquatic sensitivity of very high,** due to the area being classified as a FEPA catchment (NFEPA, 2011). The remaining northern portion of the TSF Option B has a **low aquatic sensitivity.**		
Strategic Water Source Areas for Surface Water (2017)		
Surface water SWSAs are defined as areas of land that supply a disproportionate (i.e., relatively large) quantity of mean annual surface water runoff in relation to their size. They include transboundary areas that extend into Lesotho and Swaziland. The sub-national Water Source Areas (WSAs) are not nationally strategic as defined in the report but were included to provide a complete coverage.	Name and Criteria	The five proposed projects do not fall within a SWSA.

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

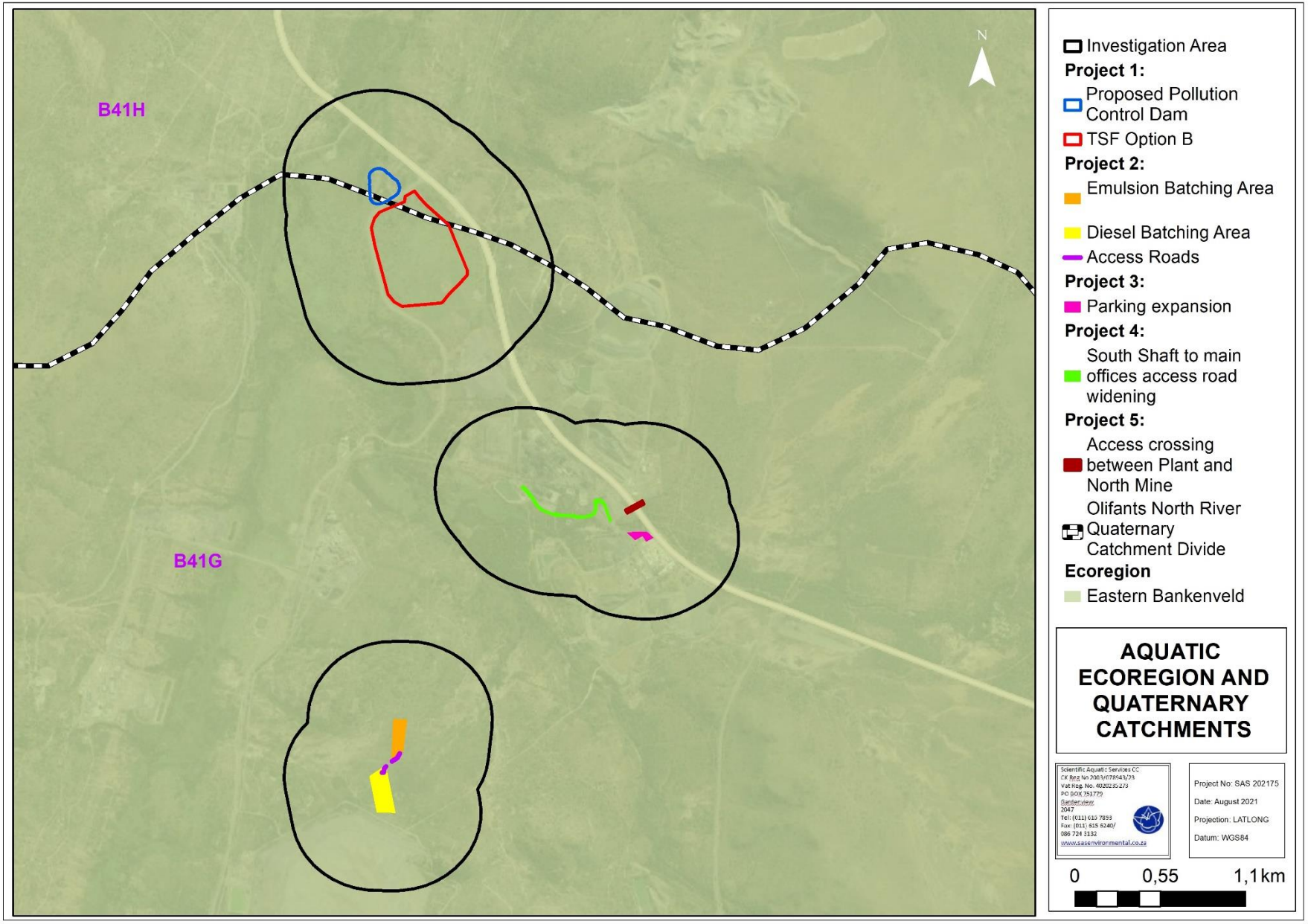


Figure 3: The aquatic ecoregion and quaternary catchments associated with the proposed five projects.

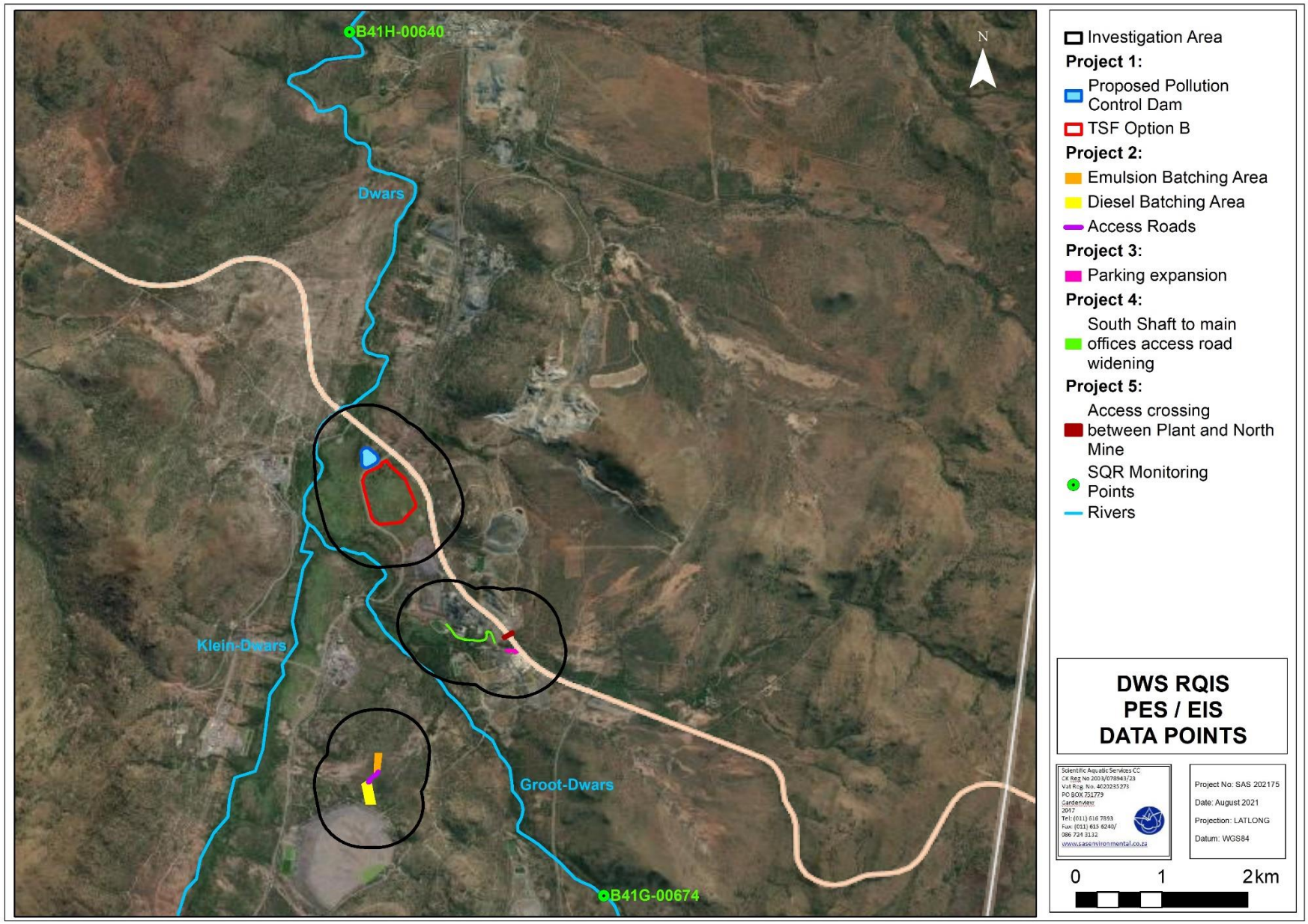


Figure 4: Relevant sub-quaternary catchment reaches (SQR) associated with the five proposed projects.

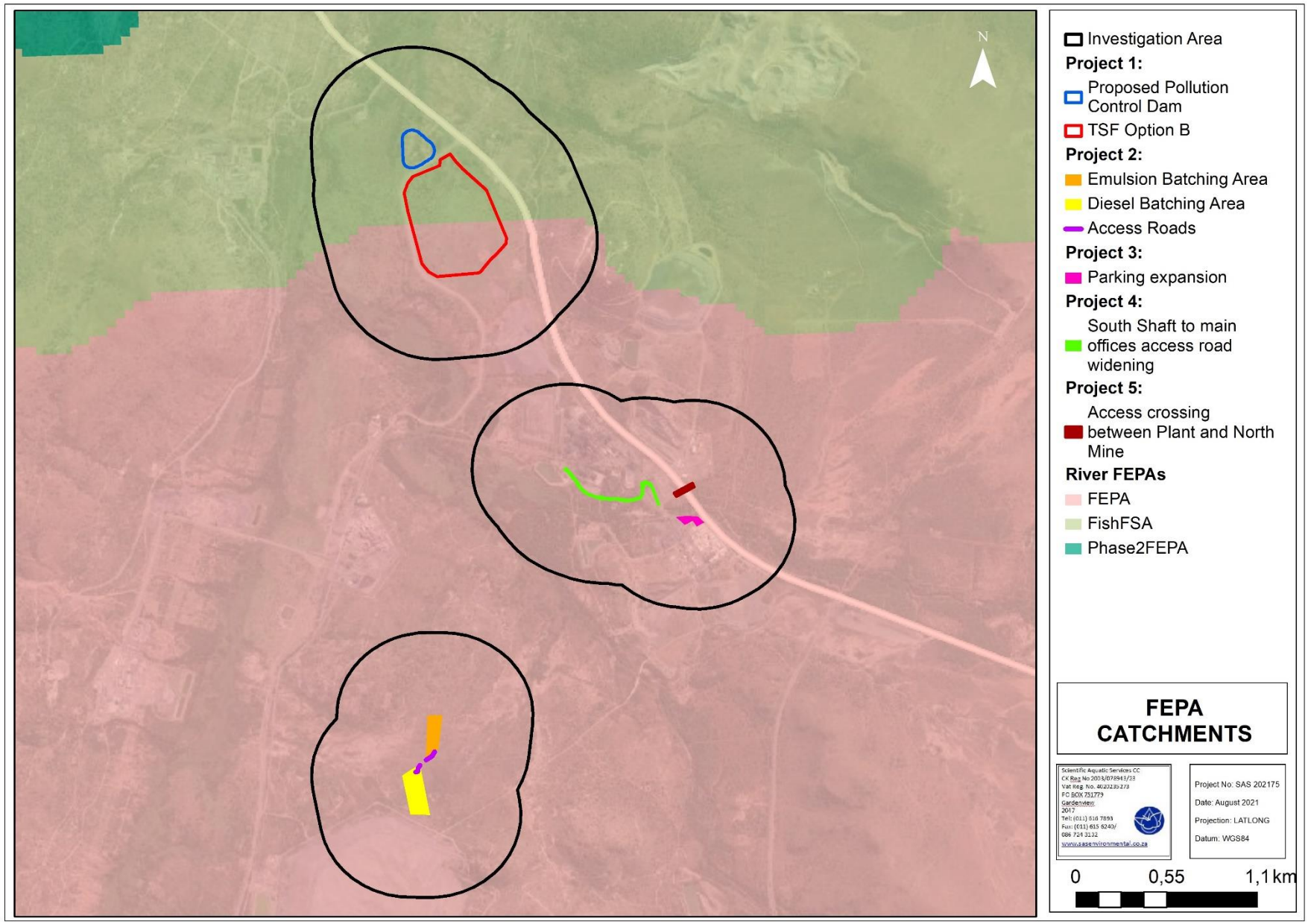


Figure 5: The FEPA catchment status of the five proposed projects according to the NFEPA Database (NFEPA, 2011).

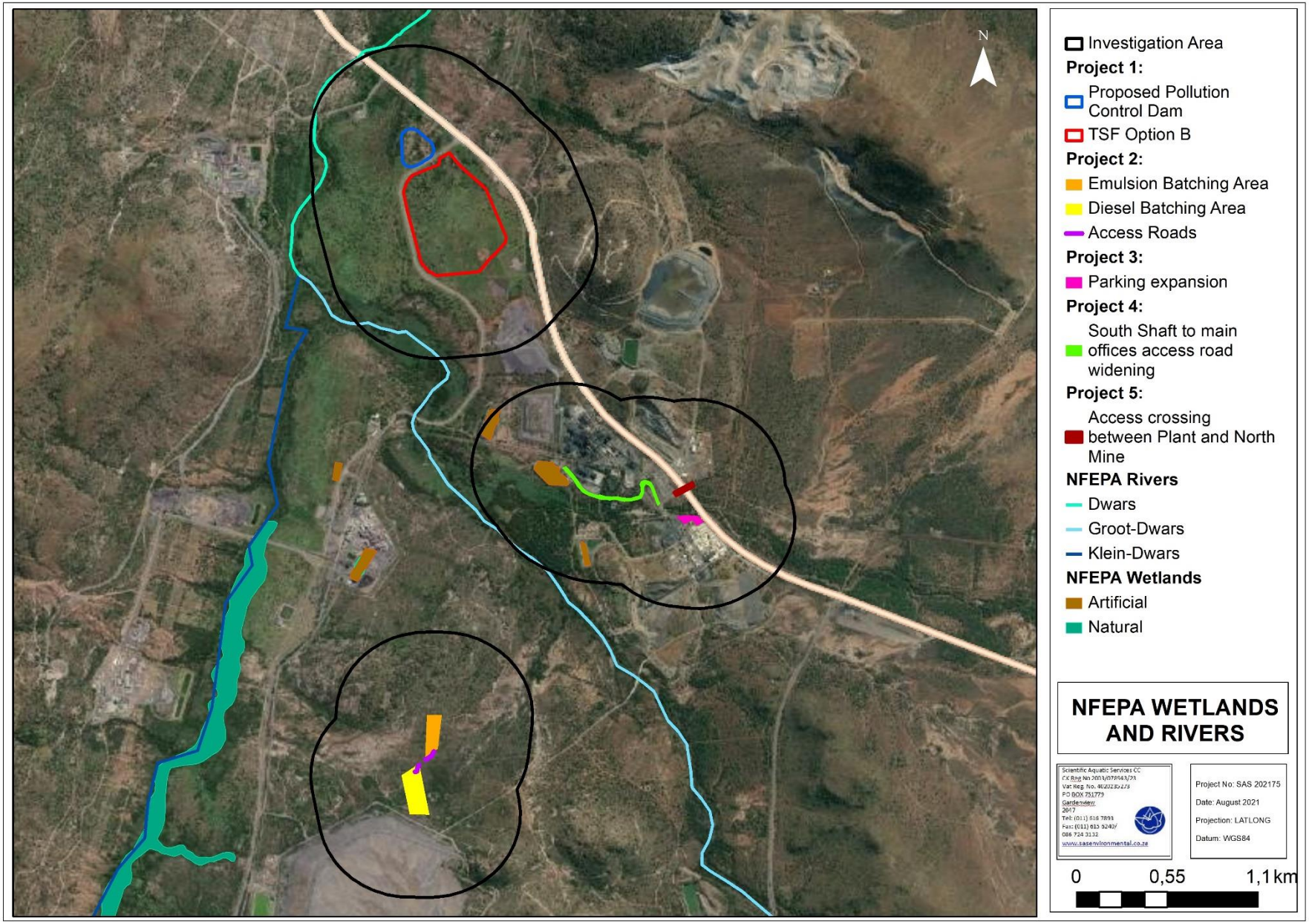


Figure 6: The natural and artificial wetland features, and rivers associated with the five proposed projects according to the NFEPA Database (2011).

