Appendix G: Aquatic Assessment Report

South Coast Stone Crushers:

Margate Quarry Expansion, KwaZulu-Natal

Specialist Aquatic Assessment Report

Version 1.0

Date: September 2015

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Details of Authors

The relevant experience of specialist team members involved in the specialist aquatic assessment and compilation of this report are briefly summarized below. *Curriculum Vitae's* of the specialist team are available on request.

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SPECIALIST ASSESSMENT REPORT DETAILS AND DECLARATION OF INDEPENDENCE

This is to certify that the following report has been prepared as per the requirements of Appendix 6 (1) of the NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (Act No. 107 OF 1998) ENVIRONMENTAL IMPACT ASSESSMENT REGULATIONS 2014 as per Government Notice No. 38282 GOVERNMENT GAZETTE, 04 DECEMBER 2014.

Document Title:	*South Coast Stone Crushers, Margate Quarry Expansion KwaZulu-Natal:* ***Specialist Aquatic Assessment Report***
Report prepared by:	**Ross van Deventer** Environmental Scientist (Eco-Pulse Consulting)
Field of study/Expertise:	Wetland/Aquatic Ecology
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Client:	SRK Consulting, on behalf of South Coast Stone Crushers

I Adam Teixeira-Leite hereby declare that this report has been prepared independently of any influence or prejudice as may be specified by the Department of Agriculture and Environmental Affairs.

Signed:  Date: 07 September 2015

EXECUTIVE SUMMARY

This report sets out the findings of a **Specialist Aquatic Assessment**, including wetlands and river ecosystems, associated with the existing South Coast Stone Crushers (SCSC) quarry operation, located near Margate/Uvongo, southern KwaZulu-Natal. The main findings of this specialist report have been summarized below:

Background to the quarry operation and assessment:

The Margate quarry operated by South Coast Stone Crushers (SCSC), located on the Vungu River, has been operating for a number of years with a valid Environmental Management Programme (EMPr) in place under the MPRDA (Minerals and Petroleum Resources Development Act No. 28). The quarry 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.

As part of the planned expansion, the quarry has already constructed an access road and turning circle by pushing rock and filling a section of wetland adjacent to the site. This was identified as a contravention of the National Water Act as impacts to wetlands are involved. SCSC (South Coast Stone Crushers) has acknowledged that the impact of the fill material must be assessed as part of the EMPr amendment and WULA. SRK Consulting has been appointed by the quarry (South Coast Stone Crushers) to assist in completing and submitting an application for an amendment to SCSC's existing EMPr and WSP Environmental has been appointed by SCSC to apply for a Water Use License (WUL) from the Department of Water and Sanitation (DWS). Eco-Pulse Environmental Consulting Services was subsequently appointed to assist with undertaking a specialist assessment of aquatic ecosystems (including wetlands and rivers affected by the quarry operations) in order to inform the amendment and Water Use Licensing processes.

Baseline Aquatic Assessment Findings:

The word "wetland" is a family name given to a variety of ecosystems, ranging from rivers, springs, seeps and mires in the upper catchment, to midlands marshes, pans and floodplains, to coastal lakes, mangrove swamps and estuaries at the bottom of the catchment. Three separate aquatic ecosystems were identified for the project area surrounding the quarry site that has been affected by current operations, including:

1. A **small (0.75 ha) seepage wetland (W-01)** located in the adjacent valley to the west which was regarded as being **Largely to Seriously Modified** in terms of wetland condition or Present Ecological State (PES) and associated with a *large change in ecological processes as a result of a combination of catchment and on-site impacts to wetland hydrology, geomorphology and vegetation integrity*. Existing impacts to the wetland included dense alien plant infestation,

sugarcane cultivation, artificial drainage and infilling. This wetland was regarded as being of **Low Ecological Importance and Sensitivity** (EIS).

2. The **relatively large perennial Vungu River reach (R-02)** below the quarry site which drains in a south-easterly towards the downstream estuary. The river reach was regarded as being **Moderately Modified (PES)** and of **Moderate to High EIS**. Existing impacts to the river reach assessed included dense alien plant infestations, channel crossings, bank modification and sediment/water quality impacts.
3. A **small tributary river connected to the Vungu River (R-01)** and also located in the western valley and draining in a southerly direction along the perimeter of the quarry, connected at its head to seepage wetland W-01. This small river system was regarded as being **Largely Modified (PES)** and of **Low EIS**. Existing impacts to the river reach assessed included very dense alien plant infestation levels, channel crossings, bank modification/erosion and sediment/water quality impacts.

Future management of the aquatic ecosystems identified for the project area should be informed by recommended management objectives for the water resource which are to ***maintain the current status quo of aquatic ecosystems without any further loss of integrity (PES) or functioning (EIS), with the recommendation for the Vungu River (R-02) being to improve current PES and EIS based on a moderately high ecological importance & sensitivity associated with this system.*** This is also supported by Ezemvelo KZN Wildlife (EKZNW) whose guiding principle with regards to biodiversity conservation and sustainable development is one of "***no net loss of biodiversity and ecosystem processes"***.

Assessment of Ecological Impacts:

Existing impacts and potential ecological risks to the wetland and two riverine/riparian areas associated with the quarry were identified, described and assessed in terms of the level of significance of impacts/risks to aquatic resources. This was informed by on-site findings and experience in undertaking similar assessments. The following key ecological impacts/risks were identified for the site:

- **Contaminated storm water runoff from the quarry site and discharge into adjacent rivers;**
- **Contaminated surface water runoff from the concrete batching plant entering rivers (R-01 and R-02);**
- **Risk of flooding (rivers);**
- **Risk of pollution by chemicals & hazardous substances;**
- **Disturbance leading to increased levels of alien plants within riparian areas and wetlands;**
- **Infilling and loss of wetland habitat at W-01 and reduced ecosystem functioning; and**
- **Risk of sedimentation/pollution of wetland resources (W-01).**

An impact significance assessment was undertaken for two scenarios: (i) in the absence of any mitigation (i.e. the current situation at the quarry) and (ii) with mitigation or corrective/remedial actions applied. This indicated that ***should the remedial/corrective actions described and recommended in this report be implemented correctly, effectively and timeously, the risk of further impacts/degradation could be reduced considerably.*** Should remedial/corrective actions not be implemented or if these

are implemented ineffectively, residual impacts affecting the wetlands and riparian areas at the site are likely to remain at moderate to high significance levels. The residual impact to wetland W-01 as a result of infilling (access road construction) will still remain at a medium impact significance level.

Impact Mitigation and Recommended Remedial/Corrective Action:

At the heart of the need to protect aquatic resources such as wetlands and rivers, is the recognition that functioning aquatic ecosystems are a critical part of the environment as they support a high level of biological productivity and diversity, provide habitat for flora and fauna including rare and threatened communities and species, maintain local and regional hydrological regimes, remove nutrients and pollutants, act as stores for rain and flood waters, help combat climate change and support human activities and values. In order **to address impacts associated with the current operation as well as the proposed quarry expansion, practical on-site mitigation and corrective actions were recommended** to be included into the management programme for the quarry operation and are to include:

- Practical measures for dealing with contaminated storm water runoff from the quarry site;
- Recommendations to improve flood protection and erosion/sediment controls at the site;
- Wetland buffer zones for wetland W-01 to protect wetland and prevent further degradation/impact during quarry expansion; and
- Onsite rehabilitation of wetland and riparian habitat as compensation for wetland loss at W-01, with the objectives being to improve the condition, biodiversity and functioning of the remaining semi-intact aquatic habitats and to deal with alien plant infestations affecting the various wetlands and riparian areas.

An assessment of the residual impacts to the wetland W-01 as a result of recent infilling and the need and desirability of wetland offsets vs onsite wetland/riparian area rehabilitation was undertaken as part of this study. Based on this assessment, the habitat loss at wetland W-01 was ***not considered to be a particularly significant impact and one can motivate that this does not warrant the need for an offset*** (i.e. small size of impact, small functional losses anticipated, no loss of sensitive species). It was therefore recommended that as a means of compensating for the loss of wetland habitat at W-01, **on-site rehabilitation of the wetland and riparian areas should be prioritised with a focus on** improving the condition/biodiversity of remaining wetland/riparian habitat within the project area.

Development and implementation of an EMPr:

It is recommended that the mitigation recommendations and rehabilitation guidelines in this report be used in the development of an **Environmental management Programme (EMPr)** for the quarry operation which should be implemented as soon as possible. The report has also recommended that an **ecological monitoring programme** be developed with a focus on:

- Environmental water quality monitoring; and
- Habitat/Alien plant monitoring.

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DEFINITION OF TERMS

Buffer zone	The strip of vegetation maintained to limit impacts to natural ecosystems from adjoining land use activities.
Catchment	A catchment is an area where water is collected by the natural landscape. In a catchment, all rain and run-off water eventually flows to a river, wetland, lake or ocean, or into the groundwater system.
Conservation	The safeguarding of biodiversity and its processes (often referred to as Biodiversity Conservation).
Delineation	Refers to the technique of establishing the boundary of a resource such as a wetland or riparian area.
Drain	In the context of wetlands, refers to a natural or artificial feature such as a ditch or trench created for the purpose of removing surface and sub-surface water from an area (commonly used in agriculture).
Ecosystem	An ecosystem is essentially a working natural system, maintained by internal ecological processes, relationships and interactions between the biotic (plants & animals) and the non-living or abiotic environment (e.g. soil, atmosphere). Ecosystems can operate at different scales, from very small (e.g. a small wetland pan) to large landscapes (e.g. an entire water catchment area).
Ecosystem Goods and Services	The goods and benefits people obtain from natural ecosystems. Various different types of ecosystems provide a range of ecosystem goods and services. Aquatic ecosystems such as rivers and wetlands provide goods such as forage for livestock grazing or sedges for craft production and services such as pollutant trapping and flood attenuation. They also provide habitat for a range of aquatic biota.
Erosion (gulley)	Erosion is the process by which soil and rock are removed from the Earth's surface by natural processes such as wind or water flow, and then transported and deposited in other locations. While erosion is a natural process, human activities have dramatically increased the rate at which erosion is occurring globally. Erosion gullies are erosive channels formed by the action of concentrated surface runoff.
Ezemvelo KZN Wildlife	Ezemvelo KwaZulu-Natal Wildlife, the local conservation authority for the Province of KwaZulu-Natal.
Endemic	Refers to a plant, animal species or a specific vegetation type which is naturally restricted to a particular defined region (not to be confused with indigenous). A species of animal may, for example, be endemic to South Africa in which case it occurs naturally anywhere in the country, or endemic only to a specific geographical area within the country, which means it is restricted to this area and grows naturally nowhere else in the country.
Function/functioning /functional	Used here to describe natural systems working or operating in a healthy way, opposed to dysfunctional, which means working poorly or in an unhealthy way.
General Authorisation	Pertaining to Section 39 of the National Water Act (No. 26 of 1998), a General Authorisation is an authorization to use water without a license, provided that the water use is within the limits and conditions set out in the General Authorisation.
Habitat	The general features of an area inhabited by animal or plant which are essential to its survival (i.e. the natural "home" of a plant or animal species).
Hectare Equivalent	The primary currency for wetland offset negotiations. This is an expression of wetland functional area based on joint consideration of wetland area and condition.
Indigenous	Naturally occurring or "native" to a broad area, such as South Africa in this context.
Intact ecosystems/ environments	Used here to describe natural environment that is not badly damaged, and is still functioning in a largely natural manner.
Invasive alien species	Invasive alien species means any non-indigenous plant or animal species whose establishment and spread outside of its natural range threatens natural ecosystems, habitats or other species or has the potential to threaten ecosystems, habitats or other species.
Limnetic	>2m maximum depth of inundation at low water (i.e. deep water habitat)
Littoral	<2m maximum depth of inundation at low water (i.e. shallow water habitat)
Mitigate/Mitigation	Mitigating impacts refers to reactive practical actions that minimize or reduce in situ impacts. Examples of mitigation include "changes to the scale, design, location, siting, process, sequencing, phasing, and management and/or monitoring of the proposed activity, as well as restoration or rehabilitation of sites". Mitigation actions can take place anywhere, as long as their effect is to reduce the effect on the site where change in ecological character is likely, or the values of the site are affected by those changes (Ramsar Convention, 2012).
Pristine	Unspoiled, used here to describe the natural environment in its undisturbed state.
Residual Impacts	Impacts that remain after the proponent has made all reasonable and practicable changes to the location, siting, scale, layout, technology and design of the proposed development, in consultation with the environmental assessment practitioner and specialists (including a biodiversity specialist), in order to avoid, minimize, and/or

	repair/restore negative impacts on, amongst others, biodiversity (DEA&DP, 2007). That is, after consideration has been given to the first three measures in the mitigation hierarchy.
Riparian (area)	Includes the physical structure and associated vegetation within a zone or area adjacent to and affected by surface and subsurface hydrologic features such as rivers, streams, lakes or drainage ways and are commonly associated with alluvial soils.
Risk	A prediction of the likelihood and impact of an outcome; usually referring to the likelihood of a variation from the intended outcome.
Systematic conservation plan	An approach to conservation that prioritises actions by setting quantitative targets for biodiversity features such as broad habitat units or vegetation types. It is premised on conserving a representative sample of biodiversity pattern, including species and habitats (the principle of representation), as well as the ecological and evolutionary processes that maintain biodiversity over time (the principle of persistence).
Threatened ecosystem	In the context of this document, refers to Critically Endangered, Endangered and Vulnerable ecosystems.
Threat Status	Threat status (of a species or community type) is a simple but highly integrated indicator of vulnerability. It contains information about past loss (of numbers and / or habitat), the number and intensity of threats, and current prospects as indicated by recent population growth or decline. Any one of these metrics could be used to measure vulnerability. One much used example of a threat status classification system is the IUCN Red List of Threatened Species (BBOP, 2009).
Transformation (habitat loss)	Refers to the destruction and clearing an area of its indigenous vegetation, resulting in loss of natural habitat. In many instances, this can and has led to the partial or complete breakdown of natural ecological processes.
Water course	Means a river or spring; a natural channel in which water flows regularly or intermittently: a wetland, lake or dam into which, or from which, water flows: und any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks (National Water Act, 1998).
Wetland	Refers to land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil (National Water Act, 1998).
Wetland Type	This is a combination between wetland vegetation group and Level 4 of the National Wetland Classification System, which describes the Landform of the wetland.
Wetland Vegetation Group	Broad wetland vegetation groupings reflect differences in regional context such as geology, soils and climate, which in turn affect the ecological characteristics and functionality of wetlands.

ABBREVIATIONS USED

CARA	Conservation of Agricultural Resources Act No. 43 of 1983
CBA	Critical Biodiversity Area
CR	Critically Endangered (threat status)
DEARD	Department of Environment, Agriculture and Rural Development
DEAT	Department of Environmental Affairs & Tourism (now DEA)
DWS	Department of Water and Sanitation (formerly DWA)
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment: EIA regulations promulgated under section 24(5) of NEMA and published in Government Notice R.543 in Government Gazette 33306 of 18 June 2010
EIS	Ecological Importance and Sensitivity
EKZNW	Ezemvelo KwaZulu-Natal Wildlife: as defined in Act 9 of 1997 to be the KZN Nature Conservation Service
EMF	Environmental Management Framework
EMP	Environmental Management Plan
EN	Endangered (threat status)
FEPA	Freshwater Ecosystem Priority Area
FSCP	Freshwater Systematic Conservation Plan
FW	Facultative wetland species - usually grow in wetlands (67-99% occurrence) but occasionally found in non-wetland areas
GIS	Geographical Information Systems
GPS	Global Positioning System
HGM	Hydro-Geomorphic (unit)
IAPs	Invasive Alien Plants
IEM	Integrated Environmental Management

KZN	Province of KwaZulu-Natal
LT	Least Threatened (threat status)
MPRDA	Minerals and Petroleum Resources Development Act No. 28 of 2002
NT	Near Threatened (threat status)
NEMA	National Environmental Management Act No.107 of 1998
NEMBA	National Environmental Management: Biodiversity Act No.10 of 2004
NFEPA	National Freshwater Ecosystem Priority Areas, identified to meet national freshwater conservation targets (CSIR, 2011)
NWA	National Water Act No.36 of 1998
Ow	Obligate wetland species - almost always growing in wetlands (>90% occurrence)
PES	Present Ecological State, referring to the current state or condition of an environmental resource in terms of its characteristics and reflecting change from its reference condition.
SANBI	South African National Biodiversity Institute
SEA	Strategic Environmental Assessment
VU	Vulnerable (threat status)
WULA	Water Use License Application

1. INTRODUCTION

1.1 Background to the assessment, study area and quarry activity

The Margate quarry open cast mine operated by South Coast Stone Crushers (SCSC) is located near Uvongo, KwaZulu-Natal (Figure 1) and has been operational for the past forty-five (45) years, extracting Dwyka tillite rock to be supplied to the construction industry. The quarry has been operating with an approved Environmental Management Programme (EMPr) in place under the MPRDA (Minerals and Petroleum Resources Development Act No. 28 of 2002). The quarry seeks to expand operations onto adjacent land and is required to amend the existing EMPr to better align this with the National Environmental Management Act No. 107 of 1998 (NEMA). In addition, the planned activities on currently undeveloped portions of land that were not previously assessed will need to be assessed and management measures provided in line with the current Environmental Impact Assessment (EIA) Regulations that were promulgated in December 2014. SCSC is also currently applying for a Water Use Licence (WUL) for the facility and its supporting infrastructure.

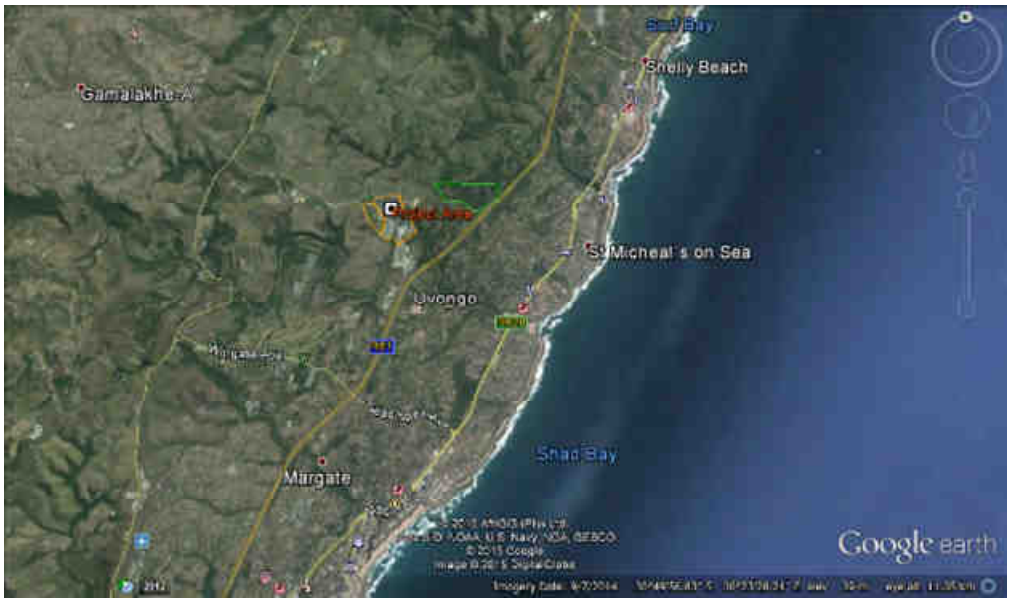

Figure 1 Google Earth™ map showing the location of the project area ("Orange" polygon) near Uvongo, southern KwaZulu-Natal.

As part of the planned expansion, the quarry has already constructed an access road and turning circle by pushing rock and filling a section of wetland adjacent to the site. This was identified as a contravention of the National Water Act as impacts to wetlands are involved. SCSC has acknowledged that the impact of the fill material must be assessed as part of the EMPr amendment and WULA. SRK Consulting has been appointed by the quarry (South Coast Stone Crushers) to assist in completing and submitting an application for an amendment to SCSC's existing EMPr and WSP Environmental has been appointed by SCSC to apply for a Water Use License (WUL) from the Department of Water and Sanitation (DWS). Eco-Pulse Environmental Consulting Services was subsequently appointed to assist with undertaking a specialist assessment of aquatic ecosystems

(including wetlands and rivers affected by the quarry operations) in order to inform the amendment and WUL processes.

1.2 Scope of work

The specialist aquatic assessment involved in-field surveys to determine the extent (outer boundary), PES (Present Ecological State), EIS (Ecological Importance and Sensitivity) and functional (ecosystem service) importance of the wetland and river ecosystems impacted by the quarry operation. The assessment has been aligned in such a way as to provide the basic information required for a Water Use License Application (WULA) through DWS as well as to inform the EMPr amendment (DMR) for the project. The following scope of works applied to this assessment:

- Contextualization of the study area in terms of important biophysical characteristics and conservation planning e.g. NFEPA, KZN Freshwater Conservation Plan, etc.;
- Desktop mapping of all watercourses within 500m of the quarry activity;
- Risk assessment for the mapped watercourses that stand to be affected by the proposed activity (only those watercourses to be affected are assessed in detail);
- Detailed infield delineation of wetland/riparian habitat that stands to be affected/impacted by the proposed development according to the methods contained in the manual '*A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas*' (DWAF, 2005);
- Classification of the delineated wetland areas using the latest National Wetland Classification System for Wetlands and other Aquatic Ecosystems in South Africa (SANBI, 2013);
- Description of the biophysical characteristics of the delineated wetland/riparian habitats based on onsite observations and sampling – basic hydrology, soils, plants etc.;
- Assessment of the pre- and post-development ecological state of the delineated wetland units using the Level 1 WET-Health tool (Macfarlane *et al.,* 2008);
- Assessment of the functional importance of the delineated wetland units using the Level 2 WET-EcoServices tool (Kotze *et al.,* 2009);
- Assessment of the Ecological Importance and Sensitivity (EIS) of the delineated wetland units using the Wetland EIS tool (Eco-Pulse, 2015);
- Identification, description and assessment of the potential impacts to wetland/riparian systems;
- Provision of recommendations for mitigating impacts identified, including the determination of appropriate aquatic buffer zones; and
- Compilation of a single specialist aquatic ecological assessment report.

1.3 The Importance of wetlands and their conservation

The word "wetland" is a family name given to a variety of ecosystems, ranging from rivers, springs, seeps and mires in the upper catchment, to midlands marshes, pans and floodplains, to coastal lakes,

mangrove swamps and estuaries at the bottom of the catchment. At the heart of the need to protect wetlands, is the recognition that functioning wetlands are a critical part of the environment as they support a high level of biological productivity and diversity, provide habitat for flora and fauna including rare and threatened communities and species, maintain local and regional hydrological regimes, remove nutrients and pollutants, act as stores for rain and flood waters, help combat climate change and support human activities and values.

Despite their importance, wetlands are one of the most globally endangered habitat types due to the fragile and vulnerable nature of these ecosystems. In South Africa, wetlands account for less than 3% of the country's surface area and are considered to be the most threatened of all ecosystems, with almost 50% of wetland ecosystem types regarded as critically endangered (Driver *et al.,* 2012). The degradation of South African wetlands is a concern now recognized by Government as requiring urgent action and the protection of wetlands is considered fundamental to the sustainable management of South Africa's water resources in the context of the reconstruction and development of the country.

1.4 Relevant Environmental Legislation

1.4.1 *Relevant legislation pertaining to wetlands*

In response to the importance of wetland systems, protection of wetlands has been campaigned at national and international levels. This has led to the development of various policies and promulgation of a range of legislation to help protect wetland systems.

At an International level, wetland protection is emphasized through the following conventions and agreements:

The RAMSAR Convention	Emphasis is placed on protecting wetlands and implementing initiatives to maintain or improve the state of wetland resources.
Convention on Biological Diversity	Countries are to rehabilitate or restore degraded ecosystem through the formulation of appropriate strategies and plans;
United Nations Convention to Combat Desertification	South Africa has responded to the UN Convention to Combat Desertification by developing a National Action Plan. The aim of the NAP is to implement at current and future policies that affect natural resource management and rural development, and establish partnerships between government departments, overseas development agencies, the private sector and NGOs
New Partnership for Africa's Development (NEPAD)	Wetland conservation and sustainable use is one of the eight themes under the environment initiative.
The World Summit on Sustainable Development (WSSD)	The Implementation Plan highlights actions that reduce the risk of flooding in drought-vulnerable countries by promoting the restoration and protection of wetlands and watersheds.

At a National level, there are a plethora of policies and legislation dealing either directly or indirectly with wetland protection and management. These include:

South African Constitution 108 of 1996	This includes the right to have the environment protected through legislative or other means.
National Environmental Management Act 107 of 1998	This is a fundamentally important piece of legislation and effectively promotes sustainable development and entrenches principles such as the 'precautionary approach', 'polluter pays', and requires responsibility for impacts to be taken throughout the life cycle of a project.

Environmental Impact Assessment (EIA) regulations	New regulations have been promulgated in terms of Chapter 5 of NEMA and were published on 4 December 2014 in Government Notice No. R. 32828. In addition, listing notices (GN 983-985) lists activities which are subject to an environmental assessment.
The National Water Act 36 of 1998	This Act imposes 'duty of care' on all landowners, to ensure that water resources are not polluted. The following Clause in terms of the National Water Act is applicable in this case: **19 (1**) "*An owner of land, a person in control of land or a person who occupies or uses the land on which (a) any activity or process is or was performed or undertaken; which causes, has caused or likely to cause pollution of a water resource, must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring*" Chapter 4 of the National Water Act is of particular relevance to wetlands and addresses the use of water and stipulates the various types of licensed and unlicensed entitlements to the use water. Water use is defined very broadly in the Act and effectively requires that any activities with a potential impact on wetlands (within a distance of 500m upstream or downstream of a wetland) be authorized.
General Authorisations (GAs)	These have been promulgated under the National Water Act and were published under GNR 398 of 26 March 2004. Any uses of water which do not meet the requirements of Schedule 1 or the GAs, require a license which should be obtained from the Department of Water Affairs and Forestry.
National Environmental Management: Biodiversity Act No 10 of 2004	The intention of this Act is to protect species and ecosystems and promote the sustainable use of indigenous biological resources. It addresses aspects such as protection of threatened ecosystems and imposes a duty of care relating to listed alien invasive species.
Conservation of Agricultural Resources Act 43 of 1967	The intention of this Act is to control the over-utilization of South Africa's natural agricultural resources, and to promote the conservation of soil and water resources and natural vegetation. This includes wetland systems and requires authorizations to be obtained for a range of impacts associated with cultivation of wetland areas.

At the Provincial level, there is little legislation. The following guidelines and ordinances are however relevant:

Guidelines for development activities that may affect wetlands released by the KwaZulu-Natal Department of Agriculture and Environmental Affairs (2002)	This includes a draft set of norms and standards for the avoidance and mitigation of impacts to wetlands in urban areas.
Natal Nature Conservation Ordinance 15 of 1974 & KwaZulu Nature Conservation Act 29 of 1992	Makes extensive provision for protected areas (including private nature reserves) and protection of flora and fauna (including marine and freshwater fish).

Other pieces of legislation that are also of some relevance to wetlands include:

- The National Forest Act 84 of 1998;
- The National Environmental Management: Protected Areas Act 57 of 2003;
- The Mountain Catchments Areas Act 62 of 1970

Any developments with a potential impact to wetland systems therefore typically need to be assessed to ensure that impacts are adequately minimized. Authorizations may also be required before planned activities can commence.

1.4.2 *Relevant legislation pertaining to rivers*

Rivers and their associated riparian zones are vital for supplying freshwater (SA's most scare natural resource) and are important in providing additional biophysical, social, cultural, economic and

aesthetic services. In response to the importance of freshwater resources, rivers and their catchment areas are protected by several pieces of legislation. Locally the South African Constitution, seven (7) Acts and one (1) international treaty allow for the protection of rivers and water courses. These systems are protected from destruction or pollution by the following:

- Section 24 of The Constitution of the Republic of South Africa;
- Agenda 21 – Action plan for sustainable development of the Department of Environmental Affairs and Tourism (DEAT) 1998;
- National Environmental Management Act No. 107 of 1998 (NEMA) inclusive of all amendments, as well as the NEM: Biodiversity Act No. 10 of 2004;
- National Water Act, 1998 (Act No. 36 of 1998);
- Conservation of Agricultural Resources Act No. 43 of 1983;
- Minerals and Petroleum Resources Development Act No. 28 of 2002;
- Nature and Environmental Conservation Ordinance No. 19 of 1974;
- National Forest Act No. 84 of 1998; and
- National Heritage Resources Act No. 25 of 1999.

1.4.3 *National Environmental Management Act (NEMA)*

NEMA is South Africa's overarching environmental legislation and has, as its primary objective to provide for co-operative governance by establishing principles for decision making on matters affecting the environment, institutions that will promote co-operative governance and procedures for co-ordinating environmental functions exercised by organs of state and to provide for matters connected therewith (Government Gazette, 1998). The Act provides for the right to an environment that is not harmful to the health and well-being of South African citizens; the equitable distribution of natural resources, sustainable development, environmental protection and the formulation of environmental management frameworks. In addition there is recognition that development must be socially, environmentally and economically sustainable and that the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied (Government Gazette, 1998).

Specific principles of NEMA that are of particular relevance to the management and protection of biodiversity are indicated below in Table 1. Any developments with a potential impact to biodiversity and natural ecosystems therefore typically need to be assessed to ensure that impacts are adequately minimized. Authorizations may also be required before planned activities can commence.

Table 1. Summary of NEMA principles applicable to the management of wetlands and biodiversity.

Section	Principle
2(4) (a) (i)	The disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied.
2(4) (a) (ii)	Pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimised and remedied.
2(4) (a) (vi)	The development, use and exploitation of renewable resources and the ecosystems of which they are part do not exceed the level beyond which their integrity is jeopardised.
2(4) (a) (vii)	A risk-averse and cautious approach is applied, which takes into account the limits of current

Section	Principle
	knowledge about the consequences of decisions and actions.
2(4) (e)	Responsibility for the environmental health and safety consequences of a policy, programme, project, product, process, service or activity exists throughout its life cycle.
2(4) (o)	The environment is held in public trust for the people, the beneficial use of environmental resources must serve the public interest and the environment must be protected as the people's common heritage.
2(4) (p)	The costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects must be paid for by those responsible for harming the environment.
2(4) (r)	Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal habitats including dunes, beaches and estuaries, reefs, wetlands, and similar ecosystems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.

1.4.4 *NEMA: EIA guidelines and EMPr requirements*

NEMA also governs the Environmental Impact Assessment (EIA) process. In terms of the latest NEMA: EIA (Environmental Impact Assessment) regulations (4 December 2014), a number of activities are listed in Listing Notice 1of the 2014 EIA regulations, identified in terms of sections 24(2) and 24D of the National Environmental Management Act. Activities listed in Appendix 1 are identified in terms of section 24(2) (a) of NEMA as activities that may not commence without an environmental authorisation from the competent authority. With regards to activities occurring near wetlands/rivers, this includes under subsection 12:

"The development of -

(i) canals exceeding 100 square metres in size;

(ii) channels exceeding 100 square metres in size;

(iii) bridges exceeding 100 square metres in size;

(iv) dams, where the dam, including infrastructure and water surface area, exceeds 100 square metres in size;

(v) weirs where the weir, including infrastructure and water surface area, exceeds 100 square metres in size;

(vi) bulk storm water outlet structures exceeding 100 square metres in size;

(vii) marinas exceeding 100 square metres in size;

(viii) jetties exceeding 100 square metres in size;

(ix) slipways exceeding 100 square metres in size;

(x) buildings exceeding 100 square metres in size;

(xi) boardwalks exceeding 100 square metres in size; or

(xii) infrastructure or structures with a physical footprint of 100 square metres or more

where such construction occurs –

(a) within a watercourse;

(b) in front of a development setback; or

(c) if no development setback exists, <u>within 32 metres of a watercourse</u>, measured from the edge of a watercourse'

excluding-

(aa) the development of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour;

(bb) where such development activities are related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies;

(cc) activities listed in activity 14 in Listing Notice 2 of 2014 or activity 14 in Listing Notice 3 of 2014, in which case that activity applies;

(dd) where such development occurs within an urban area; or

(ee) where such development occurs within existing roads or road reserves.

Here the term "watercourse" is defined in terms of the NWA (National Water Act, 1998) and refers to "*a river or spring; a natural channel in which water flows regularly or intermittently: a wetland, lake or dam into which, or from which, water flows, and any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks*".

1.4.5 *Water-Use Licensing in South Africa*

Certain development-related activities require the application for a water use license where activities trigger Section 21 of the National Water Act (No. 36 of 1998). According to the Act, water use must be licensed unless its use is excluded. In terms of regulation 3(b)(i) of the Water Use Registration Regulations published under Government Notice R1352 in Government Gazette 20606 of 12 November1999, a person who uses water as contemplated in section 21 of the National Water Act, 1998 (Act No. 36 of 1998) must, when called upon by the responsible authority to do so, register the water use. Registration is the process of officially notifying the Department of a water use. There are several reasons why water users are required to register their water use with the Department of Water & Sanitation (DWS), the most important being:

- to manage and control water resources for planning and development;
- to protect water resources against over-use, damage and impacts; and
- to ensure fair allocation of water among users.

Currently Section 21 (c) and (i) General Authorizations (GAs) do not apply to the use of water within a 500m radius from the boundary of any wetland. Should construction/development within these boundaries be considered, licensing and not registration will have to take place. Any new water-user who fails to comply with the terms and conditions of the General Authorisations for listed activities in terms of section 21 of the NWA, must approach the DWA for a water-use license. The following Section 21 water use activities are generally likely to be triggered by certain development activities in the vicinity of water resources and would require a water use license from the DWA:

a) taking water from a water resource;

b) storing water;

c) impeding or diverting the flow of water in a watercourse;

d) engaging in a stream flow reduction activity contemplated in section 36;

e) engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1);

f) discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;

g) disposing of waste in a manner which may detrimentally impact on a water resource;

h) disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process;

i) altering the bed, banks, course or characteristics of a watercourse;

j) removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and

k) using water for recreational purposes.

1.4.6 *NEMBA Invasive Species Regulations*

The NEM: Biodiversity Act provides for the management and conservation of South Africa's biodiversity within the framework of the National Environmental Management Act (NEMA). The intention of this Act is to protect species and ecosystems and promote the sustainable use of indigenous biological resources. It addresses aspects such as protection of threatened ecosystems and imposes a duty of care relating to listed alien invasive species. The South African National Biodiversity Institute (SANBI) is established by this Act and is responsible for coordinating and implementing programs.

The legislative requirements in terms of Invasive Alien Plants (IAPs) are informed by the National Environmental Management: Biodiversity Act No. 10 of 2004 (NEMBA). IAPs are categorized according to the NEMBA *Alien and Invasive Species List 1: National list of Invasive Terrestrial and Fresh-water Plant Species*, contained within Government Notice 599 (Government Gazette No. 37886, 1 August 2014) in terms of sections 66(1), 67(1), 70(1)(a), 71(3) and 71A of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004). NEMBA classifies three categories of invasive alien plants according to Government Notice R. 598 National Environmental Management: Biodiversity Act (No. 10 of 2004): Alien and Invasive Species Regulations, 2014, as contained within Government Gazette No. 37885 (Vol. 590), 1 August 2014. These categories and relevant management requirements are summarized in Table 2, below.

