Appendix B: Impact Assessment Report

Environmental Impact Assessment Report:

Draft Environmental Management Programme (Second Revision)

Report Prepared for

South Coast Stone Crushers (Pty) Ltd.

Report Number 483383-IAR

Report Prepared by

srk consulting

August 2016

Environmental Impact Assessment Report:

Draft Environmental Management Programme (Second Revision)

South Coast Stone Crushers (Pty) Ltd.

SRK Consulting (South Africa) (Pty) Ltd.
Section A Second Floor
Norfolk House
54 Norfolk Terrace
Westville 3630
South Africa

e-mail: Durban@srk.co.za
website: www.srk.co.za

Tel: +27 (0) 31 279 1200
Fax: +27 (0) 31 279 1204

SRK Project Number 483383-IAR
August 2016

Compiled by:

Romi Bellusci
Environmental Scientist

Reviewed by:

Wouter Jordaan (Pr.Sci.Nat)
Principal Scientist

Andy Smithen (Pr.Eng)
Partner

Email: wjordaan@srk.co.za

Authors:

Ms. R. Bellusci and Mr. W. Jordaan

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Abbreviations

AEL	Atmospheric Emissions Licence
DAFF	Department of Agriculture, Forestry and Fisheries
DEAT	Department of Environmental Affairs and Tourism
DMR	Department of Mineral Resources
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMPR	Environmental Management Programme Report
HIA	Heritage Impact Assessment
IAR	Impact Assessment Report
IHAS	Invertebrate Habitat Assessment System
IWULA	Integrated Water Use Licence Application
LoM	Life of Mine
MES	Minimum Emission Standards
MSDS	Material Safety Data Sheets
NEMA	National Environmental Management Act
NEM:AQA	National Environmental Management: Air Quality Act
PES	Present Ecological State
SANBI	South African National Biodiversity Institute
SAS	Scientific Aquatic Services
SCSC	South Coast Stone Crushers (Pty) Ltd
SCC	Species of Conservational Concern
SGS	Environmental Services
SRK	SRK Consulting South Africa (Pty) Ltd

Disclaimer

The opinions expressed in this Report have been based on the information supplied to SRK Consulting (South Africa) (Pty) Ltd (SRK) by South Coast Stone Crushers (Pty) Ltd (SCSC) SRK has exercised all due care in reviewing the supplied information from SCSC and specialist studies which were undertaken. Whilst SRK has evaluated the information supplied, the accuracy of and conclusions of the Impact Assessment Report are entirely reliant on the accuracy and completeness of the supplied data.

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1 Introduction

1.1 Background

South Coast Stone Crushers (Pty) Ltd. (SCSC) operates a mine approximately 4.5 km north of Margate, KwaZulu-Natal. Refer to **Figure 1-1.** The Mine is located on Lots 1995, 1996, 1997, 1998, 2000 and 2001 of Uvongo within Ugu District Municipality, KwaZulu-Natal. Access to the site is obtained from Quarry road with the surrounding landuse being characterised by small to medium size industries, industrial parks, canelands, banana plantations, two nature reserves and an informal settlement.

The mine has been operational for over 45 years and is a main supplier of aggregates to the manufacturing and road construction industries along the southern coast of KwaZulu-Natal. The mine is an open cast operation and is used to mine blue-grey Tillite which is washed and crushed to form aggregates. The site consists of the quarry site itself, site offices, the crushing plant and a batching plant.

1.2 Project Description

SCSC has an approved Environmental Management Programme Report (EMPR). However, since the EMPR was last revised in 2000 the information is outdated and therefore the existing EMPR needs to be revised. SCSC is also proposing to expand the mine operations onto the adjacent Lots 1997, 1998 and a portion of Lot 1994 and therefore the EMPR needs to be updated to include these portions. Refer to **Figure 1-2.**

The Department of Mineral Resources (DMR) has requested that the existing EMPR[1] be updated and amended to make provision for the new Lots to be mined, i.e. Lots 1997, 1998 and 1994 and to align the EMPR with the National Environmental Management Act (107 of 1998) (NEMA) Environmental Impact Assessment (EIA) (2014) Regulations' requirements for EMPr's.

This report constitutes the Impact Assessment Report (IAR) which forms part of the EMPr. In addition, this report must be studied in conjunction with the specialist studies that were undertaken as part of the project. The specialist reports compiled to inform the impact assessment are attached to this report.

1.3 Benefits of the Project

Benefits of the mine include the following:

- The mine has been operational for an excess of 45 years and supplies aggregates to many industries;
- The estimated expenditure injected to date, to bring the project into production has been approximately R 151 000 000;
- Annual expenditure at full production is estimated at approximately R 37 343 584; and
- Labour force at full production is estimated at R 6 169 856 per annum.

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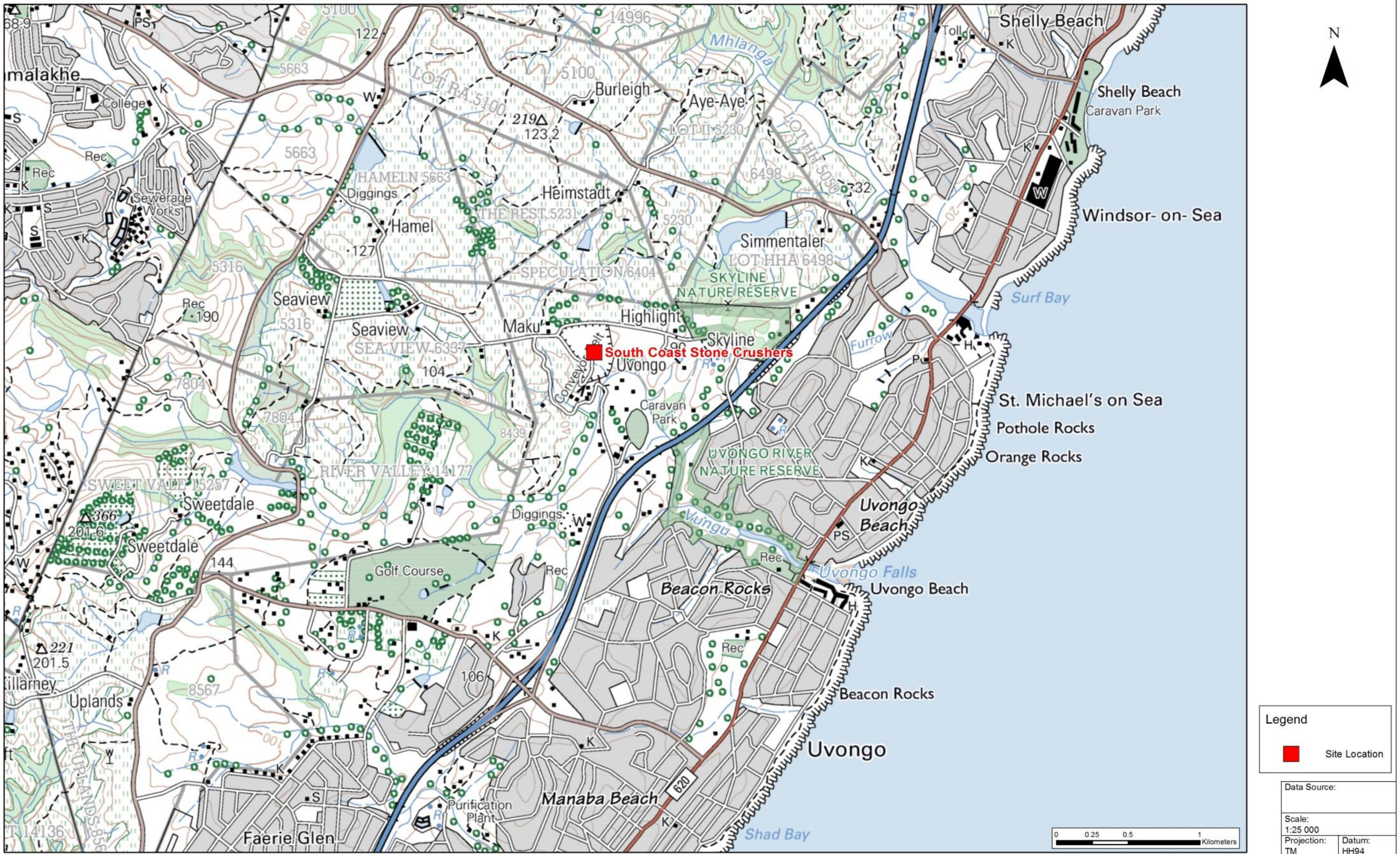
[1] The acronyms "EMPR" and "EMPr" are used in this document as follows: EMPR (all capital letters) refers to the Environmental Management Programme Report compiled under the MPRDA in 2000 and the EMPr (small "r") refers to the Environmental Management Programme compiled in 2015 in terms of the requirements of Appendix 4 of the NEMA EIA Regulations (2014). The EMPr includes the provisions of the amended mining right issued by the DMR to SCSC in 2011.



SOUTH COAST STONE CRUSHERS

LOCALITY MAP

Data Source:	
Scale: 1:25 000	
Projection: TM	Datum: HH94
Central Meridian/Zone: Lo 31	
Date: 18/11/2014	Compiled by: GOVD
Project No: 483383	Fig No: 1-1

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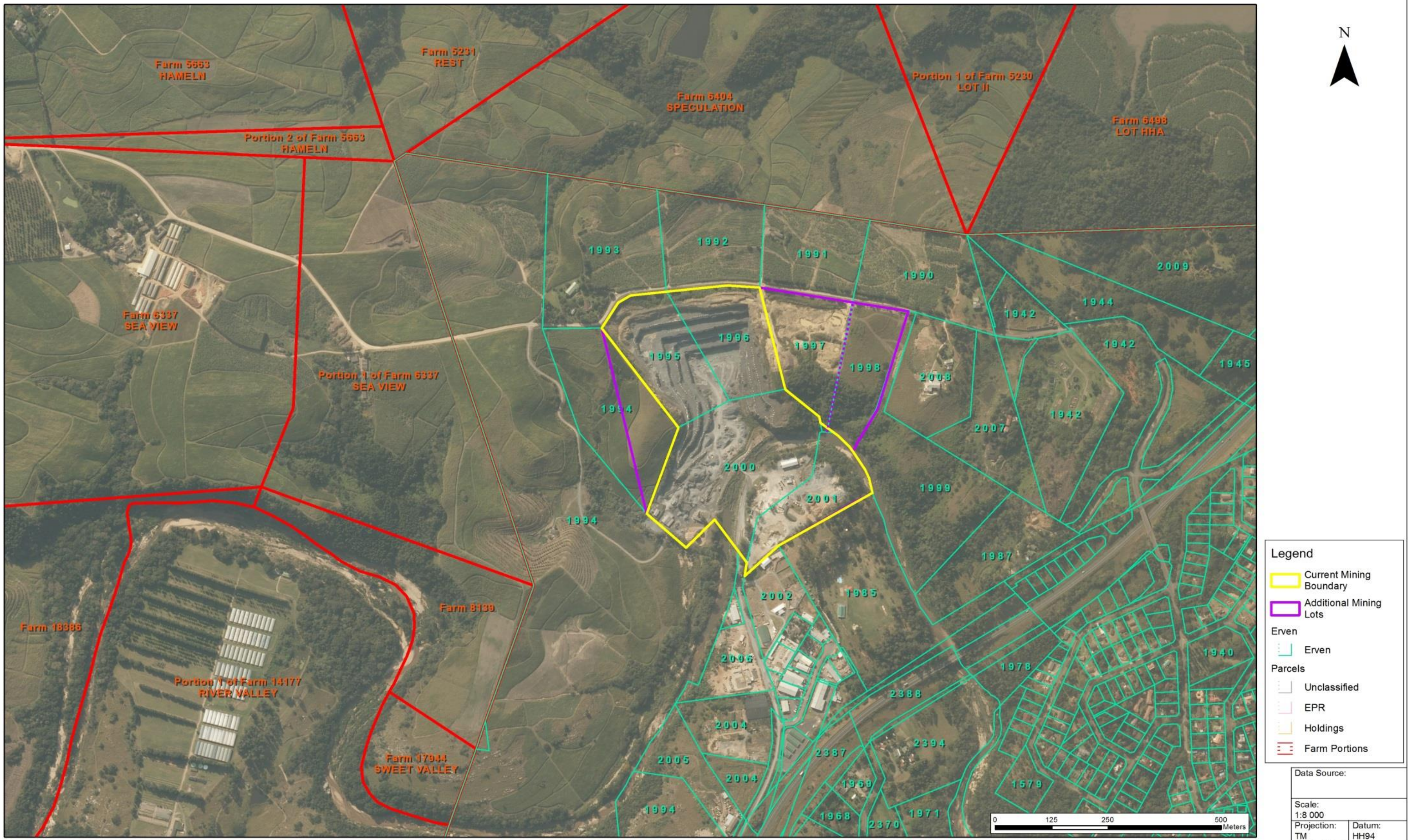
Revision: B Date: 16 09 2015



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Scale: 1:8 000

Projection: TM

Datum: HH94

Central Meridian/Zone: Lo 31

Date: 18/11/2014

Compiled by: GOVD

Project No: 483383

Fig No: 1-2

srk consulting

SOUTH COAST STONE CRUSHERS

AERIAL IMAGE INDICATING THE EXISTING AND NEW MINING AREAS

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Revision: B Date: 16 09 2015

2 Receiving Environment

2.1 Site Locality

The mine is located at Lots 1995, 1996, 1997, 1998, 2000 and 2001, Quarry road, Uvongo in the Margate Transitional Local Council of the Ugu District Municipality in KwaZulu-Natal. The mine is situated approximately 2km north-west of Uvongo and 4.5 km north of Margate. The Vungu River passes through the site before it meets the Indian Ocean approximately 5km to the south. The R61 main road is situated approximately 0.5 km southeast from the site.

2.2 Geology of the Area

The mine is situated near the southern extremity of a fault-bounded block of Karoo sequence sedimentary rocks which extends from Uvongo to Melville in the north. The Dwyka formation predominantly consists of Tillite outcrops in a down faulted basin parallel to the coastline and R61.

To the south of the mine the Tillite has a faulted contact with the older natal group of rocks. Refer to Appendix A for a figure showing the Regional Geology indicating Margate Mine Site (Lee, Walker and Cele; 2000).

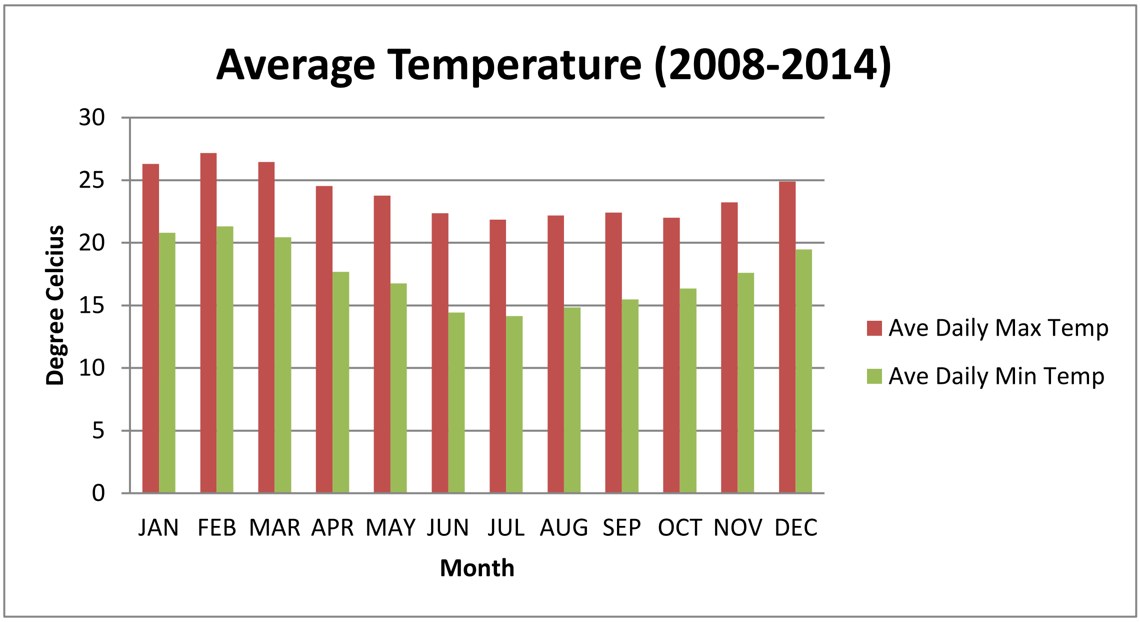
2.3 Local Geology

A geotechnical investigation was undertaken by L.C Loudon in 1983 in the area surrounding the mine (Lee, Walker and Cele; 2000). The focus of this study was to determine the extent and quality of Dwyka Tillite in the vicinity of the mine. Dwyka Tillite is used for road and railway construction, it can also be used as fill in road construction. The findings from the geotechnical study show that brown Tillite was intersected at depths ranging from 1m -15m from the surface and the overburden can be found at a depth ranging from 1m - 10m from the surface, with the average depth being 3m from the surface. Refer to Appendix B for the Geotechnical Investigation.

2.4 Climate

The climate of Margate, KwaZulu-Natal ranges from mild to warm winters and warm to hot summers. Over the past seven years the average daily maximum temperature in Margate during the summer months ranged from a high of 22 °C to 27 °C and the average daily minimum temperature during the summer months ranged from a low of 16 °C to 21 °C. During the winter months the average daily maximum temperature ranges from a high of 21 °C to 23 °C and the average daily minimum temperature during the winter months ranges from a low of 14 °C to 16 °C. (Refer to Table 2-1).

Table 2-1: Average monthly temperature from 2008-2014

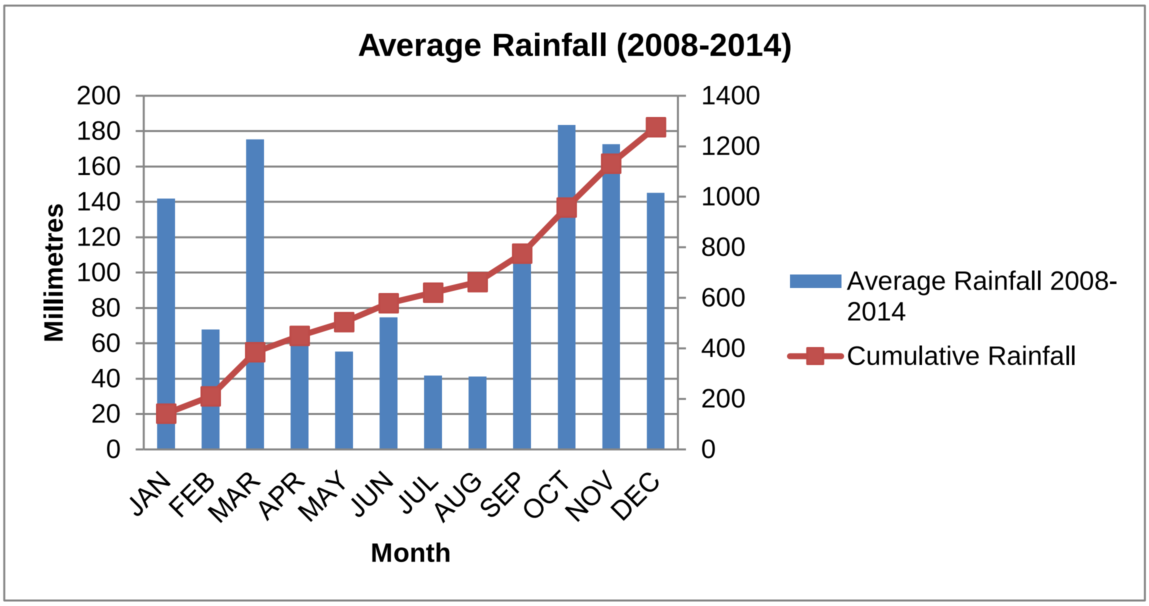


(Source: SAWS; 2014)

Rain is prevalent throughout the year in the study area, with a higher occurrence of rainfall in summer. The average cumulative rainfall is approximately 1275 mm of precipitation per annum. The average rainfall during the winter months ranges from 41-74 mm of precipitation and the average rainfall during the summer months ranges from 67 mm-183 mm of precipitation.

During the summer months there is an increase in the occurrence of weather patterns conducive to rainfall. Refer to Table 2-2 below.

Table 2-2: Average monthly rainfall from 2008-2014



(Source: SAWS; 2014)

The Wind Rose for the period January 2008 to December 2014 is presented in **Figure 2-1** below. The prevailing winds for this period are from the north-northeast and northeast, with lower occurrences from the southwest. The strongest winds are from south-southwest and southwest. The average wind speed for this period was 1.5 and 3.5 metres per second.

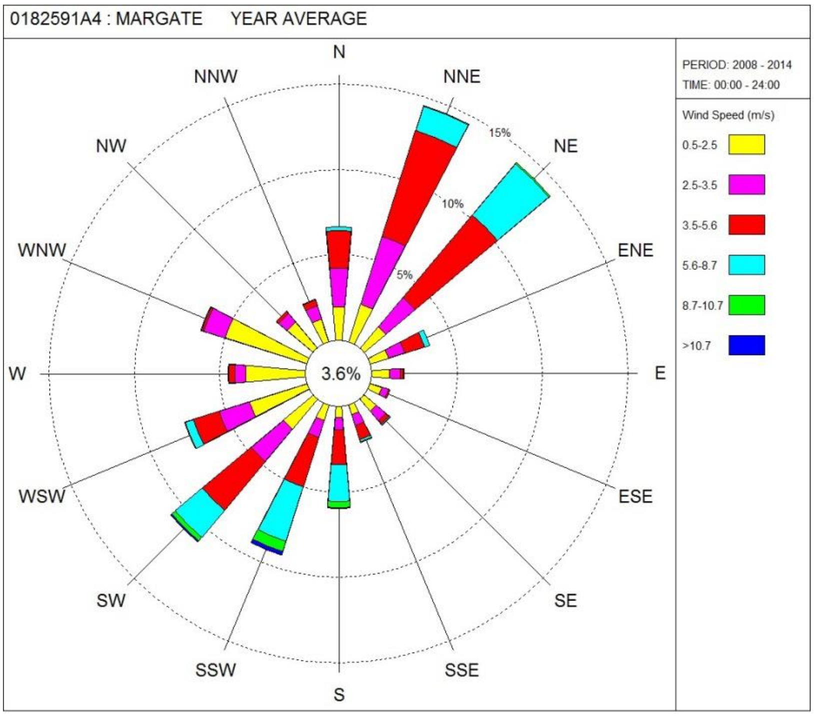


Figure 2-1 Average wind rose

2.5 Topography

The surrounding land is predominantly sugar cane and the landscape is characterized by low gentle rolling hillsides and incised meandering river valleys. The mining area is intersected by the Vungu River.

The elevation of the quarry at the base is approximately 26 metres above sea level, while at the top of the mine it is approximately 80 metres above sea level. The floor base will not be deepened as this may lead to flooding into the mine from the Vungu River.

2.6 Soils

The surface soils of decomposed Dwyka Tillite (which weathers to form a Glenrosa type soil) is characterised by a grey fine sandy loam with a sandy subsoil which has clay wedges in a yellow decomposed bedrock (Lee, Walker and Cele; 2000). As the mine has been operational for many years most of the topsoil has been cleared ahead of the mine excavation faces, some of the area has been mined by a local farmer who was undertaking clay mining on a portion of the mine. Most of the topsoil which was cleared for mining has been stored in stockpiles located to the north of the mine.

2.7 Water

The Vungu River passes through the mine, dividing the site into two portions, access across the river within the mine property is over a low-level bridge. The river flows from west to east across the site before it meets the Indian Ocean approximately 5km south of the mine. Water is currently being abstracted from the Vungu River via two pumps. The water is used primarily for the conveyor sprinklers, material (stone) washing plant, batching plant and sometimes water is abstracted for dust suppression. SCSC is in the process of applying for an Integrated Water Use Licence Application (IWULA).

2.8 Land Capability and Land Use

The land capability has not been formally established, however the pre-mining land-use was agricultural.

The mine borders on the edge of urban residential areas and commercial agriculture the R61 acts as a buffer between the residential and industrial zone. Currently, the surrounding land-use comprises sugar cane, banana plantations and small to medium size industries, industrial parks, informal settlements and two nature reserves. The surrounding properties have been zoned for light industrial and commercial agricultural use.

2.9 Flora

The South Coast of KwaZulu-Natal forms part of the Savanna Biome and is classified by grassland/coastal bushveld with small pockets of coastal forest (Lee, Walker and Cele; 2000). Much of the vegetation has been cleared for urban development, as well as for agricultural purposes. There has also been an increase in secondary vegetation and alien species which is due to anthropogenic activities.

The area in the vicinity of the mine has been mostly cleared of vegetation for mining purposes. The vegetation type found on portion 1994 is comprised predominantly of transformed land. Portions 1997 and 1998 comprise of transformed land which was cleared for clay mining as well as coastal grassland and coastal forest.

According to the Floral and Faunal Ecological Assessment undertaken by Scientific Aquatic Services (SAS) in September 2015 there are 4 habitat units in the mining area (which includes the proposed extension portions). The four habitat units are shown in **Figure 2-2** below and detailed in the subsections to follow (Scientific Aquatic Services, 2015). Refer to Appendix C for the Floral and Faunal Ecological Assessment.

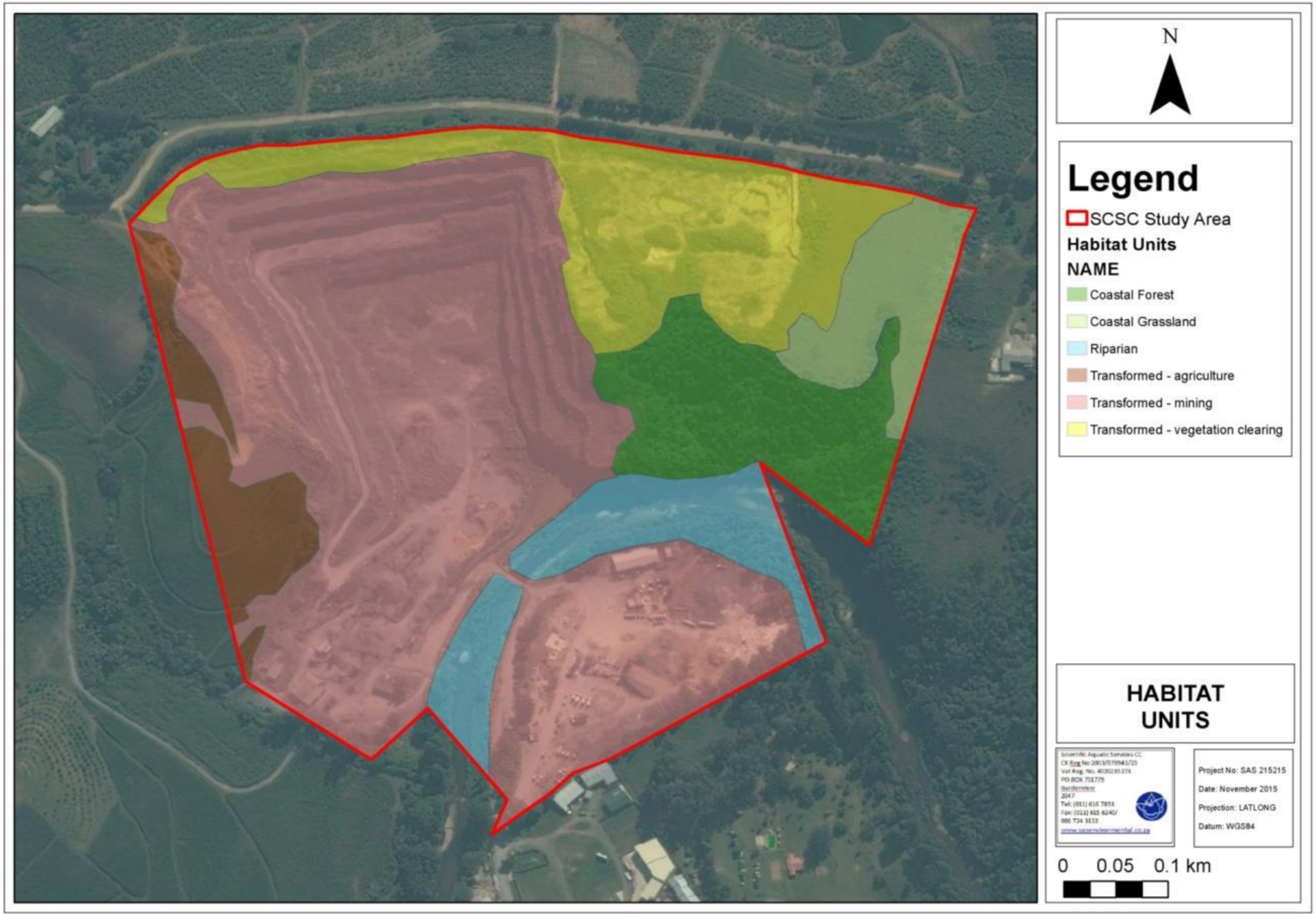


Figure 2-2 Habitat units in and around the mine

2.9.1 Habitat unit 1 - Transformed

This habitat unit comprises of the land that has been transformed for mining, agriculture and clay mining. Most of the land in this unit is disturbed and is dominated by alien vegetation with limited indigenous vegetation present (Scientific Aquatic Services, 2015).

2.9.2 Habitat unit 2 - Riparian

The riparian unit is located in the vicinity of the Vungu River. Natural vegetation in this habitat unit has been impacted on by anthropogenic activities and the vegetation has therefore been significantly altered. There are a large amount of indigenous floral species, however this habitat unit comprises mostly of alien vegetation. There were two Species of Conservational Concern (SCC) located in the riparian habitat unit, namely *Haemanthus humulis* and *Scadoxus puniceus.* According to the Floral and Faunal Ecological Assessment the riparian habitat unit is considered to have an increased conservational value as it provides migratory connectivity and a habitat for faunal and floral species (Scientific Aquatic Services, 2015).

2.9.3 Habitat unit 3 - Coastal Forest

Patches of coastal forest are located in the eastern portion of the study area and on portions 1997 and 1998. This habitat unit is associated with two unnamed tributaries of the Vungu River and originates within steep kloofs above the river (Scientific Aquatic Services, 2015). The remaining portion of the coastal forests shows limited signs of recent disturbance with an intact habitat for a number of faunal species and a high biodiversity of forest floral species. Alien vegetation encroachment is only restricted to the periphery of the coastal forest unit.

According to the Floral and Faunal Ecological Assessment two floral SCC, protected under the National Forest Act (Act 84 of 1998), namely *Pittosporum viridiflorum* and *Sideroxylon inerme* were encountered within this habitat unit, but it is anticipated that other floral SCC are also likely to occur in this area. *Pittosporum viridiflorum* and *Sideroxylon inerme* are listed as being protected by the National Forest Act (Act 84 of 1998). In terms of this act, protected species may not be cut, damaged or destroyed, except under licence granted by the Department of Agriculture, Forestry and Fisheries (DAFF).

This habitat unit is considered to be in a good ecological condition and is deemed to have a high level of ecological sensitivity (Scientific Aquatic Services, 2015).

2.9.4 Habitat unit 4 - Grassland Habitat

The grassland habitat unit is located in the north-eastern portion of the study area. This habitat unit shows signs of recent habitat disturbance relating to earthworks, road servitudes and topsoil stripping. This habitat unit provides a habitat for a relatively high diversity of grass species and forb species of which one was identified as a floral SCC, namely, *Hypoxis hemerocallidea* (Scientific Aquatic Services, 2015).

2.10 Fauna

The disturbed habitats are mostly desolate of faunal species, whilst the western sugarcane areas provide some habitat for reptiles, avifaunal and amphibian species. The coastal forest found in the eastern portion of the study area located along the Vungu River was the only section of the study area that was noted to have retained the natural vegetation characteristics, and as such provided the most suitable habitat area for faunal species. The Vungu River with its naturally vegetated banks also provides a movement corridor for faunal species moving through the area (Scientific Aquatic Services, 2015). The following subsections describe the faunal species identified on site.

2.10.1 Mammals

According to the Floral and Faunal Ecological Assessment, six mammals were identified on the site visit, all via spoor identification. The coastal forest provides a refuge to many mammals and is seen as important in terms of mammal conservation within the area. Table 2-3 below lists the species identified on site. According to the study no SCC or threatened mammal species were identified within the study area.

Table 2-3: Mammal species identified within study and surrounding region

Scientific Name	Common Name
Galerella sanguinea	Slender Mongoose
Aonyx capensis	Cape Clawless Otter
Philantomba monticola	Blue Duiker
Sylvicapra grimmia	Common Duiker
Atilax paludinosus	Water Mongoose
Tragelaphus scriptus	Bushbuck

2.10.2 Avifauna

There were several avifaunal species identified, however no avifaunal SCC were identified within the study area. Table 2-4 below lists the avifaunal species identified on site (Scientific Aquatic Services, 2015).

Table 2-4: Avifaunal species identified during the SAS assessment

Scientific Name	Common Name
Streptopelia capicola	Cape Turtle Dove
Streptopelia seneggalensis	Laughing Dove
Bostrychia hagedash	Hadeda Ibis
Acridotheres tristis	Indian Myna
Ploceus velatus	Southern Masked Weaver
Ploceus ocularis	Spectacled Weaver
Lybius torquatus	Black-collared Barbet
Alopochen aegyptiacus	Egyptian Goose
Crithagra mozambicus	Yellow-fronted Canary
Motacilla aguimp	African Pied Wagtail
Streptopelia semitorquata	Red-eyed Dove
Columba livia	Rock Dove
Andropadus importunus	Sombre Greenbul
Colius striatus	Speckled Mousebird
Oriolus larvatus	Black-headed Oriole
Zosterops virens	Cape White-eye
Prinia subflava	Tawny-flanked Prinia
Centropus burchellii	Burchell’s Coucal
Lanius collaris	Common Fiscal Shrike
Pycnonotus barbatus	Dark-capped Bulbul
Onychognathus morio	Red-winged Starling
Corvus albus	Pied Crow

Scientific Name	**Common Name**
Dicrurus adsimilis	Fork-tailed Drongo
PternistIs natalensis	Natal Francolin
Zosterops pallidus	CapeWhite-eye
Pogoniulus bilineatus	Yellow-rumped Tinkerbird
Passer diffusus	Southern Grey-headed Sparrow
Cossypha natalensis	Red-capped Robin-chat
Camaroptera brachyura	Green-backed Bleating Warbler
Lonchura cucullata	Bronze Mannikin
Milvus aegyptius	Yellow-billed Kite

2.10.3 Reptiles

According to the Floral and Faunal Ecological Assessment only three reptiles were identified within the study area. Refer to Table 2-5. Table 2-6 below, lists other species recognised that were not identified on site, but that are most likely to occur on site given the environment and habitat requirements (Scientific Aquatic Services, 2015).

Table 2-5: Reptiles identified during the SAS assessment

Scientific Name	**Common Name**
Dendroaspis polylepis	Black Mamba
*Agama atra**	Southern Rock Agama
*Rachylepis varia**	Variable Skink

Table 2-6: Reptiles species expected to occur within the study area and surrounding area

Scientific Name	**Common Name**
Dispholidus typus	Boomslang
Crotaphopeltis hotamboeia	Herald Snake
Lamprophis aurora	Aurora House Snake
Philothamnus natalensis	Natal Green Snake
Gerrhosaurus flavigularis	Yellow-throated Plate Lizard
Chamaeleo dilepis	Common Flap-neck Chameleon
Boaedon capensis	Brown House Snake
Amblyodipsas polylepis	Common Purple-glossed Snake
Philothamnus semivariegatus	Spotted Bush Snake

2.10.4 Amphibians

Only one amphibian species was encountered during the field assessment, namely *Ametia angolensis* (Common River frog, which is not a SCC). It is expected that the majority of amphibian species that are likely to occur within the study area will inhabit the wetland and riparian areas.

Table 2-7 lists other amphibian species that were not identified on site, but that given the environment and habitat requirements are most likely to occur on site or in the surrounding region (Scientific Aquatic Services, 2015).

Table 2-7: Amphibians species expected to occur within the study area and surrounding area

Scientific Name	Common Name
Hyperolius marmoratus	Painted Reed Frog
Hyperolius pusillus	Water Lily Frog
Leptopelis natalensis	Forest Tree Frog
Amietophrynus rangeri	Raucous Toad
Phrynobatrachus natalensis	Snoring Puddle Frog
Hyperolius tuberilinguis	Tinker Reed Frog
Afrixalus spinifrons	Natal Banana Frog
A. spinifrons	Kloof Frog

2.10.5 Invertebrates

The invertebrate assessment undertaken was a general assessment aimed at identifying common invertebrate species in the study area. Table 2-8 below lists the invertebrate species identified on site. No invertebrates of SCC were identified (Scientific Aquatic Services, 2015).

Table 2-8: Invertebrate species identified during the SAS assessment

Family	Scientific Name	Common Name
Pieridae	*Belenois aurota*	Brown-veined White
	Eurema brigitta	Broad-bordered Grass Yellow
	Colotis danae	Scarlet Tip
Nymphalidae	*Junonia hierta*	Yellow Pansy
	Danaus chrysippus	African Monarch
	Junonia orithya madagascariensis	Eyed Pansy
Papilionidae	*Papilio demodocus demodocus*	Citrus Swallowtail
	Graphium antheus	Large Striped Swordtail
Acrididae	*Nomadacris septemfasciata*	Red Locust
	Tmetanota sp	N/A
	Tylotropidius sp	N/A
	Truxaloides sp	N/A
Pamphagidae	*Stolliana sp*	N/A
Libellulidae	*Pantala flavescens*	Wandering Glider
	Trithemis furva	Dark Dropwing
	Hemistigma albipuncta	Piedspot
	Orthetrum julia	Julia Skimmer
Coenagrionidae	*Africallagma glaucum*	Swamp Bluet
	Pseudagrion sublacteum	Riffle Sprite
Aeshnidae	*Anax imperator*	Blue Emperor
Formicidae	*Anoplolepis custodiens*	Pugnacious Ant

Although not directly observed the Floral and Faunal Ecological Assessment considers it likely that two IUCN listed butterflies may occur within the study area, namely *Durbania amakosa albescens* and *Lepidochrysops ketsi leucomacula*. Both these species are listed as Vulnerable and are localised endemics to the Margate region (Scientific Aquatic Services, 2015).

2.10.6 Arachnids and Scorpions

No arachnid and scorpion species were observed during the Floral and Faunal Ecological Assessment undertaken by SAS, however the coastal forest in the eastern portion of the study area is likely to provide habitat for a number of arachnid and scorpion species. Table 2-9 lists arachnid and scorpion species that may be observed in the coastal forest (Scientific Aquatic Services, 2015).

Table 2-9: Arachnid and Scorpion species expected to occur within the coastal forest

Scientific Name	Common Name
Uroplectes formosus	Scorpion
Harpactira tigrina	Common yellow-banded baboon spider
Hermacha bicolor	N/A
Poecilomigas abrahami	Abrahams banded-legged trapdoor spider
P Ancylotrypa zebra	Zebra trapdoor spider

None of the arachnid species listed above are considered to be threatened nationally or provincially, nor are any threatened arachnid species expected to occur within the study area (Scientific Aquatic Services, 2015).

2.11 Biodiversity Sensitive Areas

The Floral and Faunal Ecological Assessment included a sensitivity map (**Figure 2-3**) using the floral and faunal integrity and diversity encountered during the assessment of the study area. From the assessment it is clear that the majority of the study area comprises the Transformed Habitat Unit (THU), which includes active mining areas, areas where topsoil and vegetation has been cleared and agricultural lands. These areas are considered to have low ecological sensitivity and no significant loss of ecological resources will occur should these areas be mined (Scientific Aquatic Services, 2015).

The Vungu River is an important source of water and temporary or permanent habitat for faunal species. The bankside vegetation provides cover for faunal species whilst drinking as well as habitat for smaller more cryptic species, and is therefore considered an important feature of the area and overall river system.

The Floral and Faunal Ecological Assessment recommended that as far as possible the river, its associated vegetation and the coastal forest along the river and cliffs in the eastern portion of the study area are conserved and remain exempt from mining activities (Scientific Aquatic Services, 2015).

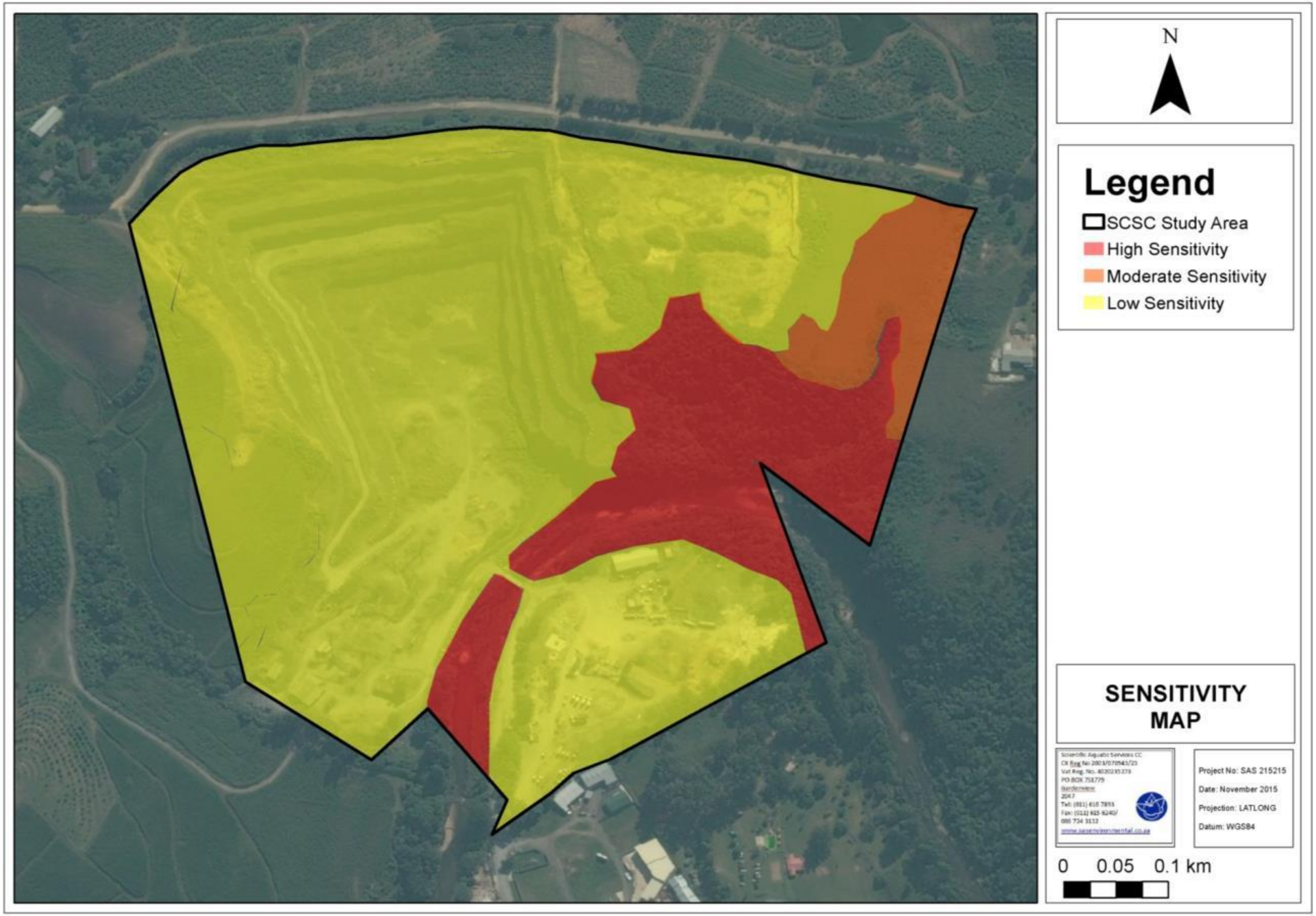


Figure 2-3 Sensitivity map for the study area

3 Description of Existing Activities

This section of the report has been compiled using the existing EMPR and site observations made.

3.1 Infrastructure

3.1.1 External infrastructure

The mine is situated approximately 2km north of the R61, Uvongo/Margate off-ramp with access off Quarry road. The mine is strategically located close to the R61, municipal water supply and power supply.

3.1.2 Solid waste management facilities

Industrial and domestic waste disposal site

Domestic and general waste is stored on-site in bins until such time that it is collected by Ugu Municipal services and disposed of. The only hazardous waste produced on site is oil, cement powder from batching plant and materials that come into contact with oils and lubricants. Other wastes include electronic waste (e-waste) and medical waste. Oil is collected by Oilkol and waste manifests are retained and kept on site.

Any medical waste (such as swabs, syringes and sharps) generated are collected by the nurse whilst undertaking her site visit and are taken back to the NPC Simuma Plant where it is disposed of by Compass Waste at the Westmead Treatment Facility in Marianhill. Annual internal audits are undertaken at the NPC Simuma Plant where waste manifests are checked to ensure that correct disposal have taken place and that the waybills and waste manifests are retained and filed.

Table 3-1 categorises the waste generated on site.

Table 3-1: SCSC Waste Categorisation

Waste	Resp. Person	Service provider	Hazardous (Yes/No)	Management	Waste Disposal Facility
Waste Paper	Workshop Manager	Hibiscus Coast Municipality	No	Disposal	Oatlands Landfill
Scrap Metal	Workshop Manager	Nivnick Scrap metals	No	Recycle	N/A
Oil and contaminated items - Used oil	Workshop Manager	Oilkol	Yes	Treatment/ Disposal	
Oily rags	Workshop Manager	Oilkol	Yes	Treatment/ Disposal	
Electronic waste (e-waste)	IT Durban NPC	Ricoh	Yes	Reuse	N/A
Glass	Plant Manager	Hibiscus Coast Municipality	No	Disposal	Oatlands Landfill

Waste	Resp. Person	Service provider	Hazardous (Yes/No)	Management	Waste Disposal Facility
General Refuse	Plant Manager	Hibiscus Coast Municipality	No	Disposal	Oatlands Landfill
Plastic	Plant Manager	Hibiscus Coast Municipality	No	Disposal	Oatlands Landfill s
Medical Waste	J. Brown	Compass Waste Service	Yes	Treated, autoclaved at compass Westmead Treatment Facility and sent to Marianhill Landfill/ Incineration.	Westmead Treatment Facility/ Marianhill
Batteries	Workshop Manager	Autozone	Yes	Old - re-use	N/A
Mercury vapour lamps/ fluorescent tubing	Workshop Manager	MP Electrical	Yes	Disposal	N/A
Mechanical parts	Workshop Manager	Auctioned			
Sludge	Plant Manager	Mixed with the concrete and sold			
Wiring/ cables	Workshop Manager	MP Electrical – plant Autozone – vehicles	Yes	Reuse	N/A

Mine residue disposal sites (Dried Tailings)

Liquid effluent is produced during the washing process. The outflow of contaminated water from the wash area collects in a small concrete lined settling pond where the flocculent is added, the water then passes through a second and third settling pond. Water is extracted from the last pond and is used for dust suppression, in the event of a flood the excess water flows back into the Vungu River. There is virtually no dry tailings produced, small quantities that are produced are managed by SCSC in their processes.

3.1.3 Water management

The mine uses a septic tank system for sewage disposal, there should not be any groundwater and soil contamination, assuming it functions adequately, the septic tanks are cleaned on a quarterly basis by an external contractor (currently Drain Away). Sewage is disposed of at the Ugu Waste Services Works.

There are three lined settling ponds which act as pollution control dams and allow any fine particles to settle out of suspension before water is extracted for dust suppression. Due to the sediment runoff and fine material emanating from the crushing and washing processes, sediments and suspended solids are captured in the water. The water flows into the first settling pond where flocculent (Qualfloc) is added, it then passes through the second and third settling pond. Some water is also extracted periodically from the third settling pond for dust suppression. The water is not contaminated with chemicals as no other materials are introduced, other than the flocculent, during processing.

3.1.4 Potable and process water

Potable water is available via a pipeline from the Hibiscus Coast Municipality at approximately 3000m^3 to 6000m^3 per month. Water from the Vungu River is extracted via a pump and is used during the washing process and for dust suppression. If the pump is continually used then approximately 5500 m^3 is abstracted per month from the Vungu River.

3.1.5 Processing plant

The processing plant consists of traditional series of crushers, screens and conveyor belts for refining of the rock to the various aggregate sizes. Once the aggregate has been crushed it goes through a washing process whereby the aggregate is washed to eliminate any loose silt. A flocculent is added to the wash water to facilitate the settling out of fine particles.

3.1.6 Diesel/Petrol storage tanks

There is a fuelling station within the plant, with two underground diesel storage tanks. The tanks are contracted and maintained by Engen. There are no petrol storage tanks or above ground tanks on site.

3.1.7 Access and security gate

There are two security gates, the main gate (southern boundary of the site) and the second gate (western boundary of the site). Both gates are manned by security guards; the main gate is manned 24hours a day by a dedicated security guard. All vehicles are signed in and breathalyser tests are carried out on the occupants of each vehicle upon entering the site. The mine area is fenced.

3.1.8 Stormwater control and water balance schematic

There is one stormwater drain which drains the water to the western boundary of the site near the second gate. The mine uses both municipal water and water from the Vungu River, there is approximately 247m^3 of municipal water that is used for the site offices, washings, ablutions, cooking and in the laboratory. The domestic sewage then goes into the septic tank. There are two pumps that are used to extract water from the river; the first pump is used on the conveyors, primary crusher and the wash plant, excess water from these processes goes into the primary settling pond, then onto the secondary settling pond and finally onto the last settling pond/evaporation dam. Most of the water evaporates in the settling ponds, the water in the final settling pond is abstracted and used for dust suppression around the site. During flood events some water that overflows from the last settling pond is discharged into the river. Water that is extracted from the second pump in the Vungu River is used for truck washing, batching plant and the truck drum mixer, the excess water from the truck washing and batching plant goes into a catchment sump, some of that water is released back into the batching plant and the rest of it is used in the water truck for dust suppression. Refer to the water flow schematic in **Figure 3-1.**

3.1.9 Soil utilisation

Topsoil which was stripped prior to blasting has been stockpiled in well-managed stockpiles in the northern portion of the mine. These stockpiles will be used as part of ongoing site rehabilitation and have been vegetated to prevent soil erosion.

3.1.10 Mining method

Mining is by conventional modern bench-type, open-cast method. Rock extraction is performed by drilling and blasting with primary blasting taking place approximately three times a year.

Every blast is carefully planned for optimisation. Factors such as cloud cover, wind direction, and timing of the blast, are all considered to eliminate, or to reduce air blast; sound, percussion and vibration.

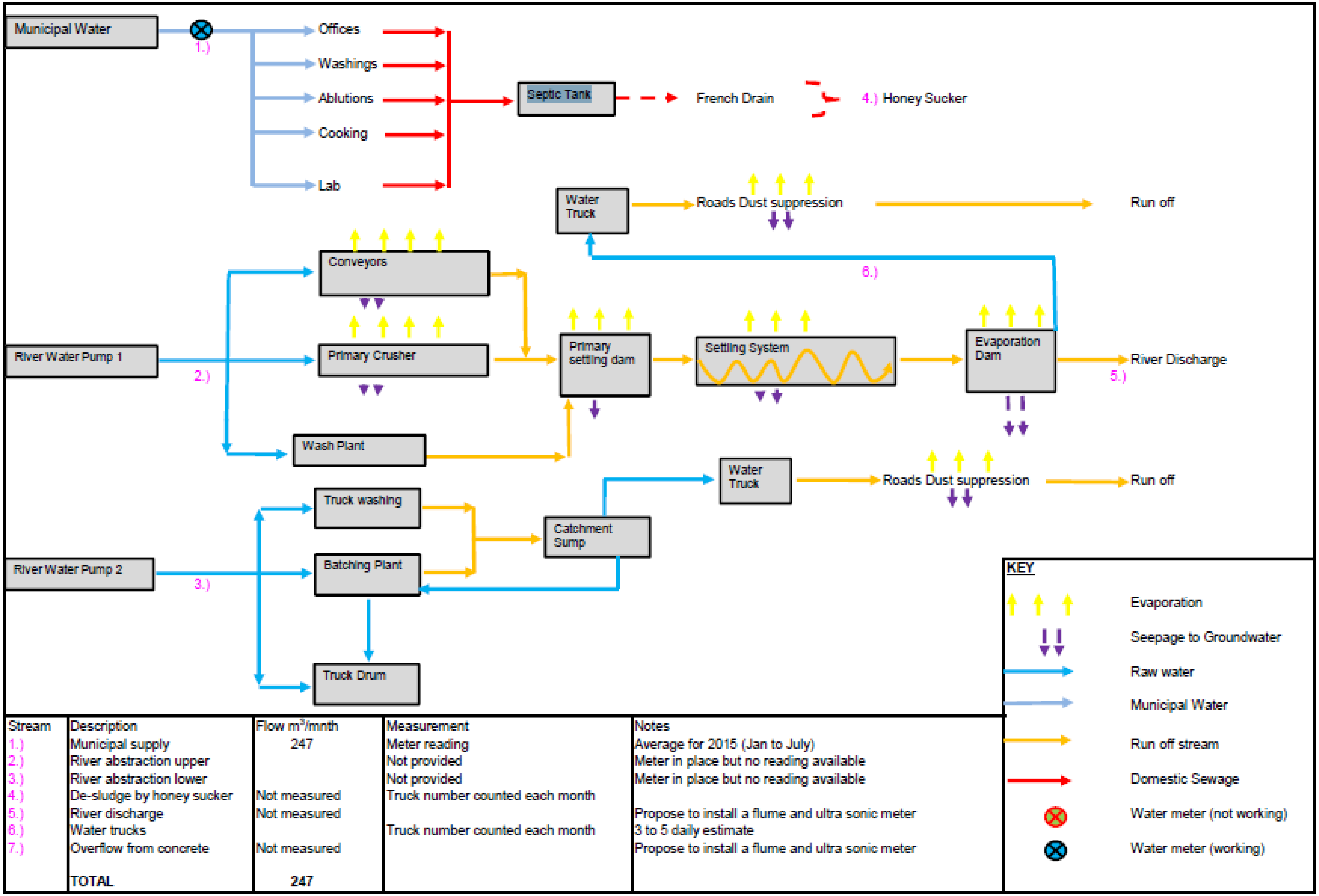
Explosives used are chosen for maximum fragmentation and low noise. An external company (Brauteseth Blasting) has been appointed to undertake the blasting and therefore no explosives are stored on site. The impacts of blasting have not been formally assessed, but it is envisaged that no structures are likely to be affected by blasting vibration.

Broken rock and rubble is loaded onto dump-trucks, transported to the plant area and tipped directly into the bin of the primary crusher.

All adjacent landowners are notified prior to blasting and are requested to vacate their homes, at a safe distance, for that period for safety purposes.

3.1.11 Transport

The final product of aggregate is transported from the site via road. SCSC transport aggregates via road transport, ranging from 2 500 – 10 000 tons per week (depending on demand).



Stream	Description	Flow m³/mnth	Measurement	Notes
1.)	Municipal supply	247	Meter reading	Average for 2015 (Jan to July)
2.)	River abstraction upper		Not provided	Meter in place but no reading available
3.)	River abstraction lower		Not provided	Meter in place but no reading available
4.)	De-sludge by honey sucker	Not measured	Truck number counted each month	
5.)	River discharge	Not measured		Propose to install a flume and ultra sonic meter
6.)	Water trucks		Truck number counted each month	3 to 5 daily estimate
7.)	Overflow from concrete	Not measured		Propose to install a flume and ultra sonic meter
	TOTAL	247		

Figure 3-1 Water balance schematic

4 Existing Environmental Impacts

4.1 Surface Water

4.1.1 Surface water quantity and flow

The Vungu River intersects the mine and access to the site is gained by means of a low-level bridge. The drainage and water flow over the mine moves from west to east. The Vungu River meanders to the Indian Ocean, with the river mouth being approximately 5km away. The width of the river ranges from 10m -20m where it traverses the mine.

The plant and other infrastructure are situated in the flood-plain of the river. The mine has been subjected to many floods over the years. The relevant flood peaks for the 50 and 100 year return interval for each catchment are shown in Table 4-1 below (WSP, 2015).

Table 4-1: Design flood values

Return interval	Rational Method	Alternative rational Method	Unit Hydrograph	Empirical Method	Average
Vungu River					
50	319.02	370.58	167.66	208.20	266.37
100	404.22	445.75	226.74	263.54	335.07

4.1.2 Vungu river water quality

In April 2015, an aquatic bio-monitoring assessment was commissioned to assess the impacts SCSC has on the Present Ecological State (PES) of the Vungu River. (Refer to Appendix D for the aquatic bio-monitoring assessment). Samples were taken from three different points, upstream of the mining site (SCM 01), in the middle of the site where the river passes through the site (SCM 02) and downstream of the site (SCM 03). Refer to **Figure 4-1** for a map showing the exact locations of the bio-monitoring points. The overall results indicated that the in-situ water quality results for the survey were all within the Department of Water Affairs and Forestry (DWAF) Ecosystem guideline values.

The Invertebrate Habitat Assessment System (IHAS) indicated that the habitat at SCM 01 for macro invertebrate was inadequate. The Sample at point SCM 02 (which passes through the plant) was found to have a good habitat suitability and the Sample at point SCM 03 which lies downstream of the mine was found to have an adequate habitat suitability (Knight Piesold Consulting; 2015). These results indicate that the mining activities are not having a negative impact on the macro invertebrate habitat.

The results of the assessment indicated that the diatom communities at all three sample sites are indicative that the river has been impacted on by anthropogenic activities, there is however a general improvement in the condition of the river downstream, this is due to the decreased organic pollution and nutrient levels. The assessment indicted that the river reach is impacted by high density settlements, urban impacts from Uvongo, waste water treatment works (Uvongo and Gamalakhe), and mining (Knight Piesold Consulting; 2015). In terms of Resource Quality Objectives, this river reach is in a B Ecological Category and was identified as a high water quality priority area. Refer to Appendix D for the bio-monitoring study.

In addition to the bio-monitoring assessment SCSC undertakes surface water monitoring on a yearly basis the results of which indicate that the water quality in the Vungu River is of good quality. Most recent water samples were taken from the Vungu River in April 2015. Three samples were provided by SCSC but the exact sample points are unknown. However one sample was taken upstream in the river (roughly 100 metres before the mining site boundary), one in the middle (as the river passes the plant) and the other downstream (roughly 100 metres after the mining site boundary); in an effort to provide a comparison of the water quality in the Vungu River before it passes past the mine and after. Refer to Appendix E for water quality results.

The results indicate that the site does not appear to be impacting on the Vungu River at present. Marginal increases were observed between the up-gradient and down-gradient points for the following parameters:

- pH;
- oxygen absorbed;
- alkalinity;
- o-Phosphate as PO; and
- o-Phosphate as P.

It should be noted that the suspended solids had a more significant increase from 2 mg/L in the up-gradient point to 36 mg/L at the Middle river point and 25 mg/L at the down-gradient point.

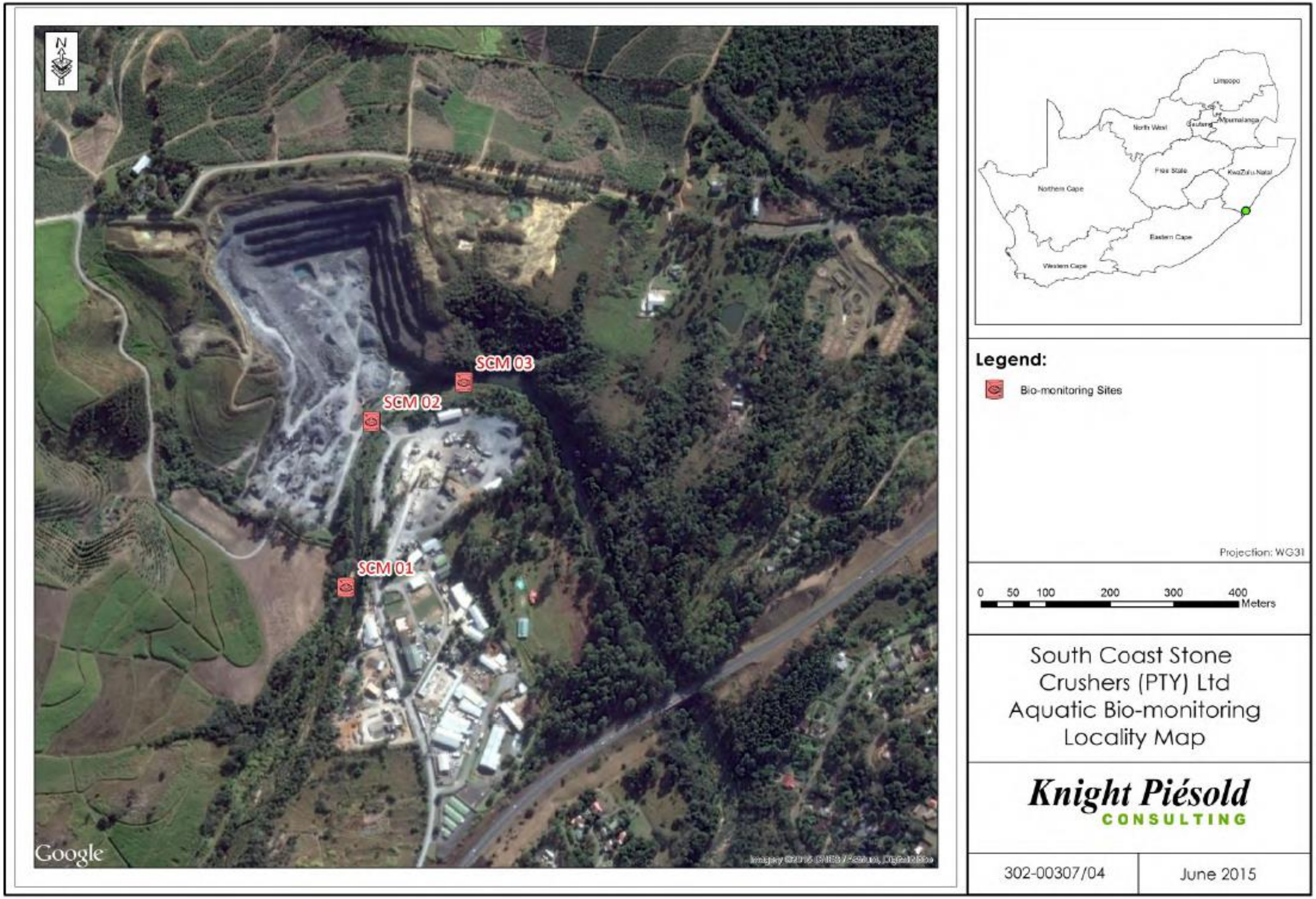


Figure 4-1 Bio-monitoring points

4.1.3 Mine water quality

Water samples were taken by SCSC from within the stormwater drain and settling pond in 2014. The exact locations of the sampling points are unknown. Once water leaves the crushing plant it is treated with a flocculent (Qualfloc), which assists in settling suspended solids as well as purifying water.

The water quality results are compared with SAGS: 2004 as well as the waste water limit values applicable to discharge of wastewater into a water resource as per the National Water Act No 36 of 1998 (GN 655).

Based on the annual sampling run, the water quality within the stormwater drain as well as the settling ponds appears to be acceptable, with the exception of suspended solids. Refer to Appendix E for the water quality results.

4.2 Groundwater

SCSC has a groundwater monitoring programme in place and groundwater monitoring is undertaken bi-annually. Groundwater samples are obtained from five sampling points, of which four monitoring wells are situated on-site and one is situated off site. Refer to Appendix F for the Water Monitoring Programme and latest groundwater results.

4.3 Wetland and Riparian Zones

There is a small seepage wetland located upstream of the mining activities in the valley to the west of the mine. Refer to Figure 3 of Appendix G (the aquatic assessment). This wetland has been impacted on by alien plant infestation, sugarcane cultivation, artificial draining and filling of the wetland by SCSC to construct an access road and turning circle for haul trucks. A specialist aquatic assessment report was undertaken in March 2015 by Eco-pulse Environmental Consulting to assess the impacts the mine has had on the surrounding aquatic systems and to inform the Impact Assessment as part of the EMPr amendment.

The assessment identified three aquatic ecosystems, a small seepage wetland, the Vungu River and a small tributary connected to the Vungu River. The assessment report indicated that while the wetlands and the tributary were regarded as having a largely modified to seriously modified Present Ecological State (PES). They were identified as having a low ecological importance and sensitivity (EIS). On the other hand the Vungu River was identified as having a moderately modified PES and moderate to high EIS (Eco-Pulse; 2015). Refer to Appendix G for the aquatic assessment.

4.4 Air Quality

Due to various smaller industries having developed in and around the Uvongo area, it is anticipated that the ambient air quality has been impacted on by sources other than the mine. No formal air quality assessments have been undertaken on the site, although monthly dust fallout monitoring is undertaken at various points around the site. Potential sources of atmospheric pollution include vehicular emissions and dust as a result of the activities on the site (screening, blasting, drilling and vehicle movement). The impact (including the cumulative impact) and distribution of air pollution has not been determined to date.

SCSC have contracted SGS Environmental Services (SGS) to undertake monthly dust fallout monitoring at the site. The monitoring is undertaken by means of placing 5 litre dust buckets, filled with a copper sulphate solution, on raised platforms which are approximately 2 m above the ground. Buckets are left on the platform for an average of 30 days, after which they are removed and analysed.

In terms of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) (NEM: AQA, 2004), the acceptable dust fallout rates are presented in Table 4-2.

Table 4-2: NEM: AQA, 2004 Acceptable Dust Fallout Rates given in mg/m^2/day

Restriction Area	Dust fall rate (D) (mg/m^2/day,30-day average)	Permitted frequency of exceeding dust fall rate
Residential Area	D < 600	Two within a year, not sequential months
Non-residential Area	600 < D < 1,200	Two within a year, not sequential months

Two exceedances of the Residential Area and Non-Residential Area are permitted within a year, but not for two sequential months. If there are more than two exceedances within a year, or two exceedances in consecutive months, then within three months after the submission of the dust fallout monitoring report, a dust management plan must be submitted to the Ugu Air Quality Officer for approval.

The results for the monitoring period (January to December 2015) are tabulated in Table 4-3, and graphically presented in **Figure 4-2.** The results for the monitoring period (January to April 2016) tabulated in Table 4-4 and graphically presented in **Figure 4-3.**

The Non-Residential Area standard of 1,200 mg/m^2/day was exceeded 14 times during the period from January to December 2015, with 7 of the exceedances being noted at the sampling point outside the workshop. The Non-Residential area standard of 1,200 mg/m$^{2/}$/day was exceeded 3 times from January to April 2016, all of which were outside the workshop.

Dust fallout concentrations over the period range from a low 154 mg/m^2/day (at the Concrete loading hoppers, December 2015) to a high 11,499 mg/m^2/day (outside the workshop, February 2015). The exceedances at the monitoring point outside the workshop can be attributed to issues relating to crusher not functioning adequately. In addition to this the location of the point (outside the workshop) is within the site property in close proximity to the crusher activities. Due to safety concerns the point cannot be moved beyond the site boundary.

As per the National Dust Control Regulations, there should be no more than two consecutive exceedances of the Non-Residential Area standard, per year, hence the Entrance / Guard Post and outside the workshop points are considered non-compliant with the standard during the monitoring period.

Refer to Appendix H for the SGS dust fall reports.

Table 4-3: Dust fallout results for the period January to December 2015

Field ID	15-Jan	15-Feb	15-Mar	15-Apr	15-May	15-Jun	15-Jul	15-Aug	15-Sep	15-Oct	15-Nov	15-Dec
Units	mg/m^2/day	mg/m^2/day	mg/m^2/day	mg/m^2/day	mg/m^2/day	mg/m^2/day	mg/m^2/day	mg/m^2/day	mg/m^2/day	mg/m^2/day	mg/m^2/day	mg/m^2/day
Entrance / Guard Post	899	1,243	1,672	1,217	1,577	290	1,049	1,211	546	709	911	249
Concrete loading hoppers	186	433	1,065	459	5,153	300	■	583	1,026	714	922	154
Outside the admin office	496	734	206	494	1,101	432	1,131	330	804	843	727	236
Outside the workshop	4,123	11,499	407	3,941	1,116	2,662	10,395	■	1,853	2506	1025	548
Near the crushing plant	8,667	372	534	587	■	■	■	■	■	■	■	■
EME Parking	■	■	■	■	1,118	■	1,006	555	313	■	■	■

Exceedance with the Non-Residential Area Standard of 1,200 mg/m^2/day
Monitoring Data below the Non-Residential Area Standard of 1,200 mg/m^2/day
■ No Data recorded

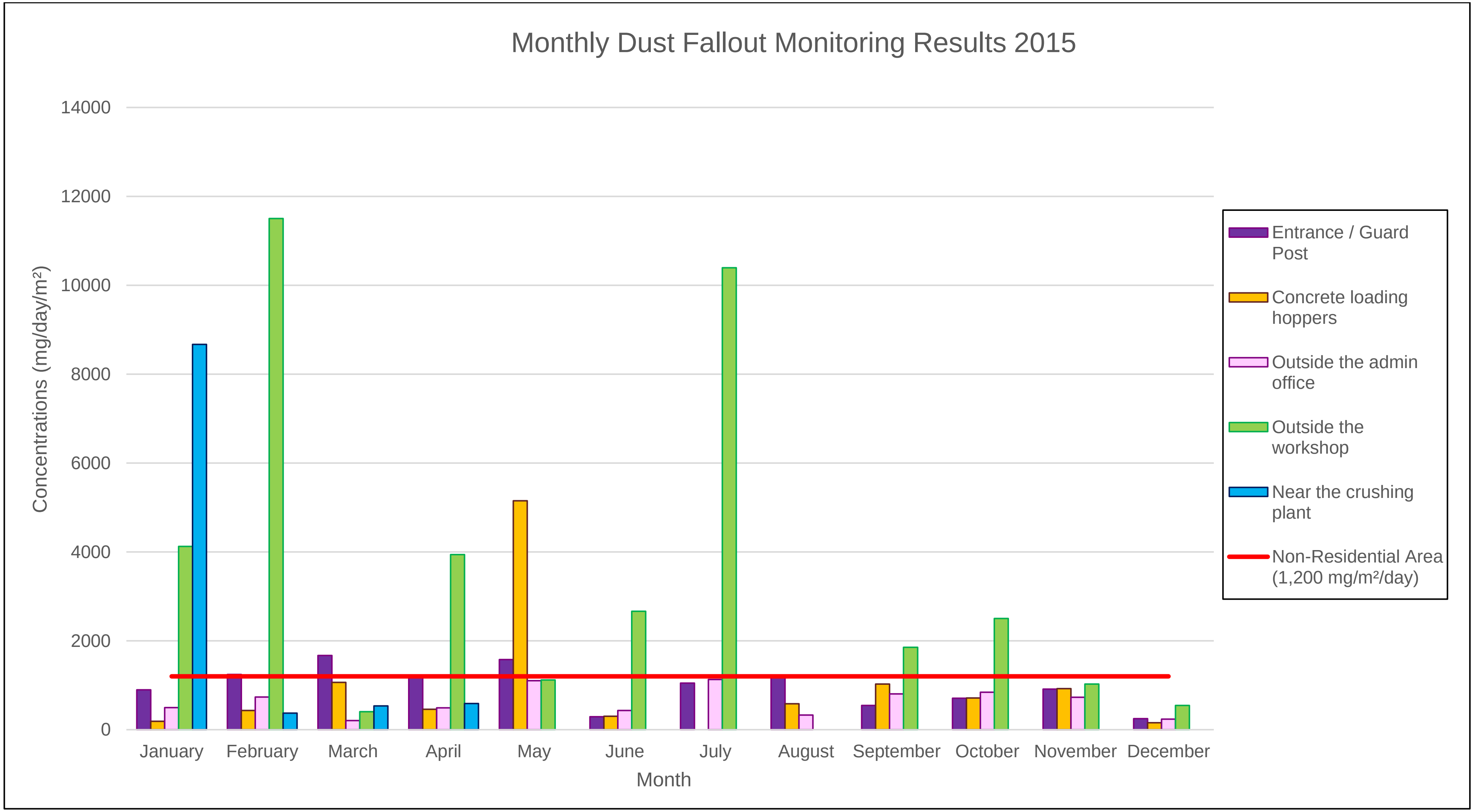


Figure 4-2 **Dust fallout concentrations for the period January 2015 to December 2015**

Table 4-4: Dust fallout results for the period January 2016 to April 2016

Field ID	16-Jan	16-Feb	16-Mar	17-Apr
Units	mg/m^2/day	mg/m^2/day	mg/m^2/day	mg/m^2/day
Entrance / Guard Post	683	557	330	372
Concrete loading hoppers	705	324	298	425
Outside the admin office	588	560	593	527
Outside the workshop	2502	3232	936	1603
Near the crushing plant	■	■	■	■
EME Parking	■	■	■	■

Exceedance with the Non-Residential Area Standard of 1,200 mg/m^2/day

Monitoring Data below the Non-Residential Area Standard of 1,200 mg/m^2/day

No Data recorded

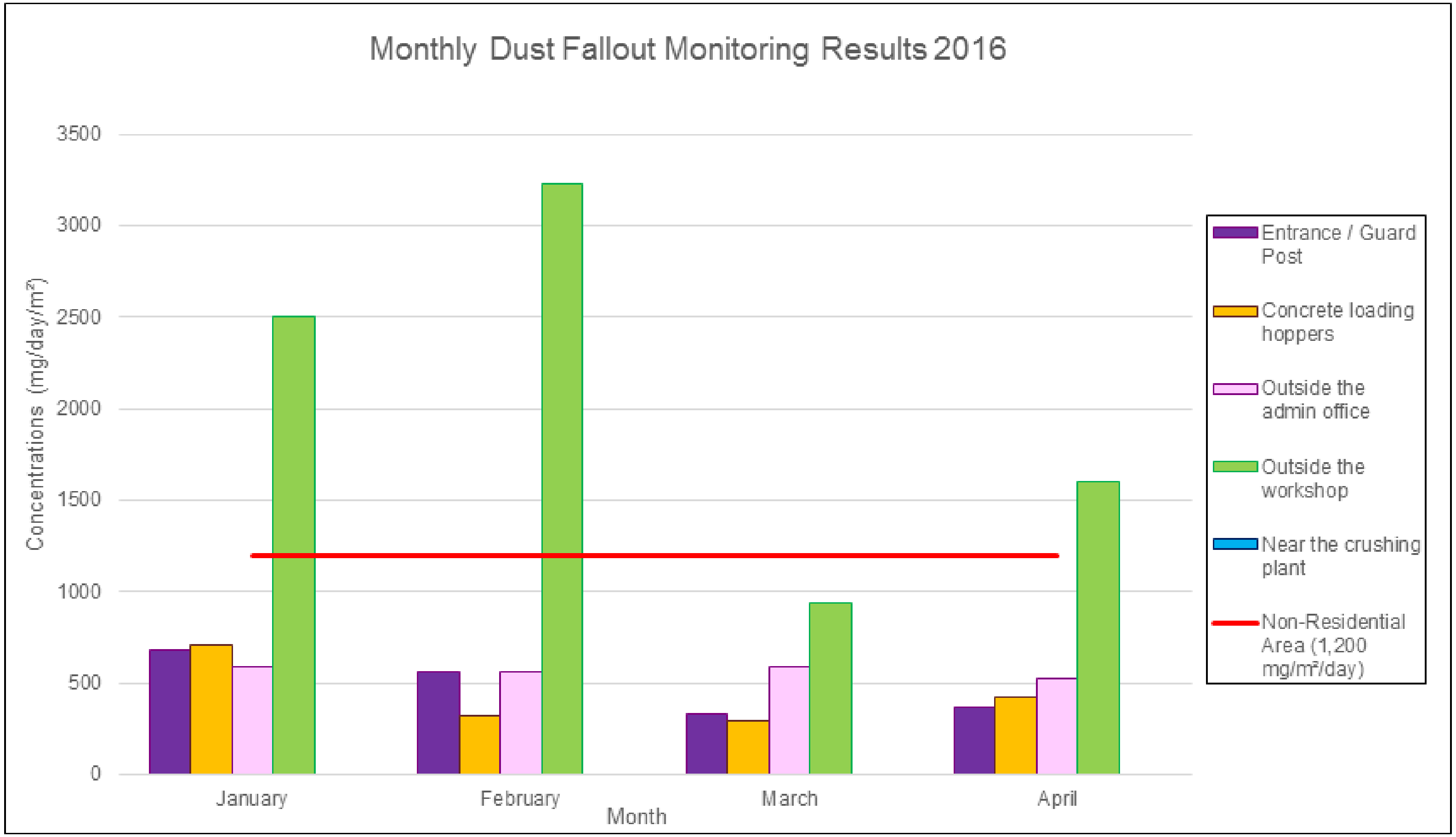


Figure 4-3 Dust fallout concentrations for the period January 2016 to April 2016

4.5 Noise

Sources of noise within the mining plant are mainly from blasting, drilling, crushing, screening, processing and washing of aggregate and the movement of heavy vehicles. Other sources contributing to the ambient noise levels include the National Asphalt plant and NPC Concrete Margate operations who lease a portions of the mine as well as small industries surrounding the site.