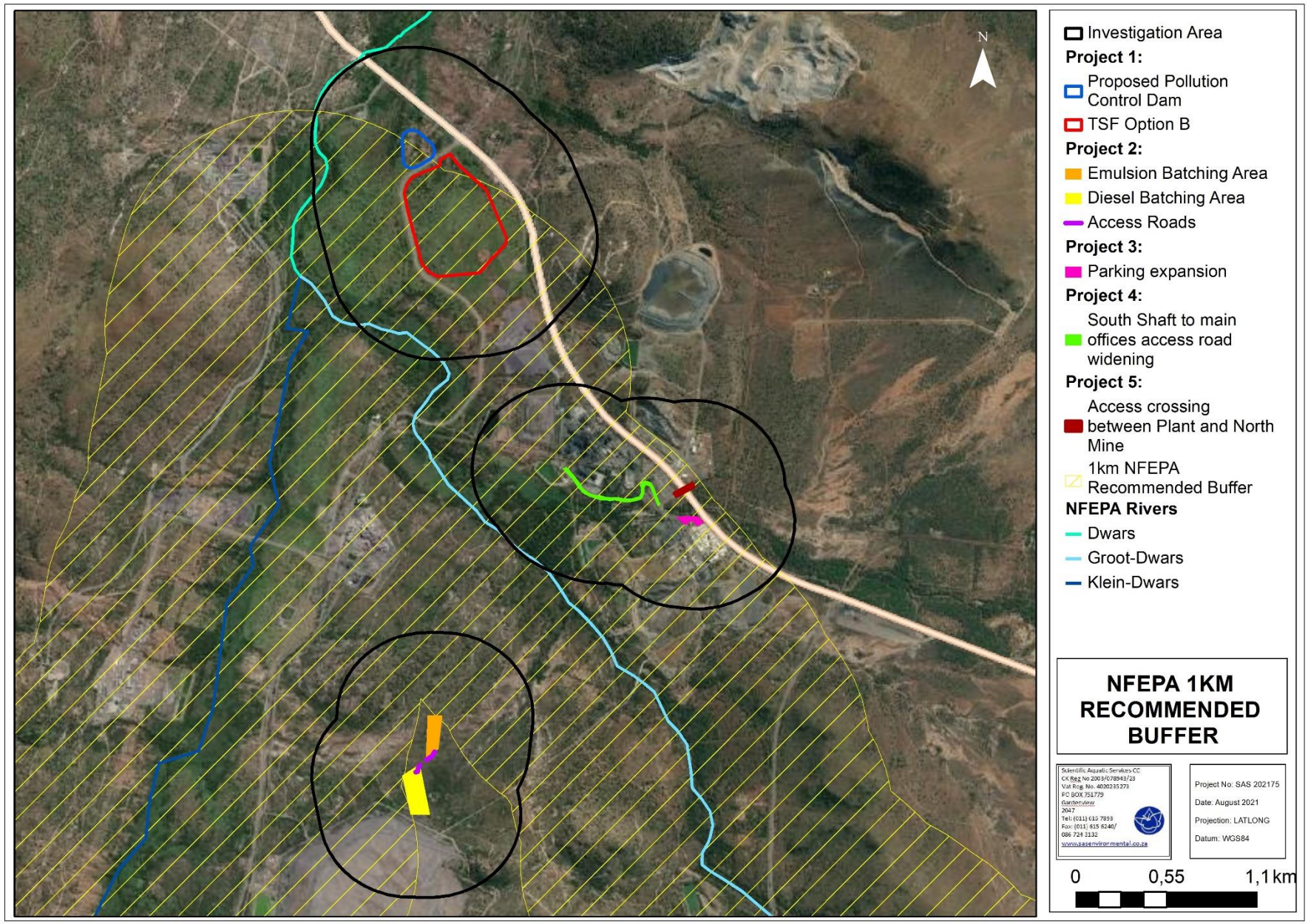


Figure 7: The 1 km recommended buffer around the FEPA Rivers, according to the NFEPA Database (2011).

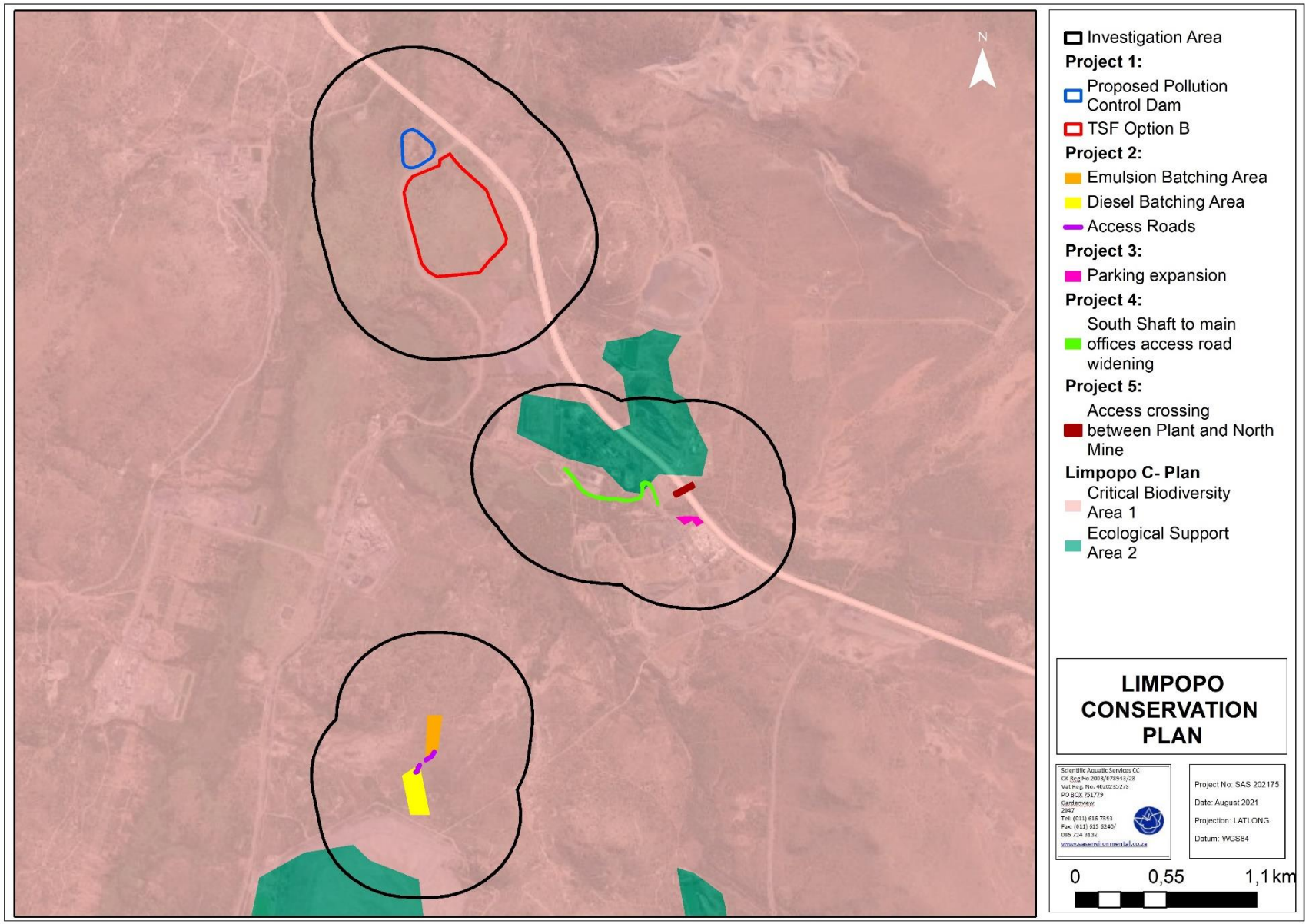


Figure 8: Critical Biodiversity Areas (CBA) and Ecological Support Areas (ESA) associated with the five proposed projects according to the Limpopo Conservation Plan (2013).

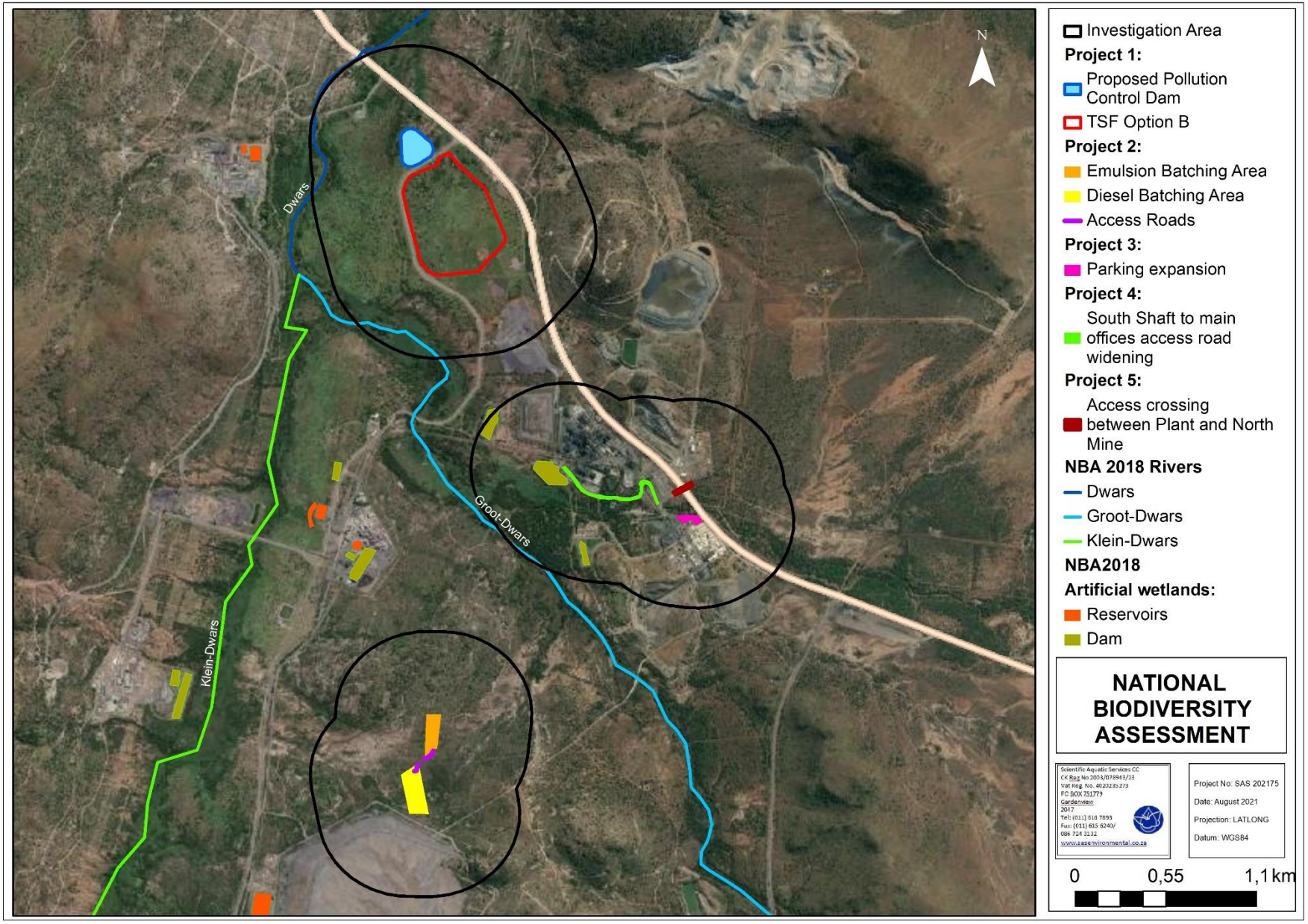


Figure 9: Artificial wetlands associated with the five proposed projects according to the National Biodiversity Assessment (NBA) (2018).

4 DELINEATION AND SENSITIVITY MAPPING

4.1 Delineation

As noted in Section 1.3, the watercourse delineations were limited to each of the proposed project footprint areas only, although these delineations were augmented with data obtained during previous studies undertaken by SAS. The delineations as presented in this report are thus regarded as a best estimate of the riparian zone boundaries based on the site conditions associated with each of the five proposed projects at the time of assessment.