Table 2. Summary of NEM:BA invasive alien plant categories and management requirements.

NEMBA Category	NEMBA Management Requirements
1a	Category 1a invasive species are those species listed as such by notice in terms of section 70(1)(a) of the NEM:BA as species which must be combated or eradicated immediately. By law, any specimens of these plants require compulsory eradication from the environment (to be removed and destroyed so they can no longer persist in the environment). No permits will be issued for Category 1a species. If an Invasive Species Management Programme has been developed in terms of section 75(4) of the NEM:BA, a person must combat or eradicate the listed invasive species in accordance with such programme.
1b	Category 1b invasive species are those species listed as such by notice in terms of section 70(1)(a) of the NEM:BA as species which must be controlled. By law, any specimens of these plants require compulsory control as part of an invasive species control programme.
2	Category 2 invasive species are regulated by area. These species require a permit to carry out a restricted activity specified in the permit (e.g. import, possess, grow, breed, move, sell, buy or accept as a gift) or an area specified in the permit. No permits will be issued for Category 2 plants to exist in riparian zones. Unless otherwise indicated in the Notice, no person may carry out a restricted activity in respect of a Category 2 Listed Invasive Species without a permit. A landowner on whose land a Category 2 Listed

	Invasive Species occurs or person in possession of a permit, must ensure that the specimens of the species do not spread outside of the land or the area specified in the permit or over which they have control. Any species listed as a Category 2 species that occurs outside the specified/permitted area is to be considered a Category 1 b Listed Invasive Species and must be managed accordingly.
3	Category 3 invasive species are regulated by activity and are as species which are subject to exemptions in terms of section 71(3) and prohibitions in terms of section 71A of NEM:BA. No permits will be issued for Category 3 plants to exist in riparian zones and any plant species identified as a Category 3 Listed Invasive Species that occurs in riparian areas will be considered to be a Category 1b Listed Invasive Species and must be controlled in accordance with an invasive plant control programme.

Landowner obligations and IAP control/eradication in terms of NEM:BA:

In terms of **section 73** of NEMBA, a person who is the owner of land on which a listed invasive species occurs must:

- notify any relevant competent authority, in writing, of the listed invasive species occurring on that land;
- take steps to control and eradicate the listed invasive specimens to prevent it from spreading; and
- take all the required steps to prevent or minimise harm to biodiversity.

In terms of **section 75** of NEMBA, the following applies to the control & eradication of invasive species:

- The control and eradication of a listed invasive species must be carried out by means of methods that are appropriate for the species concerned and the environment in which it occurs;
- Any action taken to control and eradicate a listed invasive species must be executed with caution and in a manner that may cause the least possible harm to biodiversity and damage to the environment; and
- The methods employed to control and eradicate a listed invasive species must also be directed at the offspring, propagating material and re-growth of such invasive species in order to prevent such species from producing offspring, forming seed, regenerating or re-establishing itself in any manner.

Requirements for Invasive Species Monitoring, Control & Eradication Plans are included under **section 76** of NEMBA and need to include the following:

- a detailed list and description of any listed invasive species occurring on the relevant land;
- a description of the parts of that land that are infested with such listed invasive species;
- an assessment of the extent of such infestation;
- a status report on the efficacy of previous control and eradication measures;
- the current measures to monitor, control and eradicate such invasive species; and
- measurable indicators of progress and success, and indications of when the control plan is to be completed.

2. APPROACH AND METHODOLOGY FOLLOWED

2.1 Approach

The approach to the assessment involved three phases:

1. **Collation of baseline information on the affected environment:** Aquatic habitats (wetlands and riparian areas associated with rivers/streams) were identified and mapped at a desktop level using available digital imagery and available datasets (see Table 3, below) in a Geographical Information System (GIS). These were then verified in the field in order to determine:
    a. The extent of wetland/riparian habitat (wetland delineation);
    b. Condition (PES) of wetlands/riparian areas; and
    c. Ecological Importance & Sensitivity (EIS), including important ecological processes and ecosystem services provided by aquatic resources.
2. **The identification and assessment of potential impacts**: An assessment of potential ecological impacts was undertaken based on the development information (expansion project) with respect to the baseline status of aquatic habitat/ecosystems.
3. **Recommendations for mitigation**: Site-specific management and mitigation recommendations were compiled to assist with addressing the range of impacts identified and other ecological concerns related to actions, activities and processes associated with the proposed development, for both construction and operation phases of the project.

2.2 Data sources consulted

The following data sources and GIS spatial information provided in Table 3 below was consulted to inform the assessment. The data type, relevance to the project and source of the information has been provided.

Table 3. Information and data coverage's used to inform the assessment.

DATA/COVERAGE TYPE	RELEVANCE	SOURCE
Colour Aerial Photography (2009)	*Mapping of wetlands, rivers and other features*	National Geo-Spatial
Latest Google Earth™ imagery	*To supplement available aerial photography where needed*	Google Earth™
10m Elevation Contours	*To assist with desktop mapping of wetlands, delineation of catchments and calculation of slope/gradients*	Surveyor General
NFEPA wetlands/rivers coverage	*Shows location of FEPA river and wetland sites*	CSIR (2011)
Freshwater Systematic Conservation Plan (CPLAN) for KZN	*Used to identify and interrogate provincial level aquatic biodiversity concerns at a desktop level*	Ezemvelo KZN Wildlife (EKZNW, 2007)
KZN Vegetation Layer 2012	*Used to classify vegetation type and threat status*	EKZNW (2012)

2.3 Methods used

A brief summary of the methods used in the specialist aquatic assessment has been included below in Table 4. For additional details on the individual assessment methods applied in this study, refer to **Annexure A** at the back of this report.

Table 4. Summary of methods used in the assessment.

METHOD/TECHNIQUE		REFERENCE FOR METHODS/TOOLS USED	APPENDIX
Wetland/riparian area delineation		➢ *A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas' (DWAF, 2005)*	A1
Classification of water resources		➢ *National Wetland Classification System for Wetlands and other Aquatic Ecosystems in South Africa (SANBI, 2014)* ➢ *NFEPA wetland vegetation groups (CSIR, 2011)* ➢ *Classification system for channeled watercourses (Eco-Pulse, 2013)*	A2/A3
Assessment of conservation context of aquatic resources		➢ *National Freshwater Ecosystem Priority Areas or NFEPA Project (CSIR, 2011)* ➢ *Aquatic Systematic Conservation Plan (CPLAN) for the Province (EKZNW, 2007)*	-
Wetlands	**Wetland condition/Present Ecological State (PES)**	➢ *WET-Health: A technique for rapidly assessing wetland health (Macfarlane et al., 2008)*	A4
	Wetland Ecological Importance & Sensitivity (EIS)	➢ *WET-Ecoservices: A technique for rapidly assessing ecosystem services supplied by wetlands (Kotze et al., 2009)* ➢ *Wetland EIS tool (Eco-Pulse, 2015)*	A5 / A6
Rivers	**River condition/Present Ecological State (PES)**	➢ *Modified IHI (Index of Habitat Integrity) tool developed by DWAF (*Kleynhans, 1996)	A7
	River Ecological Importance & Sensitivity (EIS)	➢ Rapid DWAF EIS tool (Kleynhans, 1999).	A8
Assessment of Ecological Impacts		➢ *Impact assessment methodology for EIAs provided by SRK Consulting (2014)*	A9
Aquatic Buffer Zone Requirements		➢ *Development of a methodology to determine appropriate buffer zones for developments associated with wetlands, rivers and estuaries (Macfarlane et al., 2014)*	-

2.4 Assumptions and Limitations

The following assumptions and limitations apply to the studies undertaken for this report:

- This report deals exclusively with a defined area and the impacts upon aquatic ecosystems in that area.
- The wetland boundary must be identified and classified along a transitional gradient from saturated through to terrestrial soils which makes it difficult to identify the exact boundary of the wetland. The wetland boundaries mapped in this specialist report therefore represent the

approximate boundary of these wetlands as evaluated by an assessor familiar and well-practiced in the delineation technique.

- Wetland boundaries are based largely on the GPS locations of soil sampling points. GPS accuracy will therefore affect the accuracy rating of mapped sampling points and therefore wetland boundaries. A Garmin Oregon 550 GPS was used which has an estimated accuracy rating of 3-5 metres.
- It is important to note that delineation of wetland/riparian areas on this site was made difficult by the disturbed nature of sections of the site; where in places, sedimentary fill, soil mixing, hardened surfaces and altered/compacted soil surfaces made soil sampling and boundary determination difficult. The boundaries in these areas is therefore an approximate representation of the wetland habitat thought to naturally occur in these areas prior to infilling and transformation.
- Areas assessed only at a desktop level (beyond the site boundary and in areas that have been in-filled) have a relatively low level of accuracy.
- While disturbance and transformation of aquatic habitats can lead to shifts in the type and extent of aquatic ecosystems, it is important to note that the current extent and classification is reported on here.
- Water quality inferences were based on indicators of water quality such as colour, odour and the observation of waste and other contaminants entering aquatic ecosystems as well as experience in water quality sampling in similar informal development scenarios in KZN.
- The field assessment was undertaken in summer (February 2015) and thus does not cover the seasonal variation in conditions at the site. A more accurate assessment would require that assessments take place in all seasons of the year.
- No detailed assessment of aquatic fauna/biota was undertaken. Fauna documented in this report are based on site observations during site visits and are therefore not intended to reflect the overall faunal composition of the habitats assessed.
- With ecology being dynamic and complex, there is the likelihood that some aspects (some of which may be important) may have been overlooked.
- Sampling by its nature, means that generally not all aspects of ecosystems can be assessed and identified.
- The assessment of impacts and recommendation of mitigation measures was informed by the site-specific ecological concerns arising from the field surveys and based on the assessor's working knowledge and experience with similar development projects.
- Information used to inform the assessment was limited to data and GIS coverage's available for the Province at the time of the assessment.

3. AQUATIC ASSESSMENT

3.1 Background information

3.1.1 *Climate*

The study area (Margate) is located within the North Eastern Coastal Belt in KwaZulu-Natal, which ranges from sea level to an altitude of 700 m a.m.s.l. (above mean sea level) and is characterised by high rainfall, ranging from 700 to 1000mm per annum (Le Roux, 1993). The region experiences a warm, humid sub-tropical climate, with most rainfall being experienced during the summer months (November to March). Few dry months occur and very little, or no frost occurs in winter (Le Roux, 1993). Rainfall is seasonal and the highest rainfall is typically experienced over December. High temperatures experienced during the summer season in particular, cause the potential for evaporation to be high across South Africa in general, which plays a significant role in reducing the volume of rainfall available for use by the environment. Average daily temperatures range from 22°C in winter (July) to 26°C in summer (February). Source of information: http://www.saexplorer.co.za/south-africa/climate/margate_climate.asp

3.1.2 *Ecoregion*

When assessing the ecology of any area it is important to know within which ecoregion the study area is located. This knowledge allows for improved interpretation of data to be made, since reference information and representative species lists are often available at this level of assessment to guide the assessment. The study area falls within the North Eastern Coastal Belt (Ecoregion 17.01) which can be characterised by a diversity of terrain morphological types from plains with low relief to closed hills and mountains with a moderate to high relief Kleynhans *et al.,* 2005). Vegetation consists mainly of grassland, valley thicket and bushveld types with patches of coastal and afromontane forest. Drainage density is medium-high with stream frequency being generally high to very high.

3.1.3 *Vegetation*

The site falls within the Indian Ocean Coastal Belt bioregion (Mucina & Rutherford, 2006). 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 provide an indication of the ecological integrity of the assessment site. Ezemvelo's KZN Wildlife Provincial Vegetation Map (EKZNW, 2012) indicates that the development project areas falls within the **KZN Coastal Belt Grassland and the Pondoland-Ugu Sandstone Sourveld**, both of which are considered Critically Endangered (CR). Due to the level of transformation caused by agriculture and other land uses at the site, these vegetation types are no longer represented. Riverine and wetland areas are not shown at the mapping scale of the KZN vegetation map, although the vegetation type

typically associated with wetlands and riverine areas would be Freshwater wetlands (Vulnerable status, VU) or Alluvial wetlands (Endangered status, EN).

3.1.4 *Hydrology*

The project site falls within DWS Quaternary catchment T40G, drained by a number of small streams and tributary rivers which feed into the large Vungu River. Approximately 2kms downstream of the project area (Margate quarry) the Vungu River discharges in a closed estuary at the inlet to the South Indian Ocean.

3.1.5 *Topography*

The landscape is characterized by steeply sloping hillsides with relatively closed/confined valleys, with associated moderately sloping valley bottom areas that are characterised by riparian and wetland habitats. The local elevation ranges between 25m – 85m a.m.s.l.

3.1.6 *Geology, Geomorphology and Soils*

Partridge *et al.* (2010) recently undertook a physiographic subdivision of South Africa, Swaziland and Lesotho in order to define "geomorphic provinces" (regions of relatively uniform physiography) based on recent work on the geological and geomorphological evolution of southern African fluvial systems. The study area falls within the Southeastern Coastal Platform geomorphic province, which represents a narrow coastal platform that strikes northeast to southwest from the Zululand Coastal Plain in the northeast to just east of Algoa Bay (Partridge *et al.,* 2010). The province is fairly narrow, ranging in width from ~5 to 30km and its elevation ranges from ~110m a.m.s.l. to a little above the present shoreline, terminating sharply inland where it adjoins then adjacent Southeastern Coastal Hinterland geomorphic province. Thirteen main systems traverse this province, from the Thukela River in the northeast to the Bushmans River in the southwest. There are possibly two groups of rivers within this province, the first group extending from the Thukela to the Kei and which have narrower cross-sectional profiles than the second western group of rivers (Buffalo to Bushmans), which occupy broader valleys. The coastline of this province is slightly oblique to the strike of the country rocks as a result of differential tectonic uplift that has overridden the earlier structural grain of the underlying rocks. One of the impacts of this multi-cyclic, differential movement was to expose the adjoining continental shelf so that rivers extended their new courses straight across it to the new coastline, incising steep valleys and cutting deep gorges in the process. The general straightness of the coastline bears testimony to tectonic control where rivers crossing the hinterland in the past were unable to widen their valleys in line with rising sea-levels, with the effects of sea-level rise seen also in the many drowned estuaries and river mouths (e.g., Mzimvubu). Other noteworthy features of this province include:

- straight river courses in contrast to the tight meandering channel forms of the interior with the change in pattern occurring at a clearly defined scarp representing an ancient line of sea-cliffs;
- rivers have flat to medium valley gradients and generally narrow valley cross-sectional profile (a function of recent tectonic uplift and subsequent incision); and

- smaller tributaries of this province are generally swampy and river capture/stream rejuvenation is common.

The Southeastern Coastal Platform is underlain mainly by clastic sedimentary rocks belonging to the Cape Supergroup and Karoo Supergoup, which is essentially a platform sequence of sediments deposited in shallow marine to continental shelf environments and include sandstones, shales and quartzite's of Palaeozoic age (300 - 250Ma old). A summary of the different lithostratigraphic units (underlying geology) occurring within the general area of study has been included below in Table 5.

Table 5. Summary of the different lithostratigraphic units occurring within the area of study (after Johnson, 1989-2006).

Supergroup / Group		Period	Description and Location
Karoo Supergroup	Dwyka Group	Carboniferous to lower Permian (300-280 Ma)	These rocks overlying the Natal Group comprise a thick unit of Dwyka Tillite which are clastic rocks (diamictites & shales) that display features reflecting a glacial-related origin (deposited in a glacial environment by retreating ice sheets). Rocks imbedded in the slowly moving ice sheets scoured and polished the underlying older rocks giving rise to glacial pavements with distinct striations that indicate the orientation of ice flows. Tillite is mostly a very fine-grained, blue-grey rock comprised of clay matrix with inclusions (or clasts) of many other rock fragments. Tillite has a slight to moderate erosion rating.
Cape Supergroup	Natal Group	Ordovician (490Ma)	Greyish-red feldspathic sandstone with subordinate siltstone, quartz arenite and conglomerate. Unconformably overlies Precambrian basement complex and disconformably overlain by Dwyka group. Structures preserved in these rocks indicate that the sediments have fluvial origins (were transported and deposited by rivers). Outcrops form resistant sandstone cliffs.

3.1.7 *Land use and existing impacts*

Land use in the area and catchment is mainly in the form of commercial agriculture (sugar cane farming) as well as existing quarry operations and associated infrastructure. Associated with quarry operations is extensive excavations and open pit areas as well as a large source of fine sediment and debris that contaminates surface water run-off. Clearing of riparian vegetation associated with quarry operations and the extensive colonisation of disturbed areas by Invasive Alien Plants (IAPs) is another common impact.

3.2 Conservation context of aquatic ecosystems

Understanding the conservation context and importance of the site is important to inform decision making regarding the future use of the area. In this regard, available national, provincial and local/municipal level conservation planning information was used to obtain an overview of the conservation context and importance of the development site.

3.2.1 *National-level aquatic conservation priorities*

- ***National Threatened Ecosystems***

A national process has been undertaken to identify and list threatened ecosystems that are currently under threat of being transformed by other land uses. The first national list of threatened terrestrial ecosystems for South Africa was gazetted on 9 December 2011 (National Environmental Management: Biodiversity Act or NEMBA: National list of ecosystems that are threatened and in need of protection, G34809, GN 1002, 9 December 2011). The purpose of listing threatened ecosystems is primarily to reduce the rate of ecosystem and species extinction by preventing further degradation and loss of structure, function and composition of threatened ecosystems (SANBI, 2011). The NEMBA provides for listing of threatened or protected ecosystems, in one of four categories: critically endangered (CR), endangered (EN), vulnerable (VU) or protected. There are four main types of implications of listing ecosystems:

- Planning related implications which are linked to the requirement in the Biodiversity Act (Act 10 of 2004) for listed ecosystems to be taken into account in municipal IDPs and SDFs;
- Environmental authorisation implications in terms of NEMA and the EIA regulations;
- Proactive management implications in terms of the National Biodiversity Act; and
- Monitoring and reporting implications in terms of the Biodiversity Act.

According to the National Threatened Ecosystems coverage, remaining untransformed habitat and vegetation in the vicinity of the quarry operations is considered to be **Critically Endangered** in terms of conservation/threat status.

- ***National Freshwater Ecosystem Priority Areas (NFEPA)***

The broader catchment has not been prioritised nationally as a Freshwater Ecosystem Priority Area (CSIR, 2011). The Vungu River itself is recognised nationally as a Freshwater Ecosystem Priority Area (CSIR, 2011) and should be managed in such a way as to protect the current state and functioning. Wetlands identified within the project area are not considered important FEPA wetland sites (Figure 2, below). The NFEPA wetland vegetation group for wetlands occurring in the region includes the Indian Ocean Coastal Belt Group 2 (Critically Endangered, CR) and Indian Ocean Coastal Belt Group 3 (Endangered, EN) types. The ecosystem threat status of these vegetation groups suggests that wetlands occurring within this vegetation group have already been subjected to high levels of wetland transformation and degradation with little protection.

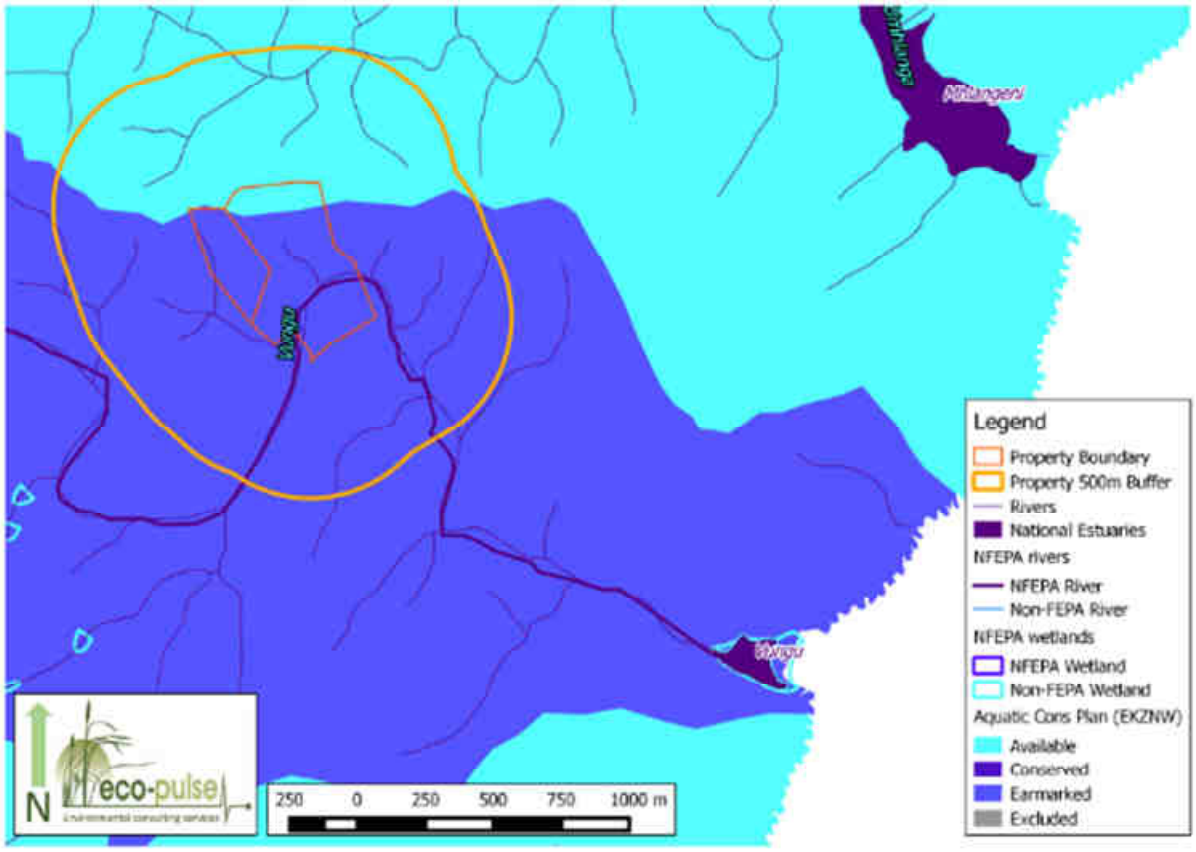

Figure 2 Map showing the site ("Red" polygon) in relation to the broader catchment area and the Vungu River and estuary that has been earmarked for conservation according to the Provincial Freshwater Conservation Plan for the Province (EKZNW, 2007).

- ***Strategic Water Source Areas (SWSAs)***

Strategic Water Source Areas or SWSA's are areas that supply a disproportionate amount of mean annual runoff to a geographical region of interest (Nel *et al.,* 2013). SWSA's are considered national assets vital for South Africa's water security as they have the potential to contribute significantly to overall water quality and supply, supporting growth and development needs and forming the foundational ecological infrastructure on which a great deal of built infrastructure for water services depends (Nel *et al.,* 2013). The importance of managing this small fraction of land that contributes so vitally to our water security should be acknowledged at the highest level across all sectors as the deterioration of water quality and quantity in these areas can have a disproportionately large negative effect on the functioning of downstream ecosystems and the overall sustainability of growth and development in the regions they support. This is particularly important in the South African context, where not only are the country's surface water resources extremely limited, but the country also has a growing water quality problem which represents a major challenge to water security in the near future. Water management in the country is inevitably faced with finding new and innovative ways of improving both water quality and quantity to meet the increasing water demands of the country and managing Strategic Water Source Areas is one such opportunity. Investing in SWSA's is also an important mechanism for long-term adaptation to the effects on climate change on water provision, growth and development. According to Nel *et al.* (2013), appropriate management of these areas should include:

- maintaining healthy functioning riparian zones and wetlands;
- ensuring good agricultural management leads to soil conservation that supports the water cycle;
- avoiding activities that reduce stream flow (e.g. irrigated agriculture and forestry plantations) and where this is not possible ensuring careful regulation of these activities;
- minimizing ground water abstraction;
- clearing invasive alien plants; and
- restoring the hydrological functioning of degraded landscapes.

SWSA's for South Africa have recently been mapped, and reviewed through an extensive stakeholder process. The spatial data outputs for the project area show that the site falls within a Category 2 Strategic Water Source Area (moderate MAR) which are collectively responsible for >30% of water supply.

3.2.2 *Provincial-level aquatic conservation priorities*

According to the Aquatic Conservation Plan the project area is "*Earmarked*" for conservation in terms of the Freshwater Systematic Conservation Plan (Ezemvelo KZN Wildlife, 2007) (see Figure 2).

3.3 Baseline ecological assessment findings

The findings of the specialist aquatic assessment are presented in this section of the report. This includes the following:

- Location, extent and classification of aquatic resources (*section 3.3.1*);
- Baseline ecological assessment of wetland W-01 (*section 3.3.2*);
- Baseline ecological assessment of riparian area R-01 (*section 3.3.3*); and
- Baseline ecological assessment of the Vungu River R-02 (*section 3.3.4)*.

3.3.1 *Location, extent and classification of aquatic resources*

The location and extent of aquatic resources (including wetlands and rivers/riparian areas) identified and mapped within a 500m radius of the quarry operations at Margate Quarry is shown below in Figure 3. Following onsite investigations it was found that many of the aquatic resources are currently impacted/affected by the **current operations** (Area A in Figure 3), with only the wetland in the western sections of the site affected by the **proposed quarry expansion** (Area B in Figure 3). Figure 3 below shows the extent of the aquatic resources and habitats that were assessed in detail as part of this specialist investigation based on their proximity to existing and future quarry activities (i.e. Areas A and B in Figure 3) and risk/vulnerability to quarry impacts. These aquatic resources that formed the focus of this assessment included:

(i) **Wetland W-01**: small seepage wetland to the west of the existing quarry operation and associated with quarry expansion in Area B (see Figure 3);
(ii) **Riparian area R-01**: lower reaches of wetland W-01 in the west immediately adjacent to the existing quarry operation and which forms a small river channel with associated riparian habitat; and
(iii) **The Vungu River (R-02**): large perennial river system and associated riparian zone that drains in a south-easterly direction and passes through the existing quarry operation (Area A in Figure 3).

The outer wetland/riparian boundary of wetlands and riparian areas is shown mapped in Figure 3 and was based on a combination of desktop and field investigations. Areas where the assessment focused on in detail (ie.W-01, R-01 and R-02) were delineated in the field using three principal indicators, including topography, vegetation composition and hydric status as well as the sampling and description of hydric soils (wetlands) and alluvial deposits (rivers) within the top 50cm of the soil profile. These areas are shown in detail in Figure 4. Further details of the wetland delineation study can be found in **Annexure B,** with more details on the method used in **Annexure A**.

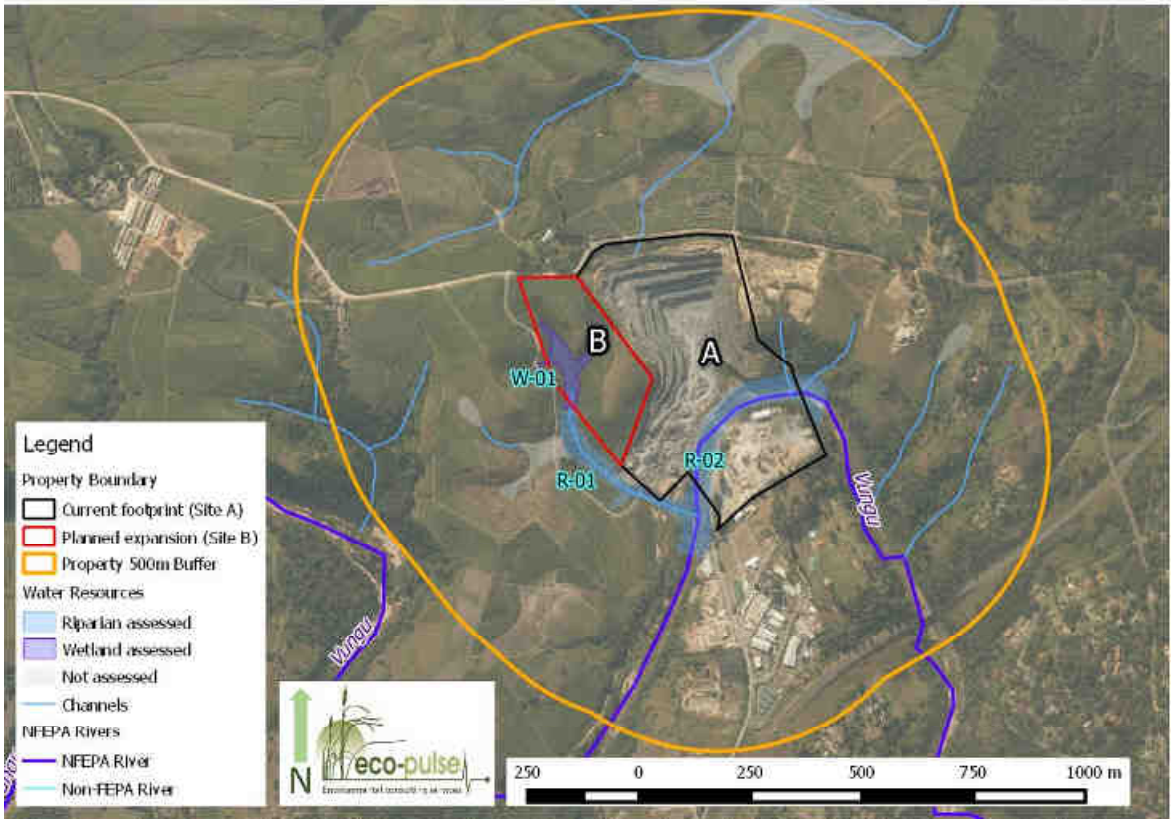

Figure 3 Map showing the location, extent and classification of aquatic resources including wetlands and riparian areas identified within a 500m radius of the quarry operation and used to prioritise areas for focused assessment.

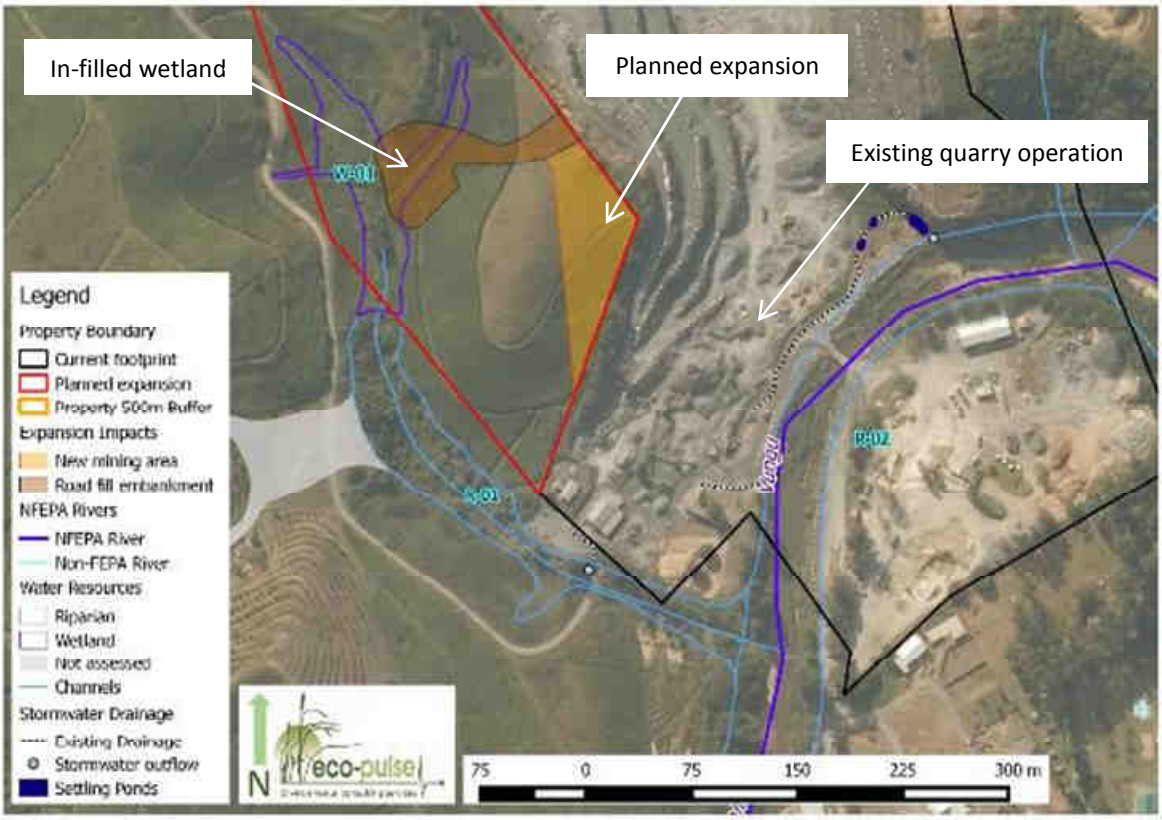

Figure 4 Map showing the extent of wetland and riparian areas (delineated outer boundary of resources) for focal assessment areas (W-01, R-01 and R-02).

3.3.2 *Baseline ecological assessment of Wetland W-01*

Wetland W-01 in Figure 4 is located in the small valley to the west of the current quarry operation and associated with planned expansion into Area B. The wetland can be classified as a **small hillslope seepage HGM (Hydro Geomorphic) unit type** (approximately 0.75ha in extent) linked to a stream channel (see Photo 1, below). The valley is relatively steep and the wetland is supported by a relatively small catchment with land use dominated by agriculture, including sugarcane cultivation and a Macadamia nut farm (see Photos 2 and 3, below). Water inputs are driven primarily by lateral surface and sub-surface flows from the valley sides. This wetland can be classified as a wet-grass meadow and has a low indigenous floristic diversity, being dominated by exotic grasses such as *Paspalum urvillei* and *Sorghum halepense* (Photo 5, below) with a number herbaceous alien shrubs and creepers including *Ageratum conyzoides, Canna indica, Conyza Canadensis, Centella asiatica* and *Cynodon nlemfuensis*. Sugar has been cultivated in the catchment and up to the edge of the wetland, and in the upper sections cane has been planted in the wetland system, with associated artificial drainage channels also present at the head of the wetland. Few indigenous species are present, mainly scattered amongst the exotics, and included hydric (wetland) species such as *Cyperus denudatus, Cyperus dives, Fimbristylis complanata, Digitaria eriantha, Kyllinga melanosperma, Leersia hexandra* and *Typha capensis* (see **Annexure C** for full vegetation species list including indigenous and exotic species). A small patch of indigenous trees was observed towards the base of the wetland, including *Syzigium cordatum* and *Trema orientalis* (see Photo 6). The western side of the system was found to be slightly elevated and soil sampling in this section of the wetland revealed large amounts of foreign fill material which is likely to have been deposited within the wetland and related to historic dirt road construction along the western perimeter of wetland W-01. The most prominent impact observed was the recent infilling of the eastern section of the wetland caused by the construction of an access road and truck turning circle (shown below in Photo 1, with the extent of the fill also shown mapped in Figure 4).