A noise study was undertaken by Apex Environmental in October 2014 for the mine. The study was undertaken to identify whether the noise emissions generated from the various operations on site could constitute community complaints. The results from this study are shown in table 4-4 below.

Table 4-5: Noise monitoring results

Position	Day Time Monitoring	Day Time NRL (06H00 – 22H00 L(A)EQ	Evaluation/Noise Sources
1	Ron's Workshop – Entrance Gate	49.4	The main noise source was noted as distant and passing vehicular traffic.
2	Behind Ron's Workshop	48.5	Distant on-site noise sources included the loading of dump trucks and excavator operation.
3	Top of Mine – Clay Area	55.5	The main noise source was noted as excavator operation, loading the dump trucks.
4	Near the Uvongo Road	50.6	Distant noise emissions related to dump trucks transporting material.
5	Sugar Cane- Behind the Workshop	57.6	Operations at the plant (screens) were noted as the main noise source.
6	Parking Area	69.0	Operations at the plant (screens) along with vehicular traffic were noted as the main noise source.
7	At the Mobile Workshop	66.4	The main noise source was attributed towards the operation of the National Asphalt operations.
8	Main Gate	65.9	Cars and trucks entering and exiting the site were noted as the main noise sources.

Table 4-6: Acceptable rating levels for ambient noise in districts

Type of District	Equivalent continuous rating level ($L_{Req.T}$) for noise dB(A)					
	Outdoors			Indoors, with Open Windows		
	Day-Night	Day Time	Night Time	Day-Night	Day Time	Night Time
a) Rural Districts	45	45	35	35	35	25
b) Suburban districts with little road traffic	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
d) Urban districts with some workshops, with business premises, and with main roads	60	60	50	50	50	40
e) Central business districts	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50
The values given in columns 2 & 5 are equivalent continuous rating levels and include corrections for tonal character, impulsiveness of the noise and the time of day.						

b The values given in columns 3, 4, 6 & 7 are equivalent continuous rating levels and include corrections for tonal character and impulsiveness of the noise.

As the mine is classified as an industrial zone, the equivalent continuous rating level limit is 70dB(A) for the day-time and 60 dB(A) for the night-time. The mine is not operational during the night, therefore the night-time ranking does not apply. The monitoring results for all positions are less than 70 dB(A). Therefore the study indicates that the monitoring results were found to be in compliance with the SANS guidelines standards (Apex Environmental, 2014).

An additional study was undertaken focussing on environmental noise and Particulate Matter during September 2015 by the Health & Occupational Hygiene Laboratory. The study concluded that sounds from the plant were audible during the night time at the residential areas, the main source of the noise was from the hooters of the plant vehicles (as the plant was not in full operation at night). The primary plant, which was in full operation during the day, was not audible during the day. Refer to Appendix I for the noise studies.

4.6 Alien Vegetation

According to the Floral and Faunal Ecological Assessment undertaken by SAS, the current mine area is dominated by alien vegetation. A vegetation management plan has been compiled as part of the SAS report and has been included in the Floral and Faunal Ecological Assessment Report in Appendix C.

4.7 Visual Aspects

The mine does not blend with the surrounding landscape. The mine is visible to a number of surrounding properties to the south and south-east of the site as well as from motorists passing by on the R61. Most of the properties that lie to the north and east of the plant are screened from the view of the mine as they are elevated and are screened by thick vegetation.

4.8 Flood

There is a risk of flooding at the mine as the mine lies within the floodplain; a flood risk assessment was undertaken by WSP, which indicated that the screening and crushing plant within the mine falls within the 1:50 year flood line. Refer to Appendix J for the flood risk assessment.

A Stormwater Management Plan has been developed by WSP and all the proposed stormwater management infrastructure will be implemented by SCSC. Refer to Appendix K for the Stormwater Management Plan.

4.9 Heritage Resources

An archaeological field based survey was undertaken by eThembeni Cultural Heritage in May 2016 in direct response to a request from Amafa Heritage KwaZulu Natali. The results from the field study indicated that the areas immediately surrounding the mine had been subjected to commercial sugarcane farming since the mid-20th century and later moved to other forms of cultivation. These agrarian activities, which included contour ploughing of steeply sloped topography coupled with stockpiling of aggregates at the mine has removed any archaeological material that may have been present and therefore there were no archaeological findings noted in the study.

In addition to the above, Dwyka Tillite which is being mined is considered moderately sensitive in terms of its palaeontology. The formation being quarried is large and comprises undifferentiated material of low to no palaeontological significance.

4.10 Local/Regional Socio-economic

The total population in Margate according to the Census 2011 Community Profile Databases demonstrates that there were 26,785 persons residing in the Margate area. The economic activities surrounding the mine include small scale cultivation, banana plantations and small scale industries with the prominent employment source being along Quarry road. The core economic activity in Margate is tourism.

5 Potential Environmental Impacts

Potential issues requiring further investigation were identified at the onset of the project. A summary of the key issues and concerns that were addressed further in the Assessment Phase are provided in the subsections that follow.

5.1 Impacts on Water Resources

A wetland is found to the west of the mine, this wetland has already been impacted on by the SCSC operations, the Vungu River passes through the mine and a small tributary leads from the west of the mine and connects to the Vungu River before it passes through the mine. Any further impact on these systems and potential for groundwater impacts must be considered.

Potential further impacts may occur to the wetland when the SCSC extends its benches on the western portion of the mine.

5.2 Biodiversity Impacts

The Floral and Faunal Ecological Assessment undertaken by SAS indicated that the current mining activities within the study area have already impacted on the faunal and floral species in the study area. There are several floral SCC in the surrounding habitat units that SCSC intent on extending into; there is a potential for loss of floral SCC including protected floral species. The removal of floral species will lead to habitat loss for faunal species.

5.3 Cumulative Impacts

As cited in DEAT (2004) a guide prepared for the Canadian Environmental Assessment Agency defined cumulative effects as: "… changes to the environment that are caused by an action in combination with other past, present and future human actions."

Cumulative impacts can occur over different temporal and spatial scales by interacting, combining and compounding so that the overall effects often exceeds the simple sum of previous effects. The spatial scale can be local, regional or global, whilst the frequency or temporal scale includes past, present and future impacts on a specific environment or region. Cumulative effects can simply be defined as the total impact that a series of developments, either present, past or future, will have on the environment within a specific region over a particular period of time (DEAT, 2004).

Cumulative impacts take cognisance of surrounding factors and impacts in order to determine the potential impact of a multitude of factors acting together, and the potential result thereof.

The impacts of the extended mine have been considered in conjunction with the pre-existing impacts associated with the current operations and the potential future impacts associated with the proposed future extension.

6 Impact Assessment Methodology

6.1 Estimate of Mine Impacts

The impacts below are based on information gathered from the former EMPR produced in 2000 and site observations in October 2014, technical information that has been supplied to SRK by SCSC and specialist studies. The objective is to provide an estimate of the significance of mine impacts on the environmental components of the mine, and provide information for further impact analysis.

6.2 Method

The following impact assessment methodology has been used to comply with Appendix 3 of the EIA Regulations, NEMA (2014), which states the following:

"(3) An environmental impact assessment report must contain all information that is necessary for the competent authority to consider and come to a decision on the application, and must include –

(J) an assessment of each identified potentially significant impact and risk, including –

(i) cumulative impacts;

(ii) the nature, significance and consequences of the impact and risk;

(iii) the extent and duration of the impact and risk;

(iv) the probability of the impact and risk occurring;

(v) the degree to which the impact and risk can be reversed;

(vi) the degree to which the impact and risk may cause irreplaceable loss of resources; and

(vii) the degree to which the impact and risk can be mitigated."

Based on the above, the EIA Methodology will require that each potential impact identified is clearly described (providing the nature of the impact) and be assessed in terms of the following factors:

- The extent (spatial scale) - national, regional or local environment, or only that of the site;
- Duration (temporal scale) - how long will the impact last;
- Magnitude (severity) - will the impact be of high, moderate or low severity; and
- Probability (likelihood of occurring) - how likely is it that the impact may occur.

To enable a scientific approach for the determination of the environmental significance (importance) of each identified potential impact, a numerical value has been linked to each factor. Table 6-1 identifies the ranking scales that are applicable.

Table 6-1: Ranking scales

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

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

Significance = (duration + extent + magnitude) x probability

The maximum value that can be calculated for the environmental significance of any impact is 100.

The environmental significance of any identified potential impact is then rated as either: high, moderate or low on the following basis:

More than 60 significance value indicates a **high (H)** environmental significance impact;

- Between 30 and 59 significance value indicates a **moderate (M)** environmental significance impact; and
  Less than 30 significance value indicates a **low (L)** environmental significance impact.

In order to assess the degree to which the potential impact can be reversed, cause irreplaceable loss of resources and be mitigated, each identified potential impact will need to be assessed twice.

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

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

Refer to Table 6-2 below or the impacts ranking table.

Table 6-2: Impacts ranking table

Nature of the impact	Significance of potential impact **BEFORE** mitigation						Mitigation Measures	Significance of potential impact **AFTER** mitigation					
	Probability	Duration	Extent	Magnitude	Significance			Probability	Duration	Extent	Magnitude	Significance	
Pre-mining Phase													
Indiscriminate movement of vehicles and access road expansion through surrounding floral habitat and compaction of soils	3	3	3	8	42	**Moderate**	*Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the proposed development activities.*	2	2	2	6	20	**Low**
Site clearing and removal of topsoil and vegetation within areas of increased ecological sensitivity leading to loss of floral species diversity and floral habitat	5	5	2	8	75	**High**	*A sensitivity map has been developed for the study area, indicating riparian and coastal forest areas which are considered to be of increased ecological importance. It is recommended that this sensitivity map be considered during all development phases to aid in the conservation of floral diversity within the study area. All mining footprint areas and areas affected by the proposed mine expansion should remain as small as possible and should not encroach onto surrounding more sensitive riparian areas and the associated buffer zone the 20m buffer zone from the edge of the coastal forest as stipulated by DAFF. It must also be ensured that these areas are off-limits to vehicles and personnel. Should the presence of wetlands be confirmed within the Grassland Habitat Unit, this should also be taken into consideration as part of the overall mine planning process. The boundaries of the mining footprint areas are to be clearly defined and it should be ensured that all activities remain within defined footprint areas. If any floral SCC, including nationally (SANBI) or provincially (KZN) protected floral species will be disturbed, effective relocation of individuals to suitable similar habitat should be ensured where possible upon obtaining a permit to do so.* *All rescue and relocation plans and activities should be overseen by a suitably qualified specialist or a suitably qualified appointed member of the mine personnel. Should any protected tree species be destroyed during the mine expansion activities it is recommended that a new tree be planted for each tree destroyed upon obtaining a permit to do so from the Department of Forestry and Fisheries (DAFF). Any protected trees that will remain, must be demarcated with red-tape to avoid tree disturbance.*	3	4	1	6	33	Moderate
Expansion activities taking place within or in close proximity to areas of increased ecological sensitivity	5	4	2	8	70	**High**	*All mining footprint areas and areas affected by the proposed mine expansion should remain as small as possible and should not encroach onto surrounding more sensitive riparian areas and the associated buffer zone and the 20m buffer zone from the edge of the coastal forest as stipulated by DAFF. It must also be ensured that these areas are off-limits to vehicles and personnel.* *Should the presence of wetlands be confirmed within the Grassland Habitat Unit, this should also be taken into consideration as part of the overall mine planning process. The boundaries of the proposed mine expansion footprint areas are to be clearly defined and it should be ensured that all activities remain within defined footprint areas.*	3	4	1	6	33	**Moderate**
Clearing of vegetation and expansion activities within sensitive areas leading to a decrease in faunal habitat	4	4	2	8	56	**Moderate**	*No areas falling outside of the proposed mine layout areas may be cleared for expansion purposes. The boundaries of the development footprint areas are to be clearly defined and it should be ensured that all activities remain within defined footprint areas. All mining footprint areas and areas affected by the proposed mining development should remain as small as possible and any disturbance of sensitive habitat must be actively avoided. All development footprint areas and areas*	3	3	2	4	27	**Low**

							affected by the current and future mine development should remain as small as possible and should not encroach onto surrounding more sensitive riparian and coastal forest areas. It must be ensured that these areas are off-limits to vehicles and personnel						
Encroachment of alien vegetation into disturbed areas reducing habitat for faunal species	4	5	2	8	60	**High**	*Implement the vegetation management and eradication program as defined in the Floral and Faunal Assessment in Appendix C of this report.*	3	3	2	6	33	**Moderate**
Erosion as a result of vegetation clearing activities resulting in the siltation of faunal habitat and river systems	4	3	2	8	52	**Moderate**	*To minimise the risk of erosion, the extent of vegetation clearing should be kept to a minimum. To prevent the erosion of top soils, management measures may include berms, soil traps, hessian curtains and storm water diversion away from areas susceptible to erosion. It must be ensured that topsoil stockpiles are located outside of any wetland and riparian areas and areas susceptible to erosion.*	3	3	1	6	30	**Moderate**
Trapping and hunting of faunal species leading to decrease in faunal abundance and diversity	3	4	2	6	36	**Moderate**	*Prohibit any trapping or hunting within the study area, furthermore access control to the property must be used to ensure that no illegal trapping or poaching takes place*	2	4	2	6	24	**Low**
Collision of vehicles with faunal species	*3*	*4*	2	*6*	*36*	***Moderate***	*Mining vehicles to use designated roadways. Speed limits must be implemented.*	2	4	2	6	24	**Low**
Risk of sedimentation/pollution of wetland resources	4	4	1	8	52	**Moderate**	*The following impact mitigation, management and rehabilitation recommendations are covered in more detail in the relevant sections of the specialist aquatic assessment report in Appendix G of this report: Aquatic buffer zone recommendations (section 5.2.1); and Stormwater management, erosion and sediment control (section 5.2.2). These conditions are clearly defined in the EMPr.*	*2*	*2*	*1*	*6*	18	**Low**
Disturbance leading to increased levels of alien plants within the riparian areas and wetlands	4	4	1	6	44	**Moderate**	*Alien plant clearing and planting of indigenous replacements to be undertaken as per the recommendations in Section 5.2.4 of the specialist aquatic assessment in Appendix G of this report.*	*2*	*1*	*1*	*4*	12	**Low**
Operational Phase													
Impact of mining activities on the land capability	5	5	1	8	70	**High**	*Implement a rehabilitation plan post closure*	5	5	1	8	70	**High**
Mismanagement of waste	4	4	2	8	56	**Moderate**	*All general waste to be placed in a skip and collected by Municipality, bins to be provided in a secure location, Hazardous waste to be disposed of at a licensed facility, no burning of waste or use of waste pits, no littering, MSDS must be kept on site, provision for waste segregation must be made and all leaks must be cleared and disposed of according to the waste type. It must be ensured that mining related waste or spillage and effluent do not affect the sensitive habitat boundaries and associated buffer zones. No dumping of materials and soil within riparian, grassland or coastal forest areas or associated buffers may take place and all dumps must be placed within already transformed habitat areas.*	2	1	1	4	12	**Low**
Operational (mining) activities taking place within or in close proximity to areas of increased ecological sensitivity	5	4	2	8	70	**High**	*All mining footprint areas and areas affected by the proposed mine expansion should remain as small as possible and should not encroach onto surrounding more sensitive riparian areas and the associated buffer zone and the 20m buffer zone from the edge of the coastal forest as stipulated by DAFF. It must also be ensured that these areas are off-limits to mining vehicles and personnel. Should the presence of wetlands be confirmed within the Grassland Habitat Unit, this should also be taken into consideration as part of the overall mine planning process. The boundaries of the proposed mine expansion footprint areas are to be clearly defined and it*	3	4	1	6	33	**Moderate**

							should be ensured that all activities remain within defined footprint areas.					
Loss of floral SCC during general mining operations	5	4	2	8	70	**High**	*The footprint area cleared for the proposed mine expansion areas should be kept as small as possible. Permits must be obtained for the removal/ destruction of trees protected under the National Forests Act (Act 84 of 1998) prior to the expansion phase from DAFF. The number of protected trees removed for ongoing mine expansion should be kept to a minimum and no trees should be needlessly destroyed. Any protected trees that will remain, must be demarcated with red-tape to avoid tree disturbance.* *Should any other floral SCC, including SANBI RDL species and provincially protected species, be encountered within the development footprint, these species are to be relocated as appropriate. Floral SCC are to be handled with care and the relocation of these plant species to nearby suitable similar habitat is to be overseen by a botanist. The collection of plant material for medicinal purposes or collection of firewood should be prohibited. Edge effect control needs to be implemented to ensure no further degradation and potential loss of floral SCC outside of the proposed project footprint area.*	3	4	1	6	33	**Moderate**
Edge effects such as erosion leading to loss of floral habitat in the surrounding areas	4	4	2	8	56	**Moderate**	*To minimise the risk of erosion, the extent of vegetation clearing and the duration for which bare soils are exposed in areas surrounding the mining footprint clearing should be kept to a minimum. To prevent the erosion and loss of topsoil, management measures may include berms, soil traps, hessian curtains and stormwater diversion away from areas susceptible to erosion. It must be ensured that topsoil stockpiles are located outside of any wetland and riparian areas and areas susceptible to erosion.*	3	3	1	4	24	**Low**
Indiscriminate movement of operational vehicles through surrounding floral habitat	3	3	2	6	33	**Moderate**	*Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the proposed development activities. As far as possible, existing access roads should be utilised to access the operational areas. All disturbed habitat areas must be rehabilitated and planted with indigenous floral species as soon as possible to ensure that floral ecology is re-instated.* *All soils compacted as a result of operational activities falling outside of the project footprint areas should be ripped and profiled. Special attention should be paid to alien and invasive control within these areas.*	2	2	1	4	14	**Low**
On-going disturbance of faunal habitat within surrounding areas due to activities associated with mining, as well as further clearing of vegetation as mining processes	4	4	2	6	48	**Moderate**	*No areas falling outside of the proposed mine layout areas may be cleared for mining purposes The boundaries of the development footprint areas are to be clearly defined and it should be ensured that all activities remain within defined footprint areas. All mining footprint areas and areas affected by the proposed mining development should remain as small as possible and any disturbance of sensitive habitat must be actively avoided.*	3	4	1	6	33	**Moderate**
Proliferation of alien floral species in disturbed areas resulting in decrease of floral and faunal habitat	4	5	2	8	60	**High**	*Implement the vegetation management and eradication program as defined in the Floral and Faunal Assessment. Eradication of alien invasive species should take place throughout the operational phase on an ongoing basis.* *Alien vegetation eradication recommendations include:* *• 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;*	3	4	2	6	36	**Moderate**

					🟥		• *No vehicles should be allowed to drive through designated sensitive ecologically areas during the eradication of alien and weed species.*					🟧	
Trapping and hunting of faunal species leading to decrease in faunal abundance and diversity	3	4	2	6	36	**Moderate**	*Prohibit any trapping or hunting within the study area, furthermore access control to the property must be used to ensure that no illegal trapping or poaching takes place.*	2	4	2	6	24	**Low**
Impact of mining activities on Groundwater quality	4	3	3	8	56	**Moderate**	*Ensure that monitoring is undertaken as per the requirements of the groundwater monitoring programme ensure that bi-annual groundwater monitoring reports are compiled, based on the outcomes of the reports mitigation measures are implemented where necessary. Check the integrity of the settling ponds and evaporation ponds.*	3	2	3	4	27	**Low**
Contaminated stormwater runoff and discharge into the Vungu River	5	1	2	10	65	**High**	*Move current material stockpiles away from the settling ponds to reduce the risk of further sedimentation and high turbidity levels. Monthly monitoring of surface water quality in the Vungu River will be undertaken to ensure compliance with the relevant water quality guidelines. All infrastructure as proposed in the stormwater management plan is to be constructed and implemented.*	3	1	2	6	27	**Low**
Contaminated water from cement plant	5	1	2	10	65	**High**	*Water contaminated with cement needs to be properly treated and should never be released into the environment. All infrastructure as proposed in the stormwater management plan is to be constructed and implemented.*	3	1	2	6	27	**Low**
Contaminated stormwater runoff an discharge into stream/river	5	1	2	10	65	**High**	*Replace the failing cement-block inlet structure with a robust concrete structure. Stabilise and grade the degraded river banks associated with the drop-inlet structure to their natural form.*	2	1	2	6	18	**Low**
Risk of flooding from rivers	4	1	1	8	40	**Moderate**	*Stabilise bare/eroded river banks and where necessary use gabions and reno-mattresses. Undertake alien plant control along the riparian zone of the Vungu River and re-vegetate riparian areas with suitable locally occurring indigenous riparian vegetation (it is recommended that the mine seeks the expertise of a suitably trained expert with experience in ecological rehabilitation). Gabions that have been improperly installed should be re-done. Gabions are to be properly constructed using the proper stone sizing and gabion baskets to be properly sized without gaps and tied properly. Protective works such as earthen/rock levees/berms should be considered in order to avert flood risk. These will also have a dual-purpose in trapping contaminants/sediment generated at the site. Regular monitoring and clearing of debris under low level bridge. All infrastructure as proposed in the stormwater management plan is to be constructed and implemented. All channels must be checked monthly and cleared after any major rainfall events, to ensure that there are no blockages. Stone pitching channels are recommended to reduce high runoff velocity on channels.* *Sediment that accumulates within the channels, ponds and retention facility) must be routinely removed to ensure the design capacity is maintained. Should sediment be expected to contain contamination this sediment should be appropriately handled and disposed of. Material spills must be prevented where possible on site, including within the bunds. Should spills occur, these should be addressed immediately. Should contamination be expected within the bunds, this water may not be released to the environment, and must be chemically tested to determine appropriate management requirements (i.e. disposal at an appropriate facility if unfit for release to the environment).*	2	1	1	8	20	**Low**

Risk of pollution by chemicals and hazardous substances	3	1	2	6	27	**Low**	*The storage of potentially hazardous materials (e.g. fuel, oil, cement, paint, etc.) must be outside of the 100-year flood line, or within a horizontal distance of 100m from a watercourse. Where these facilities are fixed and relocation is impractical, methods of protecting these areas from flood hazards and mechanisms to contain potential contaminants need to be investigated as per impact.*	2	1	2	6	18	**Low**
Risk of sedimentation/pollution of wetland resources	4	4	1	6	44	**Moderate**	*The following impact mitigation, management and rehabilitation recommendations are covered in more detail in the relevant sections of the specialist aquatic assessment report in Appendix G of this Report.: Aquatic buffer zone recommendations (section 5.2.1); and Stormwater management, erosion and sediment control (section 5.2.2). These conditions are also clearly defined in the EMPr.*	2	2	1	6	18	**Low**
Disturbance leading to increased levels of alien plants within the riparian areas and wetlands	4	4	1	6	44	**Moderate**	*Alien plant clearing and planting of indigenous replacements to be undertaken as per the recommendations in Section 5.2.4 of the specialist aquatic assessment in Appendix G of this report.*	2	1	1	4	12	**Low**
Impact on air quality (blasting, processing and vehicles)	5	4	2	8	70	**High**	*A fugitive dust management plan for the site should be drafted and implemented as appropriate. The fugitive dust management plan should aim to reduce dust fallout concentrations. Other measures to put in place are: water sprayed onto the roads by water trucks to reduce dust by vehicle entrainment.* *Handling of material that has the potential to generate dust should be kept to a minimum. Dust suppression should be increased in dry periods and when wind speeds increase.* *Dust should be managed in and around the site as dust fallout standards have been exceeded. Spill records should be available to determine whether there is any correlation between an increase in dust fallout and spills for a specific month. Any complaint, must to be logged in the complaints register and investigated on a monthly basis and kept on site for auditing purposes. Tenants to abide by their AEL conditions in particular compliance with monitoring requirements and Minimum Emission Standards (MES).*	4	4	1	6	44	**Moderate**
Noise impact on surrounding landowners	2	4	2	4	20	**Low**	*Consult with surrounding landowners; consider wind direction, cloud cover and temperature before blasting. Monitor noise levels and notify surrounding landowners of blasting schedule prior to blasting. Reverse hooters of vehicles must be replaced to a type with a different frequency that will reduce the distance that sound will travel. Acoustic screening methods can be implemented to try reduce the noise levels of the jaw crushers.*	2	4	2	4	20	**Low**
Impacts of mining process on archaeological sites and cultural sites	1	5	2	6	13	**Low**	*No mitigation measures are offered in this regard as the specialist study did not identify any archaeological findings and indicated that all archaeological findings have been removed by the past activities.*	1	5	2	6	13	**Low**
Impacts of the mining activities on the visual aesthetics of the landscape	5	5	2	8	75	**High**	*Update the rehabilitation plan regularly and ensure that sufficient topsoil is available for rehabilitation. Continue to update financial provision for closure, rehabilitation and maintenance. Rehabilitate abandoned excavations according to the closure and rehabilitation plan which is to be developed by SCSC.*	5	5	2	6	65	**High**

Impacts of the mining process on traffic in the region	5	4	3	6	65	**High**	*Control vehicular access to the mine.* *Make provision for safely accommodating all vehicle and pedestrian movements in the area of the works. Prevent spillage of soil, dust and stone on roads. Should this occur, the roads will be cleared. Ensure safety signage is in place and maintained.*	4	4	3	4	44	**Moderate**
Closure/Rehabilitation Phase													
Alien plant proliferation in disturbed areas leading to loss of faunal habitat	4	5	3	8	64	**High**	*Alien floral species management and eradication must continue to be implemented. Alien seed dispersal within the top layers of the soil within footprint areas also has to be controlled, through the controlling on alien invasive species on the site.* *All soils compacted as a result of closure activities should be ripped and profiled. Special attention should be paid to alien and invasive control within these areas. All disturbed habitat areas must be rehabilitated and planted with indigenous floral species as soon as possible to ensure that floral ecology is re-instated. Implement an alien plant management and eradication program.*	3	4	2	6	36	**Moderate**
Ongoing long term faunal and floral habitat modifications as a result of ineffective rehabilitation activities	4	5	3	8	64	**High**	*A biodiversity management and rehabilitation plan must be implemented to ensure that all disturbed areas are reinstated to a natural state.*	3	4	1	6	33	**Moderate**
Improper erosion control leading to further faunal and floral habitat disturbance	3	3	2	8	39	**Moderate**	*The extent of vegetation clearing should be kept to a minimum in order to minimise the risk of erosion.* *To minimise the risk of erosion, the extent of vegetation clearing should be kept to a minimum. To prevent the erosion of top soils, management measures may include berms, soil traps, hessian curtains and stormwater diversion away from areas susceptible to erosion. It must be ensured that topsoil stockpiles are located outside of any wetland and riparian areas and other areas susceptible to erosion.*	3	3	1	6	30	**Moderate**
Post-Closure Phase													
Ineffective rehabilitation may lead to permanent transformation of faunal habitat and species composition	4	5	2	8	60	**High**	*Implementation of a biodiversity rehabilitation plan to ensure that all disturbed areas are reinstated to a natural state.*	3	4	1	6	33	**Moderate**
Proliferation of alien and invasive floral species in disturbed areas may lead to altered faunal habitat within the study area	4	5	3	6	56	**Moderate**	*Implement the vegetation management and eradication program as defined in the Floral and Faunal Assessment in Appendix C of this report.*	3	4	2	6	36	**Moderate**
Ineffective Rehabilitation leading to permanent loss of floral habitat	4	5	3	8	64	**High**	*Post-closure, ongoing monitoring of rehabilitation works must take place to ensure that biodiversity and suitable vegetation cover has been reinstated until a closure certificate has been obtained*	3	3	2	4	27	**Low**
Ongoing proliferation of alien and invasive floral species leading to a permanent alteration of floral habitat	4	5	3	8	64	**High**	*Post-closure, ongoing monitoring and eradication of alien vegetation in the vicinity of the study area must take place until a closure certificate has been obtained.*	4	3	2	6	44	**Moderate**

7 Description of Environmental Impacts Identified

The following section describes the impacts and mitigation measures as assessed in Table 6-2 above.

7.1 Impacts of Planning Phase

No impacts were identified for the planning phase, the site is an existing site, the areas where the mine will be extended into are already mostly disturbed, and therefore no impacts with the planning phase were identified.

7.2 Impacts of Pre-mining Phase

7.2.1 Degradation of floral habitat from vehicle movement

Description of impact

The degradation of floral habitat can occur due to vehicle movement and creation of access roads through the surrounding floral habitats and compaction of soils. The probability of the impact occurring is medium; the duration of the impact will be medium term, assuming no rehabilitation is done. The extent of the impact could be regional and the magnitude of the impact would be high.

Proposed mitigation measure

- Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the proposed development activities.

Description of impact after mitigation measures have been implemented

The probability of the impact occurring is reduced to a low probability, the duration of the impact reduces to short term, the extent of the impact is local and the magnitude of the impact is moderate.

7.2.2 Loss of floral species due to removal of topsoil and vegetation

Description of impact

Removal of topsoil and vegetation can lead to the loss of floral species. The probability of the impact occurring is definite; the duration of the impact is permanent without mitigation. The extent of the impact is local and the magnitude of the impact is high.

Proposed mitigation measures

- A sensitivity map has been developed for the study area (Refer to Floral and Faunal Assessment in Appendix C) indicating riparian and coastal forest areas which are considered to be of increased ecological importance. It is recommended that this sensitivity map be considered during all development phases to aid in the conservation of floral diversity within the study area.
- All mining footprint areas and areas affected by the proposed mine expansion should remain as small as possible and should not encroach onto surrounding more sensitive riparian areas and the associated buffer zone and the 20m buffer zone from the edge of the coastal forest as stipulated by DAFF. It must also be ensured that these areas are off-limits to vehicles and personnel.
- Should the presence of wetlands be confirmed within the Grassland Habitat Unit, this should also be taken into consideration as part of the overall mine planning process.
- The boundaries of the mining footprint areas are to be clearly defined and it should be ensured that all activities remain within defined footprint areas.
- If any floral SCC, including nationally (South African National Biodiversity Institute - SANBI) or provincially (KZN) protected floral species will be disturbed, effective relocation of individuals to suitable similar habitat should be ensured where possible upon obtaining a permit to do so.

- All rescue and relocation plans and activities should be overseen by a suitably qualified specialist or a suitably qualified appointed member of the mine personnel.
- Should any protected tree species be destroyed during the mine expansion activities, it is recommended that a new tree be planted for each tree destroyed upon obtaining a permit to do so from the Department of Forestry and Fisheries (DAFF).
- Any protected trees that will remain must be demarcated with red-tape to avoid tree disturbance.

Description of impact after mitigation measures have been implemented

Once the mitigation measures have been implemented the probability for the impact occurring reduces to a medium probability, the duration reduces to long-term, which ceases with operational life, as rehabilitation undertaken post-closure. The extent of the impact will reduce to site only and the magnitude of the impact will reduce to moderate.

7.2.3 Expansion activities within close proximity to areas of increased ecological sensitivity

Description of impact

The probability of the impact occurring is definite; the duration of the impact is long term without mitigation. The extent of the impact is local and the magnitude of the impact is high.

Proposed mitigation measures

- All mining footprint areas and areas affected by the proposed mine expansion should remain as small as possible and should not encroach onto surrounding more sensitive riparian areas and the associated buffer zone and the 20m buffer zone from the edge of the coastal forest as stipulated by DAFF. It must also be ensured that these areas are off-limits to vehicles and personnel.
- Should the presence of wetlands be confirmed within the Grassland Habitat Unit, this should also be taken into consideration as part of the overall mine planning process.
- The boundaries of the proposed mine expansion footprint areas are to be clearly defined and it should be ensured that all activities remain within defined footprint areas.

Description of impact after mitigation measures have been implemented

The probability for the impact occurring reduces to a medium probability; the duration will be long term, which is ceases with operational life. The extent of the impact will reduce to site only and the magnitude of the impact will reduce to moderate.

7.2.4 Degradation/loss of faunal habitat due to clearance of vegetation

Description of impact

The clearing of vegetation could lead to a decrease in faunal habitat. The probability of the impact occurring is high; the duration of the impact would be long term, without mitigation. The extent of the impact would be local and the magnitude of the impact would be high.

Proposed mitigation measures

- No areas falling outside of the proposed and approved mine layout areas may be cleared for expansion purposes.
- The boundaries of the development footprint areas are to be clearly defined and demarcated. It must be ensured that all activities remain within defined footprint areas.
- All mining footprint areas and those areas affected by the proposed mining development should remain as small as possible and any disturbance of sensitive habitat must be actively avoided.
- All development footprint areas and areas affected by the current and future mine development should remain as small as possible and should not encroach onto surrounding more sensitive

riparian and coastal forest areas. It must be ensured that these areas are off-limits to vehicles and personnel.

Description of impact after mitigation measures have been implemented

Once the above mitigation measures have been implemented the probability of the impact occurring is medium, the duration of the impact would be medium term, the extent of the impact would be local and the magnitude of the impact would be low.

7.2.5 Degradation/loss of faunal habitat due to encroachment of alien vegetation

Description of impact

The probability of the impact occurring is high; the duration of the impact is permanent, without mitigation. The extent of the impact is local and the magnitude of the impact is high.

Proposed mitigation measure

- Implement the vegetation management and eradication program as specified in the Floral and Faunal Assessment attached to Appendix C of this report.

Description of impact after mitigation measures have been implemented

The probability of the impact occurring is reduced to a medium; the duration of the impact is medium term, without mitigation. The extent if the impact is reduced to local and the magnitude of the impact will be moderate.

7.2.6 Siltation of faunal habitat and river systems

Description of impact

Erosion as a result of vegetation clearing activities and which could result in the siltation of faunal habitats and river systems. The probability of the impact occurring is high; the duration of the impact is medium. The extent of the impact is local and the magnitude of the impact is high.

Proposed mitigation measures

- To minimise the risk of erosion, the extent of vegetation clearing should be kept to a minimum.
- To prevent the erosion of top soil, management measures which may include berms, soil traps, hessian curtains and storm water diversion away from areas susceptible to erosion, must be implemented. It must be ensured that topsoil stockpiles are located outside of any wetland and riparian areas and areas susceptible to erosion, and measures taken to prevent uncontrolled erosion and sediment deposition form the stockpiles.

Description of impact after mitigation measures have been implemented

The probability of the impact occurring is medium and the duration would be medium term. The extent would site only and the magnitude of the impact would be moderate.

7.2.7 Decrease in faunal species due to trapping, hunting

Description of impact

The probability of the impact occurring is medium, the duration of the impact would be long term, the extent of the impact would be local and the magnitude of the impact would be moderate.

Proposed mitigation measures

- Prohibit any trapping or hunting within the study area.
- Control access to the property must be used to ensure that no illegal trapping or poaching takes place.

Description of impact after mitigation measures have been implemented

The probability of the impact occurring reduces to low; the duration of the impact would be long term. The extent of the impact would be local and the magnitude of the impact would be moderate.

7.2.8 Decrease in faunal species due to collision with mining vehicles

Description of impact

The probability of the impact occurring is medium, the duration of the impact would be long term, the extent of the impact would be local and the magnitude of the impact would be moderate.

Proposed mitigation measures

- Vehicles to use designated roadways.
- Speed limits must be implemented.
- Training of drivers to be aware of collision risks.

Description of impact after mitigation measures have been implemented

The probability of the impact occurring reduces to low; the duration of the impact would be long term. The extent of the impact would be local and the magnitude of the impact would be moderate.

7.2.9 Degradation of wetland resources

Description of impact

The potential to impacts on the wetland and wetland resources is highly probable, considering that it has already been impacted upon, the duration of the impact would be long term without mitigation. The extent of the impact would be site only and the magnitude of the impact would be high considering the wetland is regarded as being of low EIS.

Proposed mitigation measures

- 30 metre buffer around delineated wetland with no mitigation; or
- 15 metre buffer around delineated wetland with the following mitigations:
    - Special care should be taken to demarcate the buffer zone and to actively prevent any encroachment into this zone;
    - Under no circumstance are additional access roads to be constructed within wetland or buffer zones recommended ;
    - Dumping, stockpiling, excavation, borrowing of material and any temporary storage of equipment is to be strictly prohibited within the buffer zone;
    - Buffer zones must be established and maintained as open space areas with appropriate alien plant control and slashing to maintain grass cover (or existing dense sugarcane is to be retained);
    - Recommended sediment retention measures are to be implemented to control any sediment-laden runoff that could enter the adjacent wetland/riparian areas (where relevant);
    - Any embankments, stockpiles or other sources of exposed material/soils are to be appropriately stabilized and maintained to minimize risk of erosion and sedimentation downstream; and
    - Manage any surface/storm water runoff to ensure erosion and sedimentation and pollution is avoided.
- Access roads are to be shaped so that flows are spread evenly and preferential flow paths are not formed as these can create erosion features and deliver sediment to aquatic downstream resources. Where possible, roads are to be sloped away from wetlands/rivers such that water collects on the upstream side.

- Appropriate sediment/erosion control is to be employed for access roads adjacent to wetland (as well as for existing road fill within the wetland). This can be in the form of sediment fences, rock pack, low earth berms or excavated trenches that trap sediment along the perimeter edge of the road (on the downslope side of the road).
- Vehicles are not to be left standing in areas where oil/fuel spillages could contaminate adjacent/downstream wetlands/rivers.
- Vehicles are not to be maintained/washed in close proximity to any wetland/river where there is a risk that contamination may occur.
- No fuels, chemicals or hazardous substances are to be stored, temporarily or permanently, outside of designated chemical/fuel storage areas to reduce the risk of water resource contamination.

Description of impact after mitigation measures have been implemented

The probability of the impact occurring will reduce to a low probability, the duration of the impact would reduce to short term as if the impact were to occur it would be remediated. The extent of the impact would be site only and the magnitude would be moderate.

7.2.10 Alien plants within riparian area and wetland

Description of impact

The probability of disturbance during the extension phase, which could lead to increased levels of alien plants, is highly probable. The duration of the impact would be long term without appropriate mitigation. The extent of the impact would be site only and the magnitude of the impact would be moderate.

Proposed mitigation measures

- Alien plant clearing and planting of indigenous plants to be undertaken as per the recommendations in section 5.2.4 of the Specialist Aquatic Assessment Report in Appendix G of this report.

Description of impact after mitigation measures have been implemented

The probability of the impact occurring will reduce to a low probability as alien plants will be removed progressively, the duration of the impact would reduce to immediate as if the impact were to occur it would be remediated. The extent of the impact would be site only and the magnitude would be low.

7.3 Impacts of Operational Phase

7.3.1 Land Capability

Description of impact

The surrounding land is used for agriculture and it is assumed that the mining site was also used for agriculture. The capability of the land has changed markedly to mining and therefore the probability of the impact is definite. The duration of the impact is permanent without mitigation. The extent of the impact is limited to the site only as the surrounding areas are not affected and the magnitude of the impact is high as the original land capability has been completely transformed. [Note: The impact rankings are high as there is a high level of uncertainty].

Proposed mitigation measures

There are no proposed mitigation measures that can reclaim the land capability to its original form during the operational phase; however a rehabilitation plan must be implemented post closure.

Description of Impact after mitigation measures have been implemented

All impacts will remain the same as before mitigation.

7.3.2 Waste Management

Description of impact

The probability of the inadequate waste management is highly probable; the duration of the impact would be long term without mitigation. The extent of the impact is local and the magnitude of the impact is high.

Proposed mitigation measures

- All general waste is to be placed in a skip and collected by the Hibiscus municipal services.
- Bins must be provided in secure locations. i.e. areas that are protected from the natural elements, hard-surfaced and are level.
- Ensure that hazardous waste is disposed of at a licensed waste disposal facility. Proof of disposal (certificates / waybills) must be maintained for auditing purposes.
- Prohibit the burning of waste on-site.
- The excavation and use of rubbish pits is forbidden.
- Used oil is to be collected by Oilkol and waybills are to be retained on-site.
- Littering on-site is forbidden.
- It must be ensured that mining related waste or spillage and effluent do not affect the sensitive habitat boundaries and associated buffer zones.
- No dumping of materials and soil within riparian, grassland or coastal forest areas or associated buffers may take place and all dumps must be placed within already transformed habitat areas.
- Should leaks from on-site vehicles or machinery be detected, these should be immediately cleaned up as follows:
  - Remove the soil to the depth of the contamination and dispose of at a registered hazardous waste facility.
  - Report major (>200l) oil or fuel spills to the provincial Department of Water and Sanitation, as well as to the relevant Local Authority
- Relevant Material Safety Data Sheets (MSDS) must be available on the site.
- Provision for waste segregation should be made.

Description of impact after mitigation measures have been implemented

The probability of the impact occurring is reduced to a low probability; the duration of the impact will be immediate as should an impact occur it would be remediated with immediate effect. The extent of the impact would be site only as it would be controlled and the magnitude of the impact would be low.

7.3.3 Impacts to areas of ecological sensitivity

Description of impact

The operational activities of the mine taking place in close proximity to areas of increased ecological sensitivity can have a significant impact on the floral and faunal species in those areas. The probability of the impact occurring is definite; the duration of the impact is long term. The extent of the impact is local and the magnitude of the impact is high.

Proposed mitigation measures

- All mining footprint areas and areas affected by the proposed mine expansion should remain as small as possible and should not encroach onto surrounding more sensitive riparian areas and the associated buffer zone and the 20m buffer zone from the edge of the coastal forest as stipulated by DAFF.
- It must also be ensured that these areas are off-limits to mining vehicles and activities and mine personnel.

- Should the presence of wetlands be confirmed within the Grassland Habitat Unit, this should also be taken into consideration as part of the overall mine planning process.
- The boundaries of the proposed mine expansion footprint areas are to be clearly defined and demarcated and it should be ensured that all activities remain within defined footprint areas.

Description of impact after mitigation measures have been implemented

The probability of the impact occurring is medium, the duration if the impact is long term. The extent of the impact is site only and the magnitude if the impact is moderate.

7.3.4 Loss of floral SCC

Description of impact

The probability of the impact is definite; the duration of the impact is long term. The extent of the impact is local and the magnitude of the impact is high.

Proposed mitigation measures

- The footprint area cleared for the proposed mine expansion areas should be kept as small as possible.
- Permits must be obtained for the removal/ destruction of trees protected under the National Forests Act (Act 84 of 1998) prior to the expansion phase from DAFF.
- The number of protected trees removed for ongoing mine expansion should be kept to a minimum and no trees should be needlessly destroyed.
- Should any other floral SCC, including SANBI Red Data Listed species and provincially protected species, be encountered within the development footprint, these species are to be relocated as appropriate.
- Floral SCC are to be handled with care and the relocation of these plant species to nearby suitable similar habitat is to be overseen by a botanist.
- The collection of plant material for medicinal purposes or collection of firewood should be prohibited.
- Edge effect control needs to be implemented to ensure no further degradation and potential loss of floral SCC outside of the proposed project footprint area.
- Any protected trees that will remain must be demarcated with red-tape to avoid tree disturbance.

Description of impact after mitigation measures have been implemented

The probability of the impact is medium; the duration of the impact is long term. The extent of the impact is site only and the magnitude if the impact is moderate.

7.3.5 Loss of floral habitat due to edge effects

Description of impact

Loss of floral habitat due to edge effects, such as soil erosion. The probability of the impact occurring is high, the duration of the impact occurring is long term. The extent of the impact is local and the magnitude of the impact is high.

Proposed mitigation measures

- To minimise the risk of erosion, the extent of vegetation clearing and the duration for which bare soils are exposed in areas surrounding the mining footprint clearing should be kept to a minimum.
- To prevent the erosion and loss of topsoil, management measures may include berms, soil traps, hessian curtains and stormwater diversion away from areas susceptible to erosion.

- It must be ensured that topsoil stockpiles are located outside of any wetland and riparian areas and areas susceptible to erosion.

Description of impact after mitigation measures have been implemented

The probability of the impact occurring is medium; the duration of the impact is medium term. The extent of the impact is site only and the magnitude of the impact is low.

7.3.6 Loss of floral habitat from vehicle movement

Description of Impact

The probability of the impact occurring is medium, the duration of the impact is medium term. The extent of the impact is local and the magnitude of the impact is moderate.

Proposed mitigation measures

- Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the proposed development activities.
- As far as possible, existing access roads should be utilised to access the operational areas.
- All disturbed habitat areas must be rehabilitated and planted with indigenous floral species as soon as possible to ensure that floral ecology is re-instated.
- All soils compacted as a result of operational activities falling outside of the project footprint areas should be ripped and profiled. Special attention should be paid to alien and invasive control within these areas.

Description of impact after mitigation measures have been implemented

The probability of the impact occurring is low; the duration of the impact is short term. The extent of the impact is site only and the magnitude of the impact is low.

7.3.7 On-going faunal disturbance

Description of impact

On-going disturbance of faunal habitat within surrounding areas due to activities associated with mining, as well as further clearing of vegetation as mining progresses. The probability of the impact occurring is high; the duration of the impact is long term. The extent of the impact is local and the magnitude of the impact is moderate.

Proposed mitigation measures

- No areas falling outside of the proposed mine layout areas may be cleared for mining purposes.
- The boundaries of the development footprint areas are to be clearly defined and it should be ensured that all activities remain within defined footprint areas.
- All mining footprint areas and areas affected by the proposed mining development should remain as small as possible and any disturbance of sensitive habitat must be actively avoided.

Description of impact after mitigation measures have been implemented

The probability of the impact occurring is medium; the duration of the impact is long term. The extent of the impact is site only and the magnitude of the impact is moderate.

7.3.8 Proliferation of alien floral species

Description of Impact

The proliferation of alien floral species in disturbed areas, resulting in a decrease of faunal and floral habitat. The probability of the impact occurring is high; the duration of the impact is permanent without mitigation. The extent of the impact is local and the magnitude of the impact is high.

Proposed mitigation measures

- Eradication of alien invasive species should take place throughout the operational phase on an ongoing basis.
- Alien vegetation eradication recommendations include:
    - 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 ecologically areas during the eradication of alien and weed species.
- Implement the vegetation management and eradication program as specified in the Floral and Faunal Assessment attached to Appendix C of this report.

Description of impact after mitigation measures have been implemented

The probability of the impact occurring is medium; the duration of the impact is long term. The extent of the impact is local and the magnitude of the impact is moderate.

7.3.9 Loss of faunal species due to trapping and hunting

Description of impact

The probability of the impact occurring is medium; the duration of the impact is long term. The extent of the impact is local and the magnitude of the impact is moderate.

Proposed mitigation measures

- Prohibit any trapping or hunting within the mining area.
- Access control to the property must be used to ensure that no illegal trapping or poaching takes place.

Description of impact after mitigation measures have been implemented

The probability of the impact occurring is low; the duration of the impact is long term. The extent of the impact is local and the magnitude of the impact is moderate.

7.3.10 Groundwater

Description of impact

The probability of the impact occurring is high; the duration of the impact is medium term. The extent of the impact is regional and the magnitude of the impact is high.

Proposed mitigation measures

- Ensure monitoring is undertaken as per the requirements of the groundwater monitoring programme included in Appendix F of this report.
- Ensure that bi-annual groundwater monitoring reports are compiled detailing the outcomes and of the groundwater monitoring sampling.
- Based on the outcomes of the monitoring reports – implement mitigation measures where necessary.
- Check integrity of the lining of the settling ponds and evaporation dam.

Description of impact after mitigation measures have been implemented

The probability of the impact occurring is medium; the duration of the impact is short term. The extent of the impact is regional and the magnitude of the impact is low.

7.3.11 Contaminated water from cement plant

Description of impact

Particulates will make their way into the surface water through concrete batching plant; therefore the probability of the impact is definite. The mine itself lies within the flood-plain therefore there is a high potential for the Vungu River to flood the site and the contaminants to enter the river. The duration of the impact is immediate as the stormwater is dispersed and diluted downstream. The extent of the impact would be local as it can disperse though the river and the magnitude of the impact is very high.

Proposed mitigation measures

- Water contaminated with cement needs to be properly treated and should never be released into the environment.
- All infrastructure as proposed in the stormwater management plan is to be constructed and implemented. (Refer to Appendix J).

Description of impact after mitigation measures have been implemented

The probability of the impact occurring will be reduced to a medium probability. The duration of the impact would be immediate. The extent of the impact would be local and the magnitude of the impact would reduce to moderate as it would be controlled.

7.3.12 Contaminated stormwater discharge into Vungu River

Description of impact

Particulates will make their way into the surface water through the washing plant, and runoff from the wash bay area therefore the probability of the impact is definite. The mine itself lies within the flood-plain therefore there is a definite potential for the Vungu River to flood the site and the contaminants to enter the river. The duration of the impact is immediate as the stormwater is dispersed and diluted downstream. The extent of the impact would be local as it can disperse though the river and the magnitude of the impact is very high.

Proposed mitigation measures

- Move current material stockpiles away from the settling ponds to reduce the risk of further sedimentation and high turbidity levels.
- Monthly monitoring of surface water quality to ensure compliance with the relevant water quality guidelines.
- All infrastructure as proposed in the stormwater management plan is to be constructed and implemented. (Refer to Appendix J).

Description of impact after mitigation measures have been implemented

The probability of the impact occurring will be reduced to a medium probability. The duration of the impact would be immediate. The extent of the impact would be local and the magnitude of the impact would reduce to moderate as it would be controlled.

7.3.13 Contaminated stormwater discharge into the stream on the western boundary of the site

Description of impact

The mine itself lies within the flood-plain therefore there is a definite potential for the Vungu River to flood the site and the contaminants to enter the river. The duration of the impact is immediate, the extent of the impact is local and the magnitude of the impact is very high.

Proposed mitigation measures

- Replace the failing cement-block drop inlet structure with a proper, robust concrete structure.
- Stabilise and shape the degraded river banks associated with the drop-inlet structure to their natural form.

Description of impact after mitigation measures have been implemented

The probability of the impact occurring will be reduced to a low probability. The duration of the impact would be immediate. The extent of the impact would be local and the magnitude of the impact would reduce to moderate as it would be controlled.

7.3.14 Flooding

Description of impact

As the mine lies within the floodplain, the screening and crushing plant lies within the 1:100 and 1:50 year floodline. The probability of the impact occurring is a high. The duration of the impact is immediate, the extent of the impact is site only and the magnitude of the impact is high.

Proposed mitigation measures

- Identify areas where river banks are at risk of erosion or have limited vegetation and stabilise where necessary with suitable methods. (e.g. vegetation, gabions, etc.)
- Undertake alien plant control along the riparian zone of the Vungu River and re-vegetate riparian areas with suitable locally occurring indigenous riparian vegetation (it is recommended that the mine seeks the expertise of a suitably trained/qualified expert with experience in ecological rehabilitation).
- Gabions that have been improperly installed should be re-done. Gabions are to be properly constructed using the appropriate foundation construction, correct stone sizing and gabion baskets to be properly sized without gaps and tied properly.
- Regular monitoring and clearing of debris under low level bridge.
- Protective works such as earthen/rock levees/berms should be considered in order to avert flood risk. These will also have a dual-purpose in trapping contaminants/sediment generated at the site.
- All infrastructure as proposed in the stormwater management plan is to be constructed and implemented. (Refer to Appendix J).
- All channels must be checked monthly and cleared after any major rainfall events, to ensure that there are no blockages.
- Stone pitching channels are recommended to reduce high runoff velocity on channels.
- Sediment that accumulates within the channels, ponds and retention facility) must be routinely removed to ensure the design capacity is maintained. Should sediment be expected to contain contamination this sediment should be appropriately handled and disposed.
- Material spills must be prevented where possible on site, including within the bunds. Should spills occur, these should be addressed immediately.
- Should contamination be expected within the bunds, this water may not be released to the environment, and must be chemically tested to determine appropriate management requirements (i.e. disposal at an appropriate facility if unfit for release to the environment).

- It should be noted that flood protection measures must be designed by a suitably qualified person and that potential impacts as a result of the mitigation measures, on upstream, downstream or adjacent users must be prevented.

Description of impact after mitigation measures have been implemented

The probability of the impact occurring will be reduced to a low probability. The duration of the impact would be immediate. The extent of the impact would be site only and the magnitude of the impact would remain high.

7.3.15 Pollution from chemical and hazardous substances

Description of impact

The probability of the impact occurring is a medium probability. The duration of the impact would be immediate. The extent would be local and the magnitude would be moderate.

Proposed mitigation measures

- The storage of potentially hazardous materials (e.g. fuel, oil, cement, paint, etc.) must be outside of the 100-year flood line, or within a horizontal distance of 100m from a watercourse. Where these facilities are fixed and relocation is impractical, methods of protecting these areas from flood hazards and mechanisms to contain potential contaminants need to be investigated as per impact.

Description of impact after mitigation measures have been implemented

The probability of the impact occurring is reduced to a low probability and all other aspects remain the same as before mitigation.

7.3.16 Sedimentation of wetland resources

Description of impact

The potential to impacts the wetland and wetland resources is highly probable, considering that it has already been impacted upon, the duration of the impact would be long-term without mitigation. The extent of the impact would be site only and the magnitude of the impact would be moderate considering the wetland is regarded as being of low EIS.

Proposed mitigation measures

- Any activities that could occur upstream of the wetland that could impact on the wetland area should be prevented.
- 30 metre buffer around delineated wetland with no mitigation; or
- 15 metre buffer around delineated wetland with the following mitigations::
    - Special care should be taken to demarcate the buffer zone and to actively prevent any encroachment into this zone;
    - Under no circumstance are additional access roads to be constructed within wetland or buffer zones recommended ;
    - Dumping, stockpiling, excavation, borrowing of material and any temporary storage of equipment is to be strictly prohibited within the buffer zone;
    - Buffer zones must be established and maintained as open space areas with appropriate alien plant control and slashing to maintain grass cover (or existing dense sugarcane is to be retained);
    - Recommended sediment retention measures are to be implemented to control any sediment-laden runoff that could enter the adjacent wetland/riparian areas (where relevant);

  - Any embankments, stockpiles or other sources of exposed material/soils are to be appropriately stabilized and maintained to minimize risk of erosion and sedimentation downstream; and
  - Manage any surface/storm water runoff to ensure erosion and sedimentation and pollution is avoided
- Access roads are to be shaped so that flows are spread evenly and preferential flow paths are not formed as these can create erosion features and deliver sediment to aquatic downstream resources. Where possible, roads are to be sloped away from wetlands/rivers such that water collects on the upstream side.
- Appropriate sediment/erosion control is to be employed for access roads adjacent to wetland (as well as for existing road fill within the wetland). This can be in the form of sediment fences, rock pack, low earth berms or excavated trenches that trap sediment along the perimeter edge of the road (on the downslope side of the road).
- Vehicles are not to be left standing in areas where oil/fuel spillages could contaminate adjacent/downstream wetlands/rivers.
- Vehicles are not to be maintained/washed in close proximity to any wetland/river where there is a risk that contamination may occur.
- No fuels, chemicals or hazardous substances are to be stored, temporarily or permanently, outside of designated chemical/fuel storage areas to reduce the risk of water resource contamination.

Description of impact after mitigation measures have been implemented

The probability of the impact occurring will reduce to a low probability, the duration of the impact would reduce to short-term as if the impact were to occur it would be remediated. The extent of the impact would be site only and the magnitude would be moderate.

7.3.17 Alien plants within riparian area and wetland

Description of impact

The probability of disturbance which could lead to increased levels of alien plants is highly probable; the duration of the impact would be long term without mitigation. The extent of the impact would be site only and the magnitude of the impact would be moderate.

Proposed mitigation measures

- Alien plant clearing and planting of indigenous plants to be undertaken as per the recommendations in section 5.2.4 of the Specialist Aquatic Assessment Report Appendix G.

Description of impact after mitigation measures have been implemented

The probability of the impact occurring will reduce to a low probability as alien plants will be re moved progressively, the duration of the impact would reduce to immediate as if the impact were to occur it would be remediated. The extent of the impact would be site only and the magnitude would be low.

7.3.18 Air Quality

Description of impact

The air quality is affected by dust and particulate matter released during blasting, drilling and processing of the aggregates; the probability of the impact is definite as it is occurring and the dustfall out monitoring results show that it exceeds the limit for a non-residential area. The duration of the impact is long term as dust is constantly being emitted; the extent of the impact will be local and the magnitude of the impact is high as dust could impact on the surrounding residential areas.

Proposed mitigation measures

- A fugitive dust management plan for the site should be drafted and implemented as appropriate. The fugitive dust management plan should aim to reduce dust fallout concentrations, specifically.
- Water sprayed onto the roads by water trucks to reduce dust by vehicle entrainment.
- Handling of material that has the potential to generate dust should be kept to a minimum.
- Dust suppression should be increased in dry periods and when wind speeds increase.
- Dust should be managed in and around the site as dust fallout standards have been exceeded.
- Spill records should be available to determine whether there is any correlation between an increase in dust fallout and spills for a specific month.
- Any complaint, must to be logged in the complaints register and investigated on a monthly basis. The complaints register should be readily available, on site, for auditing purposes.
- Tenants to abide by their Atmospheric Emissions Licence (AEL) conditions in particular compliance with monitoring requirements and Minimum Emission Standards (MES).

Description of impact after mitigation measures have been implemented

The probability of the impact occurring will reduce to a high probability. The duration will remain for the entire LoM and the extent of the impact will reduce site only. The magnitude of the impact will decrease from a high magnitude to a moderate magnitude due to the dust suppression measures put in place.

7.3.19 Noise

Description of impact

A noise study was undertaken in October 2014 by Apex Environmental and the results from this study indicated that it would be unlikely that SCSC would receive any complaints from surrounding landowners as the results were in compliance with the guideline standards. The probability of the impact occurring is low probability. The duration of the impact will be long term for the LoM; the extent of the impact will be local and the magnitude of the impact will be low.

Proposed mitigation measures

- Consult with surrounding landowners to identify issues and develop a transparent relationship.
- Monitor noise levels.
- Ensure factors such as wind direction, temperature and cloud cover are taken into account before blasting.
- Notify surrounding areas of blasting schedule prior to blasting.
- Reverse hooters of vehicles must be replaced to a type with a different frequency that will reduce the distance that sound will travel.
- Acoustic screening methods can be implemented to try reduce the noise levels of the jaw crushers.

Description of impact after mitigation measures have been implemented

All impacts will remain the same as before mitigation.

7.3.20 Archaeological and cultural sites

Description of impact

Based on the archaeological field survey the probability of the mine affecting a cultural or archaeological finding is improbable. The duration of the impact would be permanent (depending on the archaeological finding) as any sub-surface archaeological finding would have been destroyed or demolished and this loss will be permanent. The extent of the impact will be local and the magnitude of the impact would be moderate.

Proposed mitigation measures

No mitigation is offered in this regard.

Description of impact after mitigation measures have been implemented

All impacts will remain the same as before.

7.3.21 Visual aspects

Description of impact

It is evident that the mining site will have a definite visual impact on the surrounding property owners. The duration is permanent, without mitigation and the extent is local as only the surrounding land-users will be affected by it and the magnitude of the impact will be high as it is highly visible to surrounding land-users.

Proposed mitigation measures

- Undertake progressive rehabilitation and re-vegetation in areas where there no further mining is planned during the operational phase.
- Update financial provision for closure, rehabilitation and maintenance on a yearly basis.
- Rehabilitate abandoned excavations according to the closure and rehabilitation plan to be developed by SCSC.

Description of impact after mitigation measures have been implemented

The probability of the impact will remain definite as it has already occurred in most parts of the site, the duration of the impact will remain permanent; the extent of the impact will remain local and the magnitude of the impact will become moderate due to the ongoing vegetation management that will be undertaken.

7.3.22 Traffic

Description of impact

Since no traffic studies have been undertaken for the site, the probability of the impact occurring is definite as it is unknown. The duration of the impact is long term (LoM), the extent is regional and the magnitude is moderate considering the plant is in a remote area and is located at the end of Quarry road.

Proposed mitigation measures

- Control vehicular access to the mine.
- Make provision for safely accommodating all vehicle and pedestrian, movements in the area of the works.
- Prevent spillage of soil, dust and stone on roads. If this does occur, the roads will be cleared.
- Ensure safety signage is in place and maintained.

Description of impact after mitigation measures have been implemented

The probability of the impact of the mining activity on traffic will be reduced from definite to high as measures have been put in place to manage road damage and vehicle movement; the duration of the impact would remain for the LoM. The extent of the impact would remain regional; and the magnitude of the impact would decrease to low as the roads would be maintained.

7.4 Closure and Rehabilitation

7.4.1 Loss of faunal habitat due to alien proliferation

Description of impact

The probability of the impact occurring is high; the duration of the impact is permanent. The extent of the impact is regional and the magnitude of the impact is high.

Proposed mitigation measures

- Alien floral species management and eradication must continue to be implemented.
- Alien seed dispersal within the top layers of the soil within footprint areas, that will have an impact on future rehabilitation, also has to be controlled.
- All soils compacted as a result of closure activities should be ripped and profiled. Special attention should be paid to alien and invasive control within these areas.
- All disturbed habitat areas must be rehabilitated and planted with indigenous floral species as soon as possible to ensure that floral ecology is re-instated.
- Implement the vegetation management and eradication program as specified in the Floral and Faunal Assessment attached to Appendix C of this report.

Description of impact after mitigation measures have been implemented

The probability of the impact occurring is medium; the duration of the impact is long term. The extent of the impact is local and the magnitude of the impact is moderate.

7.4.2 Faunal and floral habitat modification

Description of impact

Ongoing long term faunal and floral habitat modifications as a result of ineffective rehabilitation activities. The probability of the impact occurring is high; the duration of the impact is permanent. The extent of the impact is regional and the magnitude of the impact is high.

Proposed mitigation measure

- A biodiversity management and rehabilitation plan must be implemented to ensure that all disturbed areas are reinstated to a natural state.

Description of impact after mitigation measures have been implemented

The probability of the impact occurring is medium; the duration of the impact is long term. The extent of the impact is site only and the magnitude of the impact is moderate.

7.4.3 Erosion leading to faunal and floral habitat disturbance

Description of impact

Improper erosion control leading to further faunal and floral habitat disturbance. The probability of the impact occurring is medium; the duration of the impact is medium term. The extent of the impact is local and the magnitude of the impact is high.

Proposed mitigation measures

- The extent of vegetation clearing should be kept to a minimum in order to minimise the risk of erosion.
- To minimise the risk of erosion, the extent of vegetation clearing should be kept to a minimum.
- To prevent the erosion of top soils, management measures may include berms, soil traps, hessian curtains and stormwater diversion away from areas susceptible to erosion.

- It must be ensured that topsoil stockpiles are located outside of any wetland and riparian areas and areas susceptible to erosion.

Description of impact after mitigation measures have been implemented
The probability of the impact occurring is medium; the duration of the impact is medium term. The extent of the impact is site only and the magnitude of the impact is moderate.

7.5 Post Closure Phase

7.5.1 Ineffective rehabilitation leading to transformation of faunal habitat

Description of impact

The probability of the impact occurring is high; the duration of the impact is permanent without mitigation. The extent of the impact is local and the magnitude of the impact is high.

Proposed mitigation measure

- Implementation of a biodiversity rehabilitation plan to ensure that all disturbed areas are reinstated to a natural state.

Description of impact after mitigation measures have been implemented
The probability of the impact occurring is medium; the duration of the impact is long term. The extent of the impact is site only and the magnitude of the impact is moderate.

7.5.2 Proliferation of alien floral species leading to an altered faunal habitat

Description of impact

The probability of the impact occurring is high; the duration of the impact is permanent without mitigation. The extent of the impact is regional and the magnitude of the impact is moderate.

Proposed mitigation measure

- Implement the vegetation management and eradication program as specified in the Floral and Faunal Assessment attached to Appendix C of this report.

Description of impact after mitigation measures have been implemented
The probability of the impact occurring is medium; the duration of the impact is long term. The extent of the impact is local and the magnitude of the impact is moderate.

7.5.3 Ineffective rehabilitation leading to permanent loss of floral habitat

Description of impact

The probability of the impact occurring is high; the duration of the impact is permanent without mitigation. The extent of the impact is regional and the magnitude of the impact is high.

Proposed mitigation measure

- Post-closure, ongoing monitoring of rehabilitation works must take place to ensure that biodiversity and suitable vegetation cover has been reinstated until a closure certificate has been obtained from the DMR.

Description of impact after mitigation measures have been implemented
The probability of the impact occurring is medium; the duration of the impact is medium term. The extent of the impact is local and the magnitude of the impact is low.

7.5.4 Proliferation of alien floral species leading to an altered floral habitat

Description of impact

The probability of the impact occurring is high; the duration of the impact is permanent without mitigation. The extent of the impact is regional and the magnitude of the impact is high.

Proposed mitigation measure

- Post-closure, ongoing monitoring and eradication of alien vegetation in the vicinity of the study area must take place until a closure certificate has been obtained.

Description of impact after mitigation measures have been implemented

The probability of the impact occurring is high; the duration of the impact is medium term. The extent of the impact is local and the magnitude of the impact is moderate.

7.6 Pre-existing Impact

The following impact was not included in the impacts and rankings table above as it is a pre-existing impact, however mitigation measures have been supplied as per the specialist aquatic assessment.

Description of impact

The permanent destruction of wetland habitat associated with the seepage wetland within the valley to the west of the current mine operation has occurred through the infilling of the eastern arm of this wetland for the purposes of constructing a dirt access road and truck turning circle to facilitate access to the proposed mine expansion area. The infilling of the wetland has resulted in the following consequences:

- Wetland hydrology has been affected as the fill material alters the way water moves through the eastern section of the wetland;
- The wetland geomorphological template and the way sediment would naturally move through the system has been altered;
- Wetland vegetation and associated habitat for flora and fauna have been lost permanently;
- Habitat connectivity has been severed;
- Associated disturbance has facilitated increased levels of colonization by alien plants;
- Ecosystem processes have been lost as a result of the infilling of the section of wetland.

Proposed mitigation measures

- 30 metre buffer around delineated wetland with no mitigation; or
- 15 metre buffer around delineated wetland with the following mitigations:
    - Special care should be taken to demarcate the buffer zone and to actively prevent any encroachment into this zone;
    - Under no circumstance are additional access roads to be constructed within wetland or buffer zones recommended ;
    - Dumping, stockpiling, excavation, borrowing of material and any temporary storage of equipment is to be strictly prohibited within the buffer zone;
    - Buffer zones must be established and maintained as open space areas with appropriate alien plant control and slashing to maintain grass cover (or existing dense sugarcane is to be retained);
    - Recommended sediment retention measures are to be implemented to control any sediment-laden runoff that could enter the adjacent wetland/riparian areas (where relevant);
    - Any embankments, stockpiles or other sources of exposed material/soils are to be appropriately stabilized and maintained to minimize risk of erosion and sedimentation downstream; and

  - Manage any surface/storm water runoff to ensure erosion and sedimentation and pollution is avoided.
- Access roads are to be shaped so that flows are spread evenly and preferential flow paths are not formed as these can create erosion features and deliver sediment to aquatic downstream

8 Conclusions and Recommendations

The mitigations measures and the recommendations made by specialists have been carried into the EMPr. It is recommended that the Final EMPr should be implemented and auditing should be undertaken on regular basis to ensure compliance during all phases of the LoM and post closure.

Furthermore the Floral and Faunal Ecological Assessment undertaken by SAS recommended that the precautionary principal be applied in the case of the coastal forest and riparian vegetation, as these areas are capable of supporting a diverse range of invertebrate species. As such it is recommended that the coastal forest and riparian vegetation be exempt from clearing and that these areas are retained in the current natural state.

Prepared by

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pp.