During the field assessments, the following indicators were used to delineate the boundaries of the watercourses:

- Terrain units were used as the primary indicator, as the terrain of all the sites have well-defined low-lying areas where water is likely to collect and/or move through the landscape;
- Vegetation was utilised as a secondary indicator, although floral species composition in the riparian zones did not necessarily differ significantly from that of the surrounding terrestrial areas, particularly in the highly ephemeral systems identified in Sites C and F. However, increased floral density along the watercourses are usually a key indicator of increased soil moisture and this was therefore used to delineate riparian zones;
- Soil morphological characteristics typically associated with wetland conditions, such as gleying or mottling, are generally not present within the MRA due to the characteristics of the dominant soil types, and by association are generally not present within the proposed project footprint areas. Therefore, the soil indicator was not used extensively.

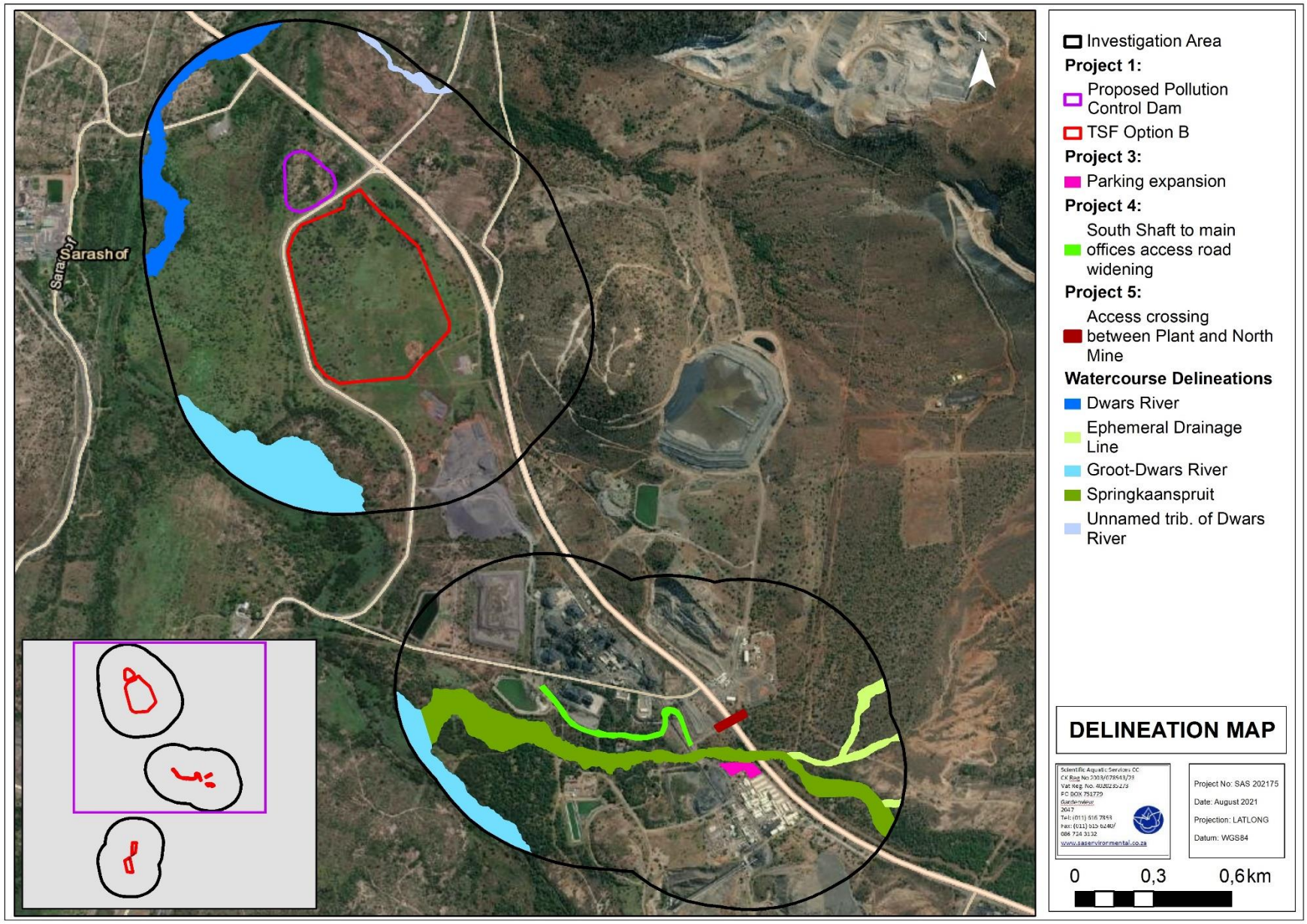


Figure 10: Identified watercourses within the vicinity of Projects 1,3, 4 and 5.

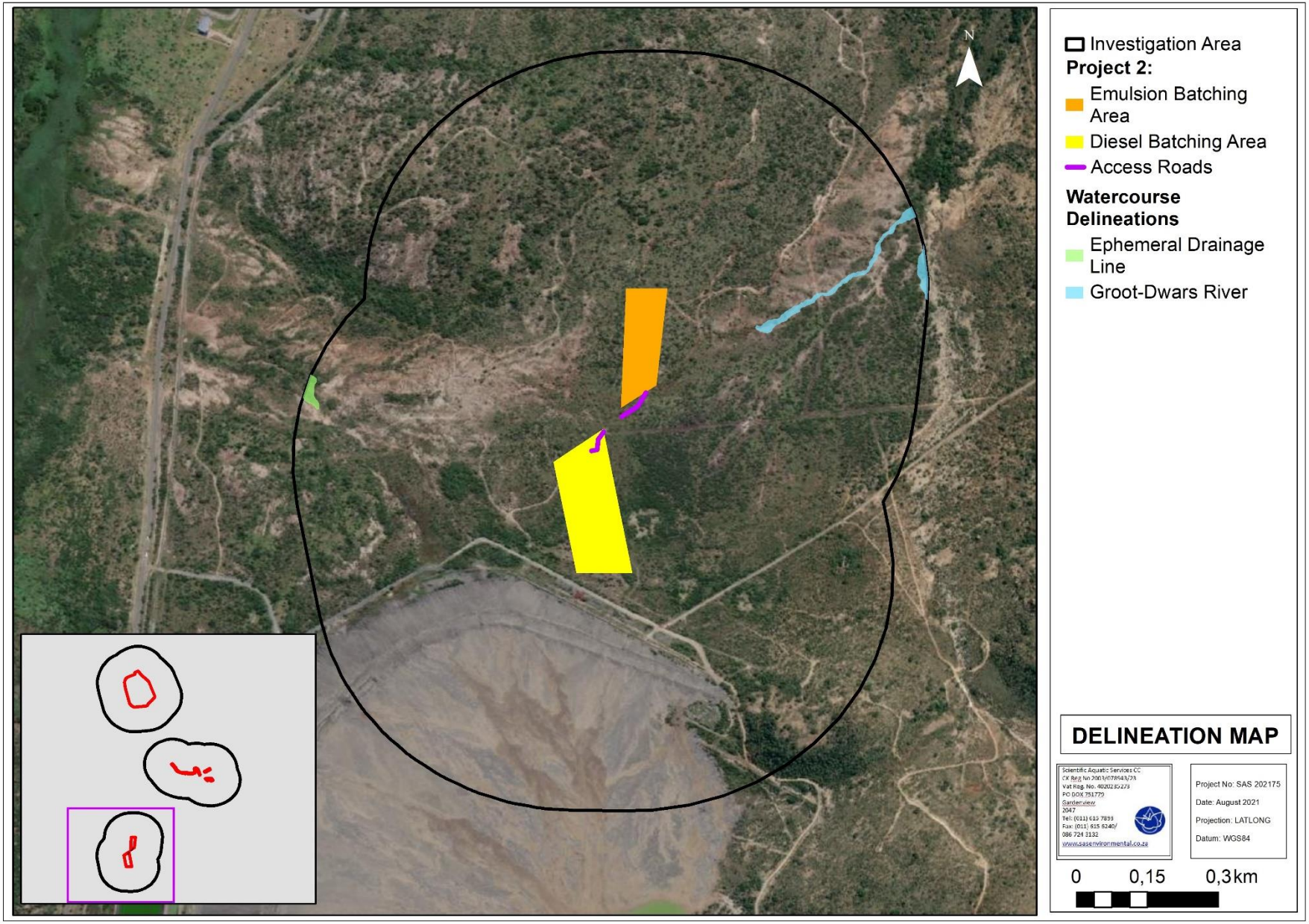


Figure 11: Identified watercourses within the vicinity of Projects 1 and 2.

5 FRESHWATER ECOLOGICAL ASSESSMENT RESULTS

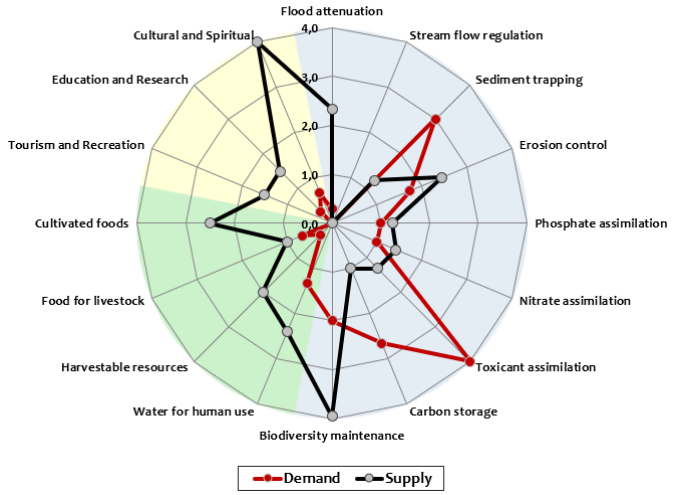
As noted in Section 1.1 and 1.4, SAS has previously undertaken various freshwater ecological assessments for the DCM, and therefore, where relevant, previous studies were used to inform this investigation. Additional site assessments were undertaken specifically for the proposed TSF Alternative B in May 2021.

The proposed diesel and emulsion batching sites in the localities presented in this report were not specifically ground-truthed; however, a site visit was undertaken in March 2020, during which three previously identified potential fuel storage sites were assessed. Those sites were located within 500 m of the proposed diesel and emulsion batching sites presented herein, and therefore, the data obtained for the original proposed footprints was utilised for the purposes of assessing the proposed diesel and emulsion batching sites.

5.1 Project 1: Proposed TSF (Option B)

During the field assessments undertaken in May 2021, TSF alternative B was assessed in terms of location, freshwater and aquatic habitat availability, ecological importance and sensitivity and any potential impacts on freshwater resources within each site which may occur as a result of the proposed activity. Previous studies conducted by SAS (2018) in the area as well as the relevant desktop data was used to provide input into the suitability and constraints of each alternative. Figure 10 above indicates the locality of identified watercourses associated with the proposed TSF. Although the topographic map (Figure 2) indicates an ephemeral drainage line within Option B, no watercourses were identified directly therein. The site is however located 230 m east and upgradient of the Dwars River, which flows south to north, confluencing with the Steelpoort River approximately 14.5 km downstream of Option B. Additionally, Option B is located approximately 385 m south, and downgradient of an ephemeral, unnamed tributary of the Dwars River. As the proposed TSF is located downgradient of the unnamed tributary of the Dwars River, that drainage system was not assessed. SAS (2018) assessed the reach of the Dwars River associated with the DCM MRA (and therefore the proposed TSF) and found that the riparian zone was moderately modified, and instream habitat was largely natural, and that the ecological importance and sensitivity correlated with the ‘very high’ category assigned by the various databases. Please refer to Table 3 below.

Table 3: Summary of the freshwater and aquatic environment (Dwars River) associated with the proposed TSF (Option B)

<table>
<tr>
<td colspan="2">Ecological & socio-cultural service provision graph:
Present State Assessment
 
</td>
<td>  
Photograph notes: Representative photographs of the less disturbed upper reaches of the Dwars River (left) depicting a relatively natural floral composition, and a section of the river approximately 1.2km downstream of Two Rivers Platinum Mine, in the far north of the MRA, depicting floral encroachment (right).</td>
</tr>
<tr>
<td>PES discussion</td>
<td>PES Category: Instream IHI PES Category B, Riparian IHI PES Category C
The portion of the Dwars River within the MRA remains in a largely natural condition, with few modifiers to the system. However, impacts such as weirs and bridge crossings are likely to have had an effect on flow patterns, whilst the riparian zone associated with the reach of the river in the far north of the MRA has been impacted by removal of vegetation, grazing by livestock and encroachment of both indigenous and alien invasive flora.</td>
<td rowspan="2">Watercourse characteristics (hydraulic regime, water quality, geomorphology and sediment balance and habitat and biota).
Instream modifiers in the portion of the Dwars River within the MRA include bridge crossings and a large weir, approximately 900m downstream of the confluence between the Klein and Groot Dwars Rivers. Flow patterns, particularly during low flow periods, are altered as a result, potentially impacting on flow-sensitive biota. The catchment area for this portion of the river has not been extensively developed however, and therefore significantly increased water inputs are not anticipated at this time.

A basic water quality assessment was undertaken at a single point on the Dwars River, downstream of the Two Rivers Platinum Mine. The results of this assessment indicate that the basic water quality parameters are in line with the OREWRA (2001) guidelines, as well as being consistent with results obtained from the Groot Dwars and Klein Dwars assessment points. The results were as follows: temperature = 17°C; pH = 7.3; EC = 49mS/m.

Geomorphological processes have not been significantly altered; at the time of the assessment, very little bank incision or erosion which could alter channel competency could be discerned. However, increased sediment inputs are anticipated, primarily transported from upstream areas, but also as a result of vegetation removal (either for firewood or due to grazing of livestock) in the far north of the MRA, around the river. The proliferation of P. australis within the active channel (depicted in the photograph above right) is indicative of excess sediment (and possibly excess nutrients) entering the system. Nevertheless, this proliferation of reeds is also likely to aid in trapping sediment, preventing it from reaching downstream areas of the river outside of the MRA.

