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FRESHWATER BASELINE ECOLOGICAL ASSESSMENT AS PART OF THE ENVIRONMENTAL AUTHORISATION AND WATER USE AUTHORISATION PROCESSES FOR THE PROPOSED WASTE TYRE MANAGEMENT FACILITY NEAR KATHU, NORTHERN CAPE

Prepared for

EXM Environmental Advisory (Pty) Ltd

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EXECUTIVE SUMMARY

Sishen Iron Ore Company (SIOC) proposes to develop a waste tyre management facility (the "proposed facility") near the town of Kathu, Northern Cape Province, on a portion of the Farm Sekgame 461 RD. The proposed facility is hereafter referred to as the "study area", and is approxaimtely 8.4 ha in extent.

During the site assessment undertaken in October 2021, no watercourses (as defined by the National Water Act, 1998 (Act No. 36 of 1998)) were identified within the study area. A single temporary depression wetland, or "cryptic wetland" was identified approximately 320 m south of the study area. This "cryptic wetland" possessed unique characteristics not observed in the study area or surrounds, including floral species.

The cryptic wetland was found to be moderately modified, as a result of various historical impacts, predominantly to the floral assemblages associated with the wetland. The Ecological Importance and Sensitivity (EIS) was determined to be 'moderate' largely due to the potential and capacity for biodiversity maintenance services. Ecoservice provision was deemed 'moderately low', attributed to the ephemeral nature of the wetland, as well as being located within an increasingly developed and urbanised area, thus community reliance on the system for goods and indirect benefits is reduced.

The proposed facility is not expected to encroach on the cryptic wetland, therefore no direct risks to the ecological integrity and functioning of the wetland are anticipated. The results of the Department of Water and Sanitation (DWS) Risk Assessment Matrix (2016) as it relates to activities as stipulated in Section 21(c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998), which was applied to determine the risk significance of the proposed facility, indicate that the risk significance will be 'low', provided that site specific, well-designed mitigation measures are implemented throughout the life of the proposed facility. It is therefore the specialist's opinion that the proposed facility may be authorised under a General Authorisation in terms of Government Notice (GN) 509 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998).

MANAGEMENT SUMMARY

Scientific Aquatic Services (SAS) was appointed to conduct an investigation considering the freshwater ecology as part of the Environmental Authorisation (EA) and Water Use Authorisation (WUA) processes for a proposed waste tyre management facility for Sishen Iron Ore Company, near Kathu, Northern Cape Province, henceforth referred to as the "study area". The study area is approximately 8.4 ha in extent and is located on the Remaining Extent of the Farm Sekgame 461 RD, approximately 240 m south of Kalk Street on the southeastern outskirts of the town of Kathu, in the administrative area of the Gamagara Local Municipality in the Northern Cape.

The purpose of this report is to define the ecology of the study area from a freshwater ecological management perspective, including mapping and classification of the area of increased wet response and any areas that can be defined as watercourses based on the definitions contained in the National Water Act, 1998 (Act No. 36 of 1998) and based on regional best practice guidelines and research for features that do not conform to the traditional definition of a watercourse.

During the site assessment, it was confirmed that no features which meet the definition of a watercourse (as defined by the National Water Act, 1998 (Act No. 36 of 1998)) occur within the study area. One area of increased wet response was identified approximately 320 m south of the study area utilising desktop methods prior to the site assessment. This area was ground-truthed, and was found to possess

distinctive characteristics including topography, soil form and specific floral species which led to the classification of this features as a “cryptic wetland”. These are features which are often “hidden” in the landscape, due to their ephemeral nature caused by, for example, arid or semi-arid climatic conditions. There is no broadly accepted definition of a “cryptic wetland”, but according to Day *et al* (2010) these are generally accepted to be systems which may remain dry (and potentially desiccated) for several seasons, only displaying certain characteristics when sufficient rainfall has occurred. For the purposes of this study, SAS defined the cryptic wetland based on a distinct topographic setting, specifically an endorheic (inward-draining) depression, the presence of at least two of five identified floral indicators and subtle yet easily discernible changes in the vegetation assemblages associated with the cryptic wetland, as well as the presence of gleying and mottling.

As part of this assessment a desktop study was conducted, and the results thereof are contained in Section 3 of this report. A single field assessment was undertaken in October 2021, with the aim of identifying, delineating and assessing any potential surface water features of interest and areas of increased wet response and to ground-truth other pre-defined areas of interest. Factors influencing the habitat integrity of this cryptic wetlands was noted along with its functional state, and the environmental and socio-cultural services provided by the cryptic wetland was determined. The results of the field assessment are contained in Section 4 of this report and are summarised in the table below.

Table A: Summary of results of the field assessment of the identified cryptic wetlands as discussed in Section 4.

PES	Ecoservices	EIS	REC / RMO / BAS
C	Moderately low	Moderate	C / C (Maintain) / C

Following the ecological assessment of the cryptic wetland, the Department of Water and Sanitation (DWS) Risk Assessment Matrix as defined in accordance with Government Notice (GN) 509 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) was applied to ascertain the significance of possible impacts which may occur as a result of the proposed facility.

No direct risks to the identified cryptic wetland are anticipated, due to the distance of the wetland from the study area and proposed activities therein. The results of the risk assessment therefore indicate that the expected risk significance is ‘low’, provided that the mitigation measures contained in this report are implemented. Based on the outcome of the risk assessment, it is the specialist’s opinion that as the proposed activities within the study area pose minimal risk significance to the cryptic wetland, they may be authorised by means of a General Authorisation. A summary of the results of the risk assessment is provided in Table B below.

Table A: Summary of results of DWS Risk Assessment applied to the proposed waste tyre management facility.

Phase	Activity	Aspect	Impact	Likelihood	Significance	Risk Rating	Reversibility
Construction	Site clearing prior to commencement of construction activities, including placement of contractor laydown areas.	•Vehicular movement and access to the site; •Removal of vegetation within the study area and associated disturbances (creation of rubble and litter) to soil upgradient of but further than 320 m from wetland.	•Damage to and loss of vegetation, leading to exposed/compacted soil, in turn leading to potential for increased runoff from exposed areas, erosion of the downgradient wetland and potential for increased sedimentation of the wetland;	12	36	L	Fully reversible

Phase	Activity	Aspect	Impact	Likelihood	Significance	Risk Rating	Reversibility
	Removal of topsoil from project footprint, and stockpiling thereof for rehabilitation.	•Increased risk of transportation of sediment from exposed soils and hydrocarbons from construction vehicles in storm water runoff into downgradient wetland.	•Increased sedimentation of the wetland may lead to changes in habitat, potentially altered surface water quality, smothering of vegetation and/or altered vegetation composition and smothering of biota and/or egg banks; •Potential impacts on water quality due to leaks and spills from construction machinery and increased sediment availability; •Decreased ecoservice provision and biodiversity maintenance capacity; and •Proliferation of alien vegetation as a result of disturbances.	12	36	L	Fully reversible
	Construction of diesel storage facility.			13	52	L	Fully reversible
	Potential indiscriminate waste disposal and/or spillage from construction vehicles.	Disposal of construction-related wastes (such as rubble, hazardous chemicals and litter).	• Altered water distribution patterns as a result of solid waste within the freshwater environment; and • Altered water quality due to chemical waste disposal.	13	39	L	Fully reversible
Operational	Operation of the proposed recycling facility.	• Increased risk of hydrocarbons and/or sediment entering the wetland indirectly via stormwater runoff.	* Further impacts to water quality as a result of increased availability of pollutants; and * Contribution to increased volume of water entering the wetland as a result of stormwater runoff emanating from hardened surfaces in the catchment.	15	48,8	L	Fully reversible
		Increased vehicular traffic upgradient of and within 320 m of the wetland.	• Disturbances of soil leading to increased alien vegetation proliferation, which may spread to the wetland; and • Increased risk of litter generation, which may be transported to the wetland in stormwater runoff or by wind, leading to pollution of the wetland.	15	48,8	L	Fully reversible

DOCUMENT GUIDE

The table below provides the specialist report requirements for the assessment and reporting of impacts on aquatic biodiversity in terms of Government Notice 320 as promulgated in Government Gazette 43110 of 20 March 2020 in line with the Department of Environmental Affairs screening tool requirements, as it relates to the National Environmental Management Act, 1998 (Act No. 107 of 1998).

No.	Requirements	Section in report/Notes
2.1	Assessment must be undertaken by a suitably qualified SACNASP registered specialist	Cover Page and Appendix F.
2.2	Description of the preferred development site , including the following aspects-	
2.2.1	a. Aquatic ecosystem type b. Presence of aquatic species and composition of aquatic species communities, their habitat, distribution and movement patterns	Section 3 and 4
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 3: 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 3: Table 1
2.2.4	A description of the Ecological Importance and Sensitivity of the aquatic ecosystem including: 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.); 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 3: Table 1
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	None.
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 5: Table 5
2.4.1	Is the development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal?	No direct impacts perceived.
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: 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); 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; 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.) and d. Assessment of the risks associated with water use/s and related activities.	Section 5: Table 5
2.4.4	How will the development impact on the functionality of the aquatic feature including:	Section 5: Table 5

	a. Base flows (e.g. too little/too much water in terms of characteristics and requirements of system); 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); 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); d. Quality of water (e.g. due to increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication); e. Fragmentation (e.g. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal); and 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 5: Table 5
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?	N/A
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).	N/A
3.	The report must contain as a minimum the following information:	
3.1	Contact detail of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae.	Appendix F
3.2	A signed statement of independence by the specialist.	Appendix F
3.3	A statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment.	Section 2
3.4	The methodology used to undertake the site inspection and the specialist assessment, including equipment and modelling used, where relevant.	Section 2, Appendix C
3.5	A description of the assumptions made, any uncertainties or gaps in knowledge or data.	Section 1.4
3.6	The location of areas not suitable for development, which are to be avoided during construction and operation, where relevant.	Section 4.4
3.7	Additional environmental impacts expected from the proposed development.	Section 5
3.8	Any direct, indirect and cumulative impacts of the proposed development on site.	Section 5
3.9	The degree to which impacts and risks can be mitigated.	Section 5
3.10	The degree to which impacts and risks can be reversed.	Section 5
3.11	The degree to which the impacts and risks can cause loss of irreplaceable resources.	Section 5
3.12	A suitable construction and operational buffer for the aquatic ecosystem, using the accepted methodologies.	N/A
3.13	Proposed impact management actions and impact management outcomes for inclusion in the Environmental Management Programme (EMPr).	Section 5
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.	N/A
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 6
3.16	Any conditions to which this statement is subjected.	Section 6

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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, animans and micro-organisms, the genes they contain, the evolutionary history and potential they encompass and the ecosystems, ecological processes and landscape of which they are integral parts.
Buffer:	A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area.
Catchment:	The area where water is collected by the natural landscape, where all rain and run-off water ultimately flows into a river, wetland, lake, and ocean or contributes to the groundwater system.
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".
Endorheic	As it relates to a depression wetland: inward-draining with no transport of water into downstream systems via subsurface or surface flow. Water leaves via evapotranspiration and infiltration only.
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.
Obligate species:	Species almost always found in wetlands (>99% of occurrences).
Perched water table:	The upper limit of a zone of saturation that is perched on an unsaturated zone by an impermeable layer, hence separating it from the main body of groundwater
Perennial:	Flows all year round.
RAMSAR:	The Ramsar Convention (The Convention on Wetlands of International Importance, especially as Waterfowl Habitat) is an international treaty for the conservation and sustainable utilisation of wetlands, i.e., to stem the progressive encroachment on and loss of wetlands now and in the future, recognising the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value. It is named after the city of Ramsar in Iran, where the Convention was signed in 1971.
RDL (Red Data listed) species:	Organisms that fall into the Extinct in the Wild (EW), critically endangered (CR), Endangered (EN), Vulnerable (VU) categories of ecological status
Seasonal zone of wetness:	The zone of a wetland that lies between the Temporary and Permanent zones and is characterised by saturation from three to ten months of the year, within 50cm of the surface
Temporary zone of wetness:	the outer zone of a wetland characterised by saturation within 50cm of the surface for less than three months of the year
Watercourse:	In terms of the definition contained within the National Water Act, a watercourse means: • A river or spring; • A natural channel which water flows regularly or intermittently; • A wetland, dam or lake into which, or from which, water flows; and • Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse; • and a reference to a watercourse includes, where relevant, its bed and banks
Wetland Vegetation (WetVeg) type:	Broad groupings of wetland vegetation, reflecting differences in regional context, such as geology, climate, and soils, which may in turn have an influence on the ecological characteristics and functioning of wetlands.