Photo 1. View over wetland W-01 taken from the dirt road on the western side and looking east towards the recent road infilling on the eastern side of the system. Existing quarry operations can be seen in the background. Exotic hydric (moisture-loving) grasses dominate the wetland, with sugarcane along the edges and in the catchment.

Photo 2. Macadamia nut farm in the wetland catchment.

Photo 3. Active sugarcane cultivation in the upper wetland catchment.

Photo 4. Shallow soils grading to shale bedrock on an exposed soil surface.

Photo 5. View taken within the seepage wetland looking south (downslope) and showing exotic hydric grasses.

Photo 6. View looking towards the lower sections of the seepage wetland below the toe of the road fill embankment and showing the patch of indigenous trees.

Photo 7. Example of a gleyed wetland soil sample taken from within a permanently wet area of the seepage wetland.

- ***Wetland PES (Present Ecological State): W-01***

The health/condition or Present Ecological State (PES) of wetlands within the study area was assessed using the **WET-Health** assessment tool (Macfarlane *et al.* 2008), which is based on an understanding of both catchment and on-site impacts and the impact that these aspects have on system **hydrology**, g**eomorphology** and the structure and composition of wetland **vegetation**. The PES of the wetland W-01 can be regarded as being **Largely to Seriously Modified** ("D/E" PES *Category) and associated with a*

large change in ecological processes as a result of a combination of catchment and on-site impacts. Table 6 (below) summarizes the findings of the WET-Health (PES) assessment for wetland W-01.

Table 6. Summary results of the WET-Health (PES) assessment undertaken for wetland W-01.

HYDROLOGY		
Score/10	**Class**	**Description**
7.0	**E: Seriously Modified**	From a hydrological perspective, the seepage wetland system is regarded as being **Seriously Modified.** Impacts driving the change from natural/reference hydrological state include the effect of sugarcane cultivation in the catchment (utilise large amounts of water) and the impact of dirt roads which function to intercept natural flows from the adjacent hillside but also to concentrate runoff and reduce infiltration, increasing the magnitude of floodpeaks to a small-moderate degree. Impacts within the wetland that influence the movement and distribution of water include the presence herbaceous alien vegetation, artificial drainage and extensive infilling with foreign material.
GEOMORPHOLOGY		
Score/10	**Class**	**Description**
3.2	**C: Moderately Modified**	Wetland geomorphological condition is regarded as being **Moderately Modified** and has resulted mainly from the impacts of extensive wetland infilling and artificial drainage associated with crop cultivation, which has modified both the natural geomorphological template as well as natural processes of sediment erosion, movement and deposition.
VEGETATION		
Score/10	**Class**	**Description**
7.4	**E: Seriously Modified**	Whilst vegetation structure is probably quite similar to the estimated natural reference state for this coastal wetland (short-medium wet grassland type), the wetland vegetation community has been **Seriously Modified** with respects to species composition and is now dominated by exotic species and sugarcane. Exotic grasses including *Paspalum urvillei* and *Sorghum halepense* are dominant although a number of other alien species were also observed. Sections of the wetland that have been infilled are now entirely void of vegetation. See **Annexure C** for vegetation species list including alien and indigenous species.
Overall PES		
6.0	**D/E: Largely to Seriously Modified**	***The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.***

For further details on the WET-Health tool and results, refer to ***Annexure A*** *(method) and* ***Annexure D*** *(results). Note that individual WET-Health assessment Microsoft Excel ™ spread sheets can be made available by Eco-Pulse Consulting upon request.*

➢ *Wetland EIS (Ecological Importance & Sensitivity): W-01*

Wetlands are known to provide a range of important ecosystem goods and services to society, and it is largely on this basis that policies aimed at protecting wetlands have been founded. This section of the report provides a summary of the current importance of the wetland W-01 assessed based on existing wetland attributes and the current demand for these services using a revised version (Eco-pulse, 2015) of the WET-Ecoservices tool (Kotze *et al.,* 2009).

Based on the assessment of wetland ecosystem goods and services, the wetland is considered moderately important, particularly in providing certain regulating and supporting services, including stream flow regulation, sediment trapping and erosion control (see summary in Table 7 and Figure 5,

below). In terms of provisioning and cultural services the wetland is not regarded as important in providing direct benefits to local communities and this is attributed to the following factors:

- The wetland is small and not a particularly useful reference example;
- The level of harvestable resources provided by the wetland is deemed to be low;
- Demand for direct benefits is relatively low at present;
- The wetland is currently not used for cultivation/grazing; and
- Access to the wetland is restricted (private farm property), discouraging public tourism, recreation, education and research.

Table 7. Summary results showing relative importance of wetland W-01 in providing ecosystem good and services using a modified (Eco-Pulse, 2015) version of the WET-Ecoservices tool (Kotze *et al.*, 2009).

Ecosystem Goods & Benefits		Supply (score out of 4)	Demand (score out of 4)	Importance (score out of 4)	
REGULATING AND SUPPORTING SERVICES	**Flood attenuation**	1.5 (low)	3.1 (high)	1.2	Moderate
	Stream flow regulation	1.8 (moderate)	1.3 (low)	0.6	Moderately Low
	Sediment trapping	1.8 (moderate)	3.0 (high)	1.3	Moderate
	Phosphate trapping	2.3 (moderate)	2.3 (moderate)	1.3	Moderate
	Nitrate removal	2.5 (moderate)	2.0 (moderate)	1.3	Moderate
	Toxicant removal	2.2 (moderate)	2.3 (moderate)	1.2	Moderate
	Erosion control	2.4 (moderate)	3.0 (high)	1.8	Moderately High
	Carbon storage	1.8 (moderate)	3.0 (high)	1.4	Moderate
	Biodiversity maintenance	0.7 (low)	1.0 (low)	0.2	Very Low
PROVISIONING SERVICES	**Water supply**	1.9 (moderate)	0.3 (very low)	0.1	Very Low
	Harvestable natural resources	0.8 (low)	1.3 (low)	0.2	Very Low
	Food for livestock	1.3 (low)	0.3 (very low)	0.1	Very Low
	Cultivated foods	2.2 (moderate)	1.0 (very low)	0.5	Moderately Low
CULTURAL SERVICES	**Cultural significance**	0.0 (very low)	0.0 (very low)	0.0	Very Low
	Tourism & recreation	0.2 (very low)	0.0 (very low)	0.0	Very Low
	Education and research	0.5 (very low)	0.0 (very low)	0.0	Very Low

Note that the original WET-Ecoservices assessment spread-sheets (Microsoft Excel ™) can be made available from Eco-Pulse Consulting upon request.

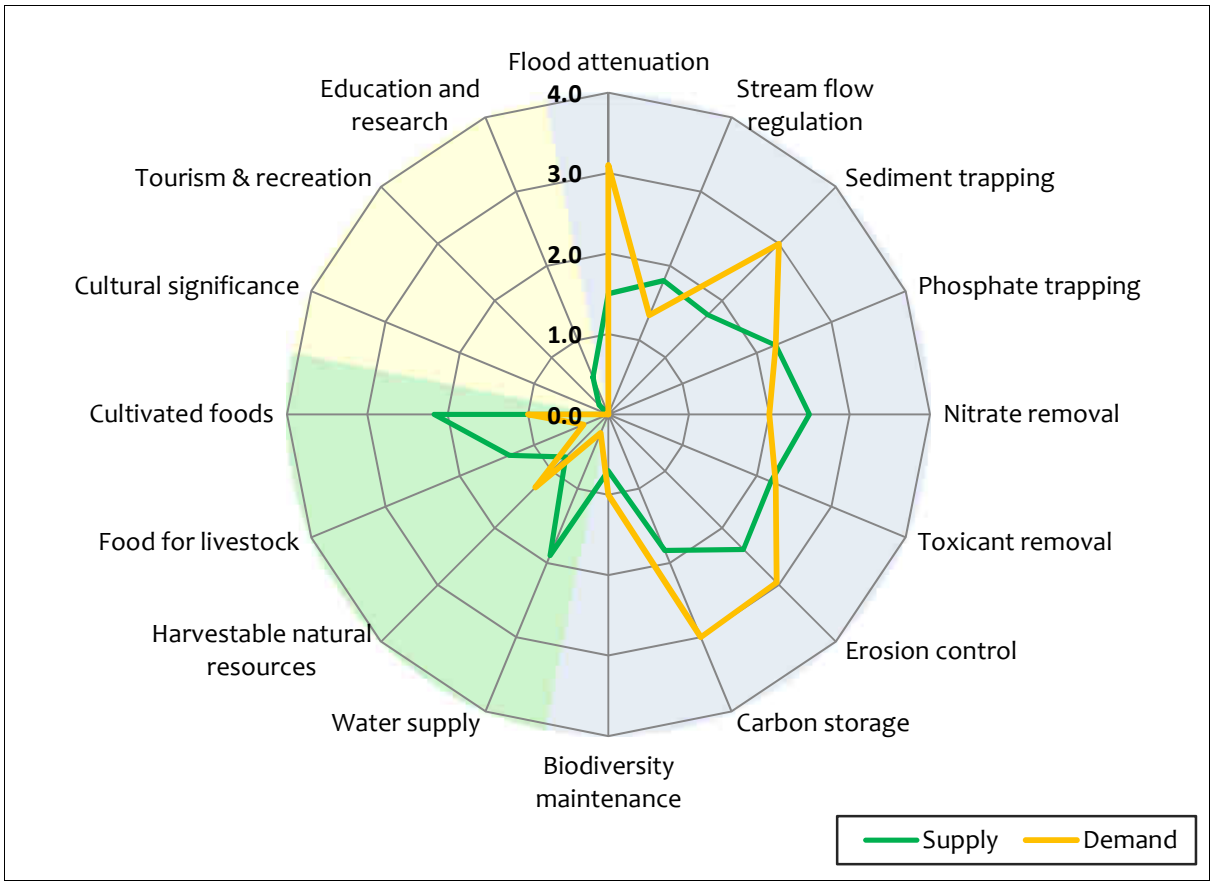

Figure 5 Spider diagram showing the level of supply and demand for ecosystem good and services provided by the wetland W-01.

Box 1. Hillslope seepage wetland and their associated ecosystem goods/services (after Kotze, 2009)

Hillslope seepage wetlands form on slopes, usually on hillsides or at the head of valleys, and are usually characterized by the colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow. These wetlands are expected to contribute to some surface flow attenuation early in the season until the soils are saturated, after which their contribution to flood attenuation is likely to be limited. It is recognized that evapotranspiration in the wetland may result in a considerable reduction in the total volume of water which would otherwise potentially reach the downstream system. The accumulation of organic matter and fine sediments in the wetland soils results in the wetland slowing down the sub-surface movement of water down the slope, increasing the storage capacity of the slope above the wetland, and prolongs the contribution of water to the stream system during low flow periods. For some hillslope seepage wetlands this contribution may continue into the dry season, but for many others it is confined mainly to the wet season. Seepage wetlands are commonly considered to supply a number of water quality enhancement benefits, for example, removing excess nutrients and inorganic pollutants produced by agriculture, industry and domestic waste. Hillslope seepages generally would be expected to have a relatively high removal potential for nitrogen in particular. Nitrogen and specifically nitrate removal could be expected as the groundwater emerges through low redox potential zones within the wetland soils, with the wetland plants contributing to the supply of organic carbon necessary to 'feed' the denitrification process. Particularly effective removal of nitrates has been recorded from diffuse sub-surface flow, as characterizes hillslope seepages. Owing to their generally steep slope, which increases the risk of erosion, hillslope seepages tend not to be very important from an "erosion control" point of view, provided that the vegetation remains intact.

The **Ecological Importance and Sensitivity (EIS**) of wetland/aquatic habitat is an expression of the importance of the wetland/aquatic resource for the maintenance of biological diversity and ecological functioning on local and wider scales; whilst Ecological Sensitivity (or fragility) refers to a system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (Kleynhans & Louw, 2007). Based on the PES assessment and importance of the wetland in terms of wetland goods and services, the Ecological Importance and Sensitivity (EIS) of wetland W-01 was rated using the Wetland EIS tool developed by Eco-Pulse (2015). Based on this assessment, the wetland system is considered to be of **Very Low Ecological Importance and Sensitivity or EIS** (see Table 8, below)**.** This is strongly linked to Biodiversity Importance/Support, Landscape Scale Importance, Functional Importance and Ecological Sensitivity being regarded as low. Modifying determinants such as small wetland size, poor condition and low connectivity/viability of the wetland reduce the EIS even further to a Very Low rating level. *For further details on the Wetland EIS tool and results, refer to* ***Annexure A*** *(method) and* ***Annexure E*** *(results).*

Table 8. Summary results of the wetland EIS assessment (Eco-Pulse, 2015).

Wetland Ecological Importance & Sensitivity (EIS)	Wetland Unit W01
1. BIODIVERSITY IMPORTANCE	**0.88 (low)**
1.1 Biodiversity Support	**0.18**
1.2 Landscape Scale Importance	**1.57**
2. FUNCTIONAL IMPORTANCE (HYDROLOGY)	**0.68 (low)**
3. ECOLOGICAL SENSITIVITY	**0.33 (very low)**
3.1 Sensitivity to changes in floods	1
3.2 Sensitivity to changes in low flows	1
3.3 Sensitivity to changes in water quality	2
4. MODIFYING DETERMINANTS	
4.1 Present Ecological State (PES)	1
4.2 Wetland Type	**Hillslope seep**
4.3 Viability of the site	**1.00 (low)**
4.2.1 Wetland size	1
4.3.2 Connectivity to adjacent ecosystems/habitat	1
4.3.3 Extent and condition of buffer surrounding site	1
ECOLOGICAL IMPORTANCE	**0.9 (low)**
ECOLOGICAL SENSITIVITY	**0.3 (very low)**
Overall Importance Score	**0.2**
Overall EIS Rating	**Very Low**

3.3.3 *Baseline ecological assessment of river and riparian area R-01*

The seepage wetland at the head of the small western valley (W-01) transitions into a channelled watercourse (small river/stream with associated riparian habitat) at R-01, a small tributary of the Vungu River system located to the south. Hydric grassland habitat ceases and is replaced by dense, wooded riparian habitat and tall reeds (see Photo 8, below). A number of locally common indigenous riparian forest species, including *Ficus natalensis, Ficus sur, Phoenix reclinata Strelitzia Nicolai, Syzigium*

cordatum, Bridelia micrantha, Trema orientalis and *Rauvolfia caffra* are represented within this zone (Photo 9, below). Of particular importance is the presence of the Specially Protected lily, ***Scadoxus puniceus*** (Snake lilly/Blood lilly) which was observed in the upper reaches of R-01, which is protected under the Natal Conservation Ordinance (see Photo 13). There are also dense infestations by a host of exotic plants which have effectively replaced indigenous riparian vegetation across much of R-01. Invasive alien species such as *Bambusa balcooa, Hedychium coronarium, Colocasia esculenta Coix lacryma-jobi, Pennisetum purpureum, Melia azedarach* and *Tithonia diversifolia* (to name but a few) are present at relatively high infestation levels (Photo 10). The channel at R-01 has also been subject to scouring and channel incision with bank erosion across the length of this stream. In the lower reaches near the quarry road access bridge, sediment laden stormwater run-off has resulted in high sediment loads entering the channel with a resultant increase in water turbidity (high sediment loads and suspended sediment in the water column). Algal blooms were also noted within the water column upstream of the road bridge crossing the stream R-01, likely attributed to increased nutrient levels (Photo 11, below).

Photo 8. View looking downslope from the toe end of the lower seepage wetland area at W-01 as it transitions into channelled, riparian habitat at R-01.

Photo 9. View of some large indigenous trees including *Trema orientalis*, *Ficus sur* and *Bridela micrantha* that characterise the riparian zone of R-01

Photo 10. View of dense invasive alien plant vegetation infestations in the mid-reaches of R-01, including species such as Napier grass and Bamboo.

Photo 11. View showing high water turbidity (fine suspended sediment in the water column) as well as algal blooms in the lower section of R-01 just upstream of the road bridge crossing on the western side of the quarry.

Photo 12. View taken along the fence line on the western perimeter of the quarry, where the fence abuts onto the riparian zone of R-01.

Photo 13. *Scadoxus puniceus* (Snake/blood lily), a Specially Protected Lily species under the Natal Conservation Ordinance, shown here occurring in the riparian forest understory at R-01.

➢ *River PES (Present Ecological State): R-01*

The Present Ecological State (PES) refers to the health or integrity of river systems, and includes both in-stream habitat as well as riparian habitat adjacent to the main channel. The rapid Index of Habitat Integrity (IHI) tool (Kleynhans, 1996) was used to determine river PES by comparing the current state of the in-stream and riparian habitats (with existing impacts) relative to the estimated reference state in the absence of anthropogenic impacts. A summary of the results of the IHI assessment for river R-01 is provided below in Table 9. This indicates that the river bed, banks and riparian vegetation has been largely modified, whilst flow and water quality is regarded as moderately impacted. Overall, anthropogenic impacts associated with catchment land use and on-site river degradation caused by erosion, pollution and alien infestations has resulted in this river system attaining a **"D" PES category**, or **Largely Modified state**.

Table 9. Summary results of the river IHI assessment used to inform the PES for river R-01.

Determinant	Present Ecological State Assessment: R-01		
	Score out of 5	Level of Modification	Description
Bed modification	3.5	Moderately High	The channel bed has undergone significant scouring and vertical incision thus causing lowering of the bed and a change in instream substrata/biotopes. Increased sediment delivery has also resulted in the sedimentation of the channel bed in the lower reaches of this river system.
Flow modification	2	Moderately Low	Flows have been modified as a result of catchment impacts to floodpeaks from transformed land cover (catchment under sugarcane). Dirt roads and surface water runoff from quarry operations are also likely to have increased flow concentration and runoff volumes/velocities.
Inundation	2.5	Moderate	The frequency and duration of inundation of the river channel is likely to have been modified as a result of altered floodpeaks caused by catchment land use (sugarcane farming) as well as modified channel morphology caused by scouring and bank erosion.
Bank condition	3.5	Moderately High	River channel banks were observed to be over-steepened to almost vertical in places for much of the river reach and often appeared unstable due to erosion and reduced vegetation cover.

Determinant	Present Ecological State Assessment: R-01		
	Score out of 5	Level of Modification	Description
Riparian condition	4	High	Impacts to the riparian were clearly the most prominent, with widespread infestation by invasive alien plants and weeds which has replaced most of the indigneous species, greatly altering the natural riparian vegetation structure and composition, with only a few remaining areas that appeared natural in the upper zone near wetland W-01.
Water quality modification	2.5	Moderate	Based on a rapid visual assessment of water quality (water turbidity/clarity and presence of algal blooms) the instream water quality appears fair to poor as a result of increased sedimentation (quarry activities and dirt roads) and increased nutrients which have manifested as algal blooms in the water column.
Overall Score	3 / 5 (60% modified)		
PES	D		
PES Class	Largely Modified		

Note that the individual river IHI assessment Microsoft Excel ™ spread sheets can be made available by Eco-Pulse Consulting upon request.

- ***River EIS (Ecological Importance & Sensitivity): R-01***

The Ecological Importance and Sensitivity (EIS) of riparian areas is an expression of the importance of the aquatic resource for the maintenance of biological diversity and ecological functioning on local and wider scales; whilst Ecological Sensitivity (or fragility) refers to a system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (Kleynhans & Louw, 2007). For the purposes of this assessment, the EIS assessment for riparian areas was based on rating the importance and sensitivity of riparian & in-stream biota (including fauna & flora) and habitat and was found to be **Low ("D" ecological category)** for river R-01. The results of the EIS assessment for riverine area R-01 is summarised in Table 10, below.

Table 10. Summary results of the river EIS assessment results for R-01.

Determinant		EIS Assessment: R-01	
		Rating	Description
RIPARIAN & INSTREAM BIOTA	Rare & endangered species	Very Low	Rare/endangered species are unlikely to occur within this degraded river system which is dominated by alien invasive species and modified habitats as a result.
	Unique species (endemic, isolated, etc.)	Low	Remaining indigenous riverine forest patches do not appear to represent a high degree of plant endemism or unique species. S single protected plant, *Scadoxus puniceus* (Snake/Blood lily) was recorded within one of the more natural riparian sections.
	Intolerant species sensitive to flow/water quality modifications	Low	Species intolerant to flow/water quality modification are unlikely to persist in this degraded system.
	Species/taxon richness	Low	There is generally a low taxonomic richness associated with the in-stream and riparian habitat due to the impacts of flow alteration, altered water quality, sedimentation and alien vegetation infestations.
RIPARIAN & INSTREAM HABITAT	Diversity of habitat types	Low	Habitat diversity is limited with instream river biotopes to exposed bedrock, sedimented channel beds and dense alien vegetation. Riparian vegetation has been highly transformed and now consists mainly of alien vegetation.
	Refugia	Low	Refugia within stream and along channel banks/riparian zones is very limited as a result of existing impacts and ecological alterations.

Determinant		EIS Assessment: R-01	
		Rating	Description
	Sensitivity to flow changes	Moderately Low	Small river systems are more sensitive to alterations in hydrological regimes and water quality than the larger rivers which are capable of buffering impacts. The level of alteration/modification to flow and water quality that has already occurred serves to reduce the sensitivity to further impacts to an extent.
	Sensitivity to flow related water quality changes		
	Migration route/corridor (instream & riparian)	Low	Small headwater systems of this nature do not provide much opportunity for species movement. The surrounding land use and transformation of the terrestrial environment also hinders the movement of species through the riparian corridor.
	Importance of conservation & natural areas	Low	Due to the degraded nature of both in-stream and riparian habitat, the system is not considered important in terms of its conservation value of habitat. The river is also not highlighted as being of particular conservation importance in terms of available National/Provincial level Conservation planning tools.
EIS Rating		D	
EIS Category		Low	

Note that individual river EIS assessment spread sheets (Microsoft Excel ™) can be made available by Eco-Pulse Consulting upon request.

3.3.4 *Baseline ecological assessment of the Vungu River and riparian area R-02*

The small tributary river/stream R-01 terminates as it discharges into the Vungu River to the south (Photo 19, below). The Vungu River channel and associated riparian habitat has been assessed as R-02, and is a relatively large perennial (C class) river system characterised by a diversity of habitat types and active macro-channel features. R-02 drains in a south-easterly direction along the lower southern perimeter of the existing quarry operation, with the river reach assessed being from the point where R-01 joins the Vungu River in the west to just downstream of the existing quarry site in the east (see Figures 3 and 4). The river channel is a mixed bedrock-alluvial system that is slightly stepped along its length with alternating pool and run/riffle habitat. Channel depth varies from deeper pool and run sections to shallow well-aerated riffle areas. Channel width also varies from wide (>10m) sections characterised by low velocities and greater water depth to narrow (2-3m) sections characterised by higher flow velocities. Current impacts to the river system include:

- channel bank modification/vegetation clearing (Photo 14);
- low-level formal concrete bridge crossings (Photo 17);
- rock bridge crossings,
- impacts to catchment hydrology, water quality impacts due to catchment land use (nutrient inputs);
- abstraction of water for quarry use (Photo 16);
- contaminated storm water runoff containing sediment from quarry activities (Photo 18);
- as well as widespread infestations by invasive alien plants.

The dominant exotic species within the riparian zone are *Eucalyptus spp., Melia azedarach, Pennisetum purpureum, Solanum mauritianum, Tithonia diversifolia* and *Ipomoea purpurea*. Indigenous species are far less abundant and limited to a few remaining or planted *Erythrina lysistemon, Ficus natalensis,*

Phoenix reclinata, Setaria megaphylla, Strelitzia Nicolai, Syzigium cordatum and *Trema orientalis. Phragmites australis (*common indigenous reed of wetands/rivers*)* and indigenous Antelope grass *(Echinochloa pyramidalis)* dominates indigenous instream vegetation with a number of alien species including *Juncus effusus, Colocasia esculenta and Hedychium coronarium* also occurring (refer to **Annexure C** for the complete vegetation species list including indigenous and exotic species). Increased nutrient inputs as well as the impeding effect of the lower road bridge crossing the Vungu River to access the quarry site, are thought to be the cause of dense growth of native Antelope grass and other exotic plants within the river channel which is currently having a blockage effect on water flows through the section immediately upstream (west) of the main road-river crossing (see Photo 15, below).

Photo 14. View of modified banks and cleared exotic riparian vegetation on the northern banks of the Vungu River as it traverses the quarry site at R-02. Alien clearing and management along the river banks is undertaken as dictated by the existing EMPr for the quarry.

Photo 15. View of the partially blocked channel with dense aquatic vegetation growth just upstream of the road bridge in Photo 17.

Photo 16. View of the current water abstraction pump placed within the Vungu River channel and being operated by the quarry to facilitate dust suppression on the plant (mechanical) equipment.

Photo 17. View of bare unstable river banks below the lower road bridge crossing. Gabions used to stabilise banks are broken or incorrectly packed, keyed-in and tied.

Photo 18. View of the existing storm water detention/settling ponds used to store contaminated runoff. The water is normally pumped from the ponds and used for dust suppression at the quarry and is not permitted to discharge into the adjacent Vungu River unless via overflow during storm events.

Photo 19. View of the Vungu River channel just downstream to the east of the quarry operation.

- ***River PES (Present Ecological State): R-03 Vungu River***

The Present Ecological State (PES) refers to the health or integrity of river systems, and includes both in-stream habitat as well as riparian habitat adjacent to the main channel. According to a desktop sub-quaternary reach PES/EIS assessment of large rivers assessment undertaken by the Department of Water and Sanitation (2014) the Vungu River is regarded as being Largely Natural (B PES Class) and of Very High Ecological Importance and Sensitivity. The rapid Index of Habitat Integrity (IHI) tool (Kleynhans, 1996) was used to determine river PES by comparing the current state of the in-stream and riparian habitats (with existing impacts) relative to the estimated reference state in the absence of anthropogenic impacts. A summary of the results of the IHI assessment for river R-02 (Vungu River main channel) is provided below in Table 11. This indicates that the river, banks and riparian vegetation has been largely to seriously modified, whilst flow and water quality is regarded as moderately impacted and the level of modification to the channel bed is regarded as low. Overall, anthropogenic impacts associated with catchment land use and on-site river degradation caused by erosion, pollution and alien infestations has resulted in this river system attaining a **"C/D" PES category**, or **Moderately to Largely Modified state** for the river reach assessed.

Table 11. Summary results of the river IHI assessment used to inform the PES for river R-02 (Vungu River).

Determinant	Present Ecological State Assessment: R-02 (Vungu River)		
	Score out of 5	Level of Modification	Description
Bed modification	1.5	Low	The channel bed of the Vungu River appears largely intact (physically unaltered), with impacts largely limited to a small road bridge crossing and informal rock weir.
Flow modification	2	Moderately Low	Catchment land use change (infrastructure, cleared vegetation and commercial sugarcane farming) is likely to have altered natural flows within the Vungu River to a moderate degree.
Inundation	3	Moderate	The level of inundation has increased upstream of the road bridge and blockage by heavy vegetation encroachment into the instream zone. Frequent flooding by the river has been reported by the quarry manager.

Determinant	Present Ecological State Assessment: R-02 (Vungu River)		
	Score out of 5	Level of Modification	Description
Bank condition	3	Moderate	River banks have in many cases been filled/modified for flood protection, and in some cases have been stabilised using gabions (rock pack). Bank morphology has therefore been moderately modified across much of the river reach assessed.
Riparian condition	4	High	Riparian vegetation associated with the reach of the Vungu River assessed was found to comprise mainly exotic/alien vegetation with a few remaining/planted tree species and grasses. Some of the banks of the river had been recently mowed/cleared of riparian vegetation.
Water quality modification	2	Moderately Low	Based on a rapid visual inspection of the water column and odour, water quality appears to be fair, with high turbidity levels noted but no odour problems likely to be associated with bacterial/faecal contamination. Sediment impacts were noted, with water turbidity being high. The results of water quality and SASS analysis performed during the latest Aquatic Bio-Monitoring on the Vungu River at SCSC (Knight Piesold: Aquatic Bio-Monitoring Report Rev 2, 2015) revealed that *'in-situ water quality was within the DWAF Ecosystem guideline values'* but that Electrical Conductivity readings were low throughout and '*diatom community composition indicated elevated organic pollution levels'* and this is likely to be attributed to upstream agricultural land-use activities (sugarcane farming). Elevated nutrient levels have likely contributed to the vigorous growth of instream mat-forming vegetation in areas of lower flow velocity upstream of the road bridge crossing. Metal toxicity was also highlighted as being of concern. Bio-monitoring results suggest that aquatic invertebrate PES has been moderately modified, as a result of water quality impacts and reduced instream habitat availability. Water quality impacts are likely to be buffered by the assimilative capacity and higher flow observed in this river.
Overall Score	**2.6 / 5 (52% modified)**		
PES	**C/D**		
PES Class	**Moderately to Largely Modified**		

Note that the individual river IHI assessment Microsoft Excel ™ spread sheets can be made available by Eco-Pulse Consulting upon request.

- ***River EIS (Ecological Importance & Sensitivity): R-02 (Vungu River)***

The Ecological Importance and Sensitivity (EIS) of riparian areas is an expression of the importance of the aquatic resource for the maintenance of biological diversity and ecological functioning on local and wider scales; whilst Ecological Sensitivity (or fragility) refers to a system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (Kleynhans & Louw, 2007). For the purposes of this assessment, the EIS assessment for riparian areas was based on rating the importance and sensitivity of riparian & in-stream biota (including fauna & flora) and habitat and was found to be **Moderately High ("B/C" ecological category)** for river R-02 (Vungu River). The results of the EIS assessment are shown in Table 12, below.

Table 12. Summary results of the river EIS assessment results for R-02 (Vungu River).

Determinant		EIS Assessment: R-02 (Vungu River)	
		Rating	Description
RIPARIAN & INSTREAM BIOTA	**Rare & endangered species**	Low	While a detailed assessment of aquatic biota (fauna) was not undertaken as part of this rapid EIS assessment, the habitat template of the Vungu River reach, including lateral and longitudinal connectivity, has been greatly transformed and probably provides potentially low levels of viability for harbouring rare or endangered species. The results of aquatic invertebrate and fish sampling and analysis performed during the latest Aquatic Bio-Monitoring on the Vungu River at SCSC

Determinant		EIS Assessment: R-02 (Vungu River)	
		Rating	Description
			(Knight Piesold: Aquatic Bio-Monitoring Report Rev 2, 2015) revealed that aquatic invertebrate PES has been moderately modified, as a result of water quality impacts and reduced/inadequate instream habitat availability with a moderate taxa sensitivity rating - *Heptageniida* (flathead mayflies) and *Calopterygidae* (Demoiselles) were the most sensitive taxa observed. The abundance of fish was low, as habitat suitability for fish species were minimal (severely modified) with no rare/endangered species recorded and only 2 of the 6 species expected being recorded (*Micropterus punctulatus*: Spotted Bass, which is an introduced species to SA and *Pseudocrenilabrus philander*: Southern Mouthbrooder).
	Unique species (endemic, isolated, etc.)	Low	Unique species (endemics, etc.) are unlikely to persist in this highly modified environment. *See also comments for rare & endangered species, above.*
	Intolerant species sensitive to flow/water quality modifications	Low	Only tolerant species are likely to be associated with this modified river system. *See also comments for rare & endangered species, above.*
	Species/taxon richness	Moderately Low	Species/taxon richness is regarded as low for this system which is in a largely degraded state with modified habitat and reduced lateral and longitudinal connectivity. *See also comments for rare & endangered species, above.*
RIPARIAN & INSTREAM HABITAT	**Diversity of habitat types**	Moderate	Instream habitat diversity is regarded as moderate and consists of a number of biotopes, including runs, riffles and pools as well as marginal vegetation types. The stone biotope was notably limited within the river reach upstream of the access road bridge to SCSC and results of the recent Aquatic Bio-Monitoring undertaken (Knight Piesold: Aquatic Bio-Monitoring Report Rev 2, 2015 revealed that habitat suitability for aquatic invertebrates and fish species ranged from being largely natural downstream of the quarry site to largely poor/unsuitable for the sampling point at the quarry and immediately upstream. Riparian habitat on the other-hand was found to be poor and quite highly disturbed
	Refugia	Moderate	A range of habitats probably provide moderately high refugia for instream biota. Wooded riparian areas also persist but have been degraded in comparison with the reference state for this river system.
	Sensitivity to flow changes	Moderately Low	Due to the perennial nature of this relatively large river system, altered flows and water quality impacts are likely to be relatively well buffered/absorbed/diluted.
	Sensitivity to flow related water quality changes		
	Migration route/corridor (instream & riparian)	Moderately Low	Lateral and longitudinal habitat connectivity has been greatly reduced/hindered by the effects of bridge structures, rock weirs and riparian habitat clearing/alien infestations replacing indigenous riparian species.
	Importance of conservation & natural areas	High	The Vungu River is a relatively large, moderately modified perennial river system that is considered to be of Regional and National conservation importance as a Strategic Water Source Area and National Freshwater Ecosystem Priority Area.
EIS Rating		**B/C**	
EIS Category		**Moderately High**	

Note that individual river EIS assessment spread sheets (Microsoft Excel ™) can be made available by Eco-Pulse Consulting upon request.

Note: *PES/EIS statements made for the Vungu River were informed largely by a rapid visual assessment of in-stream and riparian habitat structure, composition and existing impacts to these features. No detailed water quality, fish and macro-invertebrate sampling were undertaken as part of this assessment; however inferences were made based on the most recent aquatic bio-monitoring undertaken for the site (Knight Piesold, 2015). Results also refer specifically to the river reach within the property not the greater Vungu River. Some context of the PES and EIS for*

the greater Vungu River is provided based on Desktop PES/EIS assessments undertaken by the Department of Water and Sanitation (2014).

4. RECOMMENDED MANAGEMENT OBJECTIVES

Future management of the aquatic ecosystems identified for the project area should be informed by recommended management objectives for the water resource which, in the absence of classification, is generally based on the current ecological state or PES (Present Ecological State) and the EIS (Ecological Importance and Sensitivity) of water resources (DWAF, 2007 – see Table 13 below). This suggests that that the general management objective should be to ***maintain the current status quo of aquatic ecosystems without any further loss of integrity (PES) or functioning (EIS), with the recommendation for the Vungu River (R-02) to improve current PES and EIS based on a moderately high ecological importance & sensitivity associated with this system*** (see summary Table 14, below).

Table 13. Recommended aquatic management objectives in the short-term (after DWAF, 2007).

			EIS			
			Very high	**High**	**Moderate**	**Low**
PES	**A**	**Pristine**	A Maintain	A Maintain	A Maintain	A Maintain
	B	**Natural**	A Improve	A/B Improve	B Maintain	B Maintain
	C	**Good**	B Improve	B/C Improve	C Maintain	C Maintain
	D	**Fair**	C Improve	C/D Improve	D Maintain	D Maintain
	E/F	**Poor**	D Improve	E/F Improve	E/F Maintain	E/F Maintain

Table 14. Recommended management objectives for the aquatic resources assessed based on PES and EIS ratings.