R. Bellusci

Environmental Scientist

SRK Consulting - Certified Electronic Signature
srk consulting
483383/42590/Report
1951-5672-6982-JORD
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W. Jordaan Pr.Sci.Nat

Principal Scientist

Reviewed by

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8272-8553-3355-MORI
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MJ. Morris (Pr. Eng)

Partner

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

9 References

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Appendices

Appendix A: Regional Geology

Figure 2.1: Regional Geology indicating Margate Quarry Site

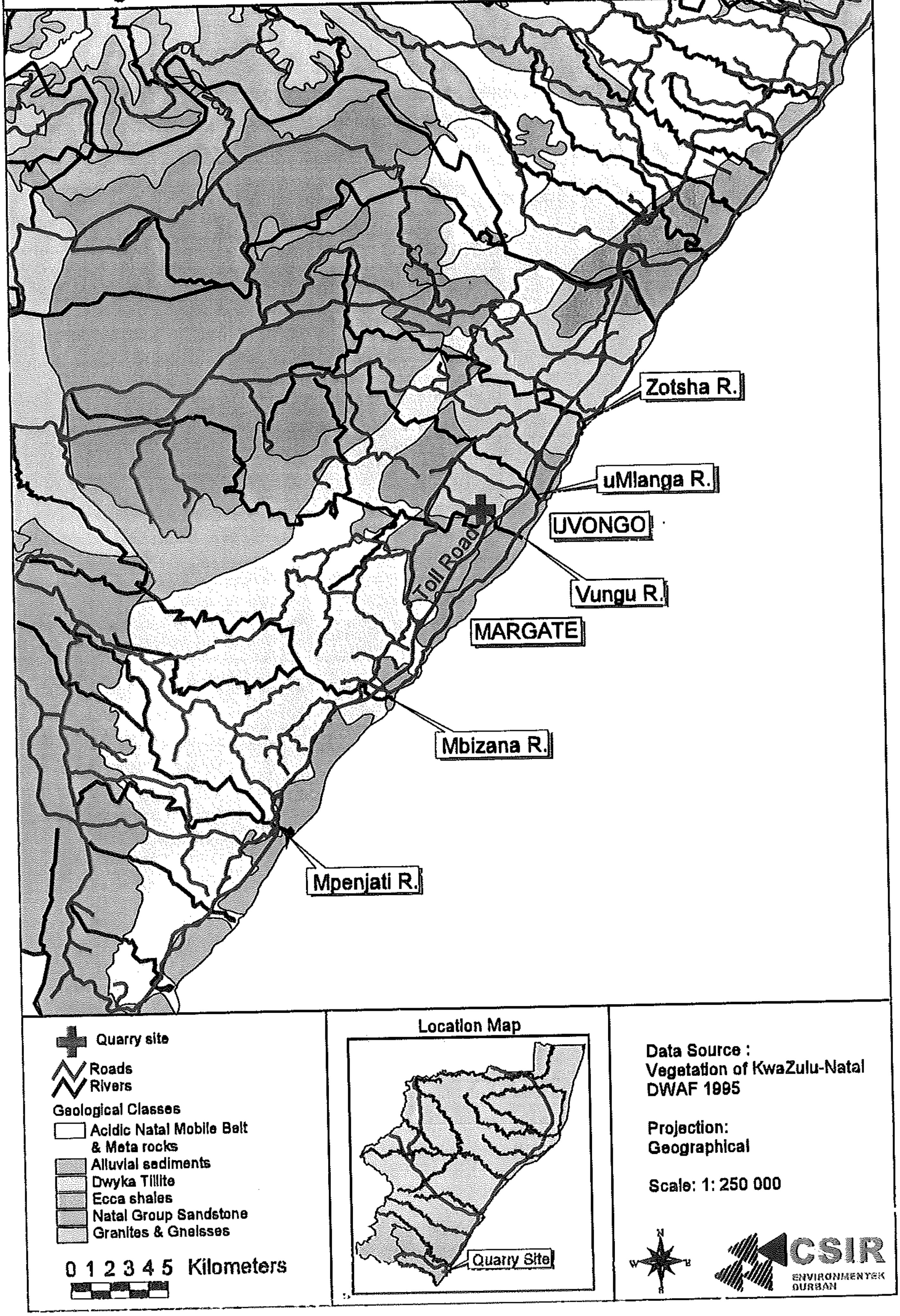
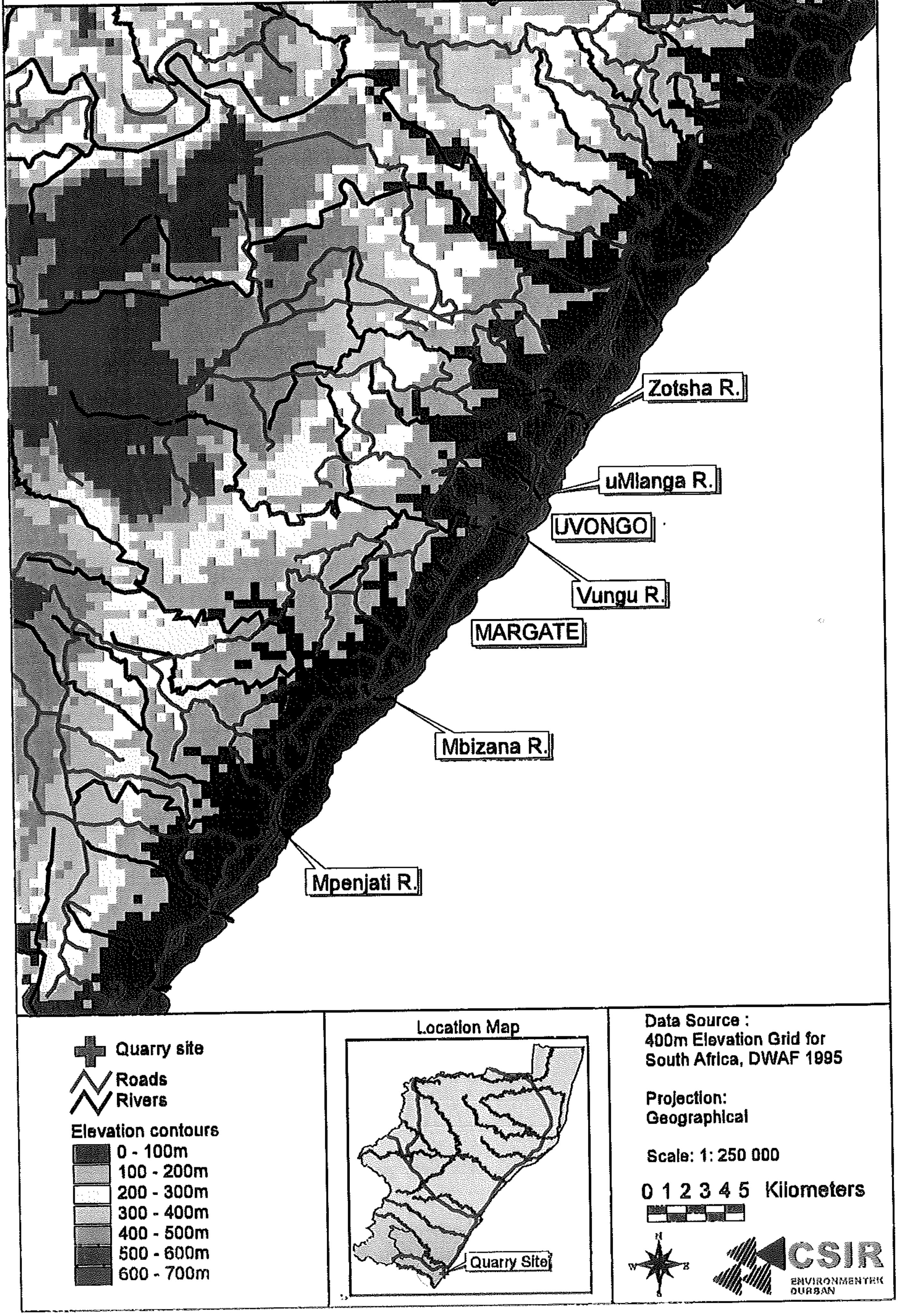


Figure 2.2: Regional Topography indicating Margate Quarry Site



Data Source :
400m Elevation Grid for
South Africa, DWAF 1995

Projection:
Geographical

Scale: 1: 250 000

Appendix B: Geotechnical Investigation

MARGATE QUARRY INVESTIGATION

1. SCOPE

The intent of this report is to describe the investigations conducted on Lots 1995, 1996 and 1998 of Uvongo Township to determine the extent and quality of the stone resources presently being quarried. Whilst some indicative investigations were undertaken on Lot 1998, the main thrust of the exercise has been centred on Lots 1995 and 1996.

2. GENERAL APPRECIATION

Margate Quarry is located on the northern banks of the Uvungu River about 2,5 km from the sea as shown on the sketch plan, figure No. 1 in the Appendix.

The site is underlain by rocks and soils of the Dwyka Tillite series of the Karroo system. A large fault along the Uvungu River has brought Table Mountain sandstones (TMS) on the south bank into juxtaposition with the Tillite.

The Quarry currently produces about 6 000 m^3 (loose) of crushed rock per month of all types of aggregate. The overburden is sold for fill, the second and third browns are sold as a subbase, and the first brown and blue are utilised for crusher run, concrete stone and road aggregates. The blue Tillite is currently being used on Provincial Main Road 395 as a high quality basecourse. Generally its ACV has been found to be in the range 14 - 20 over a 10 year testing span (NPA Roads Department) which is well within accepted hard rock standards of 29 maximum.

3. SITE INVESTIGATION

The investigation to determine the extent of the stone resources remaining on the Margate Quarry property was conducted in several phases:-

a) a full geological site reconnaisance was put in hand to determine the trend of the investigation; and thereafter

b) seismic traverses (21 off), percussion drillings (10 off) and diamond drillings (3 off) were conducted in November 1983.

Seismic Traverses

These were undertaken using a Nimbus machine with a depth probe of ± 15 m. For estimating and classifying purposes experience has shown that the following velocities are applicable to the Tillite:-

0 - 750 m/sec	overburden, rippable
750 - 1800 m/sec	brown rock, rippable
+ 1800 m/sec	brown/blue rock, blast

A velocity of +3000 m/sec has been used to delineate the hard blue Tillite horizon depth.

3. SITE INVESTIGATION

Seismic Traverses (contd)

The traverses were done on a forward and reverse basis and were positioned to take advantage of the present cane haulage road system. The approximate locations are shown on the plan to a scale of 1 : 2500 in the Appendix.

Soils Design Laboratories Natal undertook the work.

Diamond Drilling

The four envisaged holes were drilled at least 5 m into blue Tillite and then stopped. Hole DD 3 was eventually deleted, and hole DD 4 was drilled to a total depth of 60 m to prove the Tillite below the present quarry floor.

McLaren and Eger undertook the drilling and percussion contract.

Percussion Drilling

The percussion drillings were undertaken using a track rig and compressor. Chip samples were set aside and stored in plastic bags for each metre drilled, and a rough log of the times taken to progress downhole were recorded. Whilst the chip samples tell the story, the times from the drillers diary are not felt to be accurate and little store has been placed on them.

4. RESULTS OF THE INVESTIGATION

Seismic Traverses

The seismic traverses are primarily used to interpolate data between percussion and diamond drilling. The results are shown on Tables Nos. 1 and 2 in the Appendix, on individual traverse sheets, and are also shown in comparison to adjacent drilling work. The correlation is quite good and this facet of the investigation has lent credence to the percussion work.

Diamond Drilling

The logs of boreholes DD 1, DD 2 and DD 4 are tabled in the Appendix. DD 1 and DD 4 show blue tillite after 1,5 m, whilst DD 2 shows quite broken and fractured blue Tillite after 3,5 m below ground level.

Percussion Drilling

The chippings from the holes have been classified into 2 stages of brown, depending on the degree of weathering, and a schedule of the classifications used and the designated horizons are given in the Appendix as Tables Nos. 3 and 4.

5. CURRENT QUARRYING PROCEDURES

At present the quarry is removing all non-crushable material to stockpile where it may either be sold as topsoil, or fill. It is understood that if ,this is done in reasonable increments these sales cover the overburden removal costs.

The underlying brown and blue Tillites are then crushed separately for sale as road subbase or as high class blue crusher run and concrete stone.

A colour photostat is included in the Appendix which clearly indicates the quarry face, the brown Tillite overlying the blue, and the dominant joint patterns probably induced in the material from the major faulting. This joint pattern plays a major role in the method of attacking the quarry face. The procedure is to work as far as possible into the face in a direction perpendicular to this major plane. If the face is worked parallel to the plane the rock peels off in excessively large plates and requires secondary blasting.

6. QUANTITIES : LOTS 1995 and 1996

In order to assess the volumes of the various materials available three developmental phases have been assumed:-

Phase I	quarry floor taken back at RL 25 to about half the length available in the lots; and
Phase II	thereafter the floor taken at RL 25 to the back fence; and
Phase III	the floor subsequently taken down to RL 5 (ie. below river level).

A full stereonet of the joint patterns has not been undertaken as portion of this investigation, but this should be done in the future to determine accurate batter slopes. However, for purposes of this study the following parameters have been adopted:-

i) excavation may commence 10 m from boundaries; and

ii) for phases (I) and (II) batters of 0,75h to 1v have been adopted for the upper slope, followed by 0,5h to 1v below this. The faces have allowed for 5 m wide benches at 20 m intervals. This latter figure is adopted to combat undue drifting of jumper rods; and

iii) for phase (III) developments 0,25h to 1v batters have been used.

After review of all seismic and drilling results the overburden has been taken for calculation purposes to be 3 m average in depth, with saleable crushed first and second brown Tillite 3 m average in depth. Below this upper 6 m band the entire profile will be crushable blue Tillite.

The resultant quantities are as scheduled in the Table No. 5 in the Appendix.

7. QUANTITIES : LOT 1998

No analysis of rock on this lot has been undertaken or required.

8. CONCLUSIONS

The investigations have clearly highlighted very favourable overburden/rock ratios. The cores removed, the exposed quarry faces, and successful past usage all point to Margate Quarry being a technically and financially sound rock resource. This should fuel the economic growth for a great many years to come in the area.

DE LEUW CATHER LOUDON

December 1983

ACKNOWLEDGMENTS

In compiling this report the following assistance is gratefully acknowledged:-

1. Paul Hartopp & Associates assisted greatly with core logging and geological advice;
2. Mr. A.A. Loudon reviewed the script, and gave valuable general advice;
3. McLaren and Eger undertook the drilling;
4. Soils Design Laboratories Natal did the seismic work at very short notice, and with a smile.

---oo0oo---

COMPARISON OF PERCUSSION AND SEISMIC TRAVERSES

Percussion Hole Number	Classification of Cores					Adjacent Seismic Traverse Depths (m)				Correlation
	Over-burden	Brown 3	Brown 2	Brown 1	Blue	No.	Soft 0 - 750	Rip 750 - 1800	Blast (blue) + 1800	
1	0 - 2			2 - 4	+ 4	TR. 2	0 - 1,3		+ 1,3 (4,8)	reasonable blue good
						TR 3	0 - 1,3		+ 1,3 (4,0)	good blue good
2	0 - 3			3 - 9	+ 9	TR 1	0 - 1,1	1,1 - 5,3	+ 5,3 (5,3)	reasonable
						TR 7	0 - 1,5		+ 1,5 (+ 1,5)	reasonable
3	0 - 3			3 - 5	+5	TR 1	0 - 1,1	1,1 - 5,3	+ 5,3 (+5,3)	reasonable blue good
						TR 6	0 - 1,7		+ 1,7 (5,8)	reasonable blue good
4	0 - 1	1 - 5	5 - 6		+6	TR 9	0 - 1,4		+ 1,4 (6,4)	poor blue good
5	0 - 5		5 - 7	7 - 9	+ 9	TR 11	0 - 1,1	1,1 - 4,9	+ 4,9 (4,9)	good
6	0 - 3		3 - 5	5 - 6	+ 6	TR 12	0 - 1,1	1,1 - 5,0	+ 5,0 (5,0)	reasonable blue good
7	0 - 3			3 - 5	+ 5	TR 16	0 - 1,4	1,4 - 5,5	+ 5,5 (5,5)	reasonable blue good
9		0 - 6	6 - 12	12 - 15	+ 15	TR 17	0 - 1,1		+ 3,3 (3,3)	poor

← RIP —— BLAST →

NOTE: Seismic velocities in metres/second

COMPARISON OF DRILLING AND SEISMIC TRAVERSES

Borehole Number	Classification of Cores					Adjacent Seismic Traverse Depths (m)				Correlation
	Over-burden	Brown 3	Brown 2	Brown 1	Blue	No.	Soft 0 - 750	Rip 750 - 1800	Blast + 1800	
DD 1	0 - 1,5				+ 1,5	TR 7	0 - 1,5		+ 1,5	very good
						TR 13	0 - 1,2	1,2 - 6,0	+ 6,0 (6,0)	reasonable to poor
DD 2	0 - 3,5				+ 3,5	TR 14	0 - 1,5		+ 1,5 (4,2)	good blue
						TR 15	0 - 1,2	1,2 - 2,9	+ 2,9 (2,9)	reasonable blue good
DD 4	0 - 1,5				+ 1,5	TR 3	0 - 1,3		+ 1,3 (4,0)	good
						TR 9	0 - 1,4		+ 1,4 (6,4)	good

← RIP → ← BLAST →

NOTE: Seismic velocities in metres/second

CLASSIFICATION OF MATERIALS FROM PERCUSSION HOLES

Classification	Description of Material	Excavation Methods
Third Brown	Brown yellow weathered Tillite - friable	rip
Second Brown	Brown green weathered Tillite - hard	blast
First Brown	Brown grey Tillite - very hard	blast

The chippings were mainly classified on a colour basis with geological microscope correlations.

TABLE NO. 4

CLASSIFICATION OF PERCUSSION HOLES

Percussion Hole No.	Classification (m)				
	Over-burden	Brown 3	Brown 2	Brown 1	Blue
1	0 - 2			2 - 4	4 - 20
2	0 - 3			3 - 9	9 - 20
3	0 - 3			3 - 5	5 - 20
4	0 - 1	1 - 5	5 - 6		6 - 20
5	0 - 5		5 - 7	7 - 9	9 - 20
6	0 - 3		3 - 5	5 - 8	9 - 20
7	0 - 3			3 - 5	5 - 20
8	0 - 1	1 - 6	6 - 12	12 - 15	15 - 20
10	0 - 10				
11	0 - 9				

NOTE: This classification is based on Table No. 3 categories

TABLE NO. 5

ESTIMATED QUANTITIES : MARGATE QUARRY

1983

Development Phase	Quantities ($m^3 \times 10^6$)			Overburden/Rock Ratio **
	Overburden	Crushable Brown	Blue	
a) Face taken back to ± half distance of 1995,1996 floor at RL 25	0,143	0,136	1,739	0,078
b) Face taken back to northern boundary of 1995,1996 floor at RL 25	0,106	0,101	1,482	0,068
c) Full floor taken down from RL 25 to RL 5	–	–	1,225	0,000
Totals	0,249	0,237	4,446	

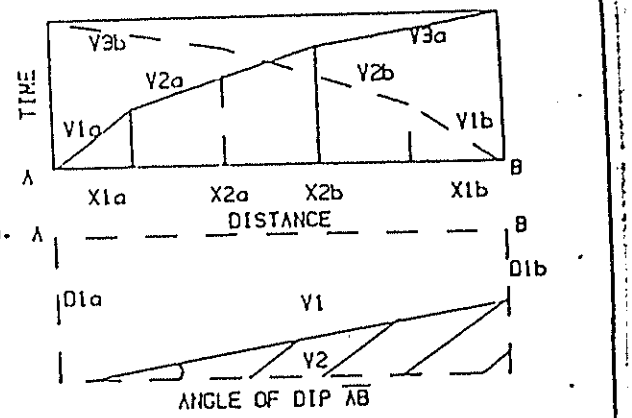
NOTE: This ratio has assumed crushable brown (first and second) is saleable at two thirds the value of crushed blue.

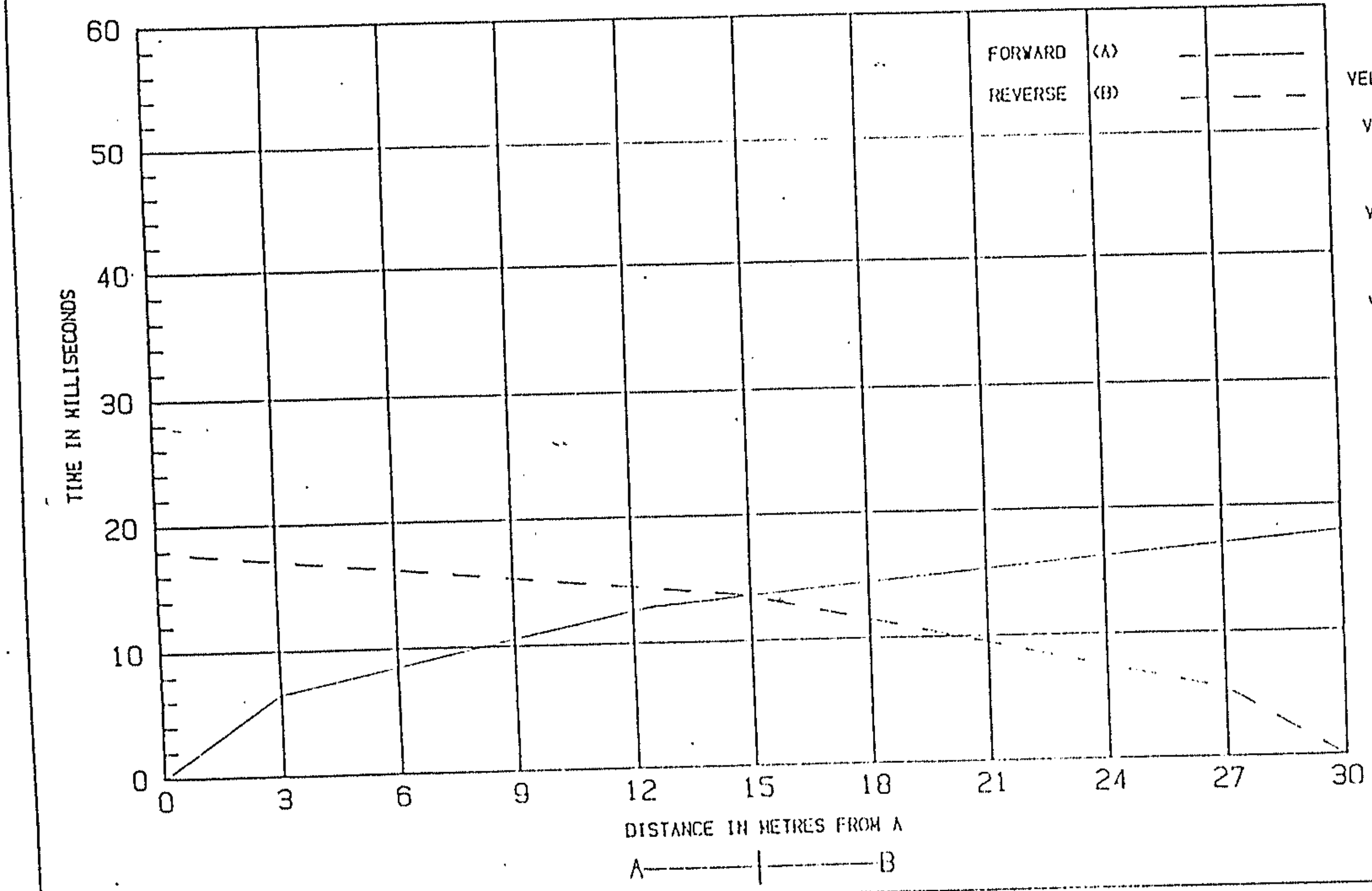
SOILS DESIGN LABORATORIES (NATAL)
SEISMIC SURVEY

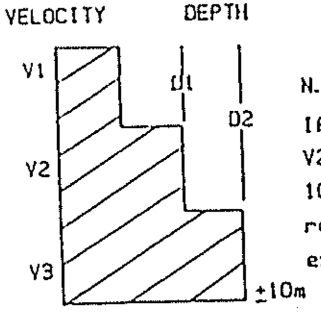
CLIENT : De Leuw Cather Loudon Inc.
PROJECT : Proposed extension to Margate Quarry.
BEARING (Magnetic) : 317 deg N. W.

TRAVERSE NO. : 1
POSITION : As per plan.
JOB CARD NO. : 17428

DATE : 1983 11 10







N. B. For 30m traverse :
If no V3 is recorded V2 will extend to +/- 10m and if no V2 is recorded V1 will extend to +/- 10m.

RESULT SUMMARY

	A	B
V1 m/sec	482	545
V2 m/sec	1477	1482
V3 m/sec	3480	3500
D1m	1.09	1.02
D2m	4.91	5.72
MEAN V1 m/sec	504	
TRUE V2 m/sec	1479	
TRUE V3 m/sec	3490	
MIDPOINT D1m	1.06	
MIDPOINT D2m	5.32	

TABLE NO. 5

ESTIMATED QUANTITIES : MARGATE QUARRY

1983

Development Phase	Quantities ($m^3 \times 10^6$)			Overburden/Rock Ratio **
	Overburden	Crushable Brown	Blue	
a) Face taken back to ± half distance of 1995,1996 floor at RL 25	0,143	0,136	1,739	0,078
b) Face taken back to northern boundary of 1995,1996 floor at RL 25	0,106	0,101	1,482	0,068
c) Full floor taken down from RL 25 to RL 5	-	-	1,225	0,000
Totals	0,249	0,237	4,446	

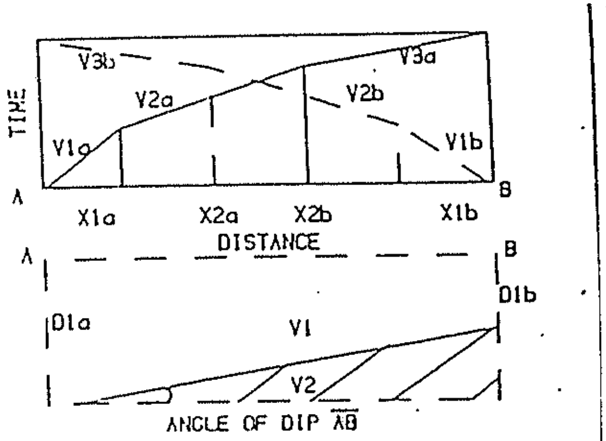
NOTE: This ratio has assumed, crushable brown (first and second) is saleable at two thirds the value of crushed blue.

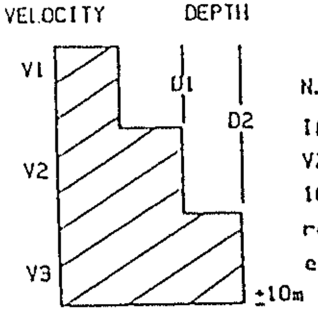
SOILS DESIGN LABORATORIES (NATAL)

SEISMIC SURVEY

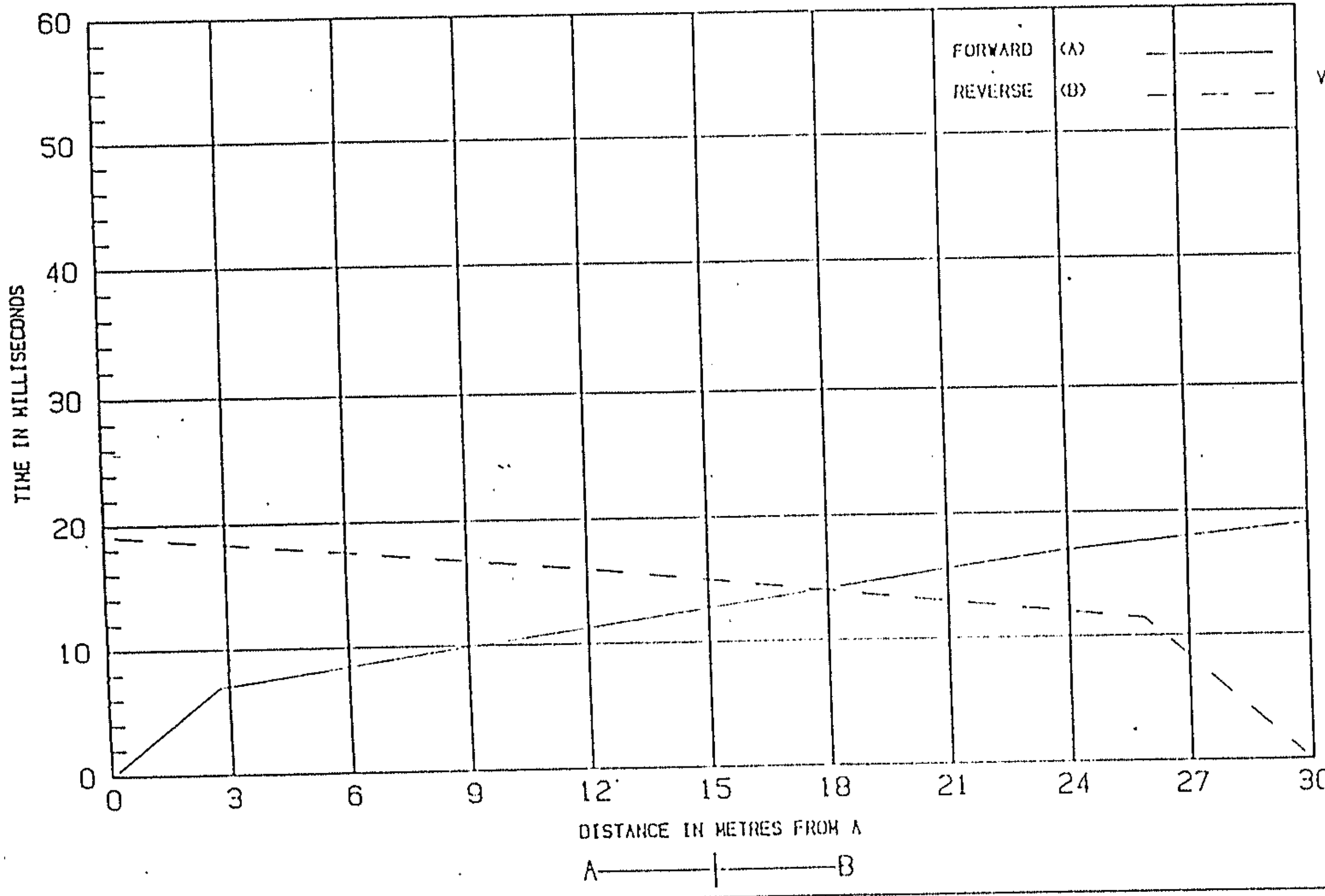
CLIENT : De Leuw Cather Loudon Inc.
PROJECT : Proposed extension to Margate Quarry.
BEARING (Magnetic) : 287 deg N.W.
DATE : 1983 11 10

TRAVERSE NO. : 7
POSITION : As per plan.
JOB CARD NO. : 17428





N.B. For 30m traverse :
If no V3 is recorded
V2 will extend to +/-
10m and if no V2 is
recorded V1 will
extend to +/- 10m.



RESULT SUMMARY

	A	B
V1 m/sec	400	357
V2 m/sec	2120	3089
V3 m/sec	3000	3750
D1m	1.18	1.83
D2m	5.94	4.32

MEAN V1 m/sec	379
TRUE V2 m/sec	2514
TRUE V3 m/sec	3333
MIDPOINT D1m	1.50
MIDPOINT D2m	5.13

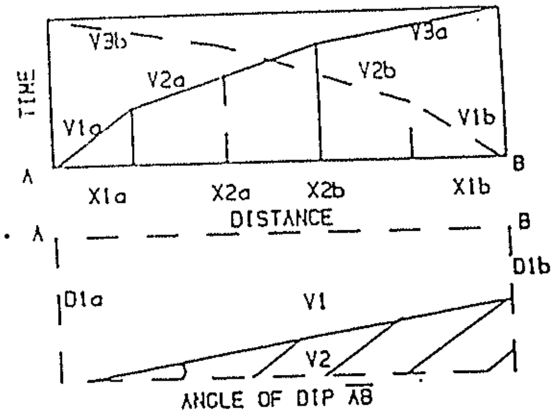
SOILS DESIGN LABORATORIES (NATAL)

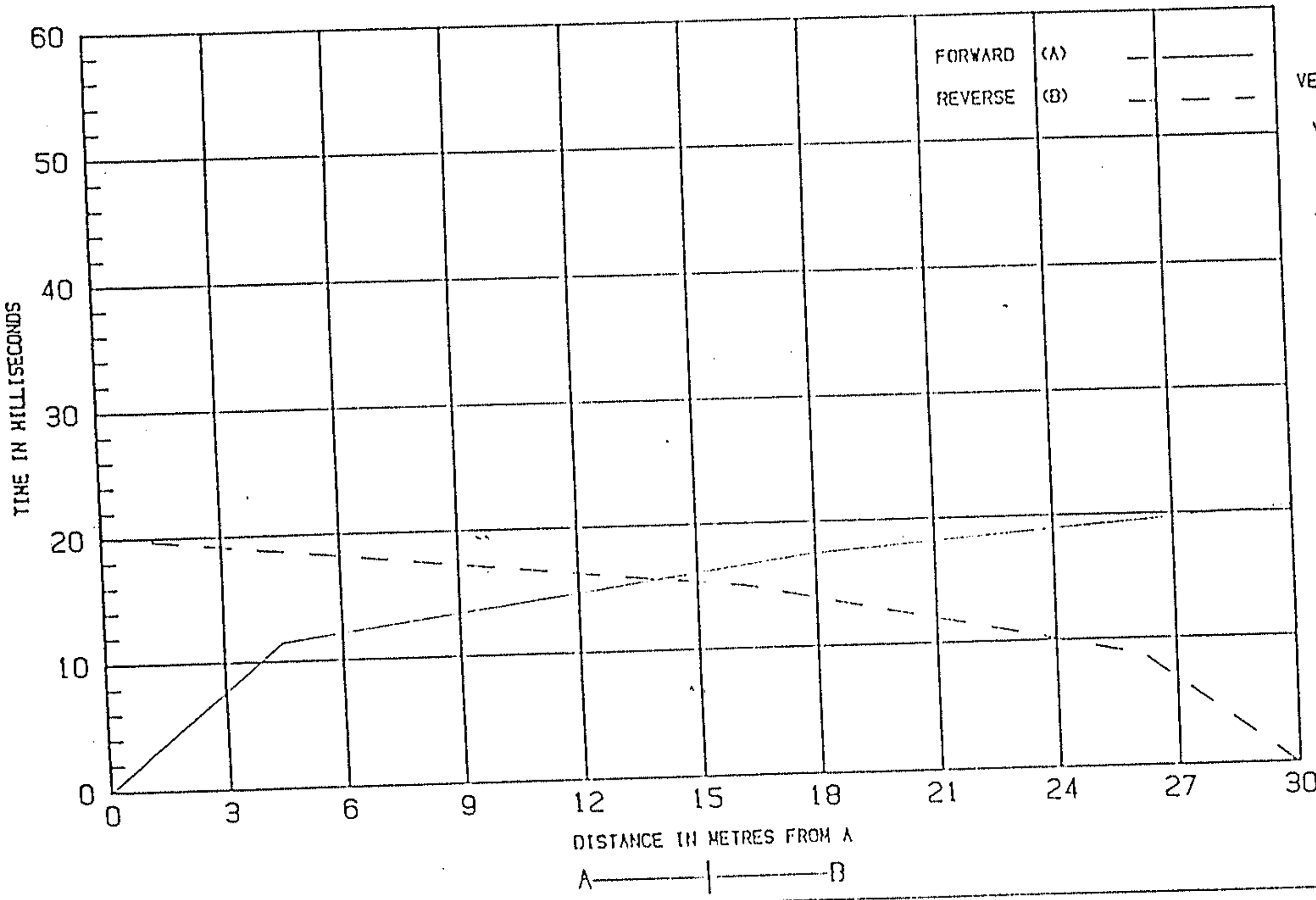
SEISMIC SURVEY

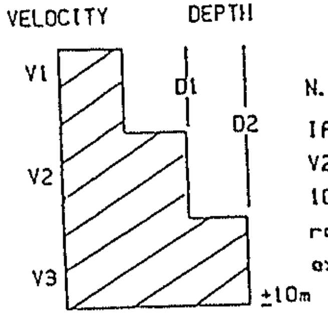
CLIENT : De Leuw Cather Loudon Inc.
PROJECT : Proposed extension to Margate Quarry.
BEARING (Magnetic) : 320 deg N.W.

DATE : 1983 11 10

TRAVERSE NO. : 6
POSITION : As per plan.
JOB CARD NO. : 17428







N.G.L. ///-///-//.

N.B. For 30m traverse ;
If no V3 is recorded
V2 will extend to +/-
10m and if no V2 is
recorded V1 will
extend to +/- 10m.

RESULT SUMMARY

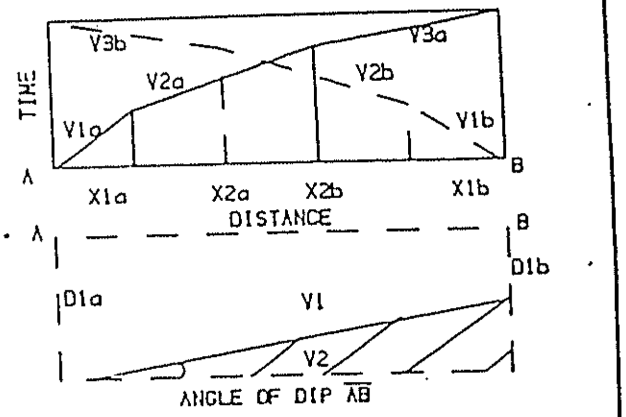
	A	B
V1 m/sec	391	432
V2 m/sec	2250	1587
V3 m/sec	4000	3178
D1m	1.89	1.44
D2m	6.34	5.19
MEAN V1 m/sec	412	
TRUE V2 m/sec	1881	
TRUE V3 m/sec	3541	
MIDPOINT D1m	1.67	
MIDPOINT D2m	5.77	

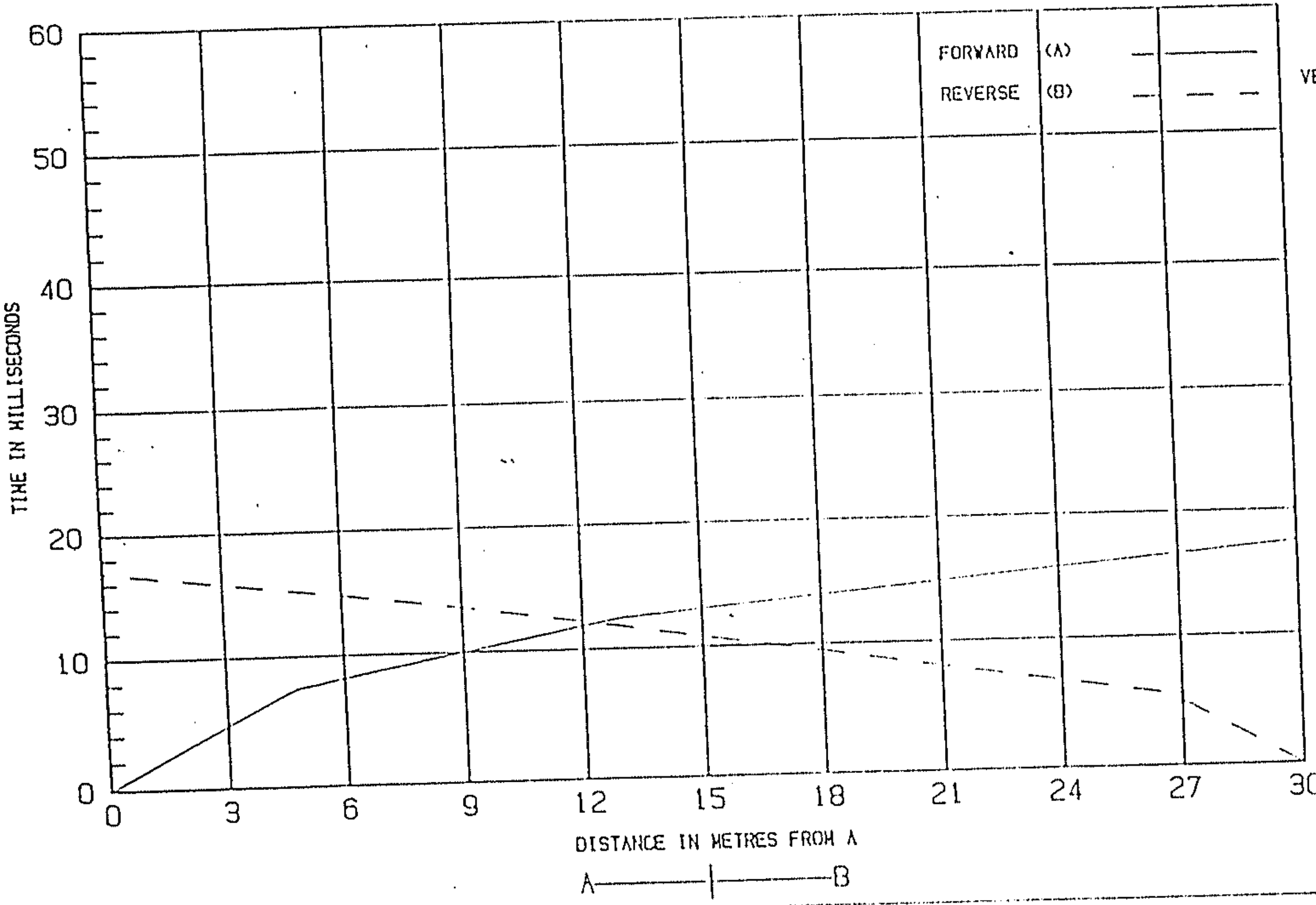
SOILS DESIGN LABORATORIES (NATAL)

SEISMIC SURVEY

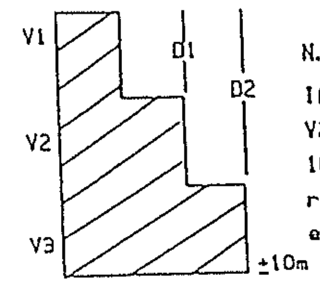
CLIENT : De Leuw Cather Loudon Inc.
PROJECT : Proposed extension to Margate Quarry.
BEARING (Magnetic) : 305 deg N.W.
DATE : 1983 11 10

TRAVERSE NO. : 10
POSITION : As per plan.
JOB CARD NO. : 17428





VELOCITY DEPTH N.G.L. ///-///-///



N.B. For 30m traverse :
If no V3 is recorded
V2 will extend to +/-
10m and if no V2 is
recorded V1 will
extend to +/- 10m.

RESULT SUMMARY

	A	B
V1 m/sec	840	800
V2 m/sec	1880	2188
V3 m/sec	3380	2700
D1m	1.60	1.25
D2m	5.18	4.59

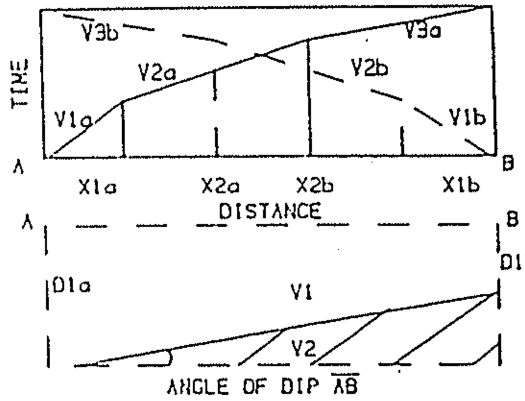
MEAN V1 m/sec	820
TRUE V2 m/sec	1888
TRUE V3 m/sec	3002
MIDPOINT D1m	1.43
MIDPOINT D2m	4.88

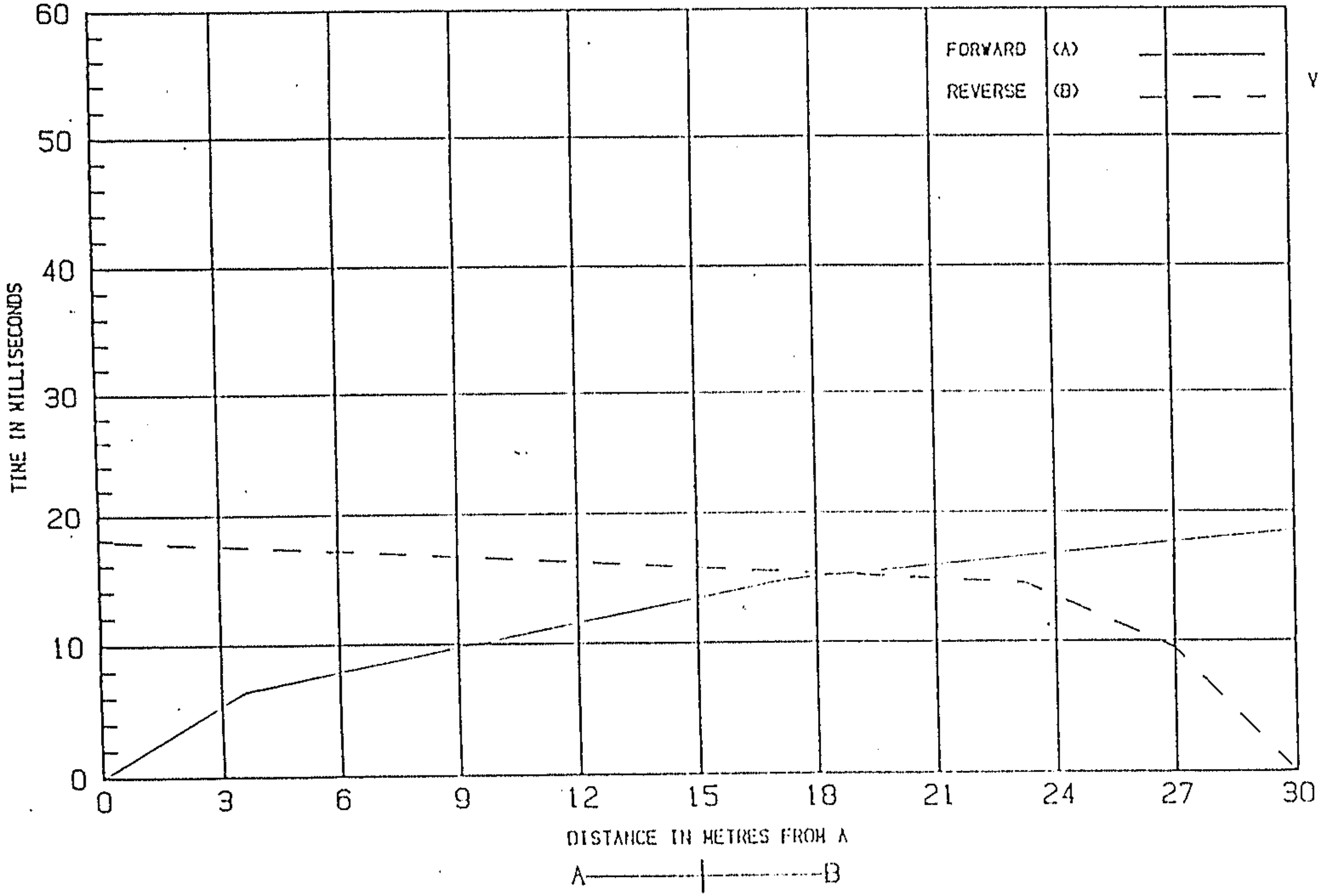
SOILS DESIGN LABORATORIES (NATAL)

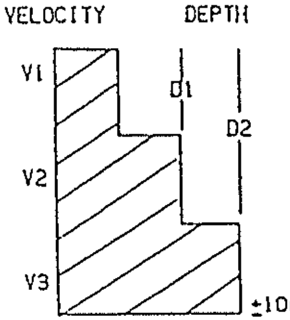
SEISMIC SURVEY

CLIENT : De Leuw Cather Loudon Inc.
PROJECT : Proposed extension to Margate Quarry.
BEARING (Magnetic) : 5 deg N.E.
DATE : 1983 11 10

TRAVERSE NO. : 12
POSITION : As per plan.
JOB CARD NO. : 17428







N.B. For 30m traverse :
If no V3 is recorded V2 will extend to +/- 10m and if no V2 is recorded V1 will extend to +/- 10m.

RESULT SUMMARY

	A	B
V1 m/sec	554	318
V2 m/sec	1651	760
V3 m/sec	3432	6829
D1m	1.27	.96
D2m	6.18	3.83

MEAN V1 m/sec	435
TRUE V2 m/sec	1041
TRUE V3 m/sec	4523
MIDPOINT D1m	1.12
MIDPOINT D2m	5.01

BOREHOLE CORE LOG

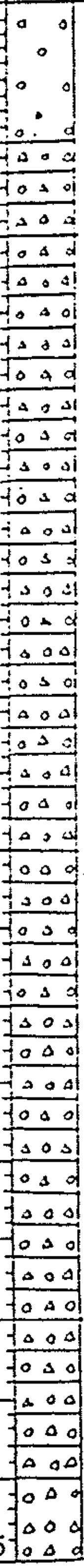
P. G. Hartopp and Associates

Contractor: McLaren & Eger
Driller:

PROJECT: Margate Quarries
Site: Margate
Job No.: EG 366(d)
Logged By: PGH Date: 30/11/83
Machine:
Drilling Started: Completed:

HOLE No: DD4
Sheet: 1
Location:
Elevation:
Orientation: Vert.

Drilling Method Size, Barrel, Bit	% Core Recovery	R.Q.D. %	Fracture Frequency	Test or Sample	Value	Depth Metres	Legend	Description
NXC	23%	NIL	N/A			0 1		Grey brown, soft to hard rock, weathered gravels and boulders
	100%	99%				2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 21,5		Blue, hard rock, fresh, sound, solid tillite.



⊥	Standard Penetration Test	[	Permeability Test	N	S.P.T. Result
≚	Water Level	●	Disturbed Sample	I	Classification Test
------	Approximate Material Changes	▮	Undisturbed Sample	S	Strength Test
				C	Consolidation Test

REMARKS:

BOREHOLE CORE LOG

P.G. Hartopp and Associates

Contractor: McLaren & Eger
Driller:

PROJECT: Margate Quarries
Site: Margate
Job No.: EG 366 (d)
Logged By: PGH Date: 30/11/83
Machine:
Drilling Started: Completed:

HOLE No: DD1
Sheet: 1
Location:
Elevation:
Orientation: Vert

Drilling Method Size, Barrel, Bit	% Core Recovery	R.Q.D. %	Fracture Frequency	Test or Sample	Value	Depth Metres	Legend	Description
NXC	100%	NIL	N/A			0 1		Moist, brown to orange, firm, (fiss) sandy clay - top soil.
	30%	NIL	N/A			2		Light grey brown gravel & boulder, soft rock, weathered, shattered tillite - residual
	100%	332/400 =83%				3 4 5 6		Blue, hard rock, fresh, fissured, solid tillite
	689/710 =97%	100%				7 8 9 10 11 12 13		

Standard Penetration Test
Water Level
...... Approximate Material Changes
[Permeability Test
● Disturbed Sample
Undisturbed Sample
N S.P.T. Result
I Classification Test
S Strength Test
C Consolidation Test

REMARKS:

CABLE / AIR

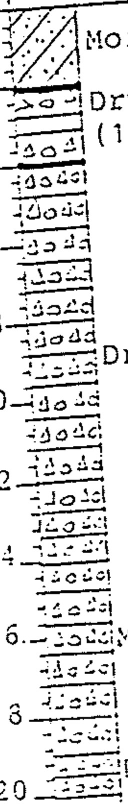
PROJECT D. AND H. CONSULTING. | HOLE No P/BH.1.

P.G.Hartopp and Associates

Contractor McLaren & Eger.
Driller Sweetman.

Site: Margate Quarries.
Job No.: EG.366(d)
Logged By: P.G.Hartopp Date 16.11.83
Machine: I.R. Track Rig.
Drilling Started: .... Completed............

Sheet: 1.
Location: ....
Elevation: ....
Orientation: Vertical

Drillers Description Material Air Loss Cavity Water Collapse	Hole Size Casing	Test Value	Penetration Rate (Mins/m)	Av. Chip Size	Depth Metres	Legend	Description
			2		0		Moist yellow brown sandy clay - O.B.
			2		2		Dry brown grey weathered tillite - (1st Br.) - B.C.
			2				
			5		4		
			5				
			5		6		
			5				
			5		8		Dry blue solid tillite - C.
			5				
			← NO TIMES →		10		
					12		
		← Seepage →			14		
					16		Moist blue solid tillite - C.
					18		
							Dry blue solid tillite - C.
					20		

Standard Penetration Test
Water Level
Approximate Material Changes
[Permeability Test
C Disturbed Sample
[Undisturbed Sample
N S.P.T. Result
I Classification Test
S Strength Test
C Consolidation Test

REMARKS:

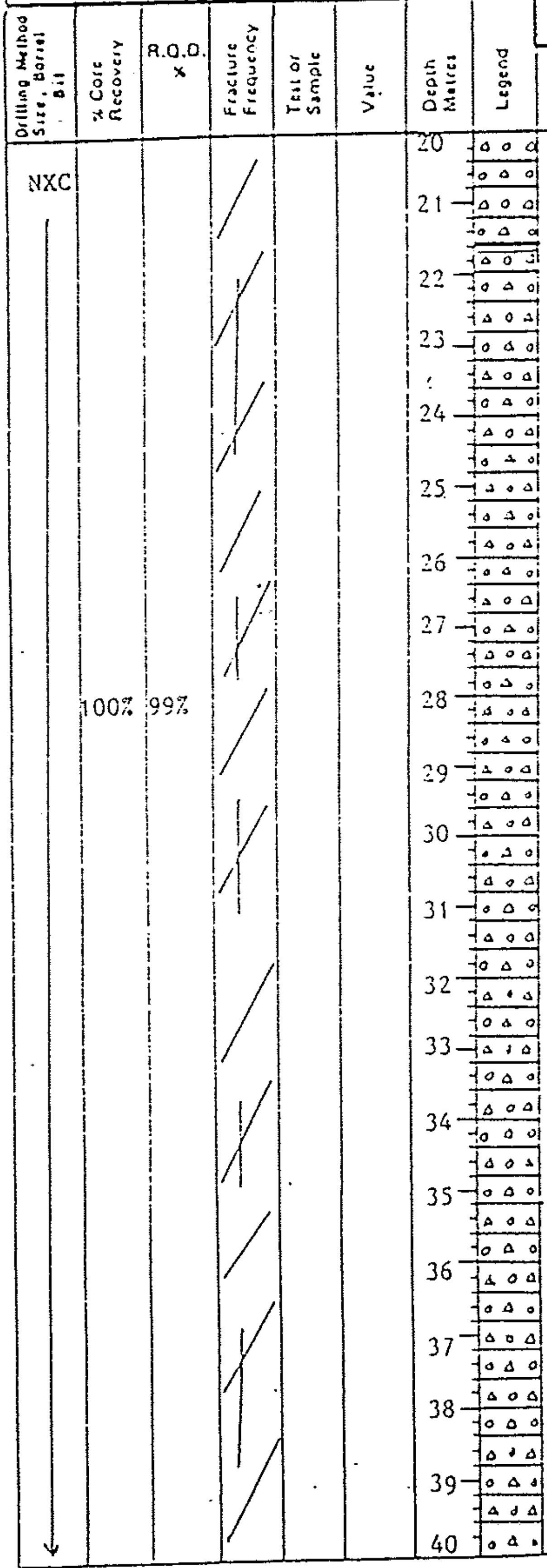
BOREHOLE CORE LOG

P.G. Hartopp and Associates

Contractor McLaren & Eger
Driller

PROJECT Margate Quarries
Site: Margate
Job No.: EG 366 (d)
Logged By: P.G.H. Date 1/12/83
Machine.
Drilling Started: Completed

HOLE No DD4
Sheet: 2
Location:
Elevation:
Orientation: Vert



Depth Metres	Description
21.5	Black, laminated shale zone. (20 mm thick)
28–29	Blue, hard rock, fresh, sound solid tillite, with closed joints with pyrite plus calcite and quartz.

Standard Penetration Test	[Permeability Test	N	S.P.T. Result
Water Level	● Disturbed Sample	I	Classification Test
.... Approximate Material Changes	▮ Undisturbed Sample	S	Strength Test
		C	Consolidation Test

REMARKS:

BOREHOLE CORE LOG

P. G. Hartopp and Associates

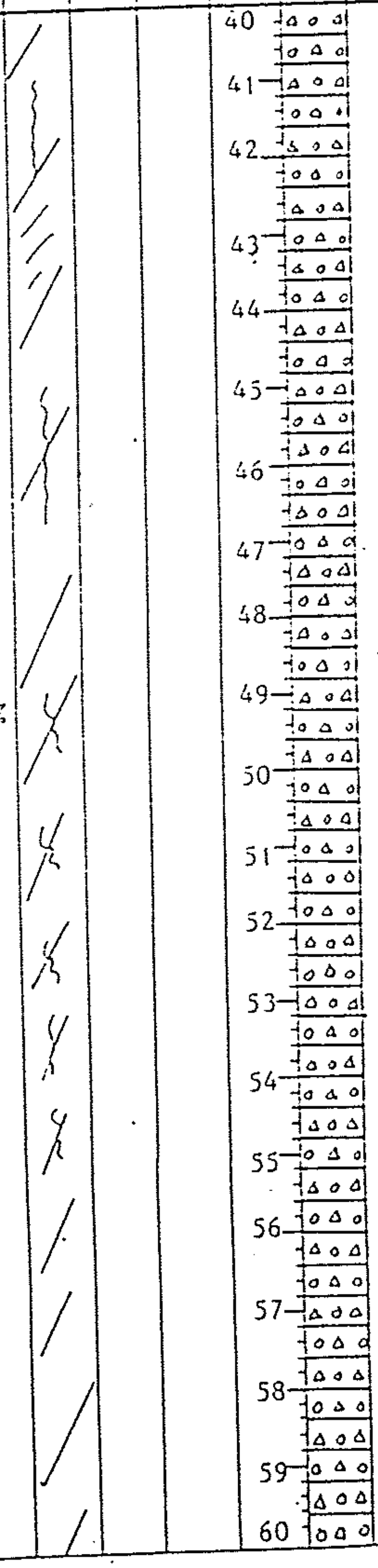
PROJECT: Margate Quarries
HOLE No: DD4

Site: Margate
Job No.: EG 366(d)
Logged By: P.G.H. Date: 1/12/83
Machine:
Drilling Started: Completed:

Sheet: 3
Location:
Elevation:
Orientation: Vert

Contractor: McLaren & Eger
Driller:

Drilling Method Size, Barrel Bit	% Core Recovery	R.Q.D. %	Fracture Frequency	Test or Sample	Value	Depth Metres	Legend	Description
NXC	100%	99%				40–60		Blue, hard rock, fresh, sound solid tillite with closed joints with pyrite and calcite and quartz.



Standard Penetration Test
Water Level
Approximate Material Changes
[Permeability Test
● Disturbed Sample
Undisturbed Sample

N S.P.T. Result
I Classification Test
S Strength Test
C Consolidation Test

REMARKS:

CABLE/AIRDRILL LOG

P.G.Hartopp and Associates

PROJECT D. AND H. CONSULTING

HOLE No P/BH.2.

Site: Margate Quarries.

Job No.: EG.366(d).

Logged By: P.G.Hartopp Date 16.11.83

Machine: I.R. Track Rig.

Drilling Started: .... Completed............

Sheet: 1.

Location: ....

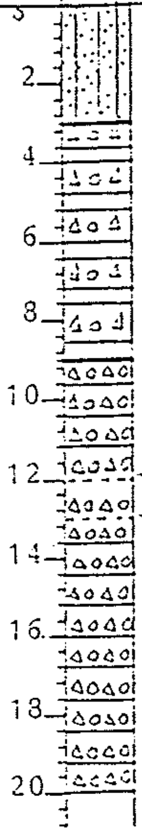
Elevation: ....

Orientation: Vertical

Contractor McLaren & Eger.

Driller Sweetman.

Drillers Description Material Air Loss Cavity Water Collapse	Hole Size Casing	Test Value	Penetration Rate (Mins/m)	Av. Chip Size	Depth Metres	Legend	Description
			NO TIMES				



Moist yellow brown sandy silt - decomposed tillite.

Slightly moist brown grey 1st brown tillite - B.C.

} Moist

Dry blue solid tillite - C.

Dry blue solid tillite - C.

Standard Penetration Test
Water Level
Approximate Material Changes

[Permeability Test
C Disturbed Sample
[Undisturbed Sample

N S.P.T. Result
I Classification Test
S Strength Test
C Consolidation Test

REMARKS:

CABLE / AIRDRILL LOG

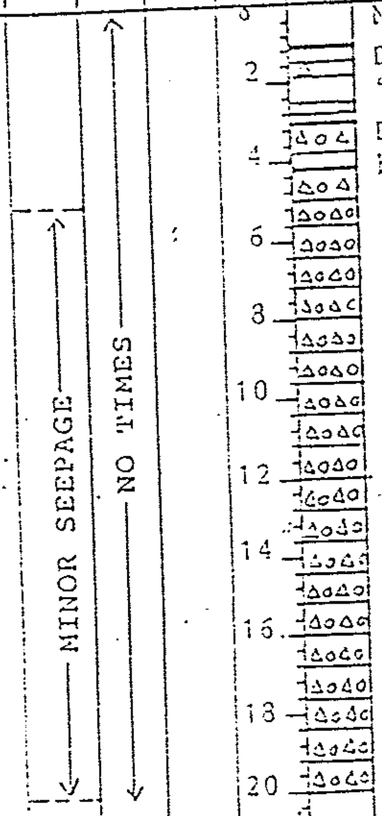
P.G.Hartopp and Associates

Contractor McLaren & Eger.
Driller Sweetman.

PROJECT D. AND H. CONSULTING
Site: Margate Quarries.
Job No.: EG.366(d).
Logged By: P.G.Hartopp Date 16.11.83
Machine: I.R. Track Rig.
Drilling Started: Completed:

HOLE No P/BH.3.
Sheet: 1.
Location:
Elevation:
Orientation: Vertical

Drillers Description Material Air Loss Cavity Water Collapse	Hole Size Casing	Test Value	Penetration Rate (Mins/m)	Av. Chip Size	Depth Metres	Legend	Description



No Sample.

Dry yellow brown decomposed tillite - 4th brown? - fill.

Dry blue/brown solid tillite - (1st brown) - 3.C.

Moist blue solid tillite - C.

⊥ Standard Penetration Test	[Permeability Test	N	S.P.T. Result
Water Level	● Disturbed Sample	I	Classification Test
---- Approximate Material Changes	[Undisturbed Sample	S	Strength Test
		C	Consolidation Test

REMARKS:

CABLE / AIRDRILL LOG

P.G.Hartopp and Associates

PROJECT D. AND H. CONSULTING

HOLE No P/BH.4.

Site: Margate Quarries.

Job No.: EG.366(d).

Logged By: P.G.Hartopp

Date 16.11.83

Machine: I.R. Track Rig.

Drilling Started: .... Completed........

Sheet: 1.

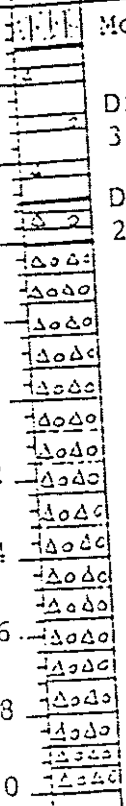
Location: ....

Elevation: ....

Orientation: Vertical

Contractor McLaren & Eger.

Driller Sweetman.



Drillers Description Material Air Loss Cavity Water Collapse	Hole Size Casing	Test Value	Penetration Rate (Mins/m)	Av. Chip Size	Depth Metres	Description
					0	Moist brown topsoil - O.B.
			2			
			2		2	
			5			Dry brown yellow weathered tillite - 3rd brown - fill.
			5		4	
			5			Dry brown green weathered tillite - 2nd brown - B.C.?
			5		6	
			5			
			5		8	
			5			
			5		10	
			5			
			5		12	
			5			Dry blue solid tillite - C.
			5		14	
			5			
			5		16	
			5			
			5		18	
			5			
			5		20	

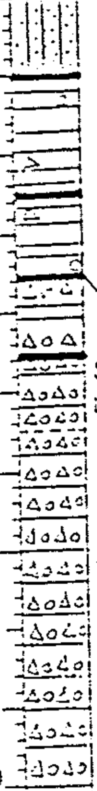
REMARKS:

- ⊥ Standard Penetration Test
- ⊻ Water Level
- —— Approximate Material Changes
- [Permeability Test
- ● Disturbed Sample
- E Undisturbed Sample
- N S.P.T. Result
- I Classification Test
- S Strength Test
- C Consolidation Test

P. G. Hartopp and Associates

PROJECT	D. AND H. CONSULTING
HOLE No	P/BH.5.
Site:	Margate Quarries.
Job No.:	EG.366(d)
Logged By:	P.G.Hartopp
Date	16.11.83.
Machine:	I.R. Track Rig.
Drilling Started:	
Completed	
Sheet:	1.
Location:	
Elevation:	
Orientation:	Vertical
Contractor	McLaren & Eger.
Driller	Sweetman.

Drillers Description Material Air Loss Cavity Water Collapse	Hole Size Casing	Test Value	Penetration Rate (Mins/m)	Av Chip Size	Depth Metres	Legend	Description
			2		0		Moist brown yellow soils and decomposed tillite - 0.3.
			2		2		
			4				Moist yellow very disintegrated tillite - 4th brown - fill.
			5		4		
			5				Slightly moist, grey yellow brown weathered tillite - 2nd and 3rd brown - fill.
			5		6		
			5				
			5				Slightly moist, brown grey slightly weathered tillite - 1st brown - B.C.
			5		8		
			5		10		Slightly moist.
			5				
		STRONG SEEPAGE	5		12		
			5				
			5		14		
			5				Very wet. Blue solid tillite - C.
			5		16		
			5				
			5		18		
			5				
			5		20		



Standard Penetration Test

Water Level

Approximate Material Changes

(Permeability Test

● Disturbed Sample

▮ Undisturbed Sample

N S.P.T. Result

I Classification Test

S Strength Test

C Consolidation Test

REMARKS:

P.G.Hartopp and Associates

Contractor McLaren & Eger
Driller Sweetman.

PROJECT D. AND H. CONSULTING
Site: Margate Quarries.
Job No.: EG.366(d).
Logged By: P.G.Hartopp Date 16.11.83
Machine: I.R. Track Rig.
Drilling Started: .... Completed........

HOLE No P/BH.6.
Sheet: 1.
Location:
Elevation:
Orientation: Vertical

Drillers Description Material Air Loss Cavity Water Collapse.	Hole Size Casing	Test Value	Penetration Rate (Mins/m)	Av Chip Size	Depth Metres	Legend	Description
			2		0		Very moist yellow-brown soil - 0.3.
			2		2		Slightly moist grey-yellow-brown very weathered tillite - 4th brown - fill.
		MINOR SEEPAGE	4 5 5		4		Moist grey brown weathered tillite - 2nd and 3rd brown - B.C.?
			5		6		Moist brown grey slightly weathered tillite - 1st brown - B.C.
			5 5		8		
			5 5		10		
			5 5		12		Moist blue solid tillite - C.
			5 5		14		
			5 5		16		
			5 5		18		
			5 5		20		

↓ Standard Penetration Test	[Permeability Test	N	S.P.T. Result
Water Level	● Disturbed Sample	I	Classification Test
---- Approximate Material Changes	▮ Undisturbed Sample	S	Strength Test
		C	Consolidation Test

REMARKS:

Appendix C: Floral and Faunal Ecological Assessment

FLORAL AND FAUNAL ECOLOGICAL ASSESSMENT AS PART OF THE ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT (EMPR) OF THE MARGATE QUARRY OPERATED BY SOUTH COAST STONE CRUSHERS (SCSC) IN THE VICINITY OF MARGATE, KWAZULU-NATAL PROVINCE

Prepared for

South Coast Stone Crushers (PTY) Ltd.

November 2015

Prepared by:	**Scientific Aquatic Services**
Report Author	**M. Pretorius (Pr. Sci. Nat)** **C. Hooton**
Report Reviewer:	**S. van Staden (Pr. Sci. Nat)** **E. van der Westhuizen**
Report Reference:	**SAS 215215**
Date:	**October 2015**

Scientific Aquatic Services CC
CC Reg No 2003/078943/23
Vat Reg. No. 4020235273
PO Box 751779
Gardenview
2047
Tel: 011 616 7893
Fax: 086 724 3132
E-mail: admin@sasenvironmental.co.za

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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.
Biome	A broad ecological unit representing major life zones of large natural areas – defined mainly by vegetation structure and climate.
Ecoregion	An ecoregion is a "recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterise that region”.
Endangered	Organisms in danger of extinction if causal factors continue to operate.
Indigenous vegetation	Vegetation occurring naturally within a defined area.
Rare	Organisms with small populations at present.
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.
Species of Conservation Concern	The term SCC in the context of this report refers to all RDL (Red Data) and IUCN (International Union for the Conservation of Nature) listed species as well as protected species of relevance to the project.

LIST OF ACRONYMS

°C	Degrees Celsius
BGIS	Biodiversity Geographic Information Systems
CBA	Critical Biodiversity Area
DMR	Department of Mineral Resources
DWA	Department of Water Affairs
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
ESA	Ecological Support Areas
EVC	Extent of Vegetation Cover (used in VIS calculations)
GIS	Geographic Information System
GPS	Global Positioning System
ha	Hectares
HGM	Hydrogeomorphic
IUCN	International Union for the Conservation of Nature
m	Metres
MAP	Mean Annual Precipitation
MAPE	Mean Annual Potential for evaporation
MASMS	Mean Annual Soil Moisture Stress
MAT	Mean Annual Temperature
MEA	Millennium Ecosystem Assessment
mm	Millimetre
MPRDA	Mineral and Petroleum Resources Development Act (Act 28 of 2002)
MU	Management Unit
NBA	National Biodiversity Assessment
NEMA	National Environmental Management Act (Act 107 of 1998)
NEMBA	National Environmental Management: Biodiversity Act (Act 10 of 2004)
NPAES	National Protected Areas Expansion Strategy (2008)
PES	Present Ecological State
POC	Probability of Occurrence.
PRECIS	Pretoria Computer Information Systems
PVC	Percentage Vegetation Cover of indigenous species (used in VIS calculations)
QDS	Quarter Degree Square
RDL	Red Data Listed

RDSIS	Red Data Sensitivity Index Score
RIS	Recruitment of Indigenous species (used in VIS calculations)
SABAP 2	Southern African Bird Atlas 2
SAFAP	South African Frog Atlas
SANBI	South African National Biodiversity Institute
SAS	Scientific Aquatic Services CC
SCC	Species of Conservation Concern
SI	Structural Intactness (used in VIS calculations)
TSP	Threatened Species Programme
TSS	Total Species Score (used in SCCSIS calculations)
VIS	Vegetation Index Score
VMP	Vegetation Management Plan
WESSA	Wildlife and Environment Society of South Africa
WUL	Water Use License

1. INTRODUCTION

1.1 Background

Scientific Aquatic Services (SAS) was appointed to conduct a floral and faunal ecological and biodiversity assessment, as well as developed a biodiversity and vegetation management plan as part of amendments to the Environmental Management Programme Report (EMPr) for South Coast Stone Crushers (SCSC) Margate quarry, hereafter referred to as the “study area” (Figures 1 & 2). The study area is situated in the near Margate in the vicinity of the town of Margate, approximately 0.5 km northwest of the R61 roadway.

The mine has been operating with an approved EMPr under the Minerals and Petroleum Resources Development Act (MPRDA; Act 28 of 2002), but it is required that this document be aligned with the National Environmental Management Act (NEMA; Act 107 of 1998) and the current Environmental Impact Assessment (EIA) Regulations that were promulgated in December 2014. The existing SCSC EMPr was last revised in 2000 and as such the information and management measures are outdated. The revision of the EMPr is further necessitated as SCSC is proposing to expand the existing operations onto adjacent land that were not previously assessed (Figure 3).

The mine seeks to expand operations onto adjacent land and is required to amend the existing EMPr to assess and provide management measures regarding the planned activities on currently undeveloped portions of land that were not previously assessed. The amendment will require the compilation of a new EMPr as per the NEMA requirements. In addition, SCSC is currently applying for a Water Use Licence (WUL) for the facility and its supporting infrastructure.

The ecological assessment was confined to the study area and its immediate surrounds and did not include an ecological assessment of surrounding properties. The surrounding area was however considered as part of the desktop assessment of the area.

This report, after consideration and the description of the ecological integrity of the study area, must therefore inform the Environmental Assessment Practitioner (EAP), regulatory authorities and mining proponent, by means of the presentation of results and recommendations as to the required terrestrial biodiversity management measures for SCSC to be included in the EMPr amendment.

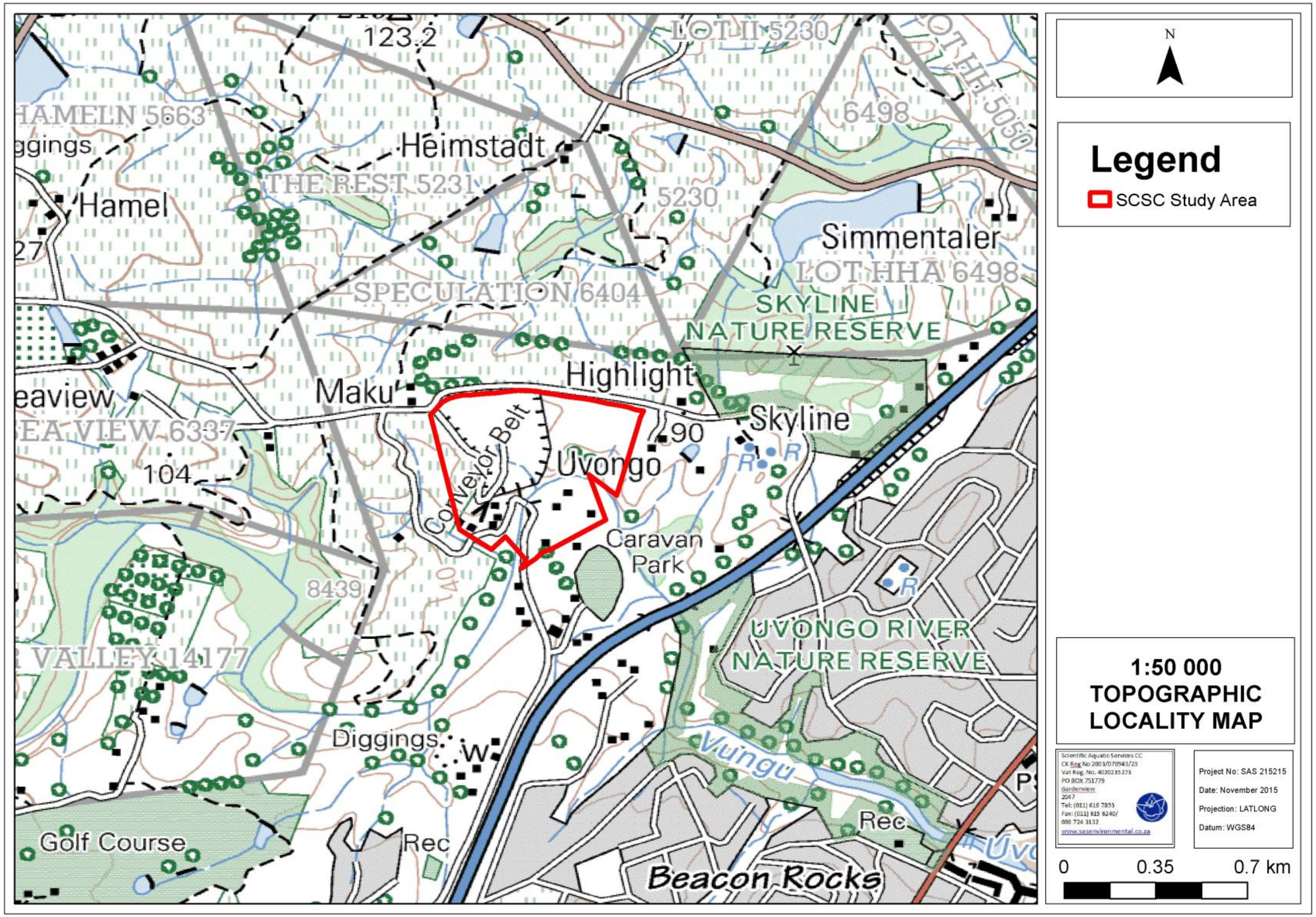

Figure 1: The study area depicted on a 1:50 000 topographical map in relation to its surrounding area.