Habitat is varied in terms of ecological integrity thereof. The portion of the Dwars River closest to Two Rivers Platinum Mine remains largely intact in terms of floral community structure and composition, with few invasive species observed. However, downstream of this area, it is apparent that anthropogenic activity increases, as indicated by noticeable vegetation removal, grazing by livestock and increased incidence</td>
</tr>
<tr>
<td>Ecoservice provision</td>
<td>Moderately High to Low (indicator dependent)
Ecological service provision by the Dwars River includes flood attenuation, streamflow regulation, assimilation of excess nutrients and toxicants, and sediment trapping. These functions are considered particularly importance in the context of increased development within the river's catchment, and downstream of the MRA. Such ecological services will provide indirect benefits to downstream users and as such, should be maintained as much as feasible. As with the other systems assessed, potential to provide socio-cultural services is limited by accessibility. However, as noted in the discussion on</td>
</tr>
</table>

<table>
<tr><td></td><td>geomorphology, community utilisation of the northern portion of the system in the MRA is apparent. Additionally, tourism and educational/research potential exists, particularly due to the Dwars River Geological Occurrence Heritage Site (declared as such in 1965).</td><td colspan="2">of alien invasive species. Nevertheless, the Dwars River and its associated riparian zone is considered to provide an important faunal migratory corridor, providing as it does, connectivity to less disturbed and more natural areas to the north and north-west of the MRA. The relatively recent discovery of a previously unidentified fish species (Enteromius sp. nov 'south africa'; common name southern Sidespot barb) within the drainage system of which the Dwars River forms part, highlights the ecological importance of the river.</td></tr>
<tr><td>REC, RMO & BAS Category</td><td>REC Category: B/C
BAS: B/C (Maintain)
RMO: B/C (Maintain)
The Dwars River, being relatively ecologically intact, of high ecological importance and sensitivity, and increased cultural/scientific value, should not be permitted to be further degraded as a result of the proposed mining activities. It is imperative that appropriate mitigation measures are implemented to ensure that edge effects relating to the construction and operation of the proposed TSF do not contribute to reduced ecological integrity of the river.</td><td>EIS discussion</td><td>EIS Category: Very High
The Dwars River system is considered to be of very high ecological importance due to the relatively intact ecology of the system and connectivity to surrounding natural areas, thus increasing the likelihood of the occurrence of threatened floral and faunal species. Additionally, the system provides important hydraulic functions, such as flood attenuation and sediment trapping.</td></tr>
<tr><td>Extent of modification anticipated</td><td colspan="3">None.
No modification of the reach of the Dwars River associated with the proposed TSF and RWD is anticipated as a result of the construction and day to day operation of the infrastructure.
The consequences in the event of a spill could be devastating however, and therefore very strict mitigation measures will be required throughout the life of the proposed TSF and RWD to ensure that failure does not occur.</td></tr>
<tr><td colspan="4">Possible significant impacts, business case, conclusion and mitigation requirements:
The proposed TSF is located between 380 m and 630 m from the Dwars River, and the associated RWD is located approximately 440 m from the river; however both are located upgradient of the river and therefore although no direct impacts are expected, appropriate mitigation measures are necessary to ensure that possible edge effects do not contribute to lowered ecological integrity of the system. A key mitigation measure in this regard is in ensuring that the design and operation of the proposed TSF and RWD do not lead to seepages or failure of either, as a spill, particularly from the TSF, could have devastating consequences on the Ecostatus of the river.

The results of the risk assessment are presented in Section 7 of this report and indicate a 'low' risk significance although this is largely attributed to the distance of the TSF and RWD from the river. Key mitigation measures include, but are not limited to:
➢ The approved construction footprint of the TSF and RWD must be adhered to, to ensure that there is no encroachment on the watercourse;
➢ The design of the TSF and the RWD must ensure that no dirty water runoff must be permitted to reach the watercourse in line with GN704 as it relates to the NWA and appropriate clean and dirty water separation and stormwater management controls must be developed as the first part of the construction activities;
➢ The TSF and RWD must be designed to contain a minimum storm event of a 24 hour 1 in 50 year flood event, and must be appropriately lined with HDPE liners to prevent seepage;
➢ As much as practically possible, limiting clearing and construction activities to the dry season to minimise the risk of sediment-laden runoff entering the river;
➢ The construction of sediment traps around the downgradient boundary of the construction area is strongly recommended to minimise the volume of sediment transported in runoff from the construction site;
➢ The TSF and RWD must be managed throughout the life of both facilities in such a way to ensure that storage and surge capacity is available if a rainfall event occurs; and
➢ An Emergency Response Plan must be compiled which must include the measures stipulated in Section 7.

Furthermore, it is imperative that mitigation measures are implemented to reduce the long-term risk of latent and cumulative impacts as well as contributing to reduced closure liability. Identified cumulative risks include altered sediment balance and changes to the physico-chemical characteristics, in particular salt concentrations, of the Dwars River due to the increased mining activity in the catchment.</td></tr>
</table>

5.2 Project 2: Proposed Diesel and Emulsion Batching Sites

Although the sites proposed for the diesel and emulsion batching sites have not been specifically ground-truthed, field-verified data obtained in March 2020 for three alternative sites located between 30 m and 100 m south and south-west of the two proposed batching sites, along with available historical data for watercourses within 500 m thereof and relevant desktop data was used to provide input into the freshwater ecological character of the batching sites.

It is important to note that no watercourses were identified directly within either the proposed batching areas; however, the headwaters of small ephemeral drainage lines were identified within 500 m thereof (Figure 11). During the March 2020 site assessment, an area of increased moisture was identified was identified approximately 240 m to the west of the proposed diesel batching area. Although graminoid species which are tolerant of increased soil moisture were identified within this area of increased moisture, numerous species which are typically associated with non-wet areas were present. Furthermore, the soil profile was extremely shallow (no more than 10 cm to 15 cm), did not indicate any characteristics associated with a fluctuating water table (such as mottling) and was notably disturbed, containing sediments not found in the immediately adjacent areas (see Figure 12 below). Additionally, surface water which was present appeared to be contaminated, based on a visual assessment. Based on the observations made during the site assessment and the analysis of 5 m contours of the site, historical aerial photographs and digital satellite imagery, it was concluded that this feature has formed as a result of seepage from the existing Two Rivers Platinum TSF and is not a naturally occurring feature.

Figure 12: Soil sample taken within the wet feature (left) and potentially contaminated surface water present in isolated small areas of ponding (right).

Table 4: Summary of the freshwater and aquatic environment associated with the proposed diesel and emulsion batching areas.



Photograph notes: (left and centre) an erosion gully situated approximately 100 m west of the proposed emulsion batching area; and **(right)** the wet feature identified approximately 240 m west of the diesel batching area. The Two Rivers Platinum TSF is visible in the background.

General Discussion and Site Analysis Results	**Possible significant impacts, business case, conclusion and mitigation requirements**
No watercourses were identified within the proposed diesel of emulsion batching sites. An ephemeral drainage line is located approximately 470 m west of the proposed diesel batching site, and another is located approximately 200 m east of the proposed emulsion batching site. Neither watercourse was assessed as the proposed infrastructure is not deemed to pose a significant quantum of risk to either watercourse. Nevertheless, the strict implementation of mitigation measures is strongly recommended to prevent any possible edge effects, particularly to the ephemeral drainage line located to the east of the proposed emulsion batching site.	No direct impacts to the watercourses is anticipated, given the distances of the batching sites from the watercourses. Nevertheless, general 'best practice' mitigation measures are strongly recommended, including but not limited to: ➢ Development of an Emergency Response Plan prior to construction to provide a protocol in the event of a spill. ➢ Retention of as much natural vegetation as possible around the sites to provide stormwater and sediment trapping capacity. ➢ As the soil in the area is susceptible to erosion, it is strongly recommended that regular monitoring for erosion takes place. Should any preferential flow paths or erosion gullies form, these must be immediately managed in accordance with the mine's existing soil management protocols.

Extent of modification anticipated	**None**. Neither proposed batching site encroaches on any watercourses, and therefore no modification to freshwater ecosystems is expected due to the construction and operation of the diesel or emulsion batching sites.

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

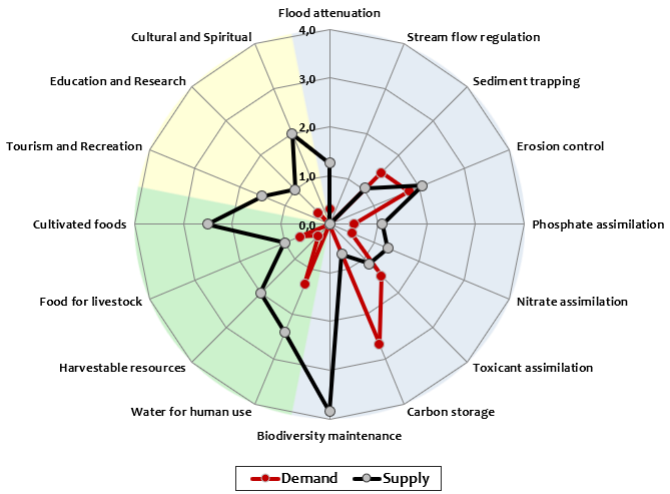
The extension of the parking facility at the Main Offices (Project 3) encroaches marginally on the delineated riparian zone of the Springkaanspruit, a small tributary of the Groot Dwars River, although the active channel of the Springkaanspruit is approximately 20 m from the proposed extension area. The proposed parking extension is also outside the 1:100 year floodline.

The access road between the South Shaft and the Main Offices which will be widened (Project 4) is currently located approximately 50 m from the Springkaanspruit, and the widening of this road will bring it to within 45 m of the Springkaanspruit.

The proposed access crossing between the Plant and North Mine (Project 5) will be approximately 122 m from the Springkaanspruit and may result in a reduction of traffic over the Springkaanspruit, as some vehicles will no longer need to traverse the Springkaanspruit to access the Plant and North Mine.

The Springkaanspruit was not ground-truthed for the purposes of this investigation; however, the results of studies undertaken by SAS (2017; 2018) were utilised. Refer to Table 7 for further details.

Table 5: Summary of the Ecostatus of the Springkaanspruit, associated with the proposed Main Parking extension (Project 3), widening of the access road between South Shaft and the Main Offices (Project 4) and the proposed access crossing between the Plant and North Mine (Project 5).

<table>
<tr><td colspan="2">Ecological & socio-cultural service provision graph:
Present State Assessment
 
</td><td>   </td></tr>
<tr><td rowspan="2">PES discussion</td><td rowspan="2">PES Category: Instream IHI PES Category B/C, Riparian IHI PES Category C
The lower reaches of the Springkaanspruit, which enters the MRA in the north-east, confluencing with the Groot Dwars River in the vicinity of the mine's Return Water Dams (RWDs) have been impacted by road and conveyor crossings, increased sedimentation due to mining activities and altered vegetation communities. However, the upper reaches located outside of the MRA are unlikely to have been significantly impacted since few disturbances occur in that vicinity.</td><td>Photograph notes Representative photographs of the Springkaanspruit in 2018 (left) and 2017 (right).</td></tr>
<tr><td>Watercourse characteristics:
a) Hydraulic regime
Instream infrastructure such as bridge and fence crossings and weirs are present in the lower reaches of the Springkaanspruit, thus impacting on instream connectivity and flow patterns. In addition, due to the increase in impermeable surfaces in the vicinity of the lower reaches of the system, increased water inputs are anticipated.

a) Water quality
According to SAS (2017), water quality within the Springkaanspruit was within the parameters stated in the in the Olifants River Ecological Water Requirements Assessment (OREWRA) (2007) for a stream in this section of the Olifants River catchment at the time of assessment. During the assessment undertaken in 2018, surface water was absent and therefore parameters could not be determined. It is anticipated that due to the proximity of mining activities, water quality is likely to be impaired with specific mention of elevated salt concentrations and potential for contamination by specific pollutants.</td></tr>
</table>

Ecoservice provision	**Moderately High to Very Low (indicator dependent)** The Spingkaanspruit is considered to provide intermediate levels of ecological service provision. It is considered important in terms of benefits such as flood attenuation, streamflow regulation, and assimilation of nutrients and toxicants. Whilst the DRCM MRA, and other mining properties adjacent to the MRA, are largely restricted access areas, when assessing socio-cultural benefits provided by these systems, consideration was given to portions of the river which are accessible to local communities.	**b) Geomorphology and sediment balance** The Spingkaanspruit has been impacted by increased sediment loads entering the system, and this increase is attributed to mining activities. SAS (2017) noted severe sedimentation at the downstream site where the stream exits the DRCM complex, leading to a "complete transformation of the bed substrate". Increased sedimentation of the system furher has the potential to lead to smothering of biota, habitat alterations and bank incision, which is already evidenced by monotypic stands of *Phragmites australis* in the lower reaches of the system. In addition, erosion within the active channel is evident, although it is more severe around infrastructure placed within the active channel, such as support structure for the conveyor traversing the Springkaanspruit.
EIS discussion	**EIS Category: High** The Springkaanspruit, although having undergone a degree of modification, is nevertheless considered important in terms of service provision to downstream systems, as well as from a biodiversity maintenance perspective.	**c) Habitat and biota** The vegetation associated with the Springkaanspruit has undergone a greater degree of modification when compared with, for example, the Groot Dwars River. Monotypic stands of reeds and alien invasive species are apparent along the Springkaanspruit, however it provides suitable breeding and foraging habitat for a variety of fauna, as well as providing essential connectivity with other natural areas, and is therefore considered an important faunal migratory corridor including for fish.
REC, RMO & BAS Category	**REC Category: B/C** **BAS: B/C (Maintain)** **RMO: B/C (Maintain)** The Springkaanspruit too, should be managed and maintained appropriately, i.e. no further impacts should be permitted, and efforts should be made to rehabilitate those areas which have been affected by current mining operations.	**Possible significant impacts, business case, conclusion and mitigation requirements:** The perceived risks associated with the widening of the existing access road between South Shaft and the Main Offices/Plant, and the construction of the access crossing between the Plant and North Mine are not anticipated to have a direct impact on the Spingkaanspruit, due to the distance of the proposed activities from the river. The expansion of the existing parking facility at the Main Offices will encroach marginally on the delineated riparian zone but will remain outside of the floodline. As the parking facility is pre-existing the expansion thereof is expected to pose a 'low' risk to the ecological integrity of the system. Nevertheless, strict implementation of mitigation measures will be required during construction in particular, including but not limited to: ➢ As much as practically feasible, limit site preparation and construction activities to the dry season to minimise the volume of contaminated runoff potentially entering the watercourse; ➢ Sediment traps must be erected around the construction site prior to commencement of construction activities to minimise the risk of sediment entering the downgradient watercourses; ➢ Limit the footprint of vegetation clearing to what is absolutely essential and focus on retention of indigenous vegetation, rather clearing alien vegetation where possible; ➢ Rehabilitation and revegetation of disturbed areas (as a result of construction) must take place immediately after construction, including replanting of indigenous tree species such as *Combretum erythrophyllum* and *Vachellia karoo*), in line with the existing Biodiversity Action Plan (SAS, 2018); and ➢ Appropriate control methods for alien vegetation in line with existing and approved alien vegetation control within the mine must be implemented.