Resource	PES	EIS	Recommended Management Objective
Wetlands			
W-01	**D/E:** *Largely to Seriously Modified*	Very Low	*Maintain current PES & EIS*
Rivers & Riparian areas			
R-01	**D:** *Largely Modified*	Low	*Maintain current PES & EIS*
R-02 (Vungu River)	**C/D:** *Moderately to Largely Modified*	Moderately-High	***Improve current PES & EIS***

This is also supported by Ezemvelo KZN Wildlife (EKZNW) in their guideline document: Guidelines for Biodiversity Impact Assessment (EKZNW, 2013). According to the document, the guiding principle with regards to biodiversity conservation and sustainable development adopted by EKZNW is one of "***no net loss of biodiversity and ecosystem processes".***

5. IMPACTS AND MITIGATION MEASURES

Current operations at Margate quarry on the Vungu River (South Coast Stone Crushers) involve the extraction of tillite rock material (open pit extraction method). The mine currently blasts three times a year to extract the required rock fragments which is then crushed to the desired particle size and sold to the construction industry. The rock fragments that are produced from the blasting are then crushed to the desired particle size and sold to the construction industry. The production rate at the current operation is approximately 20 000 to 26 000 tons per month, and the planned Life of Mine (LoM) is approximately 1.2 years. Expansion of operations to include a section of the south-east facing hillslope to the west of the existing operation is shown below in Figure 6 ("orange" polygon), which is planned in order to increase the life span of the mine. This expansion will impact on a section of the terrestrial hillside which is currently transformed and under sugarcane. In order to access this area, however, a road and truck turning circle was constructed through a section of the wetland (W-01) in the western valley (shown below in Figure 6).

The assessment of the impact to (*a) the wetland* and (*b) other existing impacts to riparian areas associated with existing quarry activities* as well as the recommendation of key mitigatory and remedial actions to rectify and reduce the effects of ecological impacts are the focus of this section of the report.

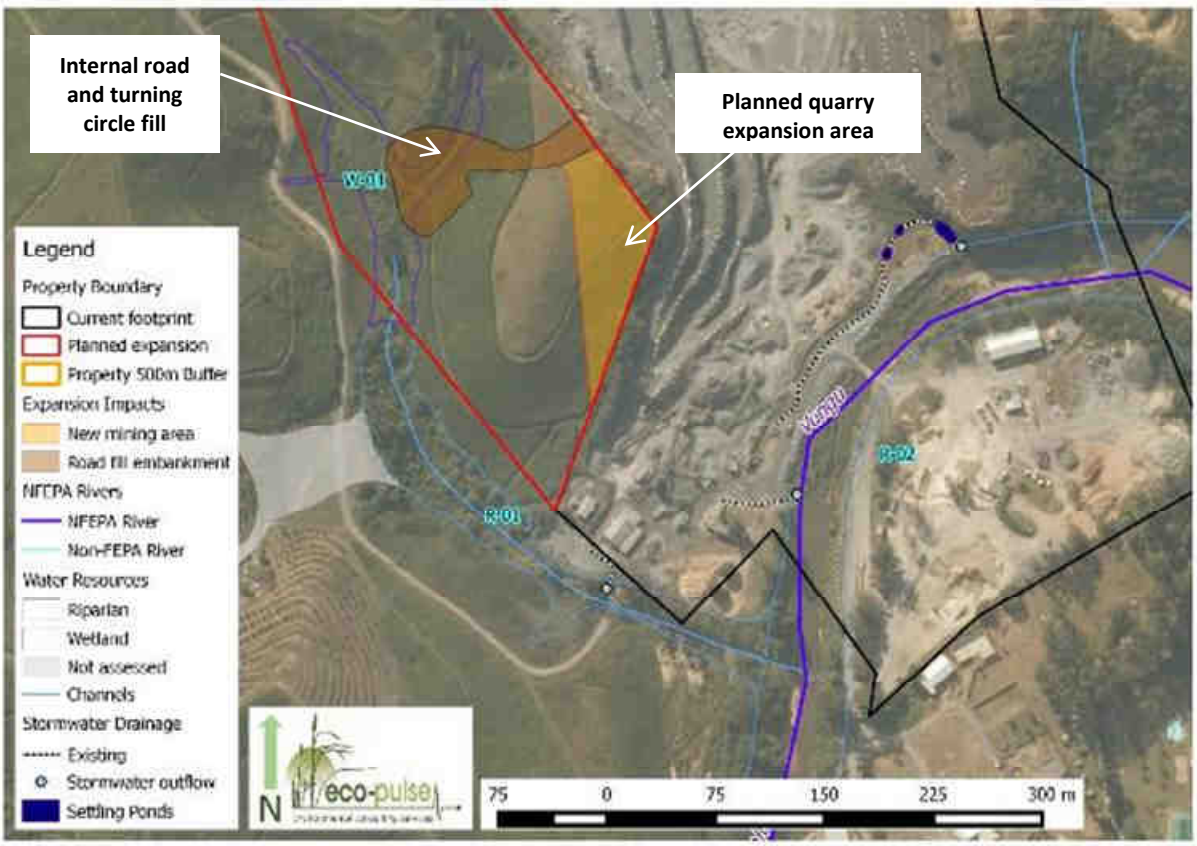

Figure 6 Map showing the planned mine expansion and existing road infill at Site B.

5.1 Ecological impact identification and remediation

Freshwater ecosystems including wetlands & rivers are particularly vulnerable to human activities and these activities can often lead to irreversible damage or longer term, gradual/cumulative changes to these ecosystems. When making inferences on the impact of development/mining activities on aquatic ecosystems it is important to understand that these impacts speak specifically to their effect on the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) or functional importance/value of aquatic ecosystems. All of these are linked to the physical components and processes of aquatic ecosystems, including hydrology, geomorphology and vegetation as well as the biota that inhabit these ecosystems. Anthropogenic activities can generally impact either directly (e.g. physical change to habitat) or indirectly (e.g. changes to water quantity & quality). Figure 7 below shows how impacts to aquatic ecosystems such as habitat loss, flow modification and pollution can have a number of negative ecological consequences for the receiving aquatic environment, ranging from loss of sensitive species to reduced ecosystem goods & services provision.

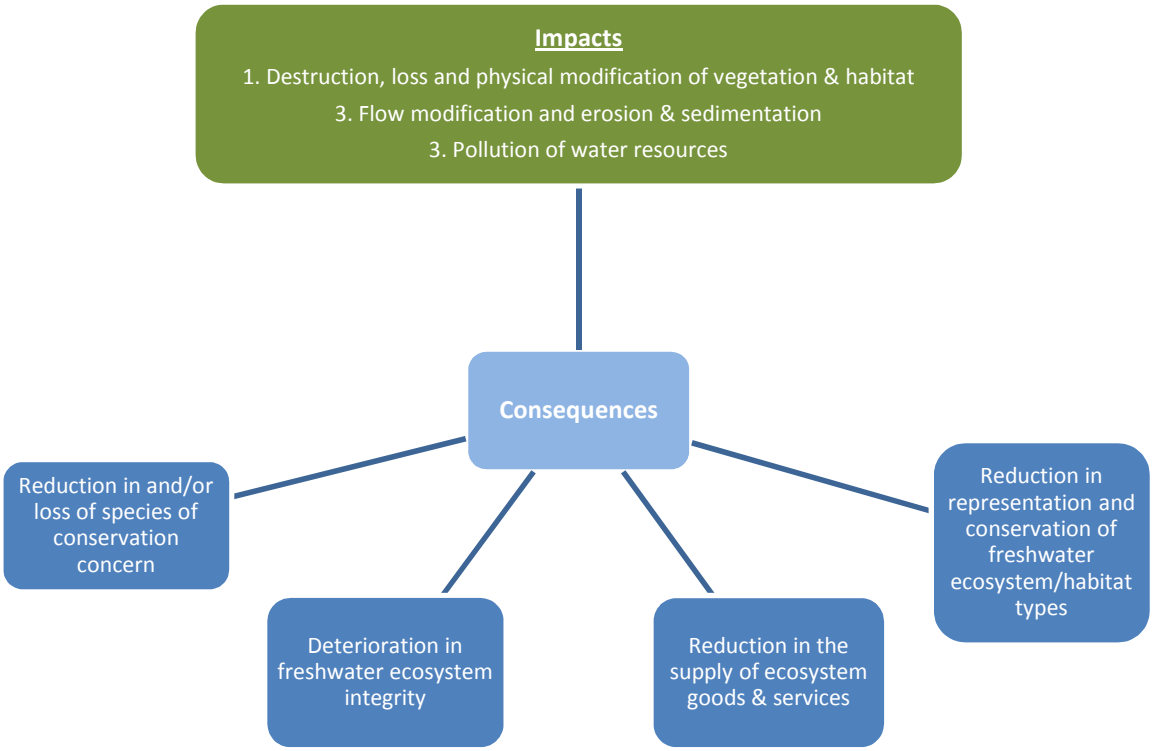

Figure 7 Diagram showing the range of negative ecological consequences of anthropogenic impacts to aquatic resources.

According to the National Environmental Management Act (NEMA), sensitive, vulnerable, highly dynamic or stressed ecosystems, such as wetlands, rivers and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure. NEMA also requires "*a risk-averse and cautious approach which takes into account the limits of current knowledge about the consequences of decisions and actions*". The 'precautionary principle' therefore applies and cost-effective measures must be

implemented to pro-actively prevent degradation of the region's water resource and the social systems that depend on it. Ultimately, the risk of water resource degradation must drive sustainability in development design. The protection of water resources (wetlands & rivers in this instance) begins with the avoidance of adverse impacts and where such avoidance is not feasible; to apply appropriate mitigation in the form of reactive practical actions that minimizes or reduces in situ impacts. Driver *et al.* (2011) recommend that the management of freshwater ecosystems should aim to prevent the occurrence of large-scale damaging events as well as repeated, chronic, persistent, subtle events which can in the long-term be far more damaging (e.g. as a result of sedimentation and pollution). Mitigation requires proactive planning that is enabled by following the mitigation hierarchy (see Figure 8, below). Examples of mitigation can include changes to the scale, design, location, siting, process, sequencing, phasing, and management and/or monitoring of the proposed development activities, as well as the restoration or rehabilitation of disturbed sites. Where environmental impacts can be severe, the guiding principle should be "anticipate and prevent" rather than "assess and repair". A stepped approach should therefore be followed in trying to minimize impacts which include:

1. Firstly, attempting to avoid/prevent impacts through project design and location;
2. Secondly, employing mitigation aimed at minimizing the magnitude/significance of impacts where these are unavoidable; and
3. Lastly, compensating for any remaining/residual impacts through on-site rehabilitation or through the application of offsets where deemed relevant.

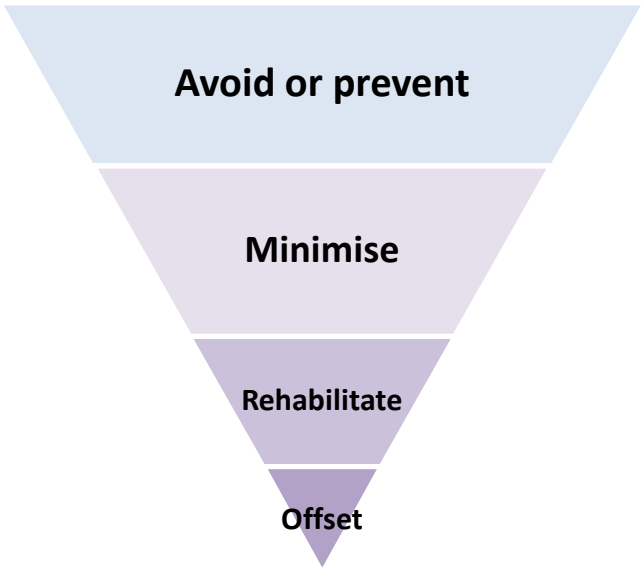

Figure 8 Diagram illustrating the 'mitigation hierarchy' (after DEA *et al.*, 2013

It is important to note that a number of significant impacts to aquatic ecosystems and habitat (including that associated with wetlands and riparian area/rivers at the site) have already occurred, and the impact assessment contained in this section of the report is aimed not so much at predicting potential impact significance but rather to document the nature, extent and significance of existing impacts and risks of the quarry operation on the aquatic environment in order to address impacts and risks through appropriate mitigation/remedial action. The existing ecological impacts and aquatic

environmental risks are documented in Section 5.1.1 (Site A) with impacts/risks associated with the quarry expansion (Site B) addressed in Section 5.1.2. These sections also identify key mitigation/remedial actions for each impact/risk with additional mitigation measures considered in Section 5.1.3. Recommendations for implementation through the development of an Environmental Management Programme (EMPr) for the quarry site, including recommendations for ecological monitoring, are contained in Section 5.3 of this report.

5.1.1 *Site A impacts – impacts of existing quarry operations*

Existing ecological impacts and aquatic environmental risks associated with the current quarry operation can be grouped into:

1. ***Impacts associated with contaminated storm water run-off from quarry areas***;
2. ***Risk of flooding of the Vungu River***;
3. ***Risk of contamination by chemicals & hazardous substances stored at the site***; and
4. ***Disturbance leading to increased levels of alien plants within riparian areas and wetlands.***

Impacts and aquatic environmental risks for Site A (existing quarry operation) are depicted in Figure 9 and discussed in detail below.

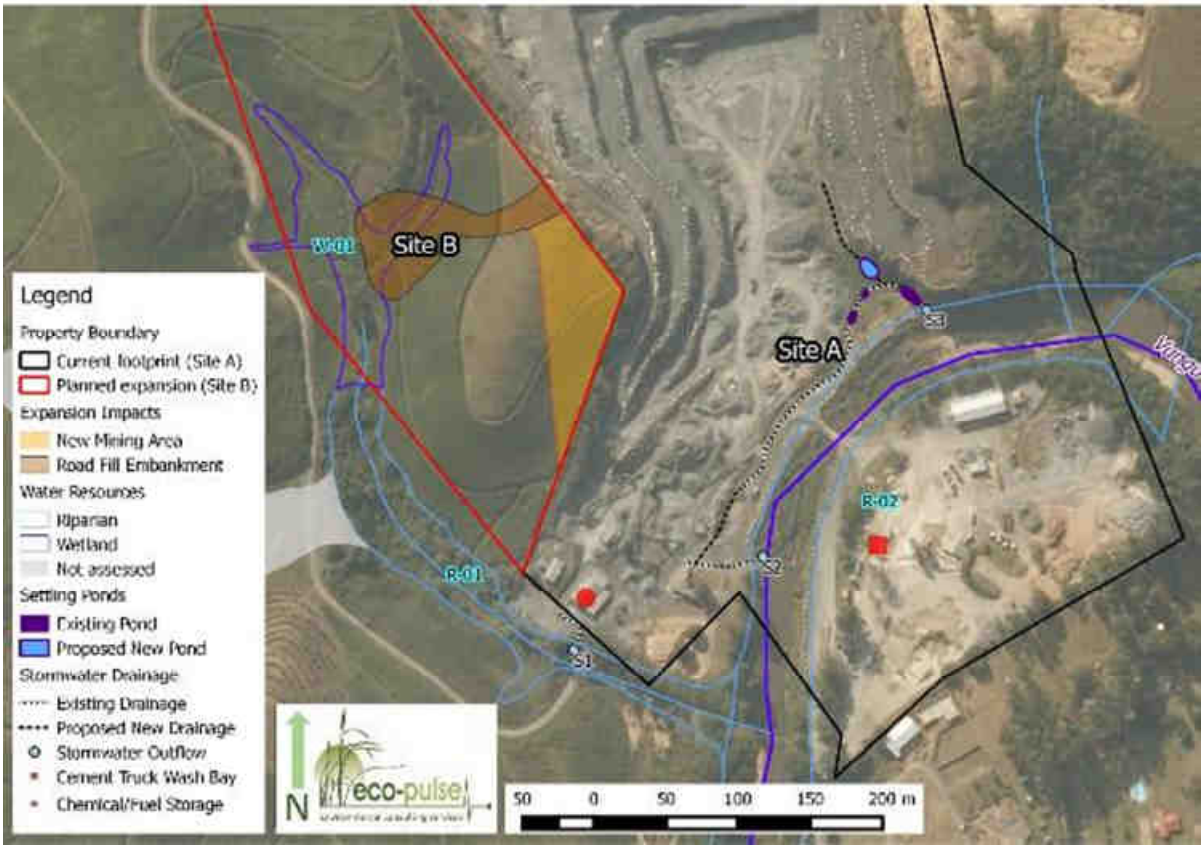

Figure 9 Map showing key concerns/impacts associated with the current mine activities as well as the mine expansion.

Impact/Risk 1: Contaminated storm water run-off and discharge into riparian areas	
The management of storm water prior to discharge and the manner in which water is released into the natural environment will be critical in managing and protecting downstream aquatic resources from degradation and to allow for the continued capacity of these natural areas to receive and absorb/transmit storm water from the quarry site. Storm water runoff from the site is currently contaminated with sediment and is being released into both stream R-01 and the Vungu River (R-02). The current storm water management system comprises a system of settling ponds and discharge points that are currently inadequately dealing with contaminated runoff from the site and will require improvements in design in order to adequately mitigate this impact.	
1.1 Contaminated storm water runoff and discharge into stream/river R-01	
Impact/Risk description	Inadequate design and construction of drainage infrastructure (see S1 on Figure 8 and Photos 1 - 4, below) resulting in water runoff contaminated with fine sediment entering the river to the west of the site (R-01) and resulting in high water turbidity due to suspended sediment in the water column. This in turn can negatively affect water quality and aquatic biota which utilise the river system.
Impact Significance *(see also Annexure F)*	**High**
Mitigation & remedial action/s proposed	▪ Formalise a concrete drainage channel/chute at road crossing (Photo 1, below) to direct water into the discharge point. ▪ Construct a settling pond and debris/litter trap above the concrete wall (Photo 2). ▪ Replace the failing cement-block drop inlet structure (Photo 4) with a proper, robust concrete structure. ▪ Stabilise and shape the degraded river banks associated with the drop-inlet structure to their natural form (see Photo 3).

Photo 1.

Photo 2.


Photo 3.


Photo 4.

1.2 Contaminated storm water runoff and discharge into the Vungu River (R-02)	
Impact/Risk description	Inadequate design and construction of drainage infrastructure (see S2 and S3 on Figure 8 and Photos 5 - 8, below) resulting in water runoff contaminated with fine sediment entering the Vungu River to the south and east of the site (R-02) and resulting in high water turbidity due to suspended sediment in the water column. This in turn can negatively affect water quality and aquatic biota which utilise the river system. Specific concerns identified include: ▪ Some discharge is directly into the river (Photo5, below); ▪ Settling ponds are operating at capacity and water remains turbid (Photo 7, below); ▪ Stockpiles are located directly adjacent to settling ponds (Photo 8); and ▪ Only one settling pond is concrete capped and the capping is very thin and unlikely to last long.
Impact Significance *(see also Annexure F)*	**High**
Mitigation & remedial action/s proposed	▪ Consider constructing another settling pond upstream of the final pond to increase storage capacity. ▪ Move current material stockpiles away from the settling ponds to reduce the risk of further sedimentation and high turbidity levels. ▪ Construct a low berm just below stockpiles to trap sediment before it enters the settling ponds from stockpiles. ▪ Construct a surface or subsurface drainage canal to capture water from the western side of the site and release this into the existing settling ponds. The alternative would be to construct additional settling ponds in the western section of the site to capture these flows and release back into the environment.

Photo 5.

Photo 6.

Photo 7.

Photo 8.

1.3 Contaminated surface water from the concrete batching plant	
Impact/Risk description	There is a risk that runoff water and surface wash contaminated with cement-based product from the concrete batching plant (Photo 9 below) and vehicle wash-bay (Photo 10) – both located on the southern floodplain of the Vungu River – can potentially enter the river, untreated. Water contaminated with cement-based products can negatively affect water quality and aquatic biota which utilise the Vungu River system should this water discharge into the river.
Impact Significance *(see also Annexure F)*	**High**
Mitigation & remedial action/s proposed	▪ Create soil/rock berms and or cut-drains draining to settling ponds along the northern edge of the concrete batching plant to capture contaminated runoff and prevent this from entering the adjacent Vungu River. ▪ Water contaminated with cement needs to be properly treated and should never be released into the environment. *Note that storm water management plans for the quarry operation are in the process of being developed to ensure that contaminated runoff is prevented from entering the adjacent river and methods of containment are being devised.*

Photo 9.

Photo 10.

Impact/Risk 2: Risk of flooding (rivers)	
Impact/Risk description	There is an immediate risk of flooding of quarry operations and infrastructure which are located within a very close proximity to the Vungu River and its floodplain. Quarry operations and infrastructure are at risk of flooding by the Vungu River, which would impact not only on infrastructure and activities but also on the river in terms of the potential contamination risk associated with flooding the quarry and infrastructure. *Note that a flood risk assessment is in the process of being developed by WSP and recommended set-backs for development from the river to avert flood risk and other methods of mitigation will need to be recommended as part of this study*. There is also currently inadequate flood protection and the bank stabilisation around bridge structures is considered to be unsatisfactory (gabion baskets are incorrectly packed with too few and too small material and baskets are incorrectly tied: see Photo's 11 and 12, below).
Impact Significance *(see also Annexure F)*	**Medium**
Mitigation & remedial action/s proposed	▪ 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 quarry 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 proper stone sizing and gabion baskets to be properly sized without gaps and tied properly. ▪ A specialist flood line assessment needs to be undertaken for the site (including the Vungu River and western tributary stream/river – i.e. R-01 and R-02). This assessment should provide recommendations for set-backs and flood protection to reduce flood risk. ▪ 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.

Photo 11.

Photo 12.

Impact/Risk 3: Risk of pollution by chemicals & hazardous substances	
Impact/Risk description	Fuels, chemicals and other hazardous substances are being stored in close proximity to the river channel without sufficiently adequate flood protection (Photo 13 and 14, below) and there is a considerable risk that flooding could affect these areas and result in contamination. See Figure 8 for the location of the fuiel/chemical storage facilities in relation to water resources.
Impact Significance *(see also Annexure F)*	**Low** under normal circumstances **High** significance rating in the event of flood water inundating the storage area
Mitigation & remedial action/s proposed	▪ Once flood lines have been determined for the rivers at the site, fuels and chemicals need to be relocated outside of flood line, in sealed containers within a bunded area. ▪ Ideally, 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/Risk 2: Risk of flooding *(discussed on the previous page of this report)*.

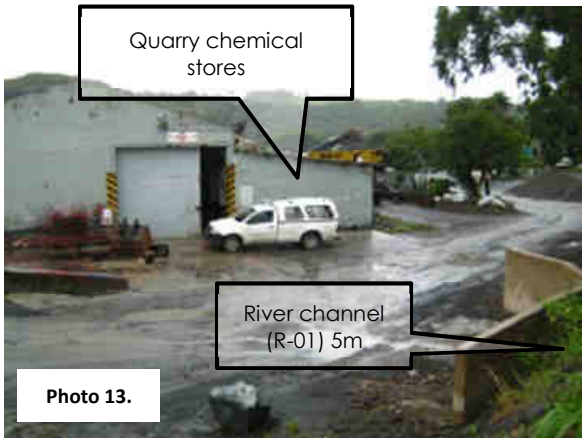

Photo 13.

Photo 14.

Impact/Risk 4: Disturbance leading to increased levels of alien plants within riparian areas and wetlands	
Impact/Risk description	Disturbance/clearing of river banks and riparian vegetation associated with the quarry operations has led to an increase in the levels of Invasive Alien Plant species which have colonised these areas to a large extent. These exotic species have replaced indigenous riparian vegetation and led to a reduction in biodiversity and riparian habitat/function.
Impact Significance *(see also Annexure F)*	Medium
Mitigation & remedial action/s proposed	▪ Alien plant clearing and planting of indigenous replacements to be undertaken *as per the recommendations in Section 5.2.4 of this report.*

5.1.2 *Site B impacts – impacts of quarry expansion*

Ecological impacts and aquatic environmental risks associated with the quarry expansion Site B (valley to the west of the current quarry operation) have been grouped into:

- ***Infilling of wetland habitat for access road construction***; and
- ***Risk of sedimentation/pollution of wetland resources by quarry activities***.

Impacts and aquatic environmental risks for Site B (quarry expansion into the western valley) are depicted in Figure 10 and discussed in detail below.

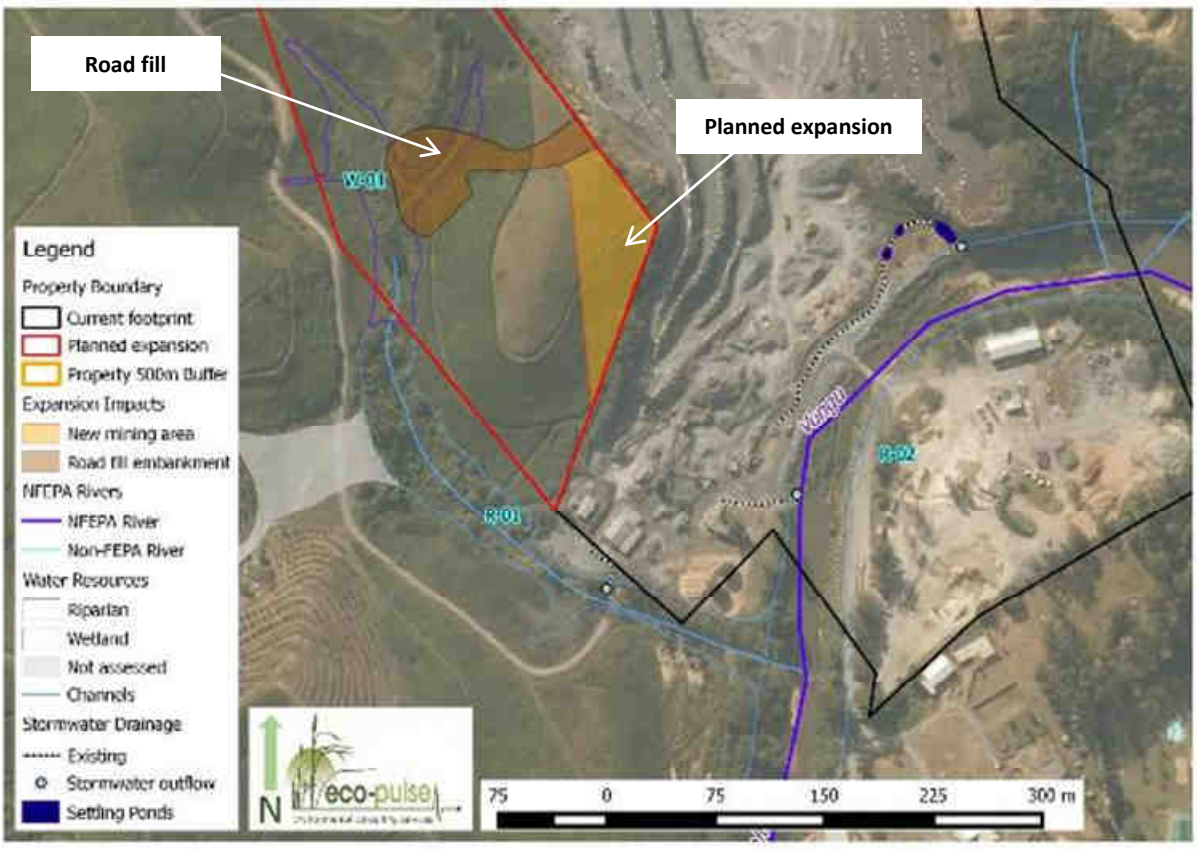

Figure 10 Map showing the planned mine expansion and existing road infill at Site B.

Impact/Risk 5: Infilling and loss of wetland habitat and reduced ecosystem functioning	
Impact/Risk description	The permanent destruction of wetland habitat associated with wetland W-091 (seepage wetland within the valley to the west of the current quarry 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 quarry expansion area (shown in Figure 8 and Photo 15, below). The infilling of the wetland has resulted in the following consequences: o Wetland hydrology has been affected as the fill material alters the way water moves through the eastern section of the wetland; o The wetland geomorphological template and the way sediment would natural move through the system has been altered; o Wetland vegetation and associated habitat for flora and fauna has been lost permanently; o Habitat connectivity has been severed; o Associated disturbance has facilitated increased levels of colonization by alien plants; o Ecosystem processes have been lost as a result of the infilling of the section of wetland.
Impact Significance *(see also Annexure F)*	**Medium** *(note the reduced impact significance due to poor condition and low importance and sensitivity of the resource)*
Mitigation & remedial action/s proposed	The following impact mitigation, management and rehabilitation recommendations are covered in more detail in the relevant sections: o **The need/desirability for wetland offsets vs on-site wetland/riparian rehabilitation (section 5.2.3)**.

Photo 15.

Impact/Risk 6: Risk of sedimentation/pollution of wetland resources	
Problem identified	There is a risk that the infilled section of the wetland (see Impact/Risk 4, above) as well as additional quarry expansion activities (mined areas and access roads) could present a risk of erosion and sedimentation to the adjacent wetland resource W-01.
Impact Significance *(see also Annexure F)*	**Medium** *(note the reduced impact significance due to poor condition and low importance and sensitivity of the resource)*
Mitigation & remedial action/s proposed	The following impact mitigation, management and rehabilitation recommendations are covered in more detail in the relevant sections: o **Aquatic buffer zone recommendations (section 5.2.1)**; and o **Stormwater management, erosion and sediment control (section 5.2.2).**

5.1.3 *Ecological Risks/Impacts Summary*

A summary of the ecological impacts/risks discussed in 5.1.2 are presented below in Table 15. For additional details on the assessment of impact significance refer to the results table in **Annexure F** and the methods in **Annexure A.** The impact significance assessment was undertaken for two scenarios: (i) in the absence of any mitigation (i.e. the current situation at the quarry) and (ii) with mitigation or corrective/remedial actions applied. This indicates that should the remedial/corrective actions described and recommended in this report be implemented correctly and effectively/timeously, the risk of further impacts should be reduced quite considerably. Should remedial/corrective actions not be implemented or implemented ineffectively, residual impacts affecting the wetlands and riparian areas at the site will remain at moderate to high significance levels. The residual impact to wetland W-01 as a result of infilling (access road construction) will still remain at a medium impact significance level (Table 15, below).

Table 15. Summary of impact significance assessment, with and without mitigation/corrective action.

IMPACT SIGNIFICANCE ASSESSMENT SUMMARY: Without Mitigation/Corrective Actions Implemented				
No.	**IMPACT**	**Consequence**	**Probability**	**Significance**
1.1	Contaminated storm water runoff and discharge into stream/river R-01	Medium	Definite	**Medium**
1.2	Contaminated storm water runoff and discharge into the Vungu River (R-02)	High	Definite	**High**
1.3	Contaminated surface water from the concrete batching plant	High	Probable	**High**
2	Risk of flooding (rivers)	Medium	Probable	**Medium**
3	Risk of pollution by chemicals & hazardous substances	Very High	Possible	**High**
4	Disturbance leading to increased levels of alien plants within riparian areas and wetlands	Medium	Definite	**Medium**
5	Infilling and loss of wetland habitat and reduced ecosystem functioning	Medium	Definite	**Medium**
6	Risk of sedimentation/pollution of wetland resources	Medium	Probable	**Medium**
IMPACT SIGNIFICANCE ASSESSMENT SUMMARY: With Mitigation/Corrective Actions Implemented				
No.	**IMPACT**	**Consequence**	**Probability**	**Significance**
1.1	Contaminated storm water runoff and discharge into stream/river R-01	Low	Possible	**Very Low**
1.2	Contaminated storm water runoff and discharge into the Vungu River (R-02)	Medium	Possible	**Low**
1.3	Contaminated surface water from the concrete batching plant	Medium	Possible	**Low**
2	Risk of flooding (rivers)	Medium	Possible	**Low**
3	Risk of pollution by chemicals & hazardous substances	Medium	Improbable	**Low**
4	Disturbance leading to increased levels of alien plants within riparian areas and wetlands	Low	Possible	**Very Low**
5	Infilling and loss of wetland habitat and reduced ecosystem functioning	Medium	Definite	**Medium**
6	Risk of sedimentation/pollution of wetland resources	Medium	Possible	**Low**

5.2 Specific wetland mitigation/remediation measures

5.2.1 *Aquatic buffer zone recommendations*

While the impact of wetland infilling for access road construction (Impact Risk 4 in section 5.1.2) has already occurred, aquatic buffer zones are nevertheless still recommended to ensure that any future mine actives avoid impacting further on the wetland and riparian systems. Buffer zone requirements are dealt with in this section of the report.

Aquatic buffer zones, also termed "development set-backs", are essentially strips of terrestrial land typically designed to act as a protective barrier between human activities and sensitive water resources such as wetlands and rivers. Research shows that buffer zones are useful at performing a wide range of functions such as sediment trapping and nutrient retention, and in doing so, play an important role in protecting water resources from the adverse impacts that are typically associated with various forms of land-use and development. Although there is no legislation regarding buffers around rivers or wetlands in the National Water Act, the application of buffers is aligned with the principles of sustaining water quality.

Based on the nature of the proposed development and the receiving aquatic environment's susceptibility to water quality, erosion and sedimentation impacts, buffer zones (or development setbacks) are proposed as a primary means of minimizing potential impacts and reducing the risk of further deterioration of wetlands and riverine ecosystems in the project area. According to the draft Guidelines for Biodiversity Impact Assessment in KZN (EKZNW, 2011), a standard buffer width of **30m** from the outer edge of the delineated wetlands and the riparian zone of rivers in the Province of KZN, often irrespective of site conditions and development type. The guideline document goes on to recommend that the determination of wetland ecological buffers should rather be based on a number of site-specific factors. Macfarlane *et al.* (2014) have developed National Guidelines for the determination of appropriate buffer zones for developments associated with wetlands, rivers and estuaries. These guidelines represent emerging best-practice in aquatic buffer zone determination and were used for this project in order to inform appropriate buffer requirements for the wetlands identified as being at risk of degradation from the quarry expansion activities. Buffer zones recommended through the application of the wetland buffers tool and assessment process are generally aimed at reducing impacts from adjacent land use activities and are based on a range of criteria including (i) threats associated with the proposed development; (ii) the sensitivity of the receiving environment and (iii) site-based buffer zone attributes. Threats posed by the expansion of quarry operations were assessed based on a qualitative assessment of the level of threat posed to the wetlands in terms of potential impacts such as nutrient/toxicant inputs, sedimentation & turbidity and changes in water volumes. The sensitivity of the aquatic resources (wetlands & rivers) to particular development threats was then evaluated based on the understanding gained from the PES and EIS assessments undertaken for each aquatic/water resource.