Figure 2: Digital Satellite image depicting the location of the study area in relation to surrounding areas.

SOUTH COAST STONE CRUSHERS: PROGRESSIVE REHABILITATION MAP

Key:
---- Current Mining Area
---- Proposed Mining Area (2015- 2020)
---- Proposed Mining Area (2020 – 2036)
---- Rehabilitation Zone (2015)

Figure 3: Digital Satellite image depicting the location of the existing mining operation in relation to the proposed mine expansion areas.

1.2 Project Scope

Specific outcomes in terms of this report are outlined below.

Ecological Assessment:

- To describe the overall mining environment from a biodiversity perspective;
- To identify and provide of a list of floral and faunal species that occur within the study area;
- To determine and describe habitat types, communities and the ecological state of the study area and to rank each habitat type based on conservation importance and ecological sensitivity;
- To identify floral and faunal Species of Conservation Concern (SCC) including protected and endangered species that may require protection or rescue, as well as the potential for such species to occur within the study area;
- To describe the spatial significance of the study area with regards to surrounding natural areas;
- To determine the environmental impacts of the proposed mine expansion activity on the terrestrial ecology within the study area and to develop mitigation and management measures as well as a directive advising future mining development/ expansion;
- To develop a biodiversity and vegetation management plan for the mine for implementation during the ongoing operational phase and to include a re-vegetation plan, plant species to be used and procedure to be followed. The management plan was designed to manage and control alien invasive vegetation within and immediately surrounding the mining activity; and
- To provide a list of floral species recommended for use during closure and progressive rehabilitation initiatives.

1.3 Assumptions and Limitations

The following assumptions and limitations are applicable to this report:

- The ecological assessment is confined to the study area as per Figures 1 & 2 and does not include the neighbouring and adjacent properties; these were however considered as part of the desktop assessment;
- The data presented in this report are based on one site visit, undertaken in September 2015. A more accurate assessment would require that assessments take place in all seasons of the year;

- Certain areas within the study area such as steep cliffs and slopes associated with the Coastal Forest Habitat Unit were not accessible by foot and were therefore not assessed in detail;
- Due to the nature and habits of most faunal taxa and the high level of surrounding anthropogenic activities, it is unlikely that all species would have been observed during a site assessment of limited duration. Therefore, site observations were compared with literature studies where necessary;
- With ecology being dynamic and complex, some aspects (some of which may be important) may have been overlooked. It is, however, expected that most faunal and floral communities have been accurately assessed and considered;
- Sampling by its nature, means that not all individuals are assessed and identified. With ecology being dynamic and complex, some aspects (some of which may be important) may have been overlooked due to seasonal and temporal variances. It is, however, expected that most faunal and floral communities have been accurately assessed and considered;
- Due to the phasing of the project, and unseasonal drought conditions, no effective wet season survey could be performed and it is likely that species dependant on rainfall to emerge and flower could have been overlooked. Extensive literature reviews of national, regional and local species databases were undertaken in order to address any perceived gaps in knowledge in order to accurately assess the faunal and floral ecology of the area; and
- The effects of natural seasonal and long-term variation in the ecological conditions are unknown, as terrestrial ecosystems are dynamic and complex. It is therefore possible that aspects of the ecology of the study area, some of which may be important, could have been overlooked.

1.4 Indemnity and Terms of Use of This Report

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

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1.5 Legislative Requirements

National Environmental Management Act (Act 107 of 1998)

The National Environmental Management Act (NEMA; Act 107 of 1998) and the associated Environmental Impact Assessment (EIA) Regulations (GN R982 of 2014) and well as listing notices 1, 2 and 3 (GN R983, R984 and R985 of 2014), state that prior to any development taking place which triggers any activity as listed within the abovementioned regulations, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment process or the EIA process depending on the nature of the activity and scale of the impact.

The guiding principles of NEMA (Act 107 of 1998) refer specifically to biodiversity management in the following Clause:

- (4)(a) Sustainable development requires the consideration of all relevant factors including the following:
- (i) That the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied.

National Environmental Management Biodiversity Act (NEMBA, Act 10 of 2004)

The objectives of this act are (within the framework of NEMA) to provide for:

- the management and conservation of biological diversity within the Republic of South Africa and of the components of such diversity;
- the use of indigenous biological resources in a sustainable manner;

- the fair and equitable sharing among stakeholders of benefits arising from bio prospecting involving indigenous biological resources;
- to give effect to‘ ratified international agreements relating to biodiversity which are binding to the Republic;
- to provide for co-operative governance in biodiversity management and conservation; and
- to provide for a South African National Biodiversity Institute (SANBI) to assist in achieving the objectives of this Act.

This act alludes to the fact that management of biodiversity must take place to ensure that the biodiversity of surrounding areas are not negatively impacted upon, by any activity being undertaken, in order to ensure the fair and equitable sharing among stakeholders of benefits arising from indigenous biological resources.

Furthermore a person may not carry out a restricted activity involving either:

a) a specimen of a listed threatened or protected species
b) specimen of an alien species; or
c) a specimen of a listed invasive species without a permit.

The NEMBA: Alien and Invasive Species Regulations, 2014, are also applicable.

National Forests Act (NFA, Act 84 of 1998, as amended in 2011)

In terms of section 15(1) of the NFA (Act No. 84 of 1998, as amended in 2011):

- No person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree or any forest product derived from a protected tree, except under a licence granted by the Minister to an applicant and subject to such period and conditions as may be stipulated.

KwaZulu-Natal Nature Conservation Management Amendment Act, Act 5 of 1999

- The sixth schedule of the Act lists specially protected indigenous plants.
- The seventh schedule of the Act lists protected indigenous plants.

<u>Restricted activities involving specially protected indigenous plants:</u>

Under Section 59 of this Act, no person may gather, export, import, introduce, purchase, sell, relocate or translocate a specially protected indigenous plant except under the authority of a permit issued by the Conservation Service and in accordance with any special protective measures listed in Section 63.

Under Section 60 of this Act, a person found in possession of a specially protected indigenous plant about where there is reasonable suspicion, that:

- (a) The plant has not been lawfully acquired from a person entitled to sell it;
- (b) The possession of the plant is not authorised by a relevant permit

And who is unable to give a satisfactory account of his or her possession commits an offence.

<u>Restricted activities involving protected indigenous plants:</u>

Under Section 61 of this Act,

(1) no person may:
  - (a) Gather a protected indigenous plant growing in the wild; or
  - (b) Convey, export or sell a protected indigenous plant,

Except under the authority of a permit issued by the Conservation Service and in accordance with any special protective measures listed in Section 63.

(2) A person may only purchase a protected indigenous plant from a person who is legally entitled to sell the plant.

Under Section 62 of the Act,

(1) No person may gather or transport an indigenous plant growing in the wild except with the prior permission of:
  - (a) The owner of the land on which it was gathered or from which it was transported; or
  - (b) The relevant tribal authority.

(2) The person under subsection (1) must produce the written permission when called upon to do so by an officer, a member of the South African Police Services or a peace officer.

Natal Nature Conservation Ordinance, No. 15 of 1974

- Section 201A of Chapter XI of the ordinance allows for the issuing of permits for the relocation of specially protected plants;
- Schedule 12 of the ordinance list specially protected indigenous plants;
- <u>This Act has been repealed by the Natal Nature Conservation Management Amendment Act, Act 5 of 1999.</u>

Kwazulu-Natal Environmental, Biodiversity and Protected Areas Management Bill, 2014

- Schedule 7 provides for Kwazulu-Natal Threatened Plant Species. No person is allowed to wilfully damage or destroy any specimen or destroy or damage the habitat of plant species listed in Schedule 7 without a permit;
- Schedule 8 provides for Kwazulu-Natal Protected Plant Species. No person may carry out any activity that may negatively impact on the survival of species listed in Schedule 7, ecological communities of which the species forms part, or its habitat, unless the activity is specifically exempted in the Schedule;
- This bill is to repeal the KwaZulu-Natal Nature Conservation Management Amendment Act, Act 5 of 1999 and Natal Nature Conservation Ordinance, No. 15 of 1974 once approved.

2. ASSESSMENT APPROACH

2.1 General approach

In order to accurately determine the Present Ecological State (PES) of the study area and capture comprehensive data with respect to floral and faunal taxa, the following methodology was used:

- Maps, aerial photographs and digital satellite images were consulted prior to the field assessment in order to determine broad habitats, vegetation types and potential sites of high or increased ecological sensitivity. An initial visual on-site assessment of the study area was made in order to confirm the assumptions made during consultation of the maps;
- A literature review with respect to habitats, vegetation types and species distribution was conducted;
- Relevant databases considered during the assessment of the study area included the South African National Biodiversity Institute (SANBI) Threatened Species Programme (TSP) and Pretoria Computer Information Systems (PRECIS);
- A field assessment was undertaken during September 2015 to determine the ecological status of the study area and the surrounding areas. A reconnaissance ‘walkabout’ was initially undertaken to determine the general habitat types found throughout the study area and, following this, specific study sites were selected that were considered to be representative of the habitats found within the area, with special emphasis being placed on areas that may potentially support floral and faunal SCC. Sites were investigated on foot in order to identify the occurrence of the dominant species and habitat diversities; and

- Specific methodologies for the assessment, in terms of field work and data analysis of floral and faunal ecological assemblages will be presented in the relevant sections following below.

2.2 Floral Method of Assessment

2.2.1 Species of Conservation Concern (SCC)

Prior to the field visit, a record of SCC floral species and their habitat requirements was acquired from SANBI for the Quarter Degree Square (QDS) 3030CD (Available on request). Throughout the floral assessment, special attention was paid to the identification of any of these RDL species as well as the identification of suitable habitat that could potentially support these species.

The Probability of Occurrence (POC) for each floral species of concern within the QDS 3030CD was determined using the following calculations wherein the habitat requirements and level of habitat disturbance were considered. The accuracy of the calculation is based on the available knowledge about the species in question, with many of the species lacking in-depth habitat research. Therefore, it is important that the literature available is also considered during the calculation.

Each factor contributes an equal value to the calculation.

Literature availability

	No Literature available					**Literature available**
Site score						
Score	0	1	2	3	4	5

Habitat availability

	No Habitat available					**Habitat available**
Site score						
Score	0	1	2	3	4	5

Habitat disturbance

	0	**Very Low**	**Low**	**Moderately**	**High**	**Very High**
Site score						
Score	5	4	3	2	1	0

[Literature availability + Habitat availability + Habitat disturbance] / 15 x 100 = POC%

2.2.2 Vegetation Surveys

Vegetation surveys were undertaken by first identifying different habitat units and then analysing the floral species composition. Vegetation analyses were conducted within areas that were perceived to best represent the various plant communities. Species were recorded and a species list was compiled for each habitat unit. These species lists were also compared with the vegetation expected to be found within the relevant vegetation types as described in Section 4.3 and 4.4, which serves to provide an accurate indication of the ecological integrity and conservational value of each habitat unit.

2.2.3 Vegetation Index Score

The Vegetation Index Score (VIS) was designed to determine the ecological state of each habitat unit defined within an assessment site. This enables an accurate and consistent description of the PES concerning the study area in question. The information gathered during these assessments also significantly contributes to sensitivity mapping, leading to a more truthful representation of ecological value and sensitive habitats.

Each defined habitat unit is assessed using separate data sheets (Appendix A) and all the information gathered then contributes to the final VIS score. The VIS is derived using the following formulas:

VIS = [(EVC)+((SIxPVC)+(RIS))]

Where:

1. **EVC** is extent of vegetation cover;
2. **SI** is structural intactness;
3. **PVC** is percentage cover of indigenous species and
4. **RIS** is recruitment of indigenous species.

Each of these contributing factors is individually calculated as discussed below. All scores and tables indicated in blue are used in the final score calculation for each contributing factor.

1. EVC=[[(EVC1+EVC2)/2]

EVC 1 - Percentage natural vegetation cover						
Vegetation cover %	**0%**	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Site score						
EVC 1 score	0	1	2	3	4	5

EVC 2 – Total site disturbance						
Disturbance score	**0**	**Very low**	**Low**	**Moderate**	**High**	**Very high**
Site score						
EVC 2 score	5	4	3	2	1	0

2. SI=(SI1+SI2+SI3+SI4)/4)

	Trees (S1)		**Shrubs (S2)**		**Forbs (S3)**		**Grasses (S4)**	
Score	Present state*	Perceived reference state**	Present state	Perceived reference state	Present state	Perceived reference state	Present state	Perceived reference state
Continuous								
Clumped								
Scattered								
Sparse								

*Present State (P/S) = currently applicable for each habitat unit

**Perceived Reference State (PRS) = if in pristine condition

Each SI score is determined with reference to the following scoring table of vegetation distribution for present state versus perceived reference state.

	Present state (P/S)			
Perceived reference state (PRS)	**Continuous**	**Clumped**	**Scattered**	**Sparse**
Continuous	3	2	1	0
Clumped	2	3	2	1
Scattered	1	2	3	2
Sparse	0	1	2	3

3. PVC=[(EVC)-(exotic x 0.7) + (bare ground x 0.3)]

Percentage vegetation cover (exotic)						
	0%	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Vegetation cover %						
PVC score	0	1	2	3	4	5
Percentage vegetation cover (bare ground)						
	0%	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Vegetation cover %						
PVC score	0	1	2	3	4	5

4. RIS

Extent of indigenous species recruitment	**0**	**Very low**	**Low**	**Moderate**	**High**	**Very high**
RIS						
RIS Score	0	1	2	3	4	5

The final VIS scores for each habitat unit are then categorised as follows:

Vegetation Index Score	Assessment Class	Description
22 to 25	**A**	Unmodified, natural
18 to 22	**B**	Largely natural with few modifications
14 to 18	**C**	Moderately modified
10 to 14	**D**	Largely modified
5 to 10	**E**	The loss of natural habitat extensive
<5	**F**	Modified completely

2.3 Faunal Method of Assessment

2.3.1 Desktop Study

As part of the faunal assessment a desktop study was initially undertaken in order to gather background information regarding the study area and its surrounding areas. All the latest available literature was utilised to gain a thorough understanding of the area and its surrounding habitats. Threatened or RDL faunal species which have been recorded in the KwaZulu-Natal Province as per the KwaZulu-Natal Nature Conservation Management Amendment Act (Act 5 of 1999) are listed in Appendix B. This information was cross-referenced with information from the International Union for the Conservation of Nature (IUCN) Red Data list for 2015 (http://www.iucnredlist.org).

2.3.2 Field Assessment

It is important to note that due to the nature and habits of fauna, varied stages of life cycles, seasonal and temporal fluctuations along with other external factors, it is unlikely that all faunal species will have been recorded during the site assessment. In addition, the levels of anthropogenic activity in the study area and surrounding area may determine whether species will be observed.

2.3.2.1 Mammals

Faunal species were recorded during the field assessment with the use of visual identification through random transect walks as well as by means of spoor, call and dung. Possible burrows in the vicinity of the study area were visually inspected for any inhabitants.

2.3.2.2 Avifauna

The Southern African Bird Atlas Project 2 (SABAP2) database (http://sabap2.adu.org.za/) lists for the QDS 3030CD (Appendix C) was compared with the avifaunal sightings as observed during the field assessment. Field surveys were undertaken utilising a pair of Vespa 7x50 binoculars and bird call identification techniques were utilised during the assessment in order to accurately identify avifaunal species.

2.3.2.3 Reptiles

Reptiles were physically identified during the field survey. Where possible, rocks were overturned and inspected and any reptiles encountered were identified. Other habitat areas where reptiles were likely to reside were also investigated. The data gathered during the assessment along with the habitat analysis provided an accurate indication of which reptile species are likely to occur on the study area.

2.3.2.4 Amphibians

All amphibian species encountered within the study area were recorded during the field assessment with the use of direct visual identification along with other identification aids such as call identification. Amphibian species flourish in and around wetland and riparian areas. It is in these areas that specific attention was paid to when searching for amphibian species. However, it is unlikely that all amphibian species will have been recorded during the site assessment, due to their cryptic nature and habits, varied stages of life cycles and seasonal and temporal fluctuations within the environment. However, the data gathered during the assessment along with the habitat analysis provided an accurate indication of which amphibian species are likely to occur on the study area.

2.3.2.5 Invertebrates

A list of visually identified and observed invertebrate species was compiled during the field surveys. However, due to their cryptic nature and habits, varied stages of life cycles, seasonal and temporal fluctuations within the environment, it is unlikely that all invertebrate species have been recorded during the field assessment period. Nevertheless, the data gathered during the general invertebrate assessment along with the habitat analysis provided an accurate indication of which invertebrate species are likely to occur on the study area.

2.3.2.6 Spiders and Scorpions

Suitable habitats, such as natural vegetation and rocky outcrop areas, where spiders and scorpions are likely to reside were searched. Rocks were overturned and inspected for signs of these species. Specific attention was paid to searching for Mygalomorphae arachnids (Trapdoor and Baboon spiders) as well as potential scorpion SCC within the study area.

2.3.3 Species of Conservational Concern Sensitivity Index Score (SCCSIS)

The term SCC in the context of this report refers to all RD (Red Data) and IUCN listed faunal species, as well as protected species of relevance to the project. Lists below are all specified in legislation except for IUCN which is the oldest and largest global environmental organisation and helps the world to find pragmatic solutions to our most pressing environment and development challenges. It should be noted that some species or families considered threatened on a national level may not be considered threatened on a provincial level due to various factors such as stable local population trends; for these species provincial status took precedence.

The following legislations and international listings were used during the SCC consideration:

I. **Provincial conservation:** protected species listed in the KwaZulu-Natal Nature Conservation Management Amendment Act (1999) as well as the KwaZulu-Natal Environmental, Biodiversity and Protected Areas Management Bill (2014), which has yet to be formally promulgated but lends valuable information to the assessment;

II. **National conservation:** National Environmental Management Act (Act 107 of 1998) (NEMA) and National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA), and

III. **Global conservation:** protected species under International Union for the Conservation of Nature (IUCN). Organisms that fall into the Extinct in the Wild (EW), critically endangered (CR), Endangered (EN), Vulnerable (VU) Least Concern (LC), and Data deficient (DD) categories of ecological status.

Given the restrictions of field assessments to identify all the faunal species that possibly occur on a particular property, the SCCSIS has been developed to provide an indication of the potential faunal SCC that could reside in the area, while simultaneously providing a quantitative measure of the study area’s value in terms of conserving faunal diversity. The SCCSIS is based on the principles that when the knowledge of a species’ historical distribution is combined with a field assessment that identifies the degree to which the property supports a species’ habitat and food requirements, interpretations can be made about the probability of that particular species residing within the study area. Repeating this procedure for all the potential faunal SCC of the area and collating this information then provides a sensitivity measure of the property that has been investigated. The detailed methodology to determine the SCCSIS of the property is presented below:

Probability of Occurrence (POC): Known distribution range (D), habitat suitability of the site (H) and availability of food sources (F) on site were determined for each of the species. Each of these variables is expressed a percentage (where 100% is a perfect score). The average of these scores provided a POC score for each species. The POC value was categorised as follows:

- **0-20% = Low;**
- **21-40% = Low to Medium;**
- **41-60% = Medium;**
- **61-80% = Medium to High and**
- **81-100% = High**

POC = (D+H+F)/3

Total Species Score (TSS): Species with POC of more than 60% (High-medium) were considered when applying the SCCSIS. A weighting factor was assigned to the different IUCN categories providing species with a higher conservation status, a higher score. This weighting factor was then multiplied with the POC to calculate the TSS for each species. The weighting as assigned to the various categories is as follows:

- **Data Deficient = 0.2;**
- **Rare = 0.5;**
- **Near Threatened = 0.7;**
- **Vulnerable = 1.2;**
- **Endangered = 1.7 and**
- **Critically Endangered = 2.0**.

TSS = (IUCN weighting*POC) where POC > 60%

Average Total Species (Ave TSS) and Threatened Taxa Score (Ave TT): The average of all TSS potentially occurring on the site is calculated. The average of all the Threatened taxa (TT) (Near threatened, Vulnerable, Endangered and Critically Endangered) TSS scores are also calculated. The average of these two scores (Ave TSS and Ave TT) was then calculated in order to add more weight to threatened taxa with POC higher than 60%.

Ave = Ave TSS [TSS/No of Spp] + Ave TT [TT TSS/No of Spp]/2

SCCSIS: The average score obtained above and the sum of the percentage of species with a POC of 60% or higher of the total number of SCC listed for the area was then calculated. The average of these two scores, expressed as a percentage, gives the SCCSIS for the area investigated.

SCCSIS = Ave + [Spp with POC>60%/Total no Of Spp*100]/2

SCCSIS interpretation:

Table 1: SCCSIS value interpretation with regards to faunal SCC importance on the study area.

SCCSIS Score	SCC mammal importance
0-20%	**Low**
21-40%	**Low-Medium**
41-60%	**Medium**
60-80%	**High-Medium**
81-100%	**High**

3. ECOLOGICAL IMPACT METHOD OF ASSESSMENT

All specialists are required to assess each identified potential impact according to the following Impact Assessment Methodology as described below.

This methodology has been formalised to comply with Regulation 31(2)(l) of the National Environmental Management Act (Act 107 of 1998) (NEMA), which states the following:

(2) An environmental impact assessment report must contain all information that is necessary for the competent authority to consider the application and to reach a decision …, and must include –

(l) an assessment of each identified potentially significant impact, including –

- *(i) cumulative impacts;*
- *(ii) the nature of the impact;*
- *(iii) the extent and duration of the impact;*
- *(iv) the probability of the impact occurring;*
- *(v) the degree to which the impact can be reversed;*
- *(vi) the degree to which the impact may cause irreplaceable loss of resources; and*
- *(vii) the degree to which the impact can be mitigated.*

Based on the above, the EIA Methodology will require that each potential impact identified is clearly described (providing the nature of the impact) and be assessed in terms of the following factors:

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

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

Table 2: Impact Assessment Ranking Scales.

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

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

Significance = (duration + extend + magnitude) x probability

The maximum value that can be calculated for the environmental significance of any impact is 100.

The environmental significance of any identified potential impact is then rated as either: high, moderate or low on the following basis:

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

In order to assess the *degree to which the potential impact can be reversed, cause irreplaceable loss of resources and be mitigated*, each identified potential impact will need to be assessed twice.

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

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

3.1 Mitigation Measure Development

According to the Department of Mineral Resources (DMR; 2013) “Rich biodiversity underpins the diverse ecosystems that deliver ecosystem services that are of benefit to people, including the provision of basic services and goods such as clean air, water, food, medicine and fiber; as well as more complex services that regulate and mitigate our climate, protect people and other life forms from natural disaster and provide people with a rich heritage of nature-based cultural traditions. Intact ecological infrastructure contributes significant savings through, for example, the regulation of natural hazards such as storm surges and flooding by which is attenuated by wetlands”.

According to the DMR (2013), ecosystem services can be divided into four (4) main categories:

- Provisioning services are the harvestable goods or products obtained from ecosystems such as food, timber, fiber, medicine, and fresh water;
- Cultural services are the non-material benefits such as heritage landscapes and seascapes, recreation, ecotourism, spiritual values and aesthetic enjoyment;
- Regulating services are the benefits obtained from an ecosystem’s control of natural processes, such as climate, disease, erosion, water flows, and pollination, as well as protection from natural hazards; and
- Supporting services are the natural processes such as nutrient cycling, soil formation and primary production that maintain the other services.

Loss of biodiversity puts aspects of the economy, wellbeing and quality of life at risk, and reduces socio-economic options for future generations. This is of particular concern for the poor in rural areas who have limited assets and are more dependent on common property resources for their livelihoods. The importance of maintaining biodiversity and intact ecosystems for ensuring on-going provision of ecosystem services, and the consequences of ecosystem change for human well-being, were detailed in a global assessment entitled the Millennium Ecosystem Assessment (MEA, 2005), which established a scientific basis for the need for action to enhance management and conservation of biodiversity.

Sustainable development is enshrined in South Africa's Constitution and laws. The need to sustain biodiversity is directly or indirectly referred to in a number of Acts, not least the National Environmental Management: Biodiversity Act (NEMBA; Act 10 of 2004) and is fundamental to the notion of sustainable development. In addition International guidelines and commitments as well as national policies and strategies are important in creating a shared vision for sustainable development in South Africa (DMR, 2013).

The primary environmental objective of the Minerals and Petroleum Resource Development Act (MPRDA) is to give effect to the environmental right contained in the South African Constitution. Furthermore, Section 37(2) of the MPRDA states that "any prospecting or mining operation must be conducted in accordance with generally accepted principles of sustainable development by integrating social, economic and environmental factors into the planning and implementation of prospecting and mining projects in order to ensure that exploitation of mineral resources serves present and future generations".

Pressures on biodiversity are numerous and increasing. According to the DMR (2013), loss of natural habitat is the single biggest cause of biodiversity loss in South Africa and much of the world. The most severe transformation of habitat arises from the direct conversion of natural habitat for human requirements, including[1]:

- Cultivation and grazing activities;
- Rural and urban development;
- Industrial and mining activities, and
- Infrastructure development.

Impacts on biodiversity can largely take place in four ways (DMR, 2013):

- **Direct impacts:** are impacts directly related to the project including project aspects such as site clearing, water abstraction and discharge of water from riverine resources;

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[1] North West Province Environment Outlook. A Report on the State of the Environment, 2008. Chapter 4.

- **Indirect impacts:** are impacts associated with a project that may occur within the zone of influence in a project such as surrounding terrestrial areas and downstream areas on water courses;
- **Induced impacts:** are impacts directly attributable to the project but are expected to occur due to the activities of the project. Factors included here are urban sprawl and the development of associated industries; and
- **Cumulative impacts:** can be defined as the sum of the impact of a project as well as the impacts from past, existing and reasonably foreseeable future projects that would affect the same biodiversity resources. Examples include numerous mining operations within the same drainage catchment or numerous residential developments within the same habitat for faunal or floral species.

Given the limited resources available for biodiversity management and conservation, as well as the need for development, efforts to conserve biodiversity need to be strategic, focused and supportive of sustainable development. This is a fundamental principle underpinning South Africa's approach to the management and conservation of its biodiversity and has resulted the definition of a clear mitigation strategy for biodiversity impacts.

'Mitigation' is a broad term that covers all components of the 'mitigation hierarchy' defined hereunder. It involves selecting and implementing measures – amongst others – to conserve biodiversity and to protect, the users of biodiversity and other affected stakeholders from potentially adverse impacts as a result of mining or any other land use. The aim is to prevent adverse impacts from occurring or, where this is unavoidable, to limit their significance to an acceptable level. Offsetting of impacts is considered to be the last option in the mitigation hierarchy for any project.

The mitigation hierarchy in general consists of the following in order of which impacts should be mitigated (DMR, 2013):

- **Avoid/prevent impact:** can be done through utilising alternative sites, technology and scale of projects to prevent impacts. In some cases if impacts are expected to be too high the "no project" option should also be considered, especially where it is expected that the lower levels of mitigation will not be adequate to limit environmental damage and eco-service provision to suitable levels;
- **Minimise impact:** can be done through utilisation of alternatives that will ensure that impacts on biodiversity and ecoservices provision are reduced. Impact minimisation is considered an essential part of any development project;

- **Rehabilitate impact:** is applicable to areas where impact avoidance and minimisation are unavoidable where an attempt to re-instate impacted areas and return them to conditions which are ecologically similar to the pre-project condition or an agreed post project land use, for example arable land. Rehabilitation can however not be considered as the primary mitigation tool as even with significant resources and effort rehabilitation that usually does not lead to adequate replication of the diversity and complexity of the natural system. Rehabilitation often only restores ecological function to some degree to avoid ongoing negative impacts and to minimise aesthetic damage to the setting of a project. Practical rehabilitation should consist of the following phases in best practice:
  - **Structural rehabilitation** which includes physical rehabilitation of areas by means of earthworks, potential stabilisation of areas as well as any other activities required to develop a long terms sustainable ecological structure;
  - **Functional rehabilitation** which focuses on ensuring that the ecological functionality of the ecological resources on the study area supports the intended post closure land use. In this regard special mention is made of the need to ensure the continued functioning and integrity of wetland and riverine areas throughout and after the rehabilitation phase;
  - **Biodiversity reinstatement** which focuses on ensuring that a reasonable level of biodiversity is re-instated to a level that supports the local post closure land uses. In this regard special mention is made of re-instating vegetation to levels which will allow the natural climax vegetation community of community suitable for supporting the intended post closure land use; and
  - **Species reinstatement** which focuses on the re-introduction of any ecologically important species which may be important for socio-cultural reasons, ecosystem functioning reasons and for conservation reasons. Species re-instatement need only occur if deemed necessary.
- **Offset impact:** refers to compensating for latent or unavoidable negative impacts on biodiversity. Offsetting should take place to address any impacts deemed to be unacceptable which cannot be mitigated through the other mechanisms in the mitigation hierarchy. The objective of biodiversity offsets should be to ensure no net loss of biodiversity. Biodiversity offsets can be considered to be a last resort to compensate for residual negative impacts on biodiversity.

The significance of residual impacts should be identified on a regional as well as national scale when considering biodiversity conservation initiatives. If the residual impacts lead to irreversible loss or irreplaceable biodiversity the residual impacts should be considered to be of very high significance and when residual impacts are considered to be of very high significance, offset initiatives are not considered an appropriate way to deal with the magnitude and/or significance of the biodiversity loss. In the case of residual impacts determined to have medium to high significance, an offset initiative may be investigated. If the residual biodiversity impacts are considered of low significance no biodiversity offset is required.[2]

In light of the above discussion the following points present the key concepts considered in the development of mitigation measures for the proposed mine expansion activities.

- Mitigation and performance improvement measures and actions that address the risks and impacts[3] are identified and described in as much detail as possible.
- Measures and actions to address negative impacts will favour avoidance and prevention over minimisation, mitigation or compensation.
- Desired outcomes are defined, and have been developed in such a way as to be measurable events with performance indicators, targets and acceptable criteria that can be tracked over defined periods, with estimates of the resources (including human resource and training requirements) and responsibilities for implementation wherever possible.

3.2 Sensitivity Mapping

All the ecological features of the study area were considered and sensitive areas were delineated with the use of a Global Positioning System (GPS). In addition identified locations of Species of Conservation Concern (SCC) were also marked by means of GPS. A Geographic Information System (GIS) was used to project these features onto aerial photographs and topographic maps. The sensitivity map should guide the design and layout of the mine expansion activities.

3.3 Recommendations

Recommendations were developed to address and mitigate impacts associated with the project. These recommendations also include general management measures which apply to the project as a whole. Mitigation measures have been developed to address issues in all

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[2] Provincial Guideline on Biodiversity Offsets, Western Cape, 2007.

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

phases throughout the life of the operation from planning, construction, operation and closure through to after care and maintenance, where applicable.

4. LAND USE AND CONSERVATION CHARACTERISTICS OF THE STUDY AREA

The following sections contain data accessed as part of the desktop assessment. It is important to note, that although all data sources used provide useful and often verifiable high quality data, the various databases used not always provide an entirely accurate indication of the study area's actual site characteristics. This information is however considered to be useful as background information to the study. Thus, this data was used as a guideline to inform the assessment and areas where increased conservation importance is indicated were paid attention to.

4.1 Importance According to the Mining and Biodiversity Guideline (2012)

The Mining and Biodiversity Guideline (2012) provides explicit direction in terms of where mining-related impacts are legally prohibited, where biodiversity priority areas may present high risks for mining projects, and where biodiversity may limit the potential for mining. The Guideline distinguishes between four categories of biodiversity priority areas in relation to their importance from a biodiversity and ecosystem service point of view as well as the implications for mining. These categories include: Legally Protected Areas, Highest Biodiversity Importance, High Biodiversity Importance and Moderate Biodiversity Importance.

According to the Mining Biodiversity Guidelines the study area falls within areas considered to be of Highest Biodiversity Importance and within areas considered to be of High Biodiversity Importance (Figure 4). Highest Biodiversity Importance areas include areas where mining is not legally prohibited, but where there is a very high risk that due to their potential biodiversity significance and importance to ecosystem services (e.g. water flow regulation and water provisioning) that mining projects will be significantly constrained or may not receive necessary authorisations.

High Biodiversity Importance Area are important for conserving biodiversity, for supporting or buffering other biodiversity priority areas, for maintaining important ecosystem services for particular communities or the country as a whole. An environmental impact assessment should include an assessment of optimum, sustainable land use for a particular area and will determine the significance of the impact on biodiversity. Mining options may be limited in these areas, and red flags for mining projects are possible.

The study area is located close to the Skyline Nature Reserve, which is indicated as a Protected Area. Mining projects cannot commence in such an area as mining is legally prohibited. Although mining is prohibited in Protected Areas, it may be allowed in Protected Environments if both the Minister of Mineral Resources and Minister of Environmental Affairs approve it. In cases where mining activities were conducted lawfully in protected areas before Section 48 of the Protected Areas Act (Act 57 of 2003) came into effect, the Minister of Environmental Affairs may, after consulting with the Minister of Mineral Resources, allow such mining activities to continue, subject to prescribed conditions that reduce environmental impacts.

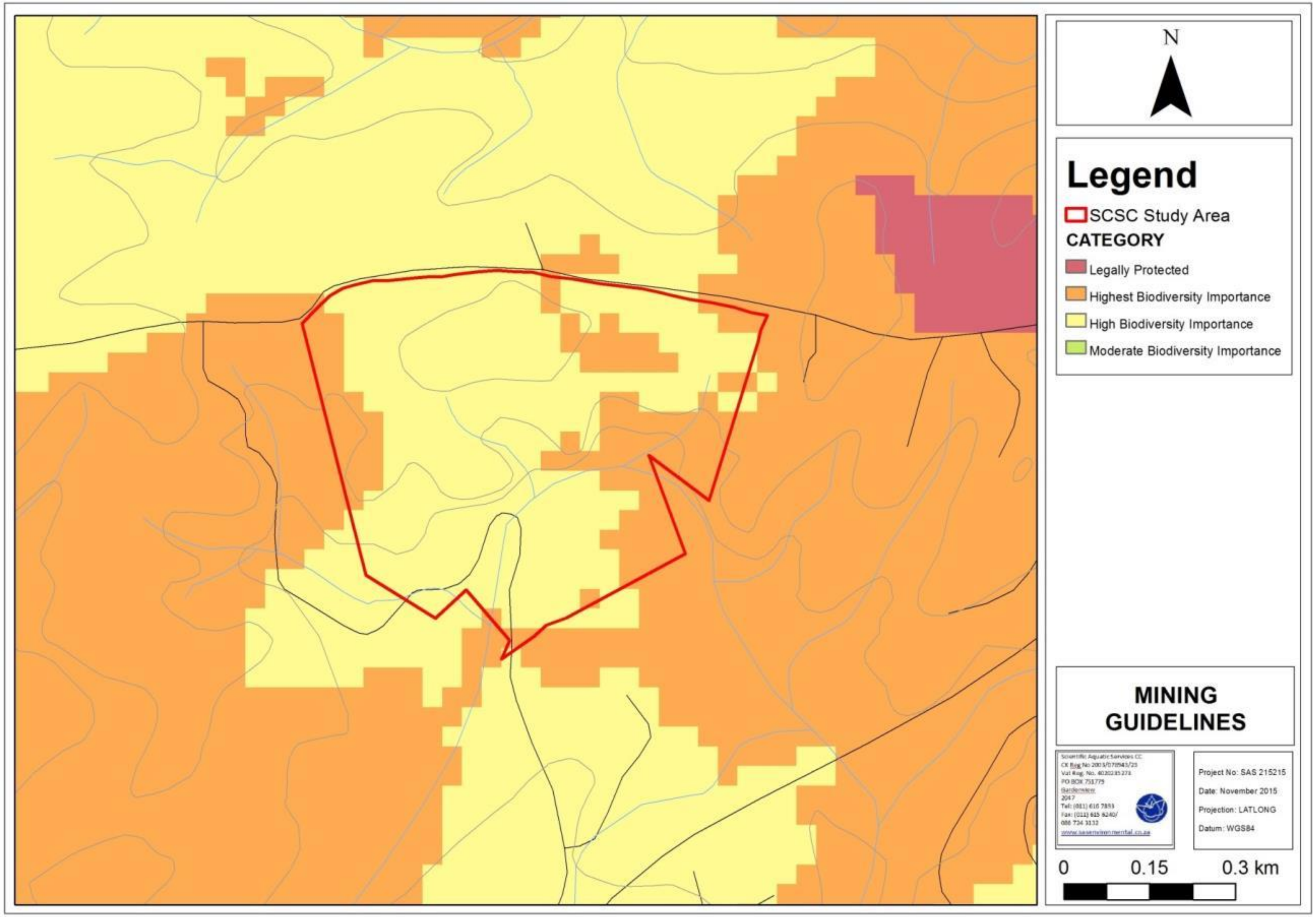

Figure 4: Importance according to the Mining and Biodiversity Guidelines (2012).

4.2 National List of Threatened Terrestrial Ecosystems for South Africa (2011)

The NEMBA (Act 10 of 2004) provides for listing of threatened or protected ecosystems, in one of four categories: critically endangered, endangered, vulnerable or protected. Threatened ecosystems are listed in order to reduce the rate of ecosystem and species extinction by preventing further degradation and loss of structure, function and composition of threatened ecosystems. The purpose of listing protected ecosystems is primarily to conserve sites of exceptionally high conservation value (SANBI, Biodiversity Geographic Information Systems (BGIS)).

According to the National List of Threatened Terrestrial Ecosystems (2011), some areas within the study area fall within the remaining extent of a Critically Endangered ecosystem, namely the Margate Pondoland-Ugu Sourveld Ecosystem and the Southern Coastal Grasslands Ecosystem (Figure 5). Critically Endangered (CR) ecosystems, are ecosystems that have, as a result of human intervention undergone severe degradation of ecological structure, function or composition, and are subject to an extremely high risk of irreversible transformation.

Margate Pondoland-Ugu Sourveld Ecosystem

This ecosystem provides habitat for 10 threatened or endemic floral and faunal SCC.

Key biodiversity features associated with this ecosystem include:

- Three millipede species namely *Centrobolus anulatus, Doratogonus infragilis* and *D. montanus;*
- Seven floral species for example *Eugenia simii, Huernia hystrix parvula, Kniphofia rooperi, Phylica natalensis, Watsonia confusa* and *Watsonia inclinata*;
- Two reptile species including *Bradypodion angustiarum* and *Bradypodion melanocephalum;* and
- Four vegetation types including KwaZulu-Natal Coastal Forest, Pondoland Scarp Forest, Pondoland-Ugu Sandstone Coastal Sourveld and KwaZulu-Natal Coastal Belt.

Southern Coastal Grasslands Ecosystem

This ecosystem is delineated by the Indian Ocean in the east, inland to within 1 km of the coast and running parallel to the coast following an approximate altitude of up to 150m. It includes small coastal forest and shrub patches that encroach inland up the estuaries. This ecosystem provides habitat for 9 threatened or endemic floral and faunal SCC.

- Key biodiversity features associated with this ecosystem include:
- One amphibian species, namely *Hyperolius pickersgilli*;
- Two millipede species including *Centrobolus anulatus* and *Doratogonus infragilis*;
- Three reptile species namely *Bradypodion caeruleogula*, *Bradypodion melanocephalum* and *Bradypodion wezae*;
- Three plant species for example *Kniphofia rooperi* and *Phylica natalensis*; and
- Five vegetation types including KwaZulu-Natal Coastal Forest, KwaZulu-Natal Dune Forest, Pondoland Scarp Forest, Pondoland-Ugu Sandstone Coastal Sourveld, and KwaZulu-Natal Coastal Belt.

4.3 KwaZulu-Natal Terrestrial Biodiversity Priority Areas

According to the KwaZulu-Natal Terrestrial Systematic Conservation Plan (2011), the study area contains areas specified as Biodiversity Priority Areas, as well as Critical Biodiversity Areas (CBA) (Figure 6).

The CBA1 Mandatory areas are based on the C-Plan Irreplaceability analyses. Identified as having a high Irreplaceability, these areas represent the only localities for which the conservation targets for one or more of the biodiversity features contained within can be achieved i.e. there are no alternative sites available.

CBA3 Optimal areas reflect the negotiable sites with an Irreplaceability score of less than 0.8. Even though these areas may display a lower Irreplaceability value it must be noted that these areas, together with CBA1’s and CBA2’s, collectively reflect the minimal reserve design required to meet the Systematic Conservation Plans targets and as such, they are also regarded as CBA areas.

Biodiversity areas represent the natural and/or near natural environmental areas not indicated to be ‘choice’ area from a biodiversity point of view. This however does not mean that these areas with no biodiversity value. Important species are still located within these areas and should be accounted for.

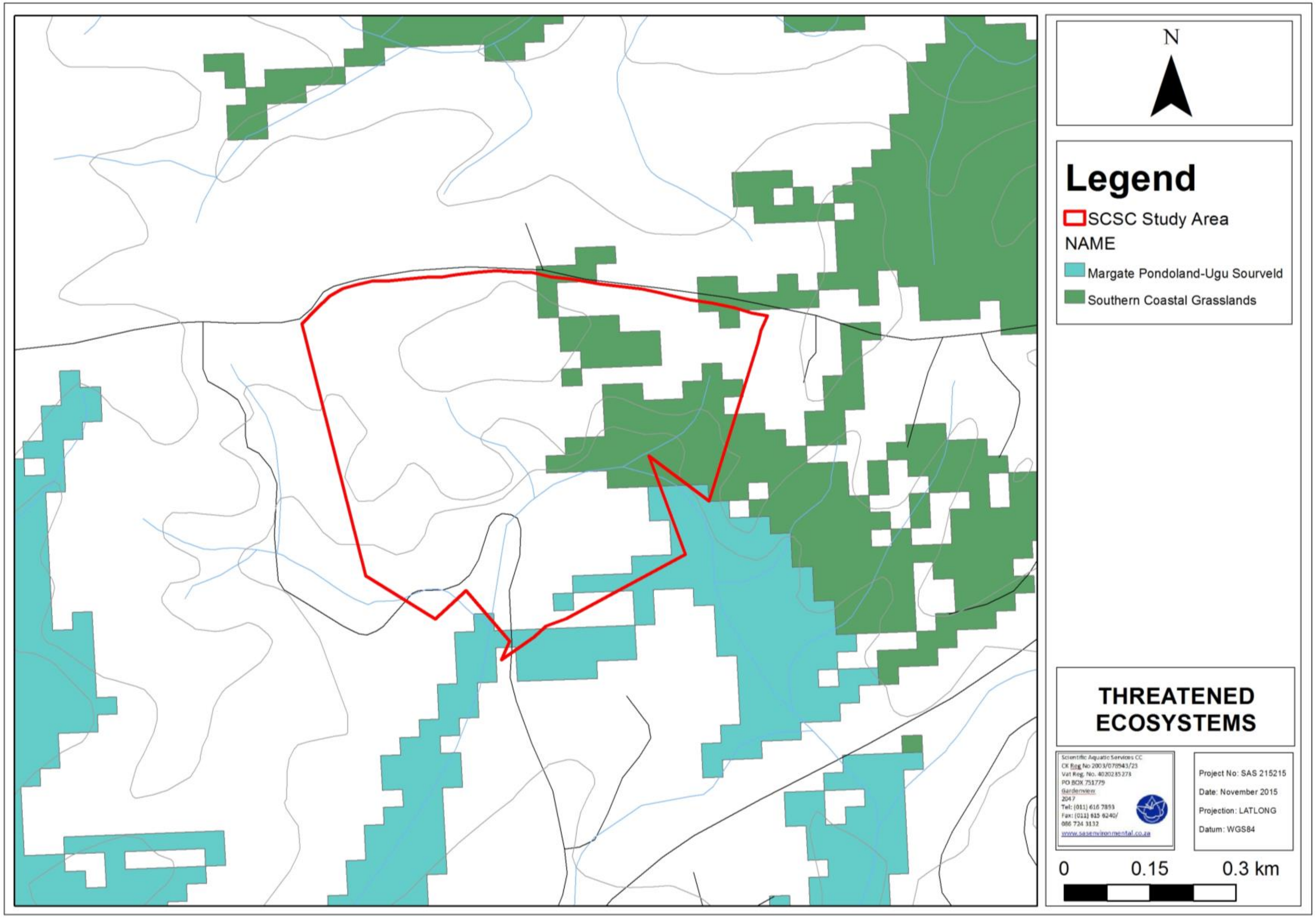

Figure 5: Remaining extent of Critically Endangered ecosystems within the study area (National List of Threatened Terrestrial Ecosystems, 2011).

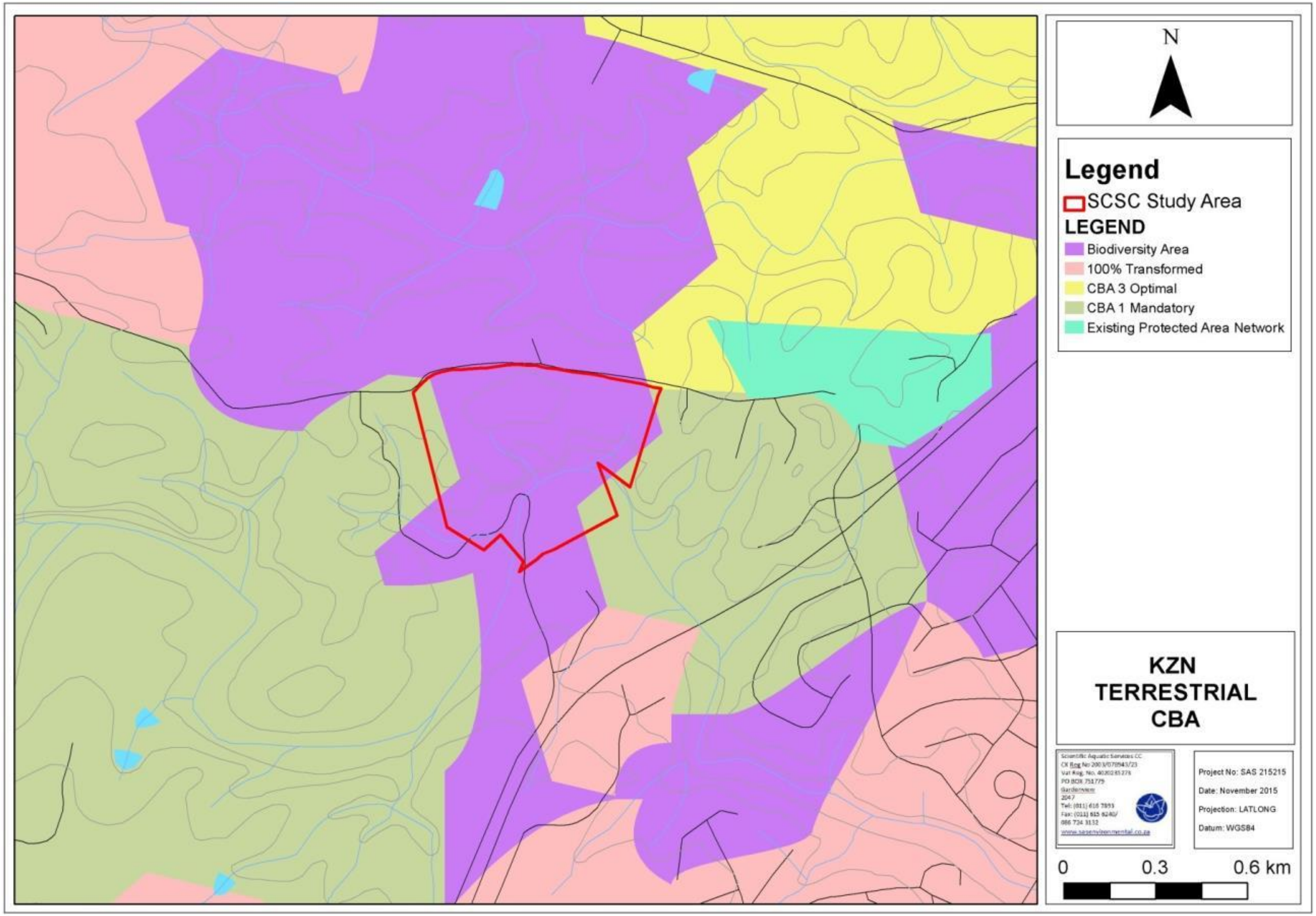

Figure 6: KZN Terrestrial Biodiversity Priority Areas associated with the study area.

4.4 NPAES Focus Areas for Protected Area Expansion

The goal of the National Protected Area Expansion Strategy (NPAES) is to achieve cost effective protected area expansion for ecological sustainability and adaptation to climate change. The NPAES sets targets for protected area expansion, provides maps of the most important areas for protected area expansion, and makes recommendations on mechanisms for protected area expansion. It deals with land-based and marine protected areas across all of South Africa's territory (SANBI, BGIS).

According to the NPAES database, the study area does not fall within an area earmarked as an NPAES area, however a protected area is situated to the east of the study area, namely the Skyline Nature Reserve (Figure 7).

4.5 National Biodiversity Assessment (NBA), 2011

The latest NBA (2011) provides an assessment of South Africa's biodiversity and ecosystems, including headline indicators and national maps for the terrestrial, freshwater, estuarine and marine environments. The NBA 2011 was led by the South African National Biodiversity Institute (SANBI) in partnership with a range of organisations. It follows on from the National Spatial Biodiversity Assessment 2004, broadening the scope of the assessment to include key thematic issues as well as a spatial assessment. The NBA 2011 includes a summary of spatial biodiversity priority areas that have been identified through systematic biodiversity plans at national, provincial and local levels (SANBI, BGIS).

The ecosystem protection level indicates whether an ecosystem is adequately protected or under-protected. Ecosystem types are categorised as well protected, moderately protected, poorly protected, or not protected based on the proportion of the biodiversity target for each ecosystem type that is included within one or more protected areas. Moderately protected, poorly protected and unprotected ecosystem types are collectively referred to as under-protected ecosystems (Driver *et al.*, 2011).

According to the NBA (2011), the majority of the study area falls within an area that is currently not protected, with only the south western section being poorly protected (Figure 8).

4.6 National Land Cover (2013)

Land cover and land use changes often indicate major impacts on biodiversity, especially if those changes show the loss of natural habitat due to urban sprawl, cultivation, etc. (BGIS, 2015). Three main land uses is associated with the study area, these are informal urban development areas, cultivation of cane for commercial use, and dense bush thicket. Three areas within the study area is identified as Mines 1 bare, these are mine related footprint areas that are non-vegetated bare ground, and include extraction pits and associated surface infrastructure such as roads and buildings. Some other land uses associated with the study area include seasonal mine water, grassland, and woodland (Figure 9).

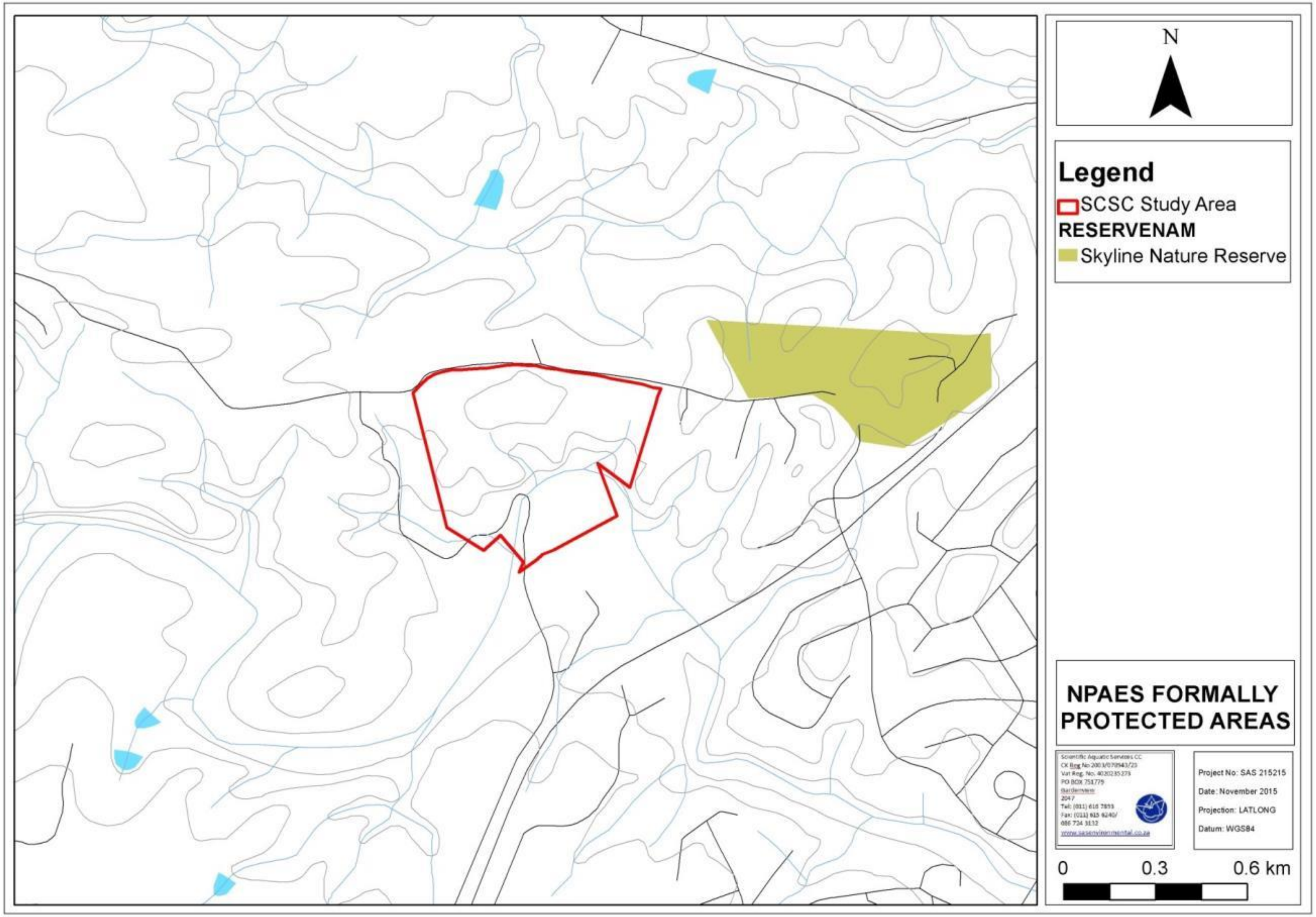

Figure 7: The formally protected Skyline Nature Reserve situated to the east of the study area

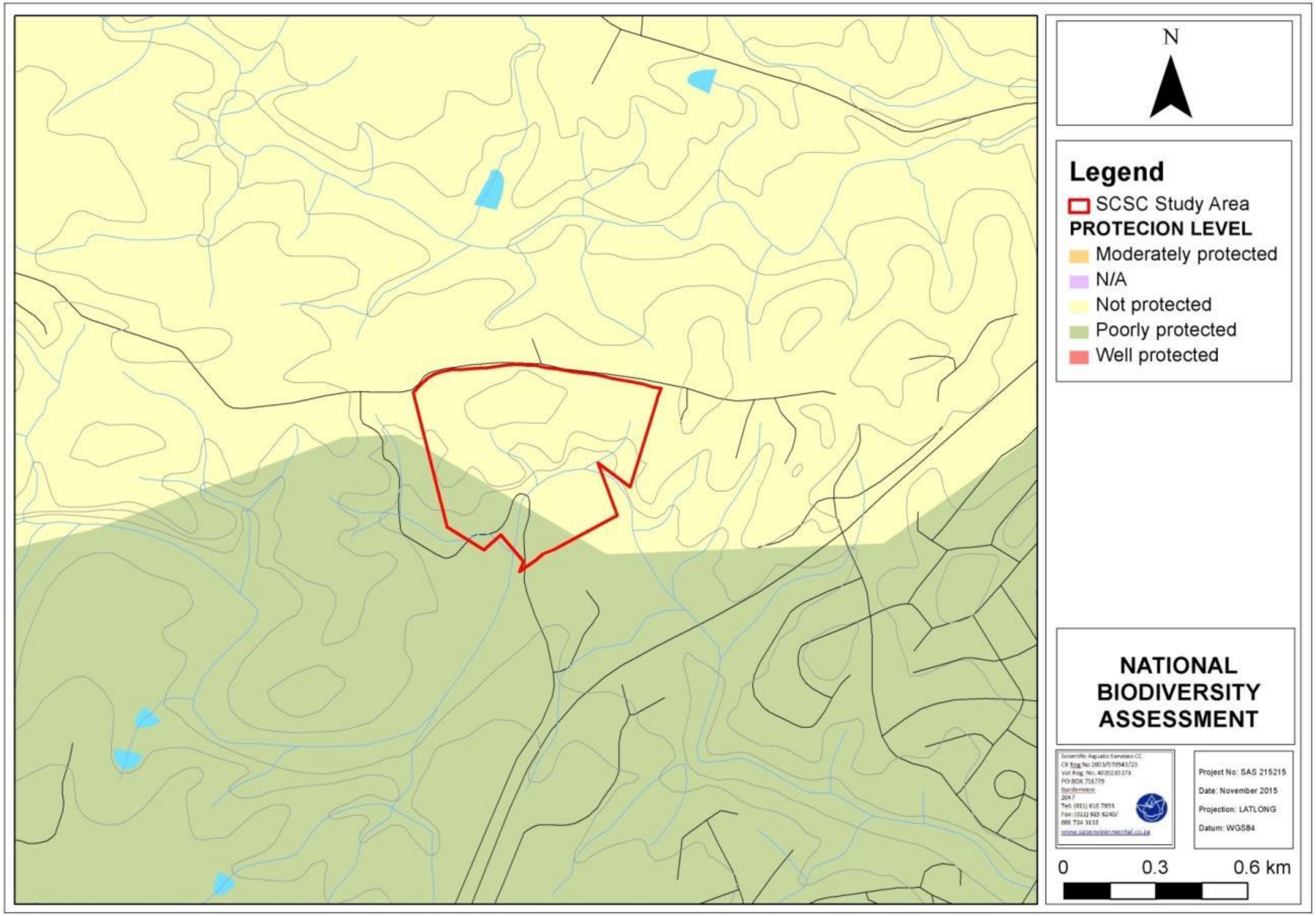

Figure 8: Level of ecosystem protection according to the National Biodiversity Assessment (2011).

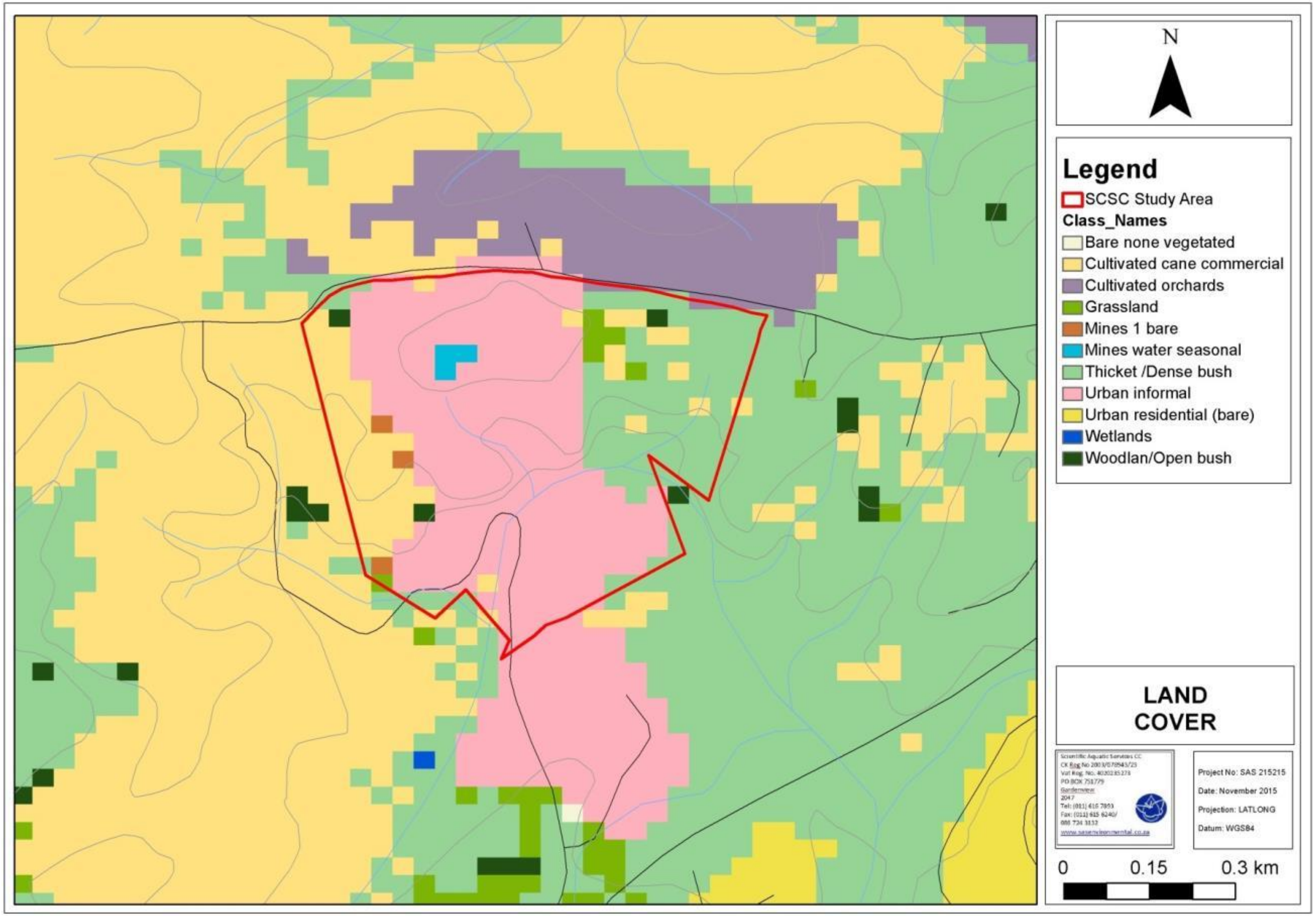

Figure 9: Land uses associated with the study area (National Land Cover, 2013).

5. FLORAL DESCRIPTION

5.1 Biome and Bioregion

Biomes are broad ecological units that represent major life zones extending over large natural areas (Rutherford, 1997). The study area under assessment falls within the Indian Ocean Coastal Belt Biome (Mucina & Rutherford, 2006). Biomes are further divided into bioregions, which are spatial terrestrial units possessing similar biotic and physical features, and processes at a regional scale. This study area is situated within the Indian Ocean Coastal Belt Bioregion (Mucina & Rutherford, 2006).

5.2 Vegetation Type and Landscape Characteristics

While biomes and bioregions are valuable as they describe broad ecological patterns, they provide limited information on the actual species that are expected to be found in an area. Knowing which vegetation type an area belongs to provides an indication of the floral composition that would be found if the assessment site was in a pristine condition, which can then be compared to the observed floral list and so give an accurate and timely description of the ecological integrity of the assessment site. When the boundary of the study area is superimposed on the vegetation types of the surrounding area, it is clear that the Northern section of the study area falls within the KwaZulu-Natal Coastal Belt vegetation type, and the Southern section within the Pondoland-Ugu Sandstone Coastal Sourveld (Mucina & Rutherford, 2006) (Figure 10).

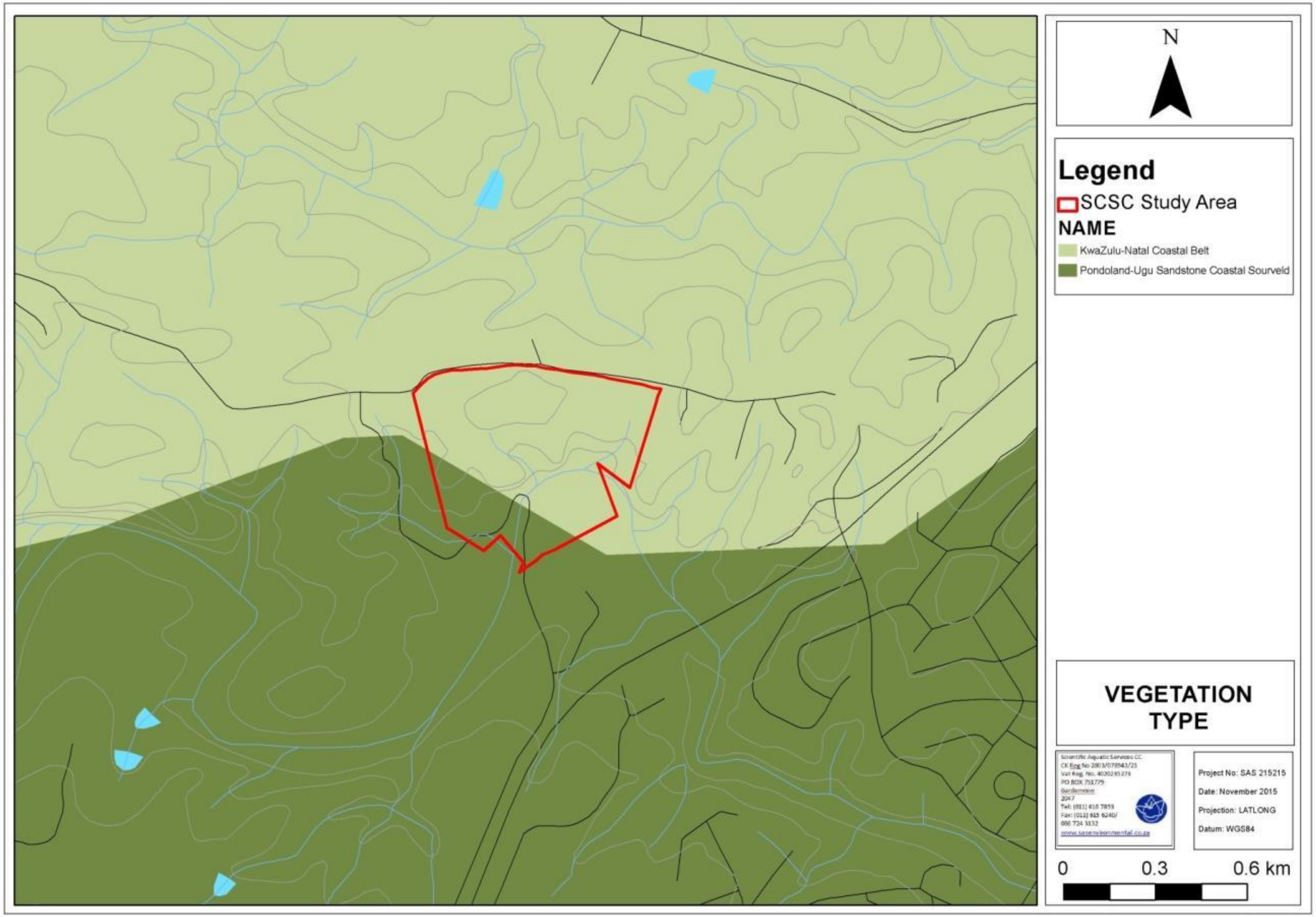

Figure 10: Vegetation types associated with the study area (Mucina & Rutherford, 2006).

5.3 KwaZulu-Natal Coastal Belt

5.3.1 Distribution

The KwaZulu-Natal Coastal Belt vegetation type is restricted to the KwaZulu-Natal Province where it occurs as a long and in places broad coastal strip along the KwaZulu-Natal coast, from near Mtunzini in the north, via Durban to Margate extending just short of Port Edward in the south. The altitude ranges from about 20-450 m (Mucina & Rutherford, 2006).

5.3.2 Climate

The vegetation type falls within a summer rainfall region, but some rainfall also falls in winter. The air humidity is high and the area is frost-free. The mean maximum and minimum monthly temperatures for January and July respectively vary between 32.6 ^{o}C and 5.8 ^{o}C and 30.6 ^{o}C and 8.8 ^{o}C (both for January and July respectively) (Mucina & Rutherford, 2006).

Table 3: General climatic information for the KwaZulu-Natal Coastal Belt (Mucina & Rutherford, 2006).

Bioregion	Vegetation types	Altitude (m)	MAP* (mm)	MAT* (°C)	MAPE* (mm)	MASMS* (%)
Indian Ocean Coastal Belt	KwaZulu-Natal Coastal Belt	20 - 450	989	19.6	1659	65

*MAP – Mean Annual Precipitation; MAT – Mean Annual Temperature; MAPE – Mean Annual Potential Evaporation; MASMS – Mean Annual Soil Moisture Stress (% of days when evaporative demand was more than double the soil moisture supply).

5.3.3 Geology and Soils

Ordovician Natal Group sandstone, Dwyka tillite, Ecca shale and Mapumulo gneiss (Mokolian) dominate the landscapes of the KwaZulu-Natal Coastal Belt vegetation type. Weathering of old dunes has produced red sand in places, referred to as Berea Red Sand. The soils supported by the above-mentioned rocks are shallow over hard sandstones and deeper over younger, softer rocks. Fa land type dominates the area, while Ab land type is only of minor importance (Mucina & Rutherford, 2006).

5.3.4 Conservation

The vegetation type is considered to be Endangered, with a conservation target of 25%. Only very small part statutorily conserved in Ngoye, Mbumbazi and Vernon Crookes Nature Reserves and about 50% thereof currently transformed for cultivation, by urban sprawl and for road-building. Dominant alien floral species include *Chromolaena odorata, Lantana* *camara, Melia azedarach* and *Solanum mauritianum*. Erosion is low to moderate (Mucina & Rutherford, 2006).

5.3.5 Dominant Floral Taxa

The vegetation type comprises highly dissected undulating coastal plains which presumably used to be covered to a great extent with various types of subtropical coastal forest. Some primary grassland, dominated by *Themeda triandra,* still occurs in hilly, high-rainfall areas where pressure from natural fire and grazing regimes prevailed. At present the KwaZulu-Natal Coastal Belt vegetation types is affected by an intricate mosaic of very extensive sugarcane fields, timber plantations and coastal holiday resorts, with interspersed secondary *Aristida* grasslands, thickets and patches of coastal thornveld (Mucina & Rutherford, 2006).

Table 4: Dominant and typical floral species of the KwaZulu-Natal Coastal Belt vegetation type (Mucina & Rutherford, 2006).

Important Taxa		
Grass species	**Forb species**	**Tree/Shrub Species**
Aristida junciformis subsp. *galpinii* (d) *Digitaria eriantha* (d) *Panicum maximum* (d) *Themeda triandra* (d) *Alloteropsis semialata* subsp. *eklonioana* *Cymbopogon caesius* *Cymbopogon nardus* *Eragrostis curvula* *Eulalia villosa* *Hyparrhenia filipendula* *Melinis repens*	*Berkeya speciosa* subsp. *speciosa* (d) *Senecio glaberrimus* (d) *Cyanotis speciosa* (d) *Alepidea longifolia* *Bulbine asphodeloides* *Centella glabrata* *Cephalaria oblongifolia* *Chamaecrista mimosoides* *Conostomium natalense* *Crotalaria lanceolate* *Disa polygonoides* *Dissotis canescens* *Eriosema squarrosum* *Gerbera ambigua* *Hebenstretia comosa* *Helicrysum cymosum* subsp. *cymosum* *Helicrysum pallidum* *Hibiscus pedunculatus* *Hybanthus capensis* *Hypoxis filiformis* *Indigofera hilaris* *Ledebouria floribunda* *Pachycarpus asperifolius* *Pentanisia prunelloides* subsp. *latifolia* *Schizocarphus nervosus* *Senecio albanensis* *Senecio bupleuroides* *Senecio coronatus* *Senecio rhyncholaenus* *Sisyranthus imbertis* *Stachys aethiopica* *Stachys nigricans* *Tritonia disticha* *Vernonia galphinii* *Vernonia oligocephela* *Gnidia kraussiana* *Tephrosia polystachya*	*Bridelia micrantha* (d) *Phoenix reclinata* (d) *Syzygium cordatum* (d) *Abrus laevigatus* *Albizia adianthifolia* *Antidesma venosum* *Asparagus racemosus* *Clutia pulchella* *Phyllanthus glaucophyllus* *Smilax anceps* *Vachellia natalitia*

Biogeographically Important Taxa			
Grass species	**Forb species**	**Tree/Shrub Species**	**Geoxylic Suffrutices**
Cyperus natalensis^{C} *Eragrostis lappula*^{S}	*Strelitzia nicolai*^{C} (d) *Helicrysum longifolium*^{C} *Selago tarachodes*^{C} *Senecio dregeanus*^{C} *Sphenostylis angustifolia*^{S} *Kniphofia gracilis*^{C} *Kniphofia littorallis*^{C} *Kniphofia rooperi*^{C} *Pachystigma venosum*^{S} *Zeuxine africana*^{S}	*Anastrabe integerrima*^{C} (d) *Helichrysum kraussii*^{S} *Agathisanthemum bojeri*^{S} *Desmodium dregeanum*^{C} *Vachellia nilotica* subsp. *kraussiana*^{S}	*Ancylobotrys petersiana*^{S} *Eugenia albanensis*^{C} *Salacia kraussii*^{S}

Endemic Taxa	
Forb Species	**Tree/Shrub Species**
Vernonia africana (extinct) *Kniphofia pauciflora*	*Barleria natalensis* (extinct)

***(d) – Dominant species for the vegetation type**
^{C} – Coastal belt element
^{S} – Southern distribution limit

5.4 Pondoland-Ugu Sandstone Coastal Sourveld

5.4.1 Distribution

The Pondoland-Ugu Sandstone Coastal Sourveld vegetation type occur within both the Eastern Cape and KwaZulu-Natal Provinces on elevated coastal sandstone plateaus from Port St Johns on the Pondoland coast (Eastern Cape) to the vicinity of Port Shepstone (Ugu District, KwaZulu-Natal) and includes the sourveld of the well-known Oribi Gorge. The altitude ranges from about 0–600 m (Mucina & Rutherford, 2006).