ACRONYMS

°C	Degrees Celsius.
BAR	Basic Assessment Report
BGIS	Biodiversity Geographic Information Systems
CBA	Critical Biodiversity Area
CSIR	Council of Scientific and Industrial Research
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EC	Ecological Class or Electrical Conductivity (use to be defined in relevant sections)
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMC	Ecological Management Class
EMP	Environmental Management Program
ESA	Ecological Support Area
EWR	Ecological Water Requirements
FEPA	Freshwater Ecosystem Priority Areas
GIS	Geographic Information System
GN	Government Notice
GPS	Global Positioning System
HGM	Hydrogeomorphic
m	Meter
MAP	Mean Annual Precipitation
NEMA	National Environmental Management Act
NFEPA	National Freshwater Ecosystem Priority Areas
NBA	National Biodiversity Assessment
NWA	National Water Act
PES	Present Ecological State
REC	Recommended Ecological Category
RMO	Resource Management Objective
ROM	Run of Mine
RQIS	Research Quality Information Services
SACNASP	South African Council for Natural Scientific Professions
SANBI	South African National Biodiversity Institute
SAS	Scientific Aquatic Services
SQR	Sub quaternary catchment reach
subWMA	Sub-Water Management Area
TSF	Tailings Storage Facility
WetVeg Groups	Wetland Vegetation Groups
WMA	Water Management Areas
WMS	Water Management System
WRC	Water Research Commission
WULA	Water Use License Application

1 INTRODUCTION

1.1 Background

Scientific Aquatic Services (SAS) was appointed to conduct an investigation considering the freshwater ecology as part of the Environmental Authorisation (EA) and Water Use Authorisation (WUA) processes for a proposed waste tyre management facility for the Sishen Iron Ore Company, near Kathu, Northern Cape Province, henceforth referred to as the "study area". The study area is approximately 8.4 ha in extent as indicated in Figures 1 and 2 and is located on the Remaining Extent (RE) of the Farm Sekgame 461 RD, approximately 240 m south of Kalk Street on the south-eastern outskirts of the town of Kathu, in the administrative area of the Gamagara Local Municipality in the Northern Cape.

The proposed waste tyre mechanical downsizing facility is intended to provide for the effective management of waste tyres produced by the Sishen Mine and will entail the initial downsizing and granulation of waste tyres. Please refer to Section 1.2 for the project description.

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

A field investigation was undertaken in October 2021, during which it was confirmed that no watercourses as defined by the National Water Act, 1998 (Act No. 36 of 1998) occur within the study area. One area of increased wet response was identified approximately 320 m south of the study area. This feature possessed distinctive characteristics, in particular, topography and specific floral species as well as soil morphological characteristics which led to the classification thereof as a temporary depression wetland, or "cryptic wetland". These cryptic wetlands are features which are often "hidden" in the landscape, due to their highly ephemeral nature caused by, for example, arid or semi-arid climatic conditions. There is no standard definition of a "cryptic wetland", but according to Day *et al* (2010) these are generally accepted to be systems which may remain dry (and potentially desiccated) for several seasons, only displaying certain characteristics when sufficient rainfall has occurred. For the purposes of this study, SAS defined the identified cryptic wetland based on a distinct topographic setting,

specifically an endorheic (inward-draining) depression, the presence of at least two of five identified floral indicators and subtle yet easily discernible changes in the vegetation assemblages associated with the cryptic wetland, as well as the presence of soil mottling, although this was weakly defined in some features (refer to Section 4).

The purpose of this report is to define the ecology of the area from a freshwater ecosystem management point of view, including mapping and classification of the area of increased wet response and any areas that can be defined as watercourses based on the definitions contained in the National Water Act, 1998 (Act No. 36 of 1998) and based on regional best practice guidelines and research for features that do not conform to the definition of a watercourse as generally applied in South Africa. In terms of global best practice, the Ramsar Commission defines wetlands as "*areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres*" (Article 2.1, Ramsar Commission)[1]. As per this definition, the cryptic wetlands identified in the study and investigation areas may be considered wetlands, despite lacking hydrophytic vegetation.

In addition, the purpose of this report is to define the area deemed to be of increased Ecological Importance and Sensitivity (EIS), and to define the Present Ecological State (PES) of the cryptic wetland associated with the study area. Furthermore, this report aims to define the socio-cultural and ecological service provision of the cryptic wetland, and the Recommended Management Objectives (RMO) and Recommended Ecological Category (REC) thereof. It is a further objective of this study to provide detailed information when considering the proposed waste tyre mechanical downsizing activities in the vicinity of the cryptic wetland, 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 Department of Water and Sanitation (DWS) Risk Assessment Matrix (2016) as it relates to activities as stipulated in Section 21(c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998) was applied to determine the significance of the perceived risks associated with the proposed tyre downsizing activities on the receiving freshwater environment. In addition,

[1] Retrieved from http://archive.ramsar.org/cda/en/ramsar-about-faqs-what-are-wetlands/main/ramsar/1-36-37%5E7713_4000_0__ 27 October 2018

mitigatory measures were developed which aim to minimise the perceived risks associated with the proposed activities.

This report, after consideration and a description of the ecological integrity of the cryptic wetland associated with the study area, must guide the EAP as well as the proponent and the relevant authorities, by means of a reasoned opinion and recommendations, as to the viability of the proposed tyre mechanical downsizing activities from a freshwater resource management point of view and recommend the way forward in terms of the enviro-legal aspects.

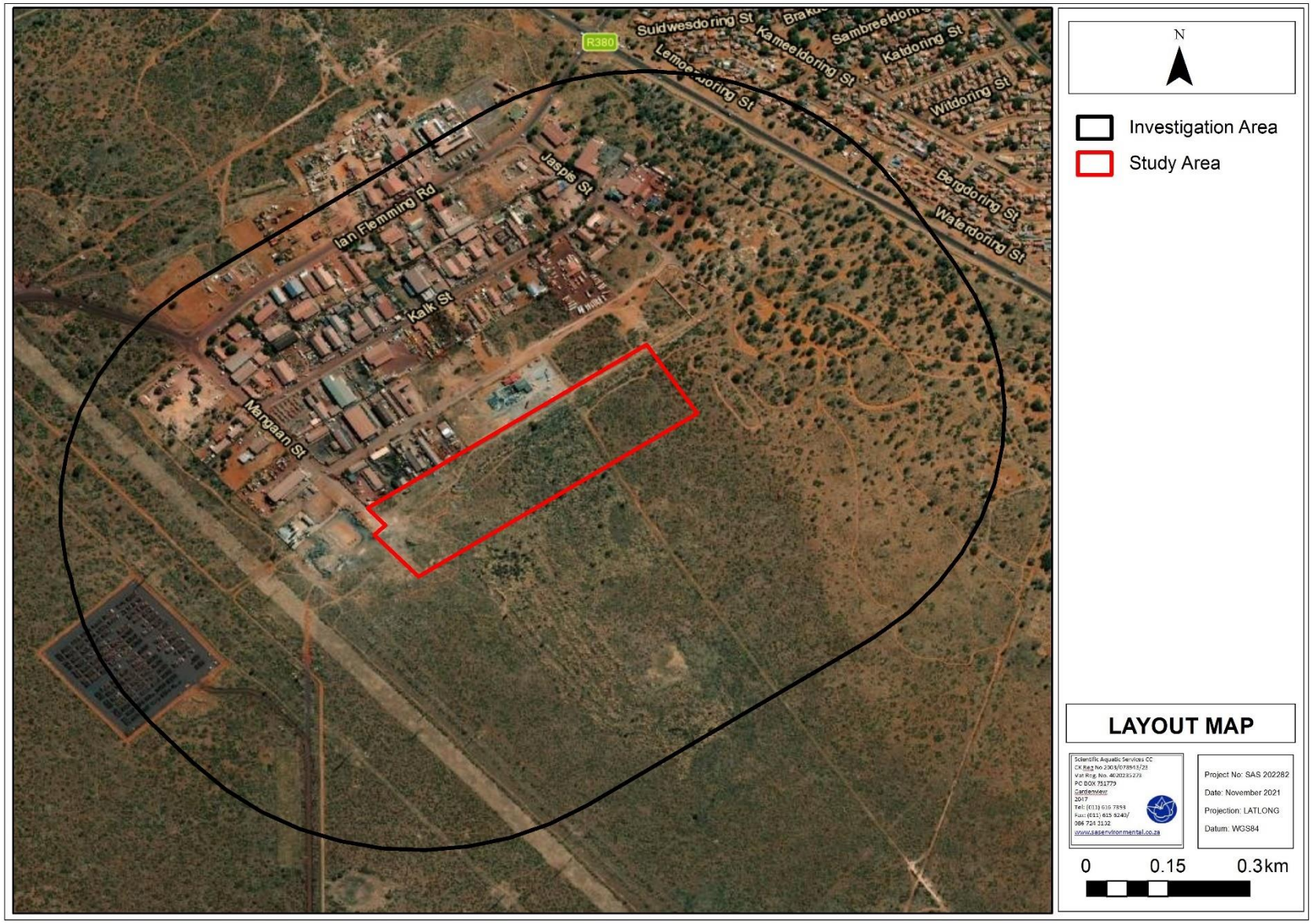

Figure 1: Locality of study area and the associated investigation area in relation to the surrounds, depicted on digital satellite imagery.

Figure 2: Locality of study area and the associated investigation area in relation to the surrounds, depicted on a 1:50,000 topographic map.

1.2 Project Description

Waste tyres will be transported to the site and downsized to approximately 30-60 mm, or even smaller. The product will be transported to offsite facilities for further processing. No further processing (recycling or recovery) of the material will be undertaken within the study area.

The proposed facility including the associated infrastructure will require the clearance of indigenous vegetation of approximately 8.4 hectares and will entail the development of the following structures/infrastructure:

- Building which contains equipment for shredding/cutting of waste tyres;
- Security office;
- Staff building with cafeteria;
- Admin and finance building;
- Diesel storage area (approximately 10 m^3);
- Waste tyre storage area;
- Workshop and parking areas; and
- Perimeter fence.

1.3 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 National Biodiversity Assessment (2018), Northern Cape Critical Biodiversity Areas Map (2016) and the Department of Water and Sanitation Research Quality Information Services [DWS RQIS PES/EIS], 2014 database was undertaken to aid in defining the PES and EIS of the cryptic wetland;
- 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 cryptic wetland was determined according to the method described by Rountree and Kotze (2013);
- The PES of the cryptic wetland was assessed according to the resource directed measures guideline as advocated by Macfarlane *et al.,* (2008);
- The cryptic wetland was mapped in relation to the study area. In addition to the delineated boundary of the cryptic wetland, the appropriate provincial recommended buffers and legislated zones of regulation were depicted where applicable;

- Allocation of a suitable Recommended Ecological Category (REC) and Recommended Management Objective (RMO) to the watercourse based on the results obtained from the PES and EIS assessments;
- The DWS Risk Assessment Matrix (2016) was applied to identify potential impacts that may affect the cryptic wetland as a result of the proposed waste tyre mechanical downsizing activities, and to aim to quantify the significance thereof; and
- To present management and mitigation measures which should be implemented during the various development phases to assist in minimising the impact on the receiving watercourse environment.

1.4 Assumptions and Limitations

The following assumptions and limitations are applicable to this report:

- The freshwater ecological assessment is confined to the study and investigation areas as illustrated in Figures 1 and 2 and does not include the neighbouring and surrounding properties outside of the study area. The general surroundings were, however considered in the desktop analysis of the study area;
- A single watercourse was identified within 500 m of the study area, and was delineated in fulfilment of GN 509 as it relates to the National Water Act, 1998 (Act No. 36 of 1998), according to the method described by the Department of Water Affairs and Forestry (DWAF)[2] (2005; 2008);
- The basis of South African methodologies for the formal identification and delineation of wetlands is primarily that of soil morphological indicators such as mottling and gleying, and presence of hydrophytic vegetation. However, a number of wetland types and conditions have been identified in which these soil morphological indicators do not readily apply, including temporary wetlands in very arid areas, which are often either 'too shallow, too saline, or too temporarily inundated" to exhibit typical wetland indicators in their soils (Day *et al*, 2010). According to Day *et al* (2010) such wetlands are referred to as "cryptic" and cannot always be reliably identified as wetlands during either normal dry season (depending on locality) or extended dry periods (such as in very arid regions or following prolonged drought) on the basis of standard wetland identification and delineation tools (i.e., the use of DWAF, 2008). Nevertheless, a number of abiotic and biotic features indicate periodic wetness and were thus used in

[2] The Department of Water Affairs (DWA) is currently known as the Department of Water and Sanitation (DWS). Prior to being known as DWA, it was known as the Department of Water Affairs and Forestry (DWAF). 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

conjunction with visual analysis of soils and topography to identify possible watercourses within the study area;

- The study area is located within a semi-arid climate receiving average annual rainfall of less than 500 mm per annum. The assessment was undertaken prior to the onset of the rainy season, and as such, floral indicators, although present, were limited in extent and could not always be accurately identified;
- Limitations in the accuracy of the delineation due to anthropogenic disturbances such as indiscriminate disposal of waste materials and various earthworks which may have changed the pattern and timing of surface water flow in the landscape are deemed possible and therefore the delineation presented in this report is regarded as a best estimate of the watercourse boundaries based on site conditions present at the time of the assessment. The presented delineation is, however considered sufficiently accurate for decision making purposes;
- The determination of the catchment associated with the identified cryptic wetland was undertaken utilising 1 m and 0.5 m contours generated using GIS software and is thus considered adequate for decision-making purposes. Should a more accurate delineation of the catchment be required, the contours will need to be determined according to applicable surveying principles;
- Global Positioning System (GPS) technology is inherently inaccurate and some inaccuracies due to the use of handheld GPS instrumentation may occur. If more accurate assessments are required, the watercourse zones will need to be surveyed and pegged according to surveying principles; 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 watercourse associated with the study area has been accurately assessed and considered, based on the field observations undertaken in terms of the freshwater ecology.