The wetland buffers model provided an indication of buffer zone requirements in the absence of alternative mitigation measures. These were then refined based on an assessment of the anticipated effectiveness of additional mitigation measures proposed. Potential risk to wetlands in terms of a range of criteria are estimated by the model and used to allocate suitable buffers based on the risk levels calculated for both the construction phase and operational phases of development projects. Key impacts addressed by the buffer zone include erosion and sedimentation, water pollution and disturbance of wetland habitat. ***The buffer tool suggests that should additional mitigation and management recommendation be implemented to specification, the final aquatic buffer zone or quarry/development exclusion zone can be reduced from 30m to15m from the delineated edge of the wetland*** (see buffer zone map in Figure 11, below). This then is provided that the following conditions are met:

- 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 construction 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 (refer to section 5.2.2 for more detail).

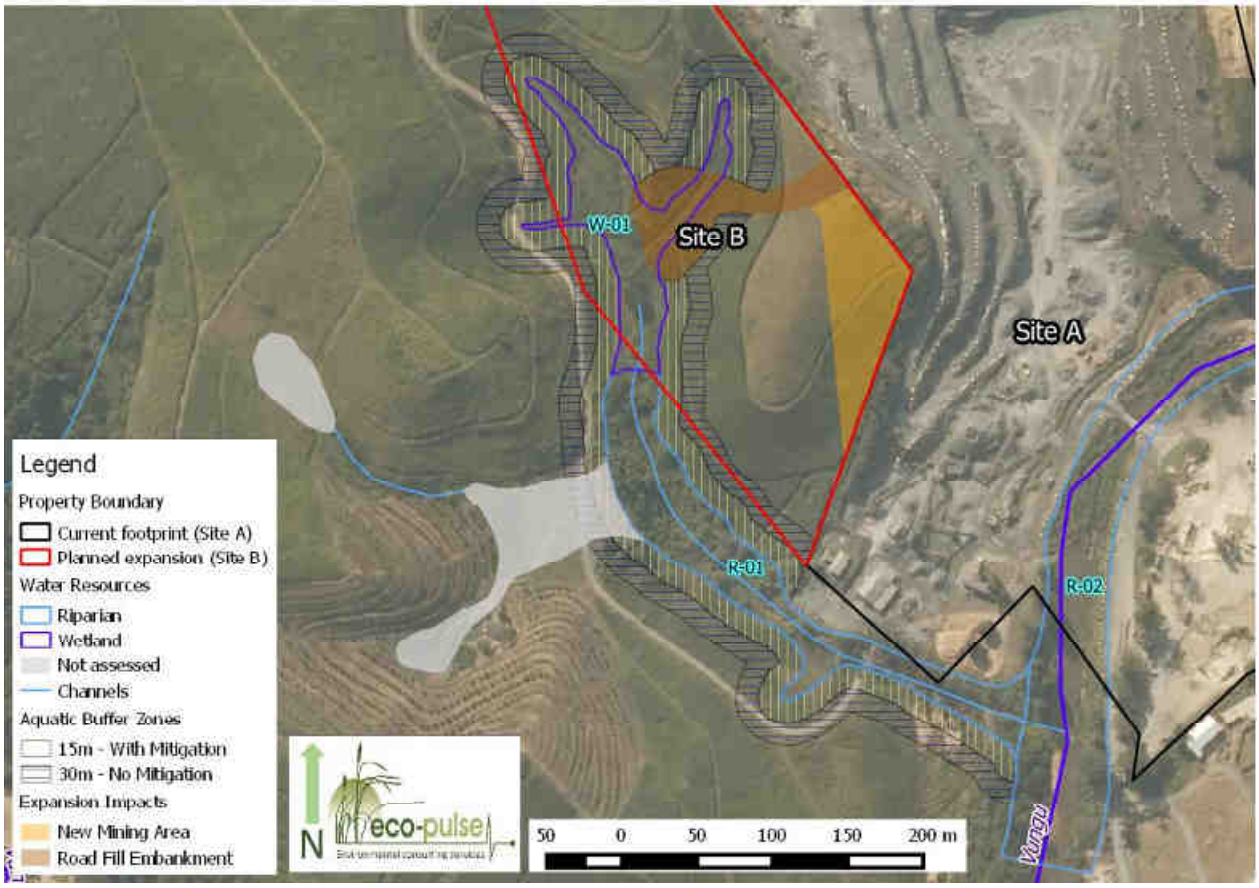

Figure 11 Map showing the recommended aquatic buffer zone of **30m** (without additional mitigation), and **15m** (with condition for additional mitigation met).

5.2.2 *Storm water management, erosion and sediment control*

The management of storm water and the manner in which water is released into the natural environment will be critical in managing and protecting downstream aquatic resources from degradation and to allow for the continued capacity of these natural areas to receive and absorb/transmit storm water from the site. Given the steep slopes and the extent of bare soils it is recommended that run-off from the existing access road fill embankment (already located within wetland W-01) be appropriately managed to reduce erosion and sediment risk. This will need to also be undertaken for additional access roads/working areas where there may be a risk of contaminated storm water reaching wetlands/riparian areas in the adjacent areas. This can be achieved through the following recommendations:

- 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 W-01). 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.

5.2.3 *Addressing residual impacts: the need and desirability of wetland offsets vs onsite wetland/riparian area rehabilitation*

While the impact mitigation and risk management measures and guidelines proposed in this document aim to reduce residual impacts to aquatic ecosystems, the nature of the existing impact to the wetland system W-01 (as a result of wetland infilling associated with access road constriction along the eastern arm of the seepage wetland) has unfortunately resulted in an unavoidable residual loss of wetland habitat. Residual impacts have therefore been quantified as far as possible to inform the need for additional mitigation by calculating **hectare equivalents** of wetland lost and through applying the principles contained in the emerging best-practice Draft Wetland Offsets Guidelines (Macfarlane *et al.*, 2014).

Preliminary aquatic offset recommendations are provided in this section of the report, in order to ensure that significant residual impacts identified are appropriately addressed through an appropriate offset mitigation process.

Emerging best-practice wetland offset guidelines (Macfarlane *et al.*, 2014) suggest that four key components be evaluated when assessing residual impacts to wetland systems. These components include (i) **Indirect** (regulating and supporting) Services, (ii) **Direct** (cultural and provisioning) Services, (iii) **Ecosystem Conservation**, and (iv) **Species of Conservation Concern**, as described in Figure 12, below:

Figure 12 Key components to be taken into account when determining wetland offset requirements.

The draft offset guidelines provide guidance on establishing offset requirements for significant impacts to wetlands and associated biota. In order to evaluate potential impacts, the anticipated residual impacts associated with each of these components needs to be assessed and evaluated. Given that detailed offset calculations were beyond the scope of this assessment, a number of broad assumptions were made in determining the significance of the impact to the wetland and whether this would warrant an offset. This is detailed in Table 16, below. In the case of indirect services, wetland area and condition are typically used to provide a surrogate measure for the level of impact through the calculation of "hectare equivalents" lost (the "hectare equivalent" is the primary currency for wetland offset negotiations and an expression of wetland functional area based on joint consideration of wetland area and condition). This suggests that ***0.3 hectare equivalents have been lost due to recent infilling of wetland W-01.*** Based on this, the habitat loss at wetland W-01 is ***not considered to be a particularly significant impact and one can motivate that this does not warrant the need for an offset*** (i.e. small size of impact, small functional losses anticipated, no loss of sensitive species). It is therefore recommended that as a means of compensating for the loss of wetland habitat at W-01, on-site rehabilitation of the wetland W-01 and riparian area R-01 be prioritised to improve the condition of remaining wetland/riparian habitat within the project area - with a focus on clearing invasive alien plants and planting suitable indigenous replacement species. *Rehabilitation recommendations for wetland and riparian areas are detailed in Section 5.2.4 of this document.*

Table 16. Wetland offset criteria and evaluation of the significance of the impact of habitat loss for wetland W-01.

Wetland Offset Component	Description	Relevance to project
Indirect Services	*Wetlands are known to provide a wide range of indirect service, some of the key ones being the role of wetlands in attenuating floods, regulating stream flows and purifying water, that support water resource management objectives. These key services may be reduced or even lost as a result of the physical destruction of wetland habitat.*	The wetland is **considered to be of low-moderate importance in providing indirect benefits such as erosion control and nutrient trapping. The small size of the wetland limits its importance in this regard** (*refer also to the results of the WET-Ecoservices assessment in Section* 3.3.2, Table 7 of this report).
Direct Services	*Wetlands can provide a wide range of direct use values which are important for local communities and which will be lost as a result of the physical destruction of wetland habitat.*	The wetland is **not considered important in providing direct human benefits and there is little local demand for these** (*refer also to the results of the WET-Ecoservices assessment in Section* 3.3.2, Table 7 of this report).
Ecosystem Conservation	*A loss of wetland habitat also contributes to a loss of areas available to meet Provincial, National and local conservation targets for habitat protection and avoiding deterioration in ecosystem threat status.*	Whilst the threat status of the vegetation type in its natural state would be considered endangered, the wetland has seen **considerable modification in terms of vegetation** condition and is no longer a representative site. The wetland is also **small and not of a rare type**.
Species of Conservation Concern	*Loss of wetland habitat can lead to a loss of wetland-dependent plant and animal species, potentially including species of conservation concern.*	**No wetland-dependent species of conservation concern recorded for this wetland**. Habitat modification makes the wetland largely unsuitable for rare, threatened and endangered species.

5.2.4 *Wetland/riparian area rehabilitation recommendations*

It is proposed that as a means of compensating for the loss of wetland habitat at W-01, on-site rehabilitation of the wetland W-01 and riparian area R-01 be prioritised to improve the condition of remaining wetland/riparian habitat within the project area. The focus here should be to address existing impacts/degradation with the aim of improving the condition and functioning of the remaining semi-intact aquatic habitats. The dominant impacts at the site affecting wetland W-01 and riparian area R-01 include:

- Dense infestations of invasive alien plants and weeds;
- Bank erosion/instability;
- Artificial drainage in wetland W-01;
- Foreign fill material in the wetland (small amounts of fill – not including extensive access road fill discussed for W-01); and
- Erosion headcuts that threaten to advance headwards up the valley.

Bearing these existing impacts in mind, aquatic rehabilitation should be to focus on (i) **clearing invasive alien plants**, (ii) **addressing minor infilling, drainage and erosion concerns** and (iii) **planting suitable indigenous wetland/riparian species** to replace the exotic vegetation. These activities are discussed in more detail below:

- **Invasive alien plant and weed eradication & control:**

Invasive alien plants (IAPs) are plant species that have been introduced, either intentionally or unintentionally, to South Africa. They can reproduce rapidly in their new environments and out-compete indigenous plants for both nutrients and water. Plant species are considered invasive when they occur outside of their natural distribution range, and pose a threat to ecosystems, other species, the economy or human health and therefore must be eradicated.

Alien plant and weed control as part of site rehabilitation should focus primarily on the invaded riparian area R-01 and specific sections towards the lower end of W-01 and around the infilled section associated with the access road on the eastern side of W-01 where extensive disturbance has led to alien plants/weeds colonising the wetland. Note that invasive alien plant control will also be required along the riparian zone of the Vungu River (R-02) which traverses along the southern boundary of the quarry. A Method Statement for IAP (Invasive Alien Plant) eradication and control has been included below (MS1) whilst Table 16 below highlights recommended target alien species for control/eradication as well as the recommended methods of control/removal (also see Box 2, below).

IAP eradication and control will comprise generally of the following three phases:

i. **Initial control phase:** This involves the initial, intensive clearing and drastic reduction of existing alien plant infestations at the site.
ii. **Follow-up control phase:** The follow-up phase involves the control of seedlings, root suckers and coppice growth after the initial control phase to control re-growth of alien seed.
iii. **Maintenance control phase:** This final phase involves a programmed control of alien plants to sustain or maintain low alien plant numbers by suppressing regeneration. Depending on the success of the initial phases this maintenance phase may be carried out at intervals ranging from quarterly annual clean ups to once a year clean-ups.

Note: a suitably trained rehabilitation/alien control expert should be consulted/contracted to undertake alien clearing work.

Method Statement 1. ***IAP Eradication & Control for aquatic habitats***

1-1 Planning for IAP Control:
Proper planning and preparations are fundamental to achieving cost-effective and successful IAP control. The following steps must be followed during planning:

i. The contractor must visit the site and assess the extent of IAP infestation and topographic challenges he will have work in.
ii. Identify and gather field equipment and personal protective equipment (PPE) required.
iii. Gather all chemicals required to control IAPs. Only herbicides registered for use on the target species may be used (*note that the application of herbicides on different types of alien invasive plant species is limited in South Africa. It is therefore necessary to assess the herbicide's activity such as its residual effect in the soil; its ability to work under wet conditions, etc.).*
iv. Train project workers and supervisors on target IAPs and identified clearing methods. This may include: environmental protection with emphasis on aquatic resources, IAP identification; safety training for use of specialised equipment such as chainsaws; specialised training for working in difficult or sensitive terrain and under difficult climatic conditions.

1-2 Strategy for IAP eradication/control:
The strategy for the removal of IAPs and weeds on the site shall be in accordance with the following practice measures and guidelines for control/eradication of IAPs:

i. Identify, locate and demarcate Protected indigenous plants (i.e. lilies - ***Zantedeschia aethiopica* & *Scadoxus puniceus***) and large indigenous trees (e.g. *Bridelia micrantha, Syzigium cordatum, Trema orientalis,* etc.) within riparian areas that should be conserved within areas to be cleared.
ii. Begin clearing at the top of the valley, moving down-stream to the south.
iii. Keep the team working in a line, with the daily tasks pegged out where possible.
iv. Target dense infestations of woody and herbaceous alien plants, focusing on the removal of the Invasive Alien Plants (IAPs) listed in Table 17.
Recommended methods of IAP control and their application are summarised in Table 17 and Box 2.
v. For large specimens that cannot be easily removed entirely, cut plants as low to ground as possible and apply herbicide to all cut surfaces and exposed roots. The "cut-stump" application method is the safest method of applying herbicides.
vi. The roots system of large, mature trees (including exotics) often play an important role in stabilising soil and therefore the cutting down or up-rooting of large mature specimens of trees is not generally advocated. It is recommended instead that large exotic trees (such as *Melia azedarach, Eucalyptus sp.*) be ring-barked and poisoned/painted with the relevant herbicides.
vii. All IAPs must be removed carefully and exposed soil should be covered with cut vegetation or leaf litter that is free of weed seeds to ensure that re-growth of alien flora will not occur.
viii. Press any loosened soil down carefully but firmly and mulch with plant material where possible.
ix. All alien seeds, fruit bulbs, tubers and stems must be stacked and burnt onsite or removed for disposal at a registered land fill for example.
x. Stack/move the slashed brush off the stumps to aid herbicide application and re-establishment of indigenous plant species.
xi. Stack the brush into hips for collection and disposal at a landfill site.

1-3 Follow-up control:
Follow up inspections are necessary to ensure the success of the control phase. It is preferable to follow up on an area and remove all seedlings or treat re-sprouting plants, rather than treat a new area. Follow-up operations must be carried out if inspections establish that initial removal efforts have failed or have had a limited impact. It is recommended that follow-up work be undertaken within 3 months of initial clearing.

1-4 Maintenance:
Maintenance control entails conducting regular control of invasive alien plants. This helps to sustain low alien plant numbers and keep the alien plants in check. Inspections of the site must be carried out every six (6) months.

1-5 Monitoring requirements

The site should be monitored through visual inspections at regular intervals to determine whether IAP control has been successful and if further follow-up treatment is required.

Notes on the use of herbicides in IAP control:
Note that herbicide application will need to be carried out strictly in accordance with the manufacturer's specifications and according to current legislation. The following pollution and safety measures must be also adhered to regarding the handling, use and storage of herbicides:
i. All herbicides, concentrated and diluted, must be stored in a secure and covered area, or off-site under lock and key.
ii. All containers into which the herbicide or mixers are decanted must be clearly marked and a copy of the original label secured to the container.
iii. Herbicides must at all times be applied according to the recommendations on the labels.
iv. All MSDS sheets are to be made available on site along with a fully kitted Medical Aid Kit.
v. Herbicide equipment must under no circumstances be washed in a local stream, river or wetland Suitable protective clothing like gloves, aprons, overalls and eye protection must be worn by herbicide applicators at all times.
vi. The correct protective clothing is to be used in line with manufacturer's instructions and/or the Occupational Health & Safety Act, Act 85 of 1993 (and amendments).
vii. Avoid contact of herbicide with skin and eyes.
viii. After contact, all applicators must wash their hands with soap and water or as recommended on the herbicide label.

Table 17. Target species for alien plant control, including relevant methods of eradication/control.

Scientific / Common name(s)	Type	NEMBA Category	Required Action	Treatment Method	Registered Herbicide (refer to list in Table 18)
Arundo donax Spanish reed/Giant reed	Grass/reed		Eradicate	Cut & treat stump	11
Canna indica	Flowering plant	1b	Eradicate	Dig up and uproot	-

Scientific / Common name(s)	Type	NEMBA Category	Required Action	Treatment Method	Registered Herbicide (refer to list in Table 18)
Indian-shot				completely	
Chromolaena odorata Triffid weed	Shrub	1b	Eradicate	Cut & spray	1, 4 , 12 , 15 , 16 , 17 or 18
Hedychium coronarium White ginger lily	Lily	1b	Eradicate	Cut & spray, dig out smaller specimens	12
Ipomoea purpurea Common morning glory	Creeper/climber		Eradicate	Trace root, poison	-
Lantana camara Lantana	Shrub	1b	Eradicate	Cut & treat stump, dig up young plants	4, 12 or 16
Melia azedarach Syringa	Tree	1b	Eradicate	Ringbark & poison, remove small plants	12, 15, 16 17 or 18
Morus alba Mulberry	Tree	2	Eradicate	Cut & treat stump, hand pull young plants	12
Pennisetum purpureum Napier grass	Grass/reed	1b	Eradicate	Cut & spray	Try Systemic grass herbicide
Ricinus communis Castor-oil plant	Tree	1b	Eradicate	Cut & spray, hand-pull young plants	12
Rubus cuneifolius Bramble	Creeper/climber		Eradicate	Cut & treat stump, hand-pull small	-
Schinus terebinthifolius Brazilian pepper tree	Tree		Eradicate	Ringbark & poison	-
Senna didymobotrya Peanut butter cassia	Shrub	1b	Eradicate	Ringbark & poison	3, 7, 12, 16 or 17
Sesbania bispinosa Spiny sesbania	Shrub		Eradicate	Hand-pull	3, 7, 16 or 17
Solanum incanum Grey bitter apple	Shrub		Eradicate	Hand-pull	3, 7, 16 or 17
Solanum mauritianum Bugweed	Tree	1b	Eradicate	Cut & spray, hand-pull saplings	3, 7, 12, 16, 17 or 19
Tithonia diversifolia Mexican sunflower	Shrub	1b	Eradicate	Cut & treat stump, Dig up and uproot completely	12

Table 18. List of registered herbicides for use in alien plant control (after WESSA, 2008).

No.	Trade Name[1]	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

[1] For full list of active ingredients, concentrate and formulation type refer to pg 124 of WESSA 2008: Invasive Alien Plants of KZN.

No.	Trade Name[1]	Type
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

Box 2. Alien Plant Control Methods

The control methods detailed below have been adapted from the ARC-PPRI (Agricultural Research Commission: Plant Protection Research Institute) Weed Research Programme (online at www.arc.agric.za/arc-ppri/), the DWA Working for Water Programme ((http://www.dwaf.gov.za/wfw/Control/) and eThekwini Municipality's *Practical tips on the management and eradication of invasive alien plants* (EcoFiles Sheet 4. Local Action for Biodiversity).

1 Mechanical control

Mechanical control entails physically damaging or removing the target alien plant. Mechanical control is generally labour intensive and therefore expensive, and can also result in severe soil disturbance and erosion. Different techniques can be applied and include uprooting/hand-pulling, felling, slashing, mowing, ring-barking or bark stripping. This control option is only really feasible in sparse infestations or on a small scale, and for controlling species that do not coppice after cutting. Species that tend to coppice (e.g. *Eucalyptus spp., Melia azedarach)* need to have the cut stumps or coppice growth treated with herbicides following mechanical treatment.

- **Hand pulling/uprooting:** The hand-pulling should be reserved for small plants and shrubs with shallow root systems (not recommended for trees with a stem diameter of more than 10cm). Grip the young plant low down and pull out by hand (using gloves). Uprooting is similar but is undertaken on slightly older individuals with the major drawback being that a relatively large area can be disturbed with the soils being altered and opening the area up to re-infestation.
- **Chopping/ cutting/ slashing:** This method is most effective for plants in the immature stage, or for plants that have relatively woody stems/trunks. An effective method for non re-sprouters or in the case of re-sprouts (coppicing), it must be done in conjunction with chemical treatment of the cut stumps. Cut/slash the stem of the plant as near as possible to ground level. Paint re-sprouting plants with an appropriate herbicide immediately after they have been cut.
- **Strip bark:** Using a bush knife, strip bark away from tree from waist height down to soil. Cambium is stripped with the bark. No herbicide used.
- **Felling:** Large trees can be cut-down in their entirety, however, this is often not recommended unless absolutely necessary as large trees can play a pivot role in soil protection and biodiversity maintenance.
- **Girdling:** Girdling involves cutting a groove or notch into the trunk of a tree to interrupt the flow of sap between the roots and crown of the tree. The groove must completely encircle the trunk and should penetrate into the wood to a depth of at least 1.5 centimetres on small trees, and 2.5 to 4 centimetres on larger trees. The effectiveness of girdling can be increased by using herbicides.

2 Chemical control

Chemical control involves the use of registered herbicides to kill the target weed. The use of herbicide is often essential to the success of an eradication/control programme as it greatly reduces the re-growth potential of alien plants. Unfortunately, if the wrong herbicide is chosen, one can potentially cause more harm than good to the environment. When choosing the most appropriate herbicide, one needs to consider the following:

- **Relative toxicity to humans/animals**
- **Selective vs non-selective herbicides**: There are advantages and disadvantages to using each type. When dealing with light to moderate infestations in grass-dominated veld types, a broad-leaf selective herbicide is recommended so as to reduce the danger that spray drift could kill natural grass. In areas of heavy infestation, a non-selective herbicide is recommended.
- **Residual effect**: Some active ingredients in herbicides will remain in the environment for months, even years, before denaturing. Others start to denature as soon as they enter the soil. If a persistent herbicide is used, ensure that it is not used near any watercourse or area with a high water table (such as wetlands & riparian areas).
- **Is the herbicide registered for the target species:** A list of registered herbicides can be obtained from the Department of Water Affairs: Working for Water Programme – Policy on the Use of Herbicides for the

Control of Alien Vegetation (January 2002). Also see http://www.arc.agric.za/arc-ppri/Pages/Weeds%20Research/Specific-IAP-Species-and-their-control-according-to-botanical-names.aspx

Some additional recommendations regarding herbicide use include:

- Herbicides should be applied during the active growing season.
- Always observe all safety precautions printed on the labels and manufacturer's instructions when mixing and applying herbicide.
- Herbicides can be applied in various ways. They can be sprayed onto dense infestations or painted onto the main stem of the plant or cut stump.
- Spraying herbicide on small infestations is not recommended, rather cut and apply herbicide to the stumps either with a brush.
- Spraying should be restricted to windless days when there is less risk of droplets drifting onto non-target species.
- Pressure or flow regulators should be fitted to sprayers for overall application. Spraying should be restricted to plants waist height or lower, but also ensuring there is sufficient foliage to carry the applied herbicide to the root system of the target plant.
- For water-based applications, Actipron Super Wetter should be added where recommended on the herbicide label, at a rate of 1.75/ha for dense-closed stands of alien vegetation.
- For all water-based treatments, a suitable brightly coloured dye should be added to the mix to ensure that all target plants are treated. For diesel-based applications, Sudan Red Dye should be added.
- Chemical control of IAPs is not recommended in aquatic systems due to the risk of water pollution, but may be used in conjunction with cutting or slashing of plants.
- Chemicals should only be applied by qualified personnel.
- Only herbicide registered for use on target species may be used.
- Follow the manufacturer's instructions carefully.
- Appropriate protective clothing must be worn.
- Only designated spray bottles to be used for applying chemicals.
- The number of herbicides for safe use under wet conditions is very limited.

3 Biological control

Biological weed control involves the releasing of natural biological enemies to reduce the vigor or reproductive potential of an invasive alien plant. Research into the biological control of invasive alien plants is the main activity of the Weeds Research Programme of ARC-PPRI and a list of biocontrol agents released against invasive alien plants in South Africa can be downloaded from their website. To obtain biocontrol agents, provincial representatives of the Working for Water Programme or the Directorate: Land Use and Soil Management (LUSM), Department of Agriculture, Forestry and Fisheries (DAFF).

4 Mycoherbicides

A mycoherbicide is a formulation of fungal spores in a carrier, which can be applied to weeds in a similar way as a conventional chemical herbicide (using herbicide application equipment). The spores germinate on the plant, penetrating plant tissues and causing a disease which can eventually kill the plant. Mycoherbicides are indigenous to the country of use and therefore are already naturally present in the environment and do not pose a risk to non-target plants. Under natural conditions they do not cause enough damage to the weed to have a damaging impact and are therefore mass produced and applied in an inundative inoculation, which leads to an epidemic of the disease knocking the weed population down. Mycoherbicides need to be re-applied at regular intervals.

5 Integrated control

It is frequently advisable to use a combination of two or more of the control method mentioned above, which is referred to as *integrated control*. Killing plants without cutting down causes the least disturbance to the soil and is the ideal.

The following integrated control options are available:

- **Basal bark and stem application**: apply recommended herbicide mixed in diesel carrier to the base of the stem of trees (<25cm stem height) and saplings. This method is appropriate for plants with thin bark or stems up to 25cm in diameter.Do not cut the bark. Apply herbicide mix with paintbrushes or using a coarse droplet spray from a narrow angle solid cone nozzle at low pressure. For multi-stemmed plants, each stem must be treated separately.
- **Ring barking**: Invasive trees growing away from any structures or roads can be ring-barked, poisoned and left standing rather than felled. They will slowly collapse over time and can establish habitat for birds, etc. Strip all bark and cambium from a height of 75cm to 100cm down to just below soil level. Cut a ring at the top and pull strips. 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.

- **Frilling:** Using an axe or bush knife, make angled cuts downward into the cambium layer through the bark in a ring. Ensure to effect the cuts around the entire stem and apply herbicide into the cuts.
- **Cut stump treatment**: This is a highly effective and appropriate control method for larger woody vegetation that has already been cut off close to the ground. The appropriate herbicide should be applied to the stump using a paintbrush within 30 min of being cut. Apply recommended herbicide mixture to the cut surface with hand sprayers, a paintbrush or knapsack sprayer at low pressure. Apply only to the cambium or outer layer of large stumps and the entire cut surface of small stumps. Ensure the stumps are cut as low to the ground as practically possible (about 10 – 15 cm or as stipulated on specific herbicide label). 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.
- **Scrape and paint**: This method is suitable for large vines and scrambling plants i.e. creepers. Starting from the base of the stem, scrape 20-100cm of the stem to expose the sapwood just below the bark. Within 20 seconds apply the herbicide to the scraped section. Do not scrape around the stem. Stems over 1cm in diameter can be scraped in 2 sides. Leave the vines to die in place to prevent damaging any indigenous plants they may be growing over.
- **Foliar spray:** This is not an advocated method of application by unqualified applicators due to the danger of spraying indigenous species. Should be restricted to droplet application made directly on the leaves on plants that are no higher than knee height. Use a solid cone nozzle that ensures an even coverage on all leaves and stems to the point of runoff. Do not spray just before rain (a rainfall-free period of 6 hours is recommended) or before dew falls. Avoid spraying in windy weather as the spray may come into contact with non-target plants. Spraying dormant or drought stressed plants is not effective as they do not absorb enough of the herbicide.
- **Burning**: Spindly invasive alien plant species, such as Triffid Weed (*Chromolaena odorata*), growing on sandy soils, where there is between 30-40% grass still present, can be eradicated using annual controlled burns. Moderate to low infestations in wetland areas can be treated by controlled burning at the beginning of autumn, followed by mechanical removal or herbicide application in mid spring. *Note that no heavy machinery should be used to remove invasive alien plants, no matter how high the infestation, without prior authorization from relevant government departments when operating in wetlands and riverine areas.*

6 Disposal of alien plant material

Treated/removed alien plant material will need to be removed from the site and disposed of at a proper/registered receiving area such as a local registered land fill site.

➢ Addressing infilling, drainage and erosion concerns:

Existing foreign fill material, the effects of artificial drainage of the wetland and erosion/bank stability concerns are addressed here:

- Existing fill material was noted along the channelled area at the bottom end of wetland W-01 (just below the small patch of indigenous trees - see Figure 13, below). This material should be removed from the wetland and placed into the artificial drain to block this man-made channel. The natural wetland level should then be re-shaped and re-vegetated with indigenous wetland vegetation (see section on planting indigenous species, below).
- Erosion headcuts (two locations shown in Figure 13, below) should be stabilized to prevent headward migration and formation of gullies by using rockpack or concrete structure to halt erosion.
- Any eroded/unstable river banks exposed during alien plant clearing along the length of the riparian zone of R-01 will need to be addressed immediately. These areas will then need to be stabilised/repaired using suitable interventions depending on the extent/intensity of erosion/destabilisation and risk of further bank instability. Potential measures suitable for bank stabilisation may include:

- Compaction of soils on stream banks by hand (no machinery to be used within sensitive riparian areas);
- Planting of suitable indigenous ground-cover to stabilise soils on stream banks;
- Use of rock pack for eroded banks; and
- Use of gabion baskets for severely eroded banks;

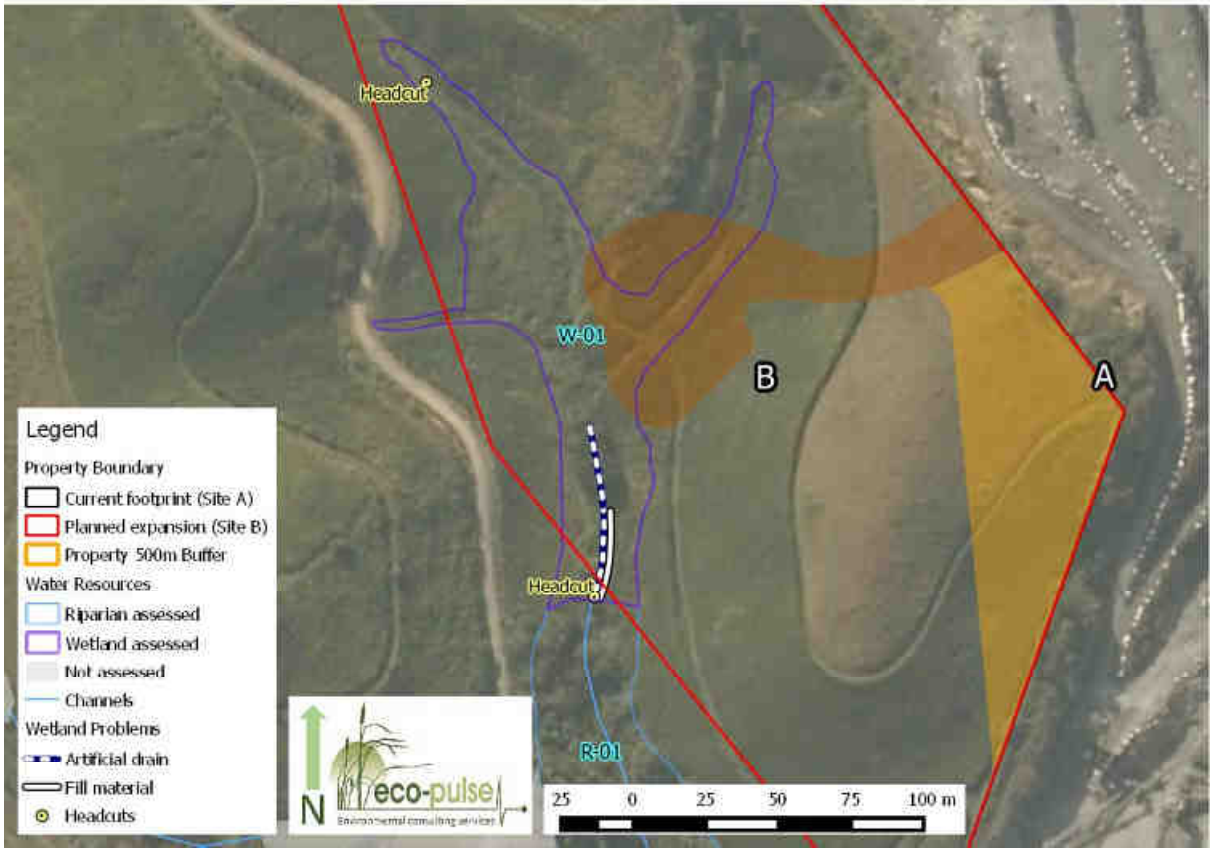

Figure 13 Map showing the location of wetland/riparian infilling and erosion concerns.

➢ **<u>Planting of indigenous wetland/riparian vegetation:</u>**

It is recommended that following alien plant removal, riparian areas R0-1 is planted with locality applicable indigenous riparian species with the aim of stabilising bare soils after alien removal and increasing the natural abundance and diversity of indigenous species. Table14 below provides a set of recommended species suitable for the planting programme.

In order to compensate for the loss of vegetation, habitat and biodiversity due to site clearing and future planned development on the developable portions of the site, ecological enhancement of remaining open space/ conservation areas on the southern edge of the site (i.e. riparian zone and stream) is proposed as a means of compensating for the loss of biodiversity on the developed portions of the site. This will be achieved through planting of suitable indigenous vegetation along the riparian zone once initial alien clearing has been completed in this zone according to **Method Statement 2**, below.

Method Statement 2. *Planting of riparian areas*

2-1 Planting procedure:

- Once the site has been cleared of alien plants, areas of bare ground (and where dense infestations have been removed), will need to be re-vegetated using a suitable indigenous plant mix.
- This will be critical in ensuring that exposed stream banks do not erode and wash downslope, in combating slope instability and erosion risks and in suppressing the re-growth of alien seed as well as serving to enhance the biodiversity of the degraded riparian zones.
- It is recommended that for each large exotic tree removed/poisoned along the riparian zone, two or three indigenous tree species be planted. Where there are large gaps in the riparian zone (i.e. where indigenous vegetation has been replaced by dense alien plant infestations), it is recommended that herb, shrub and canopy cover components be reinstated appropriately.
- The following planting procedure applies:
  - All tree holes shall be square in plan (minimum of 600mm length x 600mm width x 700mm deep).
  - Holes are to be backfilled with excavated soil in a ratio of 3:1 with compost. Where possible, any available topsoil should be placed in the hole at the level where the tree root ball will rest.
  - All trees shall be tied (using a tree tie) to a suitable timer stake planted in the ground to a depth of at least 500mm. The stake shall have a minimum diameter of 35mm and shall be at least 300mm taller than the planted tree.
  - The planting of shrubs will be in accordance with the tree planting method with the exception that the holes are to be smaller.
  - Do not plant trees in straight lines but at random with approximately 3-5m gaps between trees.