5.4.2 Climate

The vegetation type receives mainly summer rainfall, with some rain in winter and no or very infrequent incidences of frost occurrence. The mean maximum and minimum monthly temperatures for January and July respectively vary between 32.2 °C and 5.8 °C, and 29.5°C and 9.6°C (Mucina & Rutherford, 2006).

Table 5: General climatic information for the Pondoland-Ugu Sandveld Coastal Sourveld (Mucina & Rutherford, 2006).

Bioregion	Vegetation types	Altitude (m)	MAP* (mm)	MAT* (°C)	MAPE* (mm)	MASMS* (%)
Indian Ocean Coastal Belt	Pondoland-Ugu Sandstone Coastal Sourveld	0-600	1075	18.4	1549	63

*MAP – Mean Annual Precipitation; MAT – Mean Annual Temperature; MAPE – Mean Annual Potential Evaporation; MASMS – Mean Annual Soil Moisture Stress (% of days when evaporative demand was more than double the soil moisture supply).

5.4.3 Geology and Soils

The vegetation type is strictly delimited by its geology – it is built of hard, white, coarse-grained, siliceous quartz arenites (sandstones) of the Msikaba Formation of the Devonian Period giving rise to shallow, nutrient-poor (highly leached), skeletal, acidic sandy soils. Almost 80% of the area is classified as falling within the Fa land type, followed by the Aa land type (Mucina & Rutherford, 2006).

5.4.4 Conservation

The vegetation type is Vulnerable and is considered to be one of the top six vegetation units in South Africa, with the highest level of overall vulnerability. The conservation target is 25%, but only about 7% is currently statutorily conserved in the Mkambati Wildlife Reserve and Marine Sanctuary, and within the Umtamvuna, Mbumbazi and Oribi Gorge Nature Reserves.

About 29% of the vegetation type is transformed for cultivation and plantations or by urban sprawl. In the Eastern Cape the land use is mostly subsistence farming. Erosion is very low to low (Mucina & Rutherford, 2006).

5.4.5 Dominant Floral Taxa

The vegetation type occurs on coastal peneplains and partly undulating hills with flat table-lands and very steep slopes of river gorges. These sites support natural, species-rich grassland punctuated with scattered low shrubs or small trees (sometimes with bush clumps, especially in small gullies). Rocky outcrops and krantzes are common and dramatic sea-cliffs occur. Proteaceous trees (*Protea* spp. and *Faurea* spp.) can be locally common where conditions allow, the geoxylic suffrutex growth form also presented (Mucina & Rutherford, 2006).

Table 6: Dominant and typical floristic species of the Pondoland-Ugu Sandstone Coastal Sourveld vegetation type (Mucina & Rutherford, 2006).

Important Taxa		
Grass species	**Forb species**	**Tree/Shrub Species**
Alloteropsis semialata subsp. *eklonioana* (d) *Aristida junciformis* subsp. *galpinii* (d) *Cymbopogon nardus* (d) *Themeda triandra* (d) *Tristachya leucothrix* (d) *Cyperus rupestris* *Diheteropogon amplectens* *Elionurus muticus* *Eragrostis capensis* *Eragrostis plana* *Eulalia villosa* *Heteropogon contortus* *Panicum natalense* *Trachypogon spicatus*	*Chaetacanthus burchellii* (d) *Cyanotis speciosa* (d) *Helichrysum alliodes* (d) *Helichrysum appendiculatum* (d) *Helichrysum krebsianum* (d) *Helichrysum spiralepsis* (d) *Pentanisia angustifolia* (d) *Rhynchosia totta* (d) *Tephrosia macropoda* (d) *Berkeya speciosa* subsp. *speciosa* *Brachystelma tenellum* *Cephalaria oblongifolia* *Chamaecrista mimosoides* *Eriosema salignum* *Eriospermum mackenii* *Euphorbia ericoides* *Helichrysum adenocarpum* subsp. *adenocarpum* *Helichrysum aureum* var. *monocephalum* *Helichrysum herbaceum* *Helichrysum nudifolium* var. *pilosellum* *Helichrysum pallidum* *Indigofera hilaris* *Pentanisia prunelloides* subsp. *latifolia* *Pimpinella caffra* *Vernonia capensis*	*Athrixia phylicoides* *Euclea natalensis* *Euclea natalitia* *Euryops brevipapposus* *Gnidia anthylloides* *Gnidia kraussiana* *Gnidia nodiflora* *Leonotis intermedia* *Polygala hottentotta* *Syzygium cordatum* *Thesium acutissimum* *Thesium cupressoides*

Biogeographically Important Taxa			
Grass species	**Forb species**	**Tree/Shrub Species**	**Geoxylic Suffrutices**
Loudetia simplex^{S} *Calopsis paniculata*^{F} *Tetraria robusta*^{EF}	*Asclepia patens*^{C} *Berkheya insignis*^{S} *Disperis woodii*^{C} *Eriosema acuminatum*^{C} *Helichrysum acutatum*^{S} *Helichrysum auriceps*^{S} *Helichrysum natalitium*^{S} *Helichrysum pannosum*^{S} *Helicrysum longifolium*^{C} *Kniphofia rooperi*^{C} *Peucedanum natalense*^{C} *Roella glomerata*^{FC} *Senecio dregeanus*^{S} *Senecio rhyncholaenus*^{S} *Stenoglottis woodii* ^{S}	*Senecio medley-woodii*^{S} *Gnidia woodii*^{C}(d) *Agathosma ovata*^{F} *Erica aspalathifolia*^{C} *Gnidia coriacea*^{N} *Muralitia lancifolia*^{F} *Pseudarthria hookeri*^{FS} *Relhania pungens*^{F} *Stangeria eriopus* ^{C} *Syncolostemon rotundifolius*^{C} *Faurea saligna*^{S} *Protea roupelliae* subsp. *roupelliae*^{F} *Encephalartos caffer*^{N} *Loxostylis alata*^{F} *Polygala gazensis* *Protea caffra* subsp. *caffra*^{F} *Protea simplex*^{F} *Sclerocroton integerrimum*^{S}	*Gymnosporia vanwykii*^{C} *Eriosemopsis subanisophylla*^{S}

Endemic Taxa			
Grass species	**Forb species**	**Tree/Shrub Species**	**Geoxylic Suffrutices**
Fimbristylis variegata	*Brachystelma austral* *Brachystelma kerzneri* *Eriosema umtamvunense* *Geranium sparsiflorum* *Lotononis bachmanniana* *Selago peduncularis* *Senecio erubescens* var. *incisus* *Watsonia inclinata*^{F} *Watsonia mtamvunae*^{F}	*Leucadendron spissifolium* subsp. *natalense*^{F} (d) *Leucadendron spissifolium* subsp. *oribinum*^{F}(d) *Acalypha* sp. Nov. (Scott-Shaw 636 NU) *Anthospermum streyi* *Erica abbottii* *Erica cubica* var. *natalensis*^{F} *Eriosema dregei* *Eriosema latifolium* *Eriosema luteopetalum* *Euryops leiocarpus* *Gnidia triplinervis* *Leucadendron pondoense*^{F} *Leucospermum innovans*^{F} *Raspalia trigyna*^{F} *Struthiola pondoensis*^{F} *Syncolostemon ramulosus* *Tephrosia bachmannii* *Tephrosia pondoensis*	*Searsia acocksii*

***(d) – Dominant species for the vegetation type**
^{C} – Coastal belt element
^{E} – Eastern isolated occurrence
^{F} – Generic fynbos element
^{N} - Northern distribution limit
^{S} – Southern distribution limit

6. RESULTS OF THE FLORAL INVESTIGATION

Four broad habitat units were identified within the study area, namely the Transformed Habitat Unit, the Riparian Habitat Unit, the Coastal Forest Habitat Unit and the Grassland Habitat Unit. The approximate localities of the various habitat units are illustrated in Figure 11 and are further described in the sections below.

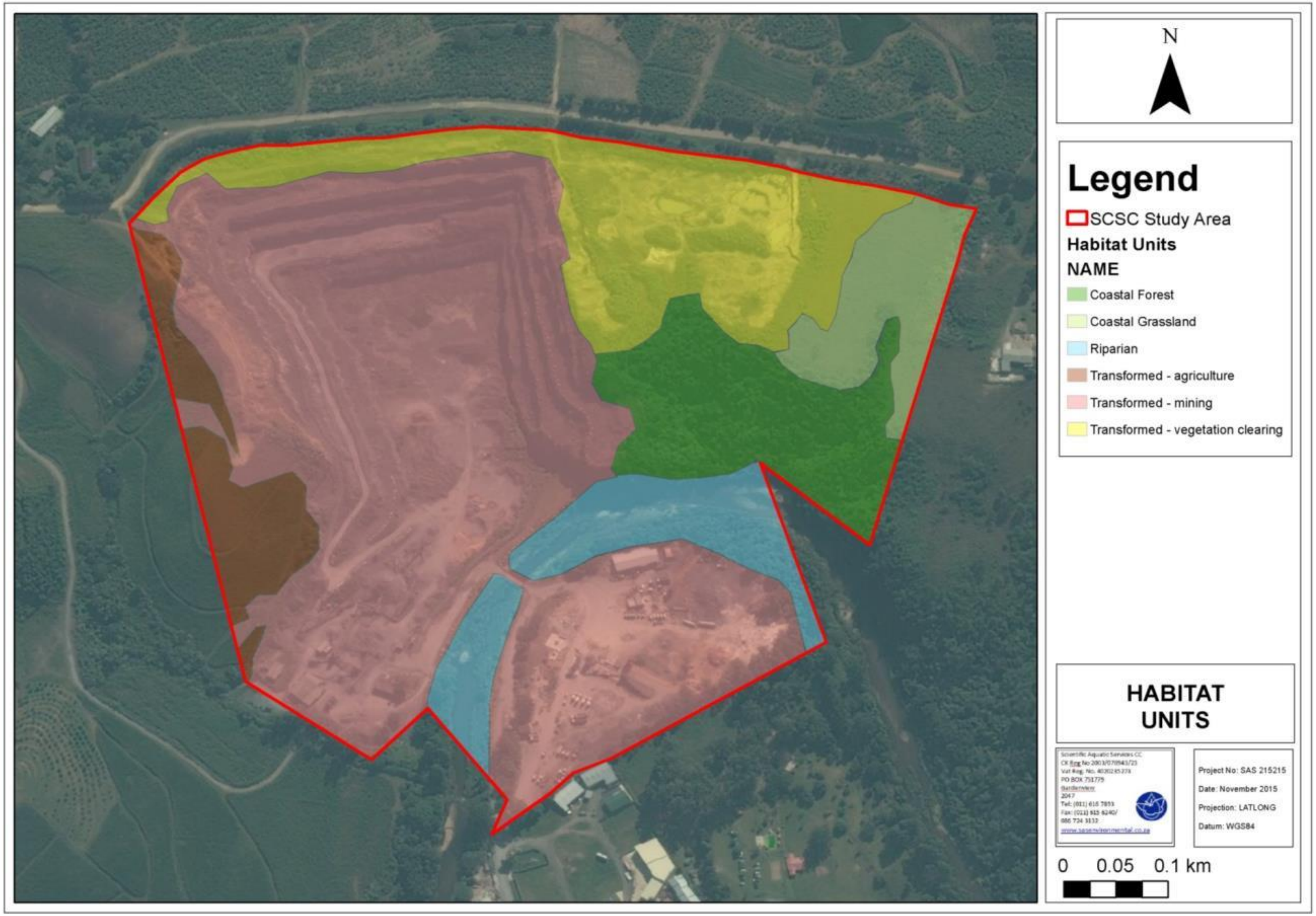

Figure 11: Habitat units identified within the study area.

6.1 Habitat Unit 1: Transformed Habitat Unit

The Transformed Habitat Unit (Figures 12 & 13) is representative of the majority of the vegetation within the study area and comprises of mining areas and associated disturbed areas as well as offices and related infrastructure within the centre and south of the study area, areas in the north where topsoil has been cleared and agricultural land in the west.

Figure 12: The photographs illustrate the Transformed Habitat Unit impacted by mining operations (top), the disturbed area to the north of the existing open pit (centre), earmarked for rehabilitation and the portion of the study area to the northeast where topsoil has been stripped as a result of clay mining activities which occurred in the past (bottom)

Figure 13: The Transformed Habitat Unit associated with agricultural (sugarcane) fields within the west of the study area.

The Transformed Habitat Unit is dominated by bare soils and alien vegetation, including species such as *Casaurina equiseifolia*, *Eucalyptus* sp., *Melia azedarach* and *Morus alba* as a result of very high levels of disturbance, with limited indigenous species present. Although these areas, including areas in the vicinity of the agricultural fields and the area where topsoil has been stripped, provide habitat for some indigenous species, this habitat is not a natural condition and has undergone significant transformation. Dominant floral species encountered within the Transformed Habitat Unit during the field assessment are listed in the table below.

Table 7: Dominant floral species encountered in the Transformed Habitat Unit. Alien species are indicated with an asterisk.

Grass/sedge/reed species	Forb species	Tree/Shrub Species
Phragmites australis	**Amaranthus hybridus*	**Casuarina equisetifolia*
Typha capensis	**Bidens pilosa*	**Eucalyptus grandis*
Cynodon dactylon	**Chromolaena odorata*	**Eucalyptus* sp.
Echinocloa pyramidalis	**Conyza canadensis*	**Grewillea robusta*
Imperata cylindrica	**Ipomoea purpurea*	**Melia azedarach*
Hyparrhenia hirta	**Lantana camara*	**Morus alba*
Eragrostis plana	**Nephrolepis exaltata*	**Phytolacca americana*
	**Ricinus communis*	**Pinus pinaster*
	**Rubus cuneifolius*	**Psidium guajava*
	**Saccharum officinarum*	*Dodonea angustifolia*
	**Senna didymobotrya*	*Gomphocarpus fruticosus*
	**Sesbania bispinosa*	*Harpephyllum caffrum*
	**Solanum mauritianum*	*Hyphaene coriaca*
	**Verbena bonariensis*	*Trichelia emetica*
	Commelina erecta	
	Persicaria sp.	
	Thelypteris interrupta	

The vegetation structure and species composition of the Transformed Habitat Unit have been completely altered, no floral SCC are expected to occur within this area and this area has a low conservation value and ecological sensitivity from a floral perspective.

6.2 Habitat Unit 2: Riparian Habitat Unit

The Riparian Habitat Unit (Figure 14) is located within the southern portion of the study area in the vicinity of the Uvongo River. It is important to note that the extent of this habitat unit as indicated in Figure 11 is an estimate based on vegetation characteristics and the exact delineation is provided by Eco-Pulse (2015).

Vegetation associated with this habitat unit has been significantly impacted by anthropogenic activities and the vegetation structure and composition has been significantly altered. Although a number of indigenous floral species are present, a high abundance and diversity of alien vegetation dominates the floral component, particularly within the immediate vicinity of the mining operations and related access roads.

Figure 14: The Riparian Habitat Unit associated with the Uvongo River, traversing the southern portion of the study area.

The instream vegetation associated with the Uvongo River channel is dominated by indigenous species such as *Commelina erecta*, *Cyperus dives, Echinocloa pyramidalis Persicaria* sp., *Phragmites australis* and the alien species *Hedychium coronarium*, with other alien species such as *Canna indica, Centella asiatica, Coix lacryma-jobi* and *Colocasia esculenta* also present.

The riparian zone associated with the river is also dominated by alien tree species such as *Eucalyptus* sp., *Melia azedarach* and alien shrubs such as *Tithonia rotundifolia*, *Solanum mauritianum* and include indigenous woody species such as *Strelitzia nicolai*, *Syzygium cordatum, Trema orientalis, Phoenix reclinata* and *Ficus natalensis*, which occur scattered and in low abundance when compared to the alien vegetation.

A list of dominant floral species encountered within this habitat is indicated in Table 8 below.

Table 8: Dominant species encountered in the Riparian Habitat Unit. Alien species are indicated with an asterisk and floral SCC are indicated in bold.

Grass/sedge/reed species	Forb species	Tree/Shrub Species
*Arundo donax	_*Ageratum conyzoides_	_*Eucalyptus sp._
*Bambusa balcooa	_*Agrimonia procera_	_*Melia azedarach_
*Pennisetum purpureum	_*Amaranthus hybridus_	_*Morus alba_
*Sorghum halepense	_*Ambrosia artemisiifolia_	_*Psidium guajava_
Cyperus dives	_*Bidens pilosa_	_*Schinus terebinthifolius_
Cyperus prolifer	_*Bidens pilosa_	_Bridelia micrantha_
Cyperus textilis	_*Canna indica_	_Erythrina lysistemon_
Echinocloa pyramidalis	_*Cardiospernum grandiflorum_	_Ficus natalensis_
Juncus effusus	_*Centella asiatica_	_Phoenix reclinata_
Melinis repens	_*Chromolaena odorata_	_Rauvolfia caffra_
Panicum maximum	_*Coix lacryma-jobi_	_Strelitzia nicolai_
Phragmites australis	_*Colocasia esculenta_	_Syzygium cordatum_
Setaria megaphylla	_*Conyza canadensis_	_Trema orientalis_
Typha capensis	_*Desmodium incanum_	_Alsophila dregei (=Cyathea dregei)_
Sporobolus africanus	_*Hedychium coronarium_	_Croton gratissimus_
	*Ipomoea alba	_*Phytolacca dioica_
	*Ipomoea purpurea	
	*Lantana camara	
	*Lemna gibba	
	*Mimosa pudica	
	*Nephrolepis exaltata	
	*Pteridium aquilinum	
	*Ricinus communis	
	*Rubus cuneifolius	
	*Saccharum officinarum	
	*Senecio madagascarensis	
	*Senna didymobotrya	
	*Senna hirsuta	
	*Sesbania bispinosa	
	*Solanum incanum	
	*Solanum mauritianum	
	*Taraxacum officinale	
	*Tithonia diversifolia	
	*Urtica urens	
	*Verbena bonariensis	
	*Wedelia trilobata	
	Asystacia gangetica	
	Commelina erecta	
	Haemanthus humulis	
	Ipomoea cairica	
	Persicaria sp.	
	Scadoxus puniceus	
	Senecio tamoides	
	Smilax anceps	
	Thelypteris interrupta	
	Thunbergia alata	

Although vegetation associated with the Uvongo River within the study area has been modified to a large degree by anthropogenic activities, this habitat unit is considered to have increased conservation value due to the provision of migratory connectivity and habitat for faunal species that move through the area and important habitat for a number of riparian floral species. This habitat unit should remain conserved as far as possible.

6.3 Habitat Unit 3: Coastal Forest Habitat Unit

The Coastal Forest Habitat Unit (Figure 15) is located within the eastern portion of the study area within the area earmarked for mining expansion activities during the 2020 to 2036 period.

Figure 15: The Coastal Forest Habitat Unit to the north of the study area.

This habitat unit is associated with two unnamed tributaries of the Uvongo River and related habitat and originates within steep kloofs above the river. Vegetation associated with this habitat unit is dominated by woody species, including *Syzygium cordatum, Phoenix reclinata, Bridelia micrantha* – all species indicated to be dominant within the KwaZulu-Natal Coastal Belt vegetation type, with other woody species including *Halleria lucida, Ficus natalensis* and *F. sur*.

This remnant portion of remnant coastal forest shows limited signs of recent disturbance, provides intact habitat for a number of faunal species and a high diversity of indigenous forest floral species, dominated by *Bridelia micrantha, Phoenix reclinata, Brachyleana discolor, Dombeya rotundifolia* and *Syzygium cordatum*, amongst others. Alien vegetation encroachment by species such as _Rubus cunefolius_ and _Lantana camara_ is mostly restricted to the edges of this habitat unit.

Two floral SCC, protected under the National Forest Act (Act 84 of 1998), namely _Pittosporum viridiflorum_ and _Sideroxylon inerme,_ was encountered within this habitat unit and other floral SCC are also likely to occur in this area.

Table 9 lists the dominant species encountered within this Habitat Unit.

Table 9: Dominant floral species encountered in the Coastal Forest Habitat Unit. Floral SCC are indicated in bold, while alien species are marked with an asterisk (*).

Grass/sedge/reed species	Forb species	Tree/Shrub Species
Aristida junciformis	_*Agave_ sp.	_*Lantana camara_
Cymbopogon excavatus	_*Bougainvillea glabra_	_*Plumeria rubra_
Cynodon dactylon	_*Rubus cuneifolius_	_*Schinus terebinthifolius_
Eragrostis curvula	_Aloe tenuior_	_*Sesbania bispinosa_
Eragrostis plana	_Euryops laxus_	_Acokanthera oppisitifolia_
Hyparrhenia hirta	_Ruellia cordata_	_Adenopodia spicata_
Setaria megaphylla	_Senecio oxyriiflius_	_Albizia adianthifolia_
	Tephrosia shiluwanensis	_Brachylaena elliptica_
	Rhoicissus tridentata	_Brachyleana discolor_
		Bridelia micrantha
		Buddleja salviifolia
		Carissa bispinosa
		Dalbergia armata
		Dombeya rotundifolia
		Euphorbia triangularis
		Ficus natalensis
		Ficus sur
		Grewia occidentalis
		Halleria lucida
		Harpephyllum caffrum
		Mystroxylon aethiopicum
		Nuxia floribunda
		Phoenix reclinata
		Pittosporum viriflorum
		Protorhus longifolia
		Rauvolfia caffra
		Searsia pyroides
		Sideroxylon inerme
		Syzygium cordatum
		Trema orientalis
		Trimeria grandifolia

Due to the overall low level of anthropogenic disturbance that resulted in impact on this habitat unit, the presence of SCC and the high number of indigenous woody species present that are representative of the expected vegetation type, this habitat unit is considered to be in a good ecological condition and is deemed to have a high level of ecological sensitivity.

6.4 Habitat Unit 4: Grassland Habitat Unit

The Grassland Habitat Unit (Figure 16) is located within the northeast of the study area and comprises a portion somewhat impacted grassland of limited extent.

Figure 16: The Grassland Habitat Unit within the northeast of the study area.

This habitat unit shows some sign of recent disturbance and is relatively isolated from any similar habitat in the region due to surrounding earthworks, disturbances from the roadway to the north, topsoil stripping and the construction of berms in its immediate vicinity. This portion of grassland, does however provide habitat for a relatively high diversity of indigenous grass species and forb species such as *Hypoxis hemerocallidea*, a floral SCC species listed by SANBI as ‘Declining’, *H. colchifolia, Helichrysum nudifolium, Cycnium tubulosum* and *Watsonia* sp. Alien species are present along the boundaries of this habitat unit.

Table 10 lists the dominant species encountered within this Habitat Unit.

Table 10: Dominant species encountered in the Open Grassland Habitat Unit. Alien species are indicated with an asterisk and floral SCC are indicated in bold

Grass/sedge/reed species	Forb species	Tree/Shrub Species
**Pennisetum setaceum*	**Bidens pilosa*	-
Eragrostis capensis	**Lantana camara*	
Hyparrhenia hirta	**Sesbania bispinosa*	
Eragrostis chloromelas	**Tagetes minuta*	
Aristida junciformis	**Verbena bonariesis*	
Cymbopogon sp.	*Aloe arborescens*	
Themeda triandra	*Berkeya sp.*	
Cyperus rupestris	*Commelina africana*	
Diheteropogon amplectens	*Cycnium tubulosum*	
Eragrostis capensis	*Eriospermum* sp.	
Eragrostis plana	*Helichrysum nudifolium*	
Panicum natalense	*Hypoxis colchifolia*	
	Hypoxis hemerocallidea	
	Oxalis sp.	

Due to the overall increased level of biodiversity and habitat for forb and grass species within this habitat unit, the occurrence of floral SCC (*Hypoxis hemerocallidea*) and the potential occurrence of wetland conditions within this habitat unit, the Grassland Habitat Unit is considered to have a moderate level of ecological sensitivity.

6.5 SCC Floral Species Status Assessments

An assessment considering the presence of any floral SCC, as well as suitable habitat to support any such species, was undertaken. The complete PRECIS RDL floral lists for the QDS 3030CD was acquired from SANBI and is presented in Table 12 and the definitions of the different national RDL categories included in Table 11 below. It is important to note that the study area is located immediately outside of the Pondoland Centre of Endemism, which accounts for the high number of SCC species listed for the QDS and is necessarily representative of the study area itself:

Table 11: National Red List Categories – Version 2015.1 as supplied by SANBI.

Category	Definition
Extinct (EX)	A species is Extinct when there is no reasonable doubt that the last individual has died.
Extinct in the Wild (EW)	A species is Extinct in the Wild when it is known to survive only in cultivation or as a naturalized population (or populations) well outside the past range.
Regionally Extinct (RE)	A species is Regionally Extinct when it is extinct within the region assessed (in this case South Africa), but wild populations can still be found in areas outside the region.
Critically Endangered, Possibly Extinct (CE PE)	Possibly Extinct is a special tag associated with the category Critically Endangered, indicating species that are highly likely to be extinct, but the exhaustive surveys required for classifying the species as Extinct has not yet been completed. A small chance remains that such species may still be rediscovered.
Critically Endangered (CR)	A species is Critically Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Critically Endangered, indicating that the species is facing an extremely high risk of extinction.
Endangered (EN)	A species is Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Endangered, indicating that the species is facing a very high risk of extinction.
Vulnerable (VU)	A species is Vulnerable when the best available evidence indicates that it meets at least one of the five IUCN criteria for Vulnerable, indicating that the species is facing a high risk of extinction.
Near Threatened (NT)	A species is Near Threatened when available evidence indicates that it nearly meets any of the IUCN criteria for Vulnerable, and is therefore likely to become at risk of extinction in the near future.
***Critically Rare**	A species is Critically Rare when it is known to occur at a single site, but is not exposed to any direct or plausible potential threat and does not otherwise qualify for a category of threat according to one of the five IUCN criteria.
***Rare**	A species is Rare when it meets at least one of four South African criteria for rarity, but is not exposed to any direct or plausible potential threat and does not qualify for a category of threat according to one of the five IUCN criteria. The four criteria are as follows: • Restricted range: Extent of Occurrence (EOO) <500 km^2, OR • Habitat specialist: Species is restricted to a specialised microhabitat so that it has a very small Area of Occupancy (AOO), typically smaller than 20 km^2, OR • Low densities of individuals: Species always occurs as single individuals or very small subpopulations (typically fewer than 50 mature individuals) scattered over a wide area, OR • Small global population: Less than 10 000 mature individuals.
***Declining**	A species is Declining when it does not meet or nearly meet any of the five IUCN criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened, but there are threatening processes causing a continuing decline of the species.
Least Concern (LC)	A species is Least Concern when it has been evaluated against the IUCN criteria and does not qualify for any of the above categories. Species classified as Least Concern are considered at low risk of extinction. Widespread and abundant species are typically classified in this category.
Data Deficient - Insufficient Information (DDD)	A species is DDD when there is inadequate information to make an assessment of its risk of extinction, but the species is well defined. Listing of species in this category indicates that more information is required and that future research could show that a threatened classification is appropriate.
Data Deficient - Taxonomically Problematic (DDT)	A species is DDT when taxonomic problems hinder the distribution range and habitat from being well defined, so that an assessment of risk of extinction is not possible.

*Categories marked with * are non-IUCN, national Red List categories for species not in danger of extinction, but considered to be of conservation concern. The IUCN equivalent of these categories is Least Concern (LC).

Table 12: PRECIS plant list for the QDS 3030CD (Raimondo *et al*., 2009; SANBI, www.sanbi.org).

Family	Species	Threat status	Growth form	Habitat
Amaryllidaceae	*Cyrtanthus obliquus*	Declining	Geophyte	Dry, rocky, sloping ground on sandstone-derived soils in open grassland and under thickets or low bushes where there is good drainage. It is found in the coastal grassland from KwaZulu-Natal through the Transkei to Humansdorp in the Eastern Cape.
Anacardiaceae	*Loxostylis alata*	Declining	Shrub, tree	Eastern Cape and KwaZulu-Natal. It occurs along forest margins, beside rivers and on outcrops of quartz and sandstone.
Anacardiaceae	*Searsia acocksii*	NT	Climber, shrub	Pondoland scarp forest, understorey shrub in forest margins or rocky outcrops above river gorges, restricted to Msikaba Formation Sandstone, 200-600 m
Apocynaceae	*Brachystelma sandersonii*	VU	Herb, succulent	Coastal grassland, 10-200 m
Aquifoliaceae	*Ilex mitis*	Declining	Shrub, tree	Banks of rivers and streams and moist spots in woods and forests. In South Africa it grows in all the provinces as well as in Swaziland and Lesotho
Arecaceae	*Jubaeopsis caffra*	EN	Tree	Pondoland coastal forest, steep sandstone cliffs above river banks, 10-80 m
Asphodelaceae	*Aloe linearifolia*	NT	Herb, succulent	High rainfall mistbelt, Ngongoni and coastal grassland, occurs in short grasslands in hilly areas, often in rocky outcrops
Asphodelaceae	*Gasteria croucheri*	VU	Herb, succulent	Scarp forest, on sandstone outcrops and cliffs, usually in partial shade in dry areas, 200-600 m.
Asteraceae	*Senecio erubescens* var. *incisus*	Threatened	Herb	Terrestrial
Begoniaceae	*Begonia homonyma*	EN	Herb, succulent	Deeply shaded sites on south-facing slopes in forests, rocky sites, 20-900 m
Celastraceae	*Elaeodendron croceum*	Declining	Tree	Margins of coastal and montane forests
Celastraceae	*Gymnosporia bachmannii*	VU	Shrub, tree	Pondoland scarp forest on sandstone, rocky banks of streams and rivers, often on islands in larger rivers.
Celastraceae	*Pseudosalacia streyi*	EN	Shrub, tree	Scarp forest on sandstone along rocky stream banks in river gorges, sometimes extending to forest margins, 50-200 m
Celastraceae	*Pterocelastrus rostratus*	Declining	Tree	Forest and montane scrub in forest margins and on mountain sides
Crassulaceae	*Crassula obovata* var. *dregeana*	VU	Dwarf shrub, succulent	Sandstone rock gardens on sandstone outcrops in coastal hills, 300-500 m.
Cyatheaceae	*Alsophila capensis*	Declining	Tree	Forest, near waterfalls, streams and permanently moist seepages
Cyperaceae	*Fimbristylis aphylla*	VU	Cyperoid, helophyte, herb	Permanently wet vleis, open places and swamps, often in water. Usually near the sea
Euphorbiaceae	*Euphorbia bupleurifolia*	Declining	Dwarf shrub,	Open grassland, usually in shallow soils

Family	**Species**	**Threat status**	**Growth form**	**Habitat**
			succulent	with a thin cover of grass
Fabaceae	*Lotononis bachmanniana*	NT	Herb	Damp sites in Pondoland coastal grassland
Hypoxidaceae	*Hypoxis hemerocallidea*	Declining	Geophyte	Occurs in a wide range of habitats, including sandy hills on the margins of dune forests, open, rocky grassland, dry, stony, grassy slopes, mountain slopes and plateaus. Appears to be drought and fire tolerant
Icacinaceae	*Apodytes abbottii*	NT	Shrub, tree	Pondoland scarp forest, in forest margins and fire protected crevices and rock cliff faces above forested gorges
Lamiaceae	*Plectranthus oertendahlii*	Rare	Herb, succulent	Scarp forest in wooded river valleys near the coast
Lauraceae	*Cryptocarya wyliei*	NT	Shrub, tree	Scarp forest. Occurs on forest margins, in fringes of riverine forest, thicket and coastal bush.
Meliaceae	*Turraea streyi*	CR PE	Dwarf shrub	Coastal grassland, in partial shade in and around the margins of scrub forest and bush clumps, 30-100 m
Myrsinaceae	*Rapanea melanophloeos*	Declining	Tree	Coastal, swamp and mountain forest, on forest margins and bush clumps, often in damp areas from coast to mountains.
Myrtaceae	*Eugenia erythrophylla*	NT	Shrub, tree	Pondoland scarp forest. Occurs in kloof forest margins near streams or along the upper edges of Msikaba Formation Sandstone cliffs above river gorges
Orchidaceae	*Disperis woodii*	Declining	Geophyte, herb	Damp grassland, usually sandy soils, sometimes within grass tussocks, from sea level to 800 m
Prioniaceae	*Prionium serratum*	Declining	Herb, hydrophyte, hyperhydate	An aquatic or semi-aquatic plant growing in marshy coastal areas, and along rivers
Proteaceae	*Leucadendron spissifolium* subsp. *natalense*	NT	Dwarf shrub	Largely confined to Pondoland coastal grassland
Proteaceae	*Leucadendron spissifolium* subsp. *oribinum*	VU	Dwarf shrub	Pondoland coastal grassland, 300-500 m
Rhamnaceae	*Phylica natalensis*	VU	Dwarf shrub	Pondoland coastal grassland, in rocky sites on Msikaba Formation Sandstone
Rhizophoraceae	*Cassipourea gummiflua* var. *verticillata*	VU*	Tree	Evergreen forest, riverine and swamp forest. Moist scarp forest and coastal lowland forest
Rhizophoraceae	*Cassipourea malosana*	Declining	Shrub, tree	In the understorey of Afromontane forest or in thickets on rocky outcrops in Mpumalanga, also in coastal and midland forests in KwaZulu-Natal
Rhynchocalycaceae	*Rhynchocalyx lawsonioides*	NT	Tree	Pondoland scarp forest, in upper margins of forests above deep river gorges and along the margins of kloof forests
Rubiaceae	*Canthium vanwykii*	NT	Shrub	Forest margins or more rarely in fire protected rocky crevices in grassland on Msikaba Formation Sandstone
Rubiaceae	*Eriosemopsis subanisophylla*	VU	Dwarf shrub	Sandstone grasslands, including Natal Group and Msikaba Formation. Gentle

Family	Species	Threat status	Growth form	Habitat
				slopes and plateaus and well-drained soils, 200-900 m
Salicaceae	*Pseudoscolopia polyantha*	NT	Shrub, tree	Sandstones. Along forest margins, or in rock outcrops usually on cliffs (Pondoland and KwaZulu-Natal). In the Western Cape it occurs along a rocky stream bank in montane fynbos
Sapotaceae	*Manilkara nicholsonii*	EN	Tree	Pondoland scarp forest. Occurs on the margins of drier forests, especially along the upper edge of cliffs above the deep forested gorges, as well as along the margins of kloof forests
Stangeriaceae	*Stangeria eriopus*	VU	Geophyte, herb	Scarp and coastal forest, Ngongoni and coastal grassland
Vitaceae	*Cyphostemma rubroglandulosum*	Rare	Herb	Pondoland scarp forest. Forest margins on rocky outcrops.

The POC of each of the species listed above was calculated (table below) with reference to habitat suitability within the study area.

Table 13: POC for floral species of concern.

Species	POC	Motivation
Cyrtanthus obliquus	27%	Suitable habitat not available within the study area
Loxostylis alata	53%	Suitable habitat not available within the study area within the Coastal Forest Habitat Unit
Searsia acocksii	13%	No suitable habitat within the study area
Brachystelma sandersonii	40%	Habitat availability limited
Ilex mitis	67%	Suitable habitat present within the study area along the river margins and within the Coastal Forest Habitat Unit
Jubaeopsis caffra	13%	Suitable habitat not present within the study area.
Aloe linearifolia	20%	No suitable habitat present within the study area
Gasteria croucheri	53%	Suitable habitat available within the study area along the cliffs of the associated with the Coastal Forest Habitat Unit.
Senecio erubescens var. *incisus*	20%	Limited information is available on the habitat of these species
Begonia homonyma	40%	Known from very few populations, and although suitable habitat are likely, the high level of disturbance renders the POC low
Elaeodendron croceum	60%	Suitable habitat present within the study area within the Coastal Forest Habitat Unit
Gymnosporia bachmannii	60%	Suitable habitat is present within the Coastal Forest habitat unit. It has been previously recorded from the Uvongo River in the vicinity of the study area, however habitat disturbance since the time of initial assessment (1999) limits the probability of this species still being present, and it was not recorded during the assessment.
Pseudosalacia streyi	47%	A subpopulation of the species is known to occur along the Uvongo River, traversing the study area, however as a result of severe deforestation, it is possible that the subpopulation might be extinct (http://redlist.sanbi.org)
Pterocelastrus rostratus	60%	Suitable habitat present within the study area within the Coastal Forest Habitat Unit
Crassula obovata var. *dregeana*	33%	Limited suitable habitat within the study area
Alsophila capensis	40%	Limited suitable habitat within the study area
Fimbristylis aphylla	20%	Suitable habitat not present within the study area

Species	POC	Motivation
Euphorbia bupleurifolia	33%	Limited suitable habitat within the study area
Lotononis bachmanniana	60%	Suitable habitat present within the Grassland Habitat Unit
Hypoxis hemerocallidea	100%	This species was encountered within the Grassland Habitat Unit. It may also occur within more disturbed areas.
Apodytes abbottii	33%	Suitable habitat limited within the study area.
Plectranthus oertendahlii	47%	Suitable habitat present within the study area within the Coastal Forest Habitat Unit
Cryptocarya wyliei	27%%	Introduced subpopulations are conserved in the Skyline Nature Reserve (http://redlist.sanbi.org). These populations might have spread to the study area, however the severe degradation of the coastal grassland Habitat Unit renders this possibility unlikely.
Turraea streyi	27%	No suitable habitat within the study area
Rapanea melanophloeos	67%	Suitable habitat present within the study area along the river margins and within the Coastal Forest Habitat Unit
Eugenia erythrophylla	60%	Suitable habitat is present within the Coastal Forest habitat unit. It has been previously recorded from the Uvongo River in the vicinity of the study area, however habitat disturbance since the time of initial assessment (1999) limits the probability of this species still being present, and it was not recorded during the assessment.
Disperis woodii	73%	Suitable habitat is present within the Coastal Grassland Habitat Unit for this widespread species
Prionium serratum	60%	Suitable habitat is present within the Riparian Habitat Unit
Leucadendron spissifolium subsp. *natalense*	27%	No suitable habitat within the study area
Leucadendron spissifolium subsp. *oribinum*	40%	Limited suitable habitat within the study area within the Coastal Forest Habitat Unit
Phylica natalensis	27%	No suitable untransformed habitat is available for this species and it is only known from eight locations (http://redlist.sanbi.org).
Cassipourea gummiflua var. *verticillata*	20%	Limited suitable habitat within the study area
Cassipourea malosana	40%	Suitable habitat present within the study area within the Coastal Forest Habitat Unit
Rhynchocalyx lawsonioides	60%	Suitable habitat is present within the Coastal Forest habitat unit. It has been previously recorded from the Uvongo River in the vicinity of the study area, however habitat disturbance since the time of initial assessment (1999) limits the probability of this species still being present, and it was not recorded during the assessment.
Canthium vanwykii	33%	Limited suitable habitat within the study area within the Coastal Forest Habitat Unit
Eriosemopsis subanisophylla	20%	No suitable habitat within the study area
Pseudoscolopia polyantha	33%	Limited suitable habitat within the study area within the Coastal Forest Habitat Unit
Manilkara nicholsonii	40%	Limited suitable habitat within the study area within the Coastal Forest Habitat Unit
Stangeria eriopus	20%	No suitable habitat within the study area
Cyphostemma rubroglandulosum	27%	No suitable habitat within the study area

From the above assessment, it is clear that from the floral SCC listed for the 3030CD in the tables above, the majority of species have a limited probability of occurring within the study area due to overall loss of natural habitat, the limited extent of remaining coastal forest and grassland and the loss of forest margins, which is the preferred habitat for a number of floral SCC above. Of the species listed above, none have been encountered within the study area, with the exception of *Hypoxis hemerocallidae* which was found in the Grassland Habitat Unit.

Only three species listed as being of conservation concern for the QDS have a POC of above 65%, namely *Ilex mitis* and *Rapanea melanophloeos* which may occur within the Coastal Forest Habitat Unit and *Disperis woodii* which may occur within the Coastal Grassland Habitat Unit.

Furthermore although not listed for the QDS, two protected tree species, namely *Sideroxylon inerme* and *Pittosporum viridiflorum*, were encountered which are listed as being ‘protected’ by the National Forest Act (Act 84 of 1998). In terms of this act, protected tree species may not be cut, disturbed, damaged or destroyed and their products may not be possessed, collected, removed, transported, exported, donated, purchased or sold - except under licence granted by the Department of Fisheries and Forestry (DAFF) or a delegated authority. These species occur throughout the Coastal Forest Habitat Unit and requires a site-specific walkdown prior to commencement of mining in this area from 2020 onwards, should it be deemed appropriate to be mined, due to the large number of species likely to be present and taking into account that the number of such species may increase or decrease over time and also considering the inaccessibility of this area at the time of assessment.

Four floral species listed as protected under the Kwazulu-Natal Nature Conservation Management Amendment Act (Act 5 of 1999) was also present in the study area, namely *Albuca bracteata*, *Haemanthus humilis*, *Scadoxus puniceus* and *Alsophila dregei* (previously known as *Cyathea dregei*). All of the above species occur within the Riparian Habitat Unit, with *Albuca bracteata* occurring on the steep cliffs above the Uvongo River.

The presence of the abovementioned floral SCC increases the ecological sensitivity of the Riparian, Coastal Forest and Grassland habitat units, particularly in terms of SCC floral species conservation.

6.6 Vegetation Index Score

The information gathered during the assessment of the study area was used to determine the Vegetation Index Score (VIS) - see Appendix B for calculations. Due to variation between the different habitat units, the habitat units were assessed separately. The tables below list the scoring system as well as the results of each habitat unit.

Table 14: Scoring for the Vegetation Index Score.

Vegetation Index Score	Assessment Class	Description
22 to 25	**A**	Unmodified, natural
18 to 22	**B**	Largely natural with few modifications.
14 to 18	**C**	Moderately modified
10 to 14	**D**	Largely modified
5 to 10	**E**	The loss of natural habitat extensive
<5	**F**	Modified completely

Table 15: Vegetation Index Score

Habitat unit	Score	Class	Motivation
Transformed Habitat Unit	4	**Modified completely**	High levels of disturbance and alien floral recruitment present, as well as large areas of denuded soils
Riparian Habitat Unit	12	**Largely modified**	High levels of disturbance and high levels of alien floral species diversity has led to high levels of transformation of natural riparian vegetation structure and composition
Coastal Forest Habitat Unit	18	**Largely natural with few modifications**	Mostly undisturbed, intact, high ecological functionality, low levels of alien floral invasion and high floral diversity
Grassland Habitat Unit	15	**Moderately modified**	Relatively intact grassland, some alien species present, however hosts a high diversity of indigenous species

6.7 Alien and Invasive Floral Species

Alien invaders plants are plants that are of exotic origin and are invading previously pristine areas or ecological niches (Bromilow, 2010). Not all weeds are exotic in origin but, as these exotic plant species have very limited natural "check" mechanisms within the natural environment, they are often the most opportunistic and aggressively growing species within the ecosystem. Therefore, they are often the most dominant and noticeable within an area. Disturbances of the ground through trampling, excavations or landscaping often leads to the dominance of exotic pioneer species that rapidly dominate the area. Under natural conditions, these pioneer species are overtaken by sub-climax and climax species through natural veld succession. This process, however, takes many years to occur, with the natural vegetation never reaching the balanced, pristine species composition prior to the disturbance. There are many species of indigenous pioneer plants, but very few indigenous species can out-compete their more aggressively growing exotic counterparts.

Alien vegetation invasion causes degradation of the ecological integrity of an area, causing (Bromilow, 2010):

- A decline in species diversity;
- Local extinction of indigenous species;
- Ecological imbalance;
- Decreased productivity of grazing pastures; and
- Increased agricultural input costs.

Due to the high diversity of alien floral species present in the study area, only the alien species listed under NEMBA are included in Table 16 below. The remainder of alien floral species present are however listed in section 6.1 – 6.4 as part of the general floral species lists. Dominant alien floral species falling within an alien invasive category as per the NEMBA Alien and Invasive Species Regulations, GN R598 of 2014 are listed in the table below. Eradication of alien species falling within Category 1a and b should receive priority.

The various alien and invasive floral species categories are summarised as follows:

Category 1a: Invasive species that require compulsory control.

Invasive species that may not be owned, imported into South Africa, grown, moved, sold, given as a gift or dumped in a waterway. These species need to be controlled and removed from all areas, including private property and officials from the Department of Environmental Affairs (DEA) must be allowed access to monitor or assist with control.

Category 1b: Invasive species that require control by means of an invasive species management programme.

Invasive species that may not be owned, imported into South Africa, grown, moved, sold, given as a gift or dumped in a waterway. Category 1b species are major invaders that may need government assistance to remove. All Category 1b species must be contained, and in many cases they already fall under a government sponsored management program.

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.

Category 2 species are invasive species that can remain in private gardens, but only with a permit, which is granted under very few circumstances. These species should be monitored and controlled to prevent spread to areas outside of permitted areas. Any Category 2 plants outside permitted areas should be dealt with as stipulated in Category 1b.

Category 3: Ornamentally used plants that may no longer be planted.

These are invasive species that may remain in private gardens. However these species may not be sold or propagated and must be controlled. In riparian zones (within 32 metres of the edge of a river, lake, dam, wetland or estuary, or within the 1:100 year floodline, whichever is the greater) or wetlands all Category 3 plants fall within Category 1b.

Table 16: Dominant alien vegetation species identified during the general area assessment.

Species	English name	NEMBA Category
Trees/ shrubs		
Arundo donax	Spanish reed/Giant reed	1b
Canna indica	Indian-shot	1b
Hedychium coronarium	White ginger lily	1b
Lantana camara	Lantana	1b
Melia azedarach	Syringa	1b
Morus alba	Mulberry	2
Casuarina equisetifolia	Horsetail tree	2
Grevillea robusta	Australian silky oak	3
Eucalyptus grandis	Saligna gum	1b
Phytolacca dioica	Belhambra	3
Pinus pinaster	Cluster pine	1b
Psidium guajava	Guava	3
Ricinus communis	Castor-oil plant	1b
Rubus cuneifolius	Bramble	1b
Schinus terebinthifolius	Brazilian pepper tree	1b
Senna hirsuta	Hairy senna,	1b
Senna didymobotrya	Peanut butter cassia	1b
Solanum mauritianum	Bugweed	1b
Forbs		
Chromolaena odorata	Triffid weed	1b
Ipomoea purpurea	Common morning glory	1b
Cardiospermum granditlorum	*Balloon vine*	1b
Ipomoea alba	Moonflower	1b
Nephrolepis exaltata	Sword fern, Boston sword fern	1b
Phytolacca americana	American pokeweed	1b
Ageratum conyzoides	Invading ageratum	1b
Agrimonia procera	Scented agrimone	1b
Tithonia diversifolia	Mexican sunflower	1b
Verbena bonariensis	Purple top	1b
Gr**asses**		
Pennisetum setaceum	Fountain grass	1b
Pennisetum purpureum	Napier grass	1b
Sorghum halepense	Johnson grass, Aleppo grass	2

From the table above it is clear that a moderate abundance and diversity of alien species occur within the study area, with the majority of alien plant species being present within the Transformed and Wetland Habitat Units, including Category 1 invaders that require mandatory eradication.

6.8 Medicinal Plant Species

Medicinal plant species are not necessarily indigenous species, with many of them regarded as alien invasive weeds.

The table below presents a list of plant species with traditional medicinal value, plant parts traditionally used and their main applications, which were identified during the field assessment. These medicinal species are all commonly occurring species and are not confined to the study area.

Table 17: Prominent traditional medicinal plants identified during the field assessment and listed below with medicinal applications are also presented (van Wyk, et al., 1997; van Wyk and Gericke, 2000; van Wyk, Oudtshoorn, Gericke, 2009).

Species	Name	Plant parts used	Medicinal uses
Aloe arborescens	Krantz aloe	Leaves	The Zulu people use the leaves of this plant, dried and pounded into a powder, as a protection against storms. Decoctions of the leaves are also used in childbirth and in treating sick calves. In the Transkei it is used for stomach ache and given to chickens to prevent them from getting sick.
Centella asiatica	Pennywort	Dried aboveground parts (mainly leaves)	Used to treat leprosy, wounds and cancer. It is widely used for wound treatment, fever, syphilis, and as a diuretic and purgative.
Croton gratissimus	Lavender croton	Bark	The bark is mainly used to treat fever, but also numerous ailments such as bleeding gums, rheumatism, chest complaints, indigestion and oedema. The leaves are sometimes used for coughs.
Dombeya rotundifolia	Wild pear	Mainly bark, sometimes roots	Infusions are used orally or as enemas to treat internal ulcers, haemorrhoids, diarrhoea and stomach problems.
Gomphocarpus fruticosa	Milkweed	Leaves, sometimes roots	Used as snuff to treat headcahes and tuberculosis.
Helichrysum nudifolium	Everlasting	Leaves, twigs and sometimes the roots	Many ailments are treated, including coughs, colds, fever, infections, headache and menstrual pains. It is a popular ingredient in wound dressing.
Hypoxis colchifolia	Broad-leaved Hypoxis	Tuberous rootstock	Infusions of corm are used to treat dizziness, bladder disorders and insanity
Hypoxis hemerocallidea	African potato	Rootstock	Infusions of corm are used as emetics to treat dizziness, bladder disorders and insanity. Decoctions have been given to weak children as a tonic and the juice is reported to be applied to burns.
Pittosporum viridifolium	Cheesewood	Bark	Decoctions or infusions are widely used to treat stomach complaints, abdominal pain and fever. It is said to ease pain and have a calming effect. Dried, powdered root or bark is sometimes added to beer as an aphrodisiac.
Rhoicissus tridentata	Bushman’s grape	Roots	Used to induce labour.

Species	Name	Plant parts used	Medicinal uses
Sideroxylon inerme	White milkwood	Bark and roots	Used to cure broken bones, to treat fevers, to dispel bad dreams, and to treat gall sickness in stock.
Tagetes minuta	Tall khaki bush	Leaves, flowers	The repellent properties of essential oil have been known for a long time and were found to be effective in preventing sheep from becoming infected with blow-fly larvae. Many gardeners use warm water extracts of the fresh plant to keep roses and other garden plants free from insects and fungal diseases. The essential oil is used in perfumery and as a flavourant in food, beverages and tobacco.
Typha capensis	Bulrush	Rhizomes	Used for venereal diseases or during pregnancy to ensure an easy delivery, and for dysmenorrhoea, diarrhoea, dysentery and to enhance male libido.

7. RESULTS OF THE FAUNAL INVESTIGATION

The study area comprised of a large excavated area in the central section of the study area, surrounded to the west and north by agriculture, namely banana plantations and sugar cane farming. The southern section of the study area is bordered by the Uvongo River, whilst the eastern section of the study area is comprised of natural coastal forest, grassland areas and a large area that has been disturbed. The disturbed areas were largely devoid of faunal species, whilst the western sugar cane areas provided a small degree of habitat to reptile, amphibian and avifaunal species. The coastal forest found in the eastern portion of the study area located along the Uvongo River was the only section of the study area that was noted to have retained the natural vegetation characteristics, and as such provided the most suitable habitat area for faunal species. The Uvongo River with its naturally vegetated banks also provides a movement corridor for faunal species moving through the area.

7.1 Mammals

Six mammals were observed during the site visit, all via spoor identification. No mammal species were directly observed, however, the high abundance of spoor observed within the study area indicates that the area is utilised by the identified mammals on a regular basis, either for foraging forays or as a corridor between the river system and other natural habitat areas in the immediate region. It is likely that the coastal forest provides a refuge to many of the mammal species, and as such is seen as important in terms of mammal conservation within the area.

Mammals larger than the ones already identified are unlikely to occur within the study area due to the level of anthropogenic and mining activities currently in the area. Mammals identified during the site assessment of the study area are listed below in table 18, and are all are considered to be common species to the region.

Table 18: Mammal species identified within the study area and surrounding region.

Scientific Name	Common Name	KZN Status	IUCN 2015 Status
Galerella sanguinea	Slender Mongoose	N/A	LC
Aonyx capensis	Cape Clawless Otter	Schedule 1	LC
Philantomba monticola	Blue Duiker	Schedule 2	LC
Sylvicapra grimmia	Common Duiker	N/A	LC
Atilax paludinosus	Water Mongoose	N/A	LC
Tragelaphus scriptus	Bushbuck	N/A	LC

LC = Least Concern

In terms of conservation, no SCC or threatened mammal species were encountered during the field assessment. Furthermore, the likelihood of any mammal species as listed in Appendix C being encountered within the study area is considered to be low due to the high levels of anthropogenic activity.

In summary, anthropogenic and mining activities have led to habitat transformation, a decrease in mammal species diversity as well as a decrease favourable mammal habitat. The proposed mining expansion is therefore considered unlikely to pose a threat to the conservation of mammal species in the region.

7.2 Avifauna

Avifaunal surveys were conducted throughout the study area, with particular focus placed on assessing the intact and disturbed areas around the mining and crushing area. The coastal forest within the eastern portion of the study area proved to have the highest number of avifaunal species, with the remaining disturbed areas showing a very low level of avifaunal endemism. Avifaunal species seen or heard during the time of the field assessment were recorded and are listed in the table below.

No avifaunal SCC were identified within the study area. From Table 19 below it can be seen that all avifaunal species identified within the study area are fairly common species known to reside within or utilise the habitat in the region and may be either permanently or occasionally present within the study area.

Table 19: Avifaunal species recorded during the survey.

Scientific Name	Common Name	IUCN status
Streptopelia capicola	Cape Turtle Dove	LC
Streptopelia seneggalensis	Laughing Dove	NYBA
Bostrychia hagedash	Hadeda Ibis	LC
Acridotheres tristis	Indian Myna	LC
Ploceus velatus	Southern Masked Weaver	LC
Ploceus ocularis	Spectacled Weaver	LC
Lybius torquatus	Black-collared Barbet	LC
Alopochen aegyptiacus	Egyptian Goose	LC
Crithagra mozambicus	Yellow-fronted Canary	LC
Motacilla aguimp	African Pied Wagtail	LC
Streptopelia semitorquata	Red-eyed Dove	LC
Columba livia	Rock Dove	LC
Andropadus importunus	Sombre Greenbul	LC
Colius striatus	Speckled Mousebird	LC
Oriolus larvatus	Black-headed Oriole	LC
Zosterops virens	Cape White-eye	NYBA
Prinia subflava	Tawny-flanked Prinia	LC
Centropus burchellii	Burchell's Coucal	NYBA
Lanius collaris	Common Fiscal Shrike	LC
Pycnonotus barbatus	Dark-capped Bulbul	LC
Onychognathus morio	Red-winged Starling	LC
Corvus albus	Pied Crow	LC
Dicrurus adsimilis	Fork-tailed Drongo	LC
Pternistls natalensis	Natal Francolin	LC
Zosterops pallidus	CapeWhite-eye	LC
Pogoniulus bilineatus	Yellow-rumped Tinkerbird	LC
Passer diffusus	Southern Grey-headed Sparrow	LC
Cossypha natalensis	Red-capped Robin-chat	LC
Camaroptera brachyura	Green-backed Bleating Warbler	LC
Lonchura cucullata	Bronze Mannikin	LC
Milvus aegyptius	Yellow-billed Kite	NYBA

LC = Least Concern, NYBA = Not yet been assessed by the IUCN.

The complete list of species of concern as listed for the KwaZulu-Natal region is included in Appendix C. Schedule 4 and 5 of the KwaZulu-Natal Nature Conservation Management Act (Act No 5 of 1999) lists a number of avifaunal species that may occur within the study area from time to time, however these schedules refer to the need for permit applications if the incumbent intends to trap, hunt or relocate any of the listed species, and as such has limited reference to the current project and the ongoing mining activities, provided that no relocation of species is necessary and no hunting activities occur within the study area.

7.3 Reptiles

Only two reptile species were observed within the study area, namely *Agama atra* (Southern Rock Agama) and *Rachylepis varia* (Variable Skink). Following discussions with personnel on site, mention was made of *Dendroaspis polylepis* (Black Mamba) being observed within the eastern and western borders of the study area. Although this species was not observed by the specialist at the time of the site assessment, the habitat requirements, natural distribution as well as previous observations of this species allows one to infer that it is likely that this species will occur within the study area. The table below further lists reptile species that are likely to occur within the study area, most notably in the natural riverine and coastal forest habitats associated with the far eastern section of the study area.

The complete list of reptile species as listed within the within the KZN Act No 5 (1999) is included in Appendix C.

Table 20: Reptile species expected within the study area and surrounding region.

Scientific Name	Common Name	KZN Status	IUCN 2015 Status
Dendroaspis polylepis	Black Mamba	N/A	LC
Dispholidus typus	Boomslang	N/A	NYBA
Crotaphopeltis hotamboeia	Herald Snake	N/A	NYBA
Lamprophis aurora	Aurora House Snake	N/A	LC
Philothamnus natalensis	Natal Green Snake	N/A	NYBA
Gerrhosaurus flavigularis	Yellow-throated Plate Lizard	N/A	NYBA
Chamaeleo dilepis dilepis	Common Flap-neck Chameleon	N/A	NYBA
*Agama atra**	Southern Rock Agama	N/A	NYBA
*Rachylepis varia**	Variable Skink	N/A	NYBA
Boaedon capensis	Brown House Snake	N/A	NYBA
Amblyodipsas polylepis polylepis	Common Purple-glossed Snake	N/A	NYBA
Philothamnus semivariegatus	Spotted Bush Snake	N/A	NYBA

*Species observed within study area, LC = Least Concern

7.4 Amphibians

Only one amphibian species was encountered during the field assessment, namely *Ametia angolensis* (Common River frog). It is expected that the majority of amphibian species likely to occur within the study area will inhabit the wetland and riparian areas. Species which are expected to occur in this region, and have been previously observed within the QDS include *Hyperolius marmoratus* (Painted Reed Frog), *Hyperolius pusillus* (Water Lily Frog), *Leptopelis natalensis* (Forest Tree Frog), *Amietophrynus rangeri* (Raucous Toad), *Phrynobatrachus natalensis* (Snoring Puddle Frog) and *Hyperolius tuberilinguis* (Tinker Reed Frog).

In terms of conservation, there is a possibility of encountering two amphibian SCC within the study area, namely *Afrixalus spinifrons* (Natal Banana Frog) and *Natalobatrachus bonebergi* (Kloof Frog). Both of these species are known to occur in wetland and coastal forest areas within or alongside streams and pools. *A. spinifrons* (Natal Banana Frog) is listed as Near Threatened whilst *N. bonebergi* (Kloof Frog) is listed as Endangered.

On consultation of the South African Frog Atlas (SAFAP), for the QDS, *A. spinifrons* has been recorded previously on a number of occasions. The likelihood of encountering *N. bonebergi* within the study area is considered to be low as this species is known to prefer rocky stream-beds within closed canopy areas, and is never found in open areas. The Uvongo is an open air river (no closed canopy) and as such is unlikely to provide supportive habitat for *N. bonebergi*.

A list of conservational concern amphibian species known to occur within the province is included in Appendix C.

7.5 Invertebrates

The invertebrate assessment conducted was a general assessment with the purpose of identifying common species and taxa in the study area. As such, the invertebrate assessment is not an indication of the complete invertebrate diversity potential of the study area and surrounding area. A representation of commonly encountered families in the Insecta class that were observed during the assessment is listed in Table 21 below.

Table 21: Results of the invertebrates observed during the field assessment.

Order	Family	Scientific Name	Common Name	IUCN 2015 Status
Lepidoptera	Pieridae	*Belenois aurota*	Brown-veined White	NYBA
		Eurema brigitta brigitta	Broad-bordered Grass Yellow	NYBA
		Colotis danae	Scarlet Tip	NYBA
	Nymphalidae	*Junonia hierta*	Yellow Pansy	LC
		Danaus chrysippus	African Monarch	NYBA
		Junonia orithya madagascariensis	Eyed Pansy	NYBA
	Papilionidae	*Papilio demodocus demodocus*	Citrus Swallowtail	NYBA
		Graphium antheus	Large Striped Swordtail	NYBA
Orthoptera	Acrididae	*Nomadacris septemfasciata*	Red Locust	NYBA
		Tmetanota sp	N/A	NYBA

Order	Family	Scientific Name	Common Name	IUCN 2015 Status
		Tylotropidius sp	N/A	NYBA
		Truxaloides sp	N/A	NYBA
	Pamphagidae	*Stolliana sp*	N/A	NYBA
Odonata	Libellulidae	*Pantala flavescens*	Wandering Glider	LC
		Trithemis furva	Dark Dropwing	LC
		Hemistigma albipuncta	Piedspot	LC
		Orthetrum julia	Julia Skimmer	LC
	Coenagrionidae	*Africallagma glaucum*	Swamp Bluet	LC
		Pseudagrion sublacteum	Riffle Sprite	LC
	Aeshnidae	*Anax imperator*	Blue Emperor	LC
Hymenoptera	Formicidae	*Anoplolepis custodiens*	Pugnacious Ant	NYBA

The results from the invertebrate survey indicate that only invertebrate species common to the area are presently found within the study area. No invertebrates of conservational concern were observed during the site visit. Although not directly observed it is considered likely that two IUCN listed butterflies may occur within the study area, namely *Durbania amakosa albescens* and *Lepidochrysops ketsi leucomacula*. Both these species are listed as Vulnerable and are localised endemics to the Margate region. These species are known to occur within the Indian Ocean Coastal Belt, notably in grassland areas such as the grassland area in the northeastern portion of the study area. As such it is recommended that the grassland area in the northeastern portion of the study area be excluded from future mining activities in order to prevent further habitat loss for these already area restricted species.

Furthermore, it is recommended that the precautionary principal be applied in the case of the coastal forest and riparian vegetation, as these areas are capable of supporting a diverse range of invertebrate species. As such it is recommended that the coastal forest and riparian vegetation be exempt from clearing and that these areas are retained in the current natural state. A list of conservational concern invertebrate species known to occur within the region is included in Appendix C.

7.6 Arachnids and Scorpions

Arachnids can be notoriously hard to observe in the field due to their behavioural habits and hiding when danger is approaching. Additionally, due to the size and nocturnal or crepuscular nature of many arachnid species; it is not practical to identify all possibly occurring species during a limited site visit. Therefore an inference of possible occurring species has to be made by evaluating habitat suitability, prey sources and the study areas location. No arachnid species were observed during the site assessment, however the coastal forest in the eastern portion of the study area is likely to provide habitat for a number of arachnid species. Taking into the locality of the study area as well as the habitat composition, it is likely that the species of scorpion *Uroplectes formosus* is likely to be found within this coastal forest. This species is known to favour trees, and can often be found hidden under loose or broken bark attached to tree limbs, and is often found within dune forests and coastal areas of Natal.

The coastal forest and the open grassland areas within the north eastern portion of the study area have the highest probability of occurrence for spider species, notably the more important trapdoor and baboon spiders. Within these habitat localities, it is likely that the following species may be observed; *Harpactira tigrina* (Common yellow-banded baboon spider), *Hermacha bicolor*, *Poecilomigas abrahami* (Abrahams banded-legged trapdoor spider) and *Ancylotrypa zebra* (Zebra trapdoor spider).

None of the aforementioned arachnid species are considered to be threatened nationally or provincially, nor are any threatened arachnid species expected to occur within the study area.

8. FAUNAL SPECIES OF CONSERVATIONAL CONCERN ASSESSMENT

The SCCIS provides a quantitative measure of the study area's value in terms of conserving faunal diversity. The SCCIS is based on the principles that when the knowledge of a species' historical distribution as well as SCC status, in this case for KwaZulu-Natal province, is combined with a field assessment that identifies the degree to which the study area is able to support a species in terms of a species' habitat and food requirements. Interpretations can then be made about the probability of that particular species residing within the study area. Repeating this procedure for all the potential faunal SCC of the area and collating this information then provides a sensitivity measure of the study area that has been investigated.

The only remaining habitat in a natural state present within the study area was that of the coastal forest along the Uvongo River within the eastern portion of the study area, and to a degree the small section of grassland with wetland characteristics above the ridge of the coastal forest in the northeastern section of the study area. A number of provincially listed species were observed within the aforementioned habitat units, namely *Aonyx capensis* (Cape Clawless Otter) and *Philantomba monticola* (Blue Duiker). However it must be noted that these listings are relevant to the provincial schedules in terms of possession, trading, destruction and/or trapping of these species. Although these species are listed as provincially protected in terms of the schedules, they are however listed as least concern by the IUCN as they have widespread populations and are not considered to be threatened nationally or internationally at the current time.

The coastal forest habitat unit located in the east of the study area is part of a greater habitat area continuing eastwards. As such, species observed within this section of the study area are likely to predominate much further eastwards and are not entirely dependent on the habitat provided within the study area for their only means of survival. However, consideration must be given to the importance of the Uvongo River as a source of water and temporary/ permanent habitat for faunal species. The bankside vegetation provides cover for faunal species whilst drinking as well as habitat for smaller more cryptic species, and is therefore considered an important feature of the area and overall river system. As such it is recommended that as far as possible the river, its associated vegetation and the coastal forest along the river and cliffs in the eastern portion of the study area are conserved and remain exempt from mining activities.

Taking into consideration the habitat availability of the study area, the location of the study area within the KwaZulu-Natal province and species whose distribution fall within the study area it can be concluded that the only SCC that are likely to occur within the study area are those *Afrixalus spinifrons* (Natal Banana Frog), *Natalobatrachus bonebergi* (Kloof Frog), *Durbania amakosa albescens* (Butterfly) and *Lepidochrysops ketsi* leucomacul (Butterfly). These species are expected to be highly restricted within the study area, namely to the coastal forest, wetland and open grassland areas of the study area. Due to the restricted nature of the useable habitats within the study area and the low number of expected SCC, the full SCCSIS was not used as it would give a scewed output for the entire study area. As such, only the Probability of Occurrence (POC was calculated and is expressed for the aforementioned SCC). *Afrixalus spinifrons* is considered to have a POC of 83% whilst *Natalobatrachus bonebergi* is considered to have a POC of 53%. Both *Durbania amakosa albescens* and *Lepidochrysops ketsi leucomacula* achieved a score of 73% and are expected to be localised to the grassland areas within the study area. It is highly likely that *Afrixalus spinifrons* will occur within the coastal forest and grassland areas in the eastern portions of the study area, whilst *Natalobatrachus bonebergi* is considered to have a low likelihood of occurrence within the study area, primarily due to its niche habitat preferences.

9. SENSITIVITY MAPPING

A sensitivity map (Figure 17) was created with the use of the floral and faunal integrity and diversity encountered during the assessment of the study area. From the assessment it is clear that the majority of the study area comprises of the Transformed Habitat Unit which includes active mining areas, areas where topsoil and vegetation have been cleared and agricultural lands. These areas are considered to have low ecological sensitivity and no significant loss of ecological resources will occur should these areas be mined.

From an ecological perspective, it is however important that the Uvongo River which forms the Riparian Habitat Unit and its associated buffers in terms of the National Water Act (Act 36 of 1998) remain intact, as this area is considered to have high ecological sensitivity, due to the importance of this system in terms of biodiversity maintenance and acting as a migratory corridor for faunal species. The Coastal Forest Habitat Unit is also considered to have high ecological sensitivity due to this unit being largely intact and providing habitat for a high abundance and diversity of floral and faunal species, and also providing suitable habitat within the study area for a number of floral and faunal SCC to occur.

The small portion of Grassland present within the northeastern portion of the study area is also considered to be relatively intact and appears to be associated with wetland conditions. This habitat unit provides habitat for a number of grassland and smaller forb species and is considered to be of moderate ecological sensitivity. Confirmation of whether wetlands are present in this area will however ultimately determine its conservation status.

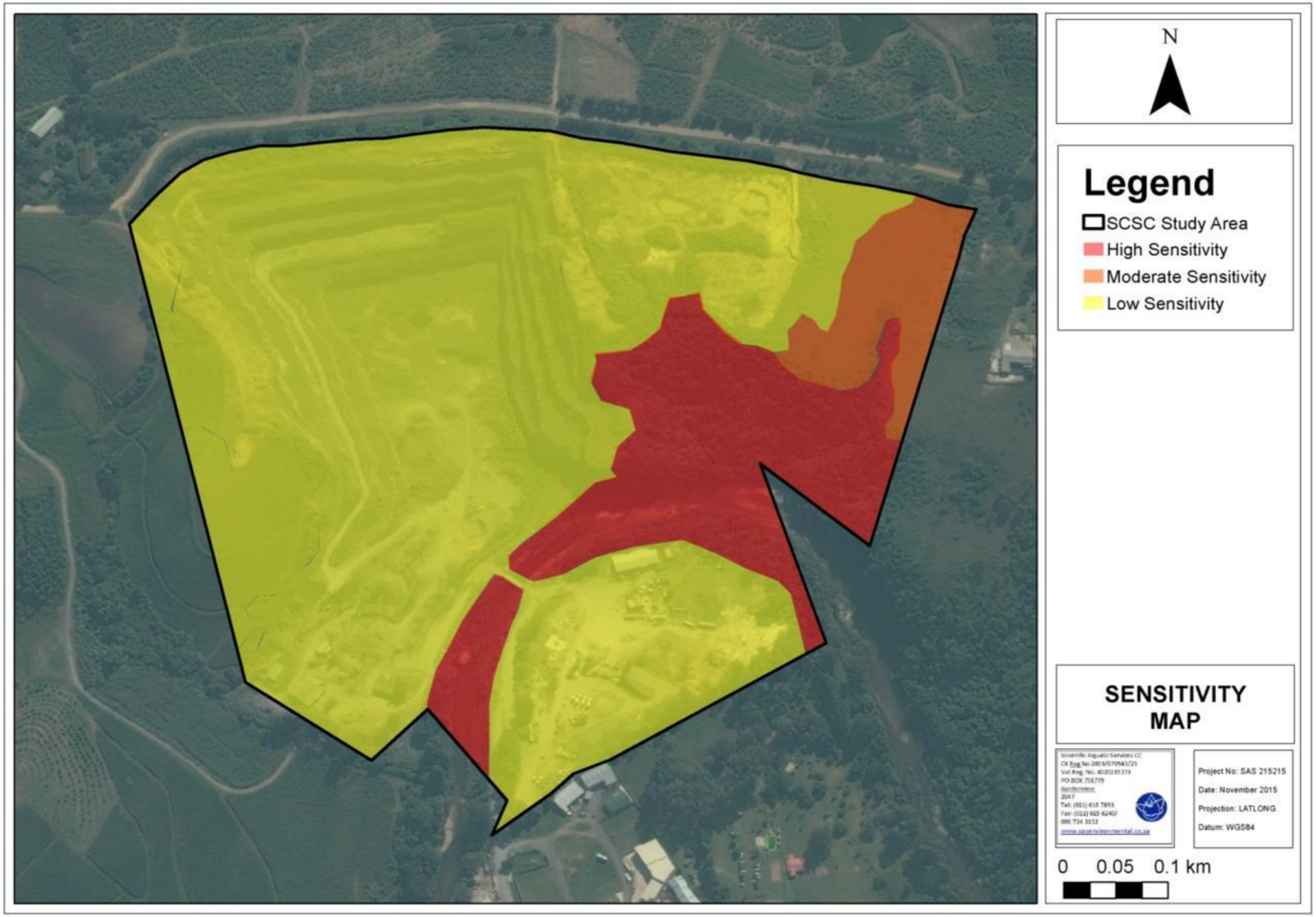

Figure 17: Sensitivity Map for the study area.

10. IMPACT ASSESSMENT

10.1 Floral Impact Assessment Results

The tables below present the impact assessment according to the method described in Section 3 and serve to summarise the significance of potential impacts on the floral features occurring within the study area. In addition, it also indicates the required mitigatory and management measures needed to minimise potential ecological impacts and presents an assessment of the significance of the impacts taking into consideration the available mitigatory measures, assuming that they are fully implemented.

