## APPENDIX L: WATERCOURSE ECOLOGICAL ASSESSMENT

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# WATERCOURSE ECOLOGICAL ASSESSMENT AS PART OF THE ENVIRONMENTAL AND WATER USE AUTHORISATION PROCESSES FOR VENTILATION SHAFTS AT MARULA PLATINUM MINE, LIMPOPO PROVINCE

## Prepared for

## SLR Consulting (Africa) (Pty) Ltd

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# EXECUTIVE SUMMARY

**Scientific Aquatic Services (SAS) was appointed to conduct a watercourse ecological assessment as part of the Environmental and Water Use Authorisation processes for the proposed ventilation shafts and associated infrastructure (surface main fans, electrical rooms and bulk air cooler), as well as powerlines, pipelines and product stockpile at Marula Platinum Mine, Limpopo Province.**

**The Tshwenyane, Mogompane, Motse Rivers and an unnamed tributary of the Moopetsi River (with riparian vegetation), along with numerous non-perennial and ephemeral drainage lines without riparian characteristics and an artificial wetland in the vicinity of the proposed mining infrastructure were identified during this study. A number of the proposed project components directly cross the Tshwenyane River and an unnamed tributary of the Moopetsi River. Both watercourses are deemed to have a largely modified ecological state due to the historical and current small-scale agricultural activities, utilisation of the rivers and their tributaries for domestic purposes by local communities, and the presence of mining activities within the area of focus.**

**The results of the SLR Risk Assessment indicates that if, mitigation is not implemented the impact significance will be low. According to the results of the DWS Risk Assessment, assuming strict implementation of mitigation measures takes place, the impact significance of activities such as site preparation activities are anticipated to be of 'Low' impact significance, due to the nature and extent of the activities and non-perennial, ephemeral nature of the watercourses.**

**Based on the above outcomes and taking into account the mostly localised nature of the impacts associated with the proposed ventilation shafts and related mining activities it is the opinion of the ecologist that the proposed project may be considered for authorisation, provided that the mitigation measures stipulated in this report are implemented.**

# MANAGEMENT SUMMARY

Scientific Aquatic Services (SAS) was appointed to conduct a watercourse ecological assessment as part of the Environmental and Water Use Authorisation processes for the proposed ventilation shafts and associated infrastructure, hereafter collectively referred to as the "focus area") at Marula Platinum Mine, Limpopo Province.

The purpose of this report is to define the ecology of the Focus Area in terms of watercourse characteristics, including mapping of the watercourses, discussion of key ecological drivers and definition of the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS), as well as the socio-cultural and ecological service provision of the watercourses utilising current industry "best practice" assessment methods, in order to ascertain what, if any, impact the proposed mining related activities will have on the watercourses related to the Focus Area. Additionally, this report aims to define the Recommended Management Objectives (RMO) and Recommended Ecological Category (REC) for the watercourses. It is a further objective of this study to provide detailed information when considering the proposed mining related activities in the vicinity of the watercourses, to ensure the ongoing functioning of the ecosystem, 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.

The assessment took the following approach:

- A desktop study was conducted, in which possible watercourses were identified for on-site investigation, and relevant national and provincial databases were consulted (Section 4);
- A single field assessment took place in November 2020, in order to ground-truth the identified watercourses within the Focus Area and associated investigation area (defined as 500 m from

the Focus Area in accordance with GN509 as it relates to the National Water Act (NWA), 1998 (Act No. 36 of 1998). A number of watercourses were identified within the Focus Area, and were classified according to the Ollis *et al.* (2013) classification system;

- The characteristics of the watercourses were defined including the PES, EIS, REC, RMO and BAS (Section 5); and
- The results obtained were used to assess the impacts of the proposed development footprint on the watercourses in the Focus Area (Section 6). In this regard, only the proposed powerlines, pipelines, ventilation shafts and associated infrastructure were assessed, as the remaining proposed project components are not likely to affect the watercourses as they are situated within existing disturbed areas.

The results of the field assessment are presented in Section 5 of this report, and are summarised in the table below:

**Table A: Summary of results of the field assessment as discussed in Section 5.**

| HGM Unit | PES | Ecoservices | EIS | REC / RMO / BAS |
|---|---|---|---|---|
| Unnamed tributary of the Moopetsi River | D | Intermediate | Moderate | D / D / Maintain |
| Tshwenyane River | D | Intermediate | Moderate | D / D / Maintain |
| Non-perennial and ephemeral drainage lines without riparian vegetation | N/A | Low | Moderate | N/A |

Cleared sites and compacted ground from mining infrastructure and roads have stormwater runoff impacts, where the removal of vegetation and hardening of surfaces increases the impacts created by seasonal rainfall events. Mining vent infrastructure and toxic residue on roads (left behind from vehicles) may leave stormwater water runoff impaired in terms of physical-chemical parameters causing impacts on the immediate and downstream users. Disturbances within the landscape and watercourse channels have also encouraged a high rate of bush encroachment and alien invasive plant proliferation. The watercourses within the focus area are of moderate EIS which suggests the site's ecological state, at minimum be maintained. In order to achieve this or an improved ecological state, mitigation measures should be strictly implemented.

**Table B: Summary of the DWS Risk Assessment applied to the proposed overhead transmission powerlines.**

| No. | Phases | Activity | Aspect | Impact | Risk Rating |
|---|---|---|---|---|---|
| 1 | **Planning phase of 33kV overhead transmission powerlines** | Planning and site preparation prior to construction activities associated with the construction of the powerlines. | Potentially inadequate or unsuitable design of infrastructure leading to changes to watercourse characteristics | Tower bases constructed within 32 m of watercourses may lead to erosion and sedimentation of riparian resources, arising from increased runoff due to cleared areas, thus leading to loss of riparian habitat; and<br>*The alteration to stream flow patterns due to support structures placed in the channel. | L |
| | | | | | |
| 2 | **Construction Phase of 33kV overhead transmission powerlines** | Site preparation prior to construction activities including placement of contractor laydown areas and storage facilities. | *Disturbance/ compaction of soils from heavy construction vehicles and laydown facilities;<br>*Removal of vegetation at powerline tower locations; and<br>*Oil contamination from construction vehicles. | *Stormwater runoff from the reduced infiltration, flood water discharge, and velocity increases from hardened surfaces causing erosion of the landscape and channel banks, and subsequent sedimentation of the channel bed. Sedimentation can lead to suffocation of vegetation, destroying sensitive freshwater habitats;<br>*Decreased ecoservice provision (e.g., flood attenuation, sediment trapping and nutrient and toxicant assimilation);<br>*Proliferation of alien vegetation as a result of disturbances; | L |
| 3 | | Construction of the powerline towers in close proximity to and within watercourses | *Excavation, removing and stockpiling soil (topsoil) for tower cavity; and<br>*Infilling base structure/ cavity with concrete mixture. | *Earthworks within watercourse, leading to loss of habitat, disturbance of soils and loss of ecoservices such as biodiversity maintenance, flood attenuation, nutrient assimilation;<br>*Cement that enters a watercourse will raise the pH (resulting in high alkalinity), which can be toxic to aquatic life, changing the riparian ecology; and<br>*Stockpiling of sediment adjacent to riparian areas and runoff from stockpiles can lead to changes in riparian habitat. | L |
| 4 | | | Clearing and levelling of land for the installation of the powerlines, including infilling and levelling of the watercourse, and removal of riparian vegetation. | *Construction can cause unnatural concentration of flow, unnatural ponding occurs due to a lack of runoff potential, changing the water retention and distribution in the landscape. | L |
| 5 | | Infrastructure Transportation and Storage | Potential for indiscriminate movement of vehicles through the riparian zone. | *Disturbances of soils leading to increased alien vegetation proliferation, and in turn to further altered riparian habitat; | L |

| | | | | | |
|---|---|---|---|---|---|
| 6 | | | Potential placement of contractor laydown areas, and/or potential indiscriminate storage of powerline infrastructure and construction equipment within the riparian zone and/or Zone Of Regulation ZOR. | *Altered runoff patterns, leading to increased erosion and sedimentation of instream and riparian habitat.<br>*Impacts on surface water quality due to pollution. | L |
| | | | | | |
| 7 | **Operational Phase of 33kV overhead transmission powerlines** | *Long term operation of the powerlines;<br>*Potential increased traffic adjacent to the affected reaches of the associated Rivers (Eskom service vehicles).<br>*Potential indiscriminate movement of maintenance vehicles within riparian zone and ZOR. | *Maintenance of power line infrastructure in the vicinity of the riparian zone; and<br>*Cleared and hardened surfaces and natural erodibility of the soil. | *Erosion and sedimentation of riparian resources arising from increased runoff due to cleared areas, leading to loss of riparian habitat of watercourses downgradient from the powerline towers;<br>*Altered water quality as a result of increased availability of pollutants. | L |

**Table C: Summary of the DWS Risk Assessment applied to the proposed water pipelines.**

| No. | Phases | Activity | Aspect | Impact | Risk Rating |
|---|---|---|---|---|---|
| 1 | Pre-construction phase of pipelines | Planning and site preparation prior to construction activities associated with the construction of the pipelines. | Potentially inadequate or unsuitable design of infrastructure leading to changes to watercourse characteristics | *Pipelines constructed within 32 m of watercourses will have consequences on the natural buffer zone of the watercourses, leading to erosion and sedimentation of riparian resources arising from increased runoff due to cleared areas, thus leading to loss of riparian habitat. | L |
| | | | | | |
| 2 | Construction Phase of pipelines | Site preparation prior to construction activities including placement of contractor laydown areas and storage facilities. | *Removal of vegetation a site clearing at the water pipeline locations;<br>*Disturbance/ compaction of soils from heavy construction vehicles;<br>*Oil contamination from construction vehicles. | *Stormwater runoff; and<br>*Increased proliferation of alien vegetation as a result of disturbances. | L |
| 3 | | Installation of HDPE water supply and wastewater pipelines | Trenching along existing road in close proximity to watercourse, as well as through watercourses, stockpiling, and backfilling soil for pipeline installment. | *Removing sediment will have a direct loss on habitat at removal site;<br>*Stockpiling of sediment adjacent to riparian areas and runoff from stockpiles can lead to changes in riparian habitat;<br>*Backfilling trench; and<br>*Construction edge effects. | L |
| | | | | | |
| 4 | Operational Phase of pipelines | Operation of the pipelines | Cleared and hardened areas and natural erodibility of the soil. | *Erosion and sedimentation of riparian resources arising from increased runoff due to cleared areas, leading to loss of riparian habitat of watercourses downgradient form the pipelines. | L |
| 5 | | | Potential leakage of water from the pipeline. | *Possible incision and alteration of the hydroperiod of the watercourse system. | L |

**Table D: Summary of the DWS Risk Assessment applied to the proposed ventilation shafts.**

| No. | Phases | Activity | Aspect | Impact | Risk Rating |
|---|---|---|---|---|---|
| 1 | Pre-construction phase of ventilation shafts | Planning and site preparation prior to construction activities associated with the construction of the Ventilation shafts. | Potentially inadequate or unsuitable design of infrastructure leading to changes to watercourse characteristics | *Vents constructed within 32 m of watercourses will have consequences on the natural buffer zone of the watercourses, leading to erosion and sedimentation of riparian resources arising from increased runoff due to cleared areas, thus leading to loss of riparian habitat. | L |
| | | | | | |
| 2 | Construction Phase of ventilation shafts | Site preparation prior to construction activities including placement of contractor laydown areas and storage facilities. | *Removal of vegetation or site clearing at the water pipeline locations; *Disturbance/ compaction of soils from heavy construction vehicles; *Oil contamination from construction vehicles. | *Exposure of soils can result in erosion; *Stormwater runoff from the reduced infiltration, flood water discharge, and velocity increases from hardened surfaces causing erosion of the landscape and channel banks, and subsequent sedimentation; *Increased proliferation of alien vegetation as a result of disturbances; and *Soil and stormwater contamination from oils and hydrocarbons originating from construction vehicles can infiltrate soils and runoff into surrounding watercourses, impacting watercourse water quality, habitat, and biota downgradient of the contamination site. | L |
| 3 | | Establishment of new ventilation shaft, surface main fans, electrical rooms, and bulk air cooler. | Removing and stockpiling soil for vent shaft; *Infilling base cavity with concrete mixture; Land elevation changes; soil compaction. | *Removing sediment will have a direct loss on habitat at removal site; *Stockpiling of sediment adjacent to riparian areas and runoff from stockpiles can lead to changes in riparian habitat; *Construction edge effects; *Cement that enters a watercourse will raise the pH (resulting in high alkalinity), which can be toxic to aquatic life, changing the riparian ecology; *Construction can cause unnatural concentration of flow, unnatural ponding occurs due to a lack of runoff potential, changing the water retention and distribution in the landscape; or *In steep areas the high energy of water leaving the site can reach critical levels leading to erosion. | L |
| | | | | | |
| 4 | Operational Phase of ventilation shafts | Operation of the new ventilation shafts, surface main fans, electrical rooms, and bulk air cooler | Cleared and hardened areas and natural erodibility of the soil; and * Leakage of wastewater, which will emanate from the refrigeration process at ventilation shafts, into surrounding environment | *Erosion and sedimentation of riparian resources arising from increased runoff due to cleared areas, leading to loss of riparian habitat of watercourses downgradient from the ventilation shafts; and wastewater that enters the surrounding environment can have water quality impacts. | L |

**Table E: Summary of the SLR Consulting Impact Assessment applied to the proposed powerlines.**

| Construction Phase | Management | Intensity / Severity | Duration | Extent / Spatial | Probability of exposure | Consequence | Significance |
|---|---|---|---|---|---|---|---|
| Construction | Unmanaged | L | L | VL | H | L | L |
| | Managed | VL | VL | VL | M | VL | VL |
| Operations | Unmanaged | L | M | VL | H | L | L |
| | Managed | VL | L | VL | M | VL | VL |
| Closure and post closure | Unmanaged | L | L | VL | H | L | L |
| | Managed | VL | VL | VL | M | VL | VL |

**Table F: Summary of the SLR Consulting Impact Assessment applied to the proposed water pipelines.**

| Construction Phase | Management | Intensity / Severity | Duration | Extent / Spatial | Probability of exposure | Consequence | Significance |
|---|---|---|---|---|---|---|---|
| Construction | Unmanaged | L | L | VL | H | L | L |
| | Managed | VL | VL | VL | M | VL | VL |
| Operations | Unmanaged | L | M | VL | H | L | L |
| | Managed | VL | L | VL | M | VL | VL |
| Closure and post closure | Unmanaged | M | L | VL | H | L | L |
| | Managed | VL | VL | VL | M | VL | VL |

**Table G: Summary of the SLR Consulting Impact Assessment applied to the proposed ventilation shafts and associated infrastructure.**

| Construction Phase | Management | Intensity / Severity | Duration | Extent / Spatial | Probability of exposure | Consequence | Significance |
|---|---|---|---|---|---|---|---|
| Construction | Unmanaged | L | L | VL | H | L | L |
| | Managed | VL | L | VL | M | VL | VL |
| Operations | Unmanaged | L | M | VL | H | L | L |
| | Managed | VL | L | VL | M | VL | VL |
| Closure and post closure | Unmanaged | M | L | VL | H | L | L |
| | Managed | VL | VL | VL | M | VL | VL |

Based on the findings of the freshwater ecological assessment provided in Section 5 of this report, and the results of the impacts and risk assessments as provided in Section 6, it is the opinion of the ecologist that the proposed ventilation shafts and related powerlines, pipelines and product stockpile pose a low risk to the integrity of the watercourses associated with the proposed activities. Strict implementation of mitigation measures will keep the significance of risks low, therefore ensuring low impacts to receiving watercourses found in the downstream catchment. Additionally, mitigated areas that have recovered should in turn restore the capacity of the landscape to support livestock farming/grazing within the catchment, further supporting provisional services of the watercourses.

Adherence to cogent, well-conceived and ecologically sensitive site development plans, the mitigation measures provided in this report as well as general good construction practice and ongoing management, maintenance and monitoring, are essential if the significance of perceived impacts is to be reduced to limit further degradation to the freshwater environment. This is particularly important given the highly erodible nature of the soil in the area of focus.

Based on the above outcomes, and taking into account the mostly localised nature of the impacts associated with the proposed ventilation shafts and related infrastructure and powerlines and pipelines, and product stockpile it is the opinion of the ecologist that the proposed project may be considered for authorisation, provided that the mitigation measures stipulated in this report are implemented.

# DOCUMENT GUIDE

The following table indicates the requirements for Specialist Studies as per Appendix 6 of Government Notice 326 of 2017, amendments to the Environmental Impact Assessment (EIA) Regulations, 2014 as it relates to the National Environmental Management Act, 1998 (Act No. 107 of 1998), promulgated in Government Notice 40772 of 2017.

| No. | Requirements | Section in report |
|---|---|---|
| 2.1 | Assessment must be undertaken by a suitably qualified SACNASP registered specialist. | Cover Page and Appendix G |
| 2.2 | Description of the preferred development site, including the following aspects- | Section 4 and 5 |
| 2.2.1 | a. Aquatic ecosystem type;<br>b. Presence of aquatic species and composition of aquatic species communities, their habitat, distribution, and movement patterns. | Section 4.2 |
| 2.2.2 | Threat status, according to the national web based environmental screening tool of the species and ecosystems, including listed ecosystems as well as locally important habitat types identified. | Section 4: Table 1 |
| 2.2.3 | National and Provincial priority status of the aquatic ecosystem (i.e., is this a wetland or river Freshwater Ecosystem Priority Area (FEPA), a FEPA sub- catchment, a Strategic Water Source Area (SWSA), a priority estuary, whether or not they are free-flowing rivers, wetland clusters, etc., a CBA or an ESA; including for all a description of the criteria for their given status. | Section 4.1 |
| 2.2.4 | A description of the Ecological Importance and Sensitivity of the aquatic ecosystem including:<br>a. The description (spatially, if possible) of the ecosystem processes that operate in relation to the aquatic ecosystems on and immediately adjacent to the site (e.g., movement of surface and subsurface water, recharge, discharge, sediment transport, etc.);<br>b. The historic ecological condition (reference) as well as Present Ecological State (PES) of rivers (in-stream, riparian, and floodplain habitat), wetlands and/or estuaries in terms of possible changes to the channel, flow regime (surface and groundwater). | Section 4 and 5 |
| 2.3 | Identify any alternative development footprints within the preferred development site which would be of a “low” sensitivity as identified by the national web based environmental screening tool and verified through the Initial Site Sensitivity Verification | Section 6 |
| 2.4 | Assessment of impacts - a detailed assessment of the potential impact(s) of the proposed development on the following very high sensitivity areas/ features: | Section 7 |
| 2.4.1 | Is the development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal? | Yes, with implementation of the proposed mitigation measures. |
| 2.4.2 | Is the development consistent with maintaining the Resource Quality Objectives for the aquatic ecosystems present? | |
| 2.4.3 | How will the development impact on fixed and dynamic ecological processes that operate within or across the site, including:<br>a. Impacts on hydrological functioning at a landscape level and across the site which can arise from changes to flood regimes (e.g., suppression of floods, loss of flood attenuation capacity, unseasonal flooding or destruction of floodplain processes);<br>b. Change in the sediment regime (e.g., sand movement, meandering river mouth/estuary, changing flooding or sedimentation patterns) of the aquatic ecosystem and its sub-catchment;<br>c. The extent of the modification in relation to the overall aquatic ecosystem (i.e., at the source, upstream or downstream portion, in the temporary / seasonal / permanent zone of a wetland, in the riparian zone or within the channel of a watercourse, etc.).<br>d. Assessment of the risks associated with water use/s and related activities. | Section 5 |
| 2.4.4 | How will the development impact on the functionality of the aquatic feature including:<br>a. Base flows (e.g., too little/too much water in terms of characteristics and requirements of system); | Section 6 |

| | | |
|---|---|---|
| | b. Quantity of water including change in the hydrological regime or hydroperiod of the aquatic ecosystem (e.g., seasonal to temporary or permanent; impact of over abstraction or instream or off-stream impoundment of a wetland or river);<br>c. Change in the hydrogeomorphic typing of the aquatic ecosystem (e.g., change from an unchanneled valley-bottom wetland to a channelled valley-bottom wetland);<br>d. Quality of water (e.g., due to increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication);<br>e. Fragmentation (e.g., road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal); and<br>f. Loss or degradation of all or part of any unique or important features associated with or within the aquatic ecosystem (e.g., waterfalls, springs, oxbow lakes, meandering or braided channels, peat soils, etc). | |
| 2.4.5 | How will the development impact on key ecosystem regulating and supporting services especially Flood attenuation; Streamflow regulation; Sediment trapping; Phosphate assimilation; Nitrate assimilation; Toxicant assimilation; Erosion control; and Carbon storage. | Section 6 |
| 2.4.6 | How will the development impact community composition (numbers and density of species) and integrity (condition, viability, predator-prey ratios, dispersal rates, etc.) of the faunal and vegetation communities inhabiting the site? | Section 6 |
| 2.4.7 | In addition to the above, where applicable, impacts to the frequency of estuary mouth closure should be considered, in relation to size of the estuary; availability of sediment; wave action in the mouth; protection of the mouth; beach slope; volume of mean annual runoff; and extent of saline intrusion (especially relevant to permanently open systems). | Section 6 |
| **3.** | **The report must contain as a minimum the following information:** | |
| 3.1 | Contact details and curriculum vitae of the specialist including SACNASP registration number and field of expertise and their curriculum vitae; | Appendix G |
| 3.2 | A signed statement of independence by the specialist; | Appendix G |
| 3.3 | The duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment; | Section 5.2 |
| 3.4 | The methodology used to undertake the impact assessment and site inspection, including equipment and modelling used, where relevant; | Section 3, Appendix C and Appendix D |
| 3.5 | A description of the assumptions made and any uncertainties or gaps in knowledge or data as well as a statement of the timing and intensity of site inspection observations; | Section 1.3 |
| 3.6 | Areas not suitable for development, to be avoided during construction and operation (where relevant); | Section 6 |
| 3.7 | Additional environmental impacts expected from the proposed development based on those already evident on the site and a discussion on the cumulative impacts; | Section 6 and 7 |
| 3.8 | A suitable construction and operational buffer for the aquatic ecosystem, using the accepted protocol; | Section 6 |
| 3.9 | Impact management actions and impact management outcomes proposed by the specialist for inclusion in the EMPr; | Section 6 |
| 3.10 | A motivation where the development footprint identified as per 2.3 were not considered stating reasons why these were not being considered; and | Section 6 |
| 3.11 | A reasoned opinion, based on the finding of the specialist assessment, regarding the acceptability or not, of the development and if the development should receive approval, and any conditions to which the statement is subjected. | Section 7 |
| 3.12 | A suitable construction and operational buffer for the aquatic ecosystem, using the accepted methodologies. | Section 6 |
| 3.13 | Proposed impact management actions and impact management outcomes for inclusion in the Environmental Management Programme (EMPr). | Section 6 |
| 3.14 | A motivation must be provided if there were development footprints identified as per paragraph 2.3 for reporting in terms of Section 24(5)(a) and (h) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) that were identified as having a “low” aquatic biodiversity and sensitivity and that were not considered appropriate. | Section 6 |
| 3.15 | A substantiated statement, based on the findings of the specialist assessment, regarding the acceptability or not of the proposed development and if the proposed development should receive approval or not. | Section 7 |
| 3.16 | Any conditions to which this statement is subjected. | Section 7 |