2-2 Timing:

It would be advisable to plant at the onset of the wet season (early spring – August to October) so that watering requirements are minimal. However, planting will also need to occur as soon as alien clearing has been completed so that soils/slopes are not left bare and vulnerable to erosion.

2-3 Recommended species mix:

Indigenous tree/shrub species common to coastal riparian species (many of which already occur at the site) have been included in the planting palette in Table 19 (below). These plants can be sourced from local nurseries and specifications regarding plant size and height are at the discretion of the contractor and client. *When sourcing plants from nurseries, it is important to consider the genetic origin of the plants. It is considered best to use small regional nurseries that breed plants from the region, instead of large commercial nurseries that are likely to obtain stock from large regional suppliers.*

2-4 Monitoring requirements:

The site should be monitored through visual inspections at regular intervals to determine whether planting has been successful and whether further intervention may be required.

Table 19. Recommended indigenous tree planting list for riparian areas.

Botanical Name	Description	Location
Albizia adianthifolia Flat crown	Medium to large deciduous tree	Low altitude forest and margins
Apodytes dimidiata White pear	Small-large evergreen tree	Coastal and inland forest and bushveld
Bridelia micrantha Mitzeeri	Medium to large deciduous tree	Coastal riverine and swamp forest
Cryptocarya latifolia Broad-leaved quince	Medium-large evergreen tree	Forest, often along streams
Cryptocarya woodii Cape laurel/quince	Small-medium sized evergreen tree	Forest, often along streams
Dalbergia obovata Climbing flat-bean	Robust climber	Medium altitude forest, riverine vegetation, bushveld and coastal brush
Ficus capreifolia Sandpaper fig	Shrub or small tree	Swamps, bushveld and along river banks
Ficus natalensis Natal strangler fig	Medium-large evergreen tree	Coastal forest/bush
Ficus sur Cluster fig	Medium-large semi-deciduous tree	Forest and bushveld
Macaranga capensis River macaranga	Medium to large deciduous tree	Riverine forest

Botanical Name	Description	Location
Phoenix reclinata Wild Date Palm	Palm up to 10m	On watercourses, in grasslands and forests
Psychotira capensis Blackbird tree	Shrub or small tree	Forest and forest margins
Rapanea melanophloeos Cape beech	Medium-large evergreen tree	Forest and bushclumps, usually in damp areas
Rauvolfia caffra Quinine tree	Medium to large deciduous tree	Riverine bush and coastal forest
Strelitzia nicolai Natal Wild Banana	Banana-like tree up to 12m	Common in dune bush and in evergreen forests
Syzygium cordatum Water berry	Medium-large evergreen tree	Wooded areas and forest near water
Trema orientalis Pigeonwood	Medium-large evergreen tree	Along riparian forest
Trichilia emetica Natal Mahogany	Medium-large evergreen tree	Riverine vegetation and open woodland
Trichilia dregeana Forest Mahogany	Medium-large evergreen tree	In moist forest
Trimeria grandifolia Wild mulberry	Shrub/small tree	Forest and forest margins
Voacanga thouarsii Wild frangipani	Medium-large tree	Swampy areas or stream banks

- **General guidelines and restrictions:**

Before implementation of any of the proposed mitigation measures/rehabilitation activities outlined in this section of the report, it is important to understand the following general site guidelines and restrictions:

i. **INDIGENOUS VEGETATION MAY NOT BE REMOVED DURING SITE CLEARING** for any reason whatsoever.
ii. The site is characterised by **SANDY SOILS AND THEREFORE SENSITIVE TO DISTURBANCE**. Site clearing and movement of workers/equipment within the site must therefore be aware of steep, sandy and unstable slopes and restrict movement & activities where necessary.
iii. The use of chemicals/herbicides must be **STRICTLY RESTRICTED TO A CERTIFIED HERBICDE CONTROL APPLICATOR ONLY.** The application of herbicides will need to take into account the presence of aquatic systems (wetlands/rivers) on site.
iv. Where possible, **WATER AND HERBICIDE SOLUTIONS MUST BE USED** instead of diesel and herbicide solutions. Water and herbicide solutions have lower pollution risks when compared to diesel and herbicide solutions.
v. **THE EDUCATION OF FIELD WORKERS IS VERY IMPORTANT** as they will be primarily responsible for undertaking the rehabilitation work.
vi. **WORKERS MUST BE STRICTLY MONITORED** by a suitable trained site supervisor as they undertake rehabilitation.
vii. All **VEHICLES USED TO ACCESS THE SITE AND TRANSPORT EQUIPMENT MUST BE RESTRICTED TO EXISTING ACCESS ROADS ONLY.** Under no circumstance are vehicles to be used within wetlands/riparian areas for works or transporting equipment/labour.
viii. **GOOD TIMING AND FOLLOW-UPS ARE VERY IMPORTANT** for a successful rehabilitation process which often generally capital expense in the long-term.
ix. **BASIC EQUIPMENT REQUIREMENTS:** alien plant control teams must wear the necessary personal protective clothing (PPE) and use appropriate equipment to do the work. This should include the following where relevant:
    a. Long overalls
    b. Eye protection (safety googles/glasses)
    c. Protective gloves

d. Safety boots/gum boots
e. Sun protection hats/caps
f. Bush knives, machetes, saws, axes, chainsaws, etc.
g. Registered herbicides and diesel carrier
h. Paintbrushes, spray jets to apply herbicide
i. Drinking water

5.3 Implementation and monitoring

In terms of Section 2 and Section 28 of NEMA (National Environmental Management Act, 1998), the land owner is responsible for any environmental damage, pollution or ecological degradation caused by their activities "inside and outside the boundaries of the area to which such right, permit or permission relates". In dealing with the range of potential ecological impacts to natural ecosystems and biodiversity highlighted in this report, it is recommended that management, mitigation and rehabilitation guidelines (sections 5.1 and 5.2 of this report) be incorporated into an **Environmental Management Programme (EMPr)** for the quarry operation. The EMPr should define the responsibilities, budgets and necessary training required for implementing the recommendations made in this report. This will need to include appropriate monitoring as well as impact management and the provision for regular auditing to verify environmental compliance. Compliance with the EMPr should be monitored by a suitably qualified/trained ECO (Environmental Control Officer) with any additional supporting EO's (Environmental Officers) having the required competency skills and experience to ensure that environmental mitigation measures are being implemented and appropriate action is taken where potentially adverse environmental impacts are highlighted through monitoring and surveillance. The ECO will need to be responsible for conducting regular site-inspections and report back to the relevant environmental authorities with findings of these investigations. The ECO will also need to be responsible for preparing a **monitoring programme** to evaluate compliance with the management measures stipulated in the EMPr. Ecological monitoring should form part of the monitoring programme for the site, and it is recommended that this include the following:

- **Water quality monitoring:**

Given the nature of the quarry operation, key water quality threats include runoff contaminated by large amounts of fine sediment, runoff containing cement-based products and the risk of water contamination by hazardous substances such as chemicals, oils and fuels. It is therefore recommended that a suitable environmental water quality monitoring programme be developed and implemented for the site to ensure that runoff water from the quarry operation and adjacent concrete batching plant being discharged into the Vungu River and tributary to the west is of a suitable standard (according to applicable DWS standards for environmental water quality). This is of particular importance given the importance and sensitivity of the Vungu River and downstream estuary and the need to protect these resources and their associated biota from cumulative water quality impacts. It is understood that Aquatic Bio-Monitoring is currently being undertaken and that the independent specialists responsible for undertaking these surveys have recommended that bi-annual bio-monitoring be undertaken to determine the full impact of the quarry operations on the Vungu River and to build

up a database for the river (Knight Piesold, 2015). The ecologists from Eco-Pulse consulting are in support of this recommendation for water quality, diatoms and SASS sampling and analysis to be performed for the river system on a bi-annual basis.

5.4 Additional requirements: *Licensing & permits*

5.4.1 *Water Use Licensing Requirements*

Section 21 of the National Water Act (No 36 of 1998) lists certain activities for which water use must be licensed, unless its use is excluded. There are several reasons why water users are required to register and license their water use with the Department of Water and Sanitation (DWS), the most important being: to manage and control water resources for planning and development; to protect water resources against over-use, damage and impacts; and to ensure fair allocation of water among users.

The following Section 21 water uses are triggered by the quarry operation and will require a Water Use License from the DWS:

NWA Section 21 Water Use	Description pertaining to the project
21(a):Taking water from a watercourse	*It is understood that water certificates have been obtained for the current abstraction of water from the Vungu River for quarry operations and a WUL is all that is required (this is being applied for).*
21(c): Impeding[2] or diverting[3] the flow of water in a watercourse	Infilling for road embankment is impeding flows from reaching downstream areas in wetland W-01 are associated with Section 21 (c) and (i) water use. Wetlands within a 500m buffer of the site are associated with Section 21 (c) and (i) water use.
21(i): Altering the bed, banks, course or characteristics of a water course[4]	
21(g): Disposing of waste in manner which may detrimentally impact on water resource	Use of water containing waste for dust suppression.

*Note that **General Authorization No. 542** (as published in the Government Gazette No. 32212, dated 15 May 2009) replaces the need for a water user to apply for a license for water use in terms of Section 21 (a), (c) and (i) of the National Water Act, provided that the use is within the conditions set out in the General Authorisation (GA). Currently Section 21 (c) and (i) GAs do not apply to the use of water within a 500m radius from the boundary of any watercourse, including wetlands and rivers.*

[2] ***Impeding the flow*** - means the temporary or permanent obstruction or hindrance to the flow of water into watercourse by structures built either fully or partially in or across a watercourse (DWAF, 2009).

[3] ***Diverting the flow*** - means a temporary or permanent structure causing the flow of water to be re-routed in a watercourse for any purpose (DWAF, 2009)

[4] **Altering the bed and banks** - means any change affecting the resource quality of the watercourse (the area within the riparian habitat or 1:100 year floodline, whichever is the greatest) (DWAF, 2009)

5.4.2 *Permits to remove protected indigenous plants*

Schedule 12 of the (KZN) Nature Conservation Ordinance (No. 15 of 1974) lists Specially Protected Plants that are regulated in terms of activities that can take place with respect to harvesting, selling, importing, trading and handling of these plant species. On application by a landowner wishing to develop his land in such a manner that such development may cause damage or destruction to specially protected indigenous plants, a permit for the relocation of such plants may be granted. Species listed under Schedule 12 (Specially Protected Plants) that require a permit for their relocation/removal includes all Liliaceae, thus including ***Scadoxus puniceus*** (Snake lily) and ***Zantedeschia aethiopica*** (Arum lily) which occur within the various riparian habitats at the site.

6. CONCLUSION

The **Margate quarry operated by South Coast Stone Crushers (SCSC)** is located on the Vungu River near Margate/Uvongo (southern KwaZulu-Natal) and has been operating for a number of years, with an existing EMPr in place under the MPRDA. SCSC seeks to expand operations into adjacent land and as part of the existing operation and planned expansion, SRK Consulting has been appointed by SCSC to update and amend the existing EMPr to be compliant with NEMA. Eco-Pulse Environmental Consulting Services was subsequently appointed to undertake a specialist assessment of aquatic ecosystems (including wetlands and rivers affected by the quarry operations) in order to inform the environmental assessment and Water Use License application processes being undertaken by SRK on behalf of SCSC.

The **Specialist Aquatic Assessment** of wetlands and river ecosystems associated with the quarry operation identified a **small seepage wetland** (~0.75 ha in extent) and **two riverine/riparian areas** associated with the Vungu River and tributary located at the quarry site and adjacent area. The seepage wetland and small tributary river connected downstream were found to be in a Largely to Seriously Modified state and of Low Ecological Importance and Sensitivity. The perennial Vungu River which passes through the quarry was found to be Moderately Modified state and has an estimated Moderately-High Ecological Importance and Sensitivity. **Existing impacts and potential ecological risks to the wetland and two riverine/riparian areas associated with the quarry were identified, described and assessed** in terms of the level of significance of impacts/risks to aquatic resources, and were found to be moderate-high in terms of impact significance levels, in the absence of mitigation/corrective action. In order **to address impacts associated with the current operation as well as the proposed quarry expansion, practical on-site mitigation and corrective actions** were recommended and should be used in the amendment of the **Environmental Management Programme (EMPr)** for the quarry operation, which should be implemented as soon as possible. The mitigation measures and corrective/remedial actions recommended in the specialist aquatic report include:

- Practical measures for dealing with contaminated storm water runoff from the quarry site;
- Recommendations to improve flood protection and erosion/sediment controls at the site;
- Wetland buffer zones for wetland W-01 to protect wetland and prevent further degradation/impact during quarry expansion;
- Onsite rehabilitation of wetland and riparian habitat as compensation for wetland loss at W-01, with the objectives being to improve the condition, biodiversity and functioning of the remaining semi-intact aquatic habitats and to deal with alien plant infestations affecting the various wetlands and riparian areas; and
- Development and implementation of an ecological monitoring programme, including environmental water quality monitoring.

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ANNEXURES

ANNEXURE A: Details of assessment methods used.

A1 Wetland/Riparian delineation

- **Wetland delineation**

The outer boundary of wetlands was identified and delineated according to the Department of Water Affairs wetland delineation manual '*A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas' (*DWAF, 2005). Three specific wetland indicators were used in the detailed field delineation of wetlands, which include:

1. **Terrain unit indicator**

A practical index used for identifying those parts of the landscape where wetlands are likely to occur based on the general topography of the area.

2. **Wetland vegetation indicator**

Vegetation in an untransformed state is a useful guide in finding the boundary of a wetland as plant communities generally undergo distinct changes in species composition as one proceeds along the wetness gradient from the centre of a wetland towards adjacent terrestrial areas. An example of criteria used to classify wetland vegetation and inform the delineation of wetland zones is provided in Table 20.

Table 20. Criteria used to inform the delineation of wetland habitat based on wetland vegetation (adapted from Macfarlane *et al., 2007* and DWAF, 2005).

Vegetation	Temporary wetness zone	Seasonal wetness zone	Permanent wetness zone
Herbaceous	Mixture of non-wetland species and hydrophilic plant species restricted to wetland areas	Hydrophilic sedges and grasses restricted to wetland areas	Emergent plants including reeds and bulrushes; floating or submerged aquatic plants
Woody	Mixture of non-wetland and hydrophilic species restricted to wetland areas	Hydrophilic woody species restricted to wetland areas	Hydrophilic woody species restricted to wetland areas with morphological adaptations to prolonged wetness (e.g.: prop roots)

SYMBOL	HYDRIC STATUS	DESCRIPTION/OCCURRENCE
Ow	Obligate wetland species	Almost always grow in wetlands (>90% occurrence)
Fw	Facultative wetland species	Usually grow in wetlands (67-99% occurrence) but occasionally found in non-wetland areas
F	Facultative species	Equally likely to grow in wetlands (34-66% occurrence) and non-wetland areas
Fd	Facultative dry-land species	Usually grow in non-wetland areas but sometimes grow in wetlands (1-34% occurrence)
D	Dryland/terrestrial species	Almost always grow in drylands (terrestrial/non-wetland)

3. Soil wetness indicator

According to the wetland definition used in the National Water Act (NWA, 1998), vegetation is the primary indicator which must be present under normal circumstances. However, in practice the soil wetness indicator (informed by investigating the top 50cm of wetland topsoil) tends to be the most important, and the other three indicators are used to refine the assessment. The reason for this is that vegetation responds relatively quickly to changes in soil moisture and may be transformed by local impacts; whereas the soil morphological indicators are far more permanent and will retain the signs of frequent saturation (wetland conditions) long after a wetland has been transformed/drained (DWAF, 2005a). Thus the on-site assessment of wetland indicators focused largely on using soil wetness indicators, determined through soil sampling with a soil auger, with vegetation and topography being a secondary indicator. A Munsell Soil Colour Chart was used to ascertain soil colour values including hue, colour value and matrix chroma as well as degree of mottling in order to inform the identification of wetland (hydric) soils. Soil sampling points were recorded using a GPS (Global Positioning System) and captured using Geographical Information Systems (GIS) for further processing. An example of soil criteria used to assess the presence of wetland soils is provided below in Table 21 while Figure 14 provides a conceptual overview of soil and vegetation characteristics across the different wetness zones.

Table 21. Soil criteria used to inform wetland delineation using soil wetness as an indicator (after DWAF, 2005).

Soil depth	Temporary wetness zone	Seasonal wetness zone	Permanent wetness zone
0 – 10cm	**Matrix chroma**: 1- 3 (Grey matrix <10%) **Mottles**: Few/None high chroma mottles **Organic Matter**: Low **Sulphidic**: No	**Matrix chroma**: 0- 2 (Grey matrix >10%) **Mottles**: Many low chroma mottles **Organic Matter**: Medium **Sulphidic**: Seldom	**Matrix chroma**: 0- 1 (Prominent grey matrix) **Mottles**: Few/None high chroma mottles **Organic Matter**: High **Sulphidic**: Often
30 – 50cm	**Matrix chroma**: 0 – 2 **Mottles**: Few/Many	As Above	As Above

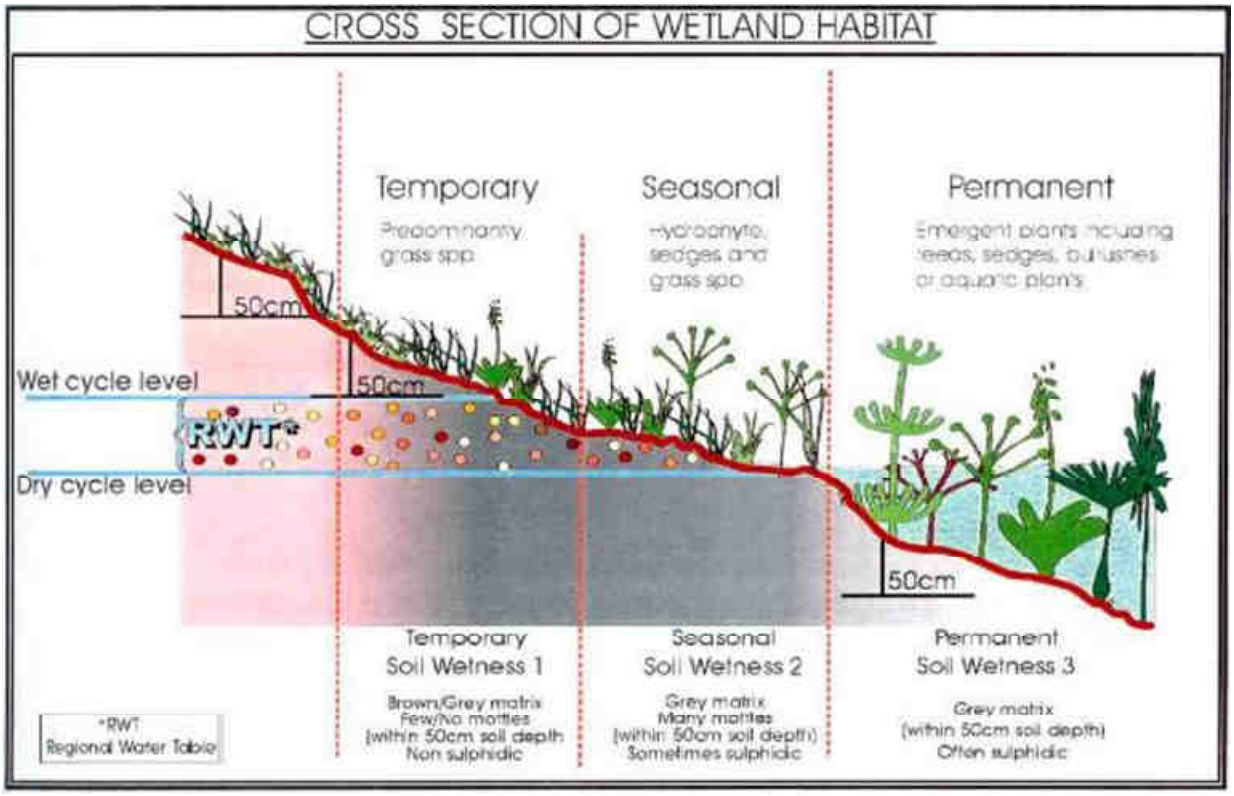


Figure 14 Diagram representing the different zones of wetness found within a wetland (DWAF, 2005).

- **Delineation of riparian areas**

The location of drainage features and boundary of any riparian areas (also known as the riparian zone) was delineated according to the methods in the Department of Water Affairs wetland delineation manual *'A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas' (*DWAF, 2005*)*. According to the manual, this involves marking the outer edge of the macro-channel bank and associated vegetation. Like wetlands, riparian areas have their own unique set of indicators required in order to delineate these features. Delineation of riparian areas generally requires that the following be taken into account:

- **Topography associated with the watercourse**: the outer edge of the macro-channel bank associated with a river/stream provides a rough indication of the outer edge of a riparian area.
- **Vegetation**: this is the primary indicator of a riparian area, whereby the edge of the riparian zone is defined as the zone where a distinctive change in species composition and physical structure occurs between those of surrounding/adjacent terrestrial areas. In this case a combination of aerial photography analysis and on-site field information (pertaining to the vegetation health, compactness, crowding, size, structure and numbers of individual plants) was used to differentiate between riparian and terrestrial vegetation.
- **Alluvial soils and deposited material**: this includes relatively recently deposited sand, mud, etc. deposited by flowing water that can be used to confirm the topographical and vegetation indicators.

A2 Classification of wetlands

For the purposes of this study, wetlands were classified according to HGM (hydro geomorphic) type (Level 4A classification level) using the National Wetland Classification System which was developed for the South African National Biodiversity Institute (SANBI, 2013) as outlined in Table 22, below.

Table 22. Wetland classification (after SANBI, 2013).

LEVEL 3	LEVEL 4A	
Landscape Setting	**HGM Type**	**Description**
SLOPE	Channel (river)	*Areas of channelled flow including rivers and streams where water is largely confined to a main channel during low flows. Flood waters may over top the banks of the channel and spread onto an adjacent floodplain*
	Hillslope seep	*Wetlands on slopes formed mainly by the discharge of sub-surface water.*
VALLEY FLOOR	Channel (river)	*River channels in a valley floor setting.*
	Channelled valley-bottom wetland	*Valley floors with one or more well-defined stream channels, but lacking characteristic floodplain features.*
	Unchannelled valley-bottom wetland	*Valley floors with no clearly defined stream channel.*
	Floodplain wetland	*Valley floors with a well-defined stream channel, gently sloped and characterised by floodplain features such as oxbows and natural levees.*
	Depression	*Basin-shaped areas that allow for the accumulation of surface water, an outlet may be absent (e.g. pans).*
	Valleyhead seep	*Seeps located at the head of a valley, often the source of streams.*
PLAIN	Channel (river)	*River channels in a plain landscape setting.*
	Floodplain wetland	*Floodplain wetlands as above but in a plain landscape setting.*
	Unchannelled valley-bottom wetland	*Unchannelled valley bottom type wetlands as above but in a plain landscape setting.*
	Depression	*Depression type wetlands as above but in a plain landscape setting.*
	Flat	*Extensive areas characterised by level, gently undulating or uniformly sloping land with a very gentle gradient.*
BENCH (HILLTOP / SADDLE / SHELF)	Depression	*Depression wetlands located on a bench.*
	Flat	*Flat wetlands located on a bench.*

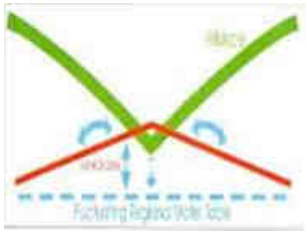
A3 Classification of riparian areas

Channels within the project areas were mapped in GIS using a combination of digital satellite imagery in conjunction with GPS points and data captured in the field. The classification of channels was based on the size of channels (Table 23) and the nature of flows through the channel (Table 24).

Table 23. Classification of channels according to channel size.

CHANNEL WIDTH	RESOURCE DESCRIPTION
>10 m	**Major Rivers**
2 – 10 m	**Rivers**
<2 m	**Streams**

Table 24. Classification of channels according to nature of flows

	CHANNEL SECTION (CLASS)		
	"A" type	**"B" type**	**"C" type**
	Ephemeral systems	**Weakly ephemeral to seasonal systems**	**Perennial systems**
DESCRIPTION	A water-course that has no riparian habitat and no soil hydromorphy (ie. strongly ephemeral systems). Signs of wetness rarely persist in the soil profile	A water-course with riparian vegetation/habitat and intermittent base flow (ie. weakly ephemeral to non-perennial/seasonal systems). These channels show signs of wetness indicating the presence of water for significant periods of time.	A water-course with permanent-type riparian vegetation/habitat, permanent base flow and permanent inundation (ie. perennial systems).
HYDROLOGY	A-section channels are situated well above the zone of saturation (no direct contact between surface water system and ground water system) and hence do not carry base-flows They do however carry storm water runoff following intense rainfall events (ephemeral), but this is generally short-lived.	Channel bed situated within the zone of the seasonally fluctuating regional water table (ie. intermittent base flow depending on water table). Periods of no flow may be experienced during dry periods, with residual pools often remaining within the channel.	Water course is situated within the zone of the permanent saturation, meaning flow is all year round except in the case of extreme drought.
TOPOGRAPHICAL POSITION	Valley head (upper reaches of catchments). Channel type also linked to steep slopes which are responsible for water leaving the system rapidly.	Mid-section of valley (middle reaches of catchments).	Valley bottom areas (middle to lower reaches of catchments).
DIAGRAM			

A4 WET-Health Assessment: Wetland Present Ecological State

The WET-Health tool (Macfarlane *et al*, 2008) provides an appropriate framework for undertaking an assessment to indicate the functional importance of the wetland system that could be impacted by the proposed development. The assessment also helps to identify specific impacts thereby highlighting issues that should be addressed through mitigation and rehabilitation activities. For the purposes of this study, a Level 1 assessment was undertaken. While this is a rapid assessment, we regard it as adequate to inform an assessment of existing impacts on wetland condition. This approach relies on a combination of desktop and on-site indicators to assess various aspects of wetland condition, including:

- ***Hydrology*:** defined as the distribution and movement of water through a wetland and its soils.

- ***Geomorphology*:** defined as the distribution and retention patterns of sediment within the wetland.
- ***Vegetation*:** defined as the vegetation structural and compositional state.

Each of these modules follows a broadly similar approach and is used to evaluate the extent to which anthropogenic changes have impacted upon wetland functioning or condition. While the impacts considered vary considerably across each module, a standardized scoring system is applied to facilitate the interpretation of results (Table 25). Scores range from 0 indicating no impact to a maximum of 10 which would imply that impacts had totally destroyed the functioning of a particular component. The reader is encouraged to refer back to the tables below to help interpret the results presented in the site assessment.

Table 25. Guideline for interpreting the magnitude of impacts on wetland integrity (after Macfarlane *et al.*, 2008).

IMPACT CATEGORY	DESCRIPTION	Score
None	No discernible modification or the modification is such that it has no impact on this component of wetland integrity.	0 – 0.9
Small	Although identifiable, the impact of this modification on this component of wetland integrity is small.	1 – 1.9
Moderate	The impact of this modification on this component of wetland integrity is clearly identifiable, but limited.	2 – 3.9
Large	The modification has a clearly detrimental impact on this component of wetland integrity. Approximately 50% of wetland integrity has been lost.	4 – 5.9
Serious	The modification has a highly detrimental effect on this component of wetland integrity. Much of the wetland integrity has been lost but remaining integrity is still clearly identifiable.	6 – 7.9
Critical	The modification is so great that the ecosystem processes of this component of wetland integrity are almost totally destroyed, and 80% or more of the integrity has been lost.	8 – 10

Impact scores obtained for each of the modules reflect the degree of change from natural reference conditions. Resultant health scores fall into one of six health categories (A-F) on a gradient from "unmodified/natural" (Category A) to "severe/complete deviation from natural" (Category F) as depicted in Table 26, below. This classification is consistent with DWAF categories used to evaluate the present ecological state of aquatic systems.

Table 26. Health categories used by WET-Health for describing the integrity of wetlands (after Macfarlane *et al.*, 2008).

PES CATEGORY	DESCRIPTION	RANGE
A	Unmodified, natural.	0 – 0.9
B	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1 – 1.9
C	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact	2 – 3.9
D	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4 – 5.9
E	The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6 – 7.9
F	Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8 – 10

An overall wetland health score was calculated by weighting the scores obtained for each module and combining them to give an overall combined score using the following formula:

Overall health rating = [(Hydrology*3) + (Geomorphology*2) + (Vegetation*2)] / 7

This overall score assists in providing an overall indication of wetland health/functionality which can in turn be used for recommending appropriate management measures.

It should be noted that while WET-Health is the most appropriate technique currently available to undertake assessments of this nature, it is nonetheless a rapid assessment tool that relies on qualitative information and expert judgment. While the tool has been subjected to an initial peer review process, the methodology is still being tested and will be refined in subsequent versions. WET-Health datasheets will be made available to the client on request.

A5 Assessment of wetland functional importance: ecosystem goods and services

The effectiveness and importance of wetlands in providing ecosystem goods and services was rated using a modified level 1 (rapid) WET-Ecoservices (Kotze *et al.*, 2009) assessment method. Common wetland ecosystem goods and services that were evaluated using the WET-Ecoservices tool are described in Table 27, below.

Table 27. Descriptions of common wetland ecosystem goods and services (after Kotze *et al.*, 2009).

ECOSYSTEM SERVICE	Description
Flood Attenuation	*Refers to the effectiveness of wetlands at spreading out and slowing down storm flows and thereby reducing the severity of floods and associated impacts.*
Stream Flow Regulation	*Refers to the effectiveness of wetlands in sustaining flows in downstream areas during low-flow periods.*
Sediment Trapping	*Refers to the effectiveness of wetlands in trapping and retaining sediments from sources in the catchment.*
Nutrient & Toxicant Retention and Removal	*Refers to the effectiveness of wetlands in retaining, removing or destroying nutrients and toxicants such as nitrates, phosphates, salts, biocides and bacteria from inflowing sources, essentially providing a water purification benefit.*
Erosion Control	*Refers to the effectiveness of wetlands in controlling the loss of soil through erosion.*
Carbon Storage	*Refers to the ability of wetlands to act as carbon sinks by actively trapping and retaining carbon as soil organic matter.*
Biodiversity Maintenance	*Refers to the contribution of wetlands to maintaining biodiversity through providing natural habitat and maintaining natural ecological processes.*
Water Supply	*Refers to the ability of wetlands to provide a relatively clean supply of water for local people as well as animals.*
Harvestable Natural Resources	*Refers to the effectiveness of wetlands in providing a range of harvestable natural resources including firewood, material for construction, medicinal plants and grazing material for livestock.*
Cultivated Foods	*Refers to the ability of wetlands to provide suitable areas for cultivating crops and plants for use as food, fuel or building materials.*
Food for Livestock	*Refers to the ability of wetlands to provide suitable vegetation as food for livestock.*
Cultural significance	*Refers to the special cultural significance of wetlands for local communities.*
Tourism & Recreation	*Refers to the value placed on wetlands in terms of the tourism-related and recreational benefits provided.*
Education & Research	*Refers to the value of wetlands in terms of education and research opportunities, particularly concerning their strategic location in terms of catchment hydrology.*

The level of predicted importance of ecosystem services provided by wetlands was rated according to the rating table found in Table 28, below. This was informed by wetland characteristics that affect the ability of wetlands to supply benefits and local and catchment context that affects the demand placed on wetlands to provide goods and services.

Table 28. Rating table used to rate level of ecosystem supply.

Rating	Importance or level of supply of ecosystem services
Low	The wetland is not considered to be important for providing this service/benefit.
Moderately-Low	The importance of the wetland in providing ecosystem goods and services is regarded as moderately low.
Moderate	The wetland is considered important for providing this particular ecosystem service to a moderate degree.
Moderately-High	The wetland is considered important for providing this particular ecosystem service to a high degree.
High	The wetland is considered very important for providing this particular ecosystem service to a high degree.

This WET-Ecoservices tool has however been updated by Eco-Pulse Environmental Consulting Services to provide a more robust assessment of the importance value of different wetland functions. This involved separately scoring demand for and supply of each function considered and then integrating these scores into a composite importance score. The level of predicted importance of ecosystem services provided by wetlands was classified according to the rating table found in Table 29, below. This was informed by wetland characteristics that affect the ability of wetlands to supply benefits and local and catchment context that affects the demand placed on wetlands to provide goods and services.

Table 29. Rating table used to rate the importance of ecosystem goods and services based on joint consideration of supply and demand (mid-points of classes used here for illustrative purposes).

	Demand				
Supply	**Low**	**Moderately-Low**	**Moderate**	**Moderately-High**	**High**
Low	Low	Low	Low	Low	Moderately-Low
Moderately-Low	Low	Moderately-Low	Moderately-Low	Moderately-Low	Moderate
Moderate	Low	Moderately-Low	Moderate	Moderate	Moderately-High
Moderately-High	Low	Moderately-Low	Moderate	Moderately-High	High
High	Moderately-Low	Moderate	Moderately-High	High	High

A6 Wetland Ecological Importance and Sensitivity (EIS)

The outcomes of the wetland Present State and Functional assessments were used to inform an assessment of the Ecological Importance and Sensitivity (EIS) of wetlands using the Wetland EIS assessment tool (developed by Eco-Pulse, 2015). The Wetland EIS tool includes an assessment of three components:

- Biodiversity support;
- Landscape scale importance;
- Functional importance (hydrological benefits);
- Sensitivity of the wetland to flow and water quality changes; and

- A range of "modifying determinants" including wetland size, condition and connectivity.

The maximum score for these components was taken as the importance rating for the wetland which is rated using Table 30, below.

Table 30. Rating table used to rate EIS (Eco-Pulse, 2015).

Rating	Explanation
Very Low/None, Rating: 0 – 0.5	Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications. They play a limited functional role in the landscape.
Low, Rating: 0.6 – 1.5	
Moderate, Rating: 1.6 -2.7	Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. They play a small functional role in the landscape.
High, Rating: 2.8 – 3.5	Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. They generally play a large functional role in the landscape.
Very high, Rating: >3.5	Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications. They generally play a major functional role in the landscape.

A7 Present Ecological State (PES) of riparian areas

Habitat is one of the most important factors that determine the health of river ecosystems since the availability and diversity of habitats (in-stream and riparian areas) are important determinants of the biota that are present in a river system (Kleynhans 1996). The Present Ecological State (PES) of rivers and streams within the proposed development site was assessed using a modified IHI (Index of Habitat Integrity) tool (EcoQuat Model), designed by DWS to provide a rapid assessment of river condition. The method considers in-stream and riparian habitat integrity to provide an overall rating of river PES. This is achieved by rating the six simple metrics below to obtain an indication of PES:

- Bed modification
- Flow modification
- Inundation
- Bank condition
- Riparian zone condition
- Water quality modification

This assessment was informed by (i) a site visit where potential impacts to each metric were assessed and evaluated and (ii) an understanding of the catchment feeding the river and upstream/adjacent land use / activities that could have a detrimental impact on the integrity of river ecosystems.