Table 22: Floral Impact Assessment: Pre-Construction Phase

Nature of the impact	Significance of potential impact **BEFORE** mitigation						**Mitigation Measures**	Significance of potential impact **AFTER** mitigation					
	Probability	**Duration**	**Extent**	**Magnitude**	**Significance**			**Probability**	**Duration**	**Extent**	**Magnitude**	**Significance**	
Pre-Mining Phase													
Site clearing and removal of topsoil and vegetation within areas of increased ecological sensitivity leading to loss of floral species diversity and floral habitat	5	5	2	8	75	**High**	● A sensitivity map has been developed for the study area, indicating riparian and coastal forest areas which are considered to be of increased ecological importance. It is recommended that this sensitivity map be considered during all development phases to aid in the conservation of floral diversity within the study area. ● All mining footprint areas and areas affected by the proposed mine expansion should remain as small as possible and should not encroach onto surrounding more sensitive riparian areas and the associated buffer zone and if possible, the coastal forest areas. It must also be ensured that these areas are off-limits to construction vehicles and personnel. ● Should the presence of wetlands be confirmed within the Grassland Habitat Unit, this should also be taken into consideration as part of the overall mine planning process. ● The boundaries of the mining footprint areas are to be clearly defined and it should be ensured that all activities remain within defined footprint areas. ● If any floral SCC, including nationally (SANBI) or provincially (KZN) protected floral species will be disturbed, effective relocation of individuals to suitable similar habitat should be ensured where possible upon obtaining a permit to do so. ● All rescue and relocation plans and activities should be overseen by a suitably qualified specialist or a suitably qualified appointed member of the mine personnel. ● Should any protected tree species be destroyed during the mine expansion activities it is recommended that a new tree be planted for each tree destroyed upon obtaining a permit to do so from the Department of Forestry and Fisheries (DAFF).	3	4	1	6	33	**Moderate**

Nature of the impact	Significance of potential impact **BEFORE** mitigation						**Mitigation Measures**	Significance of potential impact **AFTER** mitigation					
	Probability	**Duration**	**Extent**	**Magnitude**	**Significance**			**Probability**	**Duration**	**Extent**	**Magnitude**	**Significance**	
Expansion Phase													
Expansion activities taking place within or in close proximity to areas of increased ecological sensitivity	5	4	2	8	70	**High**	● All mining footprint areas and areas affected by the proposed mine expansion should remain as small as possible and should not encroach onto surrounding more sensitive riparian areas and the associated buffer zone and if possible, the coastal forest areas. It must also be ensured that these areas are off-limits to construction vehicles and personnel. ● Should the presence of wetlands be confirmed within the Grassland Habitat Unit, this should also be taken into consideration as part of the overall mine planning process. ● The boundaries of the proposed mine expansion footprint areas are to be clearly defined and it should be ensured that all activities remain within defined footprint areas.	3	4	1	6	33	**Moderate**
Indiscriminate movement of construction vehicles and access road construction through surrounding floral habitat and compaction of soils	3	3	3	8	42	**Moderate**	Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the proposed development activities.	2	2	2	6	20	**Low**
Operational/ Mining Phase													
Operational (mining) activities taking place within or in close proximity to areas of increased ecological sensitivity	5	4	2	8	70	**High**	● All mining footprint areas and areas affected by the proposed mine expansion should remain as small as possible and should not encroach onto surrounding more sensitive riparian areas and the associated buffer zone and if possible, the coastal forest areas. It must also be ensured that these areas are off-limits to construction vehicles and personnel. ● All mining footprint areas and areas affected by the proposed mine expansion should remain as small as possible and should not encroach onto surrounding more sensitive riparian areas and the associated buffer zone and if possible, the coastal forest areas. It	3	4	1	6	33	**Moderate**

Nature of the impact	Significance of potential impact **BEFORE** mitigation						Mitigation Measures	Significance of potential impact **AFTER** mitigation					
	Probability	**Duration**	**Extent**	**Magnitude**	**Significance**			**Probability**	**Duration**	**Extent**	**Magnitude**	**Significance**	
							must also be ensured that these areas are off-limits to construction vehicles and personnel. ● Should the presence of wetlands be confirmed within the Grassland Habitat Unit, this should also be taken into consideration as part of the overall mine planning process. ● The boundaries of the proposed mine expansion footprint areas are to be clearly defined and it should be ensured that all activities remain within defined footprint areas.						
Loss of floral SCC during general mining operations	5	4	2	8	70	**High**	● The footprint area cleared for the proposed mine expansion areas should be kept as small as possible. ● Permits must be obtained for the removal/ destruction of trees protected under the National Forests Act (Act 84 of 1998) prior to the construction phase from DAFF. ● The number of protected trees removed for ongoing mine expansion should be kept to a minimum and no trees should be needlessly destroyed. ● Should any other floral SCC, including SANBI RDL species and provincially protected species, be encountered within the development footprint, these species are to be relocated as appropriate. ● Floral SCC are to be handled with care and the relocation of these plant species to nearby suitable similar habitat is to be overseen by a botanist. ● The collection of plant material for medicinal purposes or collection of firewood should be prohibited. ● Edge effect control needs to be implemented to ensure no further degradation and potential loss of floral SCC outside of the proposed project footprint area.	3	4	1	6	33	**Moderate**
Encroachment of alien vegetation into disturbed areas leading to a loss of floral habitat	4	4	3	8	60	**High**	● Alien plant species proliferation, which may affect more intact habitat within surrounding areas, need to be strictly managed adjacent to the project footprint areas and removal of the alien and weed species encountered in the study areas must take place in	3	3	2	6	33	**Moderate**

Nature of the impact	Significance of potential impact **BEFORE** mitigation						Mitigation Measures	Significance of potential impact **AFTER** mitigation					
	Probability	**Duration**	**Extent**	**Magnitude**	**Significance**			**Probability**	**Duration**	**Extent**	**Magnitude**	**Significance**	
							order to comply with existing legislation (NEMBA Alien and Invasive Species Regulations, 2014). Eradication of alien invasive species should take place throughout the operational phase on an ongoing basis. Specific mention in this regard is made to the eradication of Category 1b species identified within the study area and the early detection and removal of alien vegetation within and adjacent to disturbed areas. ● Alien vegetation eradication recommendations include: • 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.						
Edge effects such as erosion leading to loss of floral habitat in the surrounding areas	4	4	2	8	56	**Moderate**	● To minimise the risk of erosion, the extent of vegetation clearing and the duration for which bare soils are exposed in areas surrounding the mining footprint clearing should be kept to a minimum. ● To prevent the erosion and loss of topsoils, management measures may include berms, soil traps, hessian curtains and stormwater diversion away from areas susceptible to erosion. It must be ensured that topsoil stockpiles are located outside of any wetland and riparian areas and areas susceptible to erosion.	3	3	1	4	24	**Low**
Dust generation during operations leading to a loss of floral habitat	3	3	2	6	33	**Moderate**	● It is recommended that all temporary access roads and construction areas be regularly sprayed with water in order to curb dust generation, if deemed necessary. ● Dust control may be particularly necessary during the dry season when increased levels of dust generation can be expected. ● Areas should not be over-sprayed causing water run-off and subsequent sediment loss into the riparian and surrounding wetland areas.	2	2	1	4	14	**Low**

Nature of the impact	Significance of potential impact **BEFORE** mitigation						Mitigation Measures	Significance of potential impact **AFTER** mitigation					
	Probability	**Duration**	**Extent**	**Magnitude**	**Significance**			**Probability**	**Duration**	**Extent**	**Magnitude**	**Significance**	
Indiscriminate movement of operational vehicles through surrounding floral habitat	3	3	2	6	33	**Moderate**	● Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the proposed development activities. ● As far as possible, existing access roads should be utilised to access the operational areas. ● All disturbed habitat areas must be rehabilitated and planted with indigenous floral species as soon as possible to ensure that floral ecology is re-instated. ● All soils compacted as a result of operational activities falling outside of the project footprint areas should be ripped and profiled. Special attention should be paid to alien and invasive control within these areas.	2	2	1	4	14	**Low**
Pollution of natural environment leading to a loss of floral habitat	4	3	3	4	40	**Moderate**	● It must be ensured that mining related waste or spillage and effluent do not affect the sensitive habitat boundaries and associated buffer zones. ● Maintenance and monitoring of septic tanks should be a priority. ● No dumping of construction materials and soil within riparian, grassland or coastal forest areas or associated buffers may take place and all dumps must be placed within already transformed habitat areas. ● In the event of a vehicle breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practiced to prevent the ingress of hydrocarbons into the topsoil. ● It must be ensured that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage. ● Regularly inspect all vehicles for leaks. Re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into topsoil.	2	2	1	2	10	**Low**
Closure/Rehabilitation Phase													
Alien plant proliferation in disturbed areas leading to loss of faunal habitat	4	5	3	8	64	**High**	● Alien floral species management and eradication must continue to be implemented. Alien and invasive vegetation control should take place throughout all development including decommissioning phases to prevent loss of floral habitat.	3	4	2	6	36	**Moderate**

Nature of the impact	Significance of potential impact **BEFORE** mitigation						Mitigation Measures	Significance of potential impact **AFTER** mitigation					
	Probability	Duration	Extent	Magnitude	Significance			Probability	Duration	Extent	Magnitude	Significance	
							● 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 mine expansion and development footprint areas. Alien seed dispersal within the top layers of the soil within footprint areas, that will have an impact on future rehabilitation, also has to be controlled. ● All soils compacted as a result of closure activities should be ripped and profiled. Special attention should be paid to alien and invasive control within these areas. ● All disturbed habitat areas must be rehabilitated and planted with indigenous floral species as soon as possible to ensure that floral ecology is re-instated.						
Ongoing long term habitat modification as a result of ineffective rehabilitation activities	4	5	3	8	64	**High**	A biodiversity management and rehabilitation plan must be implemented to ensure that all disturbed areas are reinstated to a natural state.	3	3	2	4	27	**Low**
Improper erosion control leading to further habitat disturbance	3	3	2	8	39	**Moderate**	● The extent of vegetation clearing should be kept to a minimum in order to minimise the risk of erosion. ● To prevent the erosion of top soils, management measures may include berms, soil traps, hessian curtains and stormwater diversion away from areas susceptible to erosion	3	3	1	4	24	**Low**
Post-Closure Phase													
Ineffective Rehabilitation leading to permanent loss of floral habitat	4	5	3	8	64	**High**	Post-closure, ongoing monitoring of rehabilitation works must take place to ensure that biodiversity and suitable vegetation cover has been reinstated until a closure certificate has been obtained	3	3	2	4	27	**Low**
Ongoing proliferation of alien and invasive floral species leading to a permanent alteration of floral habitat	4	5	3	8	64	**High**	Post-closure, ongoing monitoring and eradication of alien vegetation in the vicinity of the study area must take place until a closure certificate has been obtained.	4	3	2	6	36	**Moderate**

10.2 Faunal Impact Assessment Results

The tables below present the impact assessment according to the method described above and serve to summarise the significance of potential impacts on the faunal communities associated within the study area. In addition, the tables also indicate the required mitigatory and management measures required to minimise potential ecological impacts and presents an assessment of the significance of the impacts taking into consideration the available management measures, assuming that they are fully implemented.

Table 23: Faunal Impact Assessment Results

Nature of the impact	Significance of potential impact **BEFORE** mitigation						Mitigation Measures	Significance of potential impact **AFTER** mitigation					
	Probability	Duration	Extent	Magnitude	Significance			Probability	Duration	Extent	Magnitude	Significance	
Expansion Phase													
Clearing of vegetation and expansion activities within sensitive in leading to a decrease in faunal habitat	4	4	2	8	56	**Moderate**	● No areas falling outside of the proposed mine layout areas may be cleared for construction purposes. ● The boundaries of the development footprint areas are to be clearly defined and it should be ensured that all activities remain within defined footprint areas. ● All mining footprint areas and areas affected by the proposed mining development should remain as small as possible and any disturbance of sensitive habitat must be actively avoided.	3	3	2	4	27	**Low**
Encroachment of alien vegetation into disturbed areas reducing habitat for faunal species	4	5	2	8	60	**Moderate**	Implement an alien vegetation management and eradication program.	3	3	2	6	33	**Moderate**
Erosion as a result of vegetation clearing activities resulting in the siltation of faunal habitat and river systems	4	3	2	8	52	**Moderate**	● To minimise the risk of erosion, the extent of vegetation clearing should be kept to a minimum. ● To prevent the erosion of top soils, management measures may include berms, soil traps, hessian curtains and storm water diversion away from areas susceptible to erosion. It must be ensured that topsoil stockpiles are located outside of any wetland and riparian areas and areas susceptible to erosion.	3	3	1	6	30	**Moderate**
Trapping and hunting of faunal species leading to decrease in faunal abundance and diversity	3	4	2	6	36	**Moderate**	● Prohibit any trapping, hunting or killing within the study area, furthermore access control to the property must be used to ensure that no illegal trapping or poaching takes place	2	4	2	6	24	**Low**
Collision of construction vehicles with faunal species	3	4	2	6	36	**Moderate**	● Mining vehicles to use designated roadways. ● Speed limits must be implemented.	2	4	2	6	24	**Low**

Nature of the impact	Significance of potential impact **BEFORE** mitigation						**Mitigation Measures**	Significance of potential impact **AFTER** mitigation					
	Probability	**Duration**	**Extent**	**Magnitude**	**Significance**			**Probability**	**Duration**	**Extent**	**Magnitude**	**Significance**	
Operational Phase													
On-going disturbance of faunal habitat within surrounding areas due to activities associated with mining, as well as further clearing of vegetation as mining progresses	4	4	2	6	48	**Moderate**	● No areas falling outside of the proposed mine layout areas may be cleared for construction purposes ● The boundaries of the development footprint areas are to be clearly defined and it should be ensured that all activities remain within defined footprint areas. ●All mining footprint areas and areas affected by the proposed mining development should remain as small as possible and any disturbance of sensitive habitat must be actively avoided.	3	4	1	6	33	**Moderate**
Proliferation of alien floral species in disturbed areas resulting in decrease of faunal habitat	4	5	2	8	60	**Moderate**	Implement an alien vegetation management and eradication program.	3	4	2	6	36	**Moderate**
Trapping and hunting of faunal species leading to decrease in faunal abundance and diversity	3	4	2	6	36	**Moderate**	Prohibit any trapping or hunting within the study area, furthermore access control to the property must be used to ensure that no illegal trapping or poaching takes place.	2	4	2	6	24	**Low**
Loss of riparian and potential wetland habitat	4	4	2	8	56	**Moderate**	A sensitivity map has been developed for the study area, indicating riparian and potential wetland areas which are considered to be of increased ecological importance. It is recommended that this sensitivity map be considered during all development phases to aid in the conservation of faunal diversity within the study area.	3	4	2	6	36	**Moderate**
Closure/Rehabilitation Phase													
Alien plant proliferation in disturbed areas leading to loss of faunal habitat	4	5	2	8	60	**Moderate**	Implement an alien plant management and eradication program.	3	4	1	6	33	**Moderate**
Ongoing long term habitat modification as a result of ineffective rehabilitation activities	4	5	2	6	52	**Moderate**	Implementation of a biodiversity rehabilitation plan to ensure that all disturbed areas are reinstated to a natural state.	3	4	1	6	33	**Moderate**

Nature of the impact	Significance of potential impact **BEFORE** mitigation						Mitigation Measures	Significance of potential impact **AFTER** mitigation					
	Probability	**Duration**	**Extent**	**Magnitude**	**Significance**			**Probability**	**Duration**	**Extent**	**Magnitude**	**Significance**	
Improper erosion control leading to further habitat disturbance	3	3	2	6	33	**Moderate**	● To minimise the risk of erosion, the extent of vegetation clearing should be kept to a minimum. ● To prevent the erosion of top soils, management measures may include berms, soil traps, hessian curtains and stormwater diversion away from areas susceptible to erosion. It must be ensured that topsoil stockpiles are located outside of any wetland and riparian areas and areas susceptible to erosion.	3	3	1	6	30	**Moderate**
Post-Closure Phase													
Ineffective rehabilitation may lead to permanent transformation of faunal habitat and species composition	4	5	2	8	60	**High**	Implementation of a biodiversity rehabilitation plan to ensure that all disturbed areas are reinstated to a natural state.	3	4	2	6	36	**Moderate**
Proliferation of alien and invasive floral species in disturbed areas may lead to altered faunal habitat within the study area	4	5	3	6	56	**Moderate**	Implement an alien plant management and eradication program.	3	4	2	6	36	**Moderate**

10.3 Cumulative impacts

Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Cumulative impacts on the faunal and floral communities occurring within the study area would result from ongoing mine expansion activities without concurrent rehabilitation of existing mining facilities taking place, resulting in an increasing loss of faunal and floral habitat and species diversity.

10.4 Residual Impacts

Post-closure, residual impacts with respect to biodiversity are landscape scarring in the form of unrehabilitated facilities as well as continuing environmental damage from ongoing erosion, wind-blown dusts and ongoing invasion by alien invasive species, which may lead to permanent alteration of available habitat and permanent loss of faunal and floral diversity within the study area.

10.5 Impact Assessment Conclusion

10.5.1 Fauna

Based on the impact assessment it is evident that there are a number of possible impacts on the faunal ecology represented within the study area. From the tables it is evident that after mitigation and if effective management takes place, all potential faunal impacts may be reduced from High and Moderate to Moderate and Low significance levels.

Due to the already existing mining infrastructure and current mining activities within the study area, the level of faunal diversity has already been impacted upon. However, notwithstanding these pre-existing impacts faunal species were still noted to be utilising the study area, as well as the areas surrounding the study area. The more intact natural areas in the eastern portion of the study area provide the highest level of intact habitat for faunal species in the area, and as such mining of these areas should be avoided as far as possible. Clearing of habitat in the eastern portion of the study area is likely to lead to a significant loss of faunal habitat and a subsequent loss of faunal species, not just within the study area but within the neighboring areas as well. Furthermore, alien plant proliferation as can be seen in the northern section of the study area can be detrimental to the ongoing survivability of faunal species within an area. Proliferation of alien vegetation and the subsequent loss of natural vegetation is one of the largest threats faced by faunal species at present. A clear and effective alien plant management program needs to be implemented in order to restore natural vegetation to previously disturbed areas, as well as ensuring that the existing natural areas are not impacted upon. Through the implementation of the mitigation measures as well as a suitable alien plan management program further loss of faunal habitat and species can be mitigated.

10.5.2 Flora

Based on the above impact assessment it is evident that there are a number of possible impacts on the floral ecology within the study area. From the assessment it is evident that prior to management measures being put in place, the perceived floral impacts are mainly of high and moderate impact significance during all development phases. Impacts that are of particular concern include loss of floral habitat during the pre-construction and construction phases and an increase in alien invasive floral species and erosion during the construction and operational phases as a result of disturbance. Loss of floral SCC, including protected species may also occur. Should concurrent rehabilitation efforts and final rehabilitation works during the decommissioning/ rehabilitation phases not be effective, the project may also have high residual and cumulative impacts. If effective management and rehabilitation however take place, all impact significance levels may be reduced to moderate and low significance level impacts.

In order to prevent these impacts from affecting areas of increased ecological sensitivity, the site sensitivity map, along with the other mitigation measures outlined in the report, should be considered throughout all development phases.

Table 24: Summary of the results obtained from the assessment of floral ecological impacts.

Impact	Unmanaged	Managed
Pre-Construction Phase		
Site Clearing	High	Moderate
Construction Phase		
Mining infrastructure within sensitive areas	High	Moderate
Vehicle movement	Moderate	Low
Operational (Mining) Phase		
Mining in sensitive areas	High	Moderate
Loss of floral SCC	High	Moderate
Alien vegetation	High	Moderate
Erosion	Moderate	Low
Dust	Moderate	Low
Vehicle movement	Moderate	Low
Pollution	Moderate	Low
Closure/ Rehabilitation Phase		
Alien vegetation	High	Moderate
Ineffective rehabilitation	High	Low
Erosion	Moderate	Low
Post-Closure Phase		
Ineffective rehabilitation	High	Low
Alien vegetation	High	Low

Table 25: A summary of the results obtained from the assessment of faunal ecological impacts.

Impact	Unmanaged	Managed
Pre-Construction Phase		
Mining in sensitive areas	Moderate	Low
Construction Phase		
Vegetation clearing	Moderate	Low
Alien vegetation	Moderate	Moderate
Erosion	Moderate	Moderate
Trapping and hunting	Moderate	Low
Collisions	Moderate	Low
Operational (Mining) Phase		
On-going habitat disturbances	Moderate	Moderate
Alien vegetation	Moderate	Moderate
Trapping and hunting	Moderate	Low
Loss of sensitive (riparian) habitat	Moderate	Moderate
Closure/ Rehabilitation Phase		
Alien vegetation	Moderate	Moderate
Ineffective rehabilitation	Moderate	Moderate
Erosion	Moderate	Moderate
Post-Closure Phase		
Ineffective rehabilitation	Moderate	Moderate
Alien vegetation	Moderate	Moderate

11. BIODIVERSITY MANAGEMENT PLAN

The biodiversity management plan is set out below in Table 26. The plan is discussed with reference to the management units (which corresponds with the various habitat units) identified within the study area. The management units are:

- MU1 – Coastal Forest
- MU2 – Grassland
- MU3 – Riparian
- MU4 – Transformed Areas

The biodiversity action plans for the study area are prioritised as follows:

PRIORITY RANK	COLOUR
HIGH	🟧
MODERATE	🟨
LOW	🟩

Factors that will need to be considered with respect to implementation of the biodiversity management plan include the following:

- Integration into existing group policy and management systems, including the existing Closure Plans and Environmental Management Plans;

- Alignment with the applicable emergency action plans e.g. spillage management procedure and fire prevention plan, and the rehabilitation plan and/or rehabilitation strategy and implementation programme, a standard requirement of water use licences.
- Identification and liaison with stakeholders and neighbouring properties especially with respect to weed/invader and erosion control action plans;
- Post closure land use; and
- Available budget and manpower for implementation, management and maintenance.

It is also important that monitoring of the biodiversity management plan is carried out to determine the effectivity of plans, and to justify the costs and the allocation of time and manpower to such an exercise. It is for this reason that a fixed-point monitoring system has been developed addressing the various ecological aspects including floral and faunal biodiversity. Ecosystem variables such as species diversity, species abundance and veld condition can be recorded on an annual basis. Methods to obtain this data could include fixed-point photography methods as a further means of documenting change. The integration of biodiversity principles and the actions being undertaken by the group should also be implemented into the training and environmental education of staff. Training could include general aspects, such as the importance of biodiversity, and could extend to specialist training in the rehabilitation and stabilisation of riparian areas, construction of gabions and/or firebreaks.

Table 26: Biodiversity Management Plan for South Coast Stone Crushers.

OBJECTIVE	ACTION	ACTIVITIES	PRIORITY PER MANAGEMENT UNIT
To allow SCSC staff to fully understand the concept of biodiversity and its importance.	Design a training program which informs staff about the relevance and importance of biodiversity management.	• Identify key concepts of biodiversity applicable to each management unit at the hand of the biodiversity management plan. • Address important biodiversity related issues as set out in the biodiversity management plan. • Design an interactive training program for staff which can form part of the mine induction procedure. • Inform staff and visitors to the mine about biodiversity related issues through visible awareness campaigns on the facility.	MU1 MU2 MU3 MU4
To monitor changes in policies, regulations and legal requirements.	Review all relevant policies, regulations and legal requirements pertaining to biodiversity.	• Annually review all relevant policies, regulations and legal requirements pertaining to biodiversity. • Revise biodiversity and vegetation management plan accordingly.	MU1 MU2 MU3 MU4
To ensure that rehabilitation and closure activities are at a suitable level to ensure that no latent impacts on the receiving environment occur and the PES of the system is maintained wherever possible.	Employ specialist consultants to assist in developing the detailed rehabilitation and closure plans. Ensure that monitoring takes place during the aftercare and maintenance period to ensure that any latent impacts are identified. Ensure that sufficient after care and maintenance takes place and that sufficient budget for these activities is made available to ensure that rehabilitation measures become established and self-sustaining.	• Ensure that sufficient rehabilitation has taken place to prevent erosion and/or sedimentation of the riparian features and adjacent cliffs and other steep areas. • Ensure that riparian PES and function of the riparian feature as well as coastal forest area within the study area is maintained and possibly enhanced. • Appoint relevant ecological specialists to provide input into the decision making and design process of any proposed new facilities and the closure of existing facilities in order to define and assist in planning to reach ecologically sustainable closure objectives. • The after care and maintenance program must be suitably designed to ensure self-sustaining closure in support of the post closure land use. • Attention must be paid to: ○ Technical details of aftercare and maintenance; ○ Development of Key Performance Indictors for aftercare and maintenance activities; ○ Frequency of aftercare and maintenance activities; ○ Duration of aftercare and maintenance activities; and ○ Focus areas of aftercare and maintenance activities.	MU1 MU2 MU3 MU4

OBJECTIVE	ACTION	ACTIVITIES	PRIORITY PER MANAGEMENT UNIT
Increase biodiversity value by the rehabilitation of disturbed areas, removal of alien and invasive species within and surrounding mining activities.	Establish a No-Go biodiversity area, with specific reference to the sensitive riparian and coastal forest areas. Compare plans of proposed surface activities regularly to the areas of mapped sensitivity. In terms of the NEMBA alien and Invasive Species Regulations (2014) declared weed and invader species are to be removed from the property.	• Rehabilitate areas disturbed by mining related activities. • Removal of alien and invasive species should take place during the maintenance and closure period of the mine within and adjacent to the mining footprint area, coastal forest area and within the highly sensitive riparian feature. • Continually implement an annual alien and invasive floral species eradication program. • Monitor riparian PES and function changes in the designated areas. • Edge effects of mining activities in these areas including erosion and alien control need to be strictly managed. • Compare the positions of planned infrastructure to the areas of mapped sensitivity.	🟧 MU1
			🟧 MU2
			🟧 MU3
			🟧 MU4
Prevent damages to sensitive habitat from general mining activities.	Prevent infrastructure from encroaching on sensitive riparian and coastal forest features.	• Before any stockpiles are placed and mining takes place, compare the proposed position of activities to sensitivity map. • Ensure that infrastructure expansion areas do not encroach onto sensitive riparian and coastal forest habitat. • Should encroachment be unavoidable, obtain relevant legislative approval for any activities to be undertaken within sensitive areas. • Ensure demarcation of sensitive areas prior to mine expansion to ensure only authorised areas are disturbed. • Ensure adequate post construction and post mining rehabilitation.	🟧 MU1
			🟨 MU2
			🟧 MU3
			🟩 MU4
To ensure that exposed soils and steep slopes are stable and not eroding.	Erosion control and rehabilitation in riparian areas and other disturbed areas.	• Identify activities which are causing erosion and incision of any of the riparian areas, adjacent cliffs and coastal forest features in the study area. • Obtain relevant legislative approval for any activities to be undertaken within riparian features to rectify erosion/ disturbance. • Seed any areas where earthworks have taken place to prevent further erosion.	🟧 MU1
			🟨 MU2
			🟧 MU3
			🟩 MU4
To ensure that dust associated with mining activities has minimal	Dust control Dust monitoring	• Ensure that all roads and construction areas are regularly sprayed with water or treated with other dust suppressants in order to curb dust generation.	🟩 MU1
			🟩 MU2

OBJECTIVE	**ACTION**	**ACTIVITIES**	**PRIORITY PER MANAGEMENT UNIT**
impact upon the regional ecology.			MU3 MU4
To ensure that noise associated with the mining activities do not impact upon faunal species.	Noise control Noise monitoring	• Ensure that noise levels do not exceed the relevant standards. • Ensure selected ambient noise monitoring is taking place. • Monitor points in high sensitivity areas according to rural measurements.	MU1 MU2 MU3 MU4
To ensure that soil contamination does not impact on the ecological integrity of the area.	Soil pollution control	• Ensure that all hazardous storage containers comply with the relevant SABS standards to prevent leakage. Regularly inspect all vehicles for leaks. Re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into topsoil.	MU1 MU2 MU3 MU4
Eradication of weed and invader species within the mining footprint area and within the sensitive ecological features.	Removal of alien and invasive species. Monitoring of alien vegetation stands	• Develop and implement a comprehensive alien vegetation monitoring program which should include ○ Identify priority areas ○ Liaison with surrounding stakeholders, and the local municipality to control upstream and surrounding nodes of seed production; ○ Identify priority species to control in consultation with relevant stakeholders; ○ Develop protocols for the removal of all alien species; and ○ Removal of species. • Re-assessment and monitoring of the area to determine success of the action and any follow-up measures required.	MU1 MU2 MU3 MU4
Greening of facility grounds with indigenous species to improve aesthetic qualities of the facility, maintain and increase species diversity of the area and create a green consciousness among staff.	Identify and design areas to be greened with indigenous and endemic floral species.	• Identify areas to be greened. • Identify floral species to be utilised. • Identify suitable maintenance methods (water, fertilizer, etc.). • As far as possible, employ local community members. • Source plants from established nurseries in the region. • Design and implement landscape development plans. • Continuously monitor efficacy of landscaping.	MU1 MU2 MU3 MU4
Species utilised in the greening of facility areas should ideally be sourced from local nurseries to ensure that	Consider the use of endemic/SCC/Medicinal plants for utilisation during operations and rehabilitation greening	• Identify endemic/SCC/medicinal plant species present on the study area from the biodiversity assessment included in this report. • Obtain relevant permits for the transport/ handling/ propagation of protected species.	MU1 MU2 MU3

OBJECTIVE	ACTION	ACTIVITIES	PRIORITY PER MANAGEMENT UNIT
plants are adapted to local climatic conditions.	activities.		MU4
To have the area under management of the SCSC facility free of litter and domestic waste.	Removal of litter and solid waste.	• Liaison with stakeholders and surrounding landowners to ensure that surrounding sources of litter are addressed through awareness campaigns in local communities. • Identify a suitable area for disposal of collected solid waste. • Removal of litter and solid waste. • Supply facilities which promote waste recycling.	MU1 MU2 MU3 MU4
To prevent damage to property by fire and possible safety issues and dangerous conditions on the mine property.	Access control	• Identify areas where the value of the biological resource warrants protection and therefore controlled access by the public (highly sensitive coastal forest and riparian features). • Maintenance of fences to ensure that access control is maintained. • Construct and maintain fire breaks on the property in compliance with legislated requirements.	MU1 MU2 MU3 MU4
To ensure that all future developments take biodiversity management issues into consideration.	Ensure that all proposed expansion and closure plans take biodiversity management aspects into consideration as part of the planning and design phase of a proposed development or closure plan.	• Ensure that ecological issues are sufficiently considered as part of the overall design and project execution of any development or closure activity.	MU1 MU2 MU3 MU4
To ensure that surface water resources of all major watercourses are monitored for changes during all phases of the mine	Hazardous materials control, spillage control, erosion control, water quality control and monitoring.	• Bio-monitoring of the surface water systems should take place in line with the recommendations as set out in the aquatic assessment (Eco-Pulse, 2015). • Ensure that all hazardous storage containers comply with the relevant SABS standards to prevent leakage. Regularly inspect all construction vehicles for leaks. Re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into topsoil. Erosion management measures must be implemented to prevent soils from eroding into surface water resources; • Ensure that all runoff and process water are adequately contained in the dirty water system. • Ensure that runoff from impacted areas is suitably managed and that runoff volumes and velocities are similar to pre-disturbance levels. Utilise storm water control methods as set out in engineering specifications and specialist reports. • Ensure that remainder of clean water runoff will be diverted, to minimise the loss of natural flow e.g. ○ Clean/dirty water separation • Minimise all dirty water runoff as far as possible	MU1 MU2 MU3 MU4

12. VEGETATION MANAGEMENT PLANS AND PROCEDURES

12.1 Rehabilitation and Revegetation

Broad rehabilitation guidelines have been developed for the SCSC quarry. The objectives of the rehabilitation guidelines, to be implemented throughout the various development phases, are to:

- Minimise environmental impacts resulting from permanent change to ecosystems as far as possible, and with specific reference to areas of increased ecological sensitivity;
- Ensure safe, stable and resilient landforms and soils in line with final land use objectives;
- Re-establish and maintain appropriate hydrology within the study area with specific reference to riparian and potential wetland features present in the study area as per the rehabilitation guidelines provided by Eco-Pulse (2015);
- Minimise visual contrast resulting from disturbance;
- Re-establish resilient and self-sustaining vegetation comprising locally indigenous vegetation; and
- Re-establish habitats capable of supporting high levels of biodiversity.

During the construction/ operational phases of the project, rehabilitation of impacted and disturbed areas beyond the development/ mining footprint as well as any decommissioned infrastructure/ sites or areas where activities in a certain section of the site have been completed, should take place. Rehabilitation should be viewed as an ongoing, concurrent process and disturbed areas must be rehabilitated as soon as possible. This will not only reduce the total disturbance footprint, but will also reduce the overall rehabilitation effort and cost.

During the closure phase of the project, all infrastructure footprint areas, including buildings, internal roads, stockpiles and berms, with the exception permanent infrastructure, must be removed or demolished, their footprints cleared, natural topography must be reinstated and these areas must be rehabilitated and vegetated in line with the proposed final land use. Broad rehabilitation measures are outlined below.

12.2 Rehabilitation Strategy

The rehabilitation strategy involves various broad steps including:

Pre-Construction Phase:

- Removal of topsoil, where available, is to take place within the proposed mining expansion areas prior to commencement of construction activities and suitably stockpiled. Topsoil removed shall only be used for rehabilitation purposes and not for any other construction, or other activities

Construction/ Operational Phase (Concurrent Rehabilitation)

- Rehabilitation of disturbed areas should take place as soon as possible within available areas that are not part of the on-going operational phase and immediately after general site construction is completed to re-introduce indigenous vegetation within disturbed areas;
- Rehabilitation works must take place throughout the operational phase as required, with particular focus on riparian rehabilitation, the introduction of indigenous vegetation and habitat creation;
- Disturbed and compacted areas present as a result of mining activities are to be rehabilitated through removal of any imported material and existing stockpiles, ripping of compacted soils, replacement of ameliorated topsoil and revegetation with indigenous species, including tree species. Special attention should be paid to alien and invasive control within these areas;
- Rehabilitation must preferably be done in such a way that the areas being rehabilitated are revegetated during the rainy season;
- As far as possible soft rehabilitation techniques should be employed;
- Initially re-vegetation should be undertaken using a mixture of commercially available indigenous grass seeds that will germinate reliably (Table 27), followed by the establishment of indigenous forbs, shrubs and trees indigenous to the study area and surrounding region;

Table 27: Recommended grass species list for use in terrestrial rehabilitation works.

Species	Common Name
Aristida junciformis	Ngongoni three-awn grass
Digitaria eriantha	Digit grass
Panicum maximum	Guinea grass
Themeda triandra	Red Grass
Alloteropsis semialata	Black seed grass
Cymbopogon caesius	Broad-leaved Turpentine Grass
Eragrostis curvula	Weeping lovegrass
Eulalia villosa	Golden Velvet Grass
Diheteropogon amplectens	Broad-leaved Bluestem
Eragrostis plana	Tough Love-grass
Panicum natalense	Natal Buffalo Grass

- As part of the landscaping and rehabilitation of the study area, it is recommended that indigenous and regionally-specific floral species be introduced. This will also assist in providing habitat for indigenous faunal species;
- Floral species selected for rehabilitation works may include indigenous species specifically selected to attract invertebrates, birds and small mammal species;
- The following tree species are deemed suitable for use in perimeter planting and for screening purposes:

Table 28: Recommended trees species list for perimeter/ screening planting.

Species	Common Name	Description	Habitat
Trichelia emetica	Natal Mahogany	Medium to Tall evergreen tree	Riverine vegetation and open woodland
Harpephyllum caffrum	Wild plum	Medium to large tree	Forest
Protorhus longifolia	Red beech	Evergreen tree, up to 15 m tall, single-stemmed, with a dark, rounded crown.	It grows in coastal and montane forest, on rocky outcrops and in riverine vegetation
Brachylaena discolor	Coast silver oak	Evergreen shrub or small to medium-sized tree	Coastal woodland, bush and on the margins of evergreen forest
Sideroxylon inerme	White milkwood	Small to medium evergreen tree	Dune forests, almost always in coastal woodlands and also in littoral forests
Carissa bispinosa	num-num	Evergreen dense bush or rambling shrub in wooded spots or scrub.	Wooded areas
Syzygium cordatum	Water berry	Medium-large evergreen tree	Wooded areas and forest near water
Ficus natalensis	Natal strangler fig	Medium-large evergreen tree	Coastal forest/bush
Rapanea melanophloeos	Cape beech	Medium-large evergreen tree	Forest and bushclumps, usually in damp areas
Phoenix reclinata	Wild Date Palm	Palm up to 10m	On watercourses, in grasslands and forests

- The removal of alien and invasive vegetation from the study area and surroundings should be initiated during the construction and operational phases and continue throughout all phases of the development, with particular attention being paid to the boundaries of the development footprint areas;
- All revegetated areas should be regularly monitored to determine whether floral species are successfully re-establishing;
- Areas adjacent to active mining areas that have been disturbed during the construction/ operational phase should be rehabilitated immediately through ripping and reprofiling of soils (including infilling and levelling) and revegetation using an indigenous and locally occurring grass species mixture;
- The operational/ mining areas and adjacent areas should be inspected for the occurrence of erosion and should erosion be noted, appropriate remedial action must

be taken. Any areas where active erosion is observed must be immediately rehabilitated in such a way as to ensure that the hydrology of the area is re-instated to conditions which are as natural as possible;

- Any steep and exposed slopes (particularly adjacent to riparian features and in the vicinity of the coastal forest) must be resloped to blend with the surrounding natural environment and re-profiled exposed soils occurring on gradients must be covered with hessian sheets, such as Geojute, to ensure that newly established topsoil does not erode due to rain or water flow associated with the riparian area;
- Wetland and riparian rehabilitation should take place in line with the recommendations provided by Eco-Pulse (2015);
- To prevent the erosion of top soils, management measures may include berms, soil traps, hessian curtains and storm water diversion away from areas susceptible to erosion. It must be ensured that topsoil and other stockpiles are located outside of the delineated riparian, wetland and buffer areas as well as other areas susceptible to erosion;
- Erosion berms should be installed in any areas where soil disturbances within the vicinity of the riparian and wetland features have occurred to prevent gully formation and siltation of the aquatic resources. The following points should serve to guide the placement of erosion berms:
  - Where the track has slope of less than 2%, berms every 50m should be installed;
  - Where the track slopes between 2% and 10%, berms every 25m should be installed;
  - Where the track slopes between 10%-15%, berms every 20m should be installed; and
  - Where the track has slope greater than 15%, berms every 10m should be installed.

Closure Phase (Final rehabilitation)

- The rehabilitation of the infrastructure during the closure phase must take place in such a way as to ensure that the post closure land use objectives are met. Rehabilitation has to be well planned and a suitably qualified specialist must form part of the management team in order to guide the rehabilitation and closure objectives of the project;
- Removal of mining infrastructure through either demolition (removal of the man-made components) or ceasing the disturbing activity in a specific area no longer required for construction or mining operations is to take place;

- Final rehabilitation of the open pit has to be undertaken in line with post-closure land use and the envisioned final land form. It must be ensured that all final landforms are safe and stable;
- Prior to replacement and spread of topsoil for revegetation purposes, any compacted areas are to be improved through ripping of soils, and if required soil fertility may also be improved through addition of fertilisers. This process also includes the eradication of alien and invasive floral species from disturbed areas;
- Backfilling of disturbed areas and re-contouring of slopes are significant measures to be taken in restoration of land mined by open pit methods to restore the area to the original or accepted alternative post closure uses;
- Revegetation through re-establishing indigenous flora ensuring self-sustaining communities that will over time reach a stable climax state in support of the intended post closure land use;
- All revegetated areas should be regularly monitored to determine whether floral species are successfully re-establishing;
- Alien vegetation monitoring should continue annually during the closure and post-closure phases;
- Upon completion of the activities, a systematic rehabilitation plan must be undertaken to restore the riparian and wetland areas to its condition prior to commencement of the activities and in line with the report prepared by Eco-Pulse (2015);

Post-closure phase

- Monitoring of rehabilitation sustainability, maintenance of rehabilitation and environmental parameters is to be conducted as necessary;
- Rehabilitation efforts must be implemented for a period of at least 5 years after decommissioning and closure or until a closure certificate has been obtained;
- A habitat assessment must be undertaken annually for a period of three years to ensure that rehabilitation is stable, failing which remedial action must be taken to rectify any impacts; and
- Rehabilitation structures must be regularly inspected for the accumulation of debris, blockages, instabilities and erosion with concomitant remedial and maintenance actions.

12.3 Description of General Rehabilitation Methods

12.3.1 Stripping and Stockpiling of Topsoil

- Soil stripping should remove all materials that are suitable for supporting plant growth and it is recommended that soils be stripped;
- Stockpiles locations must be safe from waterlogging and erosion;
- During stockpiling compaction of soils must be prevented;
- Stockpiles that will remain in location for more than one growing season and that have not re-vegetated naturally, should be re-vegetated to avoid erosion losses. To preserve the looseness of the stockpile (where this has been achieved by correct stripping and construction of the stockpile) fertilisation and seeding should be done by hand, by hydro seeding or aerially to prevent compaction;
- It must be ensured that stockpiled soil is only used for its intended purpose in rehabilitation works as the greatest reason for loss of topsoil, when stockpiles remain *in situ* for a long period, is their use for other purposes; and
- Risks of contamination of topsoil stockpiles are also present. The dumping of waste materials next to or on the stockpiles, contamination by fly-rock from blasting and the pumping out of dirty water from the pit are all hazards faced by stockpiles on mining sites.

12.3.2 Infrastructure Removal

- This involves the removal of the disturbing activity or aspect through either demolition (removal of the man-made components) or ceasing the disturbing activity in a specific area no longer required for mining operations;
- After identifying the structures that can be sustainably used after closure, the remainder of the infrastructure should be removed so that the land can be converted to its final end land use in association with the local community and future users;
- Any re-usable items should be removed from site;
- Any hazardous material should be analysed in order to determine means of decontamination and be disposed of in approved hazardous waste deposal sites;
- Mining infrastructure must be rendered safe according to professionally engineered designs and DMR requirements;
- Remaining structures should be demolished and demolition rubble removed; and
- The final landform agreed for the infrastructure areas should be created.

12.3.3 Soil Replacement and Deposition

- This step in the rehabilitation process involves the deposition and spread of stripped and stockpiled soils or similar soils imported from elsewhere prior to planting or seeding, in order to ensure that appropriate conditions for plant growth are provided;
- Such soils should be replaced in areas ready for rehabilitation works on a concurrent basis and as rehabilitation areas become available, as well as during the mine closure phase of the project.
- The layer of topsoil should be used in rehabilitation areas should be at least 150mm thick for grasses to establish.
- Care should be taken to ensure that the topsoil does not contain any remnants of alien invasive species. This can be accomplished by screening the topsoil before application;
- Soils should be moved when dry to minimise compaction.
- After application of the topsoil on steeper slopes, slopes should be must be covered with hessian sheets.

12.3.4 Revegetation and Biodiversity Re-establishment

The following revegetation options may be considered and the success of each option may be determined through trials during concurrent rehabilitation.

Hydro-seeding

- Seeding, if applied correctly, is a reliable and often more successful method of re-vegetation than, for example seedlings. It also has the potential to provide a more representative, diverse plant community, provided the correct seed mixture is utilised for the region in which the rehabilitation occurs. Methods such as hydro-seeding are often successful in controlling erosion, as pioneer grass species populate the disturbed soils and form a vegetative base for the subsequent stages of succession of vegetative communities. It is therefore important that the species composition of the seeding mixture ensures that the grassy component allows for succession, and does not dominate or inhibit the growth of secondary species;
- Hydroseeding with a recommended indigenous veldgrass mixture after topsoil application;
- All seed mixtures used must be certified to be weed-free;
- Seeding should be done early enough in the normal rain season to allow perennial grasses to mature for survival during the dry time of the year. Seeding prior to expected rains is risky as there may not be sufficient soil moisture to make a

favourable seedbed and rain falling earlier than expected may cause germination but may not be enough to see the seedlings through to the follow-up rains;

- In identified areas and areas where soils are severely depleted, measures need to be taken to protect the soil from further erosion and kick-start soil formation processes through the addition of organic material;
- Addition of a complete fertiliser with approximately equal concentrations of the macronutrients (N, P, K) is desirable because of the low fertility of severely disturbed soils;
- To avoid burning seed, seed and fertiliser should not be mixed together in the same bin for dry seed application.
- It must be ensured that soil is not overly dry and powdery. It should be slightly damp but not sodden and muddy or the soil structure will be damaged. If it is very dry, watering of the area the day before planting is recommended.

Planting of Seedlings

Seedlings obtained from site or other nurseries are also an efficient way of re-vegetating a disturbed area, especially if there is difficulty establishing a specific species naturally or through seeding. It is generally more effective in the case of woody species and larger shrubs and succulents, whereas grassy species are more effectively established through seeding. Quality supply from nurseries is vitally important, as is consistency of supply. Before any activities take place, nurseries and suppliers must be identified, and it must be ensured that a consistent, quality supply of seedlings can be obtained.

Planting with Rescued Species

The success of re-planting species rescued prior to disturbance is reliant on the treatment of species during relocation and care during temporary storage. It must, therefore, be ensured that rescue and relocation of species is overseen by a suitably qualified and experienced specialist. Certain species are more suited to this option of re-vegetation than others, and it is important to ascertain whether species occurring within the footprint of the area to be disturbed are suited to rescue and relocation. Rescued species must be temporarily re-planted at a nursery or similar facility, in similar climatic and physical conditions to which they were removed from.

Re-vegetation through Reproductive Media Stored in Topsoil

Seeds, corms, bulbs, rhizomes and tubers stored in the topsoil rescued prior to disturbance also play a vital role in re-vegetation of a disturbed area. This method of re-vegetation is only efficient if topsoil is correctly stripped, stored and re-applied and if application of topsoil occurs soon after stripping and may therefore only be useful in rehabilitation of areas impacted by construction activities and not for rehabilitation taking place during closure. It is therefore of vital importance that the stripping, storing and re-application of topsoil is overseen by a suitably qualified and experienced soil specialist. This method allows for a natural looking species composition. It is often not effective when utilised as a sole method of re-vegetation, and is best used in combination with other methods such as seeding, especially in long-term projects as soils lose their natural seedy component after extensive periods of time due to organic decomposition, seed-predation by insects, etc.

Transplanting of Species from Surrounding Natural areas

The success of re-planting species from surrounding areas is reliant on the treatment of species during removal and transplanting. It must therefore be ensured that transplanting of species is overseen by a suitably qualified and experienced specialist. Certain species are more suited to this option of re-vegetation than others, and it is important to ascertain whether species occurring within the footprint of the area to be disturbed are suited to transplanting.

Natural Re-vegetation from Surrounding Plant Communities

Natural propagation of species from surrounding natural areas is an important contributor to re-vegetation of disturbed areas. This method of re-vegetation is best utilised in conjunction with other methods, especially seeding, and should be allowed to follow its natural course.

Seeding with Locally Collected Seed.

Locally collected seed will be fully adapted to the local climate and soil conditions, thus improving chances of germination and establishment success. Planning for collection should begin at least 2 years prior to establishment to ensure that enough seed can be sourced. Many of the indigenous species (for example, *Themeda triandra*) need treatment (heat, smoke and scarification) to initiate germination. More recently, gel planting has been tested as a technique for improving indigenous species re-establishment.

12.4 Alien Vegetation Management

Alien vegetation present within the study area is of high diversity and abundance, particularly within the Riparian and Transformed Habitat Unit. As a result of ongoing soil disturbance and mine expansion activities, the spread of invasive alien vegetation is likely to continue. It is therefore important to monitor and eradicate alien invasive vegetation on a regular basis.

12.4.1 Control Methodology

After identification of the different alien species present within the study area as well as species present within the surrounding areas that could colonise the study area in future, control methods specifically pertaining to each alien species could be ascertained. Due to the high diversity of alien species within the study area, the focus of the alien vegetation control should be on alien and invasive weed categories as indicated by the NEMBA: Alien and Invasive Species Regulations (2014). While other alien species should also be controlled, some of these species play an important role in erosion control and early stabilisation of disturbed soils.

The control methods can be divided into three basic methods of weed control, listed below (definitions compiled by using Bromilow (2010) and www.dwaf.gov.za). Control Methodology for each species was obtained from the Working for Water Species and Herbicide List, version 2.9, the Agricultural Research Council website (www.arc.agric.za), the Invasive Species South Africa website (http://www.invasives.org.za/) and guidelines provided by Bromilow (2010).

Care should be taken that all alien/ weed vegetation is removed prior to seed production, which typically occurs in the early summer. Alien control should commence during the construction/ operational phases and continue throughout all development phases.

The various methods of alien vegetation control are listed below:

- **Physical/manual (chopping and slashing; digging and bulldozing; cultivation or hoeing)**
- **Biological control (insects and diseases)**
- **Chemical (herbicides)**
  - **Ring barking**: Bark must be removed from the bottom of the stem to a height of 0.75-1.0 m. All bark must be removed to below ground level for good results. Where clean de-barking is not possible due to crevices in the stem or where exposed roots are present, a combination of bark removal and basal stem treatments should be carried out. Bush knives or hatchets should be used for debarking.
  - **Frill:** Using an axe or bush knife, make angled cuts downward into the cambium layer through the bark in a ring. Ensure to affect the cuts around the entire stem and apply herbicide into the cuts.

- **Cut stump treatment**: Stems should be cut as low as possible. Herbicides are applied in diesel or water as recommended for the herbicide. Applications in diesel should be to the whole stump and exposed roots and in water to the cut area as recommended on the label
- **Stem injection**: Punch downward slanting holes into the main stem using a sharpened metal spike. Space holes around entire circumference of lower stems. Inject the herbicide directly into the plant – ensuring to inject around the stem. Follow label recommendations for invasive cactus species.

12.4.2 Measures to be Taken when Applying Vegetation Control

- ➢ For the purposes of clearing alien vegetation within the study area it is important to note that physical/ manual methods are recommended and only in severe cases should chemical control, in the form of herbicides be used. In this regard, it is important to note that only herbicides approved by the Department of Water and Sanitation (DWS) (Working for Water Species and Herbicide List, version 2.9) and Wildlife and Environment Society of South Africa (WESSA) as listed in the table below be used. Biological control methods are not appropriate for use within the study area;
- ➢ Should herbicides be used, special attention should be afforded to the type of herbicides used in order to prevent the destruction of indigenous species;
- ➢ Care should be taken within wetland and riparian areas with the choice of herbicide to ensure no additional impacts due to the herbicide used;
- ➢ Footprint areas should be kept as small as possible when removing large trees;
- ➢ All disturbed areas must be rehabilitated using indigenous and endemic vegetation; and
- ➢ No vehicles should be allowed to drive through designated sensitive areas during eradication of alien and weed species;
- ➢ Plants located within river or stream should be felled and removed from the riparian zone to prevent blockage of the water course;
- ➢ Mature hardwood species will take a considerable time to die. The resultant stump can remain standing for up to 10 years or more. This stump is approximately a third of the mass of the original tree and poses less danger when felled compared to the original tree;
- ➢ Mature soft wood species may take quite a while to die when eradicated but may fall over before they have died back posing a greater safety hazard than with controlled felling;

- Re introduction of alien species is to be prohibited;

12.4.3 Disposal of Plant Material

- All removed alien plant material should be taken to an approved solid waste disposal site;
- All plant material must be covered with a sail during transportation by road to prevent any blow-off from the vehicle;
- It is not recommended that any species be chipped and used as mulch as there may be seeds present within the mulch that will spread to areas beyond the present alien/weed floral communities;
- Wood from large trees can be made available to the public for firewood or chopped into logs and pegs and used in rehabilitation works over hessian/ jute material.

12.4.4 Management Objectives

The following principles should be followed to ensure adequate future management. After initial control methods have been applied the identified alien species during the construction phase, alien vegetation occurrence should be assessed in monthly intervals for the duration of the construction phase to control any species that may sprout. During the operational phase of the project, an annual assessment of the alien vegetation stands should take place after the spring flush of each year but prior to seed formation. The annual assessment should include:

- Mapping/ recording of the extent of each alien vegetation invasion. The areas mapped should then be compared to mapping done in the previous season. This will aid in determining if mitigation within each community is effective;
- Determination of dominance by biomass and recruitment of each alien species/ within each alien vegetation community to identify any dominant species that may become a threat to the natural vegetation;
- Where total removal of alien communities has taken place, reseeding with indigenous grass is required. It is important to use pioneer species which are expected within the vegetation type, that will establish quickly and lead to a natural vegetation community in the future;
- Liaison with surrounding stakeholders, and the local municipality to control upstream and surrounding nodes of seed production should be undertaken;
- Re-assessment of the area to determine success of the action and any follow-up measures required; and

- Where extensive rehabilitation is needed and areas prone to erosion have been left bare as a result of alien removal a detailed and site-specific rehabilitation plan should be compiled and implemented.

Table 29: Target species for alien plant control, including relevant methods of eradication/control (basis for information sourced from Eco-Pulse, 2010).

Species	English name	NEMBA Category	Treatment method	Herbicide to be used
Trees/ shrubs				
Arundo donax	Spanish reed/Giant reed	1b	Cut & treat stump	11
Canna indica	Indian-shot	1b	Dig up and uproot completely	-
Hedychium coronarium	White ginger lily	1b	Cut & spray, dig out smaller specimens	12
Lantana camara	Lantana	1b	Cut & treat stump, dig up young plants	4, 12 or 16
Melia azedarach	Syringa	1b	Ringbark & poison, remove small plants	12, 15, 16 17 or 18
Morus alba	Mulberry	2	Cut & treat stump, hand pull young plants	12
Casuarina equisetifolia	Horsetail tree	2	Cut & treat stump, hand pull young plants	12
Grevillea robusta	Australian silky oak	3	Ringbark & poison, remove small plants	12, 15, 16 17 or 18
Eucalyptus grandis	Saligna gum	1b	Ringbark & poison, remove small plants	12, 15, 16 17 or 18
Phytolacca dioica	Belhambra	3	Ringbark & poison	3, 7, 12, 16 or 17
Pinus pinaster	Cluster pine	1b	Ringbark & poison	3, 7, 12, 16 or 17
Psidium guajava	Guava	3	Cut & treat stump, hand pull young plants	12
Ricinus communis	Castor-oil plant	1b	Cut & spray, hand-pull young plants	12
Rubus cuneifolius	Bramble	1b	Cut & treat stump, hand-pull small	-
Schinus terebinthifolius	Brazilian pepper tree	1b	Ringbark & poison	-
Senna hirsuta	Hairy senna,	1b	Dig up and uproot completely	-
Senna didymobotrya	Peanut butter cassia	1b	Ringbark & poison	3, 7, 12, 16 or 17
Solanum mauritianum	Bugweed	1b	Cut & spray, hand-pull saplings	3, 7, 12, 16, 17 or 19
Forbs				
Chromolaena odorata	Triffid weed	1b	Cut & spray	1, 4 , 12 , 15 , 16 , 17 or 18
Ipomoea purpurea	Common morning glory	1b	Trace root, poison	-
Cardiospermum granditlorum	*Balloon vine*	1b	Dig up and uproot completely	
Ipomoea alba	Moonflower	1b	Trace root, poison	-
Nephrolepis exaltata	Sword fern, Boston sword fern	1b	Dig up and uproot completely	-
Phytolacca americana	American pokeweed	1b	Cut & spray	1, 4 , 12 , 15 , 16 , 17 or 18

Species	English name	NEMBA Category	Treatment method	Herbicide to be used
Ageratum conyzoides	Invading ageratum	1b	Cut & spray	1, 4 , 12 , 15 , 16 , 17 or 18
Agrimonia procera	Scented agrimone	1b	Cut & spray	1, 4 , 12 , 15 , 16 , 17 or 18
Tithonia diversifolia	Mexican sunflower	1b	Cut & treat stump, Dig up and uproot completely	12
Verbena bonariensis	Purple top	1b	Cut & spray	1, 4 , 12 , 15 , 16 , 17 or 18
Grasses				
Pennisetum setaceum	Fountain grass	1b	Cut & spray	7
Pennisetum purpureum	Napier grass	1b	Cut & spray	Try Systemic grass herbicide
Sorghum halepense	Johnson grass, Aleppo grass	2	Dig up and uproot completely	

Table 30: List of registered herbicides for use in alien plant control (after WESSA, 2008).

No.	Trade Name	Type
1	Confront 360 SL	Selective, systemic
2	Midstream	Non-selective, contact
3	Starane 200 EC, Tomahawk 200EC	Selective, systemic
4	Plenum 160 ME	Selective, systemic
5	Roundup Max	Non-selective, systemic
6	Tumbleweed	Non-selective, systemic
7	Roundup, strip, Clar out, Erase, Glyphogan Glyphosate 360, Oneshot, Scat	Non-selective, systemic
8	Roundup Turbo	Non-selective, systemic
9	Mamba Max 480 SL	Non-selective, systemic
10	Touchdown Forte Hi Tech	Non-selective, systemic
11	Kilo WSG	Non-selective, systemic
12	Hatchet, Chopper	Non-selective, systemic
13	Nicanor 50 WP	Selective, systemic
14	Brush-off , Climax WP	Selective, systemic
15	Access 240 SL, Browser	Selective, systemic
16	Ranger 240 EC	Selective, systemic
17	Garlon EC, Triclon EC, Viroaxe	Selective, systemic
18	Lumberjack 360 SL, Trimbrel 360 SL	Selective, systemic
19	Kaput 100 Gel	Selective, systemic
20	MSMA	Non-selective, systemic

12.5 Floral SCC Rescue and Relocation

It is recommended that a site-specific walkdown prior to commencement of mining in this area from 2020 onwards, should it be deemed appropriate to be mined, due to the large number of species likely to be present and taking into account that the number of such species may increase or decrease over time and also considering the inaccessibility of this area at the time of assessment.

Constraints that may potentially limit the success of rescue and relocation of floral SCC involved include the large size of tree species, including some floral species being unsuitable for relocation due to inter-specific relationships with other species such as mycorrhiza. It is however important that as far as possible, floral SCC habitat remains intact and that such species be conserved *in situ*. Where loss of floral SCC species or floral SCC habitat is unavoidable, permits are to be obtained prior to rescue and relocation or destruction of such species.

Pre-construction Phase

- All floral SCC identified during the field assessment, are to be rescued and relocated prior to commencement of site clearance activities within areas earmarked for mine expansion. This includes the following species:

Table 31: SANBI National Red List Species.

Species	Location	Likely to be impacted
Hypoxis hemerocallidea	Grassland Habitat unit	Yes (within mining expansion area 2020 – 2036)

Table 32: Provincially Protected Species under the KwaZulu Natal Nature Conservation Management Amendment Act (Act 5 of 1999).

Species	Location	Likely to be impacted
Albuca bracteata	Steep cliffs bordering Riparian Habitat Unit	No (provided that riparian buffers remain protected)
Haemanthus humilis	Riparian Habitat Unit	No (provided that riparian buffers remain protected)
Scadoxus puniceus	Riparian Habitat Unit	No (provided that riparian buffers remain protected)
Cyathea sp.	Riparian Habitat unit	No (provided that riparian buffers remain protected)

- Permits to relocate and transport floral species protected under the KwaZulu-Natal Nature Conservation Management Amendment Act (Act 5 of 1999) and those indicated by SANBI to of conservation concern have to be obtained from Ezemvelo KZN Wildlife;
- Species should be relocated to suitable similar habitat within the study area or within the immediate vicinity thereof within areas not earmarked for future mine expansion and may also be relocated to rehabilitation areas. Relocation of species should preferably take place during the summer months to aid in location of the species;
- It is recommended that floral SCC be relocated to areas as close to its original location as possible and to similar habitat within which it originally occurred;

- Prior to relocation it is recommended that contractors and site workers be trained in the importance of floral species conservation, in identifying floral SCC and successfully relocating such species;
- A suitably qualified botanist or Environmental Control Officer (ECO) have to assist and oversee the rescue and relocation of such species;
- If any further such species are noted during the rescue operation, that may have been missed during the initial field assessments, the location of these species is to be recorded and included in the relocation process;
- Upon completion of rescue and relocation activities, a brief report is to be compiled, which will serve as visual documentation of the rescue and relocation process and explain the process and outcome of the project;
- Recommendations and any follow-up work to ensure establishment success, if required, is to be outlined in the report and the report will be made available for relevant authorities for perusal;
- Protected tree species, listed as such under the National Forest Act (Act 84 of 1998), as amended, are unlikely to be successfully relocated and permits for the destruction of these species, should they fall within the mining footprint areas, have to be obtained from the Department of Forestry and Fisheries (DAFF). This includes the following species:

Table 33: Tree species protected under the National Forest Act (Act 84 of 1998).

Species	Location	Protected under
Pittosporum viridiflorum	Coastal Forest	Yes (within mining expansion area 2020 – 2036)
Sideroxylon inerme	Coastal Forest	Yes (within mining expansion area 2020 – 2036)

- It is recommended that one new indigenous tree species, if possible of the same species, be planted elsewhere within a portion of the study area where no further mining activities will take place.

Construction/ Operational Phase

- Follow-up field visits must be conducted in order to monitor the process and to ensure the successful establishment of relocated floral species;
- Relocation areas are to be off-limits for the duration of the construction phase to allow plants to establish and to prevent disturbance of these species;
- Should any significant floral communities, expected to be of conservation value, be discovered during the construction/ operational phase of the project, the botanist involved must be notified and such species may also be relocated, based on the recommendations from the botanist;

- Edge effects from construction activities within relocation areas, such as erosion and alien vegetation control must be effectively monitored during the construction phase and remedial action implemented immediately.
- Relocation areas are to be off-limits for the duration of the operational phase to prevent disturbance of these species; and
- Annual monitoring of successful establishment of relocated plants must continue for the duration of the operational phase or for a period of 5 years following their relocation.

12.6 Faunal SCC Rescue and Relocation

Due to time constraints and high costs involved, it is not considered viable to rescue and relocate faunal species. The majority of faunal species are mobile and should be able to successfully relocate to surrounding open space areas. It is however important to ensure that faunal species are enabled to do so by putting a number of mitigation measures in place.

Pre-construction Phase

- Vegetation clearing methods should aim to minimise potential harm to faunal species, and clearing has to take place in a phased and slow manner, commencing from the interior of the study area progressing outwards towards the study area boundary, to maximise potential for mobile species to move to adjacent areas.
- Trapping of faunal species within the fenced area should be avoided;
- Prior to clearing and during the clearing process, any larger faunal species noted should be given the opportunity to move away from construction machinery. Should any nests and burrows, particularly that of larger faunal species be noted, faunal species should be flushed and allowed to move away from the construction machinery.
- Faunal species, such as frogs, reptiles and mammals encountered by construction personnel in the vicinity of the development footprint, which has not relocated or appear incapable of doing so, should be carefully and safely removed to an appropriate location beyond the extent of the development footprint by qualified personnel after consultation with the ECO as to the proper means of handling and relocation. This also applies to any injured faunal species encountered. A selected member of the construction team should be trained in snake handling for this purpose.

Construction and operational phases

- The proposed development footprint areas should remain as small as possible and no areas beyond the immediate development footprint may be unnecessary cleared or cleared for construction purposes;
- The boundaries of the development footprint areas are to be clearly defined and it should be ensured that all activities remain within defined footprint areas;
- Areas beyond the fenced development footprint area should be expressly off limits to construction personnel and construction vehicles;
- Any faunal species encountered by mine personnel in the vicinity of the development footprint, which were not relocated or appear incapable of doing so, should be carefully and safely removed to an appropriate location beyond the extent of the development footprint by qualified personnel after consultation with the ECO as to the proper means of handling and relocation;
- Conservative speed limits should be enforced through signage and penalties for speeding, to minimise the likelihood of collisions with faunal species attempting to cross access roads;
- Trapping, hunting and killing of fauna within the study area and surrounds should be prohibited;
- Any night lighting required should be minimised wherever it is safe to do so and spill of light into undeveloped areas and natural adjacent to the study area should be avoided;
- All informal fires in the vicinity of construction areas should be prohibited, unless in areas demarked and managed for this purposes.

Closure phase

- As part of the closure phase of the project, reinstatement of faunal habitat within the study area should be a priority through the spread of stockpiled topsoil, revegetating the study area with indigenous veld grass, tree species and where possible, reinstating wetland areas. Any dangerous slopes or excavations that may pose a risk to faunal species should be fenced off prior to the removal of the boundary fence.

13. BIODIVERSITY MONITORING PLAN

The biodiversity monitoring plan comprises the following monitoring programs:

- Flora
- Fauna

These programs are described in this section.

13.1 Monitoring philosophy and requirements

Prudent biodiversity monitoring on the property is of utmost importance, as this will ensure a continual flow of data, enabling all parties involved to accurately assess and manage biodiversity related progress and issues. To ensure the accurate gathering of data, the following techniques and guidelines should be followed:

- Fixed point monitoring should be applied as the preferred method of monitoring.
- All data gathered should be measurable (qualitative and quantitative).
- Monitoring report should be repeatable and temporally and spatially comparable.
- Data should be auditable.
- Data gathered should be an accurate representation of the PES of the study area, as well as the various floral communities and habitat units represented by each monitoring site.
- Data, when compared to previous sets, should show spatial and temporal trends.
- Data gathered should represent all aspects of all communities i.e. grasses, forbs, shrubs and trees.
- General habitat unit overviews should also be undertaken.
- Monitoring of protected species populations must also take place.

13.2 Monitoring Points

The proposed monitoring points to address the data requirements in Section 13.1 are presented in the figure below.

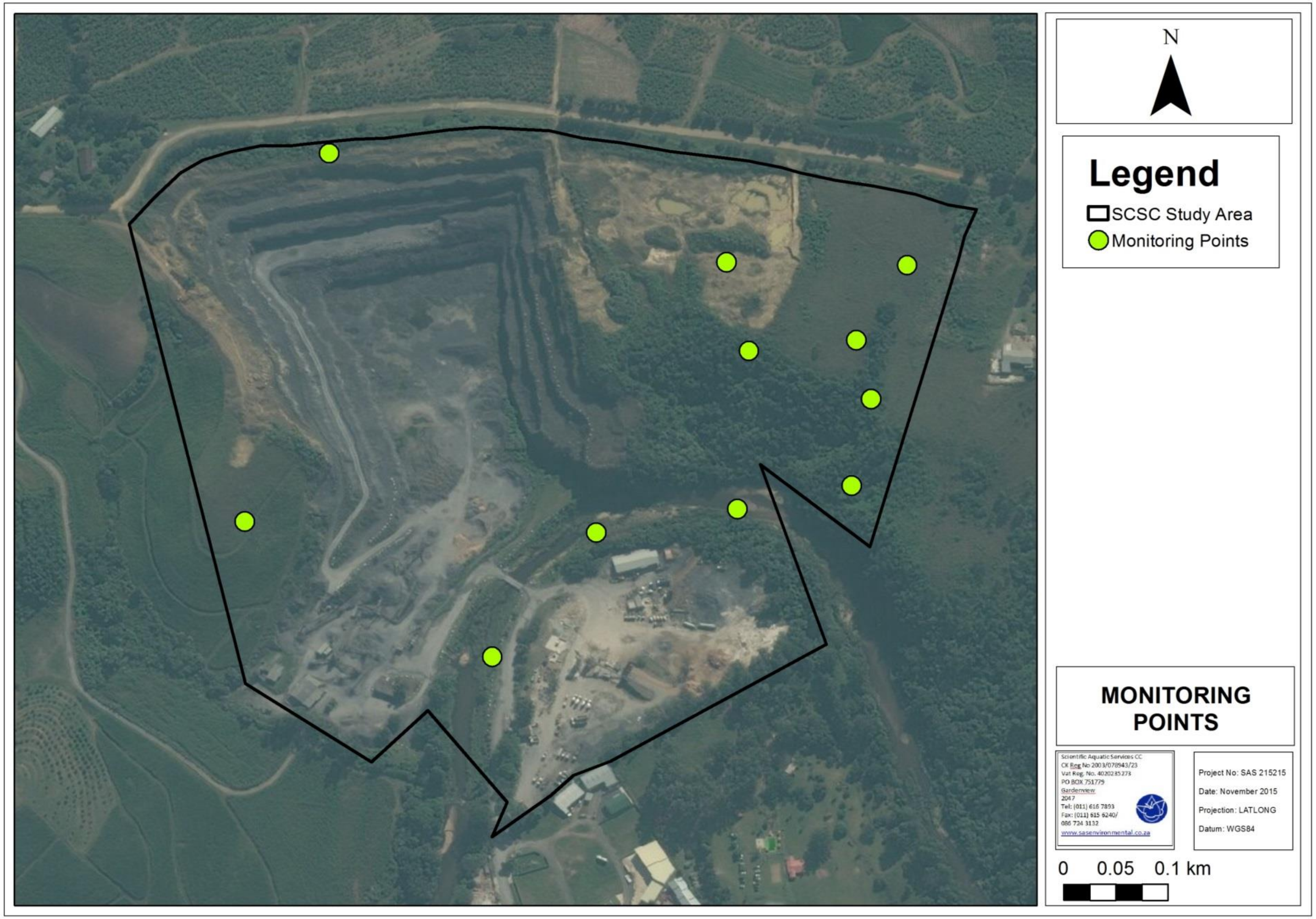

Figure 18: Proposed terrestrial monitoring points.

13.3 Floral Data Capturing Protocols

13.3.1 Monitoring/Sampling Frequency

Monitoring should occur on an annual basis in the summer growing season. In order to ensure that temporal comparisons can be made assessments should take place at the same time each year.

13.3.2 Monitoring/Sampling Technique

Vegetation data must be collected according to the methods below, which are identical to the methods utilised during the baseline ecological assessments:

- Veld condition must be determined by sampling vegetation in the different habitat units and then analysing the floral species composition and comparing the results with baseline conditions; and
- The data gathered can also be used to monitor changes in basal cover, indigenous species recruitment and species diversity through percentage analysis. Alien vegetation recruitment and medicinal species recruitment can also be monitored if these species are recorded during the assessment.

13.3.3 Monitoring/Sampling Equipment

- Sampling plot equipment, which includes pegs, string, measuring tape.
- GPS.
- Sample bags.
- Reference collection.

13.3.4 Information Generation Protocols

13.3.4.1 Reporting Frequency

Reporting should follow after monitoring has taken place, i.e. annually.

13.3.4.2 Report Content

All aspects pertaining to floral diversity and sensitive habitats as covered by the baseline ecological assessment should be included in the annual monitoring report. Reports should ensure that quantitative analyses of data are presented indicating both spatial and temporal variation.

13.4 Faunal Data Capturing Protocols

13.4.1 Monitoring/Sampling Frequency

Monitoring should occur annually during the summer season. In order to ensure that temporal comparisons can be made assessments should take place at the same time each year.

13.4.2 Monitoring/Sampling Technique

- *Ad libitum* recording of all faunal species observed through direct visual observation or identified by calls, tracks, scats and burrows;
- Bird census involving 15 minute point counts at the monitoring points; and
- Sherman traps to gather information on the small mammal community (every two years).

13.4.3 Monitoring/Sampling Equipment

- Sweep nets
- Sherman traps
- Binoculars
- Sampling bags/buckets
- Reference lists

13.4.4 Information Generation Protocols

13.4.4.1 Reporting Frequency

Reporting should follow after monitoring has taken place, i.e. annually.

13.4.4.2 Report Content

All aspects pertaining to faunal diversity and sensitive habitats as covered by the baseline ecological assessment should be included in the annual monitoring report. Reports should ensure that quantitative analyses of data are presented indicating both spatial and temporal variation.

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APPENDIX A

Vegetation Index Score

Vegetation Index Score – Transformed Habitat Unit

1. *EVC=[[(EVC1+EVC2)/2]*

<u>EVC 1 - Percentage natural vegetation cover:</u>

Vegetation cover %	0%	1-5%	6-25%	26-50%	51-75%	76-100%
Site score		X				
EVC 1 score	0	1	2	3	4	5

<u>EVC2 - Total site disturbance score:</u>

Disturbance score	0	Very Low	Low	Moderately	High	Very High
Site score						X
EVC 2 score	5	4	3	2	1	0

2. *SI=(SI1+SI2+SI3+SI4)/4)*

	Trees (SI1)		Shrubs (SI2)		Forbs (SI3)		Grasses (SI4)	
Score:	Present State	Perceived Reference State	Present State	Perceived Reference State	Present State	Perceived Reference State	Present State	Perceived Reference State
Continuous		X		X				
Clumped						X		X
Scattered			X				X	
Sparse	X				X			

Present State (P/S) = Currently applicable for each habitat unit

Perceived Reference State (PRS) = If in pristine condition

Each SI score is determined with reference to the following scoring table of vegetation distribution for present state versus perceived reference state.