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# GLOSSARY OF TERMS

| | |
|---|---|
| **Alien vegetation:** | Plants that do not occur naturally within the area but have been introduced either intentionally or unintentionally. Vegetation species that originate from outside of the borders of the biome -usually international in origin. |
| **Biodiversity:** | The number and variety of living organisms on earth, the millions of plants, animals and micro-organisms, the genes they contain, the evolutionary history and potential they encompass and the ecosystems, ecological processes, and landscape of which they are integral parts. |
| **Buffer:** | A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area. |
| **Catchment:** | The area where water is collected by the natural landscape, where all rain and run-off water ultimately flows into a river, wetland, lake, and ocean or contributes to the groundwater system. |
| **Delineation (of a wetland):** | To determine the boundary of a wetland based on soil, vegetation and/or hydrological indicators. |
| **Ecoregion**: | An ecoregion is a "recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterise that region". |
| **Ephemeral:** | 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. |
| **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. |
| **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. |
| **Indigenous vegetation:** | Vegetation occurring naturally within a defined area. |
| **Mottles:** | Soils with variegated colour patterns are described as being mottled, with the "background colour" referred to as the matrix and the spots or blotches of colour referred to as mottles. |
| **Non-perennial:** | Systems which flow intermittently, for at least nine months of the year. Flow is absent for between 1%-25% of the year. |
| **Obligate species:** | Species almost always found in wetlands (>99% of occurrences). |
| **Perched water table:** | The upper limit of a zone of saturation that is perched on an unsaturated zone by an impermeable layer, hence separating it from the main body of groundwater |
| **Perennial:** | Flows all year round. |
| **RAMSAR**: | The Ramsar Convention (The Convention on Wetlands of International Importance, especially as Waterfowl Habitat) is an international treaty for the conservation and sustainable utilisation of wetlands, i.e., to stem the progressive encroachment on and loss of wetlands now and in the future, recognising the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value. It is named after the city of Ramsar in Iran, where the Convention was signed in 1971. |
| **RDL (Red Data listed) species**: | Organisms that fall into the Extinct in the Wild (EW), critically endangered (CR), Endangered (EN), Vulnerable (VU) categories of ecological status according to the International Union for Conservation of Nature (IUCN) Classification. |
| **Seasonal zone of wetness:** | The zone of a wetland that lies between the Temporary and Permanent zones and is characterised by saturation from three to ten months of the year, within 50cm of the surface |
| **Temporary zone of wetness:** | the outer zone of a wetland characterised by saturation within 50cm of the surface for less than three months of the year |
| **Watercourse:** | In terms of the definition contained within the National Water Act, a watercourse means:<br>• A river or spring;<br>• A natural channel which water flows regularly or intermittently;<br>• A wetland, dam or lake into which, or from which, water flows; and<br>• Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse;<br>• and a reference to a watercourse includes, where relevant, its bed and banks |

| | |
|---|---|
| **Wetland Vegetation (WetVeg) type:** | Broad groupings of wetland vegetation, reflecting differences in regional context, such as geology, climate, and soils, which may in turn have an influence on the ecological characteristics and functioning of wetlands. |

# ACRONYMS

| | |
|---|---|
| **°C** | Degrees Celsius. |
| **BAR** | Basic Assessment Report |
| **BAS** | Best Attainable State |
| **BGIS** | Biodiversity Geographic Information Systems |
| **CSIR** | Council of Scientific and Industrial Research |
| **CVB** | Channelled Valley Bottom |
| **DHSWS** | Department of Human Settlements, Water and Sanitation |
| **DWA** | Department of Water Affairs |
| **DWAF** | Department of Water Affairs and Forestry |
| **DWS** | Department of Water and Sanitation |
| **EAP** | Environmental Assessment Practitioner |
| **EI** | Ecological Importance |
| **EIA** | Environmental Impact Assessment |
| **EIS** | Ecological Importance and Sensitivity |
| **EMPr** | Environmental Management Programme |
| **EPL** | Ecosystem Protection Level |
| **ES** | Ecological Sensitivity |
| **ESA** | Ecological Support Area |
| **ETS** | Ecosystem Threat Status |
| **EWR** | Ecological Water Requirements |
| **FEPA** | Freshwater Ecosystem Priority Areas |
| **GA** | General Authorisation |
| **GIS** | Geographic Information System |
| **GN** | Government Notice |
| **GPS** | Global Positioning System |
| **Ha** | Hectares |
| **HGM** | Hydrogeomorphic |
| **IAIA** | International Association of Impact Assessors |
| **IUCN** | International Union for Conservation of Nature |
| **IWUL** | Integrated Water Use Licence |
| **LaRSSA** | Land Rehabilitation Society of South Africa |
| **mm** | Millimetre |
| **m.a.m.s.l** | Metres above mean sea level |
| **MAP** | Mean Annual Precipitation |
| **MPRDA** | Mineral and Petroleum Resources Development Act |
| **NBA** | National Biodiversity Assessment |
| **NEMA** | National Environmental Management Act |
| **NEMBA** | National Environmental Management: Biodiversity Act |
| **NEMWA** | National Environmental Management: Waste Act |
| **NFEPA** | National Freshwater Ecosystem Priority Areas |
| **NOMR** | New Order Mining Right |
| **NWA** | National Water Act |
| **PCD** | Pollution Control Dam |
| **PES** | Present Ecological State |
| **PPP** | Public Participation Process |
| **REC** | Recommended Ecological Category |
| **RHP** | River Health Program |
| **RMO** | Resource Management Objective |
| **RQIS** | Research Quality Information Services |
| **SACNASP** | South African Council for Natural Scientific Professions |
| **SAIAB** | South Africa Institute of Aquatic Biodiversity |
| **SAIIAE** | South Africa Inventory of Inland Aquatic Ecosystems |
| **SANBI** | South African National Biodiversity Institute |
| **SAS** | Scientific Aquatic Services |
| **SASSO** | South African Soil Surveyors Association |
| **SQR** | Sub quaternary catchment reach |
| **subWMA** | Sub-Water Management Area |
| **WetVeg Groups** | Wetland Vegetation Groups |

| | |
|---|---|
| **WMA** | Water Management Areas |
| **WMS** | Water Management System |
| **WRC** | Water Research Commission |
| **WULA** | Water Use License Application |
| **ZOR** | Zone Of Regulation |

# 1 INTRODUCTION

## *1.1 Background*

Scientific Aquatic Services (SAS) was appointed to conduct a watercourse ecological assessment as part of the Environmental and Water Use Authorisation processes for the proposed ventilation shafts and associated infrastructure (surface main fans, electrical rooms, and bulk air cooler), as well as powerlines, pipelines and product stockpile at Marula Platinum Mine, Limpopo Province. The proposed development footprint will henceforth be referred to as the “Focus Area”.

In order to identify all possible watercourses that may potentially be impacted by the proposed project, a 500 m “zone of investigation” around the Focus Area, in accordance with Regulation 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 environment. This area – i.e., the 500 m zone of investigation around the Focus Area - will henceforth be referred to as the “investigation area” (Figure 1 and 2).

The purpose of this report is to define the ecology of the Focus Area in terms of watercourse characteristics, including mapping of the watercourses, discuss key ecological drivers and to define the Present Ecological State (PES) and the socio-cultural and ecological service provision of the watercourses utilising current industry “best practice” assessment methods, in order to ascertain what, if any, impact the proposed mining related activities will have on the watercourses associated with the Focus Area. Additionally, this report aims to define the Recommended Management Objectives (RMO) and Recommended Ecological Category (REC) for the watercourses. It is a further objective of this study to provide detailed information when considering the proposed mining related activities in the vicinity of the watercourses, to ensure the ongoing functioning of the ecosystem, 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.

This report, after consideration and a description of the ecological integrity of the Focus Area, must guide the Environmental Assessment Practitioner (EAP) and relevant authorities, by means of a reasoned opinion and recommendations, as to the viability of the proposed mining related activities from a watercourse management point of view.

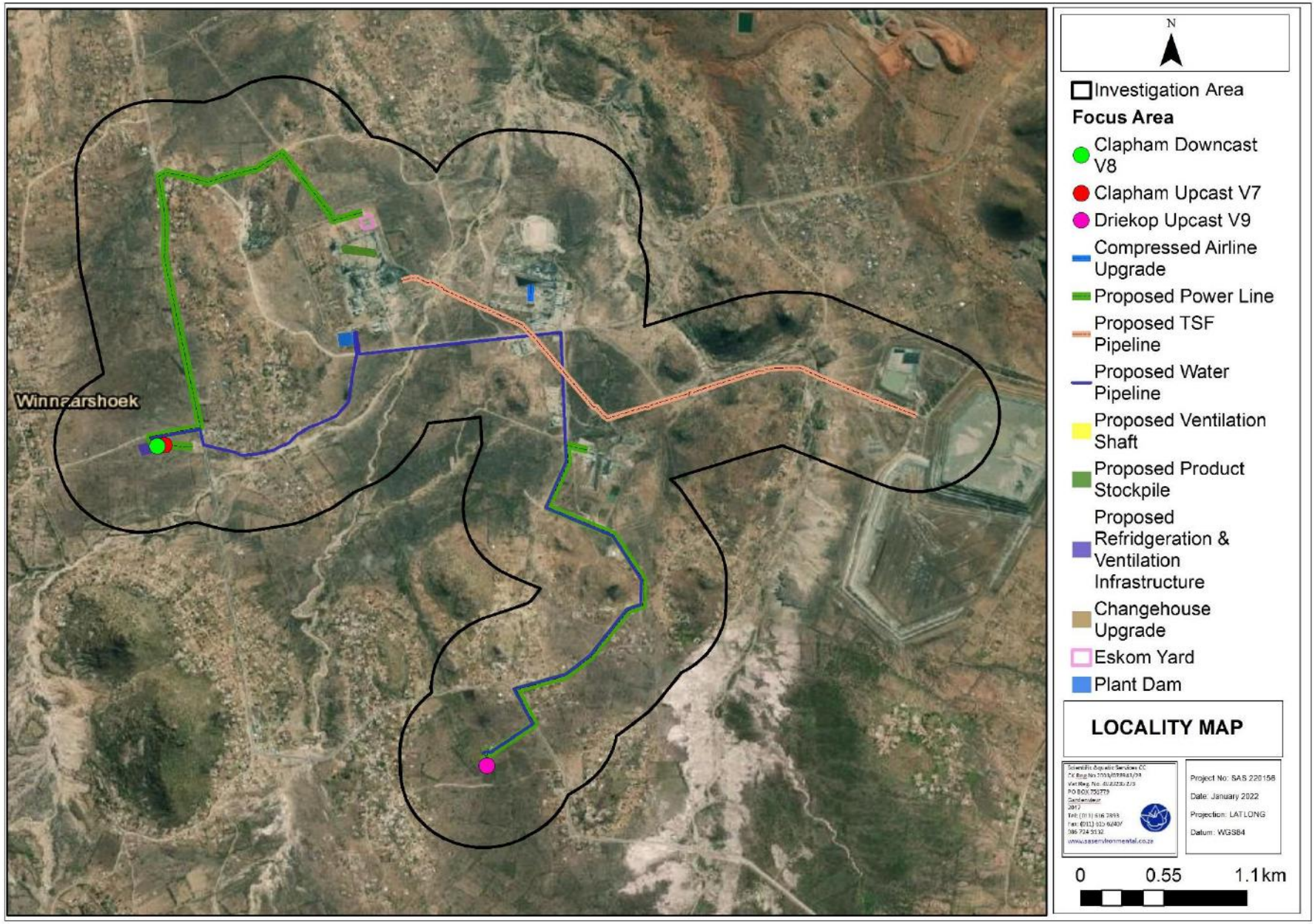



**Figure 1: A digital satellite image depicting the location of the Focus Area and investigation area in relation to the surrounding area.**

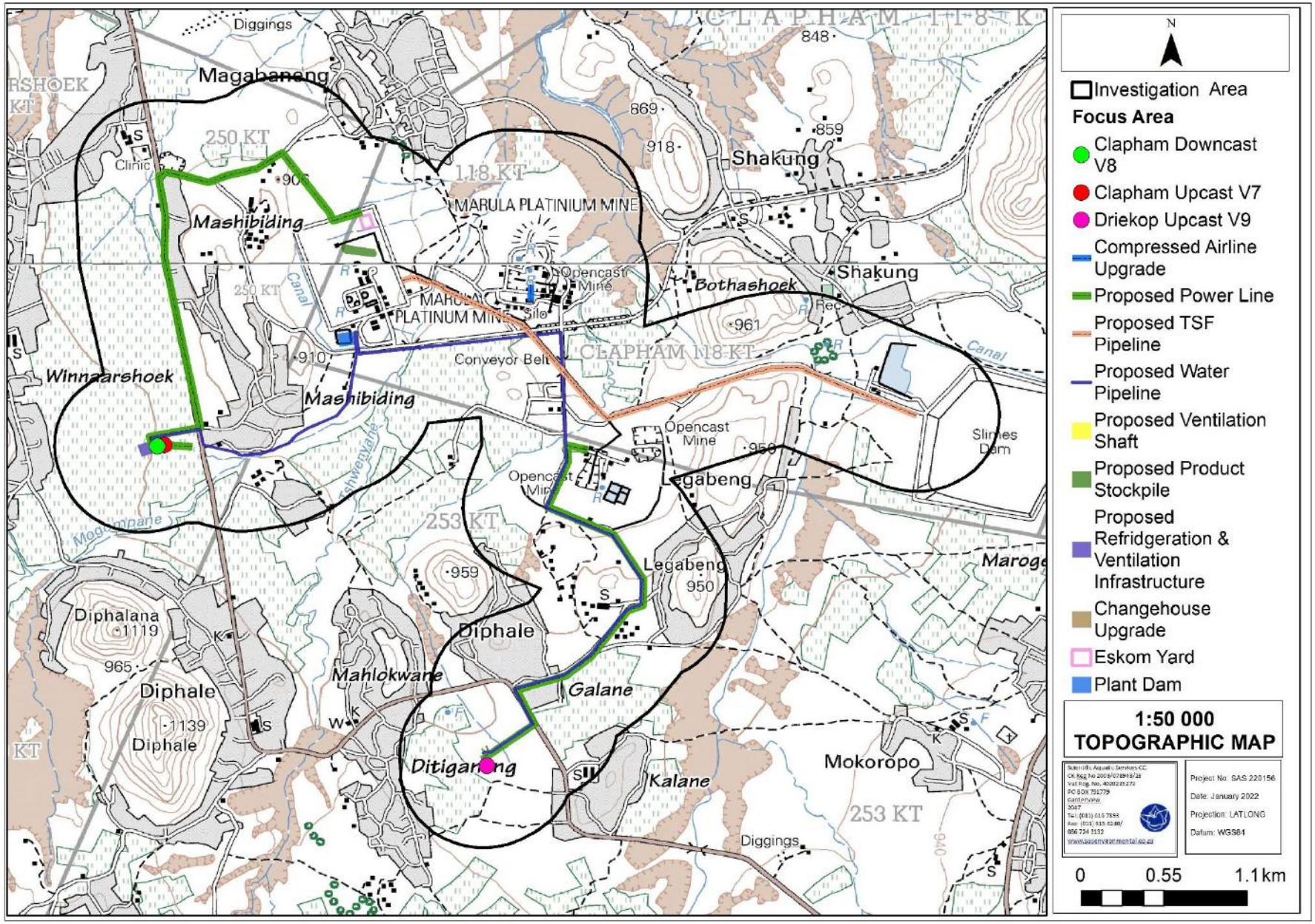



**Figure 2: The Focus Area and investigation area depicted on a 1:50 000 topographical map in relation to the surrounding area.**

## 1.2 Scope of Work

Specific outcomes in terms of this report are outlined below:

- A background study of relevant national, provincial, and municipal datasets (such as the National Freshwater Ecosystem Priority Areas [NFEPA] (2011) database, the Department of Water and Sanitation Research Quality Information Services [DWS RQIS PES/EIS] (2014) database, National Biodiversity Assessment (NBA) (2018), Limpopo Conservation Plan (2013) and the Mining and Biodiversity Guidelines (2013) was undertaken to aid in defining the PES of the watercourses;
- All watercourses within the investigation area were delineated using desktop methods in accordance with GN509 of 2016 as it relates to activities as stipulated in the National Water Act, 1998 (Act No. 36 of 1998) and verified according to the Department of Water Affairs and Forestry (DWAF)[1] (2005)[2]: "A practical field procedure for identification of wetlands and riparian areas". Aspects such as soil morphological characteristics, vegetation types and wetness were used to verify the watercourses;
- The watercourse classification assessment was undertaken according to the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems (Ollis *et al*., 2013);
- The EIS of the watercourses were determined according to the method described by Rountree & Kotze, (2013);
- The PES of the watercourses was assessed according to the resource directed measures guideline as advocated by Kleynhans *et al* (2008);
- The watercourses were mapped according to the ecological sensitivity of each hydrogeomorphic unit in relation to the Focus Area. In addition to the watercourse boundaries, the appropriate provincial recommended buffers and legislated zones of regulation were depicted where applicable;
- Allocation of a suitable Recommended Management Objective (RMO), Recommended Ecological Category (REC) and Best Attainable State (BAS) to the watercourses based on the results obtained from the PES and EIS assessments;
- The impact assessment was undertaken according to a pre-defined impact assessment methodology specifically designed to address risks to biodiversity; and

[1] The Department of Water Affairs and Forestry (DWAF) was formerly known as the Department of Water Affairs (DWA) and subsequently as the Department of Water and Sanitation (DWS). At present, the Department is known as the Department of Human Settlements, Water and Sanitation (DHSWS). 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.

[2] Even though an updated manual is available since 2008 (Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas), this is still considered a draft document currently under review.

- To present management and mitigation measures which should be implemented during the various development phases to assist in minimising the impact on the receiving environment.

## *1.3 Assumptions and Limitations*

The following assumptions and limitations are applicable to this report:

- The determination of the watercourse boundaries and the assessment thereof, is confined to the Focus Area. The watercourses within 500m of the Focus Area were delineated in fulfilment of Regulation GN509 of 2016 as it relates to the National Water Act using various desktop methods including use of topographic maps, historical and current digital satellite imagery, and aerial photographs. The general surroundings were, however, considered in the desktop assessment of the Focus Area;
- It is important to note that although all data sources used provide useful and often verifiable, high-quality data, the various databases used do not always provide an entirely accurate indication of the actual site characteristics within the Focus Area at the scale required to inform the Environmental Impact Assessment (EIA) process. However, this information is considered to be useful as background information to the study and, based on the results of the site investigation in conjunction with desktop results, informed decision making can take place with regards to the proposed development activities;
- Use was made of aerial photographs, digital satellite imagery as well as provincial and national wetland databases to identify areas of interest prior to the field survey. Any additional wetland areas, watercourses and drainage lines noted during the field survey were also assessed and added to the number of survey points. Although all possible measures were undertaken to ensure all watercourses were assessed and delineated, some smaller non-perennial/ ephemeral features may have been overlooked; However, if the sensitivity map is consulted during the planning phases of the mine expansion, the majority of watercourse/riparian habitat considered to be of increased EIS will be safeguarded;
- Global Positioning System (GPS) technology is inherently inaccurate and some inaccuracies due to the use of handheld GPS instrumentation may occur. If more accurate assessments are required the watercourse will need to be surveyed and pegged according to surveying principles and with survey equipment. If more accurate assessments are required the riparian zones and non-perennial/ ephemeral drainage line features will need to be surveyed and pegged according to surveying principles. The delineations are however deemed sufficiently accurate to ensure that the riparian

resources are adequately protected if the management and mitigation measures of this report are adhered to and adequate buffers are implemented;

- Aquatic habitats, wetlands 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. It is, however, expected that the watercourses within the Focus Area have been accurately assessed and considered, based on the field observations undertaken in terms of the watercourse ecology.

## *1.4 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:

- Constitution of the Republic of South Africa, 1996[3];
- The National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA);
- Environmental Impact Assessment (EIA) Regulations, 2014 as it relates to the National Environmental Management Act, 1998 (Act No. 107 of 1998);
- The National Water Act, 1998 (Act No. 36 of 1998);
- Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998);
- Government Notice 704 as published in the Government Gazette 20119 of 1999 as it relates to the National Water Act, 1998 (Act No. 36 of 1998);
- The National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA);
- The National Environmental Management: Biodiversity Act, 2014 (Alien and Invasive Species Regulations, 2014);
- The Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA)*;* and
- Limpopo Environmental Management Act, 2003, (Act No. 7 of 2003) (LEMA).

[3] 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.

# 2 PROJECT DESCRIPTION

The Marula Platinum Mine (hereafter 'Marula') is situated along the western side of the R37, near Burgersfort, and falls within the Tubatse Local Municipality (LM), within the Sekhukune District Municipality (DM) in the Limpopo Province. The Focus Area is approximately 3.2 km south of the town of Ga-Kgoete and approximately 11 km north from the town of Driekop.

Marula now proposes to change their approved layout by establishing additional surface infrastructure, which will require an amendment to Marulas' approved EMPr. The proposed additional surface infrastructure comprises the following:

- The establishment of two additional ventilation shafts.
- The upgrade to refrigeration and ventilation infrastructure at existing ventilation shafts.
- The establishment of additional water pipelines to support the additional ventilation shafts.
- The expansion and establishment of additional power supply and distribution infrastructure in support of the establishment of additional ventilation shaft and upgrades to existing ventilation shafts).
- The establishment of a product stockpile within the existing footprint of the Concentrator Plant.
- The establishment of an additional pipeline to the approved Tailings Storage Facility (TSF).
- Structural upgrades of the existing change house and compressed airline at the Clapham Shaft Complex.

## *2.1 Ventilation shafts and upgrades to refrigeration infrastructure*

Marula proposes to establish two new additional ventilation shafts within their existing MRA. An upcast and downcast shaft is proposed. The downcast shafts are used to draw clean air into the underground mine workings, whilst the upcast shaft will vent the "dirty/used" air to the surface. There are also existing ventilation shafts on Driekop 253 KT (Ventilation Shaft 6) and Winnarshoek 250 KT (Ventilation Shaft 5). Ventilation Shaft 7 (located on Winnarshoek 250 KT) was approved as part of the Merensky Reef project but is not constructed to date. An overview of these activities is summarised in Tables 1 and 2 below.