A8 Ecological Importance and Sensitivity (EIS) for riparian areas

The Ecological Importance and Sensitivity (EIS) of riparian areas is an expression of the importance of the aquatic resource for the maintenance of biological diversity and ecological functioning on local

and wider scales; whilst Ecological Sensitivity (or fragility) refers to a system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (Kleynhans & Louw, 2007). For the purposes of this assessment, the EIS assessment for riparian areas was based on rating the following criteria using the scheme in Table 31:

- **Riparian & in-stream biota**: referring to the presence and status of biota (*including fauna & flora)*. This includes aspects of species richness/diversity, the presence of rare/endangered species, unique species/endemics, species that are sensitive to changes in flows/water quality.
- **Riparian & in-stream habitat:** including the diversity of habitat types within the in-stream and riparian zones, the sensitivity of habitats to changes in flow/water quality and the importance of riparian areas as migration routes/ecological corridors as well as the conservation importance of areas.

Table 31. Rating scheme used to rate EIS for riparian areas.

CRITERIA	RATING SCORE				
	0	1	2	3	4
Presence of rare/endangered species	None	Low	Moderate	High	Very High
Presence of unique/endemic species					
Presence of species considered intolerant/sensitive to changes in flows/water quality					
Diversity of habitat types	Very Low	Low	Moderate	High	Very High
Presence of refugia/Refuge value of habitat types					
Habitat sensitivity to changes in flow					
Habitat sensitivity to changes in water quality					
Importance in terms of migration routes/ecological corridors					
Conservation importance	None	Low (Local level)	Moderate (Provincial level)	High (National level)	Very High (National/ International level)

The scores assigned to the criteria in Table 31 were used to rate the overall EIS of each mapped unit according to Table 32, below, which was based on the criteria used by DWS for river eco-classification (Kleynhans & Louw, 2007) and the WET-Health wetland integrity assessment method (Macfarlane *et al*., 2008).

Table 32. EIS classes used to inform the assessment (after Kleynhans & Louw, 2007).

EIS Score	EIS Rating	General Description
0	**None/ Negligible**	Features that are highly transformed and have no ecological importance at any scale. Such features have a very low sensitivity to anthropogenic disturbances.
1	**Very Low**	Features are not ecologically important and sensitive at any scale. The biodiversity of these areas is typically ubiquitous with low sensitivity to anthropogenic disturbances and play an insignificant role in providing ecological services.

EIS Score	EIS Rating	General Description
2	Low	Features regarded as somewhat ecologically important and sensitive at a local scale. The functioning and/or biodiversity features have a low-medium sensitivity to anthropogenic disturbances. They typically play a very small role in providing ecological services at the local scale.
3	Moderate	Features that are considered to be ecologically important and sensitive at a local scale. The functioning and/or biodiversity of these features is not usually sensitive to anthropogenic disturbances. They typically play a small role in providing ecological services at the local scale.
4	High	Features that are considered to be ecologically important and sensitive at a regional scale. The functioning and/or biodiversity of these features are typically moderately sensitive to anthropogenic disturbances. They typically play an important role in providing ecological services at the local scale.
5	Very High	Features that are considered ecologically important and sensitive on a national or even international level. The functioning and/or biodiversity of these features are usually very sensitive to anthropogenic disturbances. This includes areas that play a major role in providing goods and services at a local or regional level.

A9 Impact significance assessment

For the purposes of this assessment, the assessment of potential impacts was undertaken based on the principles of the "Impact Assessment Methodology for EIAs" provided by SRK Consulting. This assessment was informed by baseline aquatic information contained in this report relating to the sensitivity of habitats and potential occurrence of protected species as well as information on the proposed development provided by the client and experience in similar projects.

Once potential impacts had been identified, the significance of these impacts to the receiving environment and beneficiaries of wetland services was then assessed under two scenarios:

(a) in the absence of any mitigation; and

(b) where proposed mitigation and management measures have been implemented.

The **nature** of each identified environmental impact was described as well as the **impact status** (positive, negative or neutral effect). The **consequence** of each impact was determined by summing the rating scores for **extent, intensity** and **duration** of each potential impact according to the criteria defined in Table 33, below.

Table 33. Criteria and numerical values for rating environmental impacts.

Rating	Definition of Rating	Score
A. *Extent– the area over which the impact will be experienced*		
Local	Confined to project or study area or part thereof (e.g. site)	1
Regional	The region, which may be defined in various ways, e.g. cadastral, catchment, topographic	2
(Inter) national	Nationally or beyond	3
B. *Intensity– the magnitude of the impact in relation to the sensitivity of the receiving environment, taking into account the degree to which the impact may cause irreplaceable loss of resources*		
Low	Site-specific and wider natural and/or social functions and processes are negligibly altered	1
Medium	Site-specific and wider natural and/or social functions and processes continue albeit in a modified way	2

High	Site-specific and wider natural and/or social functions or processes are severely altered	3
C. Duration– the timeframe over which the impact will be experienced and its reversibility		
Short-term	Up to 2 years (i.e. reversible impact)	1
Medium-term	2 to 15 years (i.e. reversible impact)	2
Long-term	More than 15 years (state whether impact is irreversible)	3

Combined Score (A+B+C)	3 – 4	5	6	7	8 – 9
Consequence Rating	Very low	Low	Medium	High	Very high

The **probability** or likelihood of the impact occurring was then estimated using the following rating scheme:

Rating	Probability
Improbable	< 40% chance of occurring
Possible	40% - 70% chance of occurring
Probable	> 70% - 90% chance of occurring
Definite	> 90% chance of occurring

Impact significance was then rated using the consequence and probability ratings assigned to impacts and through the application of the impact significance rating matrix in Table 34, below. Definitions for the different impact significance categories are provided below in Table 35.

Table 34. Matrix used to rate impact significance based on impact probability and consequence.

		Consequence				
		Very High	**High**	**Medium**	**Low**	**Very Low**
Probability	**Definite**	Very High	High	Medium	Low	Very Low
	Probable	Very High	High	Medium	Low	Very Low
	Possible	High	Medium	Low	Very Low	Insignificant
	Improbable	High	Medium	Low	Very Low	Insignificant

Table 35. Impact significance categories and definitions.

Impact Significance	Definition
Very High	The proposed activity should only be approved under special circumstances.
High	The potential impact will affect a decision regarding the proposed activity.
Medium	The potential impact should influence the decision regarding the proposed activity.
Low	The potential impact may not have any meaningful influence on the decision regarding the proposed activity.
Very Low	The potential impact is very small and should not have any meaningful influence on the decision regarding the proposed activity.
Insignificant	The potential impact is negligible and will not have an influence on the decision regarding the proposed activity.

A confidence rating was also given to the impacts rated in accordance with Table 36, below:

Table 36. Confidence ratings used when assigning impact significance ratings.

Level of confidence	Contributing factors affecting confidence
Low	A low confidence level is attributed to a low-moderate level of available project information and somewhat limited data and/or understanding of the receiving environment.
Medium	The confidence level is medium, being based on specialist understanding and previous experience of the likelihood of impacts in the context of the development project with a relatively large amount of available project information and data related to the receiving environment.
High	The confidence level is high, being based on quantifiable information gathered in the field.

ANNEXURE B1: Wetland delineation field assessment details.

GENERAL	**Wetland Reference:**	**Margate Quarry wetland W-01**				
	Date of Field Assessment:	28 Jan 2015				
	Weather Conditions:	Overcast with light drizzle				
	Extent (area) of wetlands:	0.75ha				
	Site Disturbance:	Infilling, dense alien vegetation, soil erosion, dumping				
	Wetland Indicators Present:	☒ **Terrain unit indicator** ☒ **Soil type Indicator**		☒ **Soil wetness indicator** ☒ **Vegetation indicator**		
	Difficulties Encountered	Fill material and soil mixing from construction of roads, historical and active cultivation & artificial drainage made soil and vegetation sampling and delineation of the wetland boundary difficult in certain sections of the wetland				
WETLAND CLASSIFICATION	**Landscape setting (Level 3)**	☒ slope ☐ plain		☒ valley floor ☐ bench		
	Hydrogeomorphic type (Level 4A)	☐ Channelled valley bottom ☒ Unchannelled valley bottom ☒ Hillslope seep ☐ Valley head seep ☐ Artificial		☐ Floodplain ☐ Channel ☐ Depression ☐ Flat		
	Landform (Level 4B)	Valley bottom, Slope (seepage)				
	Drainage (Level 4C&D)	**Outflow:** channelled		**Inflow:** unchannelled (diffuse surface/sub-surface flow)		
	Rating scale	0 = absent (0%) 1 = rare (>0% – 10%)		2 = sparse (>10% – 35%) 3 = common (>35% – 75%)		4 = abundant (>75% < 100) 5 = entire (100%)
	Hydrological regime (Level 5)	**Inundation periodicity**		**Saturation periodicity**		**Inundation depth class**
		1	Permanently inundated		Not applicable	4	Not applicable
		2	Seasonally inundated	1	Permanently saturated	0	Limnetic (>2m depth)
		2	Intermittently inundated	3	Seasonally saturated	1	Littoral (<2m depth)
		3	Never inundated	3	Intermittently saturated		Unknown
			Unknown		Unknown		

Terrain Unit Indicator:	Terrain unit	☐ crest	☐ scarp	☒ midslope	☐ footslope	☒ valley bottom

Soil Wetness Indicator:	General Soil Type	☒ Mineral Soil ☐ Organic Soil	☐ High clay content ☒ High sand content ☐ High silt content		
	Soil Sample Type	**Terrestrial (non-wetland) soil type**	**Temporary wetland soil type**	**Seasonal wetland soil type**	**Permanent wetland soil type**
	Sample Depth	0 - 50cm	0 - 50cm	0 - 40cm	0 - 30cm
	Soil type	Mineral	Mineral	Mineral	Mineral
	Hue | Value | Chroma (Munsell soil values)	7.5YR | 6-7 | 2-3	7.5YR | 4-5 | 1-2	7.5YR | 5-6 | 2-3	7.5YR | 6 | 1-2
	Mottling	None	Few red mottles (5-10%)	Numerous red /yellow/orange mottles (15-20%)	None
	Organic Matter (estimated)	None/Very Low	Low	Low-Medium	Low-Medium
	Description	Light grey-brown to light brown	Grey to greyish-brown	Grey	Grey/Gleyed
	Sample Photo				
	Sample location	Terrestrial areas on the periphery of the wetland (upslope)	Zone of variable width between temporary wetland and the terrestrial environment	Seasonally saturated soils within the seasonal zone	Permanently saturated soils in a narrow band along the central longitudinal drains through he wetland

Vegetation indicators	Dominant / Indicator Species (Exotic species in "Red*")		Hydric Status	Location
	Asclepias physocarpa	Milkweed	Fd	Marginal zone/Dryland
	*Canna indica**	Indian-shot	Ow	Permanent/Seasonal wetland

	*Centella asiatica**	Marsh pennywort	Fw	Temporary wetland/Marginal zone
	*Chromolaena odorata**	Triffid weed	Fd	Marginal wetland/Dryland
	Commelina erecta	Blue commelina	Fw	Seasonal /temporary wetland
	*Cynodon nlemfuensis**	Star grass	F	Seasonal/Temporary wetland
	Cyperus denudatus	Sedge	Ow	Permanent swamps
	Cyperus digitatus	Sedge	Ow	Swamps and seasonally flooded areas
	Cyperus dives	Giant sedge	Ow	Along river (in-stream habitat)
	Cyperus longus	Sedge	Ow	Seasonally flooded areas, edges of rivers
	Cyperus obtusiflorus	Blunt flowered sedge	Fw	Temporary wetland/Marginal zone
	Cyperus sphaerospermus	Sedge	Fw	Marginal wetland
	Digitaria eriantha	Common finger grass	F	Grows in damp soil beside vleis
	Fimbristylis complanata	Flattened rush	Ow	Seasonally wet areas
	Fimbristylis ferruginea	Rush	Ow	Coastal marshy areas along the edges of rivers
	Isolepis prolifer	Vleigras	Ow	Seasonal/permanent wetness zone
	Kyllinga melanosperma	Kyllinga	Fw	Seasonal wetness zone
	Kyllinga pulchella	Kyllinga	Fw	Seasonal wetland
	*Lantana camara**	Lantana	Fd	Marginal zone/Dryland
	Leersia hexandra	Wild rice grass	Ow	Seasonal/permanent wetness zone
	Lobelia anceps	Wild/swamp lobelia	Fw	Seasonal wetland
	Ludwigia octovalvis	Shrubby Ludwigia	Fw	Temporary/Marginal zone
	Panicum maximum	Guinea grass	Fw	Temporary/Marginal zone
	*Paspalum urvillei**	Tall Paspalum	F	Damp areas such as marshes
	Pyceus polystachyos	Inconcodwane	Ow	Open, moist often disturbed grasslands
	Pycreus mundii	Winged sedge	Ow	Seasonal/Permanent wetland
	Pycreus unioloides	Flat sedge	Ow	Seasonal/Temporary wetland
	*Saccharum officinarum**	Sugarcane	Fd	Marginal zone/Dryland
	*Sorghum halepense**	Johnson grass	F	Grows in damp clay or sandy soils in disturbed places
	Typha capensis	Common bulrush	Ow	Seasonal/Permanent wetland
	*Urtica urens**	River stinging-nettle	Fw	Temporary wetland/Marginal zone
	Zantedeschia aethiopica	Arum lily	Fw	Seasonal/permanent wetness zone

Key to species hydric status:
Ow – Obligate wetland plants that almost always grow in wetlands (>90% occurrence).
Fw – Facultative wetland plants that usually grow in wetlands (67-99% occurrence) but are occasionally found in non-wetland areas.
F – Facultative plants that are equally likely to grow in wetlands (34-66% occurrence) and non-wetland areas.
Fd – Facultative Dryland species that usually grow in non-wetland areas but sometimes grow in wetlands (1-34% occurrence).

ANNEXURE C: Combined vegetation species list for wetlands and swamp forest ecosystems (Alien/Exotic species in "Red" text, X = species present, D = dominant species).

No.	Botanical/Latin Name	Common Name	Type	Status	Conservation Status	Hydric Status	General Location/Habitat Preference	Wetland	River: Riparian	Uvongo River: Riparian	Uvongo River: Instream
1	*Ageratum conyzoides*	Ageratum	Herb	Exotic		F	Temporay wetland/Dryland	X	X	X	
2	*Agrimonia procera*	Agrimony	Herb	Exotic		Fd	Invades grasslands and pastures	X	X	X	
3	*Amaranthus hybridus*	Purple amaranth	Herb	Exotic		Fd	Dryland/Marginal wetland	X			
4	*Ambrosia artemisiifolia*	Common ragweed	Herb	Exotic		Fd	Competetive weed of sugarcane	X	X	X	
5	*Arundo donax*	Spanish reed/Giant reed	Grass/reed	Exotic		Fw	Invades watercourses		X	X	
6	*Asclepias physocarpa*	Milkweed	Herb	Indigenous	Least Concern	Fd	Marginal zone/Dryland	X		X	
7	*Asystacia gangetica*	Wild foxglove	Creeper/climber	Indigenous	Least Concern	F	Temporary wetland/Marginal zone		X	X	
8	*Bambusa balcooa*	Common bamboo	Tree	Exotic		F	Invader of watercourses		X		
9	*Bidens pilosa*	Blackjacks	Herb	Exotic		Fd	Dryland			X	
10	*Bridelia micrantha*	Mitzeeri	Tree	Indigenous	Least Concern	Ow	Occurring in coastal, riverine and swamp forest		X	X	
11	*Canna indica*	Indian-shot	Flowering plant	Exotic		Ow	Permanent/Seasonal wetland	X	X		X
12	*Cardiospernum grandiflorum*	Balloon vine	Creeper/climber	Exotic		Fd	Growing on trees			X	
13	*Centella asiatica*	Marsh pennywort	Herb	Exotic		Fw	Temporary wetland/Marginal zone	X	X	X	X
14	*Chromolaena odorata*	Triffid weed	Shrub	Exotic		Fd	Marginal wetland/Dryland	X	X	X	
15	*Coix lacryma-jobi*	Jobs tears	Grass/reed	Exotic		Ow	Wet marshy areas, rivers		D		X
16	*Colocasia esculenta*	Elephant's ears/Madumbe	Bulbous plant	Exotic		Ow	Permanent wetland/riverine		X		X
17	*Commelina erecta*	Blue commelina	Creeper/climber	Indigenous	Least Concern	Fw	Seasonal /temporary wetland	X	X		D
18	*Conyza canadensis*	Horseweed fleabane	Herb	Exotic		Fd	Marginal wetland/Dryland	X	X	X	
19	*Cynodon nlemfuensis*	Star grass	Grass/reed	Exotic		F	Seasonal/Temporary wetland	X			
20	*Cyperus denudatus*	Sedge	Sedge/rush	Indigenous	Least Concern	Ow	Permanent swamps	X			
21	*Cyperus digitatus*	Sedge	Sedge/rush	Indigenous	Least Concern	Ow	Swamps and seasonally flooded areas	X			

No.	Botanical/Latin Name	Common Name	Type	Status	Conservation Status	Hydric Status	General Location/Habitat Preference	Wetland	River: Riparian	Uvongo River: Riparian	Uvongo River: Instream
22	*Cyperus dives*	Giant sedge	Sedge/rush	Indigenous	Least Concern	Ow	Along river (in-stream habitat)	X	X		D
23	*Cyperus longus*	Sedge	Sedge/rush	Indigenous	Least Concern	Ow	Seasonally flooded areas, edges of rivers	X			
24	*Cyperus obtusiflorus*	Blunt flowered sedge	Sedge/rush	Indigenous	Least Concern	Fw	Temporary wetland/Marginal zone	X			
25	*Cyperus prolifer*	Dwarf papyrus	Sedge/rush	Indigenous	Least Concern	Ow	Permanently wet marsh		X		X
26	*Cyperus sphaerospermus*	Sedge	Sedge/rush	Indigenous	Least Concern	Fw	Marginal wetland	X			
27	*Cyperus textilis*	Tall star sedge	Sedge/rush	Indigenous	Least Concern	Ow	Seasonal/Temporary wetland		X	X	
28	*Desmodium incanum*	Sweet hearts	Herb	Exotic		Fw	Temporary wetland/Marginal zone	X			
29	*Digitaria eriantha*	Common finger grass	Grass/reed	Indigenous	Least Concern	F	Grows in damp soil beside vleis	X		X	
30	*Echinocloa pyramidalis*	Antelope grass	Grass/reed	Indigenous	Least Concern	Ow	Only grows in damp places, sometime floating on the water surface forming a dense mat				D
31	*Erythrina lysistemon*	Common coral tree	Tree	Indigenous	Least Concern	D	Bushveld and coastal bush		X	X	
32	*Eucalyptus sp.*	Gum tree	Tree	Exotic		Fd	Dryland/Marginal wetland		X	X	
33	*Ficus natalensis*	Coastal strangler fig	Tree	Indigenous	Least Concern	Fd	Adjacent to rivers/streams		X	X	
34	*Fimbristylis complanata*	Flattened rush	Sedge/rush	Indigenous	Least Concern	Ow	Seasonally wet areas	X			
35	*Fimbristylis ferruginea*	Rush	Sedge/rush	Indigenous	Least Concern	Ow	Coastal marshy areas along the edges of rivers	X			
36	*Hedychium coronarium*	White ginger lily	Lily	Exotic		Fw	Invades shady and damp places		X		D
37	*Ipomoea alba*	Moonflower	Creeper/climber	Exotic		Fd	Dryland/Marginal wetland			X	
38	*Ipomoea cairica*	Coastal morning glory	Tree	Indigenous	Least Concern	Fd	Creeper of many habitats	X	X	X	
39	*Ipomoea purpurea*	Common morning glory	Creeper/climber	Exotic		Fd	Dryland/Marginal wetland		X	X	
40	*Isolepis prolifer*	Vleigras	Sedge/rush	Indigenous	Least Concern	Ow	Seasonal/permanent wetness zone	X			X
41	*Juncus effusus*	Soft rush	Sedge/rush	Exotic		Ow	Along river/stream banks				X
42	*Kyllinga melanosperma*	Kyllinga	Sedge/rush	Indigenous	Least	Fw	Seasonal wetness zone	X		X	

No.	Botanical/Latin Name	Common Name	Type	Status	Conservation Status	Hydric Status	General Location/Habitat Preference	Wetland	River: Riparian	Uvongo River: Riparian	Uvongo River: Instream
					Concern						
43	*Kyllinga pulchella*	Kyllinga	Sedge/rush	Indigenous	Least Concern	Fw	Seasonal wetland	X		X	
44	*Lantana camara*	Lantana	Shrub	Exotic		Fd	Marginal zone/Dryland	X	X	X	
45	*Leersia hexandra*	Wild rice grass	Grass/reed	Indigenous	Least Concern	Ow	Seasonal/permanent wetness zone	D			
46	*Lemna gibba*	Duckweed/pond weed	Water weed	Exotic		Ow	Permanent standing water				X
47	*Lobelia anceps*	Wild/swamp lobelia	Herb	Indigenous	Least Concern	Fw	Seasonal wetland	X			
48	*Ludwigia octovalvis*	Shrubby Ludwigia	Shrub	Indigenous	Least Concern	Fw	Temporary/Marginal zone	X		X	X
49	*Melia azedarach*	Syringa	Tree	Exotic		Fd	Dryland		X	X	
50	*Melinis repens*	Natal red-top	Grass/reed	Indigenous	Least Concern	Fd	Dryland			X	
51	*Mimosa pigra*	Sensitive plant	Herb	Exotic		F	Marginal zone/Dryland			X	
52	*Morus alba*	Mulberry	Tree	Exotic		F	Dryland/Marginal wetland		X	X	
53	*Nephrolepis sp.*	Sword fern	Ferb	Indigenous	Least Concern	F	Range of habitats			X	
54	*Panicum maximum*	Guinea grass	Grass/reed	Indigenous	Least Concern	Fw	Temporary/Marginal zone	X	X	X	
55	*Paspalum urvillei*	Tall Paspalum	Grass/reed	Exotic		F	Damp areas such as marshes	D			
56	*Pennisetum purpureum*	Napier grass	Grass/reed	Exotic		Fw	Wetland/Dryland		X	D	
57	*Persicaria sp.*	Persicaria	Flowering plant	Indigenous	Least Concern	Ow	Seasonal/Permanent wetland				D
58	*Phoenix reclinata*	Wild datepalm	Tree	Indigenous	Least Concern	Fw	Bushveld, usally along rivers		X	D	
59	*Phragmites australis*	Common reed	Grass/reed	Indigenous	Least Concern	Ow	Permanent wetland/riverine in-stream				D
60	*Psidium guajava*	Guava	Tree	Exotic		Fd	Marginal zone/Dryland		X	X	
61	*Pyceus polystachyos*	Inconcodwane	Sedge/rush	Indigenous	Least Concern	Ow	Open, moist often disturbed grasslands	X			
62	*Pycreus mundii*	Winged sedge	Sedge/rush	Indigenous	Least Concern	Ow	Seasonal/Permanent wetland	X			
63	*Pycreus unioloides*	Flat sedge	Sedge/rush	Indigenous	Least	Ow	Seasonal/Temporary wetland	X			

No.	Botanical/Latin Name	Common Name	Type	Status	Conservation Status	Hydric Status	General Location/Habitat Preference	Wetland	River: Riparian	Uvongo River: Riparian	Uvongo River: Instream
					Concern						
64	*Rauvolfia caffra*	Quinine Tree	Tree	Indigenous	Least Concern	F	Seasonal/permanent wetness zone		X	X	
65	*Ricinus communis*	Castor-oil plant	Tree	Exotic		Fd	Dryland/Marginal wetland		X	X	
66	*Rubus cuneifolius*	Bramble	Creeper/climber	Exotic		F	Marginal zone/Dryland		X	X	
67	*Saccharum officinarum*	Sugarcane	Grass/reed	Exotic		Fd	Marginal zone/Dryland	D	X		
68	***Scadoxus puniceus***	Snake lily/Blood lily	Sedge/rush	Indigenous	Specially Protected	Fd	Occurring in coastal and riparian forest, in shade or full sun		X		
69	*Schinus terebinthifolius*	Brazilian pepper tree	Tree	Exotic		F	Wetland/Dryland		X	X	
70	*Senecio madagascarensis*	Canary weed	Herb	Exotic		Fd	Common weed of crops and gardens	X		X	
71	*Senecio tamoides*	Canary creeper	Creeper/climber	Indigenous	Least Concern	Fd	Dryland		X	X	
72	*Senna didymobotrya*	Peanut butter cassia	Shrub	Exotic		Fd	Along river/stream banks		X	X	
73	*Senna hirsuta*	Woolly senna	Tree	Exotic		Fd	Dryland/Marginal wetland		X	X	
74	*Sesbania bispinosa*	Spiny sesbania	Shrub	Exotic		Fd	Temporary wetland/Marginal zone	X	X	X	
75	*Setaria megaphylla*	River bristle grass	Grass/reed	Indigenous	Least Concern	Fw	Along river/stream banks		X	X	
76	*Smilax anceps*	Leg-ripper	Creeper/climber	Indigenous	Least Concern	F	Seasonal wetland		X	X	
77	*Solanum incanum*	Grey bitter apple	Shrub	Exotic		Fd	Found in disturbed places	X	X	X	
78	*Solanum mauritianum*	Bugweed	Tree	Exotic		F	Dryland/Marginal wetland	X	X	X	
79	*Sorghum halepense*	Johnson grass	Grass/reed	Exotic		F	Grows in damp clay or sandy soils in disturbed places	D	X	X	
80	*Strelitzia nicolai*	Wild banana	Tree	Indigenous	Least Concern	Fd	Along river/stream banks		X	X	
81	*Syzigium cordatum*	Waterberry/Umdoni	Tree	Indigenous	Least Concern	Ow	Permanent wetland/riverine		X	X	
82	*Taraxacum officinale*	Common dandelion	Herb	Exotic		Fd	Disturbed places and cultivated lands	X	X	X	
83	*Thelypteris interrupta*	Hottentot's fern	Fern	Indigenous	Least Concern	Fw	Seasonal wetland		X		X
84	*Thunbergia alata*	Black-eyed susan	Creeper/climber	Indigenous	Least Concern	Fd	Dryland		X	X	

No.	Botanical/Latin Name	Common Name	Type	Status	Conservation Status	Hydric Status	General Location/Habitat Preference	Wetland	River: Riparian	Uvongo River: Riparian	Uvongo River: Instream
85	*Tithonia diversifolia*	Mexican sunflower	Shrub	Exotic		F	Along river (in-stream habitat)		D	D	
86	*Trema orientalis*	Pigeonwood	Tree	Indigenous	Least Concern	F	Along river/stream banks		X	X	
87	*Typha capensis*	Common bulrush	Sedge/rush	Indigenous	Least Concern	Ow	Seasonal/Permanent wetland	X	X		X
88	*Urtica urens*	River stinging-nettle	Herb	Exotic		Fw	Temporary wetland/Marginal zone	X	X		X
89	*Verbena bonariensis*	Purple top	Herb	Exotic		Ow	Invades shady and damp places	X		X	
90	*Wedelia trilobata*	Singapore daisy	Herb	Exotic		F	Along river/stream banks		X	X	
91	***Zantedeschia aethiopica***	Arum lily	Lily	Indigenous	Specially Protected	Fw	Seasonal/permanent wetness zone	X			

ANNEXURE D: Summary of the WET-Health Assessment for W-01 (Macfarlane *et al.*, 2008).

Wetland Name		**Wetland Type**		**Area**
Margate Quarry Wetland W-01		**Hillslope seepage linked to a stream**		**0.75 ha**
Hydrological Assessment			**Magnitude of impact**	**Comments**
Catchment Impacts				
Reduced inputs	Alien plants, forestry	Moderately small reduction (-2.0 to -3.9)	-2.00	Sugar and alien vegetation in catchment
Increased inputs	Community activities	Negligible increase (<1)	0.00	No increased inputs
Change in quantity of inflows			**-2.00**	
Reduced floodpeaks		No effect (0 to -1.5)	0.00	N/A
Increased floodpeaks	Hardened surfaces in catchment	Small increase (1.6 to 3.9)	1.50	Some increased runoff from dirt roads and poor sugar growth, but very limited
Alteration to floodpeaks			**1.50**	
Overall catchment impacts			***2.50***	

Onsite impacts	**Dominant impact**	**Extent (%)**	**Intensity (Average)**	**Magnitude of impact**	**Comments**
Gullies and artificial drainage channels	Erosion features & drains	50.0%	2.5	1.25	Artificial drains associated with sugarcane farming (well-vegetated and only moderately effective at draining water).
Modifications to existing channels	Channel modification			0.00	
Drainage & reduced roughness	Crop lands	10.0%	2.0	0.20	Wetland is well-vegetated. Artificial drainage has been dealt with already.
Impeding features – upstream effects	Dams – upstream effects			0.00	
	Roads - upstream effects			0.00	
Impeding features – downstream effects	Dams - downstream effects			0.00	
	Roads - downstream effects			0.00	
Increased on-site water use	Alien vegetation	80.0%	2.0	1.60	Weeds, alien plants, fast-growing pioneer grasses and sugarcane probably use more water than indigenous vegetation.
	Commercial plantations			0.00	
Deposition/infilling or excavation	Sediment deposition	5.0%	3.0	0.15	Some limited sediment deposition from eroded drains and deposited material.
	Infilling & excavation	40.0%	7.0	2.80	Large areas of fill from historical road construction (western side of wetland especially), infilled wetland associated with new quarry access road, earthen berms along lower channelled section.
	Urban infrastructure			0.00	
Untransformed areas	Untransformed areas			0.00	
Overall on-site impacts				***6.00***	
Hydrology Impact Score				**7.0**	

Health Category				**E**	**Seriously Modified**
Anticipated trajectory of change				**-1.0**	
Geomorphology assessment		**Extent (%)**	**Intensity (0 - 10)**	**Magnitude of impact**	**Comments**
Diagnostic component					
Upstream dams				0.00	
Stream diversion/shortening				0.00	
Infilling		40.0%	10.0	4.00	Extensive infilling of wetland (both historical road fill, channel berms and recent quarry access road infill)
Increased runoff		65.0%	3.0	1.95	Small modification associated with a small/minor increase in floodpeaks
Indicator-based component					
Erosional features		15.0%	3.0	0.45	Small artificial drains
Depositional features				0.00	N/A
Loss of organic sediment				0.00	N/A
Geomorphology impact score				**3.20**	
Health Category				**C**	**Moderately Modified**
Anticipated trajectory of change				**0.0**	
Vegetation Assessment		**Extent (%)**	**Intensity (Average)**	**Magnitude of impact**	**Comments**
Sugarcane planted within wetland (along margins)		15.0%	8.0	1.20	Wetland fringes are colonised by sugarcane
Dense alien vegetation patches + weeds		45.0%	7.0	3.15	Large areas of alien dominated vegetation with very few, scattered indigenous plants
Indigenous wetland vegetation with some alien plants		10.0%	2.0	0.20	Small area of wetland-riparian vegetation (indigenous trees, shrubs and grasses)
Infilled wetland habitat - No vegetation		30.0%	9.5	2.85	Extensive areas of infilling void of vegetation cover
Vegetation impact score				**7.40**	
Health Category				**E**	**Seriously Modified**
Anticipated trajectory of change				**0.0**	

ANNEXURE E: Summary of the Wetland EIS Assessment for W-01 (Eco-Pulse, 2015).

Ecological Importance & Sensitivity (EIS) Criteria	*Weighting*	Wetland Unit W01
1. BIODIVERSITY IMPORTANCE		**0.88**
1.1 Biodiversity Support		**0.18**
1.1.1 Rare, threatened & endangered biota/unique species	1	0.5
1.1.2 Diversity of habitats/features	0.5	1
1.1.3 Migration route/breeding and feeding site for wetland species	0.25	1
1.1.4 Viability of the site		1.0
1.2 Landscape Scale Importance		**1.57**
1.2.1 Threat status/rarity of habitat/vegetation type	1	2
1.2.2 Importance in terms of conservation planning	0.75	1
2. FUNCTIONAL IMPORTANCE (HYDROLOGY)		**0.68**
2.1 Flood attenuation	0.2	1.2
2.2 Stream flow regulation	0.5	0.6
2.3 Sediment trapping	0.5	1.3
2.4 Erosion control	0.5	1.8
2.5 Water purification (nutrient/toxicant trapping)	1	1.3
3. ECOLOGICAL SENSITIVITY		**0.33**
3.1 Sensitivity to changes in floods	0.25	1
3.2 Sensitivity to changes in low flows	0.25	1
3.3 Sensitivity to changes in water quality	0.25	2
4. MODIFYING DETERMINANTS		
4.1 Present Ecological State (PES)		1
4.1.1 PES rating		**E/F**
4.2 Wetland Type		**Hillslope Seep**
4.3 Viability of the site		**1.00**
4.2.1 Wetland size	1	1
4.3.2 Connectivity to adjacent ecosystems/habitat	0.8	1
4.3.3 Extent and condition of buffer surrounding site	0.6	1

SUMMARY	Score	Rating
BIODIVERSITY IMPORTANCE	0.9	Low
FUNCTIONAL IMPORTANCE (HYDROLOGY)	0.2	Very Low
ECOLOGICAL IMPORTANCE	**0.9**	**Low**
ECOLOGICAL SENSITIVITY	**0.3**	**Very Low**
SENSITIVTY MODIFIER	*0.2*	
EIS	**0.2**	**Very Low**

ANNEXURE F: Impact significance assessment.