1.5 Legislative Requirements and Provincial Guidelines

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

- The Constitution of the Republic of South Africa, 1996;
- The National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA);
- National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA);
- The National Water Act, 1998 (Act No. 36 of 1998) (NWA);

- Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998); and
- The Northern Cape Nature Conservation Act, 2009 (Act No. 9 of 2009).

2 ASSESSMENT APPROACH

2.1 Watercourse Field Verification

For the purposes of this investigation, the definition of a watercourse and wetland habitat were taken as per that in the National Water Act, 1998 (Act No. 36 of 1998). The definitions are as follows:

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

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

During the field assessment undertaken in October 2021, the presence of any watercourse characteristics as defined by DWAF (2008) and by the National Water Act, 1998 (Act No. 36 of 1998), were noted (please refer to Section 4 of this report). However, as noted in Section 1.3 of this report, in certain circumstances such as arid conditions, the identification and delineation of possible wetlands cannot always be undertaken utilising the DWAF (2008) guidelines. Thus, whilst the method presented in "A practical field procedure for identification and delineation of wetlands and riparian areas" published by DWAF in 2008 provided a basis for identifying and delineating wetlands during the site assessment, additional factors were taken into consideration. The foundation of the DWAF, 2008 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; and
- Vegetation adapted to saturated soils.

DWAF (2005) notes that "not all soils associated with wetlands exhibit these characteristics [i.e. mottling, gleying typical of hydromorphic soils] and thus may lack the characteristic mottles." Whilst it is unusual for wetland soils to lack the characteristic soil morphological characteristics described by DWAF (2005; 2008), wetlands lacking these characteristics should not be excluded from being classified as wetlands simply on the basis of absence of common soil morphological characteristics (DWAF, 2005).

According to Day *et al*, 2010, in particularly arid conditions, the above factors (with the exception of landscape position) cannot always be reliably utilised, in particular, soil wetness indicators since soils in "cryptic" wetlands are by definition not exposed to the specific conditions under which such indicators are formed (Day *et al,* 2010). Therefore, Day *et al* (2010) in "The Assessment of Temporary Wetlands During Dry Conditions" provide a number of alternative abiotic and biotic indicators which can be utilised to identify temporary wetlands, some of which – such as landscape setting - are included in the DWAF (2008) guidelines:

Abiotic indicators (Day *et al*, 2010):

- Topography / position in the landscape;
- Soil wetness (albeit an unreliable indictor in arid areas);
- Presence of a "muck" layer;
- Sediment deposits on plants and/or rocks;
- Biotic crusts; and
- Water marks.

Biotic indicators (Day *et al*, 2010):

- Invertebrates hatched out from dry season sediments under laboratory conditions;
- Presence of old cases, exoskeletons, shells of aquatic invertebrates in sediments;
- Vegetation (one or a combination of the following):
    - Presence of perennial or annual hydrophytes (either actively growing or identifiable plant remains);
    - Presence of facultative wetland species;
    - Presence of terrestrial, often ruderal species not adapted to life in saturated soils;
    - Absence of both dryland and wetland plants from the site; and
    - Presence of halophytes.

- Presence of algae, either developing in incubated samples or presence of dried algal remnants at the site.

It is important to note that the absence of any given indicator does not necessarily equate to the absence of a wetland, and that “no single indicator provides adequate information pertaining to the presence or absence of a wetland, the type, hydroperiod, biodiversity, function and principle ecological and hydrological drivers to be useful on its own, particularly with regards to actual or suspected cryptic and/or temporary wetlands” (Day *et al*, 2010).

In addition to the delineation process, a detailed assessment of the cryptic wetland associated with the study area was undertaken, whereby factors affecting the integrity of the cryptic wetland were taken into consideration and aided in the determination of the functioning as well as the provision of ecological and socio-cultural services by the watercourse. A detailed explanation of the methods of assessment undertaken is provided in Appendix C of this report.

2.2 Sensitivity Mapping

A single cryptic wetland was identified within the investigation area and was delineated with the use of a Global Positioning System (GPS). A Geographic Information System (GIS) was used to project this cryptic wetland onto digital satellite imagery and topographic maps. The sensitivity map provided in Section 4.3 should be considered during the planning and design phase of the proposed waste tyre management facility.

2.3 Risk Assessment and Recommendations

Following the completion of the assessment, a risk assessment was conducted (please refer to Appendix D for the method of approach) and recommendations were developed to address and mitigate impacts associated with the proposed mining expansion activities. These recommendations also include general ‘best practice’ management measures, which apply to the proposed development 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 5 of this report.

3 RESULTS OF THE DESKTOP ANALYSIS

3.1 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 study area’s actual site characteristics at the scale required to inform the environmental authorisation and/or water use licencing processes. Given these limitations, this information is considered useful as background information to the study. It must however be noted that site verification of key areas may potentially contradict the information contained in the relevant databases, in which case the site verified information must carry more weight in the decision-making process. Thus, this data was used as a guideline to inform the watercourse assessment and to focus on areas and aspects of increased conservation importance during the site assessment.

Table 1: Desktop data relating to the character of the watercourses associated with the study area and surrounding region.

Aquatic ecoregion and sub-regions in which the Assessment area is located	
Ecoregion	Southern Kalahari
Catchment	Orange
Quaternary Catchment	D4IJ
WMA	Lower Vaal
subWMA	Molopo
Dominant characteristics of the Southern Kalahari (29.01) Aquatic Ecoregion Level 2 (Kleynhans *et al.*, 2007)	
Dominant primary terrain morphology	Plains: moderate relief. Closed Hills and Mountains: moderate and high relief. Extremely irregular plains (almost hilly), lowlands and hills, slightly irregular plains (scattered low hills and pans.
Dominant primary vegetation types	Karroid Kalahari Bushveld, Kalahari Mountain Bushveld, Kalahari Plateau Bushveld
Altitude (m a.m.s.l)	700 to 1500
MAP (mm)	0 to 500
Coefficient of Variation (% of MAP)	30 to 40
Rainfall concentration index	60 to >65
Rainfall seasonality	Late Summer
Mean annual temp. (°C)	16 to 22
Winter temperature (July)	0 - 22 °C
Summer temperature (Feb)	16 to > 32 °C
Median annual simulated runoff	<5 to 40
Ecological Status of the most proximal sub-quaternary reach (DWS, 2014) (Figure 8)	
Sub-quaternary reach	D41J-02419
Proximity to the assessment area	Approximately 13.84 km west of the study area.
Assessed by expert?	Yes
PES Category Median	C (Moderately Modified)
Mean Ecological Importance (EI) Class	Moderate
Mean Ecological Sensitivity (ES) Class	Very Low
Stream Order	3
Default Ecological Class (based on median PES and highest EI or ES mean)	C (Moderate)
National Biodiversity Assessment (2018): South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (Figure 4)	

Detail of the Assessment area in terms of the National Freshwater Ecosystem Priority Area (NFEPA) (2011) database	
FEPACODE	The study and investigation areas are located in an upstream management area (FEPACODE 4). Although the FEPA status applies to the actual river reach, shading of the whole sub-quaternary catchment reach indicates that the surrounding land and smaller stream network need to be managed in a way that maintains the good condition of the river reach.
NFEPA Wetlands (Figure 3)	According to the NFEPA Database there is a natural depression wetland in the south-eastern portion of the investigation area. This corresponds with the NBA 2018: SAIIAE database. At the time of the database collation the depression wetland was considered to be in a natural or good ecological condition (Class AB).
Wetland Vegetation Type	The study and investigation areas fall within the Kathu Bushveld (Eastern Kalahari Bushveld Group 1), which is considered Least Threatened and Poorly Protected (Mbona *et al.* 2015).
NFEPA Rivers	According to the NFEPA database, no NFEPA rivers are in the study area or investigation area.
Detail of the Assessment area in terms of the Northern Cape Critical Biodiversity Areas (2016) (Figure 5)	
Critical Biodiversity Area (CBA): Category 1	According to the database, the study and investigation areas do not fall within a CBA.
Ecological Support Area (ESA)	A large portion of the study area and investigation area falls within an ESA. According to the Technical Guidelines for CBA Maps document ESAs are areas that must retain their ecological processes in order to meet biodiversity targets for ecological processes that have not been met in CBAs or protected areas; meet biodiversity targets for the representation of ecosystem types or Species of special concern when it's not possible to meet them in CBAs; support ecological functioning of protected areas or CBAs or a combination of these (SANBI, 2017).

According to the NBA 2018: SAIIAE there is a natural depression wetland located within the south-eastern portion of the investigation area. The wetland is classified as being of least concern **(LC)** according to the Ecosystem Threat Status **(ETS)** – mainly due to limited field assessment data collected for these wetlands at the time the dataset was collated, and is poorly protected **(PP)** (Ecosystem Protection Level **(EPL)**). The depression wetland is classified as being natural to largely natural with few modifications (WETCON A/B). This depression wetland corresponds with the wetland identified by the NFEPA database (2011).	Other Natural Areas (ONA)	A small northern portion of the study area and large portion of the investigation area falls within ONA. According to the Technical Guidelines for CBA Maps document, ONA consist of all those areas in good or fair ecological condition that fall outside the protected area network and have not been identified as CBAs or ESAs (SANBI, 2017).
	CBA Reasons	The Northern Cape Critical Biodiversity Areas (2016) database also includes the "reasons" layer, which is based on the planning units used in the spatial analysis and provides a list of biodiversity and ecological features found in each planning unit, which contribute to the biodiversity target (CBA Map Reason Metadata). According to this Northern Cape Critical Biodiversity Areas Reasons layer, the triggering biodiversity and ecological features for the CBA and ESAs within the Assessment area include the following: Kathu Bushveld, All natural wetlands, Landscape structural elements.
National Web Based Environmental Screening Tool (2020).		
The Screening Tool is intended to allow for pre-screening of sensitivities in the landscape to be assessed within the EA process. This assists with implementing the mitigation hierarchy by allowing developers to adjust their proposed development footprint to avoid sensitive areas.		
According to the screening tool the overall aquatic sensitivity of the assessment area and surrounds is **very high** due to the study and investigation areas falling within a Strategic Water Source Area.		

CBA = Critical Biodiversity Area; DWS = Department of Water and Sanitation; EI = Ecological Importance; EPL = Ecosystem Protection Level; ES = Ecological Sensitivity; ESA = Ecological Support Area; ETS = Ecosystem Threat Status; m.a.m.s.l = Metres Above Mean Sea Level; MAP = Mean Annual Precipitatio; NBA = National Biodiversity Assessment; NFEPA = National Freshwater Ecosystem Priority Areas; ONA = Other Natural Areas; PES = Present Ecological State; SAIIAE = South African Inventory of Inland Aquatic Ecosystems; SWSA = Strategic Water Source Areas; WMA = Water Management Area;