6 LEGISLATIVE REQUIREMENTS, NATIONAL AND PROVINCIAL GUIDELINES PERTAINING TO THE APPLICATION OF BUFFER ZONES

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

The definition and motivation for a regulated zone of activity for the protection of the freshwater resources can be summarised as follows:

Table 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 36 of 1998).	**General Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act 36 of 1998)** In accordance with GN509 of 2016 as it relates to the National Water Act, 1998 (Act 36 of 1998), a regulated area of a watercourse in terms of water uses as listed in Section 21(c) and 21(i) is defined as: • the outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; • in the absence of a determined 1 in 100 year flood line or riparian area the area within **100 m from the edge of a watercourse** where the edge of the watercourse is the first identifiable annual bank fill flood bench; or • a 500m radius from the delineated boundary (extent) of any wetland or pan.
	Government Notice 704 Regulations as published in the Government Gazette 20119 of 1999 as it relates to the National Water Act, 1998 (Act 36 of 1998) regarding the use of water for mining and related activities aimed at the protection of water resources. These Regulations were put in place in order to prevent the pollution of water resources and protect water resources in areas where mining activity is taking place from impacts generally associated with mining. It is recommended that the proposed project complies with GN704 of the

Regulatory authorisation required	Zone of applicability
	National Water Act, 1998 (Act no. 36 of 1998) which contains regulations on use of water for mining and related activities aimed at the protection of water resources. GN704 states that: *No person in control of a mine or activity may:* *(a) locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year floodline or within a horizontal distance of 100 metres from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on waterlogged ground, or on ground likely to become waterlogged, undermined, unstable or cracked;* According to the above, the activity footprint must fall outside of the 1:100 year floodline of the aquatic resource or 100m from the edge of the resource, whichever distance is the greatest.
Listed activities in terms of the National Environmental Management Act, 1998 (Act 107 of 1998) EIA Regulations (2014), as amended must be taken into consideration if any activities (for example, access roads) are to take place within the applicable zone of regulation. This must be determined by the EAP in consultation with the relevant authorities.	**Activity 12** of Listing Notice 1 (GN 327) of the National Environmental Management Act, 1998 (Act 107 of 1998) EIA regulations, 2014 (as amended) states that: *The development of:* *(xii) Infrastructure or structures with a physical footprint of 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.*

Taking the above into consideration, a 100 m zone of regulation in line with GN704 of the NWA is applicable to the watercourses identified within the proposed TSF, as well as a 32 m zone of regulation in line with National Environmental Management Act, 1998 (Act No. 107 of 1998) for non-mining specific infrastructure (e.g. roads or pipelines). Additionally, in terms of GN509 of the National Water Act, 1998 (Act 36 of 1998), a 100 m zone of regulation is applicable to any riparian area, in the absence of a determined 1:100 year floodline. These zones of regulation must be taken into consideration during the site selection and planning process, in line with the mitigation hierarchy as advocated by the Department of Environmental Affairs (DEA) *et. al*, 2013, and should they be encroached upon then the relevant authorisations will need to be obtained prior to the commencement of any construction activities.

The respective zones of regulation in terms of Regulations GN509 and GN704 of the National Water Act, 1998 (Act No. 36 of 1998), and the National Environmental Management Act, 1998 (Act No. 107 of 1998), are depicted in the figures below.

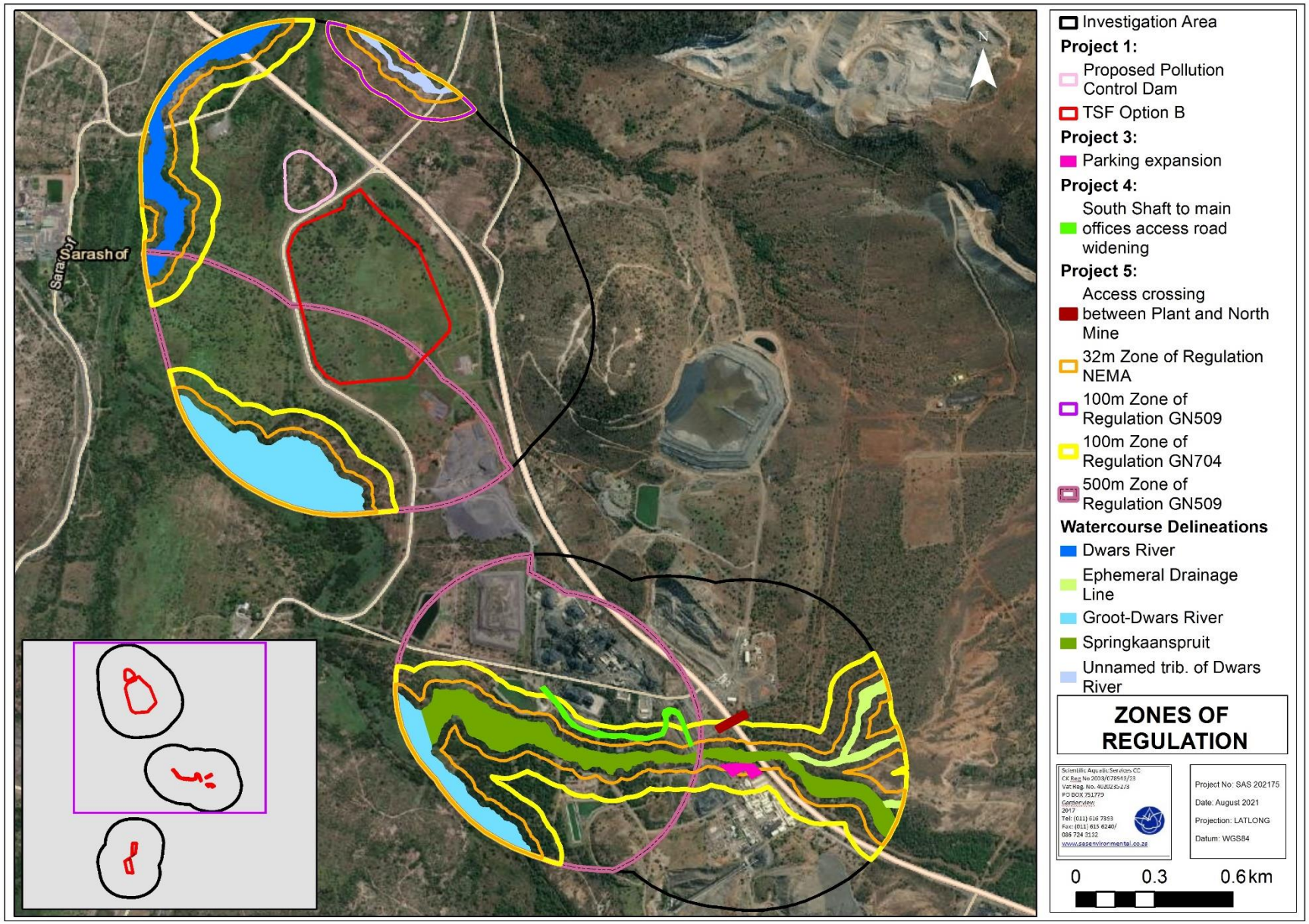


Figure 13: The relevant zones of regulation applicable to the watercourses associated with the various projects, in line with Regulations GN704 and GN509, and NEMA.

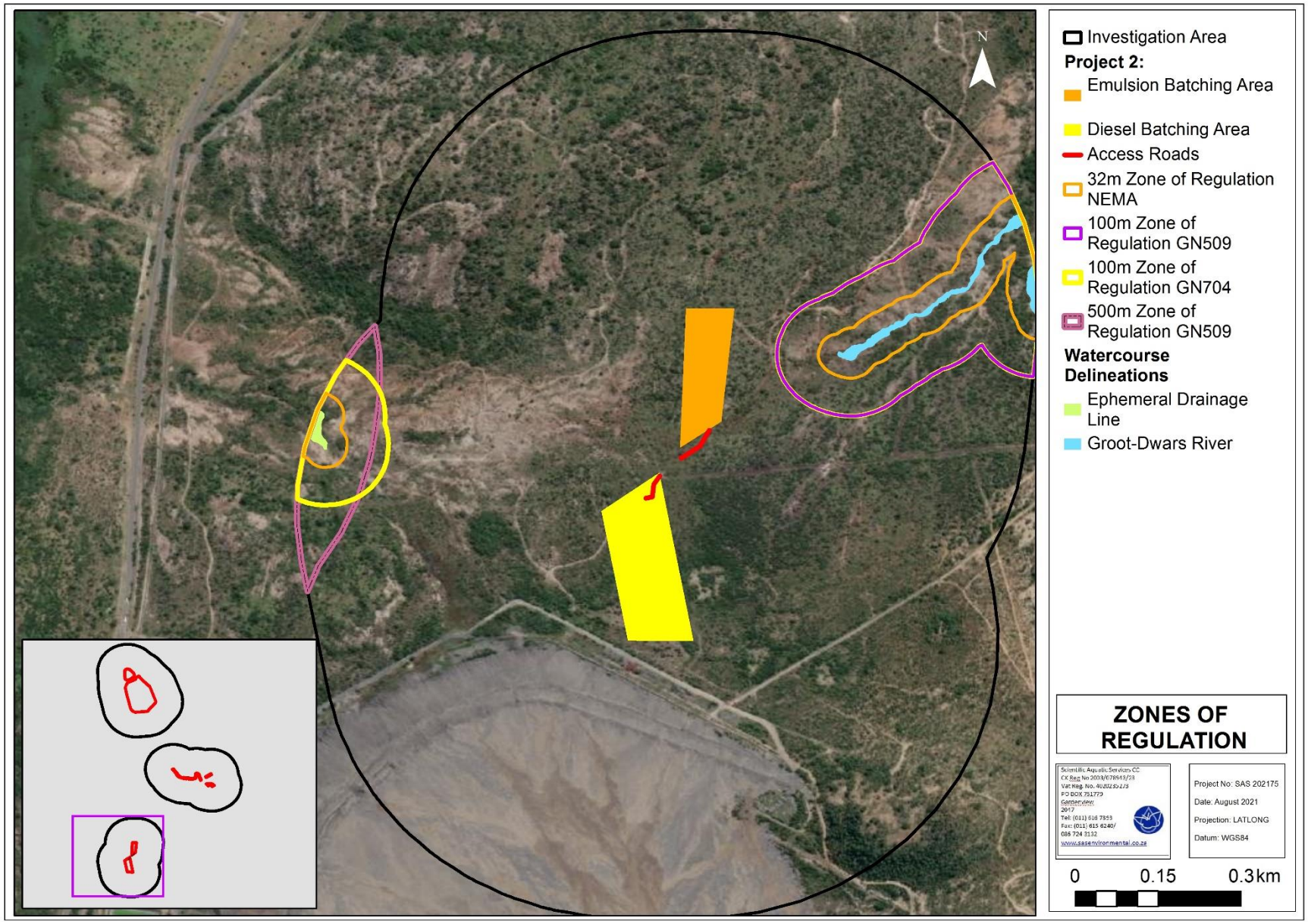


Figure 14: The relevant zones of regulation applicable to the watercourses associated with the fuel storage area alternatives, in line with Regulations GN704 and GN509, and NEMA.

7 RISK ASSESSMENT

This section presents the significance of potential impacts on the various watercourses associated with the proposed mining expansion activities. When evaluating the perceived impacts of the proposed activities on these features, the impact significance was ascertained based on the assumption that the recommended mitigation measures will be implemented, in order to reduce the impact significance. Thus, the risk assessment provided in this report presents the perceived impact significance *post-mitigation*.

7.1 Risk Analysis

7.1.1 Consideration of impacts and application of mitigation measures

The following aspects were taken into consideration when evaluating the potential impacts of the proposed development activities:

- The Risk Assessment was undertaken based on the proposed mining expansion footprint provided to the specialist in August 2021;
- The potential loss of catchment yield associated with the development of a clean and dirty water management system around the proposed TSF and RWD was considered in the risk assessment, however at the time of assessment, the volume of potential loss of catchment yield was not available. Thus the precautionary principle was employed when assessing the perceived risk significance of this. Should the required information be made available, the risk assessment will need to be revised accordingly;
- 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. the impacts would first be avoided (with the exception of a small area of encroachment into the riparian zone of the Springkaanspruit for the expansion of the parking area at the main offices, this has been achieved), minimised if avoidance is not feasible, rehabilitated as necessary and offset if required; and
- Most impacts are considered to be easily detectable; however, impacts such as surface water contamination would entail specific monitoring (when practical) to ascertain the occurrence of impacts.

7.1.2 Impact discussion and essential mitigation measures

There are four key ecological impacts on the watercourses that are anticipated to occur namely:

- Loss of habitat and ecological structure;
- Changes to the sociocultural and service provision;
- Impacts on the hydrology and sediment balance of the cryptic wetlands; and
- Impacts on water quality.

Various activities and development aspects may lead to these impacts, however, provided that the mitigation hierarchy is followed, indirect impacts to adjacent watercourses can be avoided and/or minimised if avoidance is not feasible. The mitigation measures provided in this report have been developed with the mitigation hierarchy in mind, and the implementation and strict adherence to these measures will assist in minimising the significance of impacts on the receiving environment.

A summary of the risk assessment is provided in the table below, followed by a discussion of the outcome thereof.