**Table 1: Proposed ventilation infrastructure**

| Aspect | Detail | |
|---|---|---|
| Proposed establishment of new ventilation shafts - Driekop Shaft | Name | Ventilation Shaft 9. |
| | Location | Driekop 253 KT (Portion 0) |
| | Footprint | Within approved footprint of Driekop Shaft 6. |
| | Technology | Upcast shaft. |
| | Refrigeration or ventilation infrastructure | Establishment of a new ventilation shaft with surface main fans and electrical rooms. |
| Proposed establishment of new ventilation shafts - Clapham Shaft | Name | Ventilation Shaft 8. |
| | Location | Winnarshoek 250 KT (Portion 0) |
| | Footprint | Approximately 0.5 ha. |
| | Technology | Downcast shaft. |
| | Refrigeration or ventilation infrastructure | Establishment of a new bulk air cooler.<br>Establishment of refrigeration plant and condenser cooling towers. |

**Table 2: Proposed upgrades of ventilation and refrigeration infrastructure**

| Aspect | Detail | |
|---|---|---|
| Proposed changes and upgrades at existing infrastructure - Driekop Shaft | Name | Ventilation Shaft 6 |
| | Refrigeration or ventilation infrastructure | Establishment of a new bulk air cooler.<br>Establishment of a refrigeration plant and condenser cooling towers. |
| | Location of infrastructure | Driekop 253 KT (Portion 0) |
| | Footprint | Within the existing, approved footprint of the Driekop VS 6 shaft area. |
| Proposed changes and upgrades at existing infrastructure - Clapham Shaft | Name | Ventilation Shaft 5 |
| | Refrigeration or ventilation infrastructure | Establishment of a new bulk air cooler. |
| | Location of infrastructure | Winnarshoek 250 KT (Portion 0) |
| | Footprint | Within the existing, approved footprint of the Clapham VS 5 shaft area. |
| | Name | Ventilation Shaft 7<br>(Approved but not constructed) |
| | Refrigeration or ventilation infrastructure | Establishment of surface main fans and electrical rooms. |
| | Location of infrastructure | Winnarshoek 250 KT (Portion 0) |
| | Footprint | Approximately 1.8 ha. |

## 2.2 Upgrades of existing services and infrastructure

*Water supply and distribution*

*Water supply*: Raw water required for the proposed project will be sourced from the existing on-site Lebalelo Raw Water Dam (Plant Dam). Marula has sufficient capacity and volume to accommodate the proposed project water requirements and as such no changes are anticipated to the existing water reticulation storage capacities (Plant Dam) or supply demand.

*Distribution*: The proposed project will require the establishment of pipelines from the Plant Dam to the new ventilation shafts (Driekop Ventilation Shaft 9 and Clapham Ventilation Shaft 8). The proposed HDPE pipelines will have a diameter of approximately 150 mm (0.15 cm) and will be below ground. The proposed pipeline to the Clapham Ventilation Shaft 8 will be approximately 2.1 km in length with a throughput of 24 l/s. The proposed Driekop Ventilation Shaft 9 pipeline will be approximately 5.2 km in length with a throughput of 24 l/s. The water supply pipeline will be fed into the plant room and subsequently through to the cooling tower. The establishment of the proposed Driekop water supply pipeline will have a total area of disturbance of 5 250 $m^2$/ 0.525 Ha. The establishment of the proposed Clapham water supply pipeline will have a total area of disturbance of 13 000 $m^2$ / 1.3 Ha.

*Wastewater:* Wastewater which contains an elevated salt concentration will emanate from the refrigeration process. This wastewater will be pumped into a surface sump (with approximate dimension of 2 m by 2 m). A return pipeline of approximately 50 mm will carry this wastewater back to the Concentrator Plant. The return pipeline will be located within the same below ground trench as the water supply pipeline to the ventilation shafts and will thus not result in any additional land clearance.

*Power supply and transmission*

*Supply*: Power is currently supplied to the mine by a consumer Eskom substation which is comprised of 2 x 20 MVA transformers. The power demand is expected to exceed the output from the 2 x 20 MVA transformer in 2025. In addition, the power requirements for the establishment of the new Clapham Ventilation Shaft 8 will need to be accommodated. Marula therefore proposes to increase the existing Eskom yard capacity to 60 MVA by the addition of a 40 MVA transformer. The running load will be 54 MVA. Existing power supply infrastructure is sufficient to support the project components at the remaining ventilation shafts.

*Distribution:* A new 33 kV overhead transmission line will be established from the on-site Eskom yard to the Clapham Ventilation Shaft 8. A new 33 kV overhead transmission line will also be established from the Driekop Shaft Complex to the new Driekop Ventilation Shaft 9, to supply the new ventilation shaft with power. The new 33 kV overhead transmission line will then be fed into a new step-down transformer located at the Clapham and Driekop ventilation shafts. The 33 kV will be stepped down to 11 kV and then fed into the plant room and ventilation fans. The lengths of the Clapham Ventilation Shaft 8 and the Driekop Ventilation Shaft 9 will be 3.8 km and 3.3 km, respectively.

*Disturbance to watercourses*: Watercourses within the proposed project area include the Tshwenyane, Mogompane, Motse Rivers and an unnamed tributary of the Moopetsi River (with riparian vegetation), as well as numerous non-perennial and ephemeral drainage lines. The proposed power distribution lines and tower bases will be located within 32 m the existing watercourses. A water use license (WUL) will need to be applied for due to this disturbance, however this will be undertaken separately from this Basic Assessment process.

## *2.3 Establishment of a product stockpile*

In order to alleviate storage capacity constraints experienced with their current operations, Marula proposes the establishment of an additional product stockpile. The additional product stockpile will reach a maximum capacity of 200 000 tons and will be located within the existing, disturbed footprint of the Concentrator Plant. The proposed location of the product stockpile is disturbed but unlined. The product material is similar to the mine's existing tailings and is considered low grade ore. The 2015 geochemical waste assessment undertaken by Golder (Golder, 2015) detailed that the tailings material is classified as a Type 3 waste. The results of the assessment indicated that $NO_3$ leachate concentrations exceeded the TCT0 threshold in two of the tailing composites. The material was reported to require a Class C liner. Marula will further investigate the liner requirements for the proposed stockpile as part of their WUL application which will be undertaken as a separate process.

**Figure 3: Conceptual design of the proposed product stockpile**

## 2.4 TSF pipeline

To increase the operational efficiency at the mine, an additional tailings conveyance pipeline is proposed. The proposed additional pipeline will follow the existing overland pipeline route which runs from the Concentrator Plant to the Phase 2 TSF. The additional pipeline will be 4 km in length with an internal diameter of 243 mm and comprised of HDPE lined steel.

The proposed alignment is shown in **Error! Reference source not found.** and detailed as follows:

| | |
|---|---|
| Start point | S24° 30' 3.762" E30° 4' 21.895" |
| Middle point | S24° 30' 30.037" E30° 5' 16.393" |
| End point | S24° 30' 32.641" E30° 6' 12.020" |

## 2.5 Upgrade to existing change house (including lamp room) and compressed airline

The current change house and lamp room at the Clapham Shaft Complex has reached its current capacity. An upgrade of the change house (and lamp rooms) is now proposed to accommodate an increase of the labour force for 600 people. The actual construction timeline

is expected to begin in 2024 / 2025. In addition to the upgrade of the Clapham change house, the existing 400 NB compressed air ring main from compressor house to Clapham UG mine will be upgraded from 400 NB to 600 NB. No change to the pipeline pressure is anticipated. The structural upgrades of the change house and compressed air ring main will be undertaken within the existing and disturbed Clapham Shaft Complex footprint and no additional land clearance will be required.

## *2.6 TSF contamination plume remediation*

Marula is investigating various methods of managing the contamination plume emanating from the existing Tailings Dam facility. The investigation of remediation measures is still in a feasibility phase due to budget constraints, as such there are no specific measures available. However, the approved EMPr requires an amendment to accommodate for the inclusion of management measures which are deemed feasible by Marula. The TSF contamination plume component is therefore only administrative at this stage.

# 3 ASSESSMENT APPROACH

## *3.1 Watercourse Field Verification*

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

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

**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".

**Regulated Area of a watercourse as defined by Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act (Act No. 36 of 1998) (NWA):**

(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 or dam;
(b) In the absence of a determined 1 in 100-year flood line or riparian area the area within 100m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or
(c) A 500 m radius from the delineated boundary (extent) of any wetland or pan."

A field assessment was undertaken in November 2020 to conduct a watercourse delineation and ecological assessment. The delineation of the identified watercourses took place, as far as possible, according to the method presented in the "Updated manual for the identification and delineation of wetland and riparian resources" (DWAF, 2008). The foundation of the method is based on the fact that watercourses have several distinguishing factors including the following:

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

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

## *3.2 Sensitivity Mapping*

The watercourses associated with the Focus Area were delineated with the use of a Global Positioning System (GPS). Geographic Information System (GIS) was used to project the watercourses onto digital satellite imagery and topographic maps. The sensitivity map

presented in Section 5.4 should guide the design and layout of the proposed project components.

## 3.3 Risk Assessment and Recommendations

Following the completion of the assessment, a pre-determined impact assessment method and the DWS risk assessment matrix were undertaken (please refer to Appendix D for the methods of approach) and recommendations were developed to address and mitigate impacts associated with the proposed project components. These recommendations also include general 'best practice' management measures, which apply to the proposed mining associated activities as a whole and which are presented in Appendix F. Mitigation measures have been developed to address issues in all phases throughout the life of the operation including planning, construction and operation. The detailed site-specific mitigation measures are outlined in Section 6 of this report.

# 4 RESULTS OF THE DESKTOP ANALYSIS

## 4.1 Analyses of Relevant Databases

The following section contains data accessed as part of the desktop assessment and are presented as a "dashboard style" report below (Table 1). The dashboard report aims to present concise summaries of the data on as few pages as possible in order to allow for integration of results by the reader to take place.

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 Focus 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 assessment and to focus on areas and aspects of increased conservation importance during the site assessment.

**Table 3: Desktop data relating to the character of watercourses associated with the Focus Area and surrounding region.**

| Aquatic ecoregion and sub-regions in which the Focus Area is located | | Detail of the Focus Area in terms of the National Freshwater Ecosystem Priority Area (NFEPA) (2011) database | |
|---|---|---|---|
| Ecoregion | Eastern Bankenveld | Wetland Vegetation Type | The Focus Area is located within an Upstream Management Catchment which is required to prevent the downstream degradation of Freshwater Ecosystem Priority Areas (FEPAs) and Fish Support Areas (FSAs). |
| Catchment | Olifants – North | | |
| Quaternary Catchment | B71E | | |
| WMA | Olifants | NFEPA Wetlands (Figures 3) | According to the NFEPA Database there are three artificial unchanneled valley-bottom wetlands in heavily or critically modified condition (WETCON= Z3) within the investigation area. These were identified during the site assessment and were found to be impoundments related to mining infrastructure. |
| subWMA | Middle Olifants | Wetland Vegetation Type | The Focus Area is situated within the Central Bushveld Group 7 Wetland Vegetation Type, considered least threatened as provided by Mbona *et al.* (2015). |
| Dominant characteristics of the Eastern Bankenveld Ecoregion Level 2 (9.03) (Kleynhans *et al.,* 2007) | | | |
| Dominant primary terrain morphology | Closed Hills, Mountains; moderate and high relief, Low mountains | NFEPA Rivers (Figures 3) | The Moopetsi River is situated approximately 1 km east of the Focus Area. According to the NFEPA Database the river is largely modified (RIVCON= D) and the PES 1999 considers the river to be moderately modified (Class= C). |
| 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 | Detail of the Focus Area in terms of the Limpopo Conservation Plan (2013) | |
| Rainfall seasonality | Early summer | Ecological Support Areas (Figure 5) | According to the Limpopo Conservation Plan, the majority of the Focus Area falls within an area classified as an Ecological Support Area 1. Small portions to the west and a portion of the south of the Focus Area fall within an area classified as an Ecological Support Area 2. Ecological Support Areas are areas that are not essential for meeting biodiversity targets but play an important role in supporting the functioning of Priority Areas or Critical Biodiversity Areas and are often vital for delivering ecosystem services. |
| Mean annual temp. (°C) | 14 to 22 | | |
| Winter temperature (July) (°C) | 2 – 20 | | |
| Summer temperature (Feb) (°C) | 12 – 30 | | |
| Median annual simulated runoff (mm) | 20 to 150 | | |
| National Biodiversity Assessment (2018): South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (Figure 4) | | | |
| According to the NBA 2018: SAIIAE The Moopetsi River is situated approximately 1 km east of the Focus Area and considered largely modified (RIVCON= D) (PES 1999 Class is considered to be moderately modified (C) and the PES 2018 Class is considered to be seriously modified (E)). The Moopetsi is critically endangered (Ecosystem Threat Status) and is poorly protected (Ecosystem Protection Level). Furthermore, two dams and a number of reservoirs are indicated to be within the investigation area. | | | |
| National web based environmental screening tool (2020) | | | |
| The screening tool is intended for pre-screening of sensitivities in the landscape to be assessed within the EIA process. This assists with implementing the mitigation hierarchy by allowing developers to adjust their proposed development footprint to avoid sensitive areas. The Focus Area does not fall within one of the sensitivity categories screened by the tool. | | | |
| Importance of the Focus Area according to the Mining and Biodiversity Guidelines (2013) (Figure 7). | | | |
| The majority of the Focus Area falls 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 necessary authorisations. A small portion of the Focus Area falls within an area considered to be of High Biodiversity Importance. High biodiversity importance areas may limit mining options. Mining should be tightly controlled as these areas are important for conserving biodiversity, for supporting or buffering the biodiversity priority areas, for maintaining important ecosystem services for particular communities or the country as a whole. | | | |

**CVB = Channelled Valley Bottom; DWS = Department of Water and Sanitation; EI = Ecological Importance; EPL = Ecosystem Protection Level; ES = Ecological Sensitivity; ESA = Ecological Support Area; ETS = Ecosystem Threat Status; FEPA = Freshwater Ecosystem Priority 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 Africa Inventory of Inland Aquatic Ecosystems; WMA = Water Management Area**

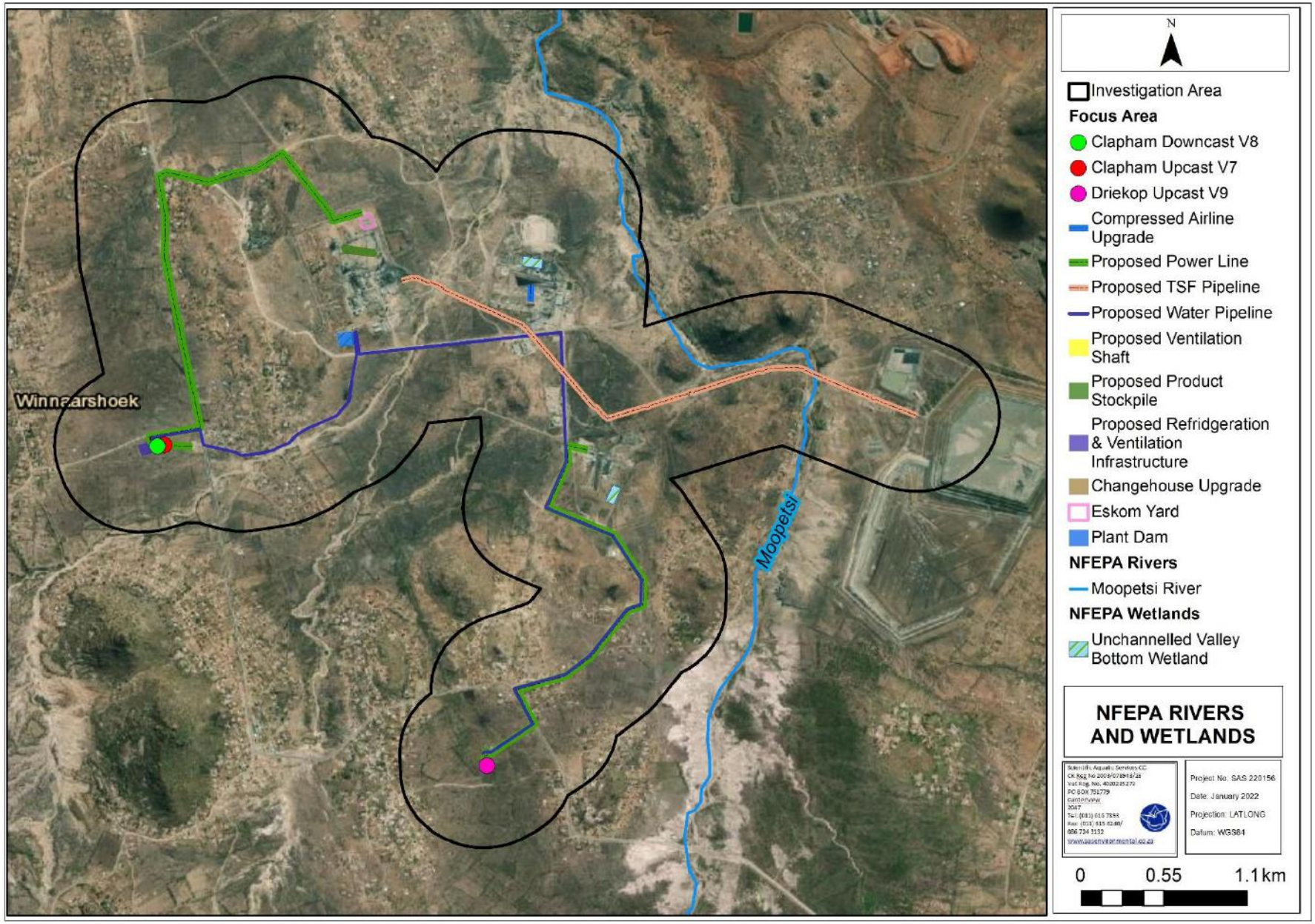



**Figure 4: The Moopetsi River and artificial wetland features associated with the Focus Area and investigation area as indicated by NFEPA (2011).**

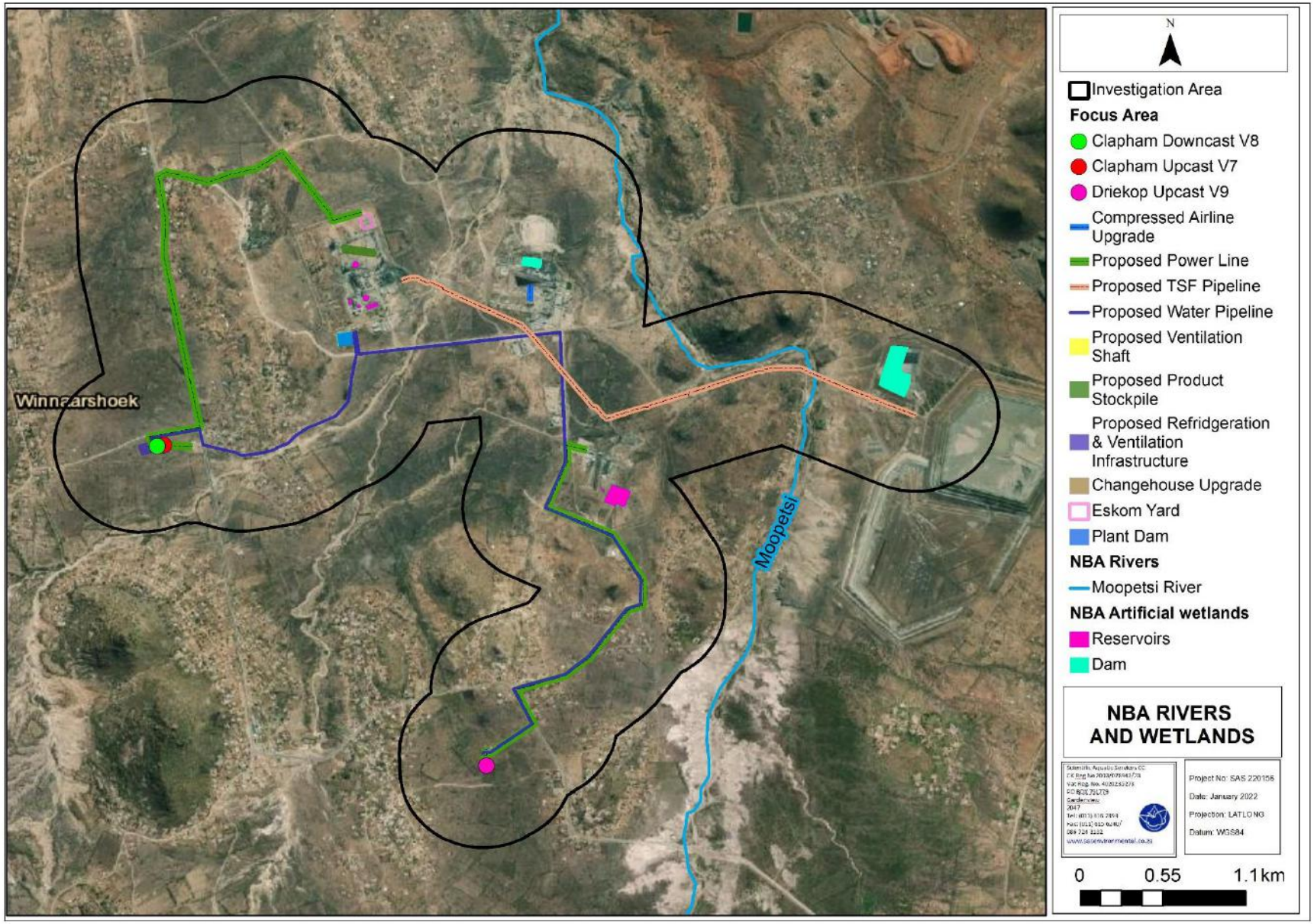



**Figure 5: Wetland and river features associated with the Focus Area and investigation area, according to the National Biodiversity Assessment: South African Inventory of Inland Aquatic Ecosystems (NBA: SAIIAE, 2018).**