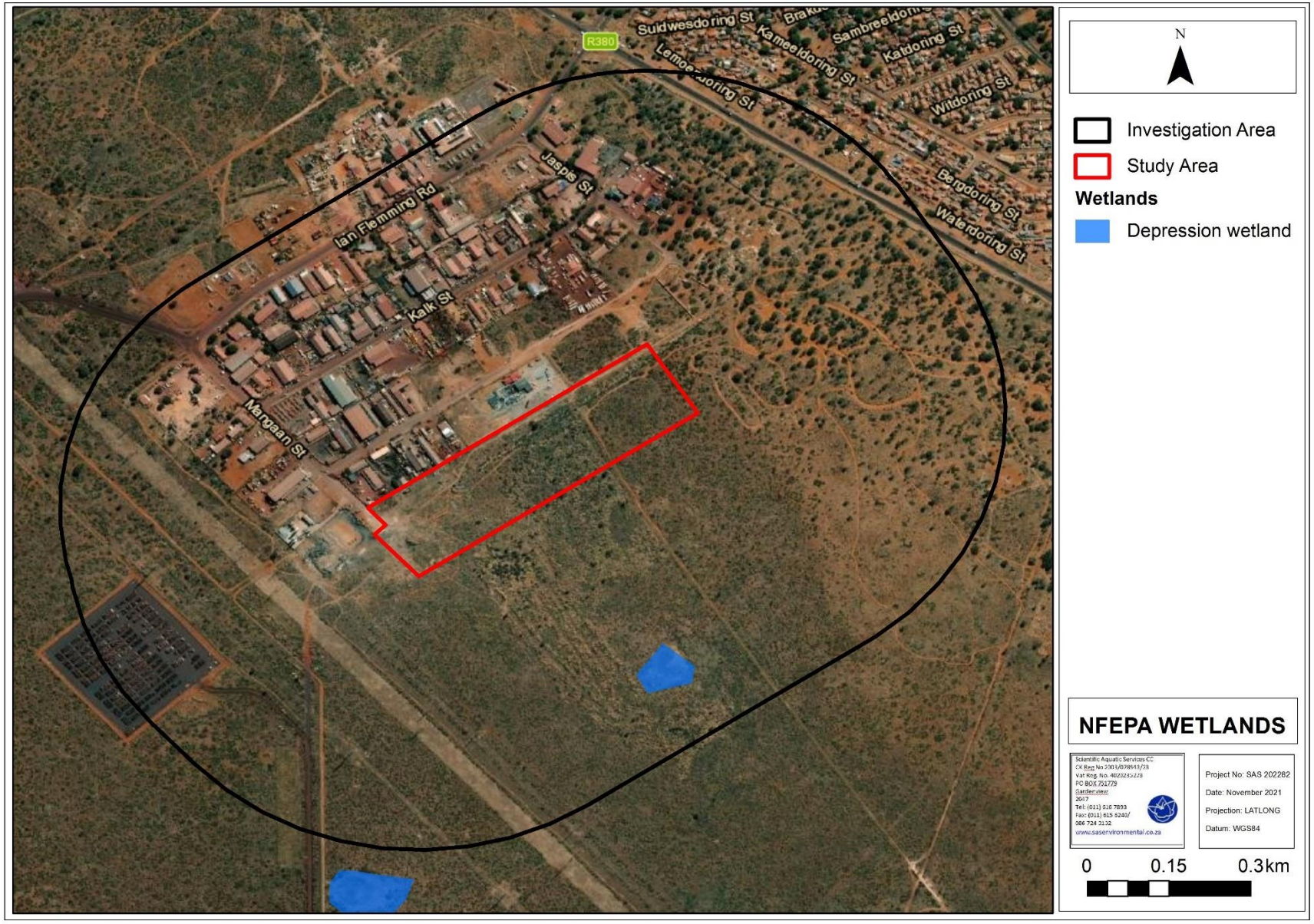

Figure 3: The wetland features associated with the study area and investigation area (NFEPA, 2011).

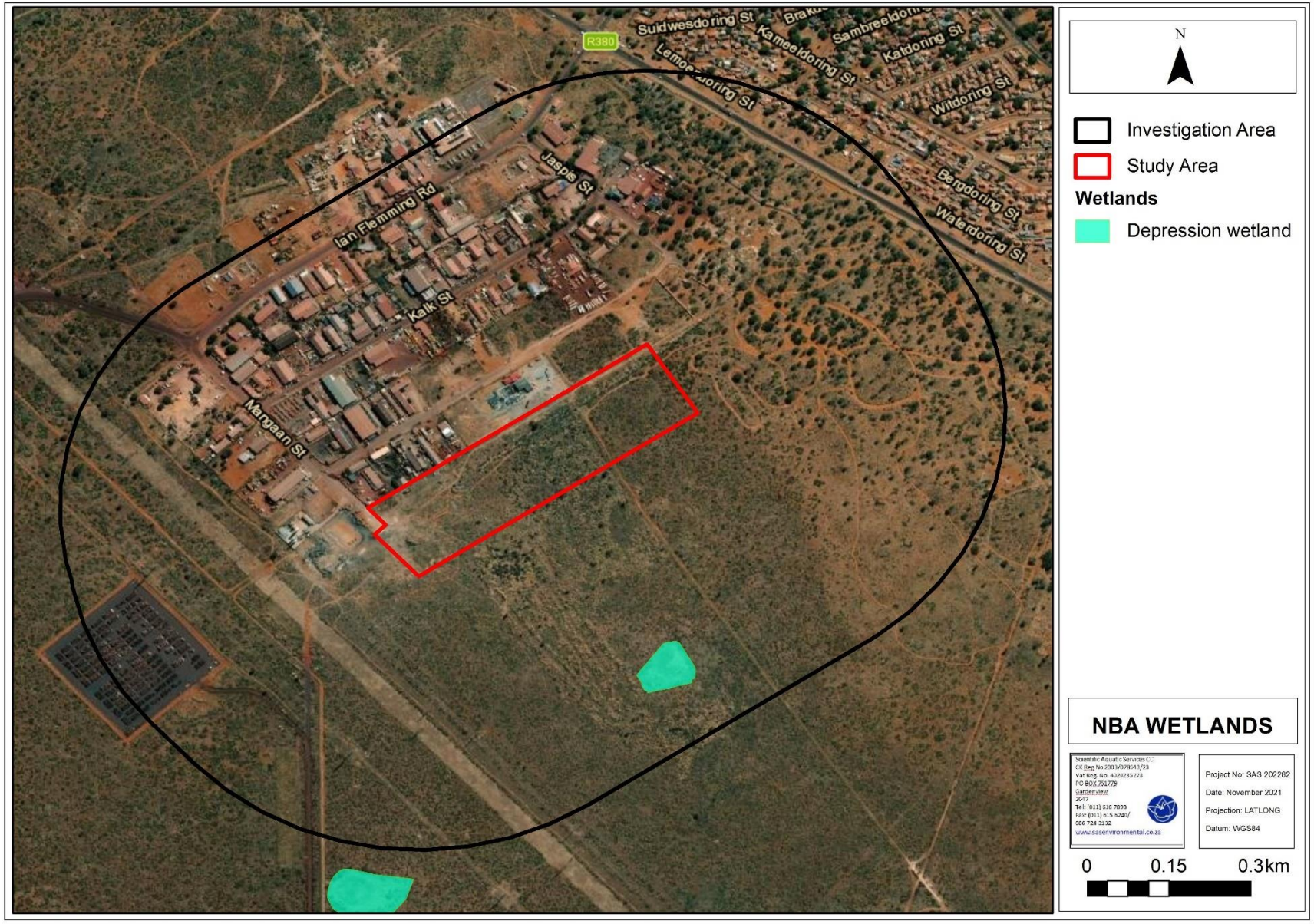

Figure 4: The National Biodiversity Assessment 2018 indicating natural wetlands associated with the study area and investigation area.

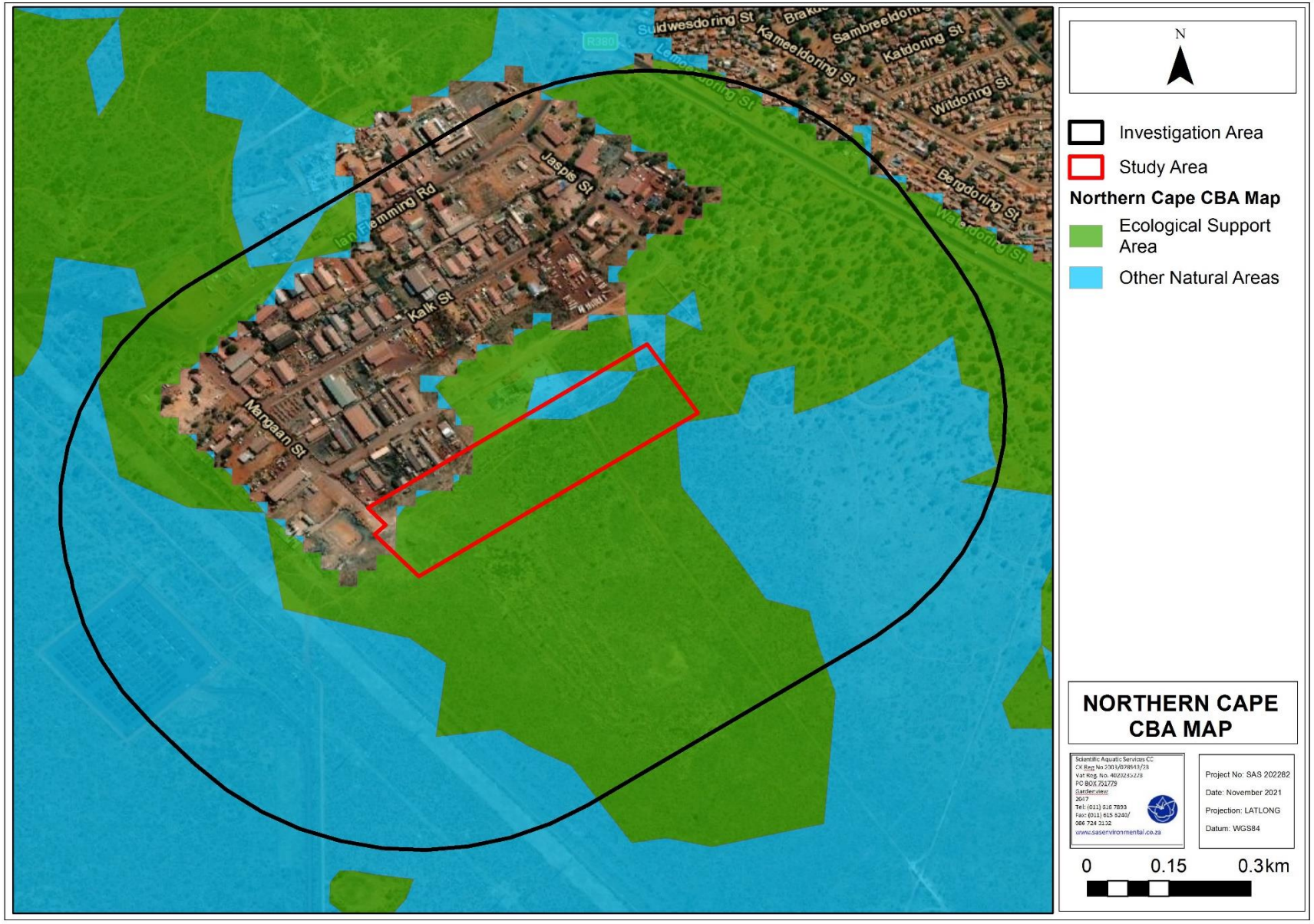

Figure 5: Important areas associated with the study area as per the Northern Cape Critical Biodiversity Area dataset (2016).

4 RESULTS: WATERCOURSE ASSESSMENT

4.1 Watercourse Delineation

As discussed in Section 2.1, the industry standard guidelines provided by DWAF (2008) for the identification and delineation of wetlands and riparian zones was used as a basis for the delineation of the features identified on site. However, due to the typically arid conditions of the region, additional indicators, as provided by Day *et al* (2010) were utilised. Whilst the presence of "vegetation typically adapted to life in saturated soil" under "normal circumstances" is the key determinant in the definition of a wetland according to the National Water Act, 1998 (Act No. 36 of 1998), but was absent throughout the study and investigation areas, one feature identified within the investigation area was nevertheless defined as a "cryptic" wetland as per Day *et al*, (2010). The characterisation of this feature is discussed in greater detail in Section 4.2 below.

During the assessment, the following indicators were used to identify and delineate the boundaries of the cryptic wetland:

- ***Topography/elevation*** was a key determinant in the identification of this. The single feature identified within the investigation area was situated within a distinct, low-lying depression in the landscape, and was a clearly defined endorheic system where surface water, when sufficient is present, will accumulate;
- ***Sediment deposits on plants*****:** the presence of sediment deposits on rocks or plants indicates minimum levels of inundation; thus a feature displaying such deposits is assumed to be seasonally inundated. The absence of such sediment deposits is inconclusive, and other indicators may be required to determine whether a feature is seasonally inundated. Whilst this is a subtle determinant of possible wetland conditions in some of the assessed features, it was nevertheless apparent in sufficient features to be utilised as an indicator;
- ***Soil wetness / morphological characteristics*****:** whilst soil wetness is considered by Day *et al* (2010) to be an unreliable indicator of wetlands in arid areas, consideration was nevertheless given to the soil classification and morphological characteristics, such as gleying and mottling, when present. Distinct gleying was present within the identified cryptic wetland (Figure 6);

- ***Vegetation***: Due to the semi-arid climate of the study area, the absence of obligate[3] floral species was expected. According to Day *et al* (2010), the **absence** of both dryland and wetland plants from a site may equally be an indicator of a cryptic wetland. However, floral indicators were present, specifically *Eragrostis bicolor, Cullen tomentosum* and *Ziziphus mucronata.*

Figure 6: Soil samples obtained within the cryptic wetland, showing distinct gleiing at depths of between 10 cm and 30 cm.

Although the cryptic wetland does not possess one of the key indicators typically associated with wetlands in South Africa, specifically, hydrophytic vegetation, it is nevertheless deemed to be potentially ecologically important and may play a significant role in the ecology of the area. Wetlands in arid areas are under-researched, particularly cryptic wetlands such as that identified in the investigation area, and little is known about the biodiversity associated with such systems[4]. For example, cryptic wetlands such as the one identified may host populations of invertebrates (mostly Branchiopods but also Phyllopods) which are considered keystone species of ephemeral pans globally, playing a pivotal role in the food web as prey[4].