Table 7: Summary of the results of the risk assessment applied to the watercourses associated with the proposed mining expansion activities

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Reversibility
Perceived Impacts: Construction of new Tailings Storage Facility (TSF) and Return Water Dam (RWD)												
1	**Construction**	Site preparation prior to construction activities of surface infrastructure, including placement of contractor laydown areas and storage facilities.	•Vehicular movement and access to the site; and •Removal of vegetation (terrestrial) and associated disturbances of soil.	•Exposure of soil, leading to increased runoff, erosion and stream incision, and thus potentially increased sedimentation of the Dwars River; •Increased sedimentation of the watercourse may lead to smothering of flora and benthic biota and potentially further alter surface water quality; •Decreased ecoservice provision; and *Further proliferation of alien vegetation or increased bush encroachment as a result of disturbances.	**1**	**4**	**8**	**32**	**L**	**70**	The approved construction footprint of the TSF and RWD must be adhered to, to ensure that there is no encroachment on the watercourse; •As far as practically possible, clearing and construction activities must take place during the dry season to limit potential impacts to the watercourse as a result of clearing and construction activities; •The construction of sediment traps around the downgradient boundary of the construction area is strongly recommended to minimise the volume of sediment transported in runoff from the construction site. •Contractor laydown areas, vehicle re-fuelling areas and material storage facilities to remain outside of the delineated watercourse and applicable setback area. •Construction footprint areas to remain as small as possible and vegetation clearing to be limited to what is absolutely essential; •Vegetation removal to be kept to a minimum, and preferably only alien floral species to be removed; and •Retain as much indigenous vegetation as possible.	Partially reversible

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Reversibility
2		Construction of the proposed TSF and RWD	•Removal of vegetation and topsoil; •Ground-breaking and earthworks relating to foundations and trenches; •Mixing and casting of concrete for construction purposes; and •Miscellaneous activities by construction personnel.	•Loss of catchment yield resulting from stormwater containment; •Increased flood peaks as a result of formalisation and concentration of surface runoff in clean water diversion structures; •Potential for erosion, leading to sedimentation of the watercourse; •Reduction in volume of water entering the watercourse, leading to loss of recharge of the watercourse; •Altered vegetation community structure and diversity due to moisture stress and changes to goods and service provision; •Disturbances of soil leading to increased alien vegetation proliferation or bush encroachment, and in turn to further alteration of surrounding watercourse and terrestrial habitat, with potential to affect the downgradient watercourse habitat; •Altered runoff patterns, leading to increased erosion and sedimentation of the downgradient watercourse; •Erosion of the exposed areas; •Potential impacts on the water quality of runoff which may potentially enter the downgradient watercourse and contamination of soils due to concrete being cast; and •Potential of backfill material to enter the downgradient watercourse, increasing the sediment load of the watercourse.	1,75	4,75	11	52,25	L		•The design of the TSF and the RWD must ensure that no dirty water runoff must be permitted to reach the watercourse in line with GN704 as it relates to the NWA and appropriate clean and dirty water separation and stormwater management controls must be developed as the first part of the construction activities; •The TSF and RWD must be designed to contain a minimum storm event of a 24 hour 1 in 50 year flood event; •The TSF and RWD must be appropriately lined with HDPE liners to prevent seepage; •Clean runoff captured in the clean and dirty water separation system should be returned back into the adjacent watercourse. Dirty water must be managed within the mine's existing water management system; and •The watercourse must be protected against erosion arising from the discharge of diverted clean stormwater. In this regard, energy dissipating structures should be installed to prevent erosion. Water should also be distributed in a diffuse manner to prevent canalisation. With regards to concrete mixing on site: •No mixed concrete may be deposited outside of the designated construction footprint; •Protective equipment should be provided, onto which any mixed concrete can be deposited whilst it awaits placing; and •Concrete spilled outside of the demarcated area must be promptly removed and taken to a suitably licensed waste disposal site.	
3		Development of additional clean and dirty water separation systems, including the proposed diversion trench			2,5	5,5	10	55	L	70		

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Reversibility
Perceived Impacts: Diesel and Emulsion Batching Areas												
4	Construction	Site clearing prior to commencement of construction activities, including placement of contractor laydown areas.	•Vehicular movement and access to the site; •Removal of vegetation (terrestrial) for the access road, security offices, parking area, and tanks and associated disturbances (creation of rubble and litter) to soil upgradient of but further than 200 m from watercourse; •Increased risk of transportation of sediment from exposed soils and hydrocarbons from construction vehicles in storm water runoff into downgradient watercourses.	•Damage to and loss of vegetation, leading to exposed/compacted soil, in turn leading to potential for increased runoff from exposed areas, erosion of the downgradient watercourses and potential for increased sedimentation of the watercourses; •Increased sedimentation of the watercourses may lead to 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 from construction machinery and increased sediment availability; •Decreased ecoservice provision and biodiversity maintenance capacity; and •Proliferation of alien vegetation as a result of disturbances.	1	4	8	32	L		•As far as practically possible, clearing and construction activities must be restricted to the dry season to minimise the risk of sediment-laden runoff entering the downgradient watercourses and reduce the risk of erosion and formation of preferential flow paths; •Sediment traps must be constructed around the construction sites line to minimise the risk of sediment entering the downgradient watercourses; •Limit the footprint of vegetation clearing to what is absolutely essential; •Retain as much indigenous vegetation as possible; •Rehabilitation and revegetation of disturbed areas (as a result of construction) must take place immediately after construction; and •Appropriate control methods for alien vegetation in line with existing and approved alien vegetation control within the mine must be implemented.	Partially reversible
5	Construction	Removal of topsoil from project footprint, and stockpiling thereof for rehabilitation.			1	4	8	32	L			
6	Construction	Construction of 80 m access road to the diesel batching area from the existing access road, parking area and security offices.			1	4	8	32	L			
7	Construction	Construction of diesel and emulsion tanks.			1	4	8	32	L			
Perceived impacts: Expansion of Parking at Main Offices												
8	Construction	Site clearing prior to commencement of construction activities, including vegetation clearing (approximately 280 m of riparian vegetation), removal of topsoil and stockpiling for use in rehabilitation, levelling of ground and placement of contractor laydown areas.	•Vehicular movement and access to the site; and •Removal of vegetation and associated disturbances to surrounding soil within the catchment of the Sprinkaanspruit. •Increased risk of transportation of sediment from exposed soils in storm water runoff.	•Damage to marginal and non-marginal vegetation, leading to exposed/compacted soil, in turn leading to potential for increased runoff from exposed areas, erosion of the watercourse and potential for increased sedimentation of the watercourse; •Increased sedimentation of the watercourse may lead to 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;	1	4	8	32	L	70	•As much as practically feasible, limit site preparation and construction activities to the dry season to minimise the volume of contaminated runoff potentially entering the watercourse; •Sediment traps must be erected around the construction site prior to commencement of construction activities to minimise the risk of sediment entering the downgradient watercourses; •Limit the footprint of vegetation clearing to what is absolutely essential; •Retain as much indigenous vegetation as possible;	Partially reversible

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Reversibility
		Laying of tar and construction of steel roof parking bays.	•Increased risk of contamination of storm water runoff entering the stream. •Loss of surface roughness due to vegetation clearing, altering the pattern and timing of flow in the landscape if runoff does not report to the dirty water system.	•Potential impacts on water quality due to leaks and spills from construction machinery; •Decreased ecoservice provision and biodiversity maintenance capacity; and •Proliferation of alien vegetation as a result of disturbances.	1	4	8	32	L	70	•Rehabilitation and revegetation of disturbed areas (as a result of construction) must take place immediately after construction; and •Appropriate control methods for alien vegetation in line with existing and approved alien vegetation control within the mine must be implemented.	
9		Potential indiscriminate disposal of hazardous and non-hazardous materials wastes within watercourse.	•Altered water quality; and •Possible changes to flow patterns as a result of blockages caused by solid waste/rubble.		1	4	8	32	L	70	•No waste material is permitted to be disposed of within the watercourse; and •The watercourse must be demarcated with an appropriate barrier to prevent unauthorised access to the watercourse.	
Perceived Impacts: Widening of Existing Access Road between South Shaft/Main Offices and Plant												
11	**Construction**	Site preparation prior to widening of roadway, including placement of contractor laydown areas and storage facilities.	•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 and instream habitat, leading to smothering of flora and benthic biota, alterations to the characteristics of the stream bed and potentially further altering surface water quality; •Decreased ecoservice provision; and •Further proliferation of alien vegetation or *Phragmites australis* as a result of disturbances.	1	4	8	32	L	80	No direct impacts to the watercourse are anticipated due to the distance of the proposed activity from the watercourse (approximately 25 m at the closest point). General 'best practice' mitigation measures are recommended including but not limited to: •Dust suppression during construction; •Placement of sediment control devices along the northern delineated boundary of the Springkaanspruit to minimise transportation of sediment into the watercourse via stormwater; and •Undertake the upgrade activities during the dry season if feasible to minimise the chance of runoff entering the watercourse.	Partially reversible

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Reversibility
Perceived Impacts: Access Crossing between Plant and North Mine												
12		Site preparation prior to widening of roadway, including placement of contractor laydown areas and storage facilities.	•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 and instream habitat, leading to smothering of flora and benthic biota, alterations to the characteristics of the stream bed and potentially further altering surface water quality; •Decreased ecoservice provision; and •Further proliferation of alien vegetation or *Phragmites australis* as a result of disturbances.	**1**	**4**	**8**	**32**	**L**	80	No direct impacts to the watercourse are anticipated due to the distance of the proposed activity from the watercourse (approximately 64 m). General 'best practice' mitigation measures are recommended as per Activity 11.	Fully reversible
OPERATIONAL PHASE IMPACTS												
Perceived Impacts: Operation of Tailings Storage Facility (TSF) and Return Water Dam (RWD)												
13	**Operational**	Operation and maintenance of the clean and dirty water separation system around the TSF and RWD.	•Containment/diversion of all runoff into the clean and dirty water system; •Discharge of clean water into the surrounding watercourse systems; and •Potential of malfunctioning of the dirty water system.	•Increased flood peaks into the watercourse 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 watercourse; •Reduction in volume of water entering the watercourse, leading to loss of recharge (and thus potential desiccation) of the watercourse systems; •Erosion and sedimentation of the watercourse at the outlet of the clean water trench; and •Altered vegetation communities due to moisture stress.	**1,75**	**5,75**	**12**	**69**	**M**	70	*The clean water outlet structures should be constructed from energy dissipating structures (such as Armorflex or reno mattresses) to slow down the velocity of water inflow into the watercourse; and *After construction of the outlet, the area surrounding the outlet should be re-seeded with indigenous watercourse vegetation.	Partially reversible

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Reversibility
14		Potential Risk of failure of TSF or RWD leading to spill of tailings in the vicinity of watercourses leading to deposition in the aquatic environment.	•Sedimentation and increased turbidity of downgradient watercourse.	•Loss of aquatic habitat and refugia; •Silt deposition may lead to smothering of benthic layer.	**1,75**	**3,75**	**6**	**22,5**	L	70	•The TSF and RWD must be managed throughout the life of both facilities in such a way to ensure that storage and surge capacity is available if a rainfall event occurs; An Emergency Response Plan must be compiled, and must include the measures below: •In the case of failure, as much sediment as possible, contaminated by the spill, must be removed from the point of its source, following the spill path to the affected watercourse. Sediment must be removed until the natural in situ substrate is reached or until a clear change in the sediment colour is reached indicating that the natural soil level has been reached; •All silt removed should be returned to the TSF or disposed of at a suitably managed site; •Following the removal of the contaminated sediment, it must be ensured the slope of the excavated areas is in line with the natural topography – i.e. a low gradient no more than 1:3; •Edge effects must be strictly controlled – for example no removal of sediment must take place beyond the spill pathway; •Possible seepage and contamination of the groundwater resources is possible and should be monitored at suitable groundwater monitoring points, as guided by the geohydrological study; •Toxicological monitoring of the receiving environment and of the RWD must occur immediately following the first rain event after rehabilitation and again at the end of the wet season. The aquatic ecologist should make a	
15			•Reduced water quality with specific mention of increased dissolved salt concentrations and potentially introducing toxins into the system.	•Loss of aquatic biodiversity and loss of aquatic taxa; •Negative impact on aquatic biota community diversity and integrity due to deterioration of water quality.	**1,75**	**3,75**	**6**	**22,5**	L	70		
16			•Temporary and momentary increased velocity and flow of downgradient watercourse.	•Potential loss of biodiversity, aquatic taxa, riparian habitat.	**2**	**4**	**6**	**24**	L	70		

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Reversibility
											recommendation concerning the necessity of future monitoring following the assessment.	
Perceived Impacts: Diesel and Emulsion Batching Areas												
17	**Operational**	Operation of the diesel and emulsion batching areas.	•Increased vehicular activity and impermeable surfaces in the catchment of the ephemeral drainage lines.	•Potential contamination of stormwater runoff from hard surfaces by hydrocarbons from vehicles, leading to potential contamination of surface water, groundwater and soil; •Increased volume of stormwater runoff entering the ephemeral drainage lines as a result of increased catchment hardening.	**1**	**4**	**7**	**28**	L	70	As the fuel batching sites are situated more than 200 m from watercourses, the risk posed is considered minimal. Nevertheless general 'best practice' mitigation measures are recommended including: •Development of an Emergency Response Plan prior to construction to provide a protocol in the event of a spill. •Retention of as much natural vegetation as possible around the sites to provide stormwater and sediment trapping capacity. •As the soil in the area is susceptible to erosion, it is strongly recommended that regular monitoring for erosion takes place. Should any preferential flow paths or erosion gullies form, these must be immediately managed in accordance with the mine's existing soil management protocols.	Partially reversible
Perceived impacts: Expansion of Parking at Main Offices												
18	**Operational**	Operation of the parking area at the Main Offices	•Increased vehicular activity and impermeable surfaces in the catchment of the Springkaanspruit.	•Potential contamination of stormwater runoff from hard surfaces by hydrocarbons from vehicles, leading to potential contamination of surface water, groundwater and soil; •Increased volume of stormwater runoff entering the episodic drainage line as a result of increased catchment hardening.	**1**	**4**	**9**	**36**	L	70	As this is an expansion of an existing parking facility, additional risk posed is considered insignificant. General 'best practice' mitigation measures are recommended.	Partially reversible

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Reversibility
Perceived Impacts: Widening of Existing Access Road between South Shaft/Main Offices and Plant												
19	**Operational**	Operation of the existing access road	•Increased vehicular activity and impermeable surfaces in the catchment of the Springkaanspruit.	•Potential contamination of stormwater runoff from hard surfaces by hydrocarbons from vehicles, leading to potential contamination of surface water, groundwater and soil; •Increased volume of stormwater runoff entering the episodic drainage line as a result of increased catchment hardening.	1	4	9	**36**	**L**		As per Activity 18.	Partially reversible
Perceived Impacts: Access Crossing between Plant and North Mine												
20	**Operational**	Operation of the existing access road	•Increased vehicular activity and impermeable surfaces in the catchment of the Springkaanspruit.	•Potential contamination of stormwater runoff from hard surfaces by hydrocarbons from vehicles, leading to potential contamination of surface water, groundwater and soil; •Increased volume of stormwater runoff entering the episodic drainage line as a result of increased catchment hardening.	1	4	9	**36**	**L**	70	As per Activity 18.	Partially reversible

8 CONCLUSION

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater ecological assessment as part of the Environmental Impact Assessment (EIA) and authorisation process for five proposed projects for the Dwarsrivier Chrome Mine (DCM) within the mine's existing Mining Rights Area (MRA). The assessment was undertaken using a combination of historical data and studies undertaken by SAS on the watercourses in question, with limited field verification of the proposed development sites.