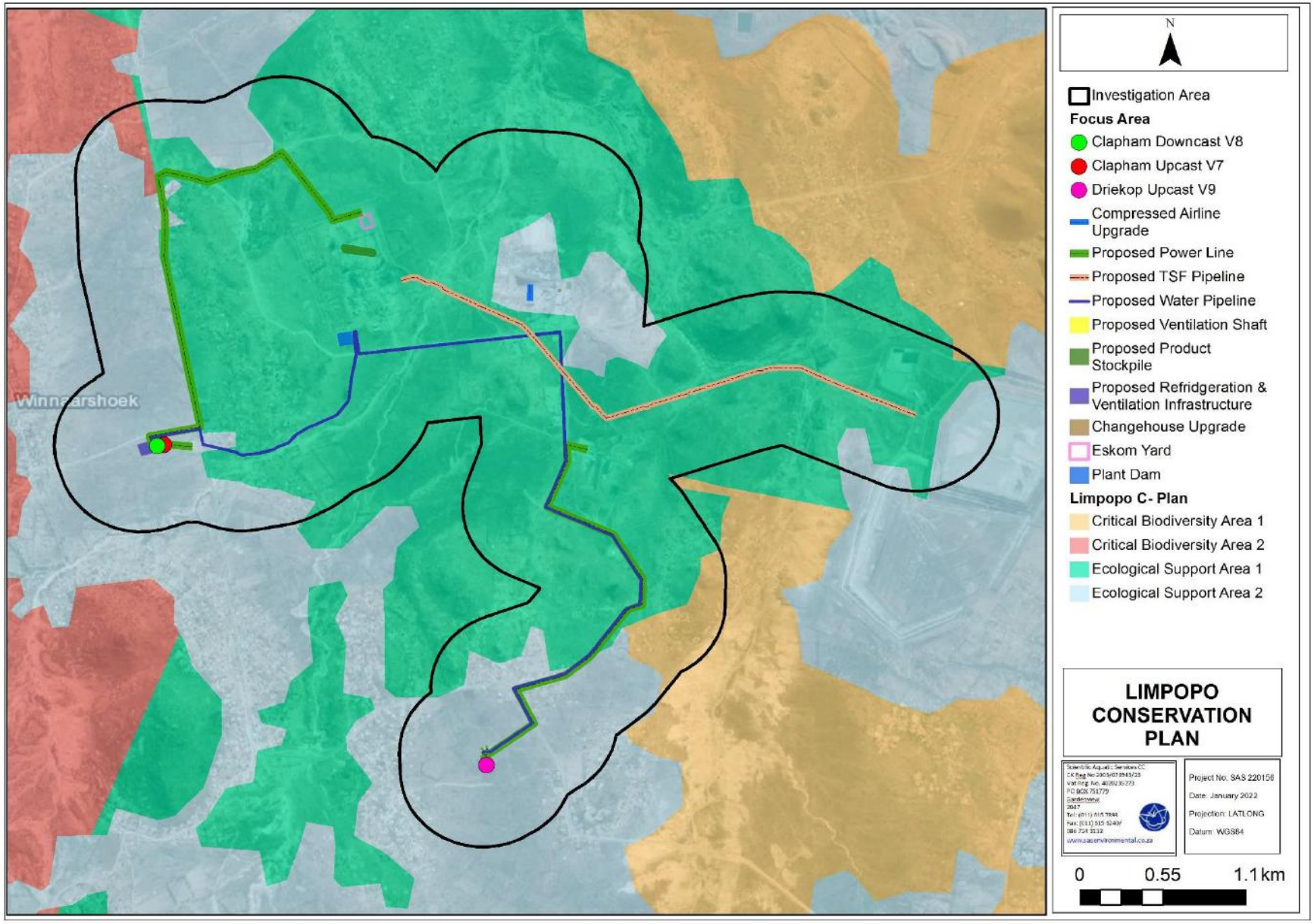



**Figure 6: Critical Biodiversity Areas and Ecological Support Areas associated with the Focus Area according to the Limpopo Conservation Plan V2 (2013).**

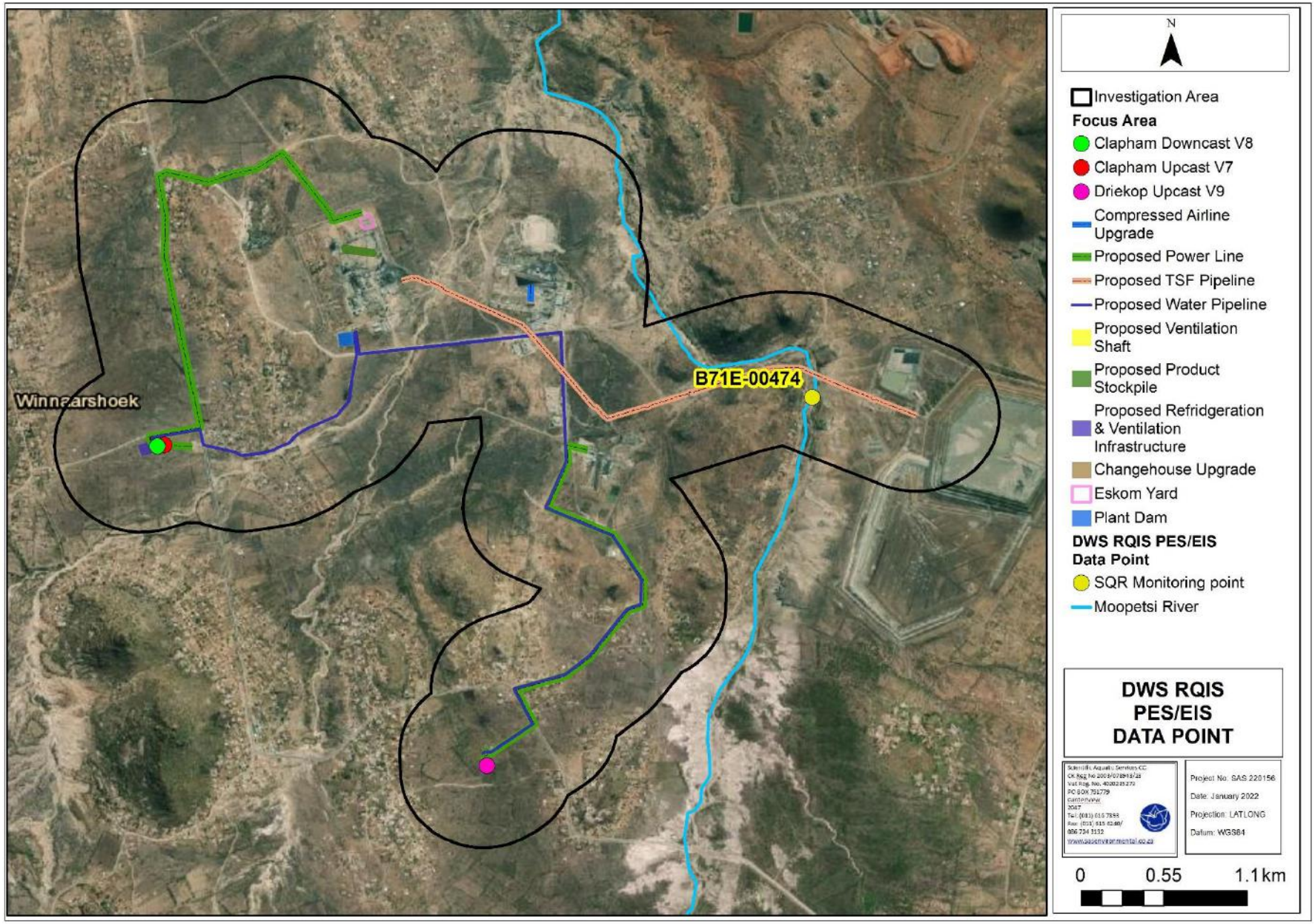



**Figure 7: Relevant Sub-Quaternary Catchment Reach (SQR) associated with the Focus Area and investigation area.**

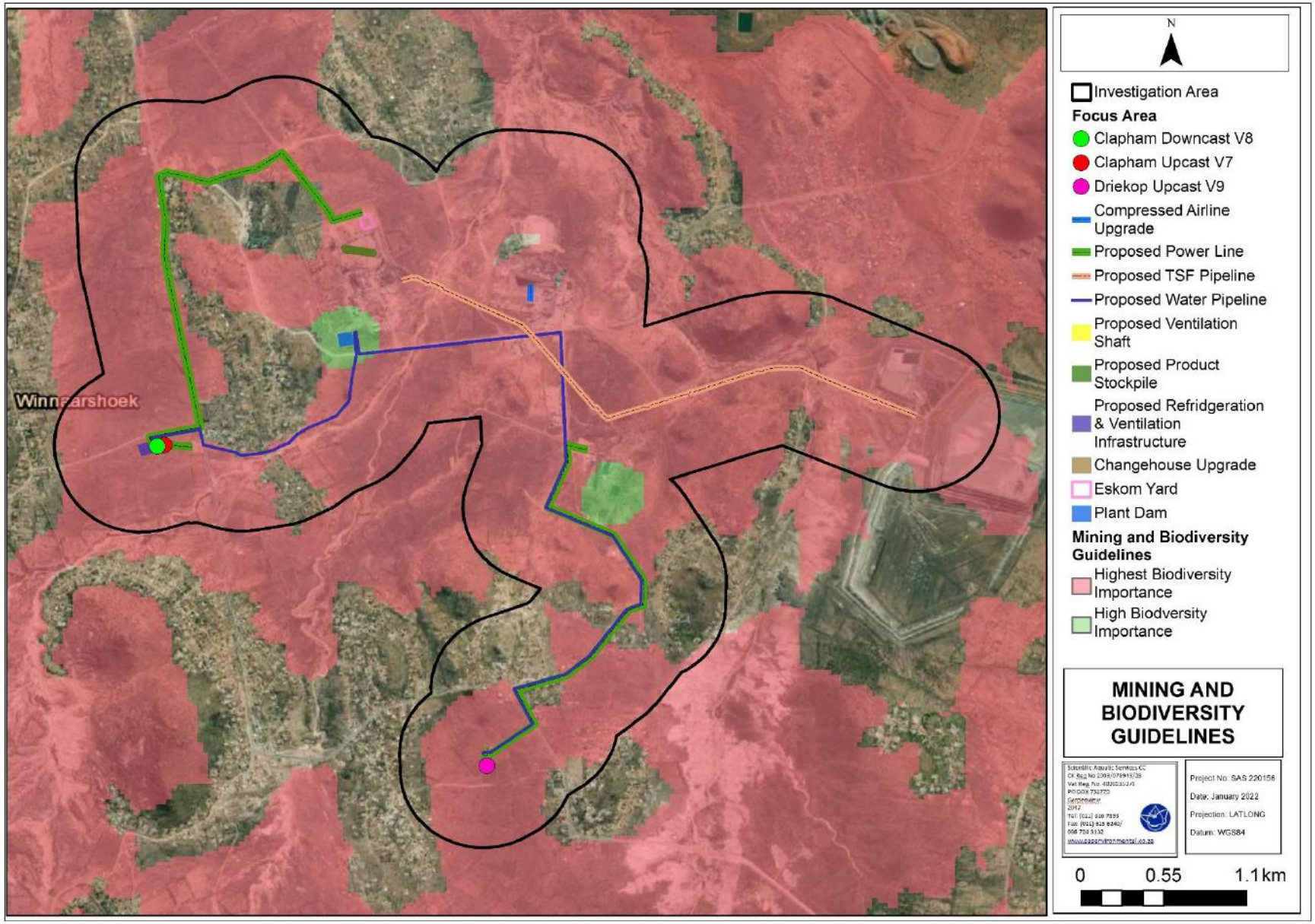



**Figure 8: Biodiversity importance associated with the Focus Area according to Mining and Biodiversity guidelines (2013).**

## 4.2 Ecological status of sub-quaternary catchments [Department of Water and Sanitation (DWS) Resource Quality Services (RQS) PES/EIS database]

The PES/EIS database, as developed by the DWS RQS department, was utilised to obtain additional background information on the project area. The information from this database is based on information at a sub-quaternary catchment reach (subquat reach) level, with the descriptions of the aquatic ecology based on the information collated by the DWS RQIS department from all reliable sources of information such as SA RHP sites, Ecological Water Requirement (EWR) sites and Hydro Water Management System (WMS) sites.

Key information on background conditions of the reach of the Moopetsi River associated with the Focus Area, as contained in this database and pertaining to the Present Ecological State (PES), ecological importance and ecological sensitivity for the sub-quaternary catchment reach (SQR) Moopetsi River (B71E-00474) is tabulated in Table 2. Based on the PES/EIS database no fish species or macro-invertebrate species have been recorded for the Moopetsi River at B71E-00474.

**Table 4: Summary of the ecological status of the sub-quaternary catchment (SQ) reach Moopetsi River (B71E-00474) based on the DWS RQS PES/EIS database.**

| **Synopsis (SQ reach Moopetsi River (B71E-00474))** | | | | | |
|---|---|---|---|---|---|
| **PES[1] category median** | **Mean EI[2] class** | **Mean ES[3] class** | **Length** | **Stream order** | **Default EC[4]** |
| E (Seriously Modified) | Low | Low | 25,11 | 1 | D |
| **PES details** | | | | | |
| **Instream habitat continuity MOD** | | Large | **Riparian/wetland zone MOD** | | Serious |
| **RIP/wetland zone continuity MOD** | | Large | **Potential flow MOD activities** | | Moderate |
| **Potential instream habitat MOD activities** | | Serious | **Potential physico-chemical MOD activities** | | Serious |
| **EI details** | | | | | |
| **Fish spp/SQ** | | na | **Fish average confidence** | | na |
| **Fish representivity per secondary class** | | na | **Fish rarity per secondary class** | | na |
| **Invertebrate taxa/SQ** | | na | **Invertebrate average confidence** | | na |
| **Invertebrate representivity per secondary class** | | na | **Invertebrate rarity per secondary class** | | na |
| **EI importance: riparian-wetland-instream vertebrates (excluding fish) rating** | | Very low | **Habitat diversity class** | | High |
| **Habitat size (length) class** | | Low | **Instream migration link class** | | Moderate |
| **Riparian-wetland zone migration link** | | Moderate | **Riparian-wetland zone habitat integrity class** | | Low |
| **Instream habitat integrity class** | | Low | **Riparian-wetland natural vegetation rating based on percentage natural vegetation in 500m** | | High |

| | | | |
|---|---|---|---|
| **Riparian-wetland natural vegetation rating based on expert rating** | | | Low |
| **ES details** | | | |
| **Fish physical-chemical sensitivity description** | na | **Fish no-flow sensitivity** | na |
| **Invertebrates physical-chemical sensitivity description** | na | **Invertebrates velocity sensitivity** | na |
| **Riparian-wetland-instream vertebrates (excluding fish) intolerance water level/flow changes description** | | | Very Low |
| **Stream size sensitivity to modified flow/water level changes description** | | | High |
| **Riparian-wetland vegetation intolerance to water level changes description** | | | Low |

**[1] PES = Present Ecological State; confirmed in database that assessments were performed by expert assessors;**
**[2] EI = Ecological Importance;**
**[3] ES = Ecological Sensitivity**

# 5 RESULTS: WATERCOURSE ASSESSMENT

## 5.1 Delineation

All features were delineated on a desktop level with the use of digital satellite imagery and topographical maps. Portions of the features were then verified during the field survey according to the guidelines advocated by DWA (2005) and the watercourse/riparian delineations as presented in this report are regarded as a best estimate of the temporary and riparian zone boundaries based on the site conditions present at the time of assessment. Ground-truthing of riparian boundaries focused on those areas within the investigation area of the proposed project components.

During the assessment, the following indicators were used to ascertain the boundaries of the temporary zones of the rivers with riparian characteristics and the ephemeral and non-perennial drainage lines without riparian zones:

- Terrain units were used as the primary indicator, as both soil profiles and vegetation communities have been transformed, and therefore it was difficult in many areas to discern riparian / drainage line boundaries utilising these indicators;
- Soil morphological characteristics were considered; however, the vertic soils within the study area do not show soil variations such as gleying (leaching out of iron). Therefore, this indicator was not used extensively to determine boundaries (particularly of the non-perennial and ephemeral drainage lines) as differences between terrestrial and wetland soils could not be reliably discerned using soil morphology; and
- Vegetation although transformed throughout the study area, was considered informative at many features, although in most instances degraded, the change in vegetation communities between terrestrial and riparian/wetland ecosystems was subtle (refer to photograph notes in Table 4).

## 5.2 Drainage System Characterisation

The Tshwenyane, Mogompane, Motse Rivers and an unnamed tributary of the Moopetsi River (with riparian vegetation), along with numerous non-perennial and ephemeral drainage lines without riparian characteristics and an artificial wetland in the vicinity of the proposed mining infrastructure were identified.

The aforementioned HGM units identified in the Focus Area were classified according to the Classification System (Ollis *et al.*, 2013) as Inland Systems, falling within the Eastern Bankenveld Aquatic Ecoregion, and within the Central Bushveld Group 7 WetVeg group,

classified by Mbona *et al.* (2015) as “Least Threatened”. At Levels 3 (Landscape Unit) and 4 (HGM Type) of the Classification System, the systems were classified as per the summary in Table 3 below.

**Table 5: Characterisation at Levels 3 and 4 of the Classification System of the riparian and wetland systems identified within the proposed investigation area.**

| Group | Level 3: Landscape unit | Level 4: Hydrogeomorphic (HGM) Unit Type |
|---|---|---|
| **Motse River** | **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. | **River:** a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water |
| **Tshwenyane River** | | |
| **Mogompane River** | | |
| **Unnamed tributaries of the Moopetsi River** | | |
| **Non-perennial drainage lines** | | |
| **Ephemeral drainage lines** | | |

The Moopetsi River is a major tributary, via the Matadi River, of the non-perennial Motse River, the catchment of which contributes to the Olifants River. The Mogompane River drains into the Tshwenyane, which in turn is a major tributary of the Moopetsi River. All of these rivers are non-perennial, characterized by stream bank incision particularly in areas which are heavily utilized by domestic livestock.

The ephemeral and non-perennial drainage lines may historically have possessed riparian vegetation, albeit weakly defined riparian zones. Due to impacts such as erosion (natural, but exacerbated by anthropogenic activities in the catchment), human activities such as harvesting firewood from woody species in the riparian zone and overgrazing or trampling by domestic livestock, the vegetation communities associated with these drainage lines have been extensively altered over a period of several years. At the time of assessment, no discernible riparian zones were noted, and therefore, the non-perennial and ephemeral drainage lines were not classified as riparian features in terms of the definition contained in DWAF (2008) and were thus excluded from detailed ecological assessments. Nevertheless, these systems convey water from the upgradient catchment to the downgradient watercourses, albeit intermittently, forming the headwaters of the riverine systems identified within the focus area. Based on the definition of a watercourse contained in the National Water Act, 1998 (Act No. 36 of 1998), these systems function as waterways and therefore enjoy legal protection.

The artificial wetlands identified by the NFEPA (2011) database were not assessed, as these are dams constructed specifically as part of the mining operations and were therefore not

considered relevant to this study. The artificial wetland was not identified by the NFEPA database and has been identified as a small depression-type wetland. The artificial wetland is located adjacent to a mining facility and formed when the old earthen dams associated with the mining activities were not decommissioned. Over a period of many years, water has collected within the former dams, and as there is not an efficient stormwater management system in place within the mining facility's parking / administration area, stormwater runoff collects in the "wetland", thus perpetuating the wetland conditions.

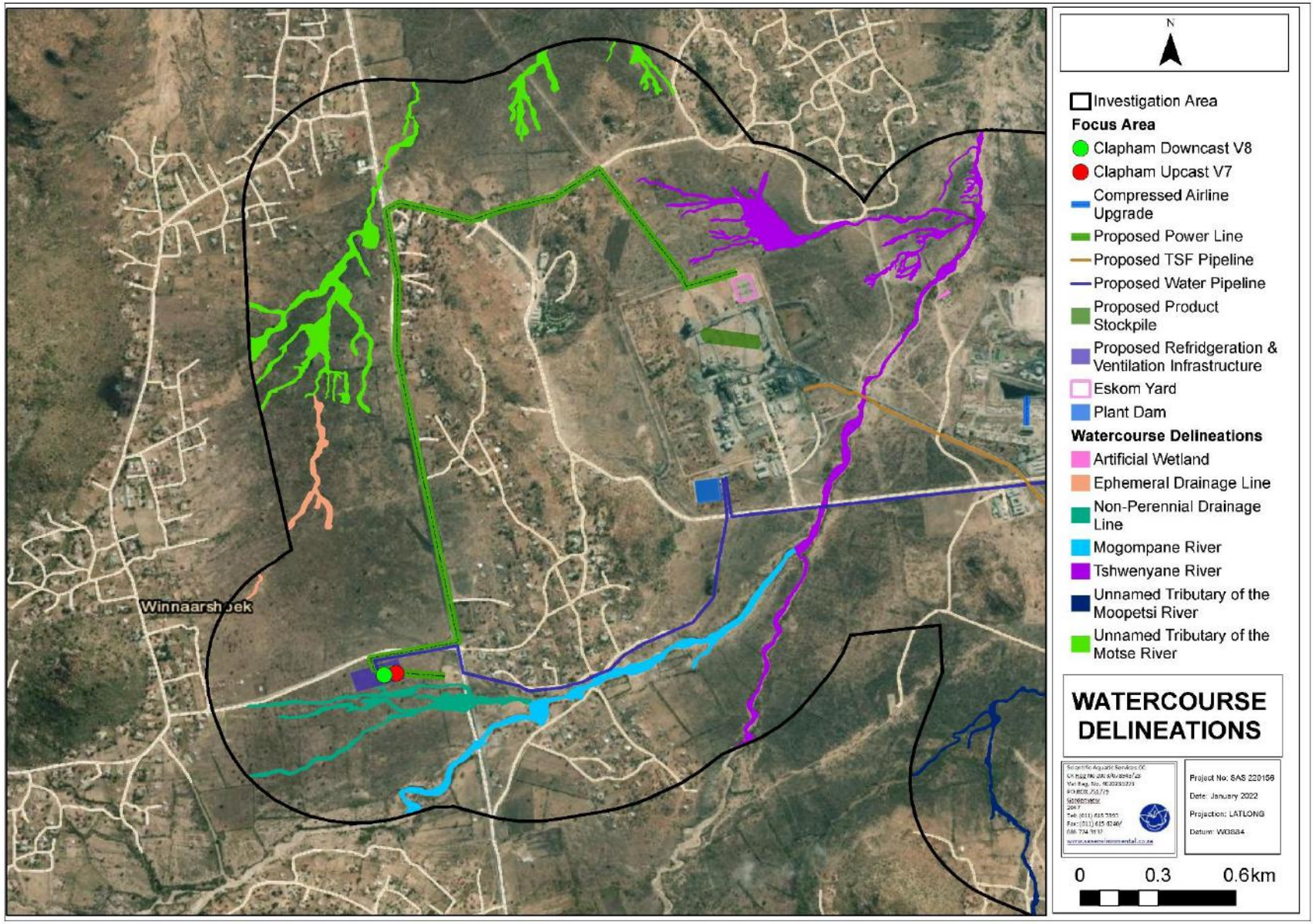



**Figure 9: Location of the watercourses within the northern portion of the Focus Area, in relation to the infrastructure.**