Thus, it is the opinion of the specialist that the cryptic wetland identified in the investigation area should be afforded the same protection as a wetland which meets the legislated definition thereof, and that suitable mitigation measures be implemented to minimise impacts to these features.

[3] Species almost always found in wetlands (>99% of occurrences).
[4] Henschel, unknown date, retrieved from http://fbip.co.za/wp-content/uploads/2018/08/Henschel-Abstract-2017-Small-Project.pdf, 18th of March 2020

4.2 Characterisation of the Cryptic Wetland

As noted above, a single feature was identified within 320 m of the study area in the south-eastern portion of the investigation area. Classification of the feature was undertaken at Levels 1-4 of the Classification System (Ollis *et al*, 2013) as outlined in Appendix C of this report. This system was classified as an Inland System falling within the Southern Kalahari Aquatic Ecoregion and the Eastern Kalahari Bushveld Group 1 Wetland Vegetation (WetVeg) group, considered "least threatened" but "poorly protected" by SANBI (2012) and Mbona *et al* (2015). The table below presents the further classification of this cryptic wetland at Levels 3 and 4 of the Classification System (Ollis *et al*, 2013).

Table 2: Characterisation of the "cryptic wetlands identified within the investigation area, according to the Classification System (Ollis *et al*, 2013).

Drainage system	Level 3: Landscape unit	Level 4: Hydrogeomorphic Unit
		HGM Type
Cryptic wetland (CW)	**Plain:** an extensive area of low relief characterised by relatively level, gently undulating or uniformly sloping land.	**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.

The cryptic wetland as described above is presented in relation to the study and investigation area in Figure 7 below.

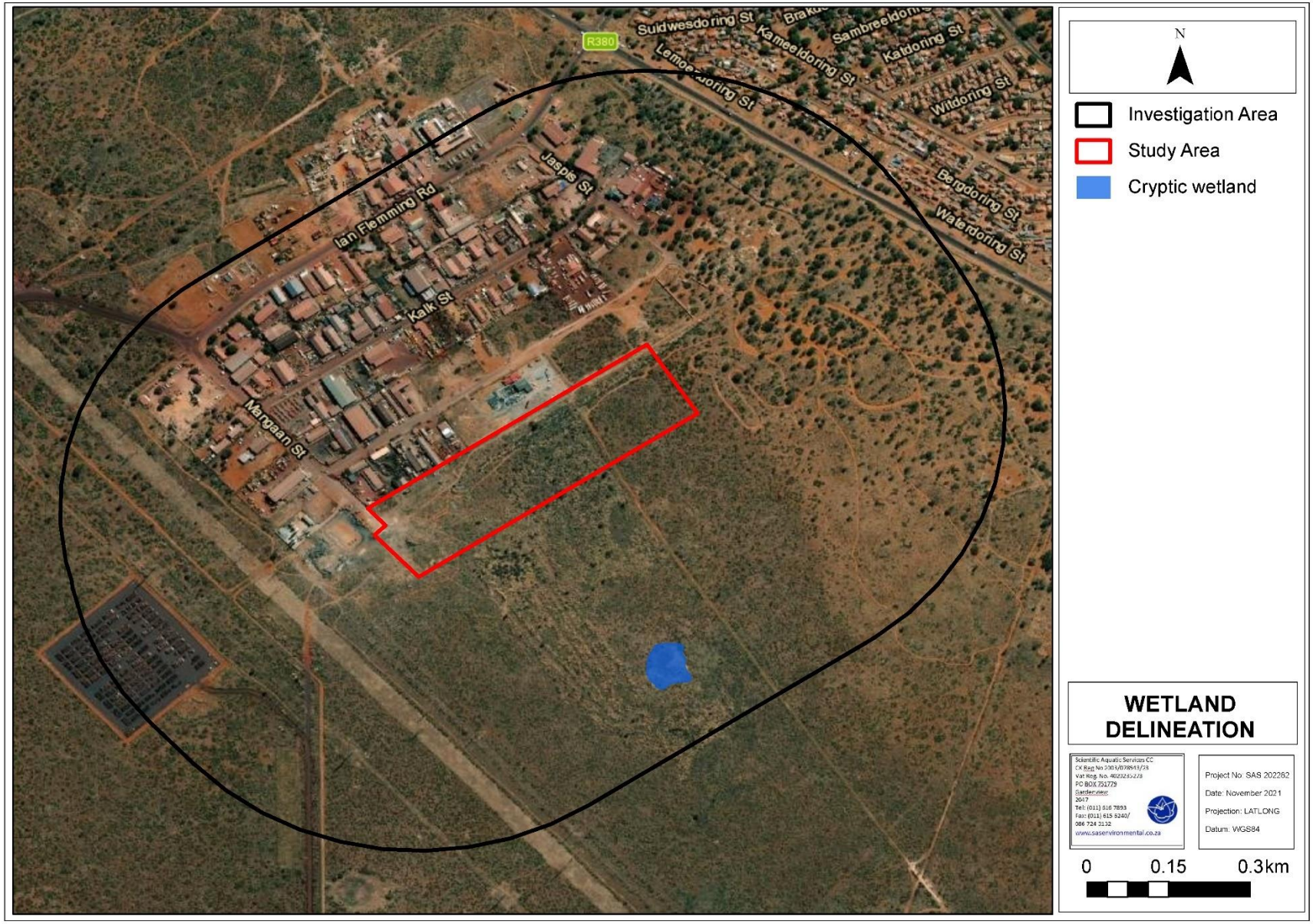

Figure 7: The location of the cryptic wetland in relation to the study area.

4.3 Field Verification Results

Following the site visit, various assessments were undertaken in order to determine the PES, EIS, and ecological service provision as well as to assign an appropriate REC, RMO and BAS as described in Section 1.2 of this report.

Whilst the various indices available in South Africa (such as WET-Health) are more appropriate for use in assessing drainage systems in wetter areas and are less suited to the assessment of systems in arid areas, in the absence of more appropriate protocols, the various indices listed in Section 1.2 were applied with the aim of characterising ecological integrity, importance and sensitivity of the systems as best as possible.

The applicable indices used to determine the PES and EIS were applied to the cryptic wetland. The detailed assessment results are presented in Appendix E of this report and summarised in the table below. It should be noted that although the WET-Ecoservices tool calculated a high score for the supply of cultivated foods this is a function of the availability of mineral soils and the absence of saturated soils both of which are considered suitable conditions for crop cultivation. However, no crops are grown in the HGM unit nor the nearby surrounds due to the arid climate among other features.

Table 3: Summary of the assessment of the cryptic wetland associated with the study area.

Ecological & socio-cultural service provision graph:

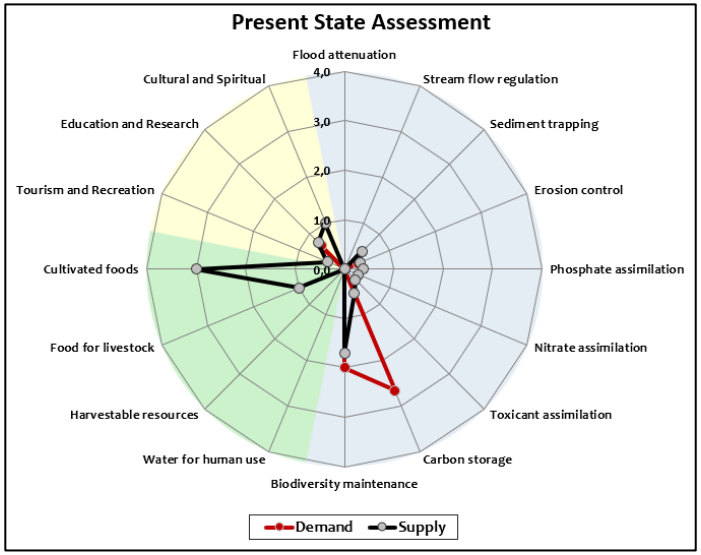

Figure 8: Representative photographs of the cryptic wetland and some of the observed impacts that have occurred.

PES discussion	**PES Category: C (2.03)** The cryptic wetland has been subjected to various impacts relating to urban development, including alterations to the local catchment caused by historical earthworks adjacent to the cryptic wetland , trampling and grazing by domestic livestock, indiscriminate disposal of waste products and encroachment of alien and invasive floral species.	**Ecoservice provision**	**Moderately low** Ecological service provision by the cryptic wetland is limited, largely due to the absence of surface water for long periods of time. Additionally, the location of the wetland in close proximity to the town of Kathu (approximately 850 m from the southern-most extent of the town) reduces the reliance on the wetland by local communities, since goods that are often associated with wetlands such as provisioning of water for human use, or nutrient-enriched soils for cultivation of crops, are not required. Although the results of the assessment indicated 'high' importance for crop cultivation, this is a function of the soil properties and characteristics, and not indicative of actual demand. The cryptic wetland is likely to be of some importance for biodiversity support in the open area surrounding the cryptic wetland, although proximity of anthropogenic activity will discourage utilisation by fauna, with the exception of less sensitive species.
EIS discussion	**EIS Category: Moderate** Although the ecological integrity of the cryptic wetland has been compromised, it nevertheless retains a level of ecological importance in terms of biodiversity support (most likely for migratory species, and therefore only on a seasonal basis and when surface water is present). It may also be of limited importance for the provision of certain direct benefits such as education and cultural significance.	**REC, RMO & BAS Category**	**REC Category: C** **BAS: C (Maintain)** **RMO: C (Maintain)** The proposed tyre reduction facility is unlikely to impact on the cryptic wetland, either directly or indirectly, provided that appropriate mitigation measures are implemented throughout the life of the facility. Thus, maintenance of the PES should be possible. However, since the wetland is situated within an open, accessible area, impacts unrelated to the proposed tyre reduction facility may occur which are beyond the control of the proponent.

Watercourse drivers and receptors discussion (hydraulic regime, geomorphological processes, water quality and habitat and biota):	
Historical earthworks which have altered the topography surrounding the cryptic wetland, in turn altering the pattern and timing of flow in the immediate catchment, thus altering the hydraulic regime of the cryptic wetland. However, the surrounding urbanisation is unlikely to have had a significant effect on the hydraulic regime due to the permeability of the surrounding soil which will capture any runoff from the town. Geomorphological processes have been affected marginally as a result of the historical earthworks, and soil disturbances associated with grazing and trampling of domestic livestock in the catchment. This is likely to lead to wind-borne sediment or sediment transported in rainfall being deposited in the cryptic wetland, which over time (decades) could lead to decreased capacity for water retention as well as further alterations to the floral assemblage. At the time of assessment, no surface water was present and therefore water quality parameters could not be assessed. Since the wetland is driven by precipitation and surface water, when water is present it may be affected by increased sediment loads and potentially by pollution, but is likely to be relatively unimpaired. The vegetation community has undergone the greatest degree of modification. Whilst floral species which are considered indicative of increased moisture were present, species such as *Chrysocoma obtusata* were present, indicating disturbance. Nevertheless, the wetland is likely to provide some degree of biodiversity support, albeit reduced and may be an important seasonal source of water for migratory species although the proximity of anthropogenic activity is likely to negatively influence faunal utilisation.	
Extent of modification anticipated	None. The proposed waste tyre management facility is not expected to encroach directly on the cryptic wetland, nor are any indirect impacts anticipated, provided that appropriate mitigation measures are implemented throughout the life of the facility.
Risk Significance & Business Case:	
With mitigation: Low	The risk significance of the proposed activity was assessed to be 'low', provided that the mitigation measures provided in this report are adhered to. No direct risk is posed to the cryptic wetland, and indirect risks are likely to be minimal especially if suitable measures are implemented to contain contaminated runoff within the premises, and to minimise dust and particulate matter generation. Key mitigation measures include: ➢ Erection of sediment traps around the construction site to minimise the risk of sediment-laden runoff reaching the cryptic wetland; ➢ Retention of as much indigenous vegetation as possible, particularly graminoid species around the southern boundary of the study area to assist in filtering runoff and trapping sediment; ➢ Adequate stormwater management measures must be implemented for the study area to ensure no dirty water is released/directed into the downgradient areas where it could potentially impact the cryptic wetland. Although is it acknowledged that minimal space is available within the study area, it is strongly recommended that the proponent investigate the viability of Sustainable Urban Drainage Systems (SUDs), as a potential mitigation against the release of contaminated stormwater into the receiving environment; ➢ Six-monthly inspections during the operational phase of stormwater discharge points for indications of discharge structure failure and/or areas of erosion and repair thereof within one month of detection; and ➢ Appropriate alien vegetation controls within the study area are to be implemented to prevent the further proliferation of alien vegetation within the surrounding areas.