No watercourses were identified directly within any of the proposed footprint areas of the various projects, with the exception of the expansion of the Main Office parking area (Project 3). The expansion encroaches marginally on a small portion of riparian vegetation associated with the Springkaanspruit, however it remains outside the 1:100 year floodline. However, as the Dwars River, which is situated between 300 m and 600 m downgradient of the proposed RWD and TSF is regarded as an important river system (designated as a Fish Support Area by the NFEPA project (2011)) in the catchment, it was included in the assessment. The ecological assessment of the Dwars River (associated with Project 1) and Springkaanspruit (Project 3) are summarised in the table below.

Table 8: Summary of the results of the ecological assessment of the watercourses associated with Projects 1 and 3.

Watercourse	Present Ecological State (PES)	Ecological Importance and Sensitivity (EIS)	Ecoservices
Dwars River	B/C	Very High	Moderately High to Low (indicator dependent)
Springkaanspruit	C/D	High	Moderately High to Very Low (indicator dependent)

Following the ecological assessment, the DWS Risk Assessment Matrix (2016) was applied to ascertain the risk significance of the various proposed activities on the receiving freshwater environment. The outcome of the risk assessment indicates that the majority of the proposed activities pose a 'low' risk to the associated watercourses, with the exception of the presence of a clean and dirty water separation system around the proposed TSF and RWD, which has the potential to result in a reduction in catchment yield. However, the precautionary principle was employed in the absence of detailed information when assessing the potential risk of this aspect, and the risk assessment would need to be refined to account for detailed information should it become available.

Based on the outcome of the ecological assessment and risk assessment, provided that strict implementation of cogent, site-specific and general 'good practice' mitigation measures takes place throughout the life of all proposed projects, it is the specialist's opinion that the five projects may be considered for authorisation with the knowledge that the significance of risk to the receiving environment is limited.

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APPENDIX A – Terms of Use and Indemnity

INDEMNITY AND TERMS OF USE OF THIS REPORT

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

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APPENDIX B – Legislation

LEGISLATIVE REQUIREMENTS

National Environmental Management Act (1998) (Act No. 107 of 1998) (NEMA)	The National Environmental Management Act 1998 (Act 107 of 1998) (NEMA) and the associated Regulations as amended in 2017, states that prior to any development taking place within a wetland or riparian area, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment Report (BAR) process or the Environmental Impact Assessment (EIA) process depending on the scale of the impact. Provincial regulations must also be considered.
National Environmental Management: Biodiversity Act (2004) (Act 10 of 2004) (NEMBA)	**Ecosystems that are threatened or in need of protection** (1) (a) The Minister may, by notice in the Gazette, publish a national list of ecosystems that are threatened and in need of protection. *(b)* An MEC for environmental affairs in a province may, by notice in *the Gazette,* publish a provincial list of ecosystems in the province that are threatened and in need of protection. (2) The following categories of ecosystems may be listed in terms of subsection (1): *(a)* critically endangered ecosystems, being ecosystems that have undergone severe degradation of ecological structure, function or composition as a result of human intervention and are subject to an extremely high risk of irreversible transformation; *(b)* endangered ecosystems, being ecosystems that have undergone degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems; (c) vulnerable ecosystems, being ecosystems that have a high risk of undergoing significant degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems or endangered ecosystems; and *(d)* protected ecosystems, being ecosystems that are of high conservation value or of high national or provincial importance, although they are not listed in terms of paragraphs *(a), (b)* or (c).
National Water Act (1998) (Act No. 36 of 1998) (NWA)	The National Water Act, 1998 (Act No. 36 of 1998) (NWA) recognises that the entire ecosystem and not just the water itself in any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the Department of Water and Sanitation (DWS). Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DWS in terms of Section 21 (c) & (i).
General Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act 36 of 1998)	In accordance with GN509 of 2016, a regulated area of a watercourse for section 21(c) and 21(i) of the National Water Act, 1998 (Act No. 36 of 1998) is defined as: a) The outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; b) In the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or c) A 500 m radius from the delineated boundary (extent) of any wetland or pan. This notice **replaces GN1199** and may be exercised as follows: i) Exercise the water use activities in terms of Section 21(c) and (i) of the Act as set out in the table below, subject to the conditions of this authorisation; ii) Use water in terms of section 21(c) or (i) of the Act if it has a low risk class as determines through the Risk Matrix; iii) Do maintenance with their existing lawful water use in terms of section 21(c) or (i) of the Act that has a LOW risk class as determined through the Risk Matrix; iv) Conduct river and stormwater management activities as contained in a river management plan; v) Conduct rehabilitation of wetlands or rivers where such rehabilitation activities has a LOW risk class as determined through the Risk Matrix; and vi) Conduct emergency work arising from an emergency situation or incident associated with the persons' existing lawful water use, provided that all work is executed and reported in the manner prescribed in the Emergency protocol. A General Authorisation (GA) issued as per this notice will require the proponent to adhere with specific conditions, rehabilitation criteria and monitoring and reporting programme. Furthermore, the water user must ensure that there is a sufficient budget to complete, rehabilitate and maintain the water use as set out in this GA.

	Upon completion of the registration, the responsible authority will provide a certificate of registration to the water user within 30 working days of the submission. On written receipt of a registration certificate from the Department, the person will be regarded as a registered water user and can commence within the water use as contemplated in the GA.
Government Notice 704 Regulations as published in the Government Gazette 20119 of 1999 as it relates to the National Water Act, 1998 (Act No. 36 of 1998)	These regulations, forming part of the National Water Act, 1998 (Act No. 36 of 1998), were put in place in order to prevent the pollution of water resources and protect water resources in areas where mining activity is taking place from impacts generally associated with mining. It is recommended that the project complies with Regulation GN 704 of the National Water Act (1998) (Act 36 of 1998) which contains regulations on use of water for mining and related activities aimed at the protection of water resources. GN 704 states that: *No person in control of a mine or activity may:* *(b) locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year floodline or within a horizontal distance of 100 metres (m) from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on waterlogged ground, or on ground likely to become waterlogged, undermined, unstable or cracked;* According to the above, the activity footprint must fall outside of the 1:100 year floodline of the drainage feature or 100m from the edge of the feature, whichever distance is the greatest, unless authorised by DWS.
Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA)	The obtaining of a New Order Mining Right (NOMR) is governed by the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA). The MPRDA requires the applicant to apply to the Department of Mineral Resources (DMR) for a NOMR which triggers a process of compliance with the various applicable sections of the MPRDA. The NOMR process requires environmental authorisation in terms of the MPRDA Regulations and specifically requires the preparation of a Scoping Report, an Environmental Impact Assessment (EIA) and Environmental Management Programme (EMP), and a Public Participation Process (PPP).
Limpopo Environmental Management Act, 2003 (Act No. 7 of 2003) (LEMA)	The objectives of this Act are: ➢ to manage and protect the environment in the Province; ➢ to secure ecologically sustainable development and responsible use of natural resources in the Province; ➢ generally, to contribute to the progressive realisation of the fundamental rights contained in section 24 of the Constitution of the Republic of South Africa Act, 1996 (Act No. 108 of 1996), and ➢ to give effect to international agreements effecting environmental management which are binding on the Province. This Act must be interpreted and applied in accordance with the national environmental management principles set out in Section 2 of the National Environmental Management Act, 1998 (Act No. 107 of 1998).

APPENDIX C - Method of assessment

1. Desktop Study

Prior to the commencement of the field assessment, a background study, including a literature review, was conducted in order to determine the ecoregion and ecostatus of the larger aquatic system within which the freshwater features present or in close proximity to the study area are located. Aspects considered as part of the literature review are discussed in the sections that follow.

1.1 National Freshwater Ecosystem Priority Areas (NFEPA, 2011)

The NFEPA project is a multi-partner project between the Council of Scientific and Industrial Research (CSIR), Water Research Commission (WRC), South African National Biodiversity Institute (SANBI), Department of Water Affairs (DWA), South African Institute of Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks). The project responds to the reported degradation of freshwater ecosystem condition and associated biodiversity, both globally and in South Africa. It uses systematic conservation planning to provide strategic spatial priorities of conserving South Africa's freshwater biodiversity, within the context of equitable social and economic development.

The NFEPA project aims to identify a national network of freshwater conservation areas and to explore institutional mechanisms for their implementation. Freshwater ecosystems provide a valuable natural resource with economic, aesthetic, spiritual, cultural and recreational value. However, the integrity of freshwater ecosystems in South Africa is declining at an alarming rate, largely as a consequence of a variety of challenges that are practical (managing vast areas of land to maintain connectivity between freshwater ecosystems), socio-economic (competition between stakeholders for utilisation) and institutional (building appropriate governance and co-management mechanisms).

The NFEPA database was searched for information in terms of conservation status of rivers, wetland habitat and wetland features present in the study area or the vicinity thereof.

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

The freshwater features encountered within the proposed study area were assessed using the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems (Ollis *et al*., 2013), hereafter referred to as the "Classification System". A summary of Levels 1 to 4 of the classification system are presented in Table C1 and C2, below.

Table C1: Proposed classification structure for Inland Systems, up to Level 3.

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

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

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

Level 1: Inland systems

From the Classification System, Inland Systems are defined as aquatic ecosystems that have no existing connection to the ocean[3](i.e. characterised by the complete absence of marine exchange and/or tidal influence) but which are inundated or saturated with water, either permanently or periodically. It is important to bear in mind, however, that certain Inland Systems may have had a historical connection to the ocean, which in some cases may have been relatively recent.

Level 2: Ecoregions& NFEPA Wetland Vegetation Groups

For Inland Systems, the regional spatial framework that has been included at Level 2 of the classification system is that of DWA's Level 1 Ecoregions for aquatic ecosystems (Kleynhans *et al.,* 2005). There is a total of 31 Ecoregions across South Africa, including Lesotho and Swaziland. DWA Ecoregions have

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

most commonly been used to categorise the regional setting for national and regional water resource management applications, especially in relation to rivers.

The Vegetation Map of South Africa, Swaziland and Lesotho (Mucina & Rutherford, 2006) group's vegetation types across the country according to Biomes, which are then divided into Bioregions. To categorise the regional setting for the wetland component of the National Freshwater Ecosystem Priority Areas (NFEPA) project, wetland vegetation groups (referred to as WetVeg Groups) were derived by further splitting bioregions into smaller groups through expert input (Nel *et al*., 2011). There are currently 133 NFEPA WetVeg Groups. It is envisaged that these groups could be used as a special framework for the classification of wetlands in national- and regional-scale conservation planning and wetland management initiatives.

Level 3: Landscape Setting

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

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

Level 4: Hydrogeomorphic Units

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

- **River:** a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water;
- **Channelled valley-bottom wetland:** a valley-bottom wetland with a river channel running through it;
- **Unchannelled valley-bottom wetland:** a valley-bottom wetland without a river channel running through it;
- **Floodplain wetland:** the mostly flat or gently sloping land adjacent to and formed by an alluvial river channel, under its present climate and sediment load, which is subject to periodic inundation by over-topping of the channel bank;
- **Depression:** a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates.
- **Wetland Flat:** a level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench. Closed elevation contours are not evident around the edge of a wetland flat; and
- **Seep:** a wetland area located on (gently to steeply) sloping land, which is dominated by the colluvial (i.e. gravity-driven), unidirectional movement of material down-slope. Seeps are often located on the side-slopes of a valley but they do not, typically, extend into a valley floor.

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

3. Riparian Vegetation Response Index (VEGRAI)

Riparian vegetation is described in the NWA (Act No 36 of 1998) as follows: 'riparian habitat' includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised 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 land areas.

The Riparian Vegetation Response Assessment Index (VEGRAI) is designed for qualitative assessment of the response of riparian vegetation to impacts in such a way that qualitative ratings translate into quantitative and defensible results[4]. Results are defensible because their generation can be traced through an outlined process (a suite of rules that convert assessor estimates into ratings and convert multiple ratings into an Ecological Category).

Table C3: Descriptions of the A-F ecological categories.

Ecological category	Description	Score (% of total)
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. A small change in natural habitat and biota may have taken place but the ecosystem functions are essentially unchanged.	80-89
C	Moderately modified. Loss and change of natural habitat have occurred, but the basic ecosystem functions are still predominately 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 modified. Modifications have reached a critical level and the lotic 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

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.

Table C4: 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

[4] Kleynhans et al, 2007

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. 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".[5] 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).

Table C5: 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

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

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 C6: 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.

6. Ecological Importance and Sensitivity (EIS) (Rountree & Kotze, 2013)

The purposed of assessing importance and sensitivity of water resources is to be able to identify those systems that provide higher than average ecosystem services, biodiversity support functions or are especially sensitive to impacts. Water resources with higher ecological importance may require managing such water resources in a better condition than the present to ensure the continued provision of ecosystem benefits in the long term (Rountree & Kotze, 2013).

In order to align the outputs of the Ecoservices assessment (i.e. ecological and socio-cultural service provision) with methods used by the DWA (now the DWS) used to assess the EIS of other watercourse types, a tool was developed using criteria from both WET-Ecoservices (Kotze, *et, al,* 2009) and earlier DWA EIA assessment tools. Thus, three proposed suites of important criteria for assessing the Importance and Sensitivity for wetlands were proposed, namely:

- Ecological Importance and Sensitivity, incorporating the traditionally examined criteria used in EIS assessments of other water resources by DWA and thus enabling consistent assessment approaches across water resource types;
- Hydro-functional importance, taking into consideration water quality, flood attenuation and sediment trapping ecosystem services that the wetland may provide; and
- Importance in terms of socio-cultural benefits, including the subsistence and cultural benefits provided by the wetland system.

The highest of these three suites of scores is then used to determine the overall Importance and Sensitivity category (Table C8) of the wetland system being assessed.

Table C7: Ecological Importance and Sensitivity Categories and the interpretation of median scores for biota and habitat determinants (adapted from Kleynhans, 1999).