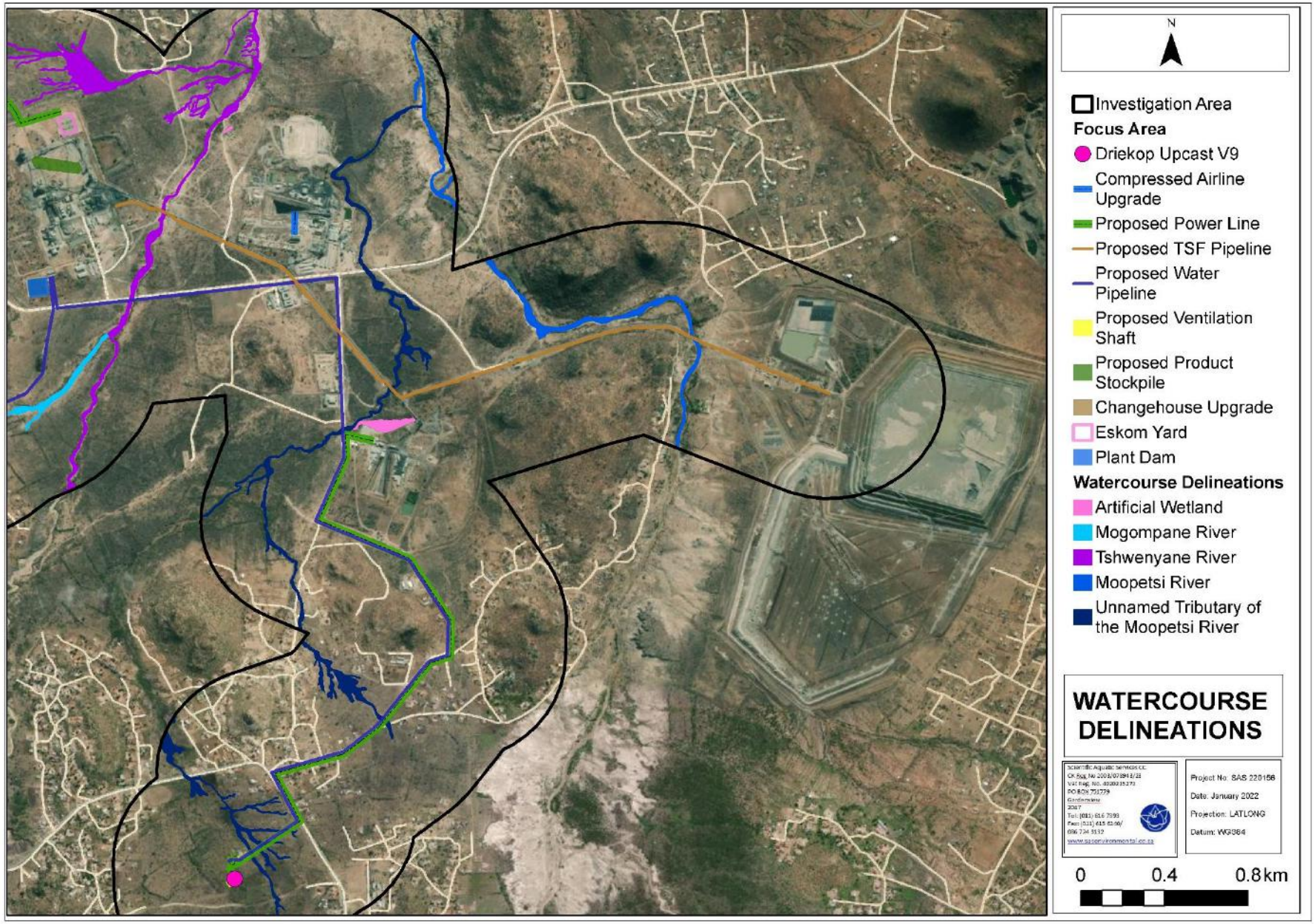



**Figure 10: Location of the watercourses within the southern portion of the Focus Area, in relation to the infrastructure.**

## 5.3 Field Verification Results

Following the site visit, various assessments were undertaken in order to determine the following:

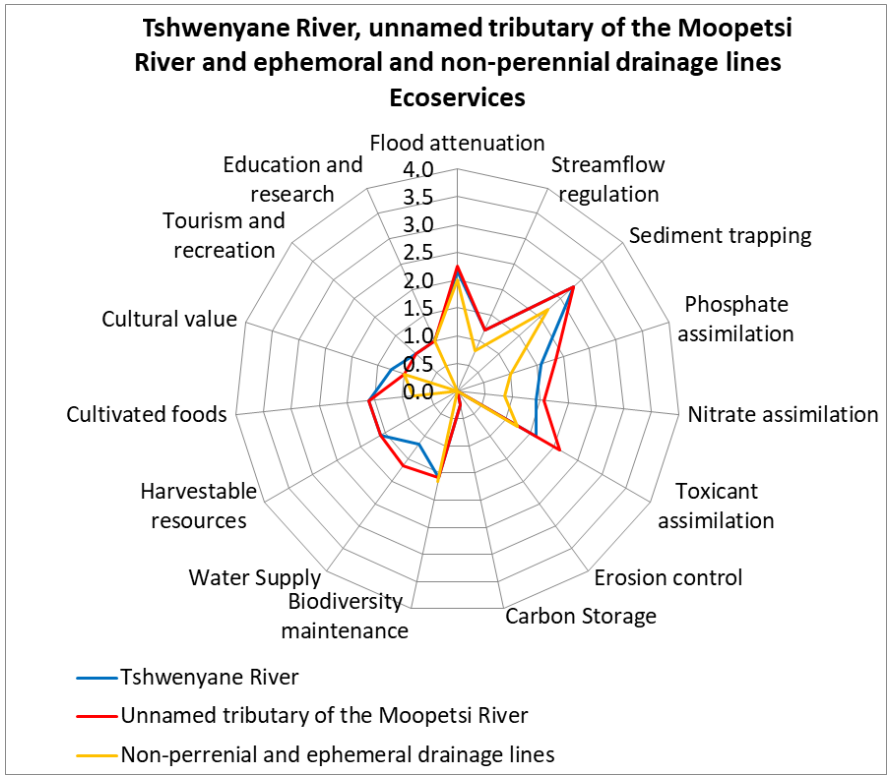
- PES, incorporating aspects such as hydrology, vegetation and geomorphology;
- Service provision of the watercourses, which incorporates aspects such as biodiversity maintenance, flood attenuation, streamflow regulation and assimilation, to name a few;
- The EIS is guided by the results obtained from the assessment of PES and service provision of the watercourses;
- An appropriate REC, RMO and BAS to guide the management of the watercourses. This is ideally assigned with the intent of enhancing the ecological integrity of the watercourse where feasible; and
- Assessment of impacts of the construction and operation of the proposed project components on the watercourse and receiving freshwater environment.

Watercourses within the 500 m investigation area were identified, however only portions located within the Focus Area were assessed and ground truthed and the potential impacts of activities such as livestock grazing, extensive erosion and clearing of natural vegetation within the greater catchment were taken into consideration during the assessment.

For the purposes of presenting a concise discussion, the Tshwenyane River, the unnamed tributary of the Moopetsi River and the non-perennial and ephemeral drainage lines, the results of the watercourse assessments are presented in one dashboard report below. The dashboard provides a summary of the ecological assessment of the watercourses in terms of relevant aspects (hydrology, geomorphology and vegetation components) associated with the watercourses. Due to the similar watercourse characteristics of the Tshwenyane River and unnamed tributary of the Moopetsi River and the fact that each of these watercourses have been subjected to the same anthropogenic impacts, the watercourses were assessed in a combined fashion. Further, the brief assessments of the ephemeral and non-perennial drainage lines were similarly combined. The details pertaining to the methodology used to assess the watercourses is contained in Appendix C.

**Table 6: Summary of the assessment of the Tshwenyane River, unnamed tributary of the Moopetsi River, and ephemeral and non-perennial drainage lines.**

**Ecological & socio-cultural service provision graph:**




**Photograph notes:** (Top left) The Tshwenyane River channel (with road crossing) associated with the location of the proposed water pipeline installation. (Top right) Non-perennial river channel showing vegetation presence of the Tshwenyane River. (Bottom left) Non-perennial drainage line at the proposed Clapham ventilation shaft, showing lack of riparian vegetation. (Bottom right) Non-perennial channel showing vegetation presence and degradation of the channel bank walls.

**Present Ecological State**

**Riparian IHI PES Category:**
**Unnamed tributary of the Moopetsi River: D**
**Tshwenyane River: D**

The IHI calculations for the unnamed tributary of the Moopetsi River, and the Tshwenyane River indicate that large modifications to the systems have occurred, and that the loss of natural habitat, biota and ecosystem functions is large. Historical and current small-scale agricultural activities, and the presence of mining activities within the Focus Area as well as the greater catchment area are the predominant modifiers to the systems. These factors, in conjunction with severely eroded soils within the systems, have resulted in

**Watercourse characteristics:**

**a) Hydraulic regime**

The extent to which hydrological regime and therefore related functions may have been altered as a result of in-stream placement of infrastructure such as bridge crossings is difficult to ascertain, since the watercourses are non-perennial/ ephemeral systems and very little to no flowing water was observed in any of the channels at the time of the assessment. However, it can be expected that flow patterns have been altered from their natural state as a result of infrastructure being placed within the active macro channels.

**b) Water quality**

There was insufficient water in the systems at the time of assessment to accurately sample water quality parameters, but that given the impacts in the catchment its likely to be impaired.

| | | |
|---|---|---|
| | loss of vegetation cover within the riparian zones, and where vegetation cover remains, the species composition consists primarily of alien vegetation or pioneer species. Loss of vegetation cover (in both the riparian and terrestrial ecosystems within the study area) and highly erodible soils has in turn led to severe bank incision and increased sediment inputs as a result of this are anticipated, thus altering the geomorphology of the systems. | **c) Geomorphology and sediment balance**<br>Channels of the unnamed tributary of the Moopetsi River were shallow to deep and channel incisions were present ranging from slightly to heavily incised banks. Channels of the Tshwenyane River were wide and relatively shallow with a mixture of alluvial sand and large sections of exposed bedrock. Due to the inherent erodibility of soils in the area, erosion has occurred in and around the watercourses associated with Focus Area, although anthropogenic influences have exacerbated it. Mining related activities such as increased traffic, within both the Focus Area and catchment area likely to be responsible for further sediment inputs, particularly from the gravel roads, which will be transported to the rivers in runoff during rainfall events. As the rivers are seasonal, additional sediment inputs to the channels may result in an accumulation of sediment, leading to blockages of culverts and smothering of instream vegetation. Increased runoff during rainfall events is likely, as the extent of hardened surfaces (rooftops, roads, paved parking areas associated with mining infrastructure) due to increased development within the catchment. Whilst additional water inputs originating from such runoff may alter hydrological patterns to some extent, such alterations are unlikely to be significant. However, as the soils are prone to erosion, increased runoff, particularly if it is channelled, may lead to further erosion of riparian areas. |
| **Ecoservice provision** | **EcoService provision Category**<br>**Unnamed tributary of the Moopetsi River: Intermediate**<br>**Tshwenyane River: Intermediate**<br>**Non-perennial and ephemeral drainage lines: Low**<br>As shown by these results, the two river systems are considered to provide intermediate levels of ecological functioning and service provision. Functions which are strongly dependent on the presence of surface water and/or long periods of saturation (i.e. a permanent zone) such as streamflow regulation, toxicant assimilation and provision of water for domestic use are likely to fluctuate seasonally, given the ephemeral nature of these rivers. Functions such as flood attenuation on the other hand are more efficient when the system is not already saturated, as there is greater capacity for the reduction of flood peaks when the system is dry. Biodiversity maintenance is considered to be intermediate within both systems, primarily due to the extent of these rivers, their connectivity to natural areas and the locality within a relatively undeveloped catchment. Nevertheless, bush encroachment and proliferation of alien vegetation as a result of removal of indigenous floral species (resulting in habitat loss), alteration of the sediment and water quality regime, and the seasonal nature of these rivers all contribute to a lowered importance in terms of maintenance.<br><br>The rivers were not considered to be important in terms of erosion control, considering the extensive bank erosion apparent at the time of the assessment. | **d) Habitat and biota**<br>Although the Mining and Biodiversity Guidelines (Table 1) indicate “high biodiversity importance” throughout the Focus Area, areas around the ventilation shafts were found to be degraded. The floral community structure, composition and species throughout the Focus Area, in both terrestrial and riparian ecosystems, has been significantly transformed as a result of historical agricultural activities (commercial and small-scale subsistence crop cultivation), overgrazing by livestock such as goats and cattle, and mining activities. Loss of vegetation cover resulting primarily from overgrazing has resulted in large expanses of exposed soils, leading to severe and widespread erosion in many areas, whilst levels of bush encroachment by indigenous species such as *Dichrostachys cinerea* (Sickle bush) and proliferation of alien vegetation such as *Agave sisalana* and *Zinnia peruviana* in some areas is high.<br><br>The rivers and tributaries are characterised by a weakly developed and moderately degraded riparian habitat. As these systems receive very little rain, flowing only after adequate rain events, water does not accumulate long enough for distinct riparian vegetation to develop. As such the riparian vegetation included a species composition similar to that of the surrounding bushveld vegetation. However, in several sections the vegetation structure did in fact differ from surrounding vegetation in that the woody component was denser. It should be noted that several upstream sections of the rivers have severe erosion and bank incision, owing to exposed soils and bare areas in such places, where little or no vegetation was present (i.e. the riparian vegetation is not continuous along these systems). The unnamed tributary, on the other hand, is characterised by a more continuous vegetation layer that, in several areas, have been overgrown / encroached upon by woody species, potentially attenuating flow during rain events.<br><br>For the non-perennial and ephemeral drainage lines, no distinct change in vegetation structure or species composition could be discerned. No riparian vegetation can thus be linked to these systems. The drainage lines were largely characterised by a lack of graminoid cover (though this could be due to season of study and overgrazing, which is prevalent in the area) with woody species occurring sporadically along, or within, these drainage lines. |

| | | | |
|---|---|---|---|
| | In terms of socio-cultural service provision, the rivers are considered to be an important – albeit seasonal - source of water for the local communities. The presence of spoor along the embankments of both watercourses indicates that they are utilised by domestic livestock. The potential for provision of harvestable resources (for example, reeds) exists primarily due to the location within a relatively rural setting, although few such resources were observed. It was not possible to definitively ascertain whether any cultural value is appended to the rivers by the local communities; however, it is assumed that due to the location and numerous small settlements in the vicinity of the rivers, there may be some cultural value associated with these resources.<br><br>The non-perennial and ephemeral drainage lines score low considering their low vegetation presence and attenuating traits. | **REC / RMO / BAS Category** | **Unnamed tributary of the Moopetsi River / Tshwenyane River:**<br>**REC:D/D: Maintain**<br>**RMO: D/D: Maintain**<br>**BAS: Maintain**<br>These assessments show that all riparian non-perennial and ephemeral watercourses within the study area have undergone significant levels of transformation as a result of historical and current agricultural practices, and to a slightly lesser extent as a result of mining activities. These systems are located in an area that is of moderate ecological and sensitivity importance and therefore management objectives should aim to maintain the ecological status of the watercourses.<br><br>Where applicable and feasible, mitigation measures to minimise the impacts associated with Marula Platinum mining activities must be implemented in order to retain current levels of ecological integrity and functioning. It is preferable however that suitable bank erosion rehabilitation measures be implemented, particularly in sections of the Moopetsi and Tshwenyane Rivers in close proximity to mining activities and related disturbances. |
| **EIS discussion** | **EIS Category for the Tshwenyane River, the Unnamed tributary of the Moopetsi River, and the non-perennial and ephemeral drainage lines: C Moderate**<br>These results indicate that the unnamed tributary of the Moopetsi River and the Tshwenyane River fall within EIS Category C, indicating that these watercourses are considered to be low in biodiversity support and low in ecological importance and sensitivity at a landscape level, however the private protection of the watercourses by the mine increases the ecological importance and sensitivity on a provincial and local scale. | **Possible significant impacts, business case, conclusion, and mitigation requirements:** | Human land uses, arid climatic conditions and the erosive nature of soils found within the Marula MRA infers a high vulnerability to erosion and sedimentation of identified watercourse channels. Current and historical platinum mining infrastructure and activities (roads, pipelines, powerlines, platinum mining activities and operations) and small-hold agricultural activities (livestock grazing) within the catchment, along with the possible domestic use by residents of the rural town of Galane, add to the largely modified/ degraded status of the watercourse channels identified and further exacerbate inherent erosional impacts of the landscape.<br><br>Disturbances within the landscape and watercourse channels have also encouraged a high rate of bush encroachment and alien invasive plant proliferation, impacting the distribution and retention of water in the landscape. Therefore, it is highly recommended that stored indigenous vegetation removed during site preparation and construction phases and newly introduced indigenous vegetation be planted in exposed and disturbed patches in locations around activities in order to limit erosion and sediment thereof. Any areas where active erosion is observed must be immediately rehabilitated in such a way as to ensure that the hydrology of the area is re-instated to conditions which are as natural as possible. This will ensure that watercourses are not impacted further and that ecosystem service provision is sustained in terms of retaining and distributing water in the landscape and supporting riparian habitats and biota. |

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## *5.4 Sensitivity Mapping*

### 5.4.1 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 to be 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 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).

Legislative requirements were used to determine the extent of buffer zone required for each watercourse depending on whether a group is considered wetland/riparian habitat or not. The Tshwenyane River and unnamed tributary of the Moopetsi River, as well as the non-perennial drainage lines with riparian characteristics are defined as watercourses. If any activities involving the proposed mine ventilation shaft, associated infrastructure, and product stockpile are to take place within 100 meters or the 1:100 year flood lines, exemption in terms of Regulation GN 704 of the National Water Act, needs to be obtained. For activities relating to the water pipeline and powerline installation, GN509 of 2016 as it relates to the National Water Act will also apply and therefore a Water Use License will be required.

**Table 7: Articles of Legislation and the relevant zones of regulation applicable to each article.**

| Regulatory authorisation required | Zone of applicability |
|---|---|
| Water Use License Application in terms of the National Water Act, 1998 (Act No. 36 of 1998). | General Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998)<br>In accordance with GN509 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998), a regulated area of a watercourse in terms of water uses as listed in Section 21c and 21i is defined as:<br>• 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;<br>• 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<br>• a 500m radius from the delineated boundary (extent) of any wetland or pan in terms of this regulation, as well as General Notice no. 509 of 2016 as it relates to the National Water Act. |
| | **Government Notice 704 Regulations as published in the Government Gazette 20119 of 1999 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) regarding the use of water for mining and related activities aimed at the protection of water resources.**<br>These Regulations were put in place in order to prevent the pollution of water resources and protect water resources in areas where mining activity is taking place from impacts generally associated with mining. It is recommended that the proposed project complies with Regulation GN 704 of the National Water Act, 1998 (Act No. 36 of 1998) which contains regulations on use of water for mining and related activities aimed at the protection of water resources. GN 704 states that:<br>*No person in control of a mine or activity may:*<br>*(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;*<br>According to the above, the activity footprint must fall outside of the 1:100 year floodline of the aquatic resource or 100m from the edge of the resource, whichever distance is the greatest. |
| Listed activities in terms of the National Environmental Management Act, 1998 (Act 107 of 1998) EIA Regulations (2014). | **Activity 12** of Listing Notice 1 (GN 327) of the National Environmental Management Act, 1998 (Act 107 of 1998) EIA regulations, 2014 (as amended) states that:<br>*The development of:*<br>*(xii) Infrastructure or structures with a physical footprint of 100 square meters or more;*<br>*Where such development occurs—*<br>*a) Within a watercourse;*<br>*b) In front of a development setback; or*<br>*c) If no development setback has been adopted, within **32 meters of a watercourse**, measured from the edge of a watercourse.* |

The delineated watercourse and applicable zones of regulation in terms of NEMA and the National Water Act (GN704 and GN509) are conceptually depicted in Figures 9 and 10 below.

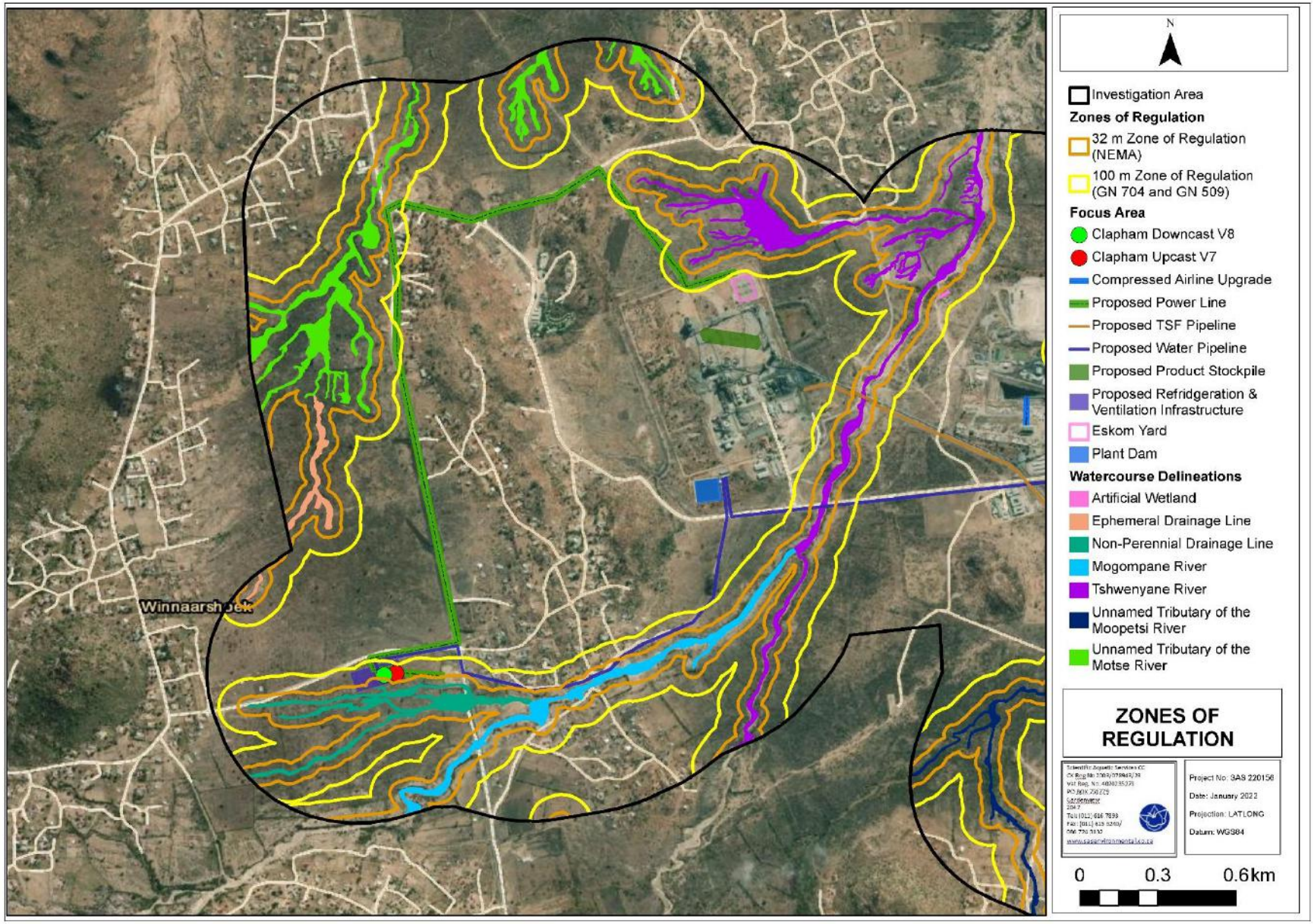


**Figure 11: Conceptual presentation of the zones of regulation applicable to the western watercourses in terms of NEMA, and GN704 and GN509 as they relate to the National Water Act in relation to the watercourses.**