4.4 Sensitivity Mapping

4.4.1 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 and wetland species as well as for certain terrestrial species, and a range of ancillary societal benefits (Macfarlane *et. al,* 2015). It should be noted however that buffer zones are not considered to be effective mitigation against impacts such as hydrological changes arising from stream flow reduction, impoundments or abstraction, nor are they considered to be effective in the management of point-source discharges or contamination of groundwater, both of which require site-specific mitigation measures (Macfarlane *et. al,* 2015).

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

Table 4: 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) (NWA). **The Department of Water and Sanitation**	**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).** In accordance with GN509 of 2016 as it relates to the NWA, a regulated area of a watercourse for section 21c and 21i of the NWA, 1998 is defined as: • the outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; • in the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or • a **500m radius from the delineated boundary (extent) of any wetland or pan** in terms of this regulation, as well as Government Notice no. 509 of 2016 as it relates to the NWA.

Regulatory authorisation required	Zone of applicability
Listed activities in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) Environmental Impact Assessment (EIA) Regulations, 2014 (as amended). **The Department of Environmental Affairs**	Activity 12 of Listing Notice 1 (GN 327) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) Environmental Impact Assessment (EIA) regulations, 2014 (as amended) states that: The development of: (xii) infrastructure or structures with a physical footprint of 100 square metres or more; Where such development occurs— a) Within a watercourse; b) In front of a development setback; or If no development setback has been adopted, **within 32 meters** of a watercourse, measured from the edge of a watercourse.

The Zones of Regulation outlined in the table above are conceptually depicted in Figure 9 below.

In addition to the applicable Zones of Regulation, the approximate catchment of the cryptic wetland was determined, to assist the proponent to ensure that no development occurs within the catchment which could have a detrimental effect on the ecological integrity or functioning of the wetland. As can be seen in Figure 10, the study area and therefore proposed development is situated approximately 196 m from the catchment of the cryptic wetland and therefore poses a low risk to the wetland.

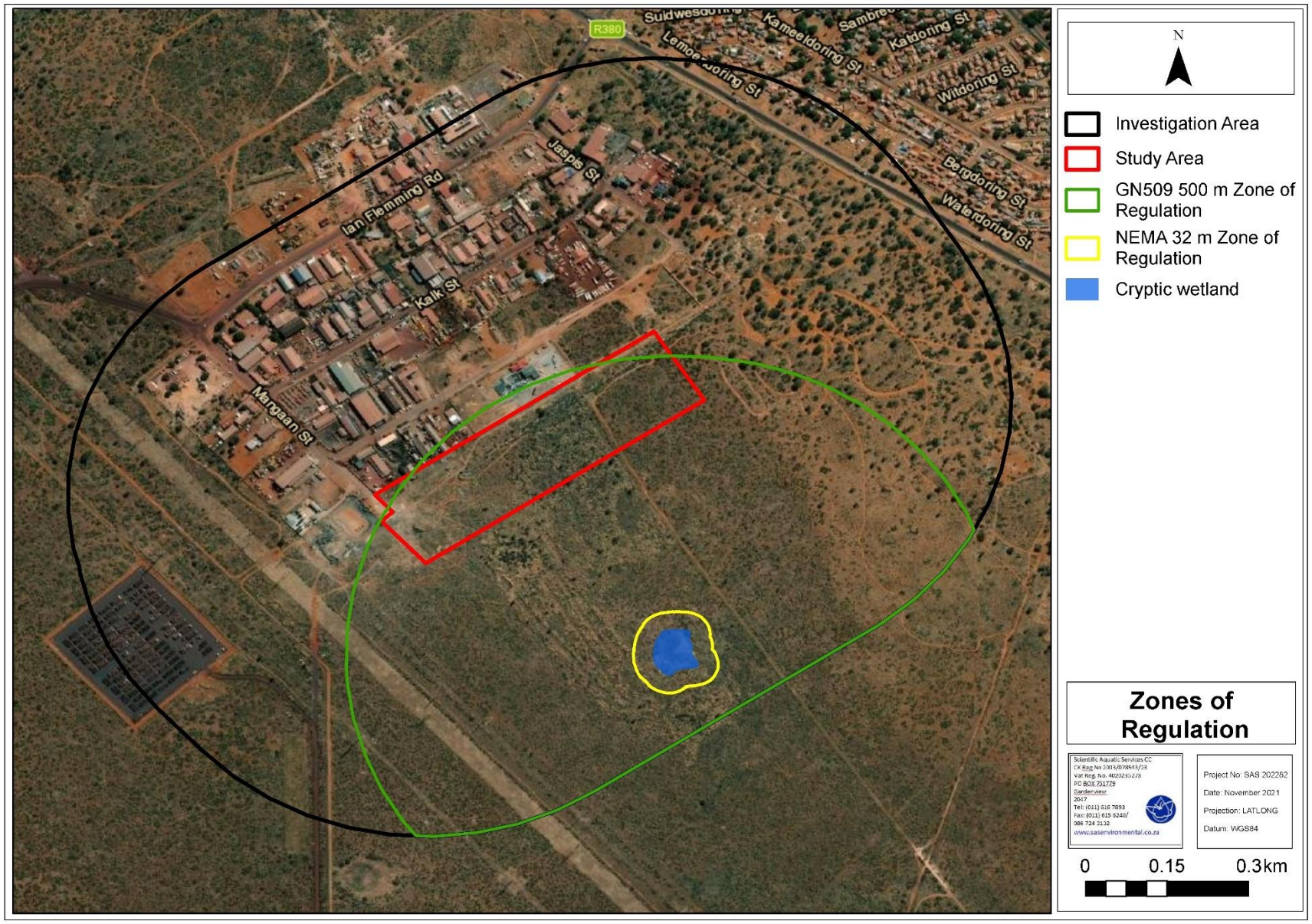

Figure 9: Conceptual presentation of the zones of regulation in terms of NEMA and GN509 of 2016 as it relates to the NWA in relation to the cryptic wetland within the investigation area.

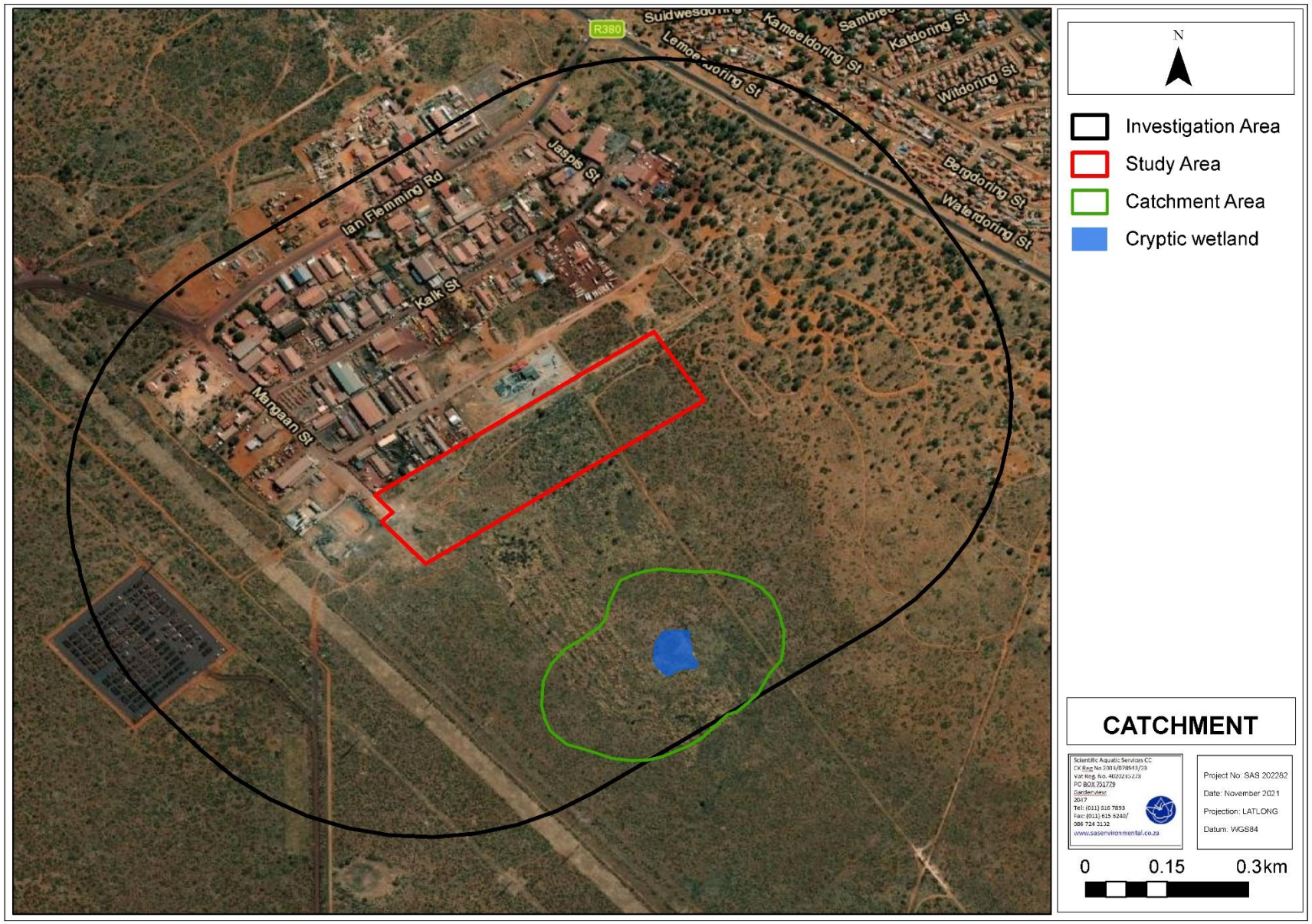

Figure 10: Conceptual presentation of the catchment associated with the cryptic wetland.

5 RISK ASSESSMENT

This section presents the significance of potential impacts on the cryptic wetland associated with the proposed waste tyre management facility. When evaluating the perceived impacts of the proposed activities on the wetland, the risk significance was ascertained based on the assumption that the recommended mitigation measures will be implemented, in order to reduce the risk significance. Thus, the risk assessment provided in this report presents the perceived risk significance *post-mitigation*.

Several potential risks to the receiving freshwater environment may be posed by the proposed waste tyre management facility, namely:

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

Various activities and development aspects may lead to these impacts, however, provided that the mitigation hierarchy is followed, indirect impacts to the cryptic wetland can be avoided and/or minimised if avoidance is not feasible. No direct risks to the cryptic wetland are anticipated. The outcome of the risk assessment is presented in Table 5 overleaf.

Table 5: Summary of the DWS Risk Assessment applied to the proposed waste tyre management facility.

Phase	Activity	Aspect	Impact	Likelihood	Significance	Risk Rating	Reversibility	Mitigation Measures to be implemented
Construction	Site clearing prior to commencement of construction activities, including placement of contractor laydown areas.	• Vehicular movement and access to the site; • Removal of vegetation within the study area and associated disturbances (creation of rubble and litter) to soil upgradient of but further than 320 m from wetland. • Increased risk of transportation of sediment from exposed soils and hydrocarbons from construction vehicles in storm water runoff into downgradient wetland.	• Damage to and loss of vegetation, leading to exposed/compacted soil, in turn leading to potential for increased runoff from exposed areas, erosion of the downgradient wetland and potential for increased sedimentation of the wetland; • Increased sedimentation of the wetland may lead to changes in habitat, potentially altered surface water quality, smothering of vegetation and/or altered vegetation composition and smothering of biota and/or egg banks; • Potential impacts on water quality due to leaks and spills from construction machinery and increased sediment availability; • Decreased ecoservice provision and biodiversity maintenance capacity; and • Proliferation of alien vegetation as a result of disturbances.	12	36	L	Fully reversible	• Limit the footprint of vegetation clearing to the demarcated 8.4 ha footprint of the proposed facility, and retain as much indigenous vegetation as practically possible; • Rehabilitation and revegetation of disturbed areas (as a result of construction) not used during operation must take place as soon as practicable after construction; • Adequate stormwater management measures must be implemented for the study area to ensure no contaminated water is released/directed into the downgradient areas where it could potentially impact the wetland; and • Appropriate control methods for alien vegetation must be implemented.
	Removal of topsoil from project footprint and stockpiling thereof for rehabilitation.			12	36	L	Fully reversible	
	Construction of diesel storage facility.			13	52	L	Fully reversible	
	Potential indiscriminate waste disposal and/or spillage from construction vehicles.	Disposal of construction-related wastes (such as rubble, hazardous chemicals and litter).	• Altered water distribution patterns as a result of solid waste within the freshwater environment; and • Altered water quality due to chemical waste disposal.	13	39	L	Fully reversible	• Waste products must be removed from the construction site and disposed at a registered facility. No waste material must be discarded within the wetland.
Operational	Operation of the proposed recycling facility.	Increased risk of hydrocarbons and/or sediment entering the wetland indirectly via stormwater runoff.	• Further impacts to water quality as a result of increased availability of pollutants; and • Contribution to increased volume of water entering the wetland as a result of stormwater runoff emanating from hardened surfaces in the catchment.	15	48,8	L	Fully reversible	• Any stormwater discharge points must be inspected at minimum every six months for indications of erosion and discharge structure failure; • Any erosion noted must be proactively managed and repaired within one month of detection. • Appropriate clean and dirty water (as defined by Regulation GN704 as it relates to the National Water Act (Act No. 36 of 1998) be installed, for example, bund walls, concrete wash bays with sumps, spill kits and so forth to avoid the release

Phase	Activity	Aspect	Impact	Likelihood	Significance	Risk Rating	Reversibility	Mitigation Measures to be implemented
								of contaminated water into the receiving environment.
		Increased vehicular traffic upgradient of and within 320 m of the wetland.	• Disturbances of soil leading to increased alien vegetation proliferation, which may spread to the wetland; and • Increased risk of litter generation, which may be transported to the wetland in stormwater runoff or by wind, leading to pollution of the wetland.	15	48,8	L	Fully reversible	As the proposed recycling facility is situated more than 320 m from the wetland, the risk posed is considered minimal. It is presumed that the facility will be fenced-off, and therefore no vehicular activity outside of the facility is likely. Nevertheless general 'best practice' mitigation measures are recommended including the retention of as much natural vegetation as possible around the site to provide stormwater, pollutant and sediment trapping capacity.