	Present state (P/S)			
Perceived Reference state (PRS)	**Continuous**	**Clumped**	**Scattered**	**Sparse**
Continuous	3	2	1	0
Clumped	2	3	2	1
Scattered	1	2	3	2
Sparse	0	1	2	3

3. ***PVC=[(EVC)-((exotic x 0.7) + (bare ground x 0.3))***

Percentage vegetation cover (exotic):

	0%	1-5%	6-25%	26-50%	51-75%	76-100%
Vegetation cover %			X			
PVC Score	0	1	2	3	4	5

Percentage vegetation cover (bare ground):

	0%	1-5%	6-25%	26-50%	51-75%	76-100%
Vegetation cover %						X
PVC Score	0	1	2	3	4	5

4. ***RIS***

Extent of indigenous species recruitment	**0**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**
		X				
RIS	**0**	**1**	**2**	**3**	**4**	**5**

VIS = [(EVC)+((SIxPVC)+(RIS))] = 4

Vegetation Index Score – Riparian Habitat Unit

1. *EVC=[[(EVC1+EVC2)/2]*

EVC 1 - Percentage natural vegetation cover:

Vegetation cover %	0%	1-5%	6-25%	26-50%	51-75%	76-100%
Site score			X			
EVC 1 score	0	1	2	3	4	5

EVC2 - Total site disturbance score:

Disturbance score	0	Very Low	Low	Moderately	High	Very High
Site score					X	
EVC 2 score	5	4	3	2	1	0

2. *SI=(SI1+SI2+SI3+SI4)/4)*

	Trees (SI1)		Shrubs (SI2)		Forbs (SI3)		Grasses (SI4)	
Score:	Present State	Perceived Reference State	Present State	Perceived Reference State	Present State	Perceived Reference State	Present State	Perceived Reference State
Continuous		X						
Clumped	X			X	X		X	
Scattered			X			X		X
Sparse								

Present State (P/S) = Currently applicable for each habitat unit

Perceived Reference State (PRS) = If in pristine condition

Each SI score is determined with reference to the following scoring table of vegetation distribution for present state versus perceived reference state.

	Present state (P/S)			
Perceived Reference state (PRS)	**Continuous**	**Clumped**	**Scattered**	**Sparse**
Continuous	3	2	1	0
Clumped	2	3	2	1
Scattered	1	2	3	2
Sparse	0	1	2	3

3. *PVC=[(EVC)-((exotic x 0.7) + (bare ground x 0.3))*

<u>Percentage vegetation cover (exotic):</u>

	0%	1-5%	6-25%	26-50%	51-75%	76-100%
Vegetation cover %					X	
PVC Score	0	1	2	3	4	5

<u>Percentage vegetation cover (bare ground):</u>

	0%	1-5%	6-25%	26-50%	51-75%	76-100%
Vegetation cover %			X			
PVC Score	0	1	2	3	4	5

4. *RIS*

Extent of indigenous species recruitment	0	Very Low	Low	Moderate	High	Very High
			X			
RIS	0	1	2	3	4	5

VIS = [(EVC)+((SIxPVC)+(RIS))] = 12

Vegetation Index Score – Coastal Forest Habitat Unit

1. EVC=[[(EVC1+EVC2)/2]

EVC 1 - Percentage natural vegetation cover:

Vegetation cover %	0%	1-5%	6-25%	26-50%	51-75%	76-100%
Site score						X
EVC 1 score	0	1	2	3	4	5

EVC2 - Total site disturbance score:

Disturbance score	0	Very Low	Low	Moderately	High	Very High
Site score			X			
EVC 2 score	5	4	3	2	1	0

2. SI=(SI1+SI2+SI3+SI4)/4)

	Trees (SI1)		Shrubs (SI2)		Forbs (SI3)		Grasses (SI4)	
Score:	Present State	Perceived Reference State	Present State	Perceived Reference State	Present State	Perceived Reference State	Present State	Perceived Reference State
Continuous	X	X						
Clumped				X				
Scattered			X		X	X	X	X
Sparse								

Present State (P/S) = Currently applicable for each habitat unit

Perceived Reference State (PRS) = If in pristine condition

Each SI score is determined with reference to the following scoring table of vegetation distribution for present state versus perceived reference state.

	Present state (P/S)			
Perceived Reference state (PRS)	**Continuous**	**Clumped**	**Scattered**	**Sparse**
Continuous	3	2	1	0
Clumped	2	3	2	1
Scattered	1	2	3	2
Sparse	0	1	2	3

3. ***PVC=[(EVC)-((exotic x 0.7) + (bare ground x 0.3))***

Percentage vegetation cover (exotic):

	0%	1-5%	6-25%	26-50%	51-75%	76-100%
Vegetation cover %			X			
PVC Score	0	1	2	3	4	5

Percentage vegetation cover (bare ground):

	0%	1-5%	6-25%	26-50%	51-75%	76-100%
Vegetation cover %		X				
PVC Score	0	1	2	3	4	5

4. ***RIS***

Extent of indigenous species recruitment	**0**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**
					X	
RIS	**0**	**1**	**2**	**3**	**4**	**5**

VIS = [(EVC)+((SIxPVC)+(RIS))] = 18

Vegetation Index Score – Grassland Habitat Unit

5. EVC=[[(EVC1+EVC2)/2]

EVC 1 - Percentage natural vegetation cover:

Vegetation cover %	0%	1-5%	6-25%	26-50%	51-75%	76-100%
Site score				X		
EVC 1 score	0	1	2	3	4	5

EVC2 - Total site disturbance score:

Disturbance score	0	Very Low	Low	Moderately	High	Very High
Site score				X		
EVC 2 score	5	4	3	2	1	0

6. SI=(SI1+SI2+SI3+SI4)/4)

	Trees (SI1)		Shrubs (SI2)		Forbs (SI3)		Grasses (SI4)	
Score:	Present State	Perceived Reference State	Present State	Perceived Reference State	Present State	Perceived Reference State	Present State	Perceived Reference State
Continuous				X			X	X
Clumped					X	X		
Scattered			X					
Sparse	X	X						

Present State (P/S) = Currently applicable for each habitat unit

Perceived Reference State (PRS) = If in pristine condition

Each SI score is determined with reference to the following scoring table of vegetation distribution for present state versus perceived reference state.

	Present state (P/S)			
Perceived Reference state (PRS)	**Continuous**	**Clumped**	**Scattered**	**Sparse**
Continuous	3	2	1	0
Clumped	2	3	2	1
Scattered	1	2	3	2
Sparse	0	1	2	3

7. PVC=[(EVC)-((exotic x 0.7) + (bare ground x 0.3))

<u>Percentage vegetation cover (exotic):</u>

	0%	1-5%	6-25%	26-50%	51-75%	76-100%
Vegetation cover %			X			
PVC Score	0	1	2	3	4	5

<u>Percentage vegetation cover (bare ground):</u>

	0%	1-5%	6-25%	26-50%	51-75%	76-100%
Vegetation cover %		X				
PVC Score	0	1	2	3	4	5

8. RIS

Extent of indigenous species recruitment	**0**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**
					X	
RIS	**0**	**1**	**2**	**3**	**4**	**5**

VIS = [(EVC)+((SIxPVC)+(RIS))] = 15

APPENDIX B1

Specially protected indigenous animals listed in Schedule 4 of the KwaZulu-Natal Nature Conservation Management Act (Act No 5 of 1999)

FOURTH SCHEDULE

SPECIALLY PROTECTED INDIGENOUS ANIMALS

SCIENTIFIC	**ENGLISH**
MAMMALS	
Amblysomus marleyi	Marley’s golden mole
Chrysospalax villoscus	Rough haired golden mole
Cloetis percivali	Short eared trident bat
Scotoecus albofuscus	Thomas’s house bat
Otomops martiensseni	Large eared free tailed bat
Chaerephon ansorgei	Ansorge’s free tailed bat
Proteles cristatus	Aardwolf
Lycaon pictus	Wild dog
Mellivora capensis	Ratel
Poecilogale albinucha	Striped weasel
Aonyx capensis	Clawless otter
Lutra maculicollis	Spotted necked otter
Felis serval	Serval
Felis lybica	African wildcat
Diceros bicornis	Black rhinoceros
Orycteropus afer	Antbear
Ourebia ourebia	Oribi
Neotragus moschatus	Suni
Manis temminickii	Pangolin
BIRDS	
All *Pelecanus* species	all Pelicans
Botaurus stellaris	Bittern
Ciconiidae: all species	all Storks
Geronticus calvus	Bald ibis
Polemaetus bellicosus	Martial eagle
Terathopius ecaudatus	Bateleur
Torgos tracheliotus	Lappetfaced vulture
Trigonoceps occipitalis	White-headed vulture
Gyps coprotheres	Cape vulture
Gyps africanus	White-baked vulture

Gypaetus barbatus	Bearded vulture
Gypohierax angolensis	Palmnut vulture
Necrosyrtes monachus	Hooded vulture
Sarothrura ayresi	White-winged flufftail
Gruidae: all species	all Cranes
Neotis denhami	Stanley’s bustard
Columba delegorguei	Delegorgue’s pigeon
Poicephalus robustus	Cape parrot
Scotopelia peli	Pel’s fishing owl
Bucorvus leadbeateri	Ground hornbill
Stactolaema olivacea	Green barbet
Mirafra ruddi	Rudd’s barbet
Hirundo atrocaerulea	Blue swallow
Zoothera guttata	Spotted thrush
Buphagidae: all species	all Oxpeckers
Spermestes fringilloides	Pied mannikin

REPTILES

Dermochelys coriacea	Leatherback turtle
Pelusios rhodesianus	Black bellied terrapin
Pelusios castanoides	Yellow bellied terrapin
Python sebae	African rock python
Bitis gabonica	Gaboon viper
Scelotes guentheri	Gunther’s burrowing skink
Cryptoblepharus boutonii	Bouton’s coral rag skink
Tetradactylus breyeri	Breyer’s longtailed seps
Cordylus giganteus	Giant sungazer
Pseudocordylus spinosus	Spiny crag lizard
Pseudocordylus langi	Lang’s crag lizard
All *Bradypodion* species	all dwarf Chamaeleons

AMPHIBIANS

Hyperolius pickersgilli	Pickersgill’s reed frog
Leptopelis xenodactylus	Long toed tree frog
Arthroleptella ngongoniensis	Mist belt chirping frog
Cacosternum poyntoni	Poynton’s caco

BUTTERFLIES AND MOTHS

Stygionympha wichgrafi grisea	Greyish wichfraf’s brown
Ornipholidotos peucitia penningtoni	Pennington’s white mimic

Durbania amalosa albescens	Amakosa rocksitter
Lolaus lulua	White spotted sapphire
Lepidocrysops ketsi leucomacula	White blotched ketsi blue
Orahrysops Ariadne	Karkloof blue
Hrysoritis orientalis	Eastern opal
Callioratis maillari	Millar's tiger mouth

DRAGONFLIES

Pseudagrion umsingaziense	Umsingazi sprite
Syncordulia gracilis	Yellow synordulia
Urothemis Luciana	St Lucia basker

FRUIT CHAFERS

Ichnestoma nasula
Lamellothyrea descarpentriesi
Elsphinis pumila
acrothyrea rufofemorata
eudicella trimeni

MOLLUSCS

Laevicaulis haroldi

ONYCOPHORANS

Opisthopatus roseus

APPENDIX B2

Protected indigenous animals listed in Schedule 5 of the KwaZulu-Natal Nature Conservation Management Act (Act No 5 of 1999)

FIFTH SCHEULE

PROTECTED INDIGENOUS ANIMALS

SCIENTIFIC	**ENGLISH**
MAMMALS	
Crocidura maquassiensis	Makwassie musk shrew
Suncus lixus	Greater dwarf shrew
Suncus infinitesimus	Lesser dwarf shrew
Chlorotalpa sclateri	Sclater's golden mole
Eidolon helvum	Straw-coloured fruit bat

Nycteris hispida	Hairy slit faced bat
Rhinolophus darling	Darling’s horseshoe bat
Rhinolophus lasii	Swinny’s horseshoes bat
Myotis welwitschi	Welwitsch’s hairy bat
Myotis tricolor	Anchieta’s pipistrele
Chalinolobus variegatus	Butterfly bat
Laephotis wintoni	Winton’s long-eared bat
Aptesicus rendalli	Rendall’s serotine bat
Eptesicus hottentotus	Long-tailed serotine bat
Eptesicus zuluensis	Somali serotine bat
Nycticeicus schlieffenii	Schlieffen’s bat
Kerivoula argentata	Damara wolly bat
Kerivoula lanosa	Lesser wolly bat
Ceropthecus mitis	Samango monkey
Vulpes chama	Cape fox
Civetticitis civetta	Civet
Paracynicitis selousi	Selousis mongoose
Helogae parvula	Dwarf mongoose
Htaena brunnea	Brown hyena
Acinonyx jubatus	Cheetah
Panther pardus	Leopard
Panhera leo	Lion
Felis nigripes	Small spotted cat
Oxodonta Africana	Elephant
Ceratotherium simum	White rhinoceros
Dendrohyrax arboreus	Tree dassie
Giraffe cameloprdalis	Giraffe
Connochaetus gnou	Black wildebeest
Alcelaphis buselaphus	Red hartebeest
Damaliscus lunatus	Tsessebe
Philantomba monticola	Blue duiker
Cephalophus natalensis	Red duiker
Oreotragus oreotragus	Klipspringer
Syncerus caffer	Buffalo
Kobus ellipsiprymnus	Waterbuck
Hippopotamus amphibious	Hippopotamus
Parazerus pallitus	Red squirrel
Pedetes capensis	Springhare
Georychs capensis	Cape molerat
Otomys lamitus	Laminate vlei rat

Otomys sloggetti	Sloggetti's rat
Tatera leucogaster	Bushveld gerbil
Mystromys albicaudatus	*White tailed mouse*
Steatomys pratensis	Fat mouse
Steatomys krebsii	Krebs's fat mouse
Dasymys incomtus	Water rat
Grammomys cometes	Mozambique woodland mouse
Pronolagus rupestris	Smith's rock hare
Petrodromus tetradactylus	Four-toed elephant shrew

BIRDS

Ardeidae: (All spp. not in the Fourth Schedule)	All herons, egrets and bitterns (except Botaurus stellaris listed in the Fourth Schedule
Scopus umbretta	Hamerkop
Threskiornithidea: (All spp. not in the Fourth Schedule)	All ibises and spoonbills (except Bald Ibis Geronticus calvus listed in the Fourth Schedule)
Phoenicopteridae: all species	All Flamingos
Nettapus auritus	*Pygmy Goose*
Accipitridae: (All spp. not in the Fourth Schedule)	All diurnal birds of prey (except all vultures listed in the Fourth Schedule
Pandion haliaetus	*osprey*
Turnix hottentotta	*Blackrumped Buttonquail*
Sarothrura: (All spp. not in the Fourth Schedule)	All flufftails (except Whitewinged Flufftail Sarothrura ayresi lited in the Fourth Schedule
Podica senegalensis	African Finfoot
Otididae: (All spp. not in the Fourth Schedule)	All bustards and korhaans (except Stanley's Bustard Neotis denhami listed in the Fourth Schedule
Jacanidae: all species	All jacanas
Glareola pratinola	Red-winged Pratincole
Hydroprohne caspia	Caspian Tern
Poicephalus cryptoxanthus	Brown headed Parrot
Musophagidae: all species	All louries
Tytonidae and Strigidae: all species	All owls
Caprimulgus natalensis	Natal Nightjar
Halcyon senegaloides	Mangrove Kingfisher
Smithornis capensis	African Broadbill

Zoothera gurneyi	Orange Thrush
Batis fratrum	Woodwards Batis
Anthus brachyurus	Shorttailed Pipit
Hemimacronyx chloris	Yellowbreasted Pipit
Macronyx ameliae	Pinkthroated Longclaw
Nectarinia neergaardi	Neegaar’s Sunbird
Mandingoa nitidula	Green Twinspot
Hypargos mararitatus	Pinkthroated Twinspot

REPTILES

Kinixys spekei	Savanna hinged tortoise
Kinixys natalensis	Natal hinged tortoise
Chelonia mydas	Green turtle
Eretmochelys imbricata	Hawksbill turtle
Caretta caretta	Loggerhead turtle
Leptotyphlops sylvicolus	Forest thread snake
Lycodonomorphus laevissimus natalensis	Natal dusky-bellied water snake
Lycodonomorphus whytei	Whyte’s water snake
Lamprophis fuscus	Yellow-bellied house snake
Lycophidion variegatum	Variegated wolf snake
Lycophidion pygmaeum	Pygmy wolf snake
Natriciteres variegate	Forest marsh snake
Prosymna janii	Mozambique shovelsnout
Amblyodipsas concolor	Natal purple-glossed snake
Amblyodipsas microphthalma	White-lipped snake
Homoroselaps dorsalis	Striped harlequin snake
Xenocalamus transvaalensis	Transvaal quill-snouted snake
Meizodon semiornatus	Semiornate snake
Philothamnus angolensis	Angola green snake
Dasypeltis medici	East African egg-eater
Montaspis gilvomaculata	Cream-spotted mountain snake
Scelotes inornatus	Smith’s burrowing skink
Scelotes bourquini	Bourquin’s burrowing skink
Scelotes fitzimonsi	Fitzimon’s burrowing skink
Mabuya homalocephala smithii	Smith’s red-sided skink
Pedioplanis lineocellata lineocellata	Ocellated sand lizard
Tropidosaura cottrelli	Cottrell’s mountain lizard
Tropidosaura Montana natalensis	Natal mountain lizard
Cordylus warreni warren	Warren’s girdled lizard
Cordylus warren barbertonensis	Barberton girdled lizard

Crocodylus niloticus	Nile crocodile

AMPHIBIANS

Bufo fenoulheti fenoulheti	Northern pygmy toad
Bufo gariepensis nubicolus	Karoo toad
Bufo pardalis	Leopard toad
Bufo pusillus	Little toad
Hemisus guttatus	Spotted shovel-nosed frog
Hyperolius marmoratus verrucosus	Warty painted reed frog
Afrixalus spinifrons	Natal leaf-folding frog
Strongylopus hymenopus	Berg stream frog
Leptopelis mossambicus	Brown-backed tree frog
Breviceps maculatus	Spotted rain frog
Breviceps verrucosus typanifer	Plaintive rain frog
Arthroleptella hewitti	Natal chirping frog
Cacosternum striatum	Lined caco
Cacosternum nanum parvum	Little bronze caco
Natalobatrachus bonebergi	Kloof frog
Phrynobatrachus acridoides	East African puddle frog
Hildebrandtia ornate ornate	Ornate frog
Pyxicephalus adspersus	Giant bullfrog
Rana dracomontana	Drakenberg river frog
Rana vertebralis	Aquatic river frog
Tomopterna marmorata	Russet-backed sand frog

FRESHWATER FISH

Opsaridium peringueyi	Barred minnow
Silhouettea sibayi	Barebreast goby
Oreochromis placidus	Black tilapia
Ctenopoma intermedium	Blackspot climbing perch
Eleotris melanosoma	Broadhead sleeper
Croilia mossambica	Burrowing goby
Redigobius dewaali	Checked goby
Myxus capensis	Freashwater mullet
Hypseleotris dayi	Golden sleeper
Serranochromis meridianus	Lowveld largemouth
Chiloglanis emarginatus	Pongolo suckermouth
Clarias theodorae	Snake catfish
Nothobranchius orthonotus	Spotted killfish
Brycinus lateralis	Striped robber

BUTTERFLIES

Dingana alaedeus	Wakkerstroom widow
Dingana dingana	Dingaan’s widow
Acraea rabbaiae	Clear-wing acraea
Acraea satis	East Coast acraea
Euryphura achlys	Mottled green nymph
Durbania amakosa flavida	Amakosa rocksitter
Aslauga australis	Southern purple
Lolaus diametra natalica	Natal Yellow-banded sapphire
Hypolycaena lochmophila	Coastal hairstreak
Capys penningtoni	Pennington’s protea-butterfly
Aloeides merces	Wakkerstroom copper
Chrysoritis oreas	Drakensberg daisy copper
Chrysoritis phosphor borealis	Scarce scarlet
Anthene minima	Little hairtail
Lepidochrysops pephredo	Estcourt blue
Papilio euphranor	Forest swallowtail
Spialia confusa confua	Confusing sandman
Abantis bicolor	Bicoloured skipper
Metisella meninx	Marsh sylph
Metisella syrinx	Bamboo sylph
Borbo ferruginea dondo	Ferrous skipper
Fresna nyassae	Variegated acraea hopper

DRAGONFLIES

Chlorolestes draconicus	Drakensberg sylph
Pseudagrion newtoni	Newton’s sprite
Enallagma rotundipenne	Scarce blue
Enallagma sinuatum	Mysterious blue
Agriocnemis falcifera falcifera	Sickle wisp
Agriocnemis gratiosa	Zanzibar wisp
Agriocnemis pinheyi	Pinhey’s wisp
Agriocnemis ruberrima ruberrima	Red wisp
Onychogomphus supinus	Scarce hooktail
Gynacantha zuluensis	Zulu darner
Hemicordulia asiatica	Asian hemicordulia
Orthetrum robustum	Robust orthetrum
Diplacodes deminuta	Tiny percher
Trithemis pluvialis	River dropwing

Zyxomma atlanticum	Cryptic zyxomma
Parazyxomma flavicans	Scarce zyxomma
Aethriamanta rezia	Rezia

FRUIT CHAFERS

Pachnoda discolor
Uloptera planate
Cytothyrea rubriceps ichthyurus
Trichocephala brincki
Caelorrhina relucens
Lonchothyrea mozambica
Heteroclita raeuperi
Anoplocheilus globosus
Phoxomeloides laticincta
Taurhina splendens
Anisorrhina serripes
Raceloma jansoni
Raceloma natalensis
Diplognatha striata
Rhinocoeta cornuta
Xeloma aspersa
Xeloma leprosa
Cosmiophaenia rubescens
Rhabdotis semipunctata
Rhabdotis sobrina
Polystalactica furfurosa
Discopeltis bellula
Discopeltis tricolor tricolor
Pseudoclinteria cincticollis

MOLLUSCS

Chlamydephorus burnupi
Chlamydephorus dimidius

APPENDIX C1

Specially protected indigenous plants listed in Schedule 6 of the KwaZulu-Natal Nature Conservation Management Act (Act No 5 of 1999)

Encephalartos cerinus	Cerinus cycad
Ocotea bullata	Black stinkwood
Warburgia salutaris	Pepperbark tree

APPENDIX C2

Protected indigenous plants listed in Schedule 7 of the KwaZulu-Natal Nature Conservation Management Act (Act No 5 of 1999)

Alberta magna	Natal flame bush
Albizia suluensis	Zulu False Thorn
Amaryllidaceae: all species	All members of the Amarylla family including the genera *Haemanthus, Scadoxus, Boophane, Clivia, Nerine, Brunsfigia, Crinum, Ammocharis, Cyrthanthus*
Aloe saundersiae	Grass aloe
Aloe cooperi	Grass aloe
Aloe aristata	Grass aloe
Aloe dominella	Grass aloe
Aloe minima	Grass aloe
Aloe modesta	Grass aloe
Aloe inconspicua	Grass aloe
Aloe kniphofioides	Grass aloe
Aloe myriacantha	Grass aloe
Aloe parvifolia	Grass aloe
Aloe thraskii	Dune aloe
Atalya natalensis	Natal krantz ash
Avicennia marina	White mangrove
Barringtonia racemosa	Brackwater mangroves, Powder puff trees
All *Bersama* species	White ash trees
Bowkeria citrina	Yellow shell-flower bush
All *Brachystelma* species	Brahystelmas
Breonadia salicina	Matumi
Bruguiera gymnorrhiza	Black mangrove

All *Cassipouria* species	Onionwood trees
All *Ceropegia* species	Ceropegias
All *Catha* species	
All *Cyathea* species	Tree ferns
Curtisia dentata	Assegaai
All *Drosera* species	Sundews
All *Encephalartos*	Species including hybrids and excluding those listed as Specially Protected cycads and their hybrids
All *Erica* species	Ericas
Euphorbia bupleurifolia	Herbaceous succulent Euphobias
Euphorbia franksiae	
Euphorbia woodii	
All *Eugenia* species	Myrtles
Ficus bizanae	Pondo fig
Ficus trichopoda	Swamp fig, Hippo fig
All *Gasteria* species	Gasterias
Gerbera aurantiaca	Hilton daisy
All *Gladiolus* species	Gladiolii
All *Haworthia* species	Haworthias
Hibiscus tilliaceus	Lagoon hibiscus
All *Huernia* species	Succulent asclepiads
Hyacinthacease: all species	Lilies. Include the genera *Eucomis, Bowiea, Albuca, Thuranthos, Urginia, Galtonia, Drimia, Dipcadi, Ornithogalum, Drimiopsis*
Bruguiera gymnorrhiza	Pepperbark tree
Hydrostachys polymorpha	Waterfall flower
Impatiens flanaganiae	Giant wild balsam
All *Kniphofia* species	Red hot pokers
Lauraceae: all species not in Schedule 6	Wild quince and stinkwood trees (except *Ocotea bullata* listed in Schedule 6)
Lumnitzera racemosa	Tongo mangrove
All *Microsorium* species	Climbing ferns
Mimusops caffra	Coastal red milkwood
Milettia sutherlandii	Giant umzimbeet
Milettia grandis	Umzimbeet
Newtonia hildebrandtii	Lebombo wattle
Orchidiacea: all species	Orchids
Oxyanthus pyriformis	Natal Loquat
All *Podocarpus* species	Yellowwood trees

All *Proteaceae* species	Proteas, Faureas, Leucospermums, Leucodendrons
Prionium serratum	Palmiet
Prunus africana	Red Stinkwood
Pseudosalacia streyi	Rock lemon
Raphia australis	Raphia palm
Raspalia trigyna	Raspalia
Rhizophora mucronata	Red mangrove
Rhyncocalyx lawsonioides	Natal privet
All *Selicornia* species	Salt marsh and mangrove species
All *Sarcoconia* species	Salt marsh and mangrove species
Sandersonia aurantiaca	Christmas bells
All *Scaevola* species	
All *Scilla* species	Blue squill
Sideroxylon inerme	While milkwood
Syphonochilus aethiopicus	Wild ginger
Stangeria eriopus	Stangeria
All *Stapelia* species	succulent asclepiads
Syzygium pondoense	Pondo waterwood
Syzygium legatii	
Todea barbara	False fern tree

APPENDIX D

Lists of avifaunal species known to occur within the 3030CD QDS

http://sabap2.adu.org.za/pentad_info.php?pentad=3030cd&section=species

Appendix D: Bio-monitoring Study

AQUATIC BIO-MONITORING OF SOUTH COAST STONE CRUSHERS (PTY) LTD

AQUATIC BIO-MONITORING SURVEY FOR SOUTH COAST STONE CRUSHERS

PREPARED FOR:

WSP, ENVIRONMENT AND ENERGY AFRICA

WSP

PREPARED BY:

Knight Piésold (Pty) Ltd.
4 De la Rey Road
Johannesburg, Rivonia
tel. 011 806 7111 • fax. 011 806 7100

30200307/04/200
Rev 2
21 July 2015

Knight Piésold
CONSULTING
www.knightpiesold.com

WSP, ENVIRONMENT AND ENERGY AFRICA

AQUATIC BIOMONITORING OF SOUTH COAST STONE CRUSHERS (PTY) LTD

AQUATIC BIOMONITORING SURVEY

REPORT NO 30200307/04

JUNE 2015

NEERVOORT

Prepared by : ____________________________
Neal Neervoort
Aquatic Ecologist

ABriel

Reviewed by : ____________________________
Amelia Briel
Environmental Unit Manager

Knight Piésold
CONSULTING
Knight Piésold (Pty) Limited
P O Box 221
RIVONIA
2128
Tel. +27 11 806-7111
Fax. +27 11 806-7100
E mail : enquiries@kprsa.co.za
Web site : www.knightpiesold.com

WSP, ENVIRONMENT AND ENERGY AFRICA

AQUATIC BIOMONITORING OF SOUTH COAST STONE CRUSHERS (PTY) LTD

AQUATIC BIOMONITORING SURVEY

REPORT NO 30200307/04

JUNE 2015

EXECUTIVE SUMMARY

Knight Piésold (Pty) Ltd was appointed by WSP to conduct the aquatic monitoring for South Coast Stone Crushers, Margate in KwaZulu Natal as part of the Water Use Licence Application (WULA). This report provides feedback on the April 2015 survey for the above mentioned operations.

Bio-monitoring was conducted to identify any possible impacts of the South Coast Stone Crushers Margate and determine the Present Ecological State (PES) of the Vungu River. The aspects considered for monitoring may be summarised as follows:

Upstream Point (SCM 01)

- The in-situ water quality for SCM 01 was within the DWAF Ecosystem guideline values
- Invertebrate Habitat Assessment System (IHAS) indicated that the upstream point had inadequate habitat suitability for macro invertebrates with the stone biotope being absent
- The invertebrate macroinvertebrate PES for the site was rated as category C (moderately modified)
- Diatom community composition indicted that organic pollution levels were increasing. Elevated organic pollution and salinity level could potentially be problematic
- Fish results indicated a PES category E (Severely modified). This could be due to the increased organics levels within the system.

Impact Site (SCM 02)

- In-situ water quality parameters was within the Ecosystem guideline values
- IHAS results indicated good habitat suitability for macro invertebrates with all biotopes available
- SASS 5 results indicted a PES category B/C (Largely natural/largely modified) with the average taxa sensitivity being moderate
- Diatom community composition indicated that organic pollution and salinity levels could be problematic

- Fish Assemblage Integrity Index (FAII) results for SCM 02 rated the site as a PES category E (severely modified). The PES did not deteriorate from the upstream site

Downstream Site (SCM 03)

- In-situ water quality remained within the Ecosystem guideline values
- IHAS indicated that adequate habitat suitable for macro invertebrates were present
- SASS 5 results rated site SCM 03 as a category B (Largely natural) improving from the upstream sites
- Higher nutrient levels and lower organic pollution levels were observed from the diatom community composition
- FAII remained as a category E (severely modified) with only two of the six expected fish species collected.

WSP, ENVIRONMENT AND ENERGY AFRICA

AQUATIC BIOMONITORING OF SOUTH COAST STONE CRUSHERS (PTY) LTD

AQUATIC BIOMONITORING SURVEY

REPORT NO 30200307/04

JUNE 2015

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DIATOM TERMINOLOGY

Trophy	
Dystrophic	Rich in organic matter, usually in the form of suspended plant colloids, but of a low nutrient content.
Oligotrophic	Low levels or primary productivity, containing low levels of mineral nutrients required by plants.
Mesotrophic	Intermediate levels of primary productivity, with intermediate levels of mineral nutrients required by plants.
Eutrophic	High primary productivity, rich in mineral nutrients required by plants.
Hypereutrophic	Very high primary productivity, constantly elevated supply of mineral nutrients required by plants.
Epilithic	Diatoms growing on rock or stone surfaces.
Epiphytic	Diatoms growing on macrophytic surfaces.
Mineral Content	
Very electrolyte poor	< 50 µS/cm
Electrolyte-poor (low electrolyte content)	50 - 100 µS/cm
Moderate electrolyte content	100 - 500 µS/cm
Electrolyte-rich (high electrolyte content)	> 500 µS/cm
Brackish (very high electrolyte content)	> 1000 µS/cm
Saline	6000 µS/cm
Pollution (Saprobity)	
Unpolluted to slightly polluted	BOD <2, O_2 deficit <15% (oligosaprobic)
Moderately polluted	BOD <4, O_2 deficit <30% (β-mesosaprobic)
Strongly polluted	BOD <7 (10), O_2 deficit <50% (β-ά-mesosaprobic)
Very heavily polluted	BOD <13, O_2 deficit <75% (ά-mesosaprobic)
Extremely polluted	BOD <22, O_2 deficit <90% (ά-meso-polysaprobic)
Critical level of pollution	BOD >22, O_2 deficit >90% (polysaprobic)

WSP, ENVIRONMENT AND ENERGY AFRICA

AQUATIC BIOMONITORING OF SOUTH COAST STONE CRUSHERS (PTY) LTD

AQUATIC BIOMONITORING SURVEY

REPORT NO 30200307/04

JUNE 2015

1 INTRODUCTION

1.1 Project Description

South Coast Stone Crushers (PTY) Ltd, Margate is located adjacent to the N2 approximately 2 km North of Margate on the South Coast of KwaZulu Natal. The Vungu River runs through the operation separating the quarry from the concrete plant. As part of the Water Use Licence Application (WULA) aquatic bio-monitoring was conducted upstream, downstream and impact site within the South Coast Stone Crushers premises.

1.2 Scope of Report

The scope of this report is as follows:

- To provide feedback on the Aquatic Bio-monitoring for the April 2015 survey;
- To assess the impacts of South Coast Stone Crushers, Margate on the Present Ecological State (PES) of the Vungu River; and
- To provide mitigation and early detection of any impacts on the aquatic ecosystem due to the effluent discharge.

2 SITE DESCRIPTION

South Coast Stone Crushers (PTY) Ltd, Margate is situated in KwaZulu Natal near Margate next to the N2 highway. The South Coast Stone Crusher property is divided into the Northern quarry area and the southern concrete plant by the Vungu River. Water is abstracted from the Vungu River and receives surface water runoff from the plant areas. Figure 1 below indicates the locality of the Southern Crusher area.

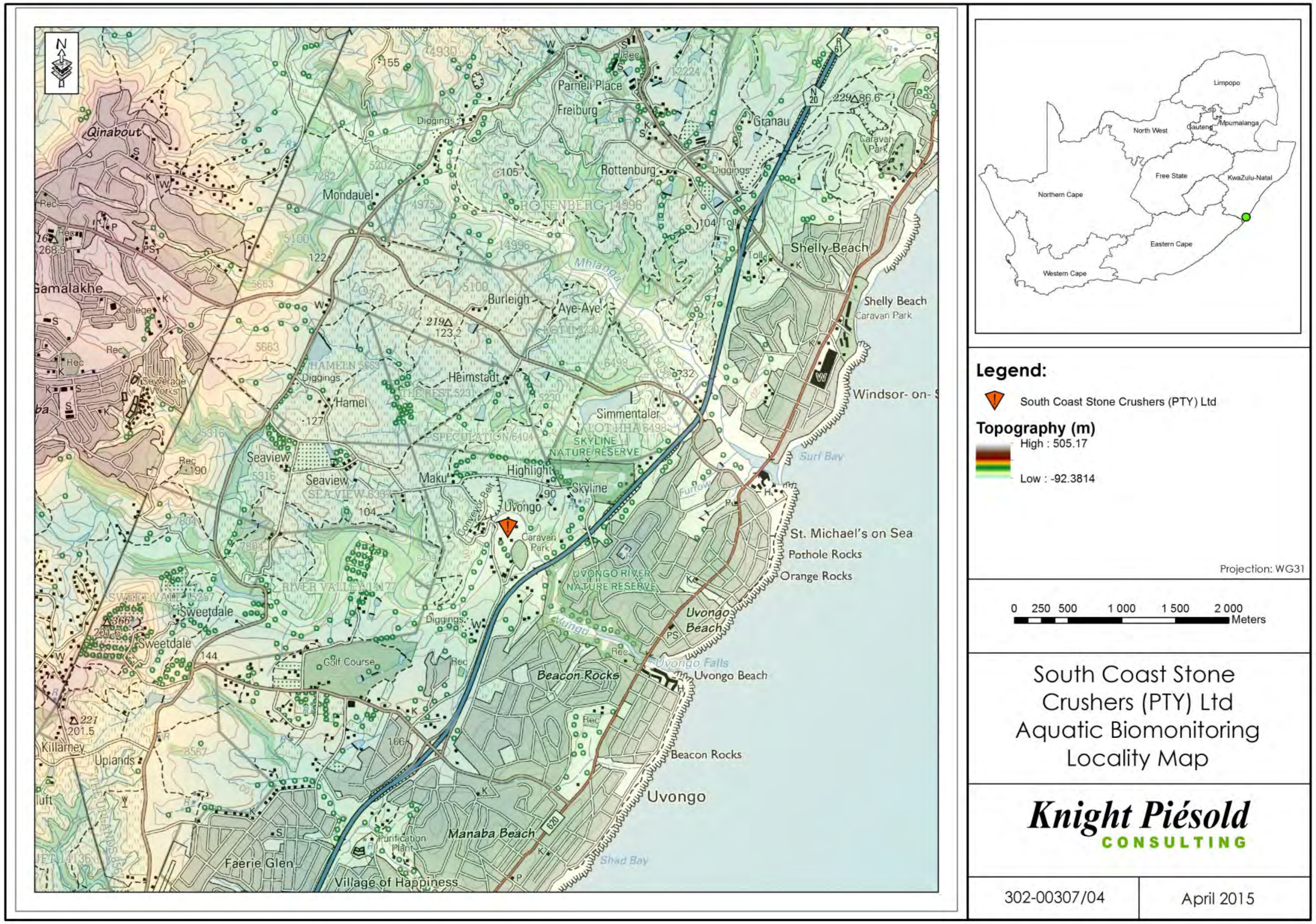

Figure 1: Location of South Coast Stone Crushers

2.1 General Site Characteristics

2.1.1 Vungu River

South Coast Stone Crushers (PTY) Ltd is situated in the catchment of the Vungu River (quaternary catchment T40G). The primary catchment of this system is the Mtamvuna catchment. In this area the primary use of the natural water resources are for agricultural (sugar cane) purposes.

2.1.2 Sites selected for aquatic bio-monitoring

Bio-monitoring has never been conducted at South Coast Stone Crushers Margate and aquatic bio-monitoring points were pre-assessed with the use of GIS imagery and verified during the site assessment. The GPS co-ordinates of the sampling points were taken. Three bio-monitoring sites were identified to assess the PES and identify possible impacts of South Coast Stone Crusher on the Vungu River system.

The bio-monitoring sites are illustrated in Figure 2 and further described in Table 1 below.

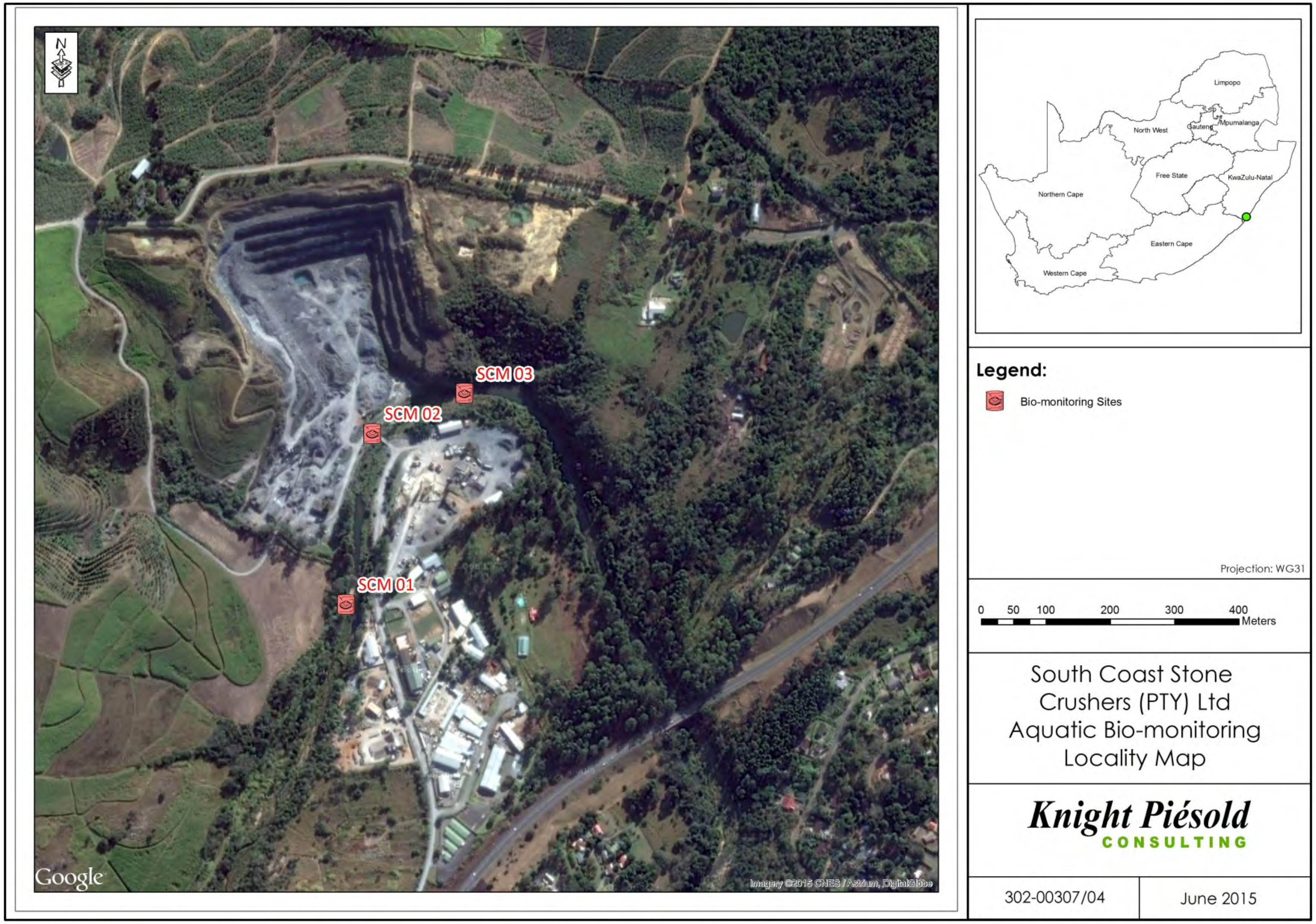

Figure 2: Locality of the Aquatic Bio-monitoring Sites

Table 1: General Description of the Bio-monitoring Sites

Site Code	Description	Position UTM (WGS 84)
SCM 01	**Southern Crusher Margate Upstream:** The upstream point is located upgradient of the South Coast Stone Crusher in the Vungu River. This point is used as the reference site upstream of the operations and is being utilised as part of the south coast stone crusher monitoring programme for water quality. Small scale brick manufacturing companies and an informal settlement is located upstream of the operations along the embankment of the Vungu River.	S 30.82575 E 30.37641
SCM 02	**Impact Site Southern Crusher Margate:** This point is located at the bridge crossing joining the quarry and aggregate plant. The monitoring point is in close proximity to the abstraction point of south coast stone crusher and the river bed has been altered due to the construction of the river crossing.	S 30.82337 E 30.37687
SCM 03	**Impact Site Downstream Southern Crusher Margate:** The downstream point is located directly downstream of the operations, as access to the river system was limited. This site will be utilised as the impact site to identify any possible impacts on the Vungu River by south coast stone crusher.	S 30.82280 E 30.37835

3 METHODS

The South African River Health Programme (RHP) was designed to measure, assess and report on the general state of rivers and to provide an overview of the ecological health of the rivers. The RHP incorporates the application of biological indicators and relevant non-biological indicators (indices) to assess the condition or “health” of the aquatic ecosystems. This assessment was based on selected abiotic and biotic components.

The results of these indices are presented in the form of one of six Present Ecological State (PES) categories. The categories range from an “A” to an “F” state. The categories and state descriptions are represented in Table 2 below.

Table 2: Present Ecological State

PES	PES Name	Description
A	Natural	Unmodified natural
B	Good	Largely natural with few modifications
C	Fair	Moderately modified
D	Poor	Largely modified
E	Severely Modified	Seriously modified
F	Critically Modified	Critically or extremely modified

The following ecological indicators were selected to represent the general ecological components involved in the aquatic environment:

- **In situ water quality** – pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS) and Temperature (^{o}C).
- **Habitat indicators** – In-stream habitat conditions include a general description of each site, GPS locations, photographs for future reference and surrounding features that may lead to pollution.
- **Invertebrates** – Benthic aquatic invertebrates comprise of a wide range of taxa that live in streams and rivers. Abundance and compositions of invertebrate communities reflect water quality and in stream habitat conditions.
- **Ichtyofauna –** Fish typically reflect water quality and instream habitat conditions. The presence of fish species provides a valuable biological indicator of aquatic health in the long term.
- **Diatoms** – Provide biological water quality information for conditions on the day of biological component sampling regarding the aquatic health and functioning of the aquatic system, and providing additional input to the physico-chemical component of the study as a response variable.

3.1 Water Quality

The following water quality parameters were determined during the field survey using an Ex-Tech 510 multi-parameter probe field instrument:

- pH;
- Total Dissolved Solids;
- Electrical Conductivity (*m*S/m); and
- Temperature (^{o}C).

The above mentioned parameters provide an in-situ picture of the current water quality at the time of the survey and can be used as an early detection system for any water quality changes.

3.2 Invertebrate Habitat Assessment System (IHAS)

IHAS evaluates the availability of suitable habitat for macro-invertebrates and expresses the availability and suitability as a percentage as described above. IHAS scores were interpreted according to the guidelines of McMillan 2002 as follows:

- <55% inadequate habitat
- 66-65% adequate habitat
- >65% good habitat

The IHAS has been tested and found to be an unsatisfactory method of quantifying invertebrate habitat suitability (Ollis *et al*. 2006). As this study forms part of a WULA, IHAS will still be utilised and compared to a suitable simple five points scale as per the SASS 5 sheet.

Each habitat category was assigned weighted importance value that varied according to the geomorphological stream type. The weighted values were multiplied by the suitability rating (0-5), and the results were expressed as a percentage, where 100% = all habitats highly suitable. The percentage values were converted to a Present Ecological State Category (A to F), to allow easy comparison among sites or sampling events.

3.3 Aquatic Invertebrates

The South African Scoring System Version 5 (SASS 5) (Dickens and Graham, 2002) is a rapid bio-assessment method to assess the integrity of macro-invertebrates in flowing aquatic ecosystems. The RHP utilises this index to detect the water quality of ecosystems. The index assigns each taxa with a sensitivity score that is used to indicate an overall average score per taxon (ASPT).

Benthic macroinvertebrates, in particular, are recognised as valuable organisms for bioassessments, due largely to their visibility to the naked eye, ease of identification, rapid life cycle often based on the seasons and their largely sedentary habits (Dickens and Graham, 2002). Sampling was conducted using a standard size SASS net with mesh <1 mm, dislodging macro invertebrates from their habitat substrates into the water column and catching the invertebrates in the net.

SASS Data Interpretation Guidelines (Dallas, 2007) were used to interpret the SASS 5 information collected during the survey. The guidelines method utilises natural variation in SASS 5 scores and ASPT to determine preliminary biological bands. The study area falls within the Level 1 Ecoregion for the North Eastern Coastal Belt and the SASS5 score and ASPT values were evaluated according to these bands. Figure 3 below indicates the Northern Eastern Coastal Belt - Lower biological band.

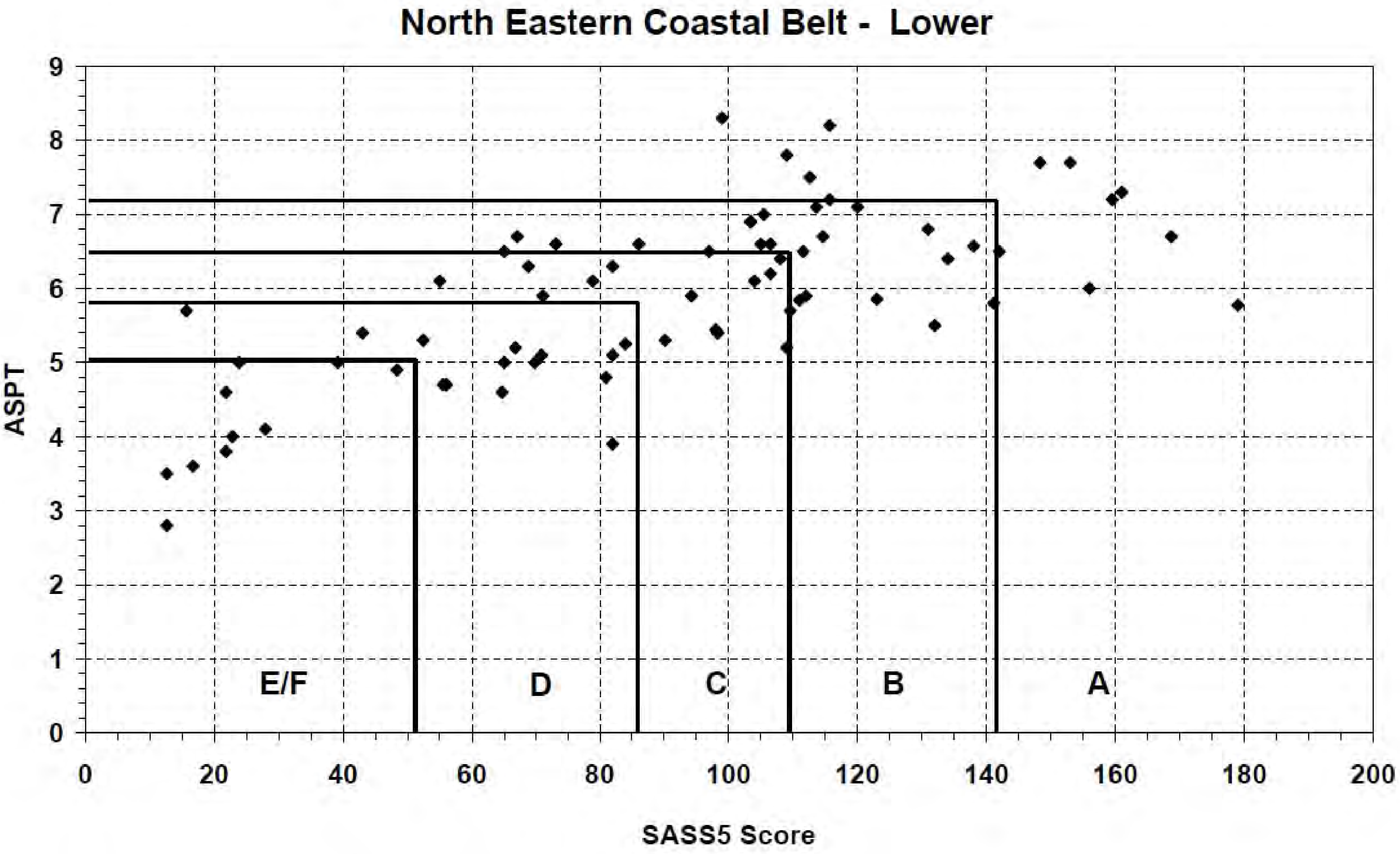

Figure 3: Biological bands for the North Eastern Coastal Belt – Lower zone, calculated using percentiles

3.4 Diatoms

The diatom analysis was conducted in South Africa by Shael Koekemoer of Koekemoer Aquatic Services. Epilithic and/or Epiphytic substrate was sampled as outlined in Taylor *et al*. (2005) and Taylor *et al*. (2007a). These methods were designed and refined as part of the Diatom Assessment Protocol (DAP), a Water Research Commission (WRC) initiative. Taylor *et al.* (2007a) have based the method manual on several key documents including Kelly *et al.* (1998), CEN (2003), DARES (2004) and Taylor *et al.* (2005). Diatom samples were taken at the site by scrubbing the substrate with a small brush and rinsing both the brush and the substrate with distilled water.

Preparation of diatom slide followed the Hot HCl and $KMnO_4$ method as outlined in Taylor *et al.* (2007a). A Nikon Eclipse E100 microscope with phase contrast optics (1000x) was used to identify diatom valves on slides. The aim of the data analysis was to count diatom valves to produce semi-quantitative data from which ecological conclusions can be drawn (Taylor *et al*., 2007a). Schoeman, (1973) and Battarbee (1986) concluded that a count of 400 valves per slide is satisfactory for the calculation of relative abundance of diatom species and this range is supported by Prygiel *et al.* (2002), according to Taylor *et al*. (2007a). Therefore a count of 400 valves per sample or more was counted and the nomenclature followed Krammer and Lange-Bertalot (1986-91). Diatom index values were calculated in the database programme OMNIDIA (Lecointe *et al.*, 1993) for epilithon data in order to generate index scores to general water quality variables.

The European numerical diatom index, the Specific Pollution sensitivity Index (SPI) was used to interpret results. De la Rey *et al.* (2004) concluded that the SPI reflects certain elements of water quality with a high degree of accuracy due to the broad species base of the SPI. The ecological characterisation of the samples was based on Van Dam *et al.* (1994). This work includes the preferences of 948 freshwater and brackish water diatom species in terms of pH, nitrogen, oxygen, salinity, humidity, saprobity and trophic state as provided by OMNIDIA (Le Cointe *et al*., 1993). The results from the Trophic Diatom Index (TDI) (Kelly and Whitton, 1995) were also taken into account as this index provides the percentage pollution tolerant diatom valves (PTVs) in a sample and was developed for monitoring sewage outfall (orthophosphate-phosphorus concentrations), and not general stream quality. The presence of more than 20 % PTVs shows significant organic impact. Valve deformities were also noted as it is an indication of possible metal toxicity that may be present within the system. According to Luís *et al*. (2008) several studies on metal polluted rivers have shown that diatoms respond to perturbations not only at the community but also at the individual level with alteration in cell wall morphology. In particular, size reduction and frustule deformations have sometimes been associated with high metal concentrations. The general threshold for the occurrence of valve deformities in a sample is usually considered between 1 – 2 % and is regarded as potentially hazardous (Taylor, *pers. comm.*).

Table 3: Adjusted Class Limit Boundaries for the SPI Index Applied

Interpretation of index scores		
Ecological Category (EC)	**Class**	**Index Score (SPI Score)**
A	High quality	18 - 20
A/B		17 - 18
B	Good quality	15 - 17
B/C		14 - 15
C	Moderate quality	12 - 14
C/D		10 - 12
D	Poor quality	8 - 10
D/E		6 - 8
E	Bad quality	5 - 6
E/F		4 - 5
F		<4

3.5 Ichtyofauna (Fish)

Fish were sampled using a portable, battery operated electro-fisher (Samus 725M). This is a standard method of sampling fish, and is less prone to biased sampling of certain species than other methods of sampling. Sampling effort at each site varied between about 10 to 30 minutes, depending on the catch.

The Present Ecological State of the fish assemblage was assessed using the species intolerance component of the Fish Assemblage Integrity Index (FAII) (Kleynhans, 1999). The species intolerance values for all species that were recorded at each site were added to obtain a total intolerance score (Kleynhans, 2003). The total scores were expressed as a percentage of the total intolerance scores for species that were expected. The results were classified using a six-point scale, as shown in Table 4.

Table 4: Guidelines used to delineate the Present Ecological State Categories of fish based on comparison and total Observed and Expected intolerance ratings (Kleynhans 2008).

Category	Description	% of Expected
A	Unmodified, or approximate natural conditions closely	90 to 100
B	Largely natural with few modifications. A change in community characteristics may have taken place but species richness and presence of intolerant species indicate little modification	80 to 89
C	Moderately Modified. A lower than expected species richness and presence of most intolerant species. Some impairment of health may be evident at the lower limit of this class.	60 to 79
D	Largely Modified. A clearly lower than expected species richness and absence or much lowered presence of intolerant and moderately intolerant species. Impairment of health may become more evident at the lower limit of this class.	40 to 59
E	Seriously Modified. A strikingly lower than expected species richness and general absence of intolerant and moderately intolerant species. Impairment of health may become very evident.	20 to 39
F	Critically Modified. An extremely lowered species richness and absence of intolerant species. Only tolerant species may be present with a complete loss of species at the lower limit of the class. Impairment of health generally very evident	0 to 19

4 RESULTS AND DISCUSSION

This section will focus on the results of the April 2015 survey conducted. Due to timing of the project and timeframes for the WULA, the survey was conducted in April 2015 to provide an indication of the wet season results. Only one survey was conducted to present the PES of the Vungu River system.

4.1 Water Quality

Water quality is used to describe the physical, chemical, biological and aesthetic properties of water that determine its fitness for a variety of uses and for the protection of the health and integrity of aquatic ecosystems (DWAF, 1996).

The results for the South Coast Stone Crushers, Margate can be seen below:

Table 5: In-situ Water Quality Results Southern Crusher Margate

Site Code	Temp (°C)	pH	DO (mg/l)	EC (mS/m)	TDS (mg/l)
DWAF Ecosystem Guidelines	**5 – 30**	**6.5 – 9.0**	**>5.0**	**<154**	**<1100**
SCM 01	24.7	7.5	5.5	14.6	101
SCM 02	20.9	7.2	5.1	15.4	108
SCM 03	25.3	7.2	5.7	15.7	110

4.1.1 SCM 01

The general water quality at site SCM 01 was of acceptable condition when compared to the DWAF Ecosystem Guidelines as seen in Table 5. No exceedances were observed. The Electrical Conductivity (EC) was relatively low, but can be attributed to the potential impacts upstream from the agricultural activities (sugar cane).

4.1.2 SCM 02

No exceedances were identified during the survey. The Dissolved Oxygen (DO) levels are close to being under the target value. The EC values seem to be low right through the system.

4.1.3 SCM 03

No exceedances were observed at the downstream monitoring point of the Southern Crusher Margate. Water quality parameters are all within the aquatic ecosystem guidelines.

4.2 IHAS

IHAS provides the overview of the general biotope availability per sampling site. The habitat scoring system is based on a percentage (%) and is split into two sections: sampling habitat and the stream characteristics (McMillan, 1998). An ideal system is shown as 100 %, with a site with good biotope available more than 65 % and adequate habitat above 55 %. Detailed results for IHAS are attached in Appendix 2.

4.2.1 SCM 01

The score of the IHAS indicate the habitat suitability at SCM01 as inadequate habitat (42 %). The alternative method used also indicates the habitat suitability as inadequate. It should be noted that the stones biotope was absent at site SCM 01 during the survey. The PES for site SCM 01 is described as class D, largely modified state.

4.2.2 SCM 02

The IHAS score for SCM 02 indicate adequate habitat (67 %) for aquatic macro invertebrates. The alternative method utilised provides a score of 65 % which groups site SCM 02 as having good habitat suitability. All three biotopes were available during the survey. Site SCM 02 indicated an ecological category of B, largely natural with a few modifications.

4.2.3 SCM 03

The habitat suitability of the downstream point SCM 03 indicate adequate habitat availability (65 %) using both methods of assessment. All three biotopes were available and sampled during the survey. The downstream point had a PES category of B, largely natural with few modifications.

4.3 Aquatic Invertebrates

Since many aquatic organisms have specific habitat requirements, seasonal variation in these factors may lead to seasonal variation in the distribution and abundance of benthic macroinvertebrates (Thirion, 2007). The variation in discharges into a river system often translates into differences in wetted perimeter, hydraulic conditions and biotope availability.

ASPT will be less affected (Dallas 1997, Chutter 1998) because the few organisms present may have the appropriate sensitivity. The ASPT is a more reliable measure of good quality rivers where the SASS score might be more important in poor quality rivers (Dickens *et al.*, 2002). The full SASS5 data results are attached in Appendix 3.

4.3.1 SCM 01

A total of 16 SASS 5 taxa were recorded during the survey with an average sensitivity of taxa being moderate with an ASPT of 5.5. The most sensitive taxa observed were *Heptageniida* (flathead mayflies) and *Calopterygidae* (Demoiselles). The PES for site SCM 01 is rated as category C (moderately modified).

4.3.2 SCM 02

The Ecological state for site SCM 02 was rated as category B/C (Largely natural/moderately modified). A total number of 17 SASS 5 taxa were observed during the survey across all three biotopes. Average sensitivity of the taxa is moderate with an ASPT of 6.5 with *Heptageniida* (flathead mayflies) and *Calopterygidae* (Demoiselles) being the most sensitive taxa observed.

4.3.3 SCM 03

The ecological state for the downstream point was rated as a B (Largely natural). The average sensitivity of taxa observed was moderate with ASPT of 5.5. A total number of 23 SASS 5 taxa were observed with a total SASS 5 score of 126. The most sensitive taxa observed were *Hydropsychidae* (>2 species) and *Psephenidae* (water pennies) that were not observed at the other two monitoring sites.

4.4 Diatoms

A summary of the diatom results are provided in Table 6 and the diatom based ecological classification based on Van Dam *et al*. (1994) for diatom based water quality is given in Table 7 below.

Table 6: Results of diatom analysis

Site	No Species	SPI score	Class	Category	PTV (%)	Deformities (%)
SCM 01	39	11.9	Moderate quality	C/D	23.3	3
SCM 02	33	13.5	Moderate quality	C	20	3.75
SCM 03	35	14.7	Good quality	B/C	17.8	3

Table 7: Generic diatom based ecological classification

Site	pH	Salinity	Organic nitrogen	Oxygen levels	Pollution levels	Trophic status
SCM 01	Alkaline	Fresh brackish	Elevated concentrations of organically bound nitrogen	Moderate (>50 % saturation)	Moderately polluted	Eutrophic
SCM 02	Alkaline	Fresh brackish	Elevated concentrations of organically bound nitrogen	Moderate (>50 % saturation)	Very heavily polluted	Eutrophic
SCM 03	Alkaline	Fresh brackish	Elevated concentrations of organically bound nitrogen	Moderate (>50 % saturation)	Moderately polluted	Eutrophic

4.4.1 SCM 01

This SPI score was 11 (C/D Ecological Category) and the water quality was Moderate. Nutrient and organic pollution levels were elevated with the potential of becoming problematic while salinity levels were normal. Oxygenation rates were moderate and moderate pollution levels prevailed (Table 7). Pollution Tolerant Valves (PTVs) made up 23.3% of the total count (Table 6). The diatom community was characteristic of anthropogenically impacted waters with high organic pollution loads. The genus *Cocconeis* has a broad ecological range and is found in most running waters except where nutrients are low or acidic conditions prevail (Taylor *et al*., 2007b). This genus is tolerant of moderate organic pollution and also extends into brackish waters. It is abundant on rocks, but is also found on other surfaces such as filamentous algae and macrophytes (Kelly *et al*., 2001). According to Fore and Grafe (2002), *C. placentula* prefer alkaline, eutrophic conditions.

The diatom community composition indicated that organic pollution levels were increasing due to dominance of *Eolimna minima*, a pioneer species and indicator of elevated organic pollution. *Planothidium* species was also dominant suggesting that salinity and organic pollution could become potentially problematic. The high occurrence of *Nitzschia* species indicated a water body with readily available nutrients (Cholnoky, 1968) and this suggested that nutrient levels were rising.

Of concern was the presence of valve deformities which were above threshold limits making up 3 % of the total count. This indicated that metal toxicity was present at the time of sampling and would impact on aquatic biota.

4.4.2 SCM 02

The biological water quality improved further downstream at SCM02. The SPI score was 13.5 (C Ecological Category) and the water quality was Moderate. Nutrient and organic pollution levels were elevated with the potential of becoming problematic while salinity levels were normal. PTVs made up 20 % of the total count which was less than observed at SCM01. Oxygenation rates were moderate and very heavy pollution levels prevailed (Table 7).

Dominant species were similar to those observed at SCM01, although *Cocconeis* species were sub-dominant rather than dominant. As with SCM01, organic pollution levels and nutrient levels were elevated and based on the diatom community composition these variables had the potential of becoming problematic.

Of concern was the presence of valve deformities which were above threshold limits making up 3.75 % of the total count. This indicated that metal toxicity was present at the time of sampling and would impact on aquatic biota.

4.4.3 SCM 03

There was a further improvement in biological water quality at the most downstream site in the Vungu River. The SPI score was 14.7 (B/C Ecological Category) and the water quality was Good. There was a general improvement in nutrient, organic pollution and salinity levels. PTVs made up 17.8 % of the total count. Oxygenation rates were moderate and moderate pollution levels prevailed (Table 7).

Although dominant species were similar to SCM01 there was a decrease in the abundance of *Planothidium* and *Eolimna* species while the abundance of *Cocconeis* species increased from SCM02 suggesting lower organic pollution levels but slightly higher nutrient levels compared to SCM02.

Valve deformities exceeded thresholds with deformities making up 3 % of the total count. This is similar to SCM01.

4.5 Ichtyofauna

Detailed results of the fish assessment including the FAII % score is attached in Appendix 4.

4.5.1 SCM 01

One of six expected fish species in the Vungu River were observed during the survey. The upstream point was rated as a PES category E (severely modified) with a FAII score of 24 %. The only species of fish collected was *Micropterus punctulatus* (Spotted Bass) which is an alien species and not endemic to South Africa. The abundance of fish was low, as habitat suitability for fish species were minimal.

4.5.2 SCM 02

Two of six expected fish species in the Vungu River were collected during the survey at the impact site. The impact site provided much more vegetation habitat for fish species as the upstream point. The PES was rated a category E (severely modified) with a FAII score of 39 %. The two species collected were *Micropterus punctulatus* (Spotted Bass) and *Pseudocrenilabrus philander* (Southern Mouthbrooder). The abundance of fish was low during the survey with a catch per unit effort of 36 fish per hour.

4.5.3 SCM 03

The results downstream of the operations are similar to the result of the impact site as only two species of fish were collected during the sampling event. The PES was rated a category E (severely modified) with a FAII score of 39 %. The same two species as mentioned above was recorded at site SCM 03.

5 CONCLUSION

The following conclusions could be made from the survey:

5.1 Water Quality

- The in-situ water quality results for the survey were all within the DWAF Ecosystem guideline values.

5.2 IHAS

- SCM 01, the upstream point for the operations, had inadequate habitat for macro invertebrate as the Stone biotope was not available
- The sediment deposition in the river from upstream and adjacent activities might contribute to the limited stone biotope available upstream of the operations
- SCM 02 had good habitat suitability
- SCM 03 had adequate habitat suitability.

5.3 Aquatic Invertebrates

- The lack of suitable habitat at site SCM 01 impacted on the SASS 5 score as the PES upstream of the operations were rated as a C category (Moderately Modified)
- SCM 02 was rated as a category B/C which is an improvement from the upstream site
- SCM 03 was rated as a category B (Largely natural).

5.4 Diatoms

- The diatom data indicated that the Vugu River was characterised by elevated nutrient and organic pollution levels which could become problematic at times. Salinity levels as reflected by the diatoms seemed normal.
- The diatom communities at the three sites situated in the Vungu River reflect that the river is impacted by anthropogenic activities surrounding the river. There is a general improvement in the condition of the river downstream of the quarry due to decreased organic pollution as well as decreasing nutrient levels.
- The occurrence of valve deformities was observed at all three sites in the Vungu River at levels that exceeded general thresholds. This suggested that metal toxicity levels were present and would impact aquatic biota.

- According to DWS (2015; in press) this river reach, sub-quaternary T40G-05616 is impacted by high density settlements, urban impacts from Uvongo, waste water treatment works (Uvongo and Gamalakhe), and sand-mining (quarry). In terms of Resource Quality Objectives, this reach is in a B Ecological Category and was identified as a high water quality priority area. Nutrients, salts, turbidity, and faecal coliforms / *E. coli* are problematic (DWS, 2015; in press).

5.5 Ichtyofauna

- Only two species of the expected six species were collected during the survey
- All three sites was rated as a PES of Severely modified (Category E).

6 RECOMMENDATIONS

- The survey was conducted at the end of the rainy season in KwaZulu Natal, but storm water management on site should be improved to limit the surface water runoff into the Vungu River
- Bi-annual bio-monitoring is recommended to determine the full impact of the Southern Crusher Margate on the Vungu River and to build up a database for the Vungu River.