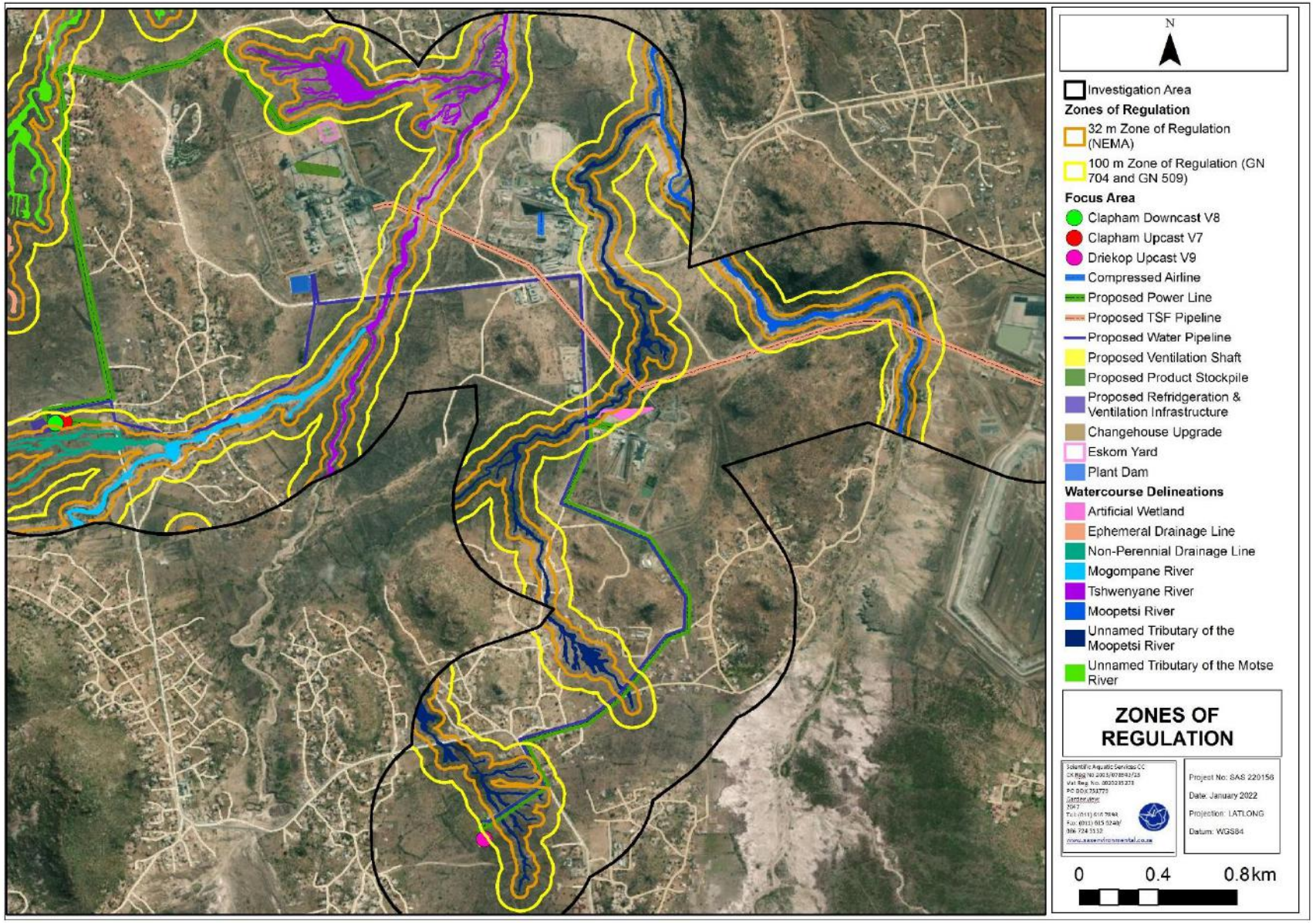


**Figure 12: Conceptual presentation of the zones of regulation applicable to the eastern watercourses in terms of NEMA, and GN704 and GN509 as they relate to the National Water Act in relation to the watercourses.**

# 6 IMPACT AND RISK ASSESSMENTS

This section presents the significance of potential impacts on the watercourses associated with the proposed project components. In addition, it indicates the required mitigatory measures needed to minimise the potential impacts of the proposed development and presents an assessment of the significance of the impacts prior and taking into consideration the available mitigatory measures and assuming that they are fully implemented. The impact significances were determined using the method provided by the Environmental Assessment Practitioner (EAP) (SLR Consulting (Pty) Ltd) and the DWS Risk Assessment Matrix (2016).

*The results of the SLR Consulting Impact Assessment as presented here will be utilised in the Basic Assessment application, whilst the results of the DWS Risk Assessment will be utilised to determine the necessity for a Water Use Licence (WUL) application in consultation with the relevant competent authority. Thus, although the DWS Risk Assessment and the SLR Consulting Impact Assessment may present different scores for the same activity, this is due to differences in their methodologies (refer to Appendix D) and not due to inconsistencies in their application, and each will be judged individually for their specified purpose as discussed above.*

The impact and risk assessments were based on the layout as provided by the proponent, which indicates that the proposed ventilation shafts and associated infrastructure, powerlines, and water pipelines will be constructed in close proximity to (within 32 m), and in some cases through the watercourses identified within the Focus Area.

## *6.1 Consideration of impacts and application of mitigation measures*

Impact assessments were undertaken to ascertain the significance of perceived impacts on the key drivers and receptors (hydrology, water quality, geomorphology, habitat and biota) of the identified watercourses. The results of the impact assessments are presented in Tables 6 to 11 below.

- The SLR Consulting Impact Assessment was applied twice, first to ascertain the impact significance in the absence of mitigation, and then to ascertain the perceived impact assessment assuming that mitigation measures are implemented;

- The DWS Risk Assessment was applied once, assuming that a high level of mitigation is implemented, thus the results of the risk assessment provided in this report present the perceived impact significance post-mitigation;
- In applying both methods, it was assumed that the mitigation hierarchy as advocated by the DEA *et al* (2013) would be followed, i.e., the impacts would first be avoided, minimised if avoidance is not feasible, rehabilitated as necessary and offset if required;
- It is assumed that appropriate mitigation measures have already been implemented for existing mining related infrastructure that does not fall within the scope of this investigation. This includes the existing concentrator plant where the proposed product stockpile is located, therefore the impacts of the proposed product stockpile on watercourses is considered minimal and no further assessment is required. Notwithstanding this, it is strongly advised that the edge effects of activities including bush encroachment, soil erosion, and alien/ weed control be strictly managed around the concentrator plant;
- At the time of this assessment, the watercourses associated with the proposed project components were deemed to be in a severely modified ecological state, and of moderate importance and sensitivity;
- Most impacts are considered to be easily detectable; however, impacts such as surface and/or groundwater contamination would entail specific monitoring to ascertain the occurrence of impacts;
- The impact assessment was applied taking into consideration the chronological order of activities;
- In the DWS Risk Assessment, the default score for legal issues (for all watercourses proposed to be traversed by linear infrastructure and that associated with Clapham Ventilation Shafts 7 and 8) is '5' since some activities, as listed in Tables 6 to 8, will be located within the 100 m ZoR in terms of GN509 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998);
- The activities relating to the proposed project components are all considered to be highly site specific, not of a significant extent relative to the area of the watercourses assessed, and therefore have a limited spatial extent;
- While the operation of some of the proposed project components will be a permanent activity, the construction thereof is envisioned to take no more than a few months. However, the frequency of the construction impacts may be daily during this time; and
- It is highly recommended that the proponent make provision for small-scale rehabilitation of the areas of the watercourses which may be directly impacted upon by construction activities. The area must preferably be rehabilitated to conditions as close as possible to the "natural" state, not the pre-construction state since the state

of the watercourses is deemed to be significantly altered from the reference condition. This will ensure that the ecological condition of the watercourse reaches associated with the proposed project activities are maintained and where feasible, improved.

### 6.1.1 Impact discussion and essential mitigation measures

There are four key ecological risks on the assessed watercourses that were assessed, namely:

- Loss of watercourse habitat and ecological structure resulting in impacts to vegetation;
- Changes to the sociocultural and service provision;
- Impacts on the hydrology and sediment balance of the watercourses; and
- Impacts on water quality.

The outcomes of the impact assessments are summarised in the tables below, after which a discussion thereof follows.

**Table 8: Summary of the DWS Risk Assessment applied to the proposed powerlines.**

| No. | Phases | Activity | Aspect | Impact | Risk Rating | Confidence level | Control Measures |
|---|---|---|---|---|---|---|---|
| 1 | **Planning phase of 33kV overhead transmission powerlines** | Planning and site preparation prior to construction activities associated with the construction of the powerlines. | Potentially inadequate or unsuitable design of infrastructure leading to changes to watercourse characteristics | Tower bases constructed within 32 m of watercourses may lead to erosion and sedimentation of riparian resources, arising from increased runoff due to cleared areas, thus leading to loss of riparian habitat; and<br>*The alteration to stream flow patterns due to support structures placed in the channel. | **L** | **70** | *Where feasible, towers must be positioned in locations that do not fall within the NEMA 32 m zone of regulation. Should engineering constraints prevent this, no towers may be placed within the regulated zone, but not directly within watercourses;<br>*Where possible it is recommended to construct powerlines in close proximity of existing powerlines in order to minimize the proposed powerline footprint; and<br>*Construction must preferably take place in the dry season where no rainfall will be experienced. |
| | | | | | | | |
| 2 | **Construction Phase of 33kV overhead transmission powerlines** | Site preparation prior to construction activities including placement of contractor laydown areas and storage facilities. | *Disturbance/ compaction of soils from heavy construction vehicles and laydown facilities;<br>*Removal of vegetation at powerline tower locations; and<br>*Oil contamination from construction vehicles. | *Vehicular movement and access to the site, and the removal of riparian vegetation and associated disturbances to soils within the Focus Area could lead to: *stormwater runoff from the reduced infiltration, flood water discharge, and velocity increases from hardened surfaces causing erosion of the landscape and channel banks, and subsequent sedimentation of the channel bed. Sedimentation can lead to suffocation of vegetation, destroying sensitive freshwater habitats;<br>*Decreased ecoservice provision (e.g. flood attenuation, sediment trapping and nutrient and toxicant assimilation);<br>*Proliferation of alien vegetation as a result of disturbances;<br>*Vegetation degradation, and the subsequent loss of breeding and foraging habitat for watercourse-dependent fauna;<br>*Soil and stormwater contamination from oils and hydrocarbons originating from construction vehicles | **L** | **70** | *Edge effects of activities including bush encroachment, erosion, and alien/ weed control need to be strictly managed in these areas;<br>*Drip trays must be located beneath any parked and leaking equipment along with lubricant/fuel absorbing media (moss type products) within the drip trays to contain spilt material and avoid groundwater pollution.<br><br>**Mixing of concrete;**<br>*Should concrete to be mixed be used, all wet and dry material should be stored within the contractor laydown areas and should be covered and contained to prevent contact with rainfall or runoff;<br>*Concrete mixing/ batching must be undertaken on an impermeable surface to prevent soil and groundwater pollution. The following recommendations must be adhered to: |

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| | | | | can infiltrate soils and runoff into surrounding watercourses, impacting watercourse water quality, habitat, and biota downgradient of the contamination site. | | | • A washout area should be designated outside of the watercourses and associated 100m buffer and wash water should be treated on-site or discharged to a suitable sanitation system (USEPA. 2005);<br>• Cement bags must be disposed of in the demarcated hazardous waste receptacles and the used bags must be disposed at a designated hazardous waste disposal facility; and<br>• Spilt or excess concrete must be disposed of at a suitable landfill site. Chain of custody documentation must be kept available at site;<br><br>**Disturbed and compact soils:**<br>*Careful planning must take place to ensure a free draining landscape that allows water to drain towards the watercourses in a natural manner with specific mention of the following:<br>• Ensure that runoff occurs in a natural diffuse manner with no unnatural concentration of flow;<br>• Ensure that no areas of unnatural ponding occur due to a lack of runoff potential;<br>• In steep areas ensure that energy dissipation takes place to ensure that water leaving the site does so without reaching critical levels which would lead to erosion; and<br>• Ensure that runoff does not lead to excessive sedimentation in area;<br>*All sediment stockpiles must be removed to a suitable landfill facility to ensure that stockpile surfaces in the area will not contribute to the contaminant land of any overland water flow; |
| 3 | | Construction of the powerline towers in close proximity to and within watercourses | *Excavation, removing and stockpiling soil (topsoil) for tower cavity; and<br>*Infilling base structure/ cavity with concrete mixture. | *Earthworks within watercourse, leading to loss of habitat, disturbance of soils and loss of ecoservices such as biodiversity maintenance, flood attenuation, nutrient assimilation;<br>*Cement that enters a watercourse will raise the pH (resulting in high alkalinity), which can be toxic to aquatic life, changing the riparian ecology;<br>*Stockpiling of sediment adjacent to riparian areas and runoff from stockpiles can lead to changes in riparian habitat; and<br>*Removing sediment will have a direct loss on habitat at removal site. | **L** | **70** | |
| 4 | | | Clearing and levelling of land for the installation of the powerlines, including infilling and levelling of the watercourse, and removal of riparian vegetation. | *Construction can cause unnatural concentration of flow, unnatural ponding occurs due to a lack of runoff potential, changing the water retention and distribution in the landscape; or<br>*In steep areas the high energy of water leaving the site can reach critical levels leading to erosion. | **L** | **70** | |
| 5 | | Infrastructure Transportation and Storage | Potential for indiscriminate movement of vehicles through the riparian zone. | *Disturbances of soils leading to increased alien vegetation proliferation, and in turn to further altered riparian habitat;<br>*Altered runoff patterns, leading to increased erosion and sedimentation of instream and riparian habitat; and<br>*impacts on surface water quality due to pollution. | **L** | **70** | |
| 6 | | | Potential placement of contractor laydown areas, and/or potential indiscriminate storage of powerline infrastructure and construction equipment within the riparian zone and/or ZOR. | | **L** | **70** | |

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| | | | | | | | *Soil stockpiles may not be contaminated, and it must be ensured that the minimum surface area is taken up;<br>The height of soil stockpiles must be in line with the existing EMPr, or an approved soil management plan if there is one in place;<br>*No temporary stockpiling of soils is to take place within 10 m of the watercourses, should be placed on the downgradient side of the watercourses so as to prevent transport of sediment in stormwater runoff into the watercourses, and as far as practical, all stockpiles must be protected with a suitable geotextile to prevent sedimentation of the watercourses;<br>*Stockpiled soil must be levelled as required during construction and post-construction to avoid sedimentation from runoff, and revegetated with indigenous vegetation; and<br>*Areas where soil has been disturbed must be suitably compacted (using handheld equipment) to minimize any erosion and subsequent sedimentation.<br><br>**Vegetation**:<br>*The time period of soil exposure must be kept to a minimum to limit the potential movement of sediments to downstream reaches of watercourses;<br>*As much vegetation growth as possible (of indigenous floral species) should be encouraged to protect soil;<br>*All vegetation clearing to be limited to the footprint of the proposed activity;<br>*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;<br>*An alien vegetation management plan must be compiled by a suitably qualified specialist, and implemented at the outset of the proposed activity, in order to minimize the risk of further proliferation |

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| | | | | | | | of alien floral species in the areas surrounding the study area;<br>*Compacted soil should be ripped, reprofiled and reseeded with indigenous vegetation following construction; and<br>*Removed alien invasive plant material must be disposed of at a registered garden refuse site and may not be burned or mulched on site. |
| | | | | | | | |
| 7 | **Operational Phase of 33kV overhead transmission powerlines** | *Long term operation of the powerlines;<br>*Potential increased traffic adjacent to the affected reaches of the associated Rivers (Eskom service vehicles); and<br>*Potential indiscriminate movement of maintenance vehicles within riparian zone and ZOR. | *Maintenance of power line infrastructure in the vicinity of the riparian zone; and<br>*Cleared and hardened surfaces and natural erodibility of the soil. | *Erosion and sedimentation of riparian resources arising from increased runoff due to cleared areas, leading to loss of riparian habitat of watercourses downgradient from the powerline towers;<br>*Disturbance to soils and ongoing erosion as a result of periodic maintenance activities.<br>*Altered water quality as a result of increased availability of pollutants. | **L** | **70** | *Stored indigenous vegetation removed during pre-construction and construction phases should be replanted in exposed and disturbed patches around the tower bases in order to limit erosion around the bases, and potential sedimentation of any adjacent watercourses;<br>*Reprofiling of soil and revegetation of areas disturbed as a result of the construction of powerlines must take place immediately after completion of construction with indigenous vegetation and monitored during the operational phase;<br>*Any areas where active erosion is observed must be immediately rehabilitated in such a way as to ensure that the hydrology of the area is re-instated to conditions which are as natural as possible; and<br>*Maintenance vehicles to stay out of watercourses where possible. |

**Table 9: Summary of the DWS Risk Assessment applied to the proposed water pipelines (including the TSF pipeline).**

| No. | Phases | Activity | Aspect | Impact | Risk Rating | Confidence level | Control Measures |
|---|---|---|---|---|---|---|---|
| 1 | **Pre-construction phase of pipelines** | Planning and site preparation prior to construction activities associated with the construction of the pipelines. | Potentially inadequate or unsuitable design of infrastructure leading to changes to watercourse characteristics | *Pipelines constructed within 32 m of, or over watercourses will have consequences on the natural buffer zone of the watercourses, leading to erosion and sedimentation of riparian resources arising from increased runoff due to cleared areas, thus leading to loss of riparian habitat; | L | 70 | *According to the assessed layout, all watercourse crossings are located within existing road servitudes. This must remain the case, as this will reduce the significance of cumulative or latent impacts on the affected watercourses. |
| | | | | | | | |
| 2 | **Construction Phase of pipelines** | Site preparation prior to construction activities. | *Removal of vegetation a site clearing at the water pipeline locations; *Disturbance/ compaction of soils from heavy construction vehicles; *Oil contamination from construction vehicles. | *Exposure of soil can result in erosion; *Stormwater runoff from the reduced infiltration, flood water discharge, and velocity increases from hardened surfaces causing erosion of the landscape and channel banks, and subsequent sedimentation of the channel bed. Sedimentation can lead to suffocation of vegetation, destroying sensitive freshwater habitats; and *Increased proliferation of alien vegetation as a result of disturbances; *Soil and stormwater contamination from oils and hydrocarbons originating from construction vehicles can infiltrate soils and runoff into surrounding watercourses, impacting watercourse water quality, habitat, and biota downgradient of the contamination site. | L | 70 | * Edge effects of activities including bush encroachment, erosion, and alien/ weed control need to be strictly managed in these areas; *Drip trays must be located beneath any parked or leaking equipment along with lubricant/fuel absorbing media (moss type products or sawdust) within the drip trays to contain spilt material and avoid groundwater pollution;<br><br>Vegetation:<br>Refer to mitigation measures pertaining to vegetation in Table 6. |
| 3 | | Installation of HDPE water supply and wastewater pipelines | Trenching along existing road in close proximity to watercourses, as well as through watercourses, | *Removing sediment will have a direct loss on habitat at removal site; *Stockpiling of sediment adjacent to riparian areas and runoff from stockpiles can lead to changes in riparian habitat; *Backfilling trench; and *Construction edge effects. | L | 70 | ***During trenching:**<br>-It is imperative that trenching occurs in the dry season where there is minimal impact on the seasonal nature of watercourses that may be excavated;<br>-soil must be stockpiled upgradient of the trench;<br>-Mixing of the lower and upper layers of the excavated soil should be kept to a minimum in order to ensure the |

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| | | | stockpiling, and backfilling soil for pipeline construction. | | | | subsurface flow of water is not impacted and the underlying clay layer is reinstated;<br>-The excavated soil must be used to backfill the trenches, immediately after installation of the pipeline;<br>-The soil must be replaced in the same layers as which it was extracted;<br>-The infilled trenches must be level with the surrounding area and compacted to prevent alteration to the flow patterns, formation of preferential flow paths or erosion from occurring;<br>-The construction footprint must be limited to the width of the trench and an additional 5 m buffer (to allow for the stockpiled soil and movement of personnel and construction equipment);<br>-The area must be rehabilitated after the completion of the construction phase, including revegetation thereof with indigenous wetland vegetation; and<br>-The eradication of alien vegetation within the footprint area must be undertaken. |
| | | | | | | | |
| 4 | **Operational Phase of pipelines** | Operation of the pipelines | Cleared and hardened areas and natural erodibility of the soil. | *Erosion and sedimentation of riparian resources arising from increased runoff due to cleared areas, leading to loss of riparian habitat of watercourses downgradient form the pipelines. | **L** | **70** | *Stored indigenous vegetation removed during pre-construction and construction phases needs to be replanted in exposed and disturbed patches around the pipelines in order to limit erosion and sedimentation of any associated watercourses;<br>*Reprofiling of soil and revegetation of areas disturbed as a result of the construction of pipelines must take place immediately after completion of construction and monitored during the operational phase; and<br>*Any areas where active erosion is observed must be immediately rehabilitated in such a way as to ensure that the hydrology of the area is re-instated to conditions which are as natural as possible. |
| 5 | | | Potential leakage of water from the pipeline. | *Possible incision and alteration of the hydroperiod of the watercourse system. | **L** | **70** | *It is recommended that the integrity of the pipeline be tested at least once every five years or more often should there be any sign of a leak;<br>*It should be ensured that the hydrological regime of the watercourses not be impacted as a result of leaks or bursting of the pipeline, and that an emergency plan should be compiled to ensure a quick response and |

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| | | | | | | | attendance to the matter in case of a leakage or bursting of the pipeline: and<br>*Maintenance vehicles to stay out of watercourses where possible |