5.1 Cumulative Impact Statement

Freshwater ecosystems in semi-arid zones are generally under-researched, and particularly in the Northern Cape are under increased pressure of development, particularly as mining and mining-related activities increase in the province. The absence of research has historically led to the ecological importance and sensitivity of these temporary (cryptic wetland) systems being unrecognised, and therefore under-valued. Literature pertaining to the potential losses of such freshwater ecosystems is scarce, and as a result, accurate indications of potential loss of such ecosystems could not be determined at the time of this investigation. Nevertheless, further loss of, or irreversible modifications to freshwater ecosystems is recognised globally as being cause for concern.

Although no direct risks to the cryptic wetland located within the investigation area associated with the proposed tyre management facility are anticipated, care must nevertheless be taken to ensure that the proposed project does not pose any indirect risks which may contribute to the continued decline of the cryptic wetland, as the cumulative impacts of the proposed development in conjunction with any future developments in the open space surrounding the wetland may have a regional and potentially provincial influence on freshwater ecosystems and representativity conservation, in turn impacting on floral and faunal assemblages and distributions thereof.

6 CONCLUSION

A single cryptic wetland was identified approximately 320m from the proposed facility which was classified as a watercourse. The results of the ecological assessment indicated that the cryptic wetland is in a moderately modified ecological condition, with few impacts on hydraulic and geomorphological processes, although the vegetation community associated with the cryptic wetland has undergone a greater degree of modification with a relatively high component of indigenous encroacher species identified within the wetland. Due to this and the natural semi-arid climatic conditions, assessing ecological service provision, importance and sensitivity proved to be challenging, as such freshwater systems (i.e,. the cryptic wetland) are under-researched, and little is known about the way in which they function and their contribution to the greater ecology of the area. Furthermore, the indices developed for the assessment of South African wetlands are largely focused towards assessing those systems found in higher rainfall regions than the study area and are thus geared towards systems which are less temporary in nature.

In addition, Day *et al* (2010) note that the basis of South African methodologies for the formal identification and delineation of wetlands is primarily that of soil morphological indicators such as mottling and gleying, and presence of hydrophytic vegetation; characteristics which are often absent in freshwater systems occurring in arid or semi-arid environments. However, notwithstanding the reduced ecological integrity, it is the specialist's opinion that the cryptic wetland may be important for biodiversity maintenance. Therefore, although the cryptic wetland associated with the study area lacks "vegetation typically adapted to life in saturated soil" this should not necessarily preclude it from the legal protection accorded to freshwater systems which meet the South African legal definition of a wetland, and therefore the ecological and risk assessments were conducted accordingly, to enable the relevant stakeholders, including the EAP, proponent and relevant competent authorities to make an informed decision.

No direct risks to the identified cryptic wetland are anticipated, due to the distance of the wetland from the study area and proposed activities therein. The results of the risk assessment therefore indicate that the expected risk significance is 'low', provided that the mitigation measures contained in this report are implemented. Based on the outcome of the risk assessment, it is the specialist's opinion that as the proposed activities within the study area pose minimal risk significance to the cryptic wetland, they may be authorised by means of a General Authorisation.

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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 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, 1998 (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.
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).
National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) (NEMBA)	**Ecosystems that are threatened or in need of protection** (1) (a) The Minister may, by notice in the Gazette, publish a national list of ecosystems that are threatened and in need of protection. *(b)* An MEC for environmental affairs in a province may, by notice in *the Gazette,* publish a provincial list of ecosystems in the province that are threatened and in need of protection. (2) The following categories of ecosystems may be listed in terms of subsection (1): *(a)* critically endangered ecosystems, being ecosystems that have undergone severe degradation of ecological structure, function or composition as a result of human intervention and are subject to an extremely high risk of irreversible transformation; *(b)* endangered ecosystems, being ecosystems that have undergone degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems; (c) vulnerable ecosystems, being ecosystems that have a high risk of undergoing significant degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems or endangered ecosystems; and *(d)* protected ecosystems, being ecosystems that are of high conservation value or of high national or provincial importance, although they are not listed in terms of paragraphs *(a), (b)* or (c).
Government Notice 598 Alien and Invasive Species Regulations (2014), including the Government Notice 864 Alien Invasive Species List as published in the Government Gazette 40166 of 2016, as it relates to the National	NEMBA is administered by the Department of Environmental Affairs and aims to provide for the management and conservation of South Africa's biodiversity within the framework of the NEMA. This act in terms of alien and invasive species aims to: ➢ Prevent the unauthorized introduction and spread of alien and invasive species to ecosystems and habitats where they do not naturally occur, ➢ Manage and control alien and invasive species, to prevent or minimize harm to the environment and biodiversity; and ➢ Eradicate alien species and invasive species from ecosystems and habitats where they may harm such ecosystems or habitats.

Environmental Management Biodiversity Act, 2004 (Act No 10 of 2004)	Alien species are defined, in terms of the NEMBA as: (a) A species that is not an indigenous species; or (b) An indigenous species translocated or intended to be translocated to a place outside its natural distribution range in nature, but not an indigenous species that has extended its natural distribution range by natural means of migration or dispersal without human intervention. Categories according to NEMBA (Alien and Invasive Species Regulations, 2017): ➢ **Category 1a:** Invasive species that require compulsory control; ➢ **Category 1b:** Invasive species that require control by means of an invasive species management programme; ➢ **Category 2:** Commercially used plants that may be grown in demarcated areas, provided that there is a permit and that steps are taken to prevent their spread; and ➢ **Category 3:** Ornamentally used plants that may no longer be planted.
Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the NWA	In accordance with Regulation GN509 of 2016, a regulated area of a watercourse for section 21c and 21i of the NWA, 1998 is defined as: a) The outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; b) In the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or c) A 500 m radius from the delineated boundary (extent) of any wetland or pan. This notice **replaces GN1199** and may be exercised as follows: i) Exercise the water use activities in terms of Section 21(c) and (i) of the Act as set out in the table below, subject to the conditions of this authorisation; ii) Use water in terms of Section 21(c) or (i) of the Act if it has a low risk class as determines through the Risk Matrix; iii) Do maintenance with their existing lawful water use in terms of section 21(c) or (i) of the Act that has a LOW risk class as determined through the Risk Matrix; iv) Conduct river and stormwater management activities as contained in a river management plan; v) Conduct rehabilitation of wetlands or rivers where such rehabilitation activities has a LOW risk class as determined through the Risk Matrix; and vi) Conduct emergency work arising from an emergency situation or incident associated with the persons' existing lawful water use, provided that all work is executed and reported in the manner prescribed in the Emergency protocol. A General Authorisation (GA) issued as per this notice will require the proponent to adhere with specific conditions, rehabilitation criteria and monitoring and reporting programme. Furthermore, the water user must ensure that there is a sufficient budget to complete, rehabilitate and maintain the water use as set out in this GA. Upon completion of the registration, the responsible authority will provide a certificate of registration to the water user within 30 working days of the submission. On written receipt of a registration certificate from the Department, the person will be regarded as a registered water user and can commence within the water use as contemplated in the GA.

APPENDIX C – Method of Assessment

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

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

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

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

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

Level 1: Inland systems

From the Classification System, Inland Systems are defined as aquatic ecosystems that have no existing connection to the ocean[5] (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.

[5] 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.

Level 2: Ecoregions & NFEPA Wetland Vegetation Groups

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

Healthy wetlands are known to provide important habitats for wildlife and to deliver a range of important goods and services to society. Management of these systems is therefore essential if these attributes are to be retained within an ever-changing landscape. The primary purpose of this assessment is to evaluate the eco-physical health of wetlands, and in so doing to promote their conservation and wise management.

Level of Evaluation
Two levels of assessment are provided by WET-Health:

- Level 1: Desktop evaluation, with limited field verification. This is generally applicable to situations where a large number of wetlands need to be assessed at a very low resolution; or
- Level 2: On-site evaluation. This involves structured sampling and data collection in a single wetland and its surrounding catchment.

Framework for the Assessment
A set of three modules has been synthesised from the set of processes, interactions and interventions that take place in wetland systems and their catchments: hydrology (water inputs, distribution and retention, and outputs), geomorphology (sediment inputs, retention and outputs) and vegetation (transformation and presence of introduced alien species).

Units of Assessment
Central to WET-Health is the characterisation of HGM Units, which have been defined based on geomorphic setting (e.g. hillslope or valley-bottom; whether drainage is open or closed), water source (surface water dominated or sub-surface water dominated) and pattern of water flow through the wetland unit (diffusely or channelled) as described under the Classification System for Wetlands and other Aquatic Ecosystems above.

Quantification of Present State of a wetland
The overall approach is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a Present State score. This takes the form of assessing the spatial *extent* of the impact of individual activities and then separately assessing the *intensity* of the impact of each activity in the affected area. The extent and intensity are then combined to determine an overall *magnitude* of impact. The impact scores, and Present State categories are provided in the table below.

Table C3: Impact scores and categories of Present State used by WET-Health for describing the integrity of wetlands.

Impact category	Description	Impact score range	Present State category
None	Unmodified, natural	0-0.9	A
Small	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1-1.9	B
Moderate	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place, but the natural habitat remains predominantly intact.	2-3.9	C
Large	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4-5.9	D

Impact category	Description	Impact score range	Present State category
Serious	The change in ecosystem processes and loss of natural habitat and biota is great, but some remaining natural habitat features are still recognisable.	6-7.9	E
Critical	Modifications have reached a critical level and the ecosystem processes have been completely modified with an almost complete loss of natural habitat and biota.	8-10	F

Assessing the Anticipated Trajectory of Change
As is the case with the Present State, future threats to the state of the wetland may arise from activities in the catchment upstream of the unit or within the wetland itself or from processes downstream of the wetland. In each of the individual sections for hydrology, geomorphology and vegetation, five potential situations exist depending upon the direction and likely extent of change (table below).

Table C4: Trajectory of Change classes and scores used to evaluate likely future changes to the present state of the wetland.

Change Class	Description	HGM change score	Symbol
Substantial improvement	State is likely to improve substantially over the next 5 years	2	↑↑
Slight improvement	State is likely to improve slightly over the next 5 years	1	↑
Remain stable	State is likely to remain stable over the next 5 years	0	→
Slight deterioration	State is likely to deteriorate slightly over the next 5 years	-1	↓
Substantial deterioration	State is expected to deteriorate substantially over the next 5 years	-2	↓↓

Overall health of the wetland
Once all HGM Units have been assessed, a summary of health for the wetland as a whole needs to be calculated. This is achieved by calculating a combined score for each component by area-weighting the scores calculated for each HGM Unit. Recording the health assessments for the hydrology, geomorphology and vegetation components provide a summary of impacts, Present State, Trajectory of Change and Health for individual HGM Units and for the entire wetland.

1. 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".[6] The assessment of the ecosystem services supplied by the identified freshwater features was conducted according to the guidelines as described by Kotze *et al.* (2020). An assessment was undertaken that examines and rates 16 different ecosystem services, selected for their specific relevance to the South African situation, as follows:

- Flood attenuation;
- Stream flow regulation;
- Sediment trapping;
- Phosphate assimilation;
- Nitrate assimilation;
- Toxicant assimilation;
- Erosion control;
- Carbon storage;
- Biodiversity maintenance;
- Provision of water for human use;
- Provision of harvestable resources;

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

- Food for livestock;
- Provision of cultivated foods;
- Cultural and spiritual experience;
- Tourism and recreation; and
- Education and research.