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APPENDIX 1:
PHOTO REPORT

Plate 1: Site SCM 01 April 2015

Plate 2: Site SCM 01 April 2015

Plate 3: Site SCM 02 April 2015

Plate 4: Site SCM 02 April 2015

Plate 5: Site SCM 03 April 2015

Plate 6: Site SCM 04 April 2015

APPENDIX 2:
INTEGRATED HABITAT ASSESSMENT SYSTEM

INVERTEBRATE HABITAT ASSESSMENT SYSTEM (IHAS)

River Name: Vungu River | **Date: 20/04/2015**

Site Code: SCM 01

SAMPLING HABITAT	**0**	**1**	**2**	**3**	**4**	**5**
Stones-in-current (SIC)						
Total length (m) of broken water (riffles or rapids)	none	0-1	>1-2	>2-3	<3-5	>5
Total length (m) of submerged stones in current (run	none	0-2	>2-5	>5-10	>10	
Number of separate SIC areas kicked (not individual stones)	0	1	2-3	4-5	6+	
Average size (cm) of stones kicked (gravel<2. bedrock >20)	none	<2 <20	2-10	11-20	2-20	
Amount to stone surface clear (of algae. sediment. silt etc)*	n/a	0-25	26-50	51-75	>75	
Protocal: time (mins) spent actually kicking SIC (grvl/bedr=0)	0	<1	<1-2	2	>2-3	>3
**Note: up to 25% of stones is usually embedded in stream bottom.*	**SIC Score (max. 20)**				0	
Vegetation						
Length (m) of fringing vegetation sampled (banks)	none	0-½	>½ - 1	>1-2	2	>2
Amount (m^2) of aquatic vegetation / algae sampled	none	0-½	>½ - 2	>1		
Fringing vegetation sampled in: (none: pool or still only: run only: mixture of both)	none		run	pool		mix
Type of veg (% leafy vegetation vs stems/shoots) (aqv only = 49)	none	0	1-25	26-50	51-75	>75
	Veg Score (max. 15)				11	
Other Habitat / General						
Stones-out-of-current (SOOC) sampled: (protocol = 1m^2)	none	0-½	>½-1	1	>1	
Sand sampled: (protocol = 1min) (present. but only below stones)	none	below	0-½	>½-1	1	>1
Mud sampled: (protocol = 1/2min) (present. but only below stones)	none	below	0-½	½	>½	
Gravel sampled: (protocol=1/2min) if all. SIC stone size =<2)**	none	0-½	½	½ **		
Bedrock sampled (all=no SIC. sand. gravel) (if all. SIC stone size > 20)**	none	some			All **	
Algae present (1-2m2=algal bed. rocks=on rocks. isol=isolated clumps)	>2m^2	rocks	1-2m^2	<1m^2	isol.	none
Tray identification (using time as per protocol)		under		Correct		over
*** Note still fill in SIC section*	**Other Habitat Score (max. 20)**				12	
	HABITAIT TOTAL (max.55)				23	
STREAM CHARACTERISTICS	**0**	**1**	**2**	**3**	**4**	**5**
Physical						
River make up (pool = pool/dam only: run only: rapid/rifle only: 2mix = 2 types etc)	pool		run	Rapid / rifle	2mix	3mix
Average stream width (m)		>10	5-10	<1	1-2	>2-5
Average stream depth (m)	>2	>1-2	1	>½ - 1	1-2	<½
Approximate stream velocity (slow ≤ 1m/s: fast ≥1m/s)	still	slow	fast	med.	½	mix
Water colour (disc = discoloured with visible colour but still clearish)	silty	opaque		disc.		clear
Recent disturbances due to: (constr = construction)***	flood	fire	Constr.	other		none
Bank/riparian vegetation is: grass=includes reeds: shrubs=includes trees)	none		grass	shrubs		mix
Surrounding impacts: (erosn = erosion/shear bare banks: farm = farmland/settlements)***	erosn.	farm	trees	other		open
Left bank cover (%) (rocks and vegetation: shear = 0%)	0-50	51-80	81-95	>95		
Right bank cover (%) (rocks and vegetation: shear = 0%)	0-50	51-80	81-95	>95		
	Stream Conditions Total (max.45)				18	
****Note: if more than one option, choose lowest*						
	TOTAL IHAS SCORE %:				41	

INVERTEBRATE HABITAT ASSESSMENT SYSTEM (IHAS)

River Name: Vungu River **Date: 20/04/2015**

Site Code: SCM 02

SAMPLING HABITAT	**0**	**1**	**2**	**3**	**4**	**5**
Stones-in-current (SIC)						
Total length (m) of broken water (riffles or rapids)	none	0-1	>1-2	>2-3	<3-5	>5
Total length (m) of submerged stones in current (run	none	0-2	>2-5	>5-10	>10	
Number of separate SIC areas kicked (not individual stones)	0	1	2-3	4-5	6+	
Average size (cm) of stones kicked (gravel<2, bedrock >20)	none	<2,<20	2-10	11-20	2-20	
Amount fo stone surface clear (of algae, sediment, silt etc)*	n/a	0-25	26-50	51-75	>75	
Protocal: time (mins) spent actually kicking SIC (grvl/bedr=0)	0	<1	<1-2	2	>2-3	>3
**Note: up to 25% of stones is usually embedded in stream bottom.*	**SIC Score (max. 20)**				**18**	
Vegetation						
Length (m) of fringing vegetation sampled (banks)	none	0-½	>½ - 1	>1-2	2	>2
Amount (m^2) of aquatic vegetation / algae sampled	none	0-½	>½ - 2	>1		
Fringing vegetation sampled in: (none; pool or still only; run only; mixture of both)	none		run	pool		mix
Type of veg (% leafy vegetation vs stems/shoots) (aqv only = 49)	none	0	1-25	26-50	51-75	>75
	Veg Score (max. 15)				**8**	
Other Habitat / General						
Stones-out-of-current (SOOC) sampled: (protocol = 1m^2)	none	0-½	>½-1	1	>1	
Sand sampled: (protocol = 1min) (present, but only below stones)	none	below	0-½	>½-1	1	>1
Mud sampled: (protocol = 1/2min) (present, but only below stones)	none	below	0-½	½	>½	
Gravel sampled: (protocol=1/2min) if all, SIC stone size =<2)**	none	0-½	½	½ **		
Bedrock sampled (all=no SIC, sand, gravel) (if all, SIC stone size > 20)**	none	some			All **	
Algae present (1-2m2=algal bed, rocks=on rocks, isol=isolated clumps)	>2m^2	rocks	1-2m^2	<1m^2	Isol.	none
Tray identification (using time as per protocol)		under		Correct		over
*** Note still fill in SIC section*	**Other Habitat Score (max. 20)**				**15**	
	HABITAIT TOTAL (max.55)				**41**	
STREAM CHARACTERISTICS	**0**	**1**	**2**	**3**	**4**	**5**
Physical						
River make up (pool = pool/dam only; run only; rapid/riffle only; 2mix = 2 types etc)	pool		run	Rapid / riffle	2mix	3mix
Average stream width (m)		>10	5-10	<1	1-2	>2-5
Average stream depth (m)	>2	>1-2	1	>½ - 1	1-2	<½
Approximate stream velocity (slow ≤ 1m/s; fast ≥1m/s)	still	slow	fast	med.	½	mix
Water colour (disc = discoloured with visible colour but still clearish)	silty	opaque		disc.		clear
Recent disturbances due to: (constr = construction)***	flood	fire	Constr.	other		none
Bank/riparian vegetation is: grass=includes reeds; shrubs=includes trees)	none		grass	shrubs		mix
Surrounding impacts: (erosn = erosion/shear bare banks; farm = farmland/settlements)***	erosn.	farm	trees	other		open
Left bank cover (%) (rocks and vegetation; shear = 0%)	0-50	51-80	81-95	>95		
Right bank cover (%) (rocks and vegetation; shear = 0%)	0-50	51-80	81-95	>95		
	Stream Conditions Total (max.45)				**26**	
****Note: if more than one option, choose lowest*						
	TOTAL IHAS SCORE %:				**67**	

INVERTEBRATE HABITAT ASSESSMENT SYSTEM (IHAS)

River Name: Vungu River	**Date: 21/04/2015**					
Site Code: SCM 03						
SAMPLING HABITAT	**0**	**1**	**2**	**3**	**4**	**5**
Stones-in-current (SIC)						
Total length (m) of broken water (riffles or rapids)	none	0-1	>1-2	>2-3	[✓ <3-5]	>5
Total length (m) of submerged stones in current (run	none	0-2	>2-5	[✓ >5-10]	>10	
Number of separate SIC areas kicked (not individual stones)	0	1	[✓ 2-3]	4-5	6+	
Average size (cm) of stones kicked (gravel<2, bedrock >20)	none	<2,<20	[✓ 2-10]	11-20	2-20	
Amount fo stone surface clear (of algae, sediment, silt etc)*	n/a	0-25	26-50	[✓ 51-75]	>75	
Protocal: time (mins) spent actually kicking SIC (grvl/bedr=0)	0	<1	<1-2	2	[✓ >2-3]	>3
**Note: up to 25% of stones is usually embedded in stream bottom.*	**SIC Score (max. 20)**				**18**	
Vegetation						
Length (m) of fringing vegetation sampled (banks)	none	0-½	>½ - 1	>1-2	[✓ 2]	>2
Amount (m^2) of aquatic vegetation / algae sampled	[✓ none]	0-½	>½ - 2	>1		
Fringing vegetation sampled in: (none; pool or still only; run only; mixture of both)	none		[✓ run]	pool		mix
Type of veg (% leafy vegetation vs stems/shoots) (aqv only = 49)	none	0	1-25	[✓ 26-50]	51-75	>75
	Veg Score (max. 15)				**9**	
Other Habitat / General						
Stones-out-of-current (SOOC) sampled: (protocol = 1m^2)	none	0-½	>½-1	[✓ 1]	>1	
Sand sampled: (protocol = 1min) (present, but only below stones)	none	below	0-½	>½-1	[✓ 1]	>1
Mud sampled: (protocol = 1/2min) (present, but only below stones)	[✓ none]	below	0-½	½	>½	
Gravel sampled: (protocol=1/2min) if all, SIC stone size =<2)**	none	0-½	½	[✓ ½ **]		
Bedrock sampled (all=no SIC, sand, gravel) (if all, SIC stone size > 20)**	[✓ none]	some			All **	
Algae present (1-2m2=algal bed, rocks=on rocks, isol=isolated clumps)	>2m^2	[✓ rocks]	1-2m^2	<1m^2	Isol.	none
Tray identification (using time as per protocol)		under		[✓ Correct]		over
*** Note still fill in SIC section*	**Other Habitat Score (max. 20)**				**14**	
	HABITAIT TOTAL (max.55)				**41**	
STREAM CHARACTERISTICS	**0**	**1**	**2**	**3**	**4**	**5**
Physical						
River make up (pool = pool/dam only; run only; rapid/riffle only; 2mix = 2 types etc)	pool		run	Rapid / riffle	[✓ 2mix]	3mix
Average stream width (m)		>10	[✓ 5-10]	<1	1-2	>2-5
Average stream depth (m)	>2	>1-2	1	>½ - 1	[✓ 1-2]	<½
Approximate stream velocity (slow ≤ 1m/s; fast ≥1m/s)	still	slow	[✓ fast]	med.	½	mix
Water colour (disc = discoloured with visible colour but still clearish)	silty	[✓ opaque]		disc.		clear
Recent disturbances due to: (constr = construction)***	flood	fire	Constr.	[✓ other]		none
Bank/riparian vegetation is: grass=includes reeds; shrubs=includes trees)	none		[✓ grass]	shrubs		mix
Surrounding impacts: (erosn = erosion/shear bare banks; farm = farmland/settlements)***	erosn.	farm	trees	[✓ other]		open
Left bank cover (%) (rocks and vegetation; shear = 0%)	0-50	[✓ 51-80]	81-95	>95		
Right bank cover (%) (rocks and vegetation; shear = 0%)	0-50	51-80	[✓ 81-95]	>95		
	Stream Conditions Total (max.45)				**24**	
****Note: if more than one option, choose lowest*						
	TOTAL IHAS SCORE %:				**65**	

APPENDIX 3:
DETAILED RESULTS FOR INVERTEBRATES

SASS Version 5 Score Sheet

Version date: Apr 2008

Date (dd:mm:yr): 13/04/2015
Site Code: SCM 01
Collector/Sampler: Neervoort
River: Vungu River
Level 1 Ecoregion: 17: NORTH EASTERN COASTAL BELT
Quaternary Catchment: T40G

			(dd.ddddd)
Grid reference (dd mm ss.s) Lat:	S	30 49 32.7	30.82575d
Long:	E	30 22 35.1	30.37641d
Datum (WGS84/Cape):		WGS84	
Altitude (m):			
Zonation:		E: Lower Foothills	

Site Description:
Upstream of Operations

Temp (°C):	24.7
pH:	7.5
DO (mg/L):	5.5
Cond (mS/m):	14.6

Routine or Project? (circle one)
Project Name:
NPC - Margate Southern Crusher

Flow:	Medium
Clarity (cm):	66
Turbidity:	Medium
Colour:	Light Brown

Riparian Disturbance:
Instream Disturbance:

Biotopes Sampled (tick & rate)	Rating	Weight
Stones In Current (SIC)	0	4.0
Stones Out Of Current (SOOC)	0	4.0
Bedrock	0	1.5
Aquatic Veg	4	1.0
MargVeg In Current	3	2.0
MargVeg Out Of Current	4	2.0
Gravel	4	4.0
Sand	5	2.0
Mud	0	1.0
Hand picking/Visual observation	y	

OVERALL BIOTOPE SUITABILITY 41% Category D

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3				
ANNELIDA					
Oligochaeta (Earthworms)	1				
Hirudinea (Leeches)	3			A	
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3			A	
Atyidae (Freshwater Shrimps)	8		B		
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8				
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12				
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6		A		
Baetidae > 2 sp	12				
Caenidae (Squaregills/Cainfles)	6				
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13		A		
Leptophlebiidae (Prongills)	9				
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9				
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10		A		
Chlorocyphidae (Jewels)	10				
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		A		
Lestidae (Emerald Damselflies/Spreadwings)	8		A		
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8				
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6			A	
Libellulidae (Darters/Skimmers)	4				
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3		A		
Corixidae* (Water boatmen)	3				
Gerridae* (Pond skaters/Water striders)	5				
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7				
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3		A		
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5		A		
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4				
Hydropsychidae 2 sp	6				
Hydropsychidae > 2 sp	12				
Philopotamidae	10				
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6		A		
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5				
Elmidae/Dryopidae* (Riffle beetles)	8				
Gyrinidae* (Whirligig beetles)	5				
Haliplidae* (Crawling water beetles)	5				
Helodidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving Beetles)	10				
Psephenidae (Water Pennies)	10				

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10				
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5			A	
Chironomidae (Midges)	2			A	
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5				
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)	5				
Tipulidae (Crane flies)	5				
GASTROPODA (Snails)					
Ancylidae (Limpets)	6				
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3		A		
Planorbinae* (Orb snails)	3				
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalvles)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		0	69	19	**88**
No. of Taxa		0	11	5	**16**
ASPT		-	6.3	3.8	**5.5**
Other biota:					

Comments/Observations:

SASS Version 5 Score Sheet

Version date: Apr 2008

Date (dd:mm:yr):	13/04/2015
Site Code:	SCM 02
Collector/Sampler:	Neervoort
River:	Vungu River
Level 1 Ecoregion:	17: NORTH EASTERN COASTAL BELT
Quaternary Catchment:	T40G
Site Description:	Downstream of Quarry

			(dd.ddddd)
Grid reference (dd mm ss.s) Lat:	S	30 49 22.1	30.8228d
Long:	E	30 22 42.1	30.37836d
Datum (WGS84/Cape):		WGS84	
Altitude (m):			
Zonation:		E: Lower Foothills	

Temp (°C):	25.3
pH:	7.2
DO (mg/L):	5.7
Cond (mS/m):	15.7

Routine or Project? (circle one)

Project Name: NPC - Margate Southern Crusher

Flow:	Medium
Clarity (cm):	70
Turbidity:	Medium
Colour:	Light Brown

Riparian Disturbance:

Instream Disturbance:

Biotopes Sampled (tick & rate)	Rating	Weight		
Stones In Current (SIC)	4	4.0		
Stones Out Of Current (SOOC)	4	4.0		
Bedrock	0	1.5		
Aquatic Veg	0	1.0		
MargVeg In Current	4	2.0		
MargVeg Out Of Current	3	2.0		
Gravel	4	4.0		
Sand	4	2.0		
Mud	0	1.0		
Hand picking/Visual observation	y			Category
OVERALL BIOTOPE SUITABILITY			65%	B

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3				
ANNELIDA					
Oligochaeta (Earthworms)	1			A	
Hirudinea (Leeches)	3			A	
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3	A			
Atyidae (Freshwater Shrimps)	8	A	A	A	
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8				
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12				
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6	A	A	A	
Baetidae > 2 sp	12				
Caenidae (Squaregills/Cainfles)	6				
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13				
Leptophlebiidae (Prongills)	9				
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9	A			
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10				
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		A		
Lestidae (Emerald Damselflies/Spreadwings)	8		A		
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8				
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6	A	A	A	
Libellulidae (Darters/Skimmers)	4	A			
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3			A	
Corixidae* (Water boatmen)	3				
Gerridae* (Pond skaters/Water striders)	5				
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7		A		
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3			A	
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5		A		
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4				
Hydropsychidae 2 sp	6				
Hydropsychidae > 2 sp	12	A			
Philopotamidae	10				
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6	A			
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5				
Elmidae/Dryopidae* (Riffle beetles)	8	1			
Gyrinidae* (Whirligig beetles)	5				
Haliplidae* (Crawling water beetles)	5				
Helodidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving Beetles)	10				
Psephenidae (Water Pennies)	10	A		A	

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10				
Blepharoceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5	A			
Chironomidae (Midges)	2	A		A	
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	A			
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)	5	A			
Tipulidae (Crane flies)	5				
GASTROPODA (Snails)					
Ancylidae (Limpets)	6				
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3				
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalvles)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3			A	
Unionidae (Perly mussels)	6				
SASS Score		89	44	45	126
No. of Taxa		14	7	10	23
ASPT		6.4	6.3	4.5	5.5
Other biota:					

Comments/Observations:

SASS Version 5 Score Sheet

Version date: Apr 2008

Date (dd:mm:yr):	13/04/2015
Site Code:	SCM 03
Collector/Sampler:	Neervoort
River:	Vungu River
Level 1 Ecoregion:	17: NORTH EASTERN COASTAL BELT
Quaternary Catchment:	T40G
Site Description:	Downstream of Quarry

				(dd.ddddd)
Grid reference (dd mm ss.s)	Lat:	S	30 49 22.1	30.8228d
	Long:	E	30 22 42.1	30.37836d
	Datum (WGS84/Cape):		WGS84	
	Altitude (m):			
	Zonation:		E: Lower Foothills	

Temp (°C):	25.3
pH:	7.2
DO (mg/L):	5.7
Cond (mS/m):	15.7

Routine or Project? (circle one)

Project Name: NPC - Margate Southern Crusher

Flow:	Medium
Clarity (cm):	70
Turbidity:	Medium
Colour:	Light Brown

Riparian Disturbance:

Instream Disturbance:

Biotopes Sampled (tick & rate)	Rating	Weight
Stones In Current (SIC)	4	4.0
Stones Out Of Current (SOOC)	4	4.0
Bedrock	0	1.5
Aquatic Veg	0	1.0
MargVeg In Current	4	2.0
MargVeg Out Of Current	3	2.0
Gravel	4	4.0
Sand	4	2.0
Mud	0	1.0
Hand picking/Visual observation	y	

		Category
OVERALL BIOTOPE SUITABILITY	65%	B

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3				
ANNELIDA					
Oligochaeta (Earthworms)	1			A	
Hirudinea (Leeches)	3			A	
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3	A			
Atyidae (Freshwater Shrimps)	8	A	A	A	
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8				
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12				
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6	A	A	A	
Baetidae > 2 sp	12				
Caenidae (Squaregills/Cainfles)	6				
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13				
Leptophlebiidae (Prongills)	9				
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9	A			
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10				
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		A		
Lestidae (Emerald Damselflies/Spreadwings)	8		A		
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8				
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6	A	A	A	
Libellulidae (Darters/Skimmers)	4	A			
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3			A	
Corixidae* (Water boatmen)	3				
Gerridae* (Pond skaters/Water striders)	5				
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7		A		
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3			A	
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5		A		
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4				
Hydropsychidae 2 sp	6				
Hydropsychidae > 2 sp	12	A			
Philopotamidae	10				
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6	A			
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5				
Elmidae/Dryopidae* (Riffle beetles)	8	1			
Gyrinidae* (Whirligig beetles)	5				
Haliplidae* (Crawling water beetles)	5				
Helodidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving Beetles)	10				
Psephenidae (Water Pennies)	10	A		A	

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10				
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5	A			
Chironomidae (Midges)	2	A		A	
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	A			
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)	5	A			
Tipulidae (Crane flies)	5				
GASTROPODA (Snails)					
Ancylidae (Limpets)	6				
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3				
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalvles)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3			A	
Unionidae (Perly mussels)	6				
SASS Score		89	44	45	126
No. of Taxa		14	7	10	23
ASPT		6.4	6.3	4.5	5.5

Other biota:

Comments/Observations:

APPENDIX 4:
DETAILED RESULTS FOR DIATOMS

Species	Spp. Abbr.	SCM01	SCM02	SCM03
Achnanthidium species	ADCS	11	5	3
Achnanthidium eutrophilum (Lange-Bertalot) Lange-Bertalot	ADEU	1		
Achnanthes exigua Grunow	AEXG	5	8	3
Aulacoseira granulata var. *angustissima* (O Müller) Simonsen	AUGA			1
Caloneis bacillum (Grunow) Cleve	CBAC	1		
Capartogramma crucicula (Grunow ex Cleve) Ross	CCRU		3	1
Craticula molestiformis (Hustedt) Lange-Bertalot	CMLF	2		
Cocconeis species	COCS	25	14	18
Cocconeis pediculus Ehrenberg	CPED	3		
Cocconeis placentula Ehrenberg	CPLA	62	14	35
Diadesmis confervacea (Kützing) DG Mann	DCOF		3	3
Abnormal diatom valve (unidentified) or sum of deformities abundances	DEFO	12	15	12
Eunotia minor (Kützing) Grunow	EMIN	2		
Encyonema minutum (Hilse) DG Mann	ENMI		2	2
Eolimna minima (Grunow) Lange-Bertalot	EOMI	31	25	18
Eolimna species	EOSP	1		
Eolimna subminuscula (Manguin) Lange-Bertalot	ESBM	5	6	
Fragilaria biceps (Kützing) Lange-Bertalot	FBCP			1
Fragilaria capucina Desmazières	FCAP	4	13	18
Fragilaria capucina var. *rumpens* (Kützing) Lange-Bertalot	FCRU	1		
Fragilaria elliptica (Schumann) Williams & Round	FELL	4		
Fragilaria ulna var. *acus* (Kützing) Lange-Bertalot	FUAC		2	
Fragilaria ungeriana Grunow	FUNG		1	
Gomphonema minutum (Agardh) Agardh	GMIN		2	1
Gomphonema species	GOMS	50	72	50
Gomphonema parvulum (Kützing) Kützing	GPAR	7	18	19
Gomphonema pumilum var. *rigidum* Reichardt & Lange-Bertalot	GPRI			1
Gyrosigma rautenbachiae Cholnoky	GRAU	1	2	
Gomphonema rhombicum Fricke	GRHO	22	67	102
Gyrosigma acuminatum (Kützing) Rabenhorst	GYAC	10	5	7
Hippodonta capitata (Ehrenberg) Lange-Bertalot Metzeltin & Witkowski	HCAP		1	
Mayamaea atomus var. *permitis* (Hustedt) Lange-Bertalot	MAPE		3	2
Melosira varians Agardh	MVAR	4	3	2
Nitzschia amphibia Grunow	NAMP	1		
Navicula arvensis Hustedt	NARV	1		1
Navicula species	NASP	7	12	4
Navicula cryptocephala Kützing	NCRY	1	1	4
Nitzschia dissipata (Kützing) Grunow	NDIS	4	7	14
Navicula gregaria Donkin	NGRE		1	4
Nitzschia solita Hustedt	NISO	7		4
Navicula notha Wallace	NNOT	3	12	3
Nitzschia paleacea (Grunow) Grunow	NPAE	1		
Nitzschia palea (Kützing) W. Smith	NPAL	1		
Navicula rostellata Kützing	NROS		10	1
Navicula schroeteri var. *symmetrica* (Patrick) Lange-Bertalot	NSSY	1		4
Navicula vandamii Schoeman & Archibald	NVDA	1		

Species	**Spp. Abbr.**	**SCM01**	**SCM02**	**SCM03**
Navicula veneta Kützing	NVEN	1	1	1
Nitzschia species	NZSS	39	23	23
Placoneis clementis (Grunow) Cox	PCLT	3		2
Planothidium frequentissima (Lange-Bertalot) Round & Bukhityarova	PLFR	40	12	9
Planothidium rostrata (Oestrup) Round & Bukhityarova	PRST	24	34	23
Tryblionella levidensis WM Smith	TLEV	1	3	4
Total Count		**400**	**400**	**400**

APPENDIX 5:
DETAILED RESULTS FOR FISH

Family/Species	**Common Englsih Name**	**Sensitivity Rating**	**Exp FROC**	**SCM 01**	**SCM 02**	**SCM 03**
Pseudocrenilabrus philander	Southern Mouthbrooder	1.4	4	-	50%	50%
Exotic/Alien Species						
Micropterus punctulatus	Spotted Bass	2.0	1	100%	50%	50%
Sample Size (n)				9	17	13
Effort (min)				32	33	27
Catch per unit effort (number/hr)				17	31	29
Number of species				1	2	2
FAII (%)				24	39	39
PES Category				E	E	E

Appendix E: Water Quality Results

b.n. kirk (natal) cc

Reg.No. CK 1994/015428/23

Water, Sewage & Industrial Effluent Testing Laboratory

45 Eaton Road, Congella, Durban P.O. Box 30140, Mayville, 4058 RSA
Tel : (031) 205 1245 Fax : (031) 205 6904 E-mail: admin@bnkirk.co.za
Web Page: www.bnkirk.co.za

TO535

CERTIFICATE OF ANALYSIS - BN Kirk (Natal) cc

CLIENT:	NPC - CIMPOR	BNK Reference No.:	Lab/NPC 29-05-2014
ADDRESS	P.O. Box 15245 Bellair 4006		
ATTENTION:	***Deepa Seepersad***	Client's Order No.:	**TO FOLLOW**
email:	dseepersad@intercement.com	DATE RECEIVED:	29-05-2014
Analysis Date:	10-06-2014	REPORT DATE:	17-05-2014

ANALYTICAL RESULTS

Parameter	**Test Method No**	**Units**	**SAGS 2004**	**Stormwater Drain Margate**	**Settlement Pond Margate**	**River Before Margate**	**River Middle Margate**	**River After Margate**
pH	P09/042	*pH units*	5.5 - 9.5	8.3	7.9	7.4	7.6	7.8
Oxygen Absorbed **{A}**	P09/020	*mg/l*	ns	5.4	2.2	1.8	2.8	2.4
Ammonia as NH_3	P09/076	*mg/l*	<6.0	0.20	<0.1	<0.1	<0.1	<0.1
Nitrates as NO_3	P09/018	*mg/l*	ns	34	5.7	11	11	10
Nitrates as N [d]	P09/018	*mg/l*	<15	7.7	1.3	2.5	2.5	2.3
Chemical Oxygen Demand	P09/006	*mg/l*	<75	<20	<20	<20	<20	<20
Chloride as Cl^- **{A}**	P09/007	*mg/l*	ns	56	69	42	41	40
Alkalinity as $CaCO_3$	P09/001	*mg/l*	ns	59	125	26	31	35
o-Phosphate as PO_4	P09/023	*mg/l*	ns	9.1	0.91	1.2	1.4	1.5
o-Phosphate as P	P09/023	*mg/l*	<10	3.0	0.30	0.39	0.46	0.49
Conductivity	P09/044	*mS/m*	<150	25	39	21	21	23
Suspended Solids	P09/029	*mg/l*	<25	696	57	2.0	36	25
Total Residual Chlorine	P09/025	*mg/l*	ns	Too Dark	Too Turbid	0.02	<0.01	<0.01
Free Residual Chlorine	P09/025	*mg/l*	ns	Too Dark	Too Turbid	<0.01	<0.01	<0.01
E.coli [a] **{A}**	P09/046	*per 100ml*	*1000*			160		66
Faecal coliforms [b] **{A}**	P09/046	*per 100ml*	*1000*			174		166

KEY :   ns = not specified

for and on behalf of B N KIRK (Natal) cc

Technical Signatory:

DBester   DSubban

17-05-2014

D. Bester - Laboratory Manager   ***D. Subban - Chemistry Supervisor***   ***Dated***

Disclaimer:

1. While every reasonable precaution is taken in obtaining these results the Company does not accept responsibility for any matters arising from the further use of these results.

2. In the case of sample/s submitted by the client, the results expressed in this certificate represent only the sample/s as received.

3. This certificate shall not be reproduced except in full, without the written approval of the Company.

Accreditation Disclaimer:

1. Results marked **{A}** *are included in the SANAS Schedule of accreditation for this laboratory.*
2. Results marked "Subcontracted Test" in this report, are not included in the SANAS Schedule of accreditation for this laboratory.
3. The estimated uncertainty of measurements for the accredited test results is obtainable from the laboratory - QP24 Appendix A.
4. The results relate to the sample tested and the most recent methods available with a 95% confidence level.

End of Report

b.n. kirk (natal) cc

Reg.No. CK 1994/015428/23

Water, Sewage & Industrial Effluent Testing Laboratory

45 Eaton Road, Congella, Durban P.O. Box 30140, Mayville, 4058 RSA
Tel : (031) 205 1245 Fax : (031) 205 6904 E-mail: admin@bnkirk.co.za
Web Page: www.bnkirk.co.za

CERTIFICATE OF ANALYSIS - BN Kirk (Natal) cc

CLIENT:	NPC - CIMPOR	BNK Reference No.:	Lab/NPC Margate Boundary 23-04-2015
ADDRESS	P.O. Box 15245 Bellair 4006		
ATTENTION:	***Deepa Seepersad***	Client's Order No.:	**To Follow**
email	Dseepersad@intercement.com	DATE RECEIVED:	22-04-2015
Analysis Date	28-04-2015	REPORT DATE:	30-04-2015

ANALYTICAL RESULTS				**Margate**		
Parameter	**Test Method No**	**Units**	**SAGS 2004**	**Boundary Before**	**Mid**	**Boundary After**
pH	P09/042	*pH units*	**5.5 - 9.5**	7,1	7,1	7,0
Oxygen Absorbed **{A}**	P09/020	mgO_2/l	**ns**	<5	<5	<5
Ammonia as N	P09/076	*mg/l*	**<6.0**	0,2	0,40	0,4
Nitrates as NO_3	P09/018	*mg/l*	**ns**	5,20	5,2	5,1
Nitrates as N [d]	P09/018	*mg/l*	**<15**	1,18	1,18	1,15
Chemical Oxygen Demand	P09/006	mgO_2/l	**<75**	<20	<20	<20
Chloride as Cl^- **{A}**	P09/007	*mg/l*	**ns**	31	32	33
Alkalinity as $CaCO_3$	P09/001	*mg/l*	**ns**	13	16	16
o-Phosphate as PO_4	P09/023	*mg/l*	**ns**	<0,4	<0,4	<0,4
o-Phosphate as P	P09/023	*mg/l*	**<10**	<0,4	<0,4	<0,4
Conductivity	P09/044	*mS/m*	**<150**	15	16	16
Suspended Solids	P09/029	*mg/l*	**<25**	9,0	4,0	<1
Total Residual Chlorine	P09/025	*mg/l*	**ns**	<0,001	<0,01	<0,01
Free Residual Chlorine	P09/025	*mg/l*	**ns**	<0,001	<0,01	<0,01
Faecal Coliforms **{A}**	P09/046	*cfu /100ml*	<1000	62	788	>2900
e-Coli **{A}**	P09/046	*cfu /100ml*	<1000	60	86	108

KEY : ns = not specified

for and on behalf of B N KIRK (Natal) cc

Technical Signatory:

DBester

DSubban

30-04-2015

D. Bester - Managing Member ***D. Subban - Laboratory Admin Manager*** ***Dated***

Disclaimer:

1. *While every reasonable precaution is taken in obtaining these results the Company does not accept responsibility for any matters arising from the further use of these results.*
2. *In the case of sample/s submitted by the client, the results expressed in this certificate represent only the sample/s as received.*
3. *This certificate shall not be reproduced except in full, without the written approval of the Company.*

Accreditation Disclaimer:

1. *Results marked* **{A}** *are included in the SANAS Schedule of accreditation for this laboratory.*
2. *Results marked "Subcontracted Test" in this report, are not included in the SANAS Schedule of accreditation for this laboratory.*
3. *The estimated uncertainty of measurements for the accredited test results is obtainable from the laboratory - QP24 Appendix A.*
4. *The results relate to the sample tested and the most recent methods available with a 95% confidence level.*

End of Report

Appendix F: Water Monitoring Programme

WATER MONITORING PROGRAMME

SOUTH COAST STONE CRUSHERS (PTY) LTD

CONFIDENTIAL

OCTOBER 2015

WATER MONITORING PROGRAMME

South Coast Stone Crushers (Pty) Ltd

Confidential

Project no: 46708
Date: October 2015

WSP | Parsons Brinckerhoff
Block A, 1 on Langford
Langford Road, Westville
Durban, 3629
South Africa

Tel: +27 (31) 240 8860
Fax: +27 (31) 240 8861
www.wspgroup.com
www.pbworld.com

QUALITY MANAGEMENT

ISSUE/REVISION	FIRST ISSUE	REVISION 1	REVISION 2	REVISION 3
Remarks	Final Draft			
Date	October 2015			
Prepared by	A Mthalane			
Signature				
Checked by	A Pickles			
Signature	Pickles			
Authorised by	G Matthews			
Signature	MATTHEWS			
Project number	46708			
Report number	R01			
File reference	46708_R01_South Coast Stone Crushers_Water Monitoring Programme_Final Draft_201501026			

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1 INTRODUCTION AND TERMS OF REFERENCE

WSP Environment & Energy (WSP) was commissioned by South Coast Stone Crushers (SCSC) to compile an Integrated Water and Waste Management Plan (IWWMP) for their Margate Quarry operation located near Uvongo, KwaZulu-Natal.

As part of the Integrated Water Use Licence Application (IWULA) submission, a Water Monitoring Programme was developed for the quarry, which includes monitoring the following:

- Surface Water;
- Groundwater; and
- Biomonitoring.

This document serves to outline the monitoring sampling protocol, the objective of which is to provide clarity on sampling locations, sampling frequency, sampling methodologies and data interpretation to ensure accurate and representative sampling and associated reporting is achieved.

2 SITE DESCRIPTION

SCSC occupies a total area of 27ha, centred at global co-ordinates 30°49’23.25” south and 30°22’33.27” east. The quarry is located approximately 1.3km north east of Uvongo (**Figure 1**). SCSC is bisected by the Vungu River, with the Aggregate Plant located on the northern bank and Concrete Plant located on the southern bank of the Vungu River (**Figure 2**).

The eastern boundary of the aggregate plant lies adjacent to the Vungu River, which is part of the T40G quaternary catchment which receives 1 055mm of rainfall annually and an annual rate of evaporation of 1 150mm; regionally the area experiences 248mm of runoff annually. The surrounding land is privately owned and comprised mainly of commercial agriculture.

3 SAMPLING PREPARATION

3.1 EQUIPMENT REQUIREMENTS

To ensure that appropriate equipment is utilised during water sampling, an equipment checklist has been compiled (**Appendix A**). This must be consulted prior to going to site and must be updated as and when necessary.

3.2 TRAINING

Prior to undertaking sampling, all personnel undertaking site works must be properly trained in the following:

- Function and operational parameters of the field equipment (including the multi-parameter meter);
- Correct care, calibration and maintenance along with appropriate storage and transport of the sampling equipment;
- Attendance of South Coast Stone Crusher's Safety induction; and
- Made aware of the relevant health safety and environmental considerations associated with the works, which would include the following key considerations:
  - Lone working;
  - Slips, trips and falls;
  - Working near water;
  - Working close to moving/operating machinery;
  - Falling objects;
  - Physical Stress;
  - Encountering dangerous animals (i.e. snakes, etc.);
  - Smoking on site; and
  - Members of the public.

3.3 EQUIPMENT CALIBRATION

A multi-parameter meter is to be used for the field measurements of various in-situ parameters (including temperature, pH and electrical conductivity). This meter must be checked, cleaned and calibrated based on manufacturer specifications to ensure accurate measurement prior to use. This process must be undertaken prior to field activities, daily during sampling, as well as after exposure to harsh environments.

The calibration history of the equipment (**Appendix B**) must be recorded on appropriate forms to ensure accuracy and included within the monthly reporting schedule.

4 WATER MONITORING PROGRAMME

The following monitoring protocols need to be followed when undertaking sampling of surface water, groundwater and biomonitoring.

4.1 SURFACE WATER MONITORING

SURFACE WATER SAMPLING LOCATION AND FREQUENCY

The Vungu River must be monitored upstream and downstream of the SCSC operations on a monthly basis to quantify the influence of the quarry's activities on the rivers water quality. The two surface water sampling locations have been identified and are summarised in **Table 1** and illustrated in **Figure 3**.

Table 1 Surface Water Sampling Locations

SAMPLING POINT	LATITUDE	LONGITUDE
Vungu River – Upstream of Quarry	29°49'31.09"S	30°22'35.85"E
Vungu River – Downstream of Quarry	29°49'21.77"S	30°22'42.81"E

SURFACE WATER SAMPLING METHODOLOGY

The surface water samples must be collected directly into laboratory supplied sample containers. Surface water samples must be obtained from at least 10cm below the water surface wherever possible, with the bottle opening facing upstream. Sample containers must be kept closed and in a clean condition up to the point of sampling.

Monitoring must be undertaken according to internationally accepted protocols, ensuring that the potential for cross contamination is minimised (i.e. during sampling, new disposable latex gloves must be worn at each point).

Once a sample is been obtained, it must immediately be stored in a temperature controlled cooler box (below 4^{o}C), which is kept sealed and dust-free. Any glass sample vessels must be wrapped in bubble wrap to prevent breakages.

For each sampling point, the temperature, pH and electrical conductivity must be measured in-situ using a calibrated multi-parameter and recorded. This information, as well as the physical and environmental information of each sampling point (e.g. visual, olfactory observations and flow conditions) must be recorded on designated field data sheet (**Appendix C**).

4.2 GROUNDWATER MONITORING

GROUNDWATER SAMPLING LOCATION AND FREQUENCY

Groundwater samples will be obtained from the five sampling points (i.e. four monitoring wells situated on-site and one off-site borehole). The offsite borehole (i.e. 3030CD00079) was the closest borehole identified from the hydrocensus used to define the background conditions of the area. Although the borehole has been included as part of the sampling locations, it should be noted that it is located in a private property (Sea View Farm) (**Plate 1** and **2**) 1km to the northeast of the quarry. Permission to sample the borehole should be pre-arranged with the landowner. It is possible that SCSC could be prevented access to sample the borehole in which case another borehole, representative of background groundwater quality, should be sampled.

Groundwater sampling should be conducted on a bi-annual basis during October (i.e. end of dry season) and April (i.e. end of wet season). The monitoring well locations are summarised in **Table 2** and illustrated in **Figure 3**.

Table 2 Groundwater Sampling Locations

SAMPLING POINT	LATITUDE	LONGITUDE
3030CD00079 – Background well (Sea View Farm)*	30°49'08.36"S	30°21'46.22"E
MW1 – 13m South-east of the Aggregate Plant	30°49'26.54"S	30°22'33.92"E
MW2 – 2m East of the Pond	30°49'21.29"S	30°22'38.66"E
MW3 – 97m North-west of the Asphalt Plant	30°49'24.20"S	30°22'38.50"E
MW4 – 30m West of the Concrete Plant	30°48'26.80"S	30°22'38.42"E

*Located in a private property, sampling of this point must be on requisite

GROUNDWATER SAMPLING METHODOLOGY

The following steps must be undertaken when sampling groundwater:

- Prior to well purging and sampling, static groundwater levels are to be measured at each monitoring well using an electronic dip-meter, which must be rinsed between wells to minimise cross-contamination.
- Based on previous monitoring results purging and sampling of wells and boreholes must be sampled from the least to the most contaminated monitoring well, to minimise the potential for cross contamination.
- The depth of each well is to be measured to determine the water column contained within the well as well as to determine the level of siltation, if any. The well volume should be calculated based on standing water column and well diameter which is to be recorded on designated field data sheets (**Appendix D**).
- Each monitoring well must be appropriately purged and sampled using either of the following techniques:
  - **3 Times Well Volume** – Using a hand bailer or submersible pump, at least three times the calculated well volume must be purged from the monitoring well. Post purging wells should be allowed to adequately recharge (>90%) prior to sampling.
  - **Purge to Stabilisation** – Using a submersible pump, and depending on expected yield, the well should be purged at a low to moderate to low flow rate (0.5 to 5 l/minute). Water quality parameters (i.e. pH, electrical conductivity and temperature) of the pump discharge should be recorded at 5 minute intervals. Stability is attained once there is less than 5% variation in 3 consecutive readings (i.e. 15 minutes). Groundwater samples can be obtained directly from the pump discharge.
- Purge data are to be recorded on designated field data sheets as provided in **Appendix D**.
- If a submersible pump is used and the pipe has been contaminated during purging, the pipe must be replaced prior to purging the next well.
- The temperature, pH and electrical conductivity must be recorded on the designated field data sheets (**Appendix D**) at the time of sampling. Physical and environmental information of each sampling point (e.g. visual and olfactory observations) should also be noted.

The samples must be collected directly into sample containers provided by an accredited laboratory. Sample containers must be kept closed and in a clean condition up to the point of sampling. Sampling needs to be undertaken according to internationally accepted protocols, ensuring that the potential for cross contamination is minimised (i.e. during sampling new disposable latex gloves must be worn at each point).

The samples must immediately be preserved in a temperature controlled cooler box (below 4^{o}C), which is kept sealed and dust-free. Any glass sample vessels must be wrapped in bubble wrap to prevent breakages.

The accuracy of the monitoring field methods and laboratory analysis needs to be evaluated through duplicate sampling. It is recommended that one duplicate sample is taken quarterly at one of the monitoring locations; with the designated monitoring location, monitoring date and time not disclosed to the laboratory. The sample can be named consecutive to the monitoring wells sampled (e.g. MW5).

4.3 BIOMONITORING

Biomonitoring must be conducted by an accredited SASS (South African Scoring System) practitioner on an annual basis altering between wet and dry season (i.e. October and April). Sampling locations are illustrated in **Table 3** and depicted in **Figure 4**.

Table 3 Biomonitoring Sampling Locations

SAMPLING POINT	LATITUDE	LONGITUDE
SCM 01 – Vungu River Upstream	30°49'32.87"S	30°22'35.78"E
SCM 02 – Bridge Crossing	30°49'24.34"S	30°22'37.49"E
SCM 01 – Vungu River Downstream	30°49'22.02"S	30°22'42.07"E

4.4 SAMPLE LABELLING, HANDLING AND ANALYTICAL PROGRAMME

On each sample, the following must be recorded to ensure proper identification:

- Site Name (e.g. SCSC - Margate Quarry);
- Sample Location and Sample Type (e.g. Groundwater MW1); and
- Sample Date and Time.

Sample containers must be kept closed and in a clean condition up to the point of sampling. Post sampling, all samples must be stored in a temperature controlled cooler box (below 4^{o}C), which is kept sealed and dust-free, until samples are dispatched to the laboratory for analysis. The analytical schedule for the various media being sampled is included in **Table 4**. The pH and electrical conductivity measured in-situ must be validated through laboratory testing.

Table 4 Analytical Schedule for Surface Water and Groundwater

SURFACE WATER	GROUNDWATER
Dissolved solids	Dissolved solids
Suspended solids	Ammoniacal Nitrogen
Ammoniacal Nitrogen	Conductivity
Conductivity	Mercury
Mercury	Chloride
Chloride	Nitrite as N
Nitrite as N	Nitrate as N
Nitrate as N	Ortho-Phosphate as P
Ortho-Phosphate as P	Arsenic
Arsenic	Cadmium
Cadmium	Chromium
Chromium	Copper
Copper	Nickel
Nickel	Lead
Lead	Selenium
Selenium	Zinc
Zinc	pH
pH	
Total Coliforms	

5 DATA INTERPRETATION

All results must be described and interpreted based on the appropriate water quality guidelines.

5.1 SURFACE WATER

In the current absence of a reserve determination for the Vungu River, a most sensitive guideline was defined based on the water quality guidelines for aquatic ecosystem and recreational. The most sensitive guideline to assess surface water is presented in **Table 5**.

Table 5 Most Sensitive Water Quality Guideline

WATER QUALITY VARIABLE	UNITS	AQUATIC ECOSYSTEM	RECREATIONAL	MOST SENSITIVE GUIDELINE
Dissolved solids	mg/l	-	-	-
Suspended solids	mg/l	-	-	-
Ammoniacal Nitrogen	mg/l	0.0072	-	0.0072
Conductivity	mS/m	-	-	-
Mercury	mg/l	-	-	-
Chloride	mg/l	-	-	-
Nitrite as N	mg/l	-	-	-
Nitrate as N	mg/l	<0.5	-	<0.5
Phosphate (ortho) as P	mg/l	-	-	
Arsenic	mg/l	0.001	-	0.001
Cadmium	mg/l	0.00015	-	0.00015
Chromium	mg/l	0.012	-	0.012
Copper	mg/l	0.0003	-	0.0003
Nickel	mg/l	-	-	-
Lead	mg/l	0.0002	-	0.0002
Selenium	mg/l	0.0002	-	0.0002
Zinc	mg/l	0.002	-	0.002
pH	mg/l	-	6.5-8.5	6.5-8.5
Ecoli	-	-		

5.2 GROUNDWATER

In the absence of groundwater quality reserves and pending Water Use Licencing guidelines, analytical results of the on-site monitoring wells must be compared to the analytical results of the background well (i.e.3030CD00078).

6 REPORTING

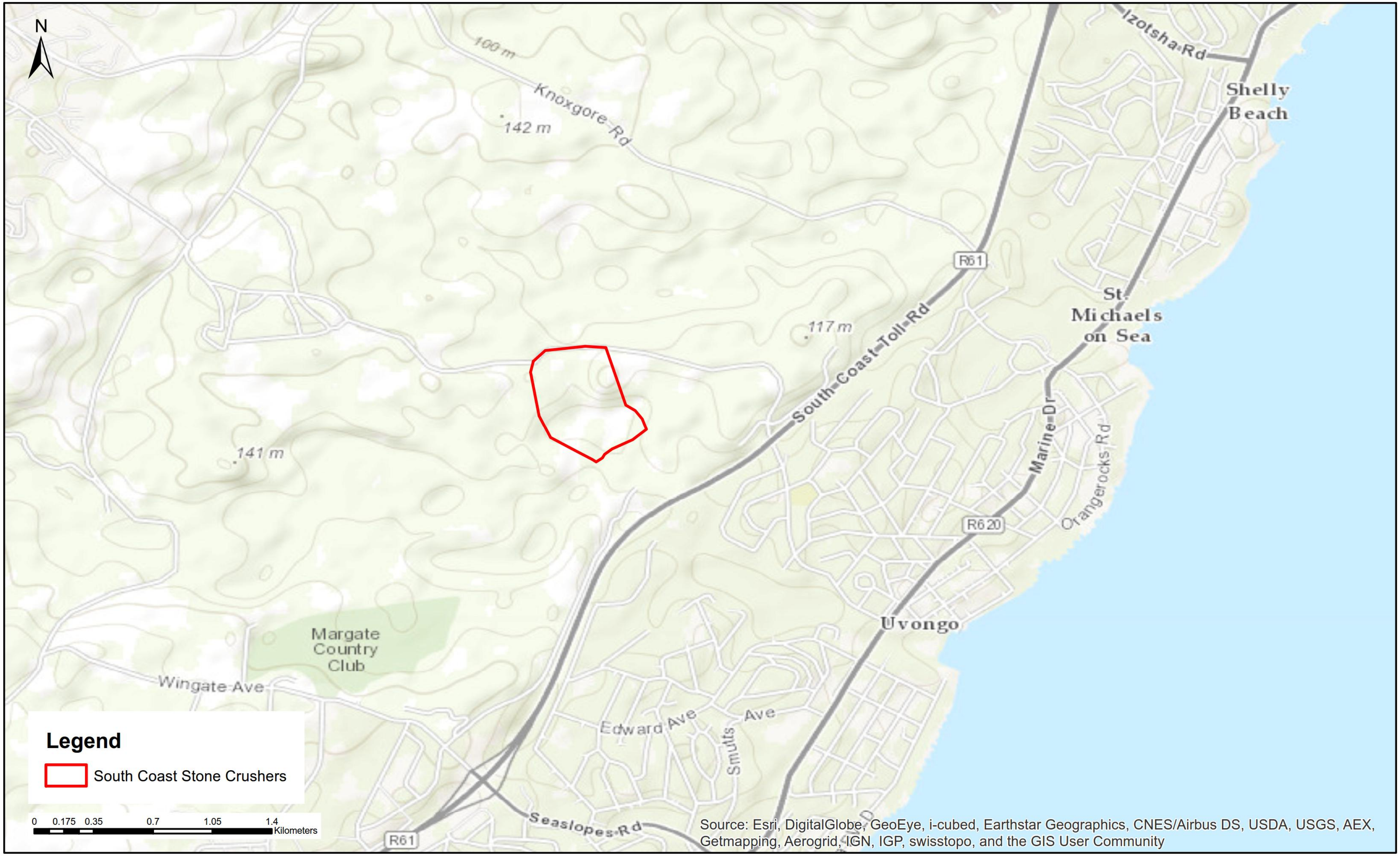
A factual and interpretive report should be drafted in accordance with the monitoring reporting requirements stipulated in the pending Water Use Licence. The report should include a description of the methodologies followed, the analytical results obtained and associated interpretation in line with the defined water quality guidelines. The precision of the sampling and analysis must be assessed through a comparison of the original and duplicate sample analytical results. This must be done through a quality assurance/quality control programme i.e. obtain the percentage variance of the duplicated sample.

PHOTOGRAPHS

Plate 1: Background well located in private property.

Plate 2: Close up image of the Background well located in Sea View Farm property.

7 FIGURES



Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

South Coast Stone Crushers (Pty) Ltd - Margate Quarry

Regional Setting

Data Source: Bing Maps (2013)

Projection

Project: SCSC - Water Monitoring Programme

Project No: 46708

Drawn by: A. Mthalane

Reviewed by: A. Pickles

Date: September 2015

Figure No. 1

WSP

www.wspenvironmental.co.za

Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

South Coast Stone Crushers (Pty) Ltd - Margate Quarry

Site Map

Data Source: Bing Maps (2013)

Projection

Project: SCSC - Water Monitoring Programme

Project No: 46708

Drawn by: A. Mthalane

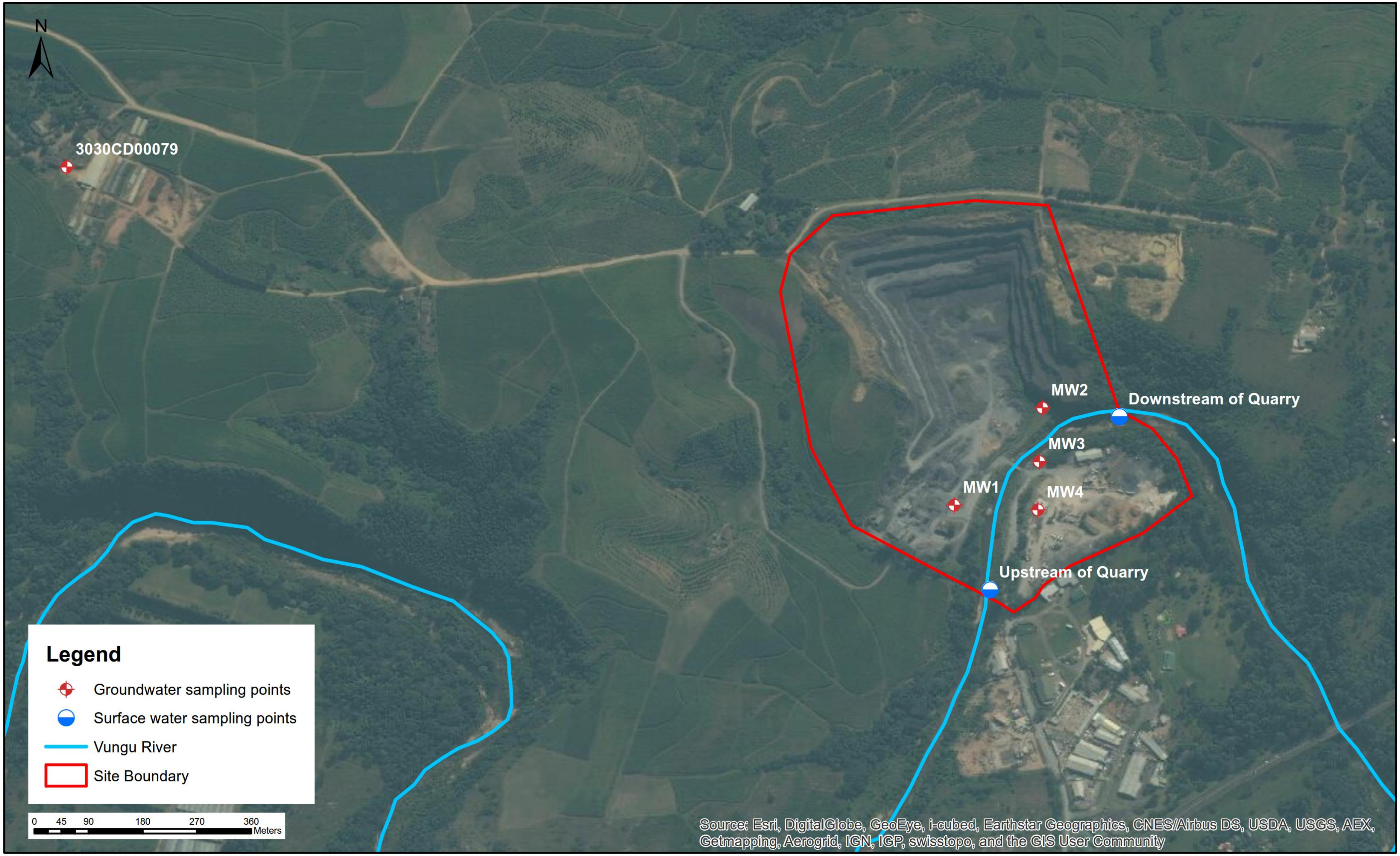
Reviewed by: A. Pickles

Date: September 2015

Figure No. 2

WSP

www.wspenvironmental.co.za



Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

South Coast Stone Crushers (Pty) Ltd - Margate Quarry

Surface Water and Groundwater Sampling Locations

Data Source:
Bing Maps (2013)

Projection

Project: SCSC - Water Monitoring Programme
Project No: 46708
Drawn by: A. Mthalane
Reviewed by: A. Pickles

Date:
September 2015

Figure No.
3

WSP
www.wspenvironmental.co.za

Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

South Coast Stone Crushers (Pty) Ltd - Margate Quarry

Biomonitoring Sampling Locations

Data Source: Bing Maps (2013)

Projection

Project: SCSC - Water Monitoring Programe

Project No: 46708

Drawn by: A. Mthalane

Reviewed by: A. Pickles

Date: September 2015

Figure No. 4

WSP

www.wspenvironmental.co.za

Appendix A

EQUIPMENT CHECKLIST

EQUIPMENT CHECKLIST

CHECK	REQUIRED EQUIPMENT	CONDITION	DATE	CHECKED BY	COMMENTS
	Helmet				
	Reflector Vest				
	Safety Boots				
	Gumboots				
	Camera				
	GPS				
	Sample bottles				
	Latex gloves				
	Cooler boxes and ice				
	Permanent Marker				
	Multi-parameter meter				
	Bailers				
	Strings				
	Pens				
	Datasheets				
	Cleaning equipment				
	Paper Towels				
	Disposable Bag				
	10L Container with clean water to rinse multi parameter				
	Dip meter				
	Super Twist Pump				
	Battery				
	Tubing				

Appendix B

CALIBRATION RECORD

CALIBRATON RECORD

Equipment	Date	Name	Signature	pH	Conductivity (mS/cm).

Appendix C

SURFACE WATER DATA SHEET

SURFACE WATER SAMPLING FIELD RECORD

SCSC Margate Quarry - Water Monitoring Programme

SUPERVISOR:		**ASSISTANT:**	

Sample ID:	**Date**	**Time**	**Temp (°C)**	**pH**	**EC (μS/m)**	**Remarks**

Appendix D

GROUND WATER DATA SHEET

GROUNDWATER SAMPLING FIELD RECORD

SCSC Margate Quarry - Water Monitoring Programme

SUPERVISOR:

ASSISTANT:

Sample ID:	Date	Time	Water Level (m)	Depth of Hole (m)	Well Head (cm/m)	Purge Volume (L)	Temp (°C)	pH	EC (µS/m)	Remarks

ALcontrol Laboratories

Unit 7-8 Hawarden Business Park
Manor Road (off Manor Lane)
Hawarden
Deeside
CH5 3US
Tel: (01244) 528700
Fax: (01244) 528701
email: mkt@alcontrol.com
Website: www.alcontrol.com

WSP Environment & Energy Africa
WSP House
Bryanston Place
199 Bryanston Drive
Bryanston
2191

Attention: Ayanda Mthalane

CERTIFICATE OF ANALYSIS

Date:	21 May 2015
Customer:	H_WSP_BRY
Sample Delivery Group (SDG):	150505-54
Your Reference:	46708
Location:	NPC South Coast Crushers
Report No:	313651

We received 9 samples on Tuesday May 05, 2015 and 9 of these samples were scheduled for analysis which was completed on Thursday May 21, 2015. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

All chemical testing (unless subcontracted) is performed at ALcontrol Hawarden Laboratories.

Approved By:

Sonia McWhan
Operations Manager

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
11308493	Background Well (Sea View Farm)	EWEW	0.00 - 0.00	21/04/2015
11308473	Cement Settlement Pond	EWEW	0.00 - 0.00	21/04/2015
11308481	Downstream	EWEW	0.00 - 0.00	21/04/2015
11308424	MW1	GGW	0.00 - 0.00	21/04/2015
11308432	MW2	GGW	0.00 - 0.00	21/04/2015
11308442	MW3	GGW	0.00 - 0.00	21/04/2015
11308448	MW4	GGW	0.00 - 0.00	21/04/2015
11308463	Settlement Pond (discharge point)	EWEW	0.00 - 0.00	21/04/2015
11308454	Upstream	EWEW	0.00 - 0.00	21/04/2015

Only received samples which have had analysis scheduled will be shown on the following pages.

CERTIFICATE OF ANALYSIS

SDG:	150505-54	**Location:**	NPC South Coast Crushers	**Order Number:**	DU8297
Job:	H_WSP_BRY-272	**Customer:**	WSP Environment & Energy Africa	**Report Number:**	313651
Client Reference:	46708	**Attention:**	Ayanda Mthalane	**Superseded Report:**	

LIQUID

Results Legend

X	Test
N	No Determination Possible

Lab Sample No(s)			11308493				11308473				11308481				11308424				11308432				11308442				11308448				11308463				11308454			
Customer Sample Reference			Background Well (Sea View Farm)				Cement Settlement Pond				Downstream				MW1				MW2				MW3				MW4				Settlement Pond (discharge point)				Upstream			
AGS Reference			EWEW				EWEW				EWEW				GGW				GGW				GGW				GGW				EWEW				EWEW			
Depth (m)			0.00 - 0.00				0.00 - 0.00				0.00 - 0.00				0.00 - 0.00				0.00 - 0.00				0.00 - 0.00				0.00 - 0.00				0.00 - 0.00				0.00 - 0.00			
Container			1000ml glass bottle	1plastic (ALE221)	Total Metals Preserv	Vial (ALE297)	1000ml glass bottle	1plastic (ALE221)	Total Metals Preserv	Vial (ALE297)	1000ml glass bottle	1plastic (ALE221)	Total Metals Preserv	Vial (ALE297)	1000ml glass bottle	1plastic (ALE221)	Total Metals Preserv	Vial (ALE297)	1000ml glass bottle	1plastic (ALE221)	Total Metals Preserv	Vial (ALE297)	1000ml glass bottle	1plastic (ALE221)	Total Metals Preserv	Vial (ALE297)	1000ml glass bottle	1plastic (ALE221)	Total Metals Preserv	Vial (ALE297)	1000ml glass bottle	1plastic (ALE221)	Total Metals Preserv	Vial (ALE297)	1000ml glass bottle	1plastic (ALE221)	Total Metals Preserv	Vial (ALE297)
Ammoniacal Nitrogen	All	NDPs: 0 Tests: 9		X				X				X				X				X				X				X				X				X		
Anions by ion Chromatography	All	NDPs: 0 Tests: 9		X				X				X				X				X				X				X				X				X		
Anions by Kone (w)	All	NDPs: 0 Tests: 9		X				X				X				X				X				X				X				X				X		
Conductivity (at 20 deg.C)	All	NDPs: 0 Tests: 9		X				X				X				X				X				X				X				X				X		
GRO by GC-FID (W)	All	NDPs: 0 Tests: 9				X				X				X				X				X				X				X				X				X
Mercury Unfiltered	All	NDPs: 0 Tests: 9			X				X				X				X				X				X				X				X				X	
Mineral Oil C10-40 Aqueous (W)	All	NDPs: 0 Tests: 9	X				X				X				X				X				X				X				X				X			
Nitrite by Kone (w)	All	NDPs: 0 Tests: 9		X				X				X				X				X				X				X				X				X		
pH Value	All	NDPs: 0 Tests: 9		X				X				X				X				X				X				X				X				X		
Suspended Solids	All	NDPs: 0 Tests: 9		X				X				X				X				X				X				X				X				X		
Total Dissolved Solids (Grav)	All	NDPs: 0 Tests: 9		X				X				X				X				X				X				X				X				X		
Total Metals by ICP-MS	All	NDPs: 0 Tests: 9		X				X				X				X				X				X				X				X				X		

ALcontrol Laboratories

Validated

CERTIFICATE OF ANALYSIS

SDG:	150505-54	**Location:**	NPC South Coast Crushers	**Order Number:**	DU8297
Job:	H_WSP_BRY-272	**Customer:**	WSP Environment & Energy Africa	**Report Number:**	313651
Client Reference:	46708	**Attention:**	Ayanda Mthalane	**Superseded Report:**	

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&♦§@	Sample deviation (see appendix)

		Customer Sample R	Background Well (Sea View Farm)	Cement Settleme nt Pond	Downstream	MW1	MW2	MW3
		Depth (m)	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00
		Sample Type	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)
		Date Sampled	21/04/2015	21/04/2015	21/04/2015	21/04/2015	21/04/2015	21/04/2015
		Sample Time	.	.	.	.	.	.
		Date Received	05/05/2015	05/05/2015	05/05/2015	05/05/2015	05/05/2015	05/05/2015
		SDG Ref	150505-54	150505-54	150505-54	150505-54	150505-54	150505-54
		Lab Sample No.(s)	11308493	11308473	11308481	11308424	11308432	11308442
		AGS Reference	EWEW	EWEW	EWEW	GGW	GGW	GGW
Component	**LOD/Units**	**Method**						
Dissolved solids, Total (gravimetric)	<10 mg/l	TM021	496 #	1380 #	104 #	462 #	538 #	343 #
Suspended solids, Total	<2 mg/l	TM022	<2 @ #	10 @ #	3 @ #	28 @ #	3 @ #	30.5 @ #
Ammoniacal Nitrogen as NH4	<0.3 mg/l	TM099	<0.3 #	<0.3 #	<0.3 #	4.62 #	<0.3 #	<0.3 #
Conductivity @ 20 deg.C	<0.005 mS/cm	TM120	0.759 #	3.49 #	0.148 #	0.72 #	0.745 #	0.509 #
Aliphatics C10-C14	<10 µg/l	TM172	<10 @	<10 @	<10 @	<10 @	<10 @	<10 @
Aliphatics C15-C36	<10 µg/l	TM172	<10	<10	<10	<10	<10	<10
Mercury (tot.unfilt)	<0.02 µg/l	TM183	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Chloride	<2 mg/l	TM184	111 #	37.6 #	29.7 #	65.7 #	26.4 #	43.7 #
Nitrite as N	<0.0152 mg/l	TM184	<0.0152 2 #	0.761 2 #	<0.0152 2 #	<0.0152 2 #	<0.0152 2 #	<0.0152 2 #
Nitrate as N	<0.0677 mg/l	TM184	4.53 @ #	0.216 @ #	1.14 @ #	<0.0677 @ #	9.7 @ #	2.72 @ #
Phosphate (ortho) as P	<0.02 mg/l	TM184	<0.02 @ #	<0.02 @ #	0.0679 @ #	<0.02 @ #	0.0202 @ #	<0.02 @ #
Arsenic (tot.unfilt)	<2 µg/l	TM191	<2 #	<2 #	<2 #	<2 #	<2 #	<2 #
Cadmium (tot.unfilt)	<0.5 µg/l	TM191	<0.5 #	<0.5 #	<0.5 #	<0.5 #	<0.5 #	<0.5 #
Chromium (tot.unfilt)	<3 µg/l	TM191	<3 #	369 #	<3 #	<3 #	<3 #	3.21 #
Copper (tot.unfilt)	<4 µg/l	TM191	4.18 #	4.98 #	<4 #	<4 #	<4 #	<4 #
Nickel (tot.unfilt)	<0.5 µg/l	TM191	<0.5 #	4.61 #	<0.5 #	0.595 #	1.12 #	1.8 #
Lead (tot.unfilt)	<0.5 µg/l	TM191	<0.5 #	<0.5 #	<0.5 #	<0.5 #	<0.5 #	1.05 #
Selenium (tot.unfilt)	<1 µg/l	TM191	2.76 #	2.88 #	<1 #	2.66 #	9.62 #	3.18 #
Zinc (tot.unfilt)	<3 µg/l	TM191	10.6 #	<3 #	<3 #	<3 #	<3 #	3.74 #
Total Oxidised Nitrogen as N	<0.01 mg/l	TM226	4.24 @ #	0.668 @ #	1.07 @ #	0.503 @ #	10.2 @ #	2.65 @ #
pH	<1 pH Units	TM256	7.92 @ #	12.2 @ #	7.27 @ #	7.11 @ #	7.76 @ #	7.04 @ #

Validated

CERTIFICATE OF ANALYSIS

SDG:	150505-54	**Location:**	NPC South Coast Crushers	**Order Number:**	DU8297
Job:	H_WSP_BRY-272	**Customer:**	WSP Environment & Energy Africa	**Report Number:**	313651
Client Reference:	46708	**Attention:**	Ayanda Mthalane	**Superseded Report:**	

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&♦§@	Sample deviation (see appendix)

		Customer Sample R	MW4	Settlement Pond (discharge point)	Upstream			
		Depth (m)	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00			
		Sample Type	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)			
		Date Sampled	21/04/2015	21/04/2015	21/04/2015			
		Sample Time	.	.	.			
		Date Received	05/05/2015	05/05/2015	05/05/2015			
		SDG Ref	150505-54	150505-54	150505-54			
		Lab Sample No.(s)	11308448	11308463	11308454			
		AGS Reference	GGW	EWEW	EWEW			
Component	**LOD/Units**	**Method**						
Dissolved solids, Total (gravimetric)	<10 mg/l	TM021	320 #	493 #	105 #			
Suspended solids, Total	<2 mg/l	TM022	48 @ #	8.5 @ #	2.5 @ #			
Ammoniacal Nitrogen as NH4	<0.3 mg/l	TM099	<0.3 #	0.428 #	<0.3 #			
Conductivity @ 20 deg.C	<0.005 mS/cm	TM120	0.492 #	0.68 #	0.145 #			
Aliphatics C10-C14	<10 µg/l	TM172	<10 @	<10 @	<10 @			
Aliphatics C15-C36	<10 µg/l	TM172	<10	<10	<10			
Mercury (tot.unfilt)	<0.02 µg/l	TM183	<0.02	<0.02	<0.02			
Chloride	<2 mg/l	TM184	51.1 #	26.8 #	30.2 #			
Nitrite as N	<0.0152 mg/l	TM184	<0.0152 2 #	0.0201 2 #	<0.0152 2 #			
Nitrate as N	<0.0677 mg/l	TM184	0.356 @ #	5.69 @ #	1.23 @ #			
Phosphate (ortho) as P	<0.02 mg/l	TM184	0.0297 @ #	<0.02 @ #	0.0649 @ #			
Arsenic (tot.unfilt)	<2 µg/l	TM191	<2 #	<2 #	<2 #			
Cadmium (tot.unfilt)	<0.5 µg/l	TM191	<0.5 #	<0.5 #	<0.5 #			
Chromium (tot.unfilt)	<3 µg/l	TM191	<3 #	3.03 #	<3 #			
Copper (tot.unfilt)	<4 µg/l	TM191	<4 #	<4 #	<4 #			
Nickel (tot.unfilt)	<0.5 µg/l	TM191	1.97 #	1.5 #	<0.5 #			
Lead (tot.unfilt)	<0.5 µg/l	TM191	2.27 #	<0.5 #	<0.5 #			
Selenium (tot.unfilt)	<1 µg/l	TM191	<1 #	8.12 #	<1 #			
Zinc (tot.unfilt)	<3 µg/l	TM191	35.6 #	5.29 #	3.19 #			
Total Oxidised Nitrogen as N	<0.01 mg/l	TM226	0.258 @ #	5.85 @ #	1.08 @ #			
pH	<1 pH Units	TM256	7.91 @ #	7.92 @ #	7.3 @ #			

CERTIFICATE OF ANALYSIS

SDG:	150505-54	**Location:**	NPC South Coast Crushers	**Order Number:**	DU8297
Job:	H_WSP_BRY-272	**Customer:**	WSP Environment & Energy Africa	**Report Number:**	313651
Client Reference:	46708	**Attention:**	Ayanda Mthalane	**Superseded Report:**	

GRO by GC-FID (W)

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&♦§@	Sample deviation (see appendix)

		Customer Sample R	Background Well (Sea View Farm)	Cement Settlement Pond	Downstream	MW1	MW2	MW3
		Depth (m)	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00
		Sample Type	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)
		Date Sampled	21/04/2015	21/04/2015	21/04/2015	21/04/2015	21/04/2015	21/04/2015
		Sample Time	.	.	.	.	.	.
		Date Received	05/05/2015	05/05/2015	05/05/2015	05/05/2015	05/05/2015	05/05/2015
		SDG Ref	150505-54	150505-54	150505-54	150505-54	150505-54	150505-54
		Lab Sample No.(s)	11308493	11308473	11308481	11308424	11308432	11308442
		AGS Reference	EWEW	EWEW	EWEW	GGW	GGW	GGW
Component	**LOD/Units**	**Method**						
Aliphatics C7-C9	<10 µg/l	TM245	<10 @	<10 @	<10 @	<10 @	<10 @	<10 @

CERTIFICATE OF ANALYSIS

SDG:	150505-54	**Location:**	NPC South Coast Crushers	**Order Number:**	DU8297
Job:	H_WSP_BRY-272	**Customer:**	WSP Environment & Energy Africa	**Report Number:**	313651
Client Reference:	46708	**Attention:**	Ayanda Mthalane	**Superseded Report:**	

GRO by GC-FID (W)

Results Legend

#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&♦§@	Sample deviation (see appendix)

Customer Sample R	MW4	Settlement Pond (discharge poi nt)	Upstream			
Depth (m)	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00			
Sample Type	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)			
Date Sampled	21/04/2015	21/04/2015	21/04/2015			
Sample Time	.	.	.			
Date Received	05/05/2015	05/05/2015	05/05/2015			
SDG Ref	150505-54	150505-54	150505-54			
Lab Sample No.(s)	11308448	11308463	11308454			
AGS Reference	GGW	EWEW	EWEW			

Component	**LOD/Units**	**Method**	MW4	Settlement Pond (discharge point)	Upstream			
Aliphatics C7-C9	<10 µg/l	TM245	<10 @	<10 @	<10 @			

SDG:	150505-54	**Location:**	NPC South Coast Crushers	**Order Number:**	DU8297
Job:	H_WSP_BRY-272	**Customer:**	WSP Environment & Energy Africa	**Report Number:**	313651
Client Reference:	46708	**Attention:**	Ayanda Mthalane	**Superseded Report:**	

Table of Results - Appendix

Method No	Reference	Description	Wet/Dry Sample ¹	Surrogate Corrected
TM021	Method 2540C, AWWA/APHA, 20th Ed., 1999	Determination of total dissolved solids in waters by gravimetry.		
TM022	Method 2540D, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part120 1981;BS EN 872	Determination of total suspended solids in waters		
TM061	Method for the Determination of EPH,Massachusetts Dept.of EP, 1998	Determination of Extractable Petroleum Hydrocarbons by GC-FID (C10-C40)		
TM099	BS 2690: Part 7:1968 / BS 6068: Part2.11:1984	Determination of Ammonium in Water Samples using the Kone Analyser		
TM120	Method 2510B, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part 9:1970	Determination of Electrical Conductivity using a Conductivity Meter		
TM172	Analysis of Petroleum Hydrocarbons in Environmental Media – Total Petroleum Hydrocarbon Criteria	EPH in Waters		
TM183	BS EN 23506:2002, (BS 6068-2.74:2002) ISBN 0 580 38924 3	Determination of Trace Level Mercury in Waters and Leachates by PSA Cold Vapour Atomic Fluorescence Spectrometry		
TM184	EPA Methods 325.1 & 325.2,	The Determination of Anions in Aqueous Matrices using the Kone Spectrophotometric Analysers		
TM191	Standard Methods for the examination of waters and wastewaters 16th Edition, ALPHA, Washington DC, USA. ISBN 0-87553-131-8.	Determination of Unfiltered Metals in Water Matrices by ICP-MS		
TM226	In-House Method	Determination of Anions in Waters using Ion Chromatography		
TM245	By GC-FID	Determination of GRO by Headspace in waters		
TM256	The measurement of Electrical Conductivity and the Laboratory determination of pH Value of Natural, Treated and Wastewaters. HMSO, 1978. ISBN 011 751428 4.	Determination of pH in Water and Leachate using the GLpH pH Meter		

[1] Applies to Solid samples only. DRY indicates samples have been dried at 35°C. NA = not applicable.

Test Completion Dates

Lab Sample No(s)	11308493	11308473	11308481	11308424	11308432	11308442	11308448	11308463	11308454
Customer Sample Ref.	Background Welll (Sea View Far)	Cement Settlement Pond	Downstream	MW1	MW2	MW3	MW4	Settlement Pondd (discharge point)	Upstream
AGS Ref.	EWEW	EWEW	EWEW	GGW	GGW	GGW	GGW	EWEW	EWEW
Depth	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00
Type	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID
Ammoniacal Nitrogen	14-May-2015	14-May-2015	14-May-2015	14-May-2015	14-May-2015	14-May-2015	14-May-2015	14-May-2015	14-May-2015
Anions by ion Chromatography	21-May-2015	21-May-2015	21-May-2015	21-May-2015	21-May-2015	20-May-2015	20-May-2015	21-May-2015	21-May-2015
Anions by Kone (w)	13-May-2015	13-May-2015	13-May-2015	13-May-2015	13-May-2015	13-May-2015	13-May-2015	13-May-2015	13-May-2015
Conductivity (at 20 deg.C)	12-May-2015	12-May-2015	12-May-2015	12-May-2015	12-May-2015	12-May-2015	12-May-2015	12-May-2015	12-May-2015
GRO by GC-FID (W)	18-May-2015	18-May-2015	18-May-2015	18-May-2015	18-May-2015	18-May-2015	18-May-2015	18-May-2015	18-May-2015
Mercury Unfiltered	11-May-2015	11-May-2015	11-May-2015	11-May-2015	11-May-2015	11-May-2015	11-May-2015	11-May-2015	11-May-2015
Mineral Oil C10-40 Aqueous (W)	18-May-2015	18-May-2015	18-May-2015	18-May-2015	18-May-2015	18-May-2015	18-May-2015	18-May-2015	18-May-2015
Nitrite by Kone (w)	07-May-2015	07-May-2015	07-May-2015	07-May-2015	07-May-2015	08-May-2015	08-May-2015	08-May-2015	07-May-2015
pH Value	18-May-2015	18-May-2015	18-May-2015	18-May-2015	18-May-2015	18-May-2015	18-May-2015	18-May-2015	18-May-2015
Suspended Solids	15-May-2015	15-May-2015	15-May-2015	15-May-2015	15-May-2015	15-May-2015	15-May-2015	15-May-2015	15-May-2015
Total Dissolved Solids (Grav)	14-May-2015	18-May-2015	18-May-2015	18-May-2015	18-May-2015	14-May-2015	18-May-2015	18-May-2015	18-May-2015
Total Metals by ICP-MS	11-May-2015	11-May-2015	11-May-2015	11-May-2015	11-May-2015	11-May-2015	11-May-2015	11-May-2015	11-May-2015

Appendix

General

1. Results are expressed on a dry weight basis (dried at 35ºC) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH4 by the BRE method, VOC TICS and SVOC TICS.

2. Samples will be run in duplicate upon request, but an additional charge may be incurred.

3. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALcontrol Laboratories reserve the right to charge for samples received and stored but not analysed.

4. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

5. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

6. When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as “Not detected”. If no asbestos fibre types are found all will be reported as “Not detected” and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible. The quantity of asbestos present is not determined unless specifically requested.

7. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

8. If appropriate preserved bottles are not received preservation will take place on receipt. However, the integrity of the data may be compromised.

9. NDP -No determination possible due to insufficient/unsuitable sample.

10. Metals in water are performed on a filtered sample, and therefore represent dissolved metals -total metals must be requested separately.

11. Results relate only to the items tested.

12. LODs for wet tests reported on a dry weight basis are not corrected for moisture content.

13. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%, they are generally wider for volatiles analysis, 50-150%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

14. **Product analyses** -Organic analyses on products can only be semi-quantitative due to the matrix effects and high dilution factors
employed.

15. Phenols monohydric by HPLC include phenol, cresols (2-Methylphenol, 3-Methylphenol and 4-Methylphenol) and Xylenols (2,3 Dimethylphenol, 2,4 Dimethylphenol, 2,5 Dimethylphenol, 2,6 Dimethylphenol, 3,4 Dimethyphenol, 3,5 Dimethylphenol).

16. Total of 5 speciated phenols by HPLC includes Phenol, 2,3,5-Trimethyl Phenol, 2-Isopropylphenol, Cresols and Xylenols (as detailed in 15).

17. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

18. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

19. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

20. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

21. For all leachate preparations (NRA, DIN, TCLP, BSEN 12457-1, 2, 3) volatile loss may occur, as we do not employ zero headspace extraction.

22. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

23. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

Sample Deviations

1	**Container with Headspace provided for volatiles analysis**
2	**Incorrect container received**
3	**Deviation from method**
4	**Holding time exceeded before sample received**
5	**Samples exceeded holding time before presevation was performed**
§	**Sampled on date not provided**
•	**Sample holding time exceeded in laboratory**
@	**Sample holding time exceeded due to sampled on date**
&	**Sample Holding Time exceeded - Late arrival of instructions.**

Asbestos

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using Alcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using Alcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than:
- Trace - Where only one or two asbestos fibres were identified.

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.