**Table 10: Summary of the DWS Risk Assessment applied to the proposed ventilation shafts and associated infrastructure.**

| No. | Phases | Activity | Aspect | Impact | Risk Rating | | Control Measures |
|---|---|---|---|---|---|---|---|
| 1 | **Pre-construction phase of ventilation shafts** | Planning and site preparation prior to construction activities associated with the establishment of new ventilation shafts and associated refrigeration and ventilation infrastructure. | Potentially inadequate or unsuitable design of infrastructure leading to changes to watercourse characteristics. | *Vents constructed within 32 m of watercourses will have consequences on the natural buffer zone of the watercourses, leading to erosion and sedimentation of riparian resources arising from increased runoff due to cleared areas, potentially leading to alterations to or loss of riparian habitat. | **L** | **70** | *Although it is acknowledged that optimization of the proposed vent shaft footprints has been undertaken, should the opportunity arise for further optimization of the footprint, it is preferred that they be positioned outside the applicable Zones of Regulation (NEMA and GN704) if feasible. If this is not possible, strict enforcement of mitigation measures during all phases is essential, including undertaking construction during the dry season if at all possible. |
| | | | | | | | |
| 2 | **Construction Phase of ventilation shafts** | Site preparation prior to construction activities.. | *Removal of vegetation a site clearing at the water pipeline locations; *Disturbance/ compaction of soils from heavy construction vehicles; *Oil contamination from construction vehicles. | *Exposure of soil can result in erosion; *stormwater runoff from the reduced infiltration, flood water discharge, and velocity increases from hardened surfaces causing erosion of the landscape and channel banks, and subsequent sedimentation of the channel bed. Sedimentation can lead to suffocation of vegetation, destroying sensitive freshwater habitats; *Increased proliferation of alien vegetation as a result of disturbances; and *Soil and stormwater contamination from oils and hydrocarbons originating from construction vehicles can infiltrate soils and runoff into surrounding watercourses, impacting watercourse water quality, habitat, and biota downgradient of the contamination site. | **L** | **70** | *Edge effects of activities including bush encroachment, erosion, and alien/ weed control need to be strictly managed in these areas; *Drip trays must be located beneath any parked and leaking equipment along with lubricant/fuel absorbing media (moss or sawdust type products) within the drip trays to contain spilt material and avoid groundwater pollution;<br><br>**Mixing of concrete:**<br>Refer to mitigation measures pertaining to Mixing concrete in Table 6.<br><br>**Disturbed and compacted soils:** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3 | | Establishment of new ventilation shaft, surface main fans, electrical rooms, and bulk air cooler. | *Removing and stockpiling soil for vent shaft; *Infilling base cavity with concrete mixture; *Land elevation changes due to earthworks; and *soil compaction. | *Removing sediment will have a direct loss on habitat at removal site; *Stockpiling of sediment adjacent to riparian areas and runoff from stockpiles can lead to changes in riparian habitat; *Construction edge effects; *Cement that enters a watercourse will raise the pH (resulting in high alkalinity), which can be toxic to aquatic life, changing the riparian ecology; *Construction can cause unnatural concentration of flow, unnatural ponding occurs due to a lack of runoff potential, changing the water retention and distribution in the landscape; or *In steep areas the high energy of water leaving the site can reach critical levels leading to erosion. | L | 70 | *Careful planning must take place to ensure a free draining landscape that allows water to drain towards the watercourses in a natural manner with specific mention of the following:<br>• Ensure that runoff occurs in a natural diffuse manner with no unnatural concentration of flow;<br>• Ensure that no areas of unnatural ponding occur due to a lack of runoff potential;<br>• In steep areas ensure that energy dissipation takes place to ensure that water leaving the site does so without reaching critical levels which would lead to erosion; and<br>• Ensure that runoff does not lead to excessive sedimentation in area;<br><br>**Vegetation**:<br>Refer to mitigation measures pertaining to vegetation in Table 6. |
| | | | | | | | |
| 4 | **Operational Phase of ventilation shafts** | Operation of the new ventilation shafts, surface main fans, electrical rooms, and bulk air cooler | Cleared and hardened areas and natural erodibility of the soil;<br>* Leakage of wastewater, which may emanate from the refrigeration process at ventilation shafts, into surrounding environment | *Erosion and sedimentation of riparian resources arising from increased runoff due to cleared areas, leading to loss of riparian habitat of watercourses downgradient form the ventilation shafts; and wastewater that enters the surrounding environment can have water quality impacts. | L | 70 | *Stored indigenous vegetation removed during pre-construction and construction phases need to be replanted in exposed and disturbed patches around the bases in order to limit erosion thereof and possible sedimentation of adjacent watercourses;<br>*Reprofiling of soil and revegetation of areas disturbed as a result of the construction of product stockpiles must take place immediately after completion of construction with indigenous vegetation and monitored during the operational phase;<br>*Any areas where active erosion is observed must be immediately rehabilitated in such a way as to ensure that the hydrology of the area is re-instated to conditions which are as natural as possible; and<br>*Maintenance vehicles to stay out of watercourses where possible |

**Table 11: Summary of the SLR Consulting Impact Assessment applied to the proposed powerlines.**

| Construction Phase | Management | Intensity / Severity | Duration | Extent / Spatial | Probability of exposure | Consequence | Significance |
|---|---|---|---|---|---|---|---|
| Construction | Unmanaged | L | L | VL | H | L | L |
| | Managed | VL | VL | VL | M | VL | VL |
| Operations | Unmanaged | L | M | VL | H | L | L |
| | Managed | VL | L | VL | M | VL | VL |
| Closure and post closure | Unmanaged | L | L | VL | H | L | L |
| | Managed | VL | VL | VL | M | VL | VL |

**Table 12: Summary of the SLR Consulting Impact Assessment applied to the proposed water pipelines (including the TSF pipeline).**

| Construction Phase | Management | Intensity / Severity | Duration | Extent / Spatial | Probability of exposure | Consequence | Significance |
|---|---|---|---|---|---|---|---|
| Construction | Unmanaged | L | L | VL | H | L | L |
| | Managed | VL | VL | VL | M | VL | VL |
| Operations | Unmanaged | L | M | VL | H | L | L |
| | Managed | VL | L | VL | M | VL | VL |
| Closure and post closure | Unmanaged | M | L | VL | H | L | L |
| | Managed | VL | VL | VL | M | VL | VL |

**Table 13: Summary of the SLR Consulting Impact Assessment applied to the proposed ventilation shafts and associated infrastructure.**

| Construction Phase | Management | Intensity / Severity | Duration | Extent / Spatial | Probability of exposure | Consequence | Significance |
|---|---|---|---|---|---|---|---|
| Construction | Unmanaged | L | L | VL | H | L | L |
| | Managed | VL | L | VL | M | VL | VL |
| Operations | Unmanaged | L | M | VL | H | L | L |
| | Managed | VL | L | VL | M | VL | VL |
| Closure and post closure | Unmanaged | M | L | VL | H | L | L |
| | Managed | VL | VL | VL | M | VL | VL |

As illustrated in the tables above, the impact significance of the majority of the proposed activities are considered low. Mitigation measures were developed to guide the proposed activities in the vicinity of the freshwater systems. These mitigation measures are presented in Tables 6 to 8 as part of the DWS Risk Assessment.

According to the SLR Impact Assessment, the perceived impacts that may result from the proposed project components have low risk significance on the Tshwenyane River, the

unnamed tributary of the Moopetsi River and the non-perennial and ephemeral drainage lines found within the investigation area. With the implementation of mitigation measures (Tables 6 to 8), as per the DWS Risk assessment, the proposed project components pose a low risk significance to the identified watercourses.

Mitigation methods proposed for activities involving watercourses significantly contribute to keeping the risk significance low. This is owing to the already degraded landscape and the need for management measures in order to maintain its ecological state. Further, the non-perennial nature of the watercourses, where flow and wet response by riparian features are only experienced intermittently according to season, impacts to watercourses will occur seasonally too, so while impacts may occur, the period over which water flows in channels is limited and therefore no significant impacts are likely to occur downstream. Hence it is imperative that construction of the proposed project components takes place in the dry season and that stormwater runoff measures are prepared for when rainfall does occur. Nevertheless, reaches of the various watercourses that are traversed by linear infrastructure, or which are located within 50 m of other surface infrastructure such as the vent shafts, may potentially show signs of latent impacts, in particular, erosion since the soil in the area is naturally prone to erosion. This in turn may lead to incision and gully formation as already observed within the MRA, and over time may result in the modification of watercourses to the extent that they are no longer able to support riparian vegetation. Therefore, ongoing monitoring of such crossings and surface infrastructure areas is essential to detect the effects of possible latent impacts.

Additional “good practice” mitigation measures applicable to a project of this nature are provided in Appendix F of this report.

# 7 CONCLUSION

Human land uses, semi-arid climatic conditions and the erosive nature of soils found within the Marula MRA infers a high vulnerability to erosion and sedimentation of identified watercourse channels. Current and historical platinum mining infrastructure and activities (roads, pipelines, powerlines, platinum mining activities and operations) and small-scale agricultural activities (livestock grazing) within the catchment, along with the possible domestic use by the residents of the rural town of Galane, contribute to the largely modified/ degraded status of the watercourse channels identified and further exacerbate inherent erosional impacts of the landscape.

Cleared sites and compacted ground from mining infrastructure and roads exacerbate stormwater runoff impacts, where the removal of vegetation and hardening of surfaces increases the impacts created by seasonal rainfall events. The subsequent decrease in soil infiltration and flood water discharge leads to an increased velocity of water flowing over the land. The increased velocity of water causes incising of channel banks and beds. Sediment removed from bank erosion is then deposited further downstream, suffocating vegetation, and causing sediment accumulation within the associated channel and the loss of ecoservices such as biodiversity maintenance, flood attenuation and nutrient assimilation.

Mining infrastructure and toxic residue on roads (left behind from vehicles) may leave stormwater water runoff impaired in terms of physical-chemical parameters causing impacts on the immediate and downstream users. Disturbances within the landscape and watercourse channels have also encouraged a high rate of bush encroachment and alien invasive plant proliferation, impacting the distribution and retention of water in the landscape. Similar disturbances and impacts to vegetation and soils are afforded by the poor livestock management that currently occurs in the catchment. Overgrazing by livestock has cleared and trampled vegetation and soils, leaving soil compact and exposed and destabilizing watercourse channel banks, degrading channels further. The site is EIS Category C which suggests the site's ecological state, at minimum be maintained. In order to achieve this or an improved state mitigation measures should be strictly implemented.

The PES, EIS and contribution to ecological and socio-cultural functioning were assessed during a single site visit undertaken mid November 2020, prior to the area receiving any significant rainfall, and following prolonged dry conditions. The results of the assessment are summarised in the table below:

**Table 14: Summary of results of the field assessment as discussed in Section 5.**

| HGM Unit | PES | Ecoservices | EIS | REC / RMO / BAS |
|---|---|---|---|---|
| Unnamed tributary of the Moopetsi River | D | Intermediate | Moderate | D / D / Maintain |
| Tshwenyane River | D | Intermediate | Moderate | D / D / Maintain |
| Non-perennial and ephemeral drainage lines without riparian vegetation | N/A | Low | Moderate | N/A |

Adherence to cogent, well-conceived and ecologically sensitive site development plans, the mitigation measures provided in this report as well as general good construction practice and ongoing management, maintenance and monitoring, are essential if the significance of perceived impacts is to be reduced to limit further degradation to the freshwater environment. If strong adherence to existing water use license conditions and the proposed mitigation

measures takes place, impacts will remain low, especially if priority is given to mitigating potential erosion, bush encroachment and alien plant proliferation risks at the locations where the proposed pipelines and powerlines will cross the Tshwenyane River and the unnamed tributary of the Moopetsi River. It is also suggested that the same focus on management occurs at the Mogompane River and the unnamed tributary of the Motse River, which although located outside the focus area are situated within the investigation area and could be indirectly impacted by the proposed activities.

Mitigation measures will keep the significance of risks low, therefore ensuring low impacts of receiving watercourses found in the Focus Area. Additionally, mitigated areas that have recovered should in turn restore the capacity of the landscape to support livestock farming/grazing within the catchment, further supporting provisional services of the watercourses. Therefore, it is in the opinion of the specialist that the proposed product stockpile, ventilation shafts and related infrastructure, water pipelines, and powerlines are acceptable for authorisation, provided that the mitigation measures stipulated in this report are implemented.

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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, at their sole discretion, 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

| | |
|---|---|
| **The Constitution of the Republic of South Africa, 1996** | The environment and the health and well-being of people are safeguarded under the Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996) by way of section 24. Section 24(a) guarantees a right to an environment that is not harmful to human health or well-being and to environmental protection for the benefit of present and future generations. Section 24(b) directs the state to take reasonable legislative and other measures to prevent pollution, promote conservation, and secure the ecologically sustainable development and use of natural resources (including water and mineral resources) while promoting justifiable economic and social development. Section 27 guarantees every person the right of access to sufficient water, and the state is obliged to take reasonable legislative and other measures within its available resources to achieve the progressive realisation of this right. Section 27 is defined as a socio-economic right and not an environmental right. However, read with section 24 it requires of the state to ensure that water is conserved and protected and that sufficient access to the resource is provided. Water regulation in South Africa places a great emphasis on protecting the resource and on providing access to water for everyone. |
| **National Environmental Management Act (Act No. 107 of 1998) (NEMA)** | The National Environmental Management Act (NEMA) (Act 107 of 1998) and the associated Regulations as amended in 2017, states that prior to any development taking place within a wetland or riparian area, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment Report (BAR) process or the Environmental Impact Assessment (EIA) process depending on the scale of the impact. Provincial regulations must also be considered. |
| **National Environmental Management: Biodiversity Act (2004) (Act 10 of 2004) (NEMBA)** | **Ecosystems that are threatened or in need of protection**<br>(1) (a) The Minister may, by notice in the Gazette, publish a national list of ecosystems that are threatened and in need of protection.<br>*(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.<br>(2) The following categories of ecosystems may be listed in terms of subsection (1):<br>*(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;<br>*(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;<br>(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<br>*(d)* protected ecosystems, being ecosystems that are of high conservation value or of high national or provincial importance, although they are not listed in terms of paragraphs *(a), (b)* or (c). |
| **The National Water Act 1998 (Act No. 36 of 1998) (NWA)** | The National Water Act (NWA) (Act 36 of 1998) recognises that the entire ecosystem and not just the water itself in any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the Department of Water and Sanitation (DWS). Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DWS in terms of Section 21 (c) & (i). |
| **Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act 36 of 1998)** | In accordance with Regulation GN509 of 2016, a regulated area of a watercourse for section 21c and 21i of the NATIONAL WATER ACT, 1998 is defined as:<br>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;<br>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<br>c) A 500 m radius from the delineated boundary (extent) of any wetland or pan.<br>This notice **replaces GN1199** and may be exercised as follows:<br>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;<br>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;<br>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;<br>v) Conduct rehabilitation of wetlands or rivers where such rehabilitation activities has a LOW risk class as determined through the Risk Matrix; and<br>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.<br>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.<br><br>Upon completion of the registration, the responsible authority will provide a certificate of registration to the water user within 30 working days of the submission. On written receipt of a registration certificate from the Department, the person will be regarded as a registered water user and can commence within the water use as contemplated in the GA. |
| **Government Notice 704 Regulations as published in the Government Gazette 20119 of 1999 as it relates to the National Water Act, 1998 (Act No. 36 of 1998)** | These Regulations were put in place in order to prevent the pollution of water resources and protect water resources in areas where mining activity is taking place from impacts generally associated with mining. It is recommended that the proposed project complies with Regulation GN 704 of the National Water Act which contains regulations on the use of water for mining and related activities aimed at the protection of water resources. GN 704 states that:<br>*No person in control of a mine or activity may:*<br>*(b) locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year floodline or within a horizontal distance of 100 metres from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on waterlogged ground, or on ground likely to become waterlogged, undermined, unstable or cracked;*<br>According to the above, the activity footprint must fall outside of the 1:100 year floodline of the aquatic resource or 100m from the edge of the resource, whichever distance is the greatest. |
| **Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA)** | The obtaining of a New Order Mining Right (NOMR) is governed by the MPRDA. The MPRDA requires the applicant to apply to the DMR for a NOMR which triggers a process of compliance with the various applicable sections of the MPRDA. The NOMR process requires environmental authorisation in terms of the MPRDA Regulations and specifically requires the preparation of a Scoping Report, an EIA, an Environmental Management Programme (EMP), and a Public Participation Process (PPP). |

# APPENDIX C – Method of Assessment

## 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 of the proposed 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), 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 vicinity of or within the proposed study area.

## 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:<br>SYSTEM | LEVEL 2:<br>REGIONAL SETTING | LEVEL 3:<br>LANDSCAPE UNIT |
| Inland Systems | DWA Level 1 Ecoregions<br>OR<br>NFEPA WetVeg Groups<br>OR<br>Other special framework | Valley Floor |
| | | Slope |
| | | Plain |
| | | Bench<br>(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[4] (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

[4] 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.

a total of 31 Ecoregions across South Africa, including Lesotho and Swaziland. DWA Ecoregions have most commonly been used to categorise the regional setting for national and regional water resource management applications, especially in relation to rivers.

The Vegetation Map of South Africa, Swaziland and Lesotho (Mucina & Rutherford, 2006) 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. Index of Habitat Integrity (IHI)

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 C4 below. To assess the PES of the wetland and riparian features, the IHI for South African floodplain and channelled valley bottom wetland types (Department of Water Affairs and Forestry Resource Quality Services, 2007) was used.

**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 |
| 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 |

## 4. 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.* (2009). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the service is provided:

- Flood attenuation;
- Stream flow regulation;
- Sediment trapping;
- Phosphate trapping;
- Nitrate removal;
- Toxicant removal;
- Erosion control;
- Carbon storage;
- Maintenance of biodiversity;

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

- Water supply for human use;
- Natural resources;
- Cultivated foods;
- Cultural significance;
- Tourism and recreation; and
- Education and research.

The characteristics were used to quantitatively determine the value, and by extension sensitivity, of the freshwater features. Each characteristic was scored to give the likelihood that the service is being provided. The scores for each service were then averaged to give an overall score to the freshwater features.

**Table C5: Classes for determining the likely extent to which a benefit is being supplied.**

| Score | Rating of the likely extent to which the benefit is being supplied |
|---|---|
| <0.5 | Low |
| 0.6-1.2 | Moderately low |
| 1.3-2 | Intermediate |
| 2.1-3 | Moderately high |
| >3 | High |

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

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

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

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

The highest of these three suites of scores is then used to determine the overall Importance and Sensitivity category (Table C6) of the wetland system being assessed.

**Table C6: Ecological Importance and Sensitivity Categories and the interpretation of median scores for biota and habitat determinants (adapted from Kleynhans, 1999).**

| EIS Category | Range of Mean | Recommended Ecological Management Class |
|---|---|---|
| Very high<br>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<br>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<br>Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. | >1 and <=2 | C |
| Low/marginal<br>Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications. | >0 and <=1 | D |

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

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

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

**Table C7: Recommended management objectives (RMO) for water resources based on PES & EIS scores.**

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

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

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

**Table C8: Description of Recommended Ecological Category (REC) classes.**

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

# APPENDIX D – Impact 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 wetlands, flora and riverine systems;
- **Resources** include components of the biophysical environment;
- **Frequency of activity** refers to how often the proposed activity will take place;
- **Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor;
- **Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards;
- **Spatial extent** refers to the geographical scale of the impact; and
- **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, 1998 (Act No. 107 of 1998) 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.

[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

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

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

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

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

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

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

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

The SLR Consulting (Pty) Ltd methodology used in determining the significance of environmental impacts is carried out by following the below steps. The method used for the assessment of environmental issues is set out in the tables below. This assessment methodology enables the assessment of cumulative impacts, the significance of impacts (including the nature of impacts and the degree to which impacts may cause irreplaceable loss of resources), the extent of the impacts, the duration and reversibility of impacts, the probability of the impact occurring and the degree to which the impacts can be mitigated. Note: Part A provides the definition for determining impact consequence (combining intensity, spatial scale and duration) and impact significance (the overall rating of the impact). Impact consequence and significance are determined from Part B and C. The interpretation of the impact significance is given in Part D.

| PART A: DEFINITIONS AND CRITERIA* | | |
|---|---|---|
| Definition of SIGNIFICANCE | | Significance = consequence x probability |
| Definition of CONSEQUENCE | | Consequence is a function of intensity, spatial extent and duration |
| Criteria for ranking of the INTENSITY of environmental impacts | VH | Severe change, disturbance or degradation. Associated with severe consequences. May result in severe illness, injury or death. Targets, limits and thresholds of concern continually exceeded. Substantial intervention will be required. Vigorous/widespread community mobilization against project can be expected. May result in legal action if impact occurs. |
| | H | Prominent change, disturbance or degradation. Associated with real and substantial consequences. May result in illness or injury. Targets, limits and thresholds of concern regularly exceeded. Will definitely require intervention. Threats of community action. Regular complaints can be expected when the impact takes place. |
| | M | Moderate change, disturbance or discomfort. Associated with real but not substantial consequences. Targets, limits and thresholds of concern may occasionally be exceeded. Likely to require some intervention. Occasional complaints can be expected. |
| | L | Minor (Slight) change, disturbance or nuisance. Associated with minor consequences or deterioration. Targets, limits and thresholds of concern rarely exceeded. Require only minor interventions or clean-up actions. Sporadic complaints could be expected. |
| | VL | Negligible change, disturbance or nuisance. Associated with very minor consequences or deterioration. Targets, limits and thresholds of concern never exceeded. No interventions or clean-up actions required. No complaints anticipated. |
| | VL+ | Negligible change or improvement. Almost no benefits. Change not measurable/will remain in the current range. |
| | L+ | Minor change or improvement. Minor benefits. Change not measurable/will remain in the current range. Few people will experience benefits. |
| | M+ | Moderate change or improvement. Real but not substantial benefits. Will be within or marginally better than the current conditions. Small number of people will experience benefits. |
| | H+ | Prominent change or improvement. Real and substantial benefits. Will be better than current conditions. Many people will experience benefits. General community support. |
| | VH+ | Substantial, large-scale change or improvement. Considerable and widespread benefit. Will be much better than the current conditions. Favourable publicity and/or widespread support expected. |
| Criteria for ranking the DURATION of impacts | VL | Very short, always less than a year. Quickly reversible |
| | L | Short-term, occurs for more than 1 but less than 5 years. Reversible over time. |
| | M | Medium-term, 5 to 10 years. |
| | H | Long term, between 10 and 20 years. (Likely to cease at the end of the operational life of the activity) |
| | VH | Very long, permanent, +20 years (Irreversible. Beyond closure) |

| PART B: DETERMINING CONSEQUENCE | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | EXTENT | | | | |
| | | | A part of the site/property | Whole site | Beyond the site, affecting neighbours | Local area, extending far beyond site. | Regional/ National |
| | | | VL | L | M | H | VH |
| INTENSITY = VL | | | | | | | |
| DURATION | Very long | VH | Low | Low | Medium | Medium | High |
| | Long term | H | Low | Low | Low | Medium | Medium |
| | Medium term | M | Very Low | Low | Low | Low | Medium |
| | Short term | L | Very low | Very Low | Low | Low | Low |
| | Very short | VL | Very low | Very Low | Very Low | Low | Low |
| INTENSITY = L | | | | | | | |
| DURATION | Very long | VH | Medium | Medium | Medium | High | High |
| | Long term | H | Low | Medium | Medium | Medium | High |
| | Medium term | M | Low | Low | Medium | Medium | Medium |
| | Short term | L | Low | Low | Low | Medium | Medium |
| | Very short | VL | Very low | Low | Low | Low | Medium |
| INTENSITY = M | | | | | | | |
| DURATION | Very long | VH | Medium | High | High | High | Very High |
| | Long term | H | Medium | Medium | Medium | High | High |
| | Medium term | M | Medium | Medium | Medium | High | High |
| | Short term | L | Low | Medium | Medium | Medium | High |
| | Very short | VL | Low | Low | Low | Medium | Medium |
| INTENSITY = H | | | | | | | |
| DURATION | Very long | VH | High | High | High | Very High | Very High |
| | Long term | H | Medium | High | High | High | Very High |
| | Medium term | M | Medium | Medium | High | High | High |
| | Short term | L | Medium | Medium | Medium | High | High |
| | Very short | VL | Low | Medium | Medium | Medium | High |
| INTENSITY = VH | | | | | | | |
| DURATION | Very long | VH | High | High | Very High | Very High | Very High |
| | Long term | H | High | High | High | Very High | Very High |
| | Medium term | M | Medium | High | High | High | Very High |
| | Short term | L | Medium | Medium | High | High | High |
| | Very short | VL | Low | Medium | Medium | High | High |

| PART C: DETERMINING SIGNIFICANCE | | | | | | | |
|---|---|---|---|---|---|---|---|
| PROBABILITY (of exposure to impacts) | Definite/ Continuous | VH | Very Low | Low | Medium | High | Very High |
| | Probable | H | Very Low | Low | Medium | High | Very High |
| | Possible/ frequent | M | Very Low | Very Low | Low | Medium | High |
| | Conceivable | L | Insignificant | Very Low | Low | Medium | High |
| | Unlikely/ improbable | VL | Insignificant | Insignificant | Very Low | Low | Medium |
| | | | VL | L | M | H | VH |
| | | | CONSEQUENCE | | | | |

| PART D: INTERPRETATION OF SIGNIFICANCE | |
|---|---|
| Significance | Decision guideline |
| Very High | Potential fatal flaw unless mitigated to lower significance. |
| High | It must have an influence on the decision. Substantial mitigation will be required. |
| Medium | It should have an influence on the decision. Mitigation will be required. |
| Low | Unlikely that it will have a real influence on the decision. Limited mitigation is likely to be required. |
| Very Low | It will not have an influence on the decision. Does not require any mitigation |
| Insignificant | Inconsequential, not requiring any consideration. |