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

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

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

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

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

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

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

4. Index of Habitat Integrity

The general habitat integrity of each site was discussed based on the application of the Index of Habitat Integrity (Kleynhans et al. 2008). It is important to assess the habitat at each site in order to aid in the interpretation of the results of the community integrity assessments, by taking habitat conditions and impacts into consideration. This method describes the Present Ecological State (PES) of both the in-stream and riparian habitat at each site. The method classifies habitat integrity into one of six classes,

ranging from unmodified/natural (Class A) to critically modified (Class F), as indicated in Table C3 below.

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

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

4. 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 Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications.	>3 and <=4	A
High Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications.	>2 and <=3	B
Moderate 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 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

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

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

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

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

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

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

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

Table 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

6. Watercourse delineation

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

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

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

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

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

APPENDIX D – Results of Field Investigation

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

Table E1: Presentation of the results of the PES (WET-Health) assessment applied to the identified cryptic wetland.

Hydrology		Geomorphology		Vegetation		Overall PES Score
Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score	2.03 (C)
1.0 (B)	-2	0.4 (A)	-1	5.2 (D)	-2	

Table E2: Presentation of the results of the Ecoservices assessment applied the identified cryptic wetland.

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

Table E4: Presentation of the results of the EIS assessment applied to the identified cryptic wetland.

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

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.

Hydro-Functional Importance			Score (0-4)	Confidence (1-5)
Regulating & supporting benefits	**Flood attenuation**		0	4
	Streamflow regulation		0	4
	Water Quality Enhancement	***Sediment trapping***	0	4
		Phosphate assimilation	0	4
		Nitrate assimilation	0	4
		Toxicant assimilation	0	4
		Erosion control	0	4
	Carbon storage		0	4
Direct Human Benefits			Score (0-4)	Confidence (1-5)
Subsistence benefits	***Water for human use***		0	4
	Harvestable resources		0	4
	Cultivated foods		3	4
Cultural benefits	***Cultural heritage***		1	4
	Tourism and recreation		0	4
	Education and research		1	4
DIRECT HUMAN BENEFITS			0,83	4

APPENDIX E – Risk Analysis and Mitigation Measures

General management and good housekeeping practices

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

Development and operational footprint

- Sensitivity maps have been developed for the study area, indicating the location of the cryptic wetland and the relevant regulatory zones in accordance with Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998), as shown in Section 4.4. It is recommended that these sensitivity maps be considered during all phases of the development;
- All development footprint areas should remain as small as possible and should not encroach onto surrounding more sensitive areas. It must be ensured that the cryptic wetland and the associated regulatory zones are off-limits to construction vehicles and personnel;
- The boundaries of footprint areas are to be clearly defined and it should be ensured that all activities remain within defined footprint areas;
- Planning of temporary roads and access routes should take the site sensitivity plan into consideration, and wherever possible, existing roads should be utilised. If additional roads are required, then wherever feasible such roads should be constructed a distance from the more sensitive cryptic wetland and not directly adjacent thereto. This should only be necessary if existing access roads are not utilised;
- All areas of increased ecological sensitivity should be marked as such and be off limits to all unauthorised construction and maintenance vehicles and personnel;
- Appropriate sanitary facilities must be provided for the life of the proposed project and all waste removed to an appropriate waste facility;
- All hazardous chemicals should be stored on bunded surfaces and no storage of such chemicals should be permitted within the wetland zones of regulation;
- No informal fires should be permitted in or near the construction areas;
- Ensuring that an adequate number of rubbish and “spill” bins are provided will also prevent litter and ensure the proper disposal of waste and spills; and
- Edge effects of activities, particularly erosion and alien/weed control need to be strictly managed.

Vehicle access

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

Alien plant species

- Proliferation of alien and invasive species is expected within any disturbed areas. These species should be eradicated and controlled to prevent their spread beyond the project footprint, particularly as the study area is located within a sensitive area. Alien plant seed dispersal within the top layers of the soil within footprint areas, that will have an impact on future rehabilitation, has to be controlled;
- Removal of the alien and weed species encountered on the property must take place in order to comply with existing legislation (amendments to the regulations under the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) and Section 28 of the National Environmental Management Act, 1998 (Act No.107 of 1998) (NEMA)). Removal of species should take place throughout the construction, operational, closure/decommissioning and rehabilitation/ maintenance phases; and
- Species specific and area specific eradication recommendations:

- Care should be taken with the choice of herbicide to ensure that no additional impact and loss of indigenous plant species occurs due to the herbicide used;
- Footprint areas should be kept as small as possible when removing alien plant species*;*
- No vehicles should be allowed to drive through designated sensitive drainage line and riparian areas during the eradication of alien and weed species.

Cryptic wetland habitat

- No encroachment of the cryptic wetland habitat should be necessary or permitted.

Soils

- To prevent the erosion of soils, management measures may include berms, soil traps, hessian curtains and stormwater diversion away from areas particularly susceptible to erosion;
- Install erosion berms during construction to prevent gully formation. Berms every 50m should be installed where any disturbed soils have a slope of less than 2%, every 25m where the track slopes between 2% and 10%, every 20m where the track slopes between 10% and 15% and every 10m where the track slope is greater than 15%;
- Sheet runoff from access roads should be slowed down by the strategic placement of berms and sandbags;
- Maintain topsoil stockpiles below 5 meters in height;
- As far as possible, all construction activities should occur in the low flow season, during the drier winter months;
- All soils compacted as a result of construction activities falling outside of project footprint areas should be ripped and profiled. Special attention should be paid to alien and invasive control within these areas; and
- Monitor all areas for erosion and incision, particularly any riparian crossings. Any areas where erosion is occurring excessively quickly should be rehabilitated as quickly as possible and in conjunction with other role players in the catchment.

Rehabilitation

- All soils compacted as a result of construction activities falling outside of project footprint areas should be ripped and profiled. Special attention should be paid to alien and invasive control within these areas. Alien and invasive vegetation control should take place throughout all construction and rehabilitation phases to prevent loss of floral habitat;
- Rehabilitate any cryptic wetland habitat areas affected by construction (although no encroachment should take place) to ensure that the ecology of these areas is re-instated during all phases. In this regard, special mention is made of the need to stockpile soils separately during the construction and/or operation phase where relevant in order for these soils to be utilised during the rehabilitation phase;
- Edge effects of activities including erosion and alien/ weed control need to be strictly managed in these areas;
- As far as possible, all rehabilitation activities should occur in the low flow season, during the drier winter months.
- As much vegetation growth (of indigenous/endemic floral species) as possible should be promoted within the proposed development area in order to protect soils;
- All alien vegetation should be removed from rehabilitated areas and reseeded with indigenous grasses as specified by a suitably qualified specialist (ecologist);
- All areas affected by construction and operation should be rehabilitated upon completion of the specific construction and operation activity throughout the life of the development;
- Cryptic wetland vegetation cover should be monitored to ensure that sufficient vegetation is present to bind the soils and prevent erosion and incision; and
- It is recommended that a detailed rehabilitation plan be developed by a suitably qualified ecologist prior to commencement of the operations phase in order to address specific rehabilitation requirements.

Risk Assessment Matrix for the proposed Sishen Recycling Facility

Compiled by: A. Mileson
Reviewed by: K. Marais (SACNASP Reg No. 117137/17)

Phase	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph+Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Reversibility
Construction	Site clearing prior to commencement of construction activities, including placement of contractor laydown areas.	•Vehicular movement and access to the site; •Removal of vegetation within the study area and associated disturbances (creation of rubble and litter) to soil upgradient of but further than 320 m from wetland. •Increased risk of transportation of sediment from exposed soils and hydrocarbons from construction vehicles in storm water runoff into downgradient wetland.	•Damage to and loss of vegetation, leading to exposed/compacted soil, in turn leading to potential for increased runoff from exposed areas, erosion of the downgradient wwetland and potential for increased sedimentation of the wetland; •Increased sedimentation of the wetland may lead to changes in habitat, potentially altered surface water quality, smothering of vegetation and/or altered vegetation composition and smothering of biota and/or egg banks; •Potential impacts on water quality due to leaks and spills from construction machinery and increased sediment availability; •Decreased ecoservice provision and biodiversity maintenance capacity; and •Proliferation of alien vegetation as a result of disturbances.	1	1	1	1	1	1	1	3	5	1	5	1	12	36	L	Fully reversible
	Removal of topsoil from project footprint, and stockpiling thereof for rehabilitation.			1	1	1	1	1	1	1	3	5	1	5	1	12	36	L	Fully reversible
	Construction of diesel storage facility.			1	1	1	1	1	1	2	4	5	2	5	1	13	52	L	Fully reversible
	Potential indiscriminate waste disposal and/or spillage from construction vehicles.	Disposal of construction-related wastes (such as rubble, hazardous chemicals and litter).	•Altered water distribution patterns as a result of solid waste within the freshwater environment; and •Altered water quality due to chemical waste disposal.	1	1	1	1	1	1	1	3	5	2	5	1	13	39	L	Fully reversible
Operational	Operation of the proposed recycling facility.	• Increased risk of hydrocarbons and/or sediment entering the wetland indirectly via stormwater runoff.	* Further impacts to water quality as a result of increased availability of pollutants; and * Contribution to increased volume of water entering the wetland as a result of stormwater runoff emanating from hardened surfaces in the catchment.	1	2	1	1	1,3	1	1	3,3	5	2	5	3	15	48,8	L	Fully reversible
		Increased vehicular traffic upgradient of and within 320 m of the wetland.	•Disturbances of soil leading to increased alien vegetation proliferation, which may spread to the wetland; and •Increased risk of litter generation, which may be transported to the wetland in stormwater runoff or by wind, leading to pollution of the wetland.	2	1	1	1	1,3	1	1	3,3	5	2	5	3	15	48,8	L	Fully reversible

APPENDIX F – Specialist information

DETAILS, EXPERTISE AND CURRICULUM VITAE OF SPECIALISTS

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

Kim Marais	BSc (Hons) Zoology (Herpetology) (University of the Witwatersrand)
Amanda Mileson	Advanced Diploma: Nature Conservation (UNISA)

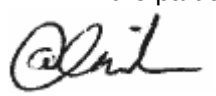
1. (a). (ii) The expertise of that specialist to compile a specialist report including a curriculum vitae

Company of Specialist:	Scientific Aquatic Services		
Name / Contact person:	Kim Marais		
Postal address:	29 Arterial Road West, Oriel, Bedfordview		
Postal code:	2007	Cell:	071 413 2245
Telephone:	011 616 7893	Fax:	011 615 6240/ 086 724 3132
E-mail:	kim@sasenvgroup.co.za		
Qualifications	BSc (Hons) (Herpetology) (University of Johannesburg)		
Registration / Associations	Registered Professional Natural Scientist at South African Council for Natural Scientific Professions (SACNASP) Member of the South African Wetland Forum		

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

I, Amanda Mileson, declare that -

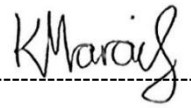
- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity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



Signature of the Specialist

I, Kim Marais, declare that -

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



Signature of the Specialist

SAS ENVIRONMENTAL GROUP OF COMPANIES –

SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF AMANDA MILESON

PERSONAL DETAILS

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

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Member of the South African Wetland Society (SAWS)
Member of the Gauteng and Northern Cape Wetland Forums (GWF and NCWF)

EDUCATION

Qualifications

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

Short Courses

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

AREAS OF WORK EXPERIENCE

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

KEY SPECIALIST DISCIPLINES

Freshwater Assessments

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

Biodiversity Assessments

- Ecological Scan
- Biodiversity Offset Plan

SAS ENVIRONMENTAL GROUP OF COMPANIES –

SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF KIM MARAIS

PERSONAL DETAILS

Position in Company	Water Resource Manager; Senior Scientist
Joined SAS Environmental Group of Companies	2015

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Professional member of the South African Council for Natural Scientific Professions (SACNASP – Reg No. 117137/17)

EDUCATION

Qualifications

BSc (Hons) Zoology (University of the Witwatersrand)	2012
BSc (Zoology and Conservation) (University of the Witwatersrand)	2011

Short Courses

Aquatic and Wetland Plant Identification (Cripsis Environment)	2019
Tools for Wetland Assessment (Rhodes University)	2018
Certificate in Environmental Law for Environmental Managers (CEM)	2014
Certificate for Introduction to Environmental Management (CEM)	2013

AREAS OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, KwaZulu-Natal, Northern Cape, Eastern Cape,
Africa - Uganda

KEY SPECIALIST DISCIPLINES

Biodiversity Assessments

- Biodiversity Action Plans (BAP)
- Alien and Invasive Control Plans (AICP)
- Faunal Eco Scans
- Faunal Impact Assessments

Freshwater Assessments

- Desktop Freshwater Delineation
- Freshwater Verification Assessment
- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Watercourse Maintenance and Management Plans
- Freshwater Offset Plans

Aquatic Ecological Assessment and Water Quality Studies

- Riparian Vegetation Integrity (VEGRAI)
- Water quality Monitoring
- Riverine Rehabilitation Plans

Legislative Requirements, Processes and Assessments

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