EIS Category	Range of Mean	Recommended Ecological Management Class
Very high Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications.	>3 and <=4	A
High Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications.	>2 and <=3	B
Moderate	>1 and <=2	C

Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications.		
Low/marginal Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications.	>0 and <=1	D

7. 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 watercourse (sections above), with the objective of either maintaining, or improving the ecological integrity of the watercourse in order to ensure continued ecological functionality.

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

PES			Ecological and Importance Sensitivity (EIS)			
			Very High	High	Moderate	Low
	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 unnacceptable (Malan and Day, 2012) and therefore, should a watercourse fall into one of these PES categories, an REC class D is allocated by default, as the minimum acceptable PES category.**

A watercourse may receive the same class for the REC as the PES if the watercourse 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 watercourse.

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

8. Wetland and Riparian Delineation

The watercourse 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 – Risk Assessment Methodology

In order for the EAP to allow for sufficient consideration of all environmental impacts, impacts were assessed using a common, defensible method of assessing significance that will enable comparisons to be made between risks/impacts and will enable authorities, stakeholders and the client to understand the process and rationale upon which risks/impacts have been assessed. The method to be used for assessing risks/impacts is outlined in the sections below.
The first stage of the risk/impact assessment is the identification of environmental activities, aspects and impacts. This is supported by the identification of receptors and resources, which allows for an understanding of the impact pathway and an assessment of the sensitivity to change. The definitions used in the impact assessment are presented below.

- An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that is possessed by an organisation.
- An **environmental aspect** is an 'element of an organizations activities, products and services which can interact with the environment'[6]. The interaction of an aspect with the environment may result in an impact.
- **Environmental risks/impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or wellbeing, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is.
- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as freshwater features, flora and riverine systems.
- **Resources** include components of the biophysical environment.
- **Frequency of activity** refers to how often the proposed activity will take place.
- **Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor.
- **Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.
- **Spatial extent** refers to the geographical scale of the impact.
- **Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.

The significance of the impact is then assessed by rating each variable numerically according to the defined criteria (refer to the table below). The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity, spatial scope and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 15. The frequency of the activity, impact, legal issues and the detection of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 20. The values for likelihood and consequence of the impact are then read off a significance rating matrix and are used to determine whether mitigation is necessary[7].

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Table D8: Rating Classes

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

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

Table D9: Calculations

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

The following points were considered when undertaking the assessment:

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

Control Measure Development

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

- Mitigation and performance improvement measures and actions that address the risks and impacts[8] are identified and described in as much detail as possible. Mitigating measures are investigated according to the impact minimisation hierarchy as follows:
  - Avoidance or prevention of impact;
  - Minimisation of impact;
  - Rehabilitation; and
  - Offsetting.
- Measures and actions to address negative impacts will favour avoidance and prevention over minimisation, mitigation or compensation; and
- Desired outcomes are defined, and have been developed in such a way as to be measurable events with performance indicators, targets and acceptable criteria that can be tracked over defined periods, wherever possible.

Recommendations

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

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

APPENDIX E – Results of Field Investigations

Table E1: Presentation of the results of the PES (IHI) assessment of the Dwars River

INSTREAM IHI	
Base Flows	-1.0
Zero Flows	0.0
Floods	1.0
HYDROLOGY RATING	**0.5**
pH	0.0
Salts	0.0
Nutrients	0.0
Water Temperature	0.0
Water clarity	0.0
Oxygen	-0.5
Toxics	0.0
PC RATING	**0.5**
Sediment	-1.0
Benthic Growth	-0.5
BED RATING	**0.8**
Marginal	-1.0
Non-marginal	-1.0
BANK RATING	**1.0**
Longitudinal Connectivity	-1.5
Lateral Connectivity	-1.0
CONNECTIVITY RATING	**1.5**
INSTREAM IHI %	**84.2**
INSTREAM IHI EC	**B**
INSTREAM CONFIDENCE	**3.0**

RIPARIAN IHI	
Base Flows	-1.0
Zero Flows	0.0
Moderate Floods	1.5
Large Floods	1.5
HYDROLOGY RATING	**0.9**
Substrate Exposure (marginal)	1.5
Substrate Exposure (non-marginal)	1.5
Invasive Alien Vegetation (marginal)	0.5
Invasive Alien Vegetation (non-marginal)	0.5
Erosion (marginal)	2.0
Erosion (non-marginal)	2.0
Physico-Chemical (marginal)	1.0
Physico-Chemical (non-marginal)	1.0
Marginal	2.0
Non-marginal	2.0
BANK STRUCTURE RATING	**2.0**
Longitudinal Connectivity	1.0
Lateral Connectivity	1.0
CONNECTIVITY RATING	**1.0**
RIPARIAN IHI %	**72.1**
RIPARIAN IHI EC	**C**
RIPARIAN CONFIDENCE	**3.0**

Table E2: Presentation of the results of the Ecoservices assessment of the Dwars River

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	2,3	0,3	1,0	Low
	Stream flow regulation	-	-	#VALUE!	#VALUE!
	Sediment trapping	1,2	3,0	1,2	Low
	Erosion control	2,4	1,7	1,8	Moderate
	Phosphate assimilation	1,2	1,0	0,2	Very Low
	Nitrate assimilation	1,4	1,0	0,4	Very Low
	Toxicant assimilation	1,3	4,0	1,8	Moderate
	Carbon storage	1,0	2,7	0,8	Low
	Biodiversity maintenance	4,0	2,0	3,5	Very High
PROVISIONING SERVICES	Water for human use	2,4	1,3	1,6	Moderately Low
	Harvestable resources	2,0	0,3	0,7	Very Low
	Food for livestock	1,0	0,7	0,0	Very Low
	Cultivated foods	2,5	0,0	1,0	Low

CULTURAL SERVICES	Tourism and Recreation	1,5	0,0	0,0	Very Low
	Education and Research	1,5	0,3	0,2	Very Low
	Cultural and Spiritual	4,0	0,7	2,8	High

Table E3: Presentation of the results of the EIS assessment of the Dwars River

Ecological Importance and Sensitivity	Score (0-4)	*Confidence (1-5)*
Biodiversity support	A (average)	(average)
	2.33	3.33
Presence of Red Data species	2	3
Populations of unique species	2	3
Migration/breeding/feeding sites	3	4
Landscape scale	B (average)	(average)
	3.20	3.80
Protection status of the wetland	3	3
Protection status of the vegetation type	4	4
Regional context of the ecological integrity	3	4
Size and rarity of the wetland type/s present	3	4
Diversity of habitat types	3	4
Sensitivity of the wetland	C (average)	(average)
	2.00	4.00
Sensitivity to changes in floods	2	4
Sensitivity to changes in low flows/dry season	2	4
Sensitivity to changes in water quality	2	4
ECOLOGICAL IMPORTANCE & SENSITIVITY	**(max of A,B or C)**	*(average of A, B or C)*
Fill in highest score:	**A**	**3.20**
Very high: Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these systems is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers.		

Hydro-Functional Importance			Score (0-4)	*Confidence (1-5)*
Regulating & supporting benefits	**Flood attenuation**		2	4
	Streamflow regulation		2	4
	Water Quality Enhancement	***Sediment trapping***	2	4
		Phosphate assimilation	2	4
		Nitrate assimilation	2	4
		Toxicant assimilation	2	4
		Erosion control	2	4
	Carbon storage		2	4
HYDRO-FUNCTIONAL IMPORTANCE			2	4
Direct Human Benefits			Score (0-4)	Confidence (1-5)
Subsistence benefits	***Water for human use***		1	4
	Harvestable resources		1	4
	Cultivated foods		2	4
Cultural benefits	***Cultural heritage***		1	4
	Tourism and recreation		2	4
	Education and research		2	4
DIRECT HUMAN BENEFITS			1.50	4

Table E4: Presentation of the results of the PES (IHI) assessment of the Springkaanspruit

INSTREAM IHI	
Base Flows	-1,0
Zero Flows	0,0
Floods	1,0
HYDROLOGY RATING	**0,5**
pH	0,0
Salts	-1,0
Nutrients	0,0
Water Temperature	0,0
Water clarity	0,0
Oxygen	0,0
Toxics	0,0
PC RATING	**1,0**
Sediment	1,0
Benthic Growth	1,0
BED RATING	**1,0**
Marginal	2,0
Non-marginal	2,0
BANK RATING	**2,0**
Longitudinal Connectivity	1,0
Lateral Connectivity	1,0
CONNECTIVITY RATING	**1,0**
INSTREAM IHI %	**80,3**
INSTREAM IHI EC	**B/C**
INSTREAM CONFIDENCE	**3,0**

RIPARIAN IHI	
Base Flows	-1,0
Zero Flows	0,0
Moderate Floods	1,5
Large Floods	1,5
HYDROLOGY RATING	**0,9**
Substrate Exposure (marginal)	1,5
Substrate Exposure (non-marginal)	1,5
Invasive Alien Vegetation (marginal)	0,5
Invasive Alien Vegetation (non-marginal)	0,5
Erosion (marginal)	2,0
Erosion (non-marginal)	2,0
Physico-Chemical (marginal)	1,5
Physico-Chemical (non-marginal)	0,5
Marginal	2,0
Non-marginal	2,0
BANK STRUCTURE RATING	**2,0**
Longitudinal Connectivity	1,0
Lateral Connectivity	1,0
CONNECTIVITY RATING	**1,0**
RIPARIAN IHI %	**72,1**
RIPARIAN IHI EC	**C**
RIPARIAN CONFIDENCE	**3,0**

Table E5: Presentation of the results of the Ecoservices assessment of the Springkaanspruit

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	1,3	0,3	0,0	Very Low
	Stream flow regulation	-	-	#VALUE!	#VALUE!
	Sediment trapping	1,0	1,5	0,3	Very Low
	Erosion control	2,1	1,8	1,4	Moderately Low
	Phosphate assimilation	1,1	0,5	0,0	Very Low
	Nitrate assimilation	1,3	0,5	0,0	Very Low
	Toxicant assimilation	1,2	1,5	0,4	Very Low
	Carbon storage	0,7	2,7	0,5	Very Low
	Biodiversity maintenance	3,9	0,0	2,4	Moderately High
PROVISIONING SERVICES	Water for human use	2,4	1,3	1,6	Moderately Low
	Harvestable resources	2,0	0,3	0,7	Very Low
	Food for livestock	1,0	0,7	0,0	Very Low
	Cultivated foods	2,5	0,0	1,0	Low
CULTURAL SERVICES	Tourism and Recreation	1,5	0,0	0,0	Very Low
	Education and Research	1,0	0,3	0,0	Very Low
	Cultural and Spiritual	2,0	0,0	0,5	Very Low

Table E3: Presentation of the results of the EIS assessment of the Springkaanspruit

Ecological Importance and Sensitivity	Score (0-4)	*Confidence (1-5)*
Biodiversity support	A (average)	(average)
	1,67	3,33
Presence of Red Data species	2	3
Populations of unique species	1	3
Migration/breeding/feeding sites	2	4
Landscape scale	B (average)	(average)
	2,20	3,80
Protection status of the wetland	3	3
Protection status of the vegetation type	4	4
Regional context of the ecological integrity	1	4
Size and rarity of the wetland type/s present	1	4
Diversity of habitat types	2	4
Sensitivity of the wetland	C (average)	(average)
	1,33	4,00
Sensitivity to changes in floods	2	4
Sensitivity to changes in low flows/dry season	1	4
Sensitivity to changes in water quality	1	4
ECOLOGICAL IMPORTANCE & SENSITIVITY	**(max of A,B or C)**	*(average of A, B or C)*

High: Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these systems may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.

Hydro-Functional Importance			Score (0-4)	*Confidence (1-5)*
Regulating & supporting benefits	**Flood attenuation**		2	4
	Streamflow regulation		1	4
	Water Quality Enhancement	***Sediment trapping***	2	4
		Phosphate assimilation	2	4
		Nitrate assimilation	2	4
		Toxicant assimilation	2	4
		Erosion control	2	4
	Carbon storage		1	4
HYDRO-FUNCTIONAL IMPORTANCE			2	4
Direct Human Benefits			Score (0-4)	Confidence (1-5)
Subsistence benefits	***Water for human use***		1	4
	Harvestable resources		1	4
	Cultivated foods		1	4
Cultural benefits	***Cultural heritage***		1	4
	Tourism and recreation		1	4
	Education and research		1	4
DIRECT HUMAN BENEFITS			1,00	4

APPENDIX F - 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 Dwars River and Springkaanspruit.

Development and operational footprint

- Sensitivity maps have been developed for the project areas, indicating the watercourses, and relevant regulatory zones in accordance with NEMA, Regulation GN509 and Regulation GN704, as shown in Section 6. It is recommended that these sensitivity maps 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 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 information

DETAILS, EXPERTISE AND CURRICULUM VITAE OF SPECIALISTS

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

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

Amanda Mileson Advanced Diploma: Nature Conservation (UNISA)

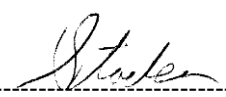
1. (a). (ii) The expertise of that specialist to compile a specialist report including a curriculum vitae

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@sasenvgroup.co.za		
Qualifications	MSc (Environmental Management) (University of Johannesburg) BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg) BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)		
Registration / Associations	Registered Natural Professional Scientist at South African Council for Natural Scientific Professions (SACNASP) Accredited River Health Practitioner by the South African River Health Program (RHP) Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum		

Declaration that the specialist is independent in a form as may be specified by the competent authority

I, Stephen van Staden, declare that -

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



Signature of the Specialist

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 International Society of Wetland Scientists

Member of the Gauteng Wetland Forum (GWF) and Northern Cape Wetland Forum (NCWF)

EDUCATION

Qualifications

N. Dip Nature Conservation (UNISA)	2017
Advanced Diploma Nature Conservation (UNISA)	2020
Postgraduate 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 Ecosystem Delineation
- Freshwater Ecosystem Verification Assessment
- Freshwater Ecosystem (wetland / riparian) Delineation and Assessment
- Freshwater Ecosystem EcoService and Status Determination
- Freshwater Ecosystem Rehabilitation Assessment / Planning
- Freshwater Ecosystem Maintenance and Management Plans
- Freshwater Ecosystem Plant Species Plans
- Freshwater Ecosystem Offset Plans

Biodiversity Assessments

- Biodiversity Ecological Assessments
- Biodiversity Offset Plans