### *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 Investigation

## PRESENT ECOLOGICAL STATE (PES) AND ECOLOGICAL IMPORTANCE AND SENSITIVITY (EIS) RESULTS

**Table E1: Presentation of the results of the IHI assessment applied to the Tshwenyane River and unnamed tributary of the Moopetsi River combined.**

| RIPARIAN IHI | |
|---|---|
| Base Flows | -2.5 |
| Zero Flows | -2.5 |
| Moderate Floods | 3.0 |
| Large Floods | 2.5 |
| **HYDROLOGY RATING** | **2.7** |
| Substrate Exposure (marginal) | 3.0 |
| Substrate Exposure (non-marginal) | 4.0 |
| Invasive Alien Vegetation (marginal) | 4.0 |
| Invasive Alien Vegetation (non-marginal) | 4.0 |
| Erosion (marginal) | 3.0 |
| Erosion (non-marginal) | 3.0 |
| Physico-Chemical (marginal) | 1.0 |
| Physico-Chemical (non-marginal) | 1.0 |
| **Marginal** | 4.0 |
| **Non-marginal** | 4.0 |
| **BANK STRUCTURE RATING** | **4.0** |
| Longitudinal Connectivity | 1.0 |
| Lateral Connectivity | 1.0 |
| **CONNECTIVITY RATING** | **1.0** |
| | |
| **RIPARIAN IHI %** | **42.3** |
| **RIPARIAN IHI EC** | **D** |
| **RIPARIAN CONFIDENCE** | **2.8** |

**Table E2: Presentation of the results of the Ecoservices assessment applied to the Tshwenyane River, unnamed tributary of the Moopetsi River and the non-perennial, and ephemeral drainage lines.**

| Ecosystem service | Tshwenyane River | Unnamed tributary of the Moopetsi River | Non-perennial and ephemeral drainage lines |
|---|---|---|---|
| Flood attenuation | 2.2 | 2.3 | 2.0 |
| Streamflow regulation | 1.2 | 1.2 | 0.8 |
| Sediment trapping | 2.8 | 2.8 | 2.2 |
| Phosphate assimilation | 1.6 | 1.9 | 1.0 |
| Nitrate assimilation | 1.4 | 1.6 | 0.9 |
| Toxicant assimilation | 1.6 | 2.1 | 1.3 |
| Erosion control | 0.0 | 0.0 | 0.0 |
| Carbon Storage | 0.3 | 0.3 | 0.0 |
| Biodiversity maintenance | 1.6 | 1.6 | 1.7 |
| Water Supply | 1.2 | 1.7 | 0.0 |
| Harvestable resources | 1.6 | 1.6 | 0.0 |
| Cultivated foods | 1.6 | 1.6 | 0.8 |
| Cultural value | 1.3 | 1.0 | 1.0 |
| Tourism and recreation | 1.0 | 1.0 | 0.0 |
| Education and research | 1.0 | 1.0 | 1.0 |
| **SUM** | **20.2** | **21.5** | **12.6** |
| **Average score** | **1.3** | **1.4** | **0.8** |

**Table E3: Presentation of the results of the EIS assessment applied to the Tshwenyane River, unnamed tributary of the Moopetsi River and the non-perennial, and ephemeral drainage lines.**

| | Unamed tributary of the Moopetsi River | Tshwenyane River | non-perennial, and ephemeral drainage lines | |
|---|---|---|---|---|
| **Ecological Importance and Sensitivity** | Score (0-4) | Score (0-4) | Score (0-4) | *Confidence (1-5)* |
| **Biodiversity support** | A (average) | A (average) | A (average) | (average) |
| | 0.33 | 0.33 | 0.33 | 3,33 |
| ***Presence of Red Data species*** | 0 | 0 | 0 | 3 |
| ***Populations of unique species*** | 0 | 0 | 0 | 3 |
| ***Migration/breeding/feeding sites*** | 1 | 1 | 1 | 4 |
| **Landscape scale** | B (average) | B (average) | B (average) | (average) |
| | 1.60 | 1.60 | 1.60 | 4,00 |
| ***Protection status of the wetland*** | 3 | 3 | 3 | 4 |
| ***Protection status of the vegetation type*** | 0 | 0 | 0 | 4 |
| ***Regional context of the ecological integrity*** | 3 | 3 | 3 | 4 |
| ***Size and rarity of the wetland type/s present*** | 1 | 1 | 1 | 4 |
| ***Diversity of habitat types*** | 1 | 1 | 1 | 4 |
| **Sensitivity of the wetland** | C (average) | C (average) | C (average) | (average) |
| | 2.00 | 2.00 | 2.00 | 3,00 |
| ***Sensitivity to changes in floods*** | 2 | 2 | 2 | 3 |
| ***Sensitivity to changes in low flows/dry season*** | 2 | 2 | 2 | 3 |
| ***Sensitivity to changes in water quality*** | 2 | 2 | 2 | 3 |
| **ECOLOGICAL IMPORTANCE & SENSITIVITY** | **(max of A,B or C)** | **(max of A,B or C)** | **(max of A,B or C)** | |
| **Fill in highest score:** | **C** | **C** | **C** | |
| **Average of A, B or C** | **2** | **2** | **2** | |

Moderate: Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these systems is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.

| | | | Unamed tributary of the Moopetsi River | Tshwenyane River | non-perennial, and ephemeral drainage lines | |
|---|---|---|---|---|---|---|
| **Hydro-Functional Importance** | | | Score (0-4) | Score (0-4) | Score (0-4) | *Confidence (1-5)* |
| **Regulating & supporting benefits** | **Flood attenuation** | | 2 | 2 | 2 | 4 |
| | **Streamflow regulation** | | 0 | 0 | 0 | 4 |
| | **Water Quality Enhancement** | ***Sediment trapping*** | 2 | 2 | 2 | 4 |
| | | ***Phosphate assimilation*** | 2 | 2 | 2 | 4 |
| | | ***Nitrate assimilation*** | 2 | 2 | 2 | 4 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | ***Toxicant assimilation*** | 2 | 2 | 2 | 4 |
| | | ***Erosion control*** | 2 | 2 | 2 | 4 |
| | **Carbon storage** | | 0 | 0 | 0 | 4 |
| **HYDRO-FUNCTIONAL IMPORTANCE** | | | 2 | 2 | 2 | 4 |
| **Direct Human Benefits** | | | Score (0-4) | Score (0-4) | Score (0-4) | Confidence (1-5) |
| **Subsistence benefits** | ***Water for human use*** | | 0 | 0 | 0 | 4 |
| | ***Harvestable resources*** | | 0 | 0 | 0 | 4 |
| | ***Cultivated foods*** | | 0 | 0 | 0 | 4 |
| | | | | | | |
| **Cultural benefits** | ***Cultural heritage*** | | 0 | 0 | 0 | 4 |
| | ***Tourism and recreation*** | | 1 | 0 | 0 | 4 |
| | ***Education and research*** | | 0 | 0 | 0 | 4 |
| **DIRECT HUMAN BENEFITS** | | | 0,17 | 0,00 | 0,00 | 4 |

# APPENDIX F –Mitigation Measures

**General construction management and good housekeeping practices**
Latent and general impacts which may affect the freshwater ecology and biodiversity, will include any activities which take place in close proximity to the proposed development that may impact on the receiving environment. Mitigation measures for these impacts are highlighted below and are relevant to the freshwater systems identified in this report:

**Development footprint**

- All development footprint areas should remain as small as possible and should not encroach into the freshwater areas unless absolutely essential and part of the proposed development. It must be ensured that the freshwater habitat is off-limits to construction vehicles and non-essential personnel
- The boundaries of footprint areas, including contractor laydown areas, are to be clearly defined and it should be ensured that all activities remain within defined footprint areas. Edge effects will need to be extremely carefully controlled;
- Planning of temporary roads and access routes should avoid freshwater areas and be restricted to existing roads where possible;
- Appropriate sanitary facilities must be provided for the life of the pre-construction and construction phase and all waste removed to an appropriate waste facility;
- All hazardous chemicals as well as stockpiles should be stored on bunded surfaces and have facilities constructed to control runoff from these areas;
- It must be ensured that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage;
- No fires should be permitted in or near the construction area; and
- Ensuring that an adequate number of waste and “spill” bins are provided will also prevent litter and ensure the proper disposal of waste and spills.

**Vehicle access and use**

- All vehicles must be regularly inspected for leaks. Re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into the topsoil;
- In the event of a vehicle breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practiced near the surface area to prevent ingress of hydrocarbons into topsoil and subsequent habitat loss; and
- All spills should they occur, should be immediately cleaned up and treated accordingly.

**Vegetation**

- Proliferation of alien and invasive species is expected within any disturbed areas. Whilst not considered severe at this time, the vegetation component within the freshwater environment is already transformed to an extent as a result of alien plant invasion; therefore, these species should be eradicated and controlled to prevent their spread beyond the project footprint;
- Removal of the alien and weed species encountered within the freshwater resources 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, and maintenance phases;
- 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; and
  - No vehicles should be allowed to drive through designated sensitive wetland areas during the eradication of alien and weed species.

**Disturbed and compact soils**

- Sheet runoff from access roads should be slowed down by the strategic placement of berms;

- As far as possible, all construction activities should occur in the low flow season, during the drier winter months;
- As much vegetation growth as possible (of indigenous floral species) should be encouraged to protect soils;
- No stockpiling of topsoils is to take place within close proximity to the river, and all stockpiles must be protected with a suitable geotextile to prevent sedimentation of the river;
- All soils compacted as a result of construction activities as well as ongoing operational activities falling outside of project footprint areas should be ripped and profiled; and
- A monitoring plan for the development and the immediate zone of influence should be implemented to prevent erosion and incision.

**Rehabilitation**

- Construction rubble must be collected and disposed of at a suitable landfill site;
- 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;
- Rehabilitate all drainage line and riparian habitat areas to ensure that the ecology of these areas is re-instated during all phases;
- 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 as possible should be promoted within the proposed development area in order to protect soils;
- All alien vegetation in the riparian zone should be removed upon completion of construction and reseeded with indigenous grasses as specified by a suitably qualified specialist (ecologist);
- All areas affected by construction should be rehabilitated upon completion of the construction phase of the development;
- Bank vegetation cover should be monitored to ensure that sufficient vegetation is present to bind the bankside soils and prevent bankside erosion and incision; and
- All alien vegetation in the footprint area as well as immediate vicinity of the proposed development activities should be removed. Alien vegetation control should take place for a minimum period of two growing seasons after rehabilitation is completed.

# 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 NDip Nature Conservation (UNISA)

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

| | | | |
|---|---|---|---|
| Company of Specialist: | Scientific Aquatic Services | | |
| Name / Contact person: | Stephen van Staden | | |
| Postal address: | 29 Arterial Road West, Oriel, Bedfordview | | |
| Postal code: | 1401 | 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)<br>BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg)<br>BSc (Zoology, Geography and Environmental Management) (University of Johannesburg) | | |
| Registration / Associations | Registered Professional Natural Scientist at South African Council for Natural Scientific Professions (SACNASP)<br>Accredited River Health Practitioner by the South African River Health Program (RHP)<br>Member of the South African Soil Surveyors Association (SASSO)<br>Member of the Gauteng Wetland Forum | | |

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

I, Stephen van Staden, declare that -

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

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Signature of the Specialist

## SCIENTIFIC AQUATIC SERVICES (SAS)

## SPECIALIST CONSULTANT INFORMATION

## CURRICULUM VITAE OF STEPHEN VAN STADEN

### PERSONAL DETAILS

| | |
|---|---|
| Position in Company | Managing Member, Group CEO, Water Resource Discipline Lead, Ecologist, Aquatic Ecologist |
| Date of Birth | 13 July 1979 |
| Nationality | South African |
| Languages | English, Afrikaans |
| Joined SAS | 2003 (year of establishment) |
| Other Business | Trustee of the Serenity Property Trust |

### MEMBERSHIP IN PROFESSIONAL SOCIETIES

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

## COUNTRIES OF WORK EXPERIENCE

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

## DEVELOPMENT SECTOR 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

## SELECTED PROJECT EXAMPLES OUT OF OVER 3000 PROJECTS COMPLETED

| PROJECT NAME | PROJECT DESCRIPTION PER DEVELOPMENT SECTOR | PROVINCE |
|---|---|---|
| **LINEAR** | | |
| N3 De Beers Pass Route | Wetland and Aquatic Assessment | KwaZulu Natal |
| SANRAL N4 Upgrades | Faunal, Floral and Wetland Assessments | Mpumalanga |
| Gautrain Rapid Rail Ext Project | Due Diligence Feasibility Study | Gauteng |
| N11 Section 13x Mokopane Ring Road | Biodiversity, Aquatic And Wetland Ecological Assessment | Limpopo |
| SASOL Gas Pipeline | Watercourse Rehab & Management Plan | Gauteng |
| Bylsbridge Development | Biomonitoring Programme and Monthly ECO | Gauteng |
| **MINING** | | |
| Tronox Namakwa Sands Mine Expansion | Floral, Faunal and Wetland Ecological Assessments | Western Cape |
| Brikor Limited | Wetland Rehabilitation and Water Use Licence Audits | Gauteng |
| Fuleni Anthracite Coal Project | Biodiversity, Wetland, Aquatic and Visual Impact Assessments | KwaZulu Natal |
| Leandra Colliery | Biodiversity, Wetland, Aquatic and Visual Impact Assessments | Gauteng |
| The Dual Project | Biodiversity, Wetland, Aquatic and Visual Impact Assessments | Limpopo |
| TGME Pilgrims Rest | Biodiversity, Wetland, Aquatic and Visual Impact Assessments | Mpumalanga |
| Barberton Mines (Fairview, Consort, Sheba) | Aquatic biomonitoring assessments | Mpumalanga |
| Modikwa Platinum Mine Integrated Water Management Study | Freshwater And Aquatic Ecological Assessment & Management Plan | Limpopo |
| Dwars River Catchment For Dwars River Environmental Forum (DREF) | Mass and Salt Load Study | Limpopo |
| Sibanye Stillwater Akanani Mine | Biodiversity, Wetland, Soils And Visual Impact Assessment | Limpopo |

| | | |
|---|---|---|
| Thaba Chueu Operations | Annual Water Quality Monitoring & Biomonitoring | Mpumalanga |
| Samada Diamonds | Water Use Authorisation And Specialist Studies | Free State |
| AngloAmerican Amandebult Mine Complex | Biodiversity Assessment | Limpopo |
| Nkomati Nickel Mine | Biodiversity, Wetland and Aquatic Assessments | Mpumalanga |
| Gravenhage Mine | Watercourse Ecological Assessment & Hydropedological Study | Northern Cape |
| Glencore Mine Operations (Thorncliffe, Magareng and Helena) | Biodiversity External Audit & Biodiversity Management and Monitoring Plan | Limpopo |
| Ikwezi Mine | Freshwater Assessment, Biodiversity Monitoring, Freshwater Rehabilitation Plan & WULA | KwaZulu Natal |
| Welstand Colliery | Hydropedological Assessment | Mpumalanga |
| Kebrafield Colliery | Wetland and Hydropedological Assessments and Wetland Offset | Mpumalanga |
| Evander Gold Mine Tailings Storage Facility expansion | Wetland Offset and Hydropedological Assessment | Mpumalanga |
| **INDUSTRIAL CHEMICALS** | | |
| Anchor Yeast | Freshwater Assessment | KwaZulu Natal |
| Sasol Sludge Plant | Wetland And Aquatic Assessment | Mpumalanga |
| NCP Alcohols | Freshwater Assessment | Gauteng |
| Enstra Paper/Blesbokspruit (SAPPI | Quarterly Biomonitoring and Toxicity Testing | Gauteng |
| Phesantekraal Light Industrial Development | Stormwater Management | Western Cape |
| **INFRASTRUCTURE** | | |
| Mzimvubu Dam | Full Ecological Assessments | Eastern Cape |
| Vissershok Dams | WULA And Wetland Assessment | Western Cape |
| Tshwane WWTW | Freshwater Ecological Assessment | Gauteng |
| Assmang Machadorp Works | Ongoing Aquatic Biomonitoring Programme | Mpumalanga |
| uMkhomazi Water Project | Biodiversity Offset | KwaZulu Natal |
| Sishen Western Dewatering Infrastructure Project | Floral Species of Conservation Concern & Tree Marking | Northern Cape |
| Richards Bay Coal Terminal | Estuarine Ecological Assessment | KwaZulu Natal |
| Vopak Richards Bay Harbour South Dunes Precinct | Wetland Offset Initiative | KwaZulu Natal |
| SASOL Fine Ash Dam-6 Borrow Pit | Hydropedological And Freshwater Assessments | Mpumalanga |
| Kwaduzuka WWTW | Freshwater Ecological Assessment | KwaZulu Natal |
| New Cargo Precinct (OR Tambo Airport) | Terrestrial & Freshwater Ecological Assessments | Gauteng |
| **COMMERCIAL & RESIDENTIAL DEVELOPMENT** | | |
| Thusaneng Housing Project | Biodiversity Study | Gauteng |
| Blue Hills Eco Estate | Flora, Faunal And Wetland Assessment | Gauteng |
| Val De Vie Estate | Integrated WULA; Watercourse Rehabilitation Plan | Western Cape |

| | | |
|---|---|---|
| Riversands Commercial Hub – Bridge Crossings | Environmental Control Officer | Gauteng |
| Carlswald Valley Residential Estate | Wetland Assessment and Wetland Rehabilitation Plan | Gauteng |
| AM Lodge | Terrestrial Ecological Habitat Sensitivity Assessment | Limpopo |
| Blair Athol Estate | Freshwater & Aquatic Ecological Assessment | Gauteng |
| Birchleigh North Ext 4 Housing Development | Wetland and Hydropedological Assessment | Gauteng |
| M&T Development various mixed use development projects | Freshwater, Biodiversity and Aquatic Assessments | Gauteng |
| **RENEWABLE ENERGY** | | |
| Century Property various mixed use development projects | Freshwater, Biodiversity and Aquatic Assessments | Gauteng |
| ADvTECH House various educational facility projects | Freshwater & Aquatic Assessments | Gauteng |
| Duhva Solar Plant | Full Ecological Assessments | Mpumalanga |
| Arnot Solar Plant | Full Ecological Assessments | Mpumalanga |
| Copperton Wind Energy Facility | Freshwater Assessment, Hydrology and WULA | Northern Cape |
| Haga Wind Energy Facility | Freshwater Assessment, Visual Impact Assessment and WULA | Eastern Cape |
| Sutherland Wind Energy Facility | Freshwater Assessment | Northern Cape |
| Kruisvallei Hydroelectric Facility | WULA Audit | Free State |
| Erasmus Park Development | Visual Impact Assessment | Gauteng |
| **AGRICULTURE** | | |
| Brand Se Baai Abalone Farm | Biodiversity Baseline Assessment | Western Cape |
| Doringbaai Aquaculture Farms | Biodiversity Assessment | Western Cape |
| Ptn 38 Elandspruit Farm | Biodiversity Assessment | Mpumalanga |
| Doornkloof Farm | Freshwater & Aquatic Ecological Assessment | KwaZulu Natal |
| Schoeman Boerdery - Olifants River | S24G Aquatic Ecological Assessment & Landscaping Plan | Limpopo |
| Lourensford Wine Farm | Freshwater Verification | Western Cape |
| Olievenhoutbosch Solar Facility | Visual Impact Assessment | Gauteng |
| Houtboschkloof Farm | Freshwater Assessment & Reserve Determination | Limpopo |
| **MUNICIPAL** | | |
| Mutsho Powerstation | Freshwater ecological assessments | Limpopo |
| Fisantkraal WasteWater Treatment Works | Aquatic Biomonitoring | Western Cape |
| Braamfonteinspruit Rehabilitation (Joburg Roads Agency) | Floral, Faunal, Freshwater and Aquatic Assessments | Gauteng |
| Kleinmond Cemetery | Wetland and Hydropedological Assessments | Western Cape |

## REFERENCES

**Marietjie Eksteen**
**Managing Director: Jacana Environmental**
**Tel**: 015 291 4015
**Email**: marietjie@jacanacc.co.za

**Daniel Cillie**
**Director: Enprocon (Pty) Ltd**
**Tel:** 034 326 3849
**Email**: danielcillie@telkomsa.net

**Jaco Kleynhans**
**Director: Jaco K Consulting**
**Tel**: 013 243 7110
**Email:** jaco@jacokconsulting.co.za

Yours faithfully

**STEPHEN VAN STADEN**

## SCIENTIFIC AQUATIC SERVICES (SAS)

## SPECIALIST CONSULTANT INFORMATION

## CURRICULUM VITAE OF

## AMANDA MILESON

### PERSONAL DETAILS

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

### MEMBERSHIP IN PROFESSIONAL SOCIETIES

South African Wetland Society

Gauteng Wetland Forum

### EDUCATION

**Qualifications**

| | |
|---|---|
| N.Dip Nature Conservation (UNISA) | 2017 |
| Advanced Diploma Nature Conservation (UNISA) | 2020 |

**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 |

### COUNTRIES OF WORK EXPERIENCE

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

Zimbabwe, Zambia

### KEY SPECIALIST DISCIPLINES

**Freshwater Assessments**

- Desktop Freshwater Delineation
- Freshwater Verification Assessment
- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater EcoService and Status Determination

- Rehabilitation Assessment / Planning
- Maintenance and Management Plans
- Plant Species Plan
- Freshwater Offset Plan

**Biodiversity Assessments**

- Biodiversity EcoScan
- Biodiversity Offset Plan

# SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

# CURRICULUM VITAE OF TIA KEIGHLEY

## PERSONAL DETAILS

| | |
|---|---|
| Position in Company | Junior Field Ecologist: Wetland Ecology |
| Date of Birth | 09 July 1992 |
| Nationality | South African |
| Languages | English |
| Joined SAS | 2020 |

## EDUCATION

**Qualifications**

| | |
|---|---|
| BSc Masters Water Resource Science (Rhodes University) | 2017 |
| BSc Honours Environmental Science (Rhodes University) | 2018 |
| BSc Environmental Science and Zoology (Rhodes University) | 2017 |
| Tools for Wetland Assessment (Rhodes University) | 2014 |

## COUNTRIES OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga

## KEY SPECIALIST DISCIPLINES

**Freshwater Assessments**

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