IMPACT SIGNIFICANCE: Scenario without Mitigation (No Corrective Action)									
No.	**IMPACT**	**Status**	**Extent**	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance**	**Confidence**
1.1	Contaminated storm water runoff and discharge into stream/river R-01	Negative	Local	Medium	Long term	**Medium**	**Definite**	**Medium**	High
1.2	Contaminated storm water runoff and discharge into the Vungu River (R-02)	Negative	Regional	Medium	Long term	**High**	**Definite**	**High**	High
1.3	Contaminated surface water from the concrete batching plants	Negative	Regional	Medium	Long term	**High**	**Probable**	**High**	Medium
2	Risk of flooding (rivers)	Negative	Local	Medium	Long term	**Medium**	**Probable**	**Medium**	Medium
3	Risk of pollution by chemicals & hazardous substances	Negative	Regional	High	Long term	**Very High**	**Possible**	**High**	Medium
4	Disturbance leading to increased levels of alien plants within riparian areas and wetlands	Negative	Local	Medium	Long term	**Medium**	**Definite**	**Medium**	High
5	Infilling and loss of wetland habitat and reduced ecosystem functioning	Negative	Local	Medium	Long term	**Medium**	**Definite**	**Medium**	High
6	Risk of sedimentation/pollution of wetland resources	Negative	Local	Medium	Long term	**Medium**	**Probable**	**Medium**	Medium
IMPACT SIGNIFICANCE: Scenario with Mitigation (Corrective Actions Implemented)									
No.	**IMPACT**	**Status**	**Extent**	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance**	**Confidence**
1.1	Contaminated storm water runoff and discharge into stream/river R-01	Negative	Local	Medium	Medium term	**Low**	**Possible**	**Very Low**	High
1.2	Contaminated storm water runoff and discharge into the Vungu River (R-02)	Negative	Regional	Medium	Medium term	**Medium**	**Possible**	**Low**	High
1.3	Contaminated surface water from the concrete batching plants	Negative	Regional	Medium	Medium term	**Medium**	**Possible**	**Low**	Medium
2	Risk of flooding (rivers)	Negative	Local	Medium	Long term	**Medium**	**Possible**	**Low**	Medium
3	Risk of pollution by chemicals & hazardous substances	Negative	Regional	Medium	Medium term	**Medium**	**Improbable**	**Low**	Medium
4	Disturbance leading to increased levels of alien plants within riparian areas and wetlands	Negative	Local	Medium	Medium term	**Low**	**Possible**	**Very Low**	High
5	Infilling and loss of wetland habitat and reduced ecosystem functioning	Negative	Local	Medium	Long term	**Medium**	**Definite**	**Medium**	High
6	Risk of sedimentation/pollution of wetland resources	Negative	Local	Medium	Long term	**Medium**	**Possible**	**Low**	Medium

Appendix H: SGS Dustfall Reports

Test Report: Monthly Dust Deposition Monitoring

January 2015

Prepared for

NPC South Coast Stone Crushers

AS1107

Sampling period: 07 January – 09 February 2015

Unit 406, Ground floor Block 4
35/37 Island Circle Office Park
Riverhorse Valley
Durban

Tel: +27 31 534 0700
Fax: +27 31 534 0735
Internet: www.sgs.com
E-mail: info@sgs.com

REPORT DETAILS

REFERENCE	AS1107
CLIENT REFERENCE	To be confirmed
REPORT TITLE	NPC South Coast Stone Crushers January 2015 Monthly Dust Deposition Report
DATE SUBMITTED:	09 March 2015
CLIENT:	Deepa Seepersad NPC South Coast Stone Crushers (South Coast Stone Crushers) Tel: +27 (31) 450 4434 E-mail: Dseepersad@intercement.com
PREPARED BY:	Delvin Govender Unit 406 Ground Floor Block 4 35/37 Island Circle Office Park Riverhorse Valley Durban Tel:+27 (0)31 534 0700 E-mail: Delvin.Govender@sgs.com
SIGNED:	Delvin Govender Signed:
TECHNICAL SIGNATORY	Mathew Weedman Signed:
STATUS	FINAL
NOTICE	**This document is issued by SGS under its General Conditions of Service accessible at http://www.sgs.com/terms_and_conditions.htm. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.** **Any holder of this document is advised that information contained hereon reflects SGS's findings at the time of its intervention only and within the limits of Client's instructions, if any. SGS's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorised alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.**

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ABBREVIATIONS

l	Litres
m	Metres
mg/m^2/day	Milligrams per metre squared per day
ml	Millilitres
mm	Millimetres

1 INTRODUCTION

1.1 Scope of work

The SGS understanding of the scope of work at NPC South Coast Stone Crushers is as follows:

- SGS changes dust samples on a monthly basis.
- Gravimetric analysis of dust samples by SGS on a monthly basis.
- Reporting of results.

The dust deposition monitoring was based on the ASTM International standard method for collection and analysis of dust fall (ASTM D1739-98 (Reapproved 2010)), with certain modifications.

The results presented in this report are compared to the South African National Dust Control Regulations, 2013.

2 METHODOLOGY

Dustfall monitoring at NPC South Coast Stone Crushers began in July 2014. Windblown settleable dust fall-out is monitored based on the ASTM International standard method for collection and analysis of dustfall (ASTM D1739 - 98), with certain modifications. This method employs a simple device consisting of a cylindrical 5 l container half-filled with de-ionised water exposed for one calendar month (30 ± 3 days). The water is treated with an inorganic algaecide to prevent algal growth in the buckets. The most common reagent used for this is a 5 % copper sulphate solution.

Figure 1: Single bucket monitoring unit, showing a sampling bucket with bird ring and security clamp.

The bucket stand comprises a ring that is raised above the rim of the bucket to prevent contamination from perching birds (Figure 1). The bucket holder is connected to a 2.1 m galvanised steel pole, which is either directly attached to a fence post or can be attached to a galvanised steel base plate, which is buried to a depth of 500 mm. This allows for a variety of placement options for the fallout samplers. Exposed buckets, when returned to the SGS Environmental laboratories, are rinsed with deionised water to remove residue from the sides of the bucket, and the bucket contents filtered through a 1mm sieve to remove insects and other coarse organic detritus. The sample is then filtered through a pre-weighed paper filter to remove the insoluble fraction, or dust fallout. This residue and filter are dried, and gravimetrically analysed to determine the insoluble fraction (dust fallout).

3 STANDARDS FOR DUST DEPOSITION

3.1 National Environmental Management: Air Quality Act, 2004; (Act No. 39 of 2004) National Dust Control Regulations

Table 3 Extract from the National Dust Control Regulations, No. 36974 Government Gazette, 1 November 2013

Restriction Areas	Dust fall rate (D) (mg/m2/day, 30-days average)	Permitted frequency of exceeding dust fall rate
Residential area	D < 600	Two within a year, not sequential months
Non-residential area	600 < D < 1200	Two within a year, not sequential months

The method to be used for measuring dustfall rate and the guideline for locating sampling points shall be ASTM D1739: 1970, or equivalent method approved by any internationally recognized body.

3.2 Residential and Non- residential areas

A residential area means any area classified for residential use in terms of local town planning scheme;

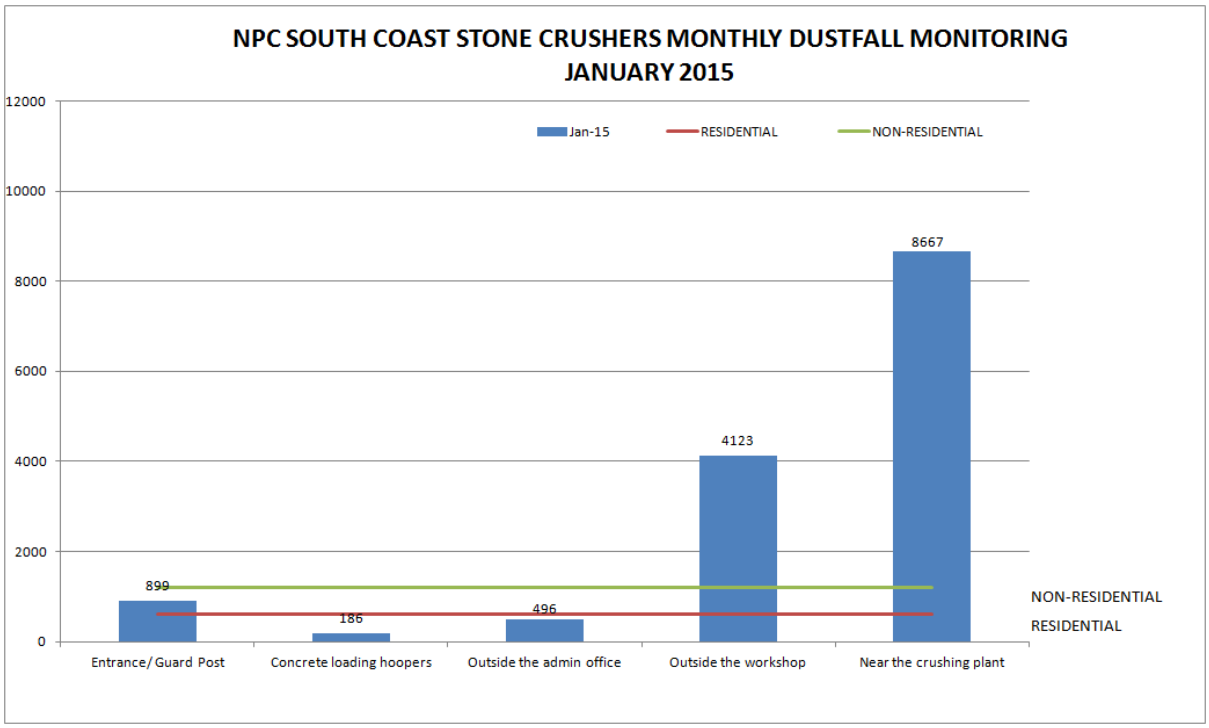
A Non-residential area means any area not classified for residential use as per local town planning scheme

4 RESULTS

4.1 Operational Aspects

The sampling period was from 07 January – 09 February 2015. Samples were exposed for 33 days. The exposure period does comply with the standard operating procedure of 30 ± 3 days. A valid sample return of 100% was achieved.

Figure 4.1: Single bucket dustfall results for NPC South Coast Stone Crushers during January 2015



4.2 Single Bucket Results

- During the month in review, Site site 4 (Outside the workshop) and site 5 (Near crushing plant) recorded Dustfalls that exceeded the NON-RESIDENTIAL threshold, with dustfalls of **4123** mg/m^2/day and **8667** mg/m^2/day respectively. Site 1 (Entrance/Guard Post) recorded a NON-RESIDENTIAL dustfall of **899** mg/m^2/day. All remaining sites recorded dustfall rates within the RESIDENTIAL threshold.

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5 CONCLUSION

- Site 4 (Outside the Workshop) and Site 5 (Near crushing plant) recorded Dustfalls that exceeded the NON-RESIDENTIAL threshold, investigation and mitigation measures should be put in place to avoid reoccurrence of such results.
- Site 1 (Entrance/Guard Post) recorded a NON-RESIDENTIAL Dustfall since this site is classified as a NON-RESIDENTIAL site, this is acceptable.
- All remaining monitoring sites recorded dustfall rates that fell within the RESIDENTIAL range. This is regarded as satisfactory.

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APPENDIX 1

Results

NPC SOUTH COAST STONE CRUSHERS SINGLE BUCKET DUSTFALL MONITORING			Month: January 2015 Sampling period: 07 January – 09 February 2015		
SITE DESCRIPTION	**SITE CLASSIFICATION**	**FILTER No.**	**NETT MASS (mg)**	**No. DAYS**	**DUST FALLOUT (mg/m^2/day)**
Entrance/Guard Post	NON-RESIDENTIAL	14K16	973	33	**899**
Concrete Loading Hoopers	NON-RESIDENTIAL	14K14	140	33	186
Outside The Admin Office	NON-RESIDENTIAL	14K13	371	33	496
Outside The Workshop	NON-RESIDENTIAL	14K15	3088	33	**4123**
Near The Crushing Plant	NON-RESIDENTIAL	5	6493	33	**8667**

BLACK BOLD – RESIDENTIAL EXCEEDANCE

RED BOLD – NON- RESIDENTIAL EXCEEDANCE

Please note that compliance with respect to the National Dust Control Regulations is provisional as the site classifications in terms of these regulations will need to be confirmed by the client by considering the town planning of the area of operation

Test Report: Monthly Dust Deposition Monitoring

April 2016

Prepared for

South Coast Stone Crushers (PTY) Ltd

AS1248 36.325 M_SCSC

Sampling period: 18 April – 19 May 2016

Dustfall levels exceeded NON-RESIDENTIAL level – INVESTIGATION AND INTERVENTION REQUIRED

sanas Testing Laboratory T0107

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Ferndale
Randburg

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Internet: www.sgs.com
E-mail: info@sgs.com

REPORT DETAILS

REFERENCE	AS1248_36.325 M_SCSC
CLIENT REFERENCE	4300024161
REPORT TITLE	South Coast Stone Crushers April 2016 Monthly Dust Deposition Report
DATE SUBMITTED	23 May 2016
CLIENT	Deepa Seepersad South Coast Stone Crushers Tel: *+27 (31) 450 4434* E-mail: Dseepersad@intercement.com
PREPARED BY	Mathew Weedman Suite 406 Ground Floor, Block 4 Island Office Park, 35/37 Island Circle, Riverhorse Valley, Durban, 4071 Tel: +27 (0)31 534 0700 E-mail: Mathew.weedman@sgs.com
SIGNED	Mathew Weedman Signed:
TECHNICAL SIGNATORY	Mia Antoni-Naidoo Signed:
STATUS	FINAL
NOTICE	**This document is issued by SGS under its General Conditions of Service accessible at http://www.sgs.com/terms_and_conditions.htm. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.** **Any holder of this document is advised that information contained hereon reflects SGS's findings at the time of its intervention only and within the limits of Client's instructions, if any. SGS's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorised alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.** **SGS Environmental Services is accredited by SANAS and conforms to the requirements of ISO/IEC 17025 for specific tests as indicated on the scope of accreditation to be found at http://sanas.co.za**

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EHS	Environment Health and Safety

1 INTRODUCTION

1.1 Scope of work

SGS's understanding of the scope of work at South Coast Stone Crushers is as follows:

- SGS changes dust samples on a monthly basis.
- Gravimetric analysis of dust samples by SGS on a monthly basis.
- Reporting of results.

The dust deposition monitoring was based on the ASTM International standard method for collection and analysis of dust fall (ASTM D1739 - 1970), with certain modifications.

The results presented in this report are compared to the South African National Dust Control Regulations, 2013.

2 METHODOLOGY

Dustfall monitoring at South Coast Stone Crushers began in July 2014. Windblown settleable dust fall-out is monitored based on the ASTM International standard method for collection and analysis of dustfall (ASTM D1739 - 1970), with certain modifications. This method employs a simple device consisting of a cylindrical 5 l container half-filled with deionised water exposed for one calendar month (30 ± 3 days). The water is treated with an inorganic algaecide to prevent algal growth in the buckets. The reagent used for this is a 5 % copper sulphate solution.

Figure 1: Single bucket monitoring unit, showing a sampling bucket with bird ring and security clamp.

The bucket stand comprises a ring that is raised above the rim of the bucket to prevent contamination from perching birds (Figure 1). The bucket holder is connected to a 2.1 m galvanised steel pole, which is either directly attached to a fence post or can be attached to a galvanised steel base plate, which is buried to a depth of 500 mm. This allows for a variety of placement options for the fallout samplers. Exposed buckets, when returned to the SGS Environmental laboratories, are rinsed with deionised water to remove residue from the sides of the bucket, and the bucket contents filtered through a 1 mm sieve to remove insects and other coarse organic detritus. The sample is then filtered through a pre-weighed paper filter to remove the insoluble fraction, or dust fallout. This residue and filter are dried, and gravimetrically analysed to determine the insoluble fraction (dust fallout).

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Table 3 Extract from the National Dust Control Regulations, No. 36974 Government Gazette, 1 November 2013

Restriction Areas	Dust fall rate (D) (mg/m2/day, 30- days average)	Permitted frequency of exceeding dust fall rate
Residential area	D < 600	Two within a year, not sequential months
Non-residential area	600 < D < 1200	Two within a year, not sequential months

The method to be used for measuring dustfall rate and the guideline for locating sampling points shall be ASTM D1739: 1970, or equivalent method approved by any internationally recognized body.

3.2 Residential and non residential areas

A residential area means any area classified for residential use in terms of local town planning scheme;

A Non- residential area means any area not classified for residential use as per local town planning scheme

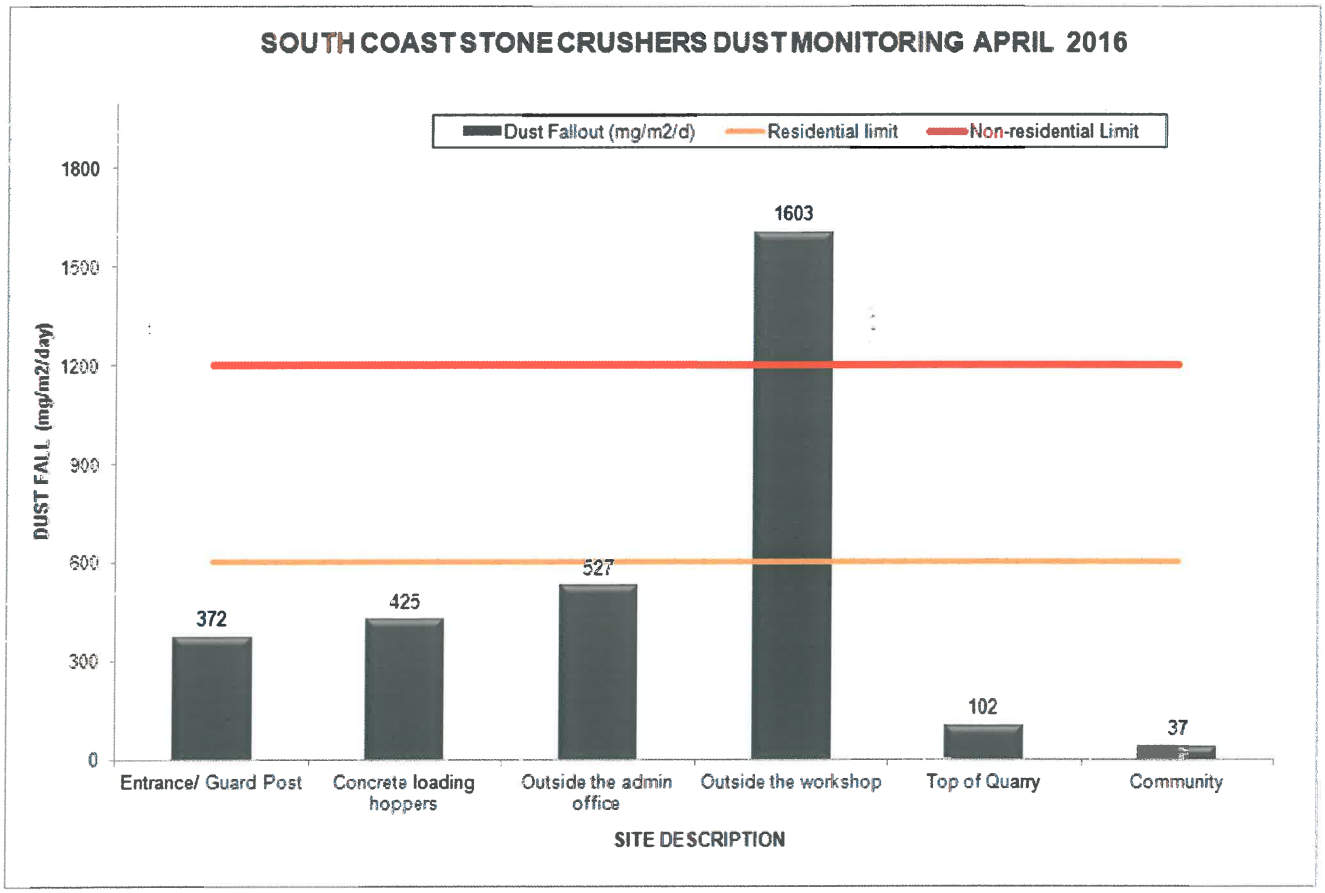
4 RESULTS

4.1 Operational Aspects

The sampling period was from 18 April – 19 May 2016. Samples were exposed for 31 days; this exposure period does comply with the standard operating procedure of 30 ± 3 days. A valid sample return of 100% was achieved for single buckets.

4.2 Single Bucket Results

Figure 2: Single bucket dustfall results for South Coast Stone Crushers during April 2016



- During the month in review, site 2 (Outside the Workshop) recorded a dustfall that exceeded the NON-RESIDENTIAL threshold; this site also recorded the highest dust fall with a rate of **1603** mg/m^2/day. All the monitoring sites recorded dust fall rates within the NON-RESIDENTIAL threshold.

4.3 Exceedance Reporting

Table 4.3.1 Exceedances for June 2015 to April 2016

Period	Number of sites that have exceeded dust fall limits	Site Description
Current month	1	Outside Workshop
Previous 11 months	8	Outside Workshop (7), Entrance (1)
Consecutive months	3	Outside Workshop (3)

Please note that compliance with respect to the National Dust Control Regulations is provisional as the site classifications in terms of these regulations will need to be confirmed by the client by considering the town planning of the area of operation.

5 CONCLUSION

- Site 2 (Outside Workshop) recorded a dustfall that exceeded the NON-RESIDENTIAL threshold, this is not permissible, dust prevention measures should be put in place to avoid such an occurrence.
- All single bucket results were within the NON-RESIDENTIAL threshold, these results are considered satisfactory.

APPENDIX 1

Results

SOUTH COAST STONE CRUSHERS DUSTFALL MONITORING			Month: April 2016 Sampling period: 18 April – 19 May 2016		
SITE DESCRIPTION	SITE CLASSIFICATION	FILTER No.	NETT MASS (mg)	No. DAYS	DUST FALLOUT (mg/m^2/day)
Entrance/Guard post	NON-RESIDENTIAL	15D18	262	31	372
Concrete loading hopper	NON-RESIDENTIAL	14K16	299	31	425
Outside admin office	NON-RESIDENTIAL	15D16	371	31	527
Outside the workshop	NON-RESIDENTIAL	15D17	1128	31	**1603**
Top of Quarry	NON-RESIDENTIAL	15D14	72	31	102
Community	RESIDENTIAL	15D15	26	31	37

BLACK BOLD – RESIDENTIAL EXCEEDANCE
RED BOLD – NON- RESIDENTIAL EXCEEDANCE

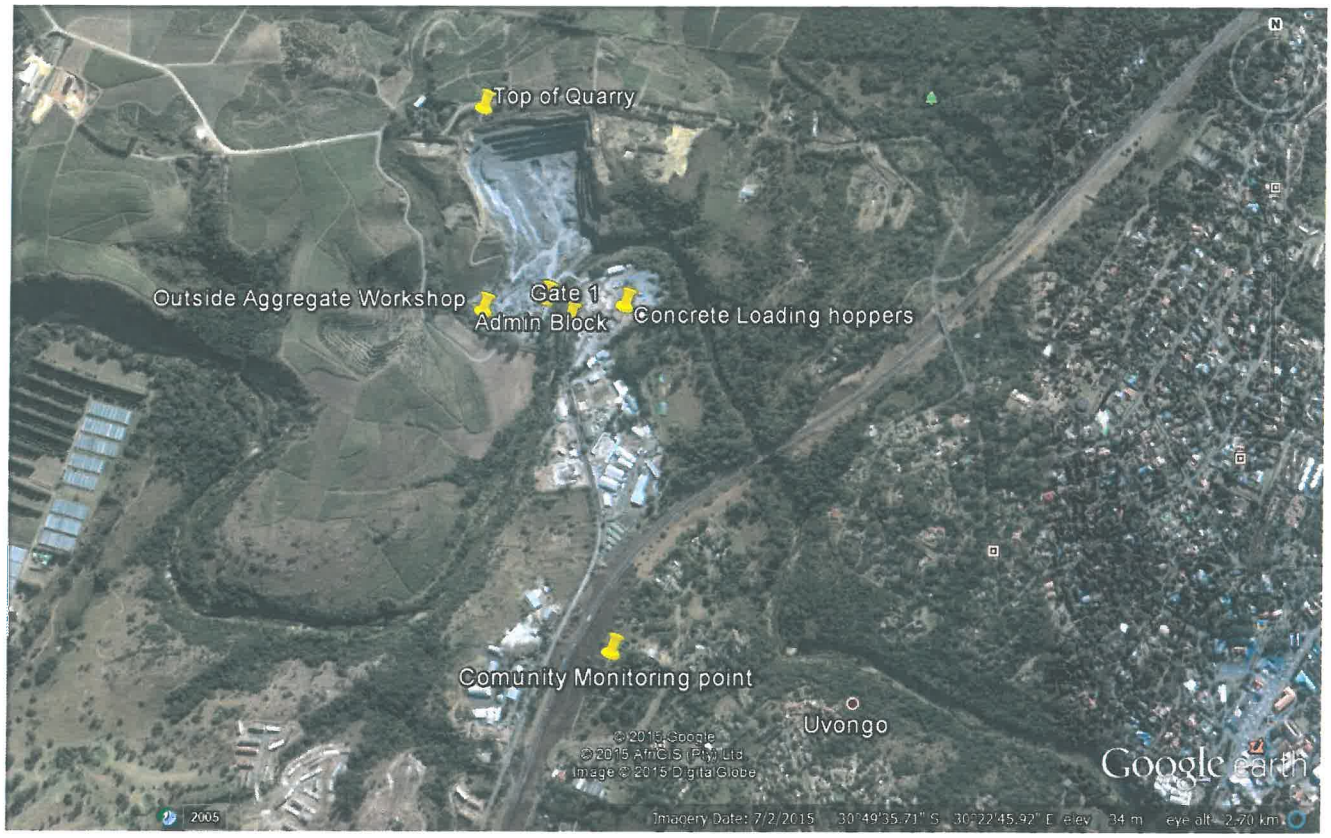
Please note that compliance with respect to the National Dust Control Regulations is provisional as the site classifications in terms of these regulations will need to be confirmed by the client by considering the town planning of the area of operation.

Specific Test Conditions	Samples stored at room temperature prior to analysis. Filters weighed at constant mass
Deviations From Method	None.
Measurement Uncertainty	± 5%

APPENDIX 2

Sampling Locations

Figure A2.1: Map illustrating the location of the bucket monitoring sites at South Coast Stone Crushers



SITE DESCRIPTION	LATITUDE	LONGITUDE
Outside admin office	30°49'27.52"S	30°22'34.33"E
Outside the workshop	30°49'28.51"S	30°22'28.78"E
Gate 1	30°49'29.15"S	30°22'36.49"E
Top of Quarry	30°49'12.53"S	30°22'28.45"E
Concrete loading hoppers	30°49'28.06"S	30°22'41.48"E
Community	30°49'54.35"S	30°22'40.81"E

Test Report: Monthly Dust Deposition Monitoring

April 2015

Prepared for

NPC South Coast Stone Crushers

AS1107

Sampling period: 16 April – 19 May 2015

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35/37 Island Circle Office Park
Riverhorse Valley
Durban

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Fax: +27 31 534 0735
Internet: www.sgs.com
E-mail: info@sgs.com

REPORT DETAILS

REFERENCE	AS1107
CLIENT REFERENCE	To be confirmed
REPORT TITLE	NPC South Coast Stone Crushers April 2015 Monthly Dust Deposition Report
DATE SUBMITTED:	01 June 2015
CLIENT:	Deepa Seepersad NPC Margate (South Coast Stone Crushers) Tel: +27 (31) 450 4434 E-mail: Dseepersad@intercement.com
PREPARED BY:	Delvin Govender Unit 406 Ground Floor Block 4 35/37 Island Circle Office Park Riverhorse Valley Durban Tel:+27 (0)31 534 0700 E-mail: Delvin.Govender@sgs.com
SIGNED:	Delvin Govender Signed:
TECHNICAL SIGNATORY	Mathew Weedman Signed:
STATUS	FINAL
NOTICE	This document is issued by SGS under its General Conditions of Service accessible at http://www.sgs.com/terms_and_conditions.htm. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. WARNING: The sample(s) to which the findings recorded herein (the "Findings") relate was(were) drawn and / or provided by the Client or by a third party acting at the Client's direction. The Findings constitute no warranty of the sample's representativity of all goods and strictly relate to the samples(s). The Company accepts no liability with regard to the origin or source from which the sample(s) is/are said to be extracted. Any unauthorised alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Any holder of this document is advised that information contained hereon reflects SGS's findings at the time of its intervention only and within the limits of Client's instructions, if any. SGS's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorised alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

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The SGS understanding of the scope of work at NPC South Coast Stone Crushers is as follows:

-
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- Gravimetric analysis of dust samples by SGS on a monthly basis.
- Reporting of results.

The dust deposition monitoring was based on the ASTM International standard method for collection and analysis of dust fall (ASTM D1739-98 (Reapproved 2010)), with certain modifications.

The results presented in this report are compared to the South African National Dust Control Regulations, 2013.

South Coast Stone Crushers perform their own samples changes and deliver buckets to SGS on a monthly basis.

2 METHODOLOGY

Dustfall monitoring at NPC South Coast Stone Crushers began in July 2014. Windblown settleable dust fall-out is monitored based on the ASTM International standard method for collection and analysis of dustfall (ASTM D1739 - 98), with certain modifications. This method employs a simple device consisting of a cylindrical 5 l container half-filled with de-ionised water exposed for one calendar month (30 ± 3 days). The water is treated with an inorganic algaecide to prevent algal growth in the buckets. The most common reagent used for this is a 5 % copper sulphate solution.

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The bucket stand comprises a ring that is raised above the rim of the bucket to prevent contamination from perching birds (Figure 1). The bucket holder is connected to a 2.1 m galvanised steel pole, which is either directly attached to a fence post or can be attached to a galvanised steel base plate, which is buried to a depth of 500 mm. This allows for a variety of placement options for the fallout samplers. Exposed buckets, when returned to the SGS Environmental laboratories, are rinsed with deionised water to remove residue from the sides of the bucket, and the bucket contents filtered through a 1mm sieve to remove insects and other coarse organic detritus. The sample is then filtered through a pre-weighed paper filter to remove the insoluble fraction, or dust fallout. This residue and filter are dried, and gravimetrically analysed to determine the insoluble fraction (dust fallout).

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The method to be used for measuring dustfall rate and the guideline for locating sampling points shall be ASTM D1739: 1970, or equivalent method approved by any internationally recognized body.

3.2 Residential and Non- residential areas

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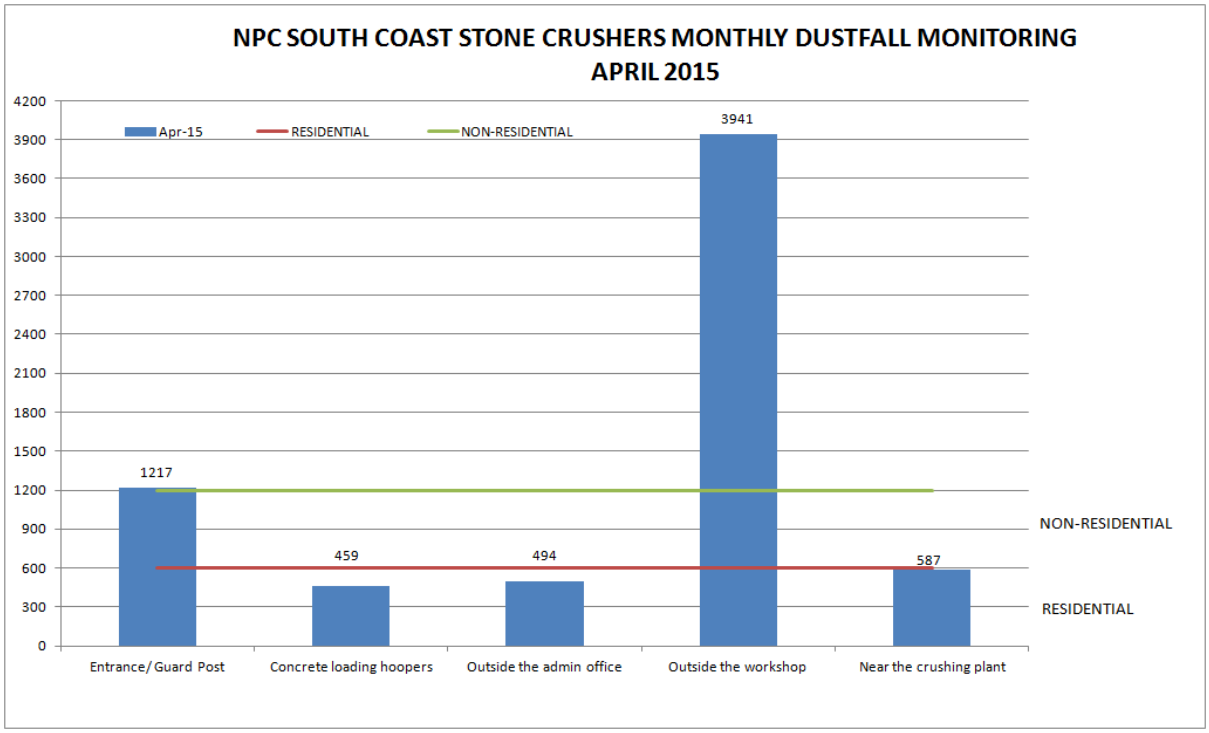
A Non-residential area means any area not classified for residential use as per local town planning scheme

4 RESULTS

4.1 Operational Aspects

The sampling period was from 16 April – 19 May 2015. Samples were exposed for 33 days. The exposure period does comply with the standard operating procedure of 30 ± 3 days. A valid sample return of 100% was achieved.

Figure 4.1: Single bucket dustfall results for NPC South Coast Stone Crushers during April 2015



4.2 Single Bucket Results

During the month in review, Site 3 (Entrance/Guard Post) and Site 2 (Outside the workshop) recorded dustfalls that exceeded the NON-RESIDENTIAL threshold, with a dustfall rate of **1217** mg/m^2/day and **3941** mg/m^2/day respectively. All remaining sites recorded dustfall rates within the RESIDENTIAL threshold.

.

5 CONCLUSION

- Site 3 (Entrance/Guard Post) and Site 2 (Outside the workshop) recorded a dustfall rate that exceeded the NON-RESIDENTIAL threshold. Investigation and mitigation measures should be put in place to avoid reoccurrence of such results.
- All remaining monitoring sites recorded dustfall rates that fell within the RESIDENTIAL range. This is regarded as satisfactory.

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APPENDIX 1

Results

NPC SOUTH COAST STONE CRUSHERS SINGLE BUCKET DUSTFALL MONITORING			Month: April 2015 Sampling period: 16 April – 19 May 2015		
SITE DESCRIPTION	**SITE CLASSIFICATION**	**FILTER No.**	**NETT MASS (mg)**	**No. DAYS**	**DUST FALLOUT (mg/m^2/day)**
Entrance/Guard Post	NON-RESIDENTIAL	03	33	912	**1217**
Concrete Loading Hoopers	NON-RESIDENTIAL	05	33	344	459
Outside The Admin Office	NON-RESIDENTIAL	01	33	370	494
Outside The Workshop	NON-RESIDENTIAL	02	33	2952	**3941**
Near The Crushing Plant	NON-RESIDENTIAL	04	33	587	587

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Test Report: Monthly Dust Deposition Monitoring

February 2015

Prepared for

NPC South Coast Stone Crushers

AS1107

Sampling period: 09 February – 9 March 2015

Unit 406, Ground floor Block 4
35/37 Island Circle Office Park
Riverhorse Valley
Durban

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REPORT DETAILS

REFERENCE	AS1107
CLIENT REFERENCE	To be confirmed
REPORT TITLE	NPC South Coast Stone Crushers February 2015 Monthly Dust Deposition Report
DATE SUBMITTED:	24 April 2015
CLIENT:	Deepa Seepersad NPC Margate (South Coast Stone Crushers) Tel: +27 (31) 450 4434 E-mail: Dseepersad@intercement.com
PREPARED BY:	Mia Antoni-Naidoo Unit 406 Ground Floor Block 4 35/37 Island Circle Office Park Riverhorse Valley Durban Tel:+27 (0)31 534 0700 E-mail: Mia.Antoninaidoo@sgs.com
SIGNED:	Mia Antoni-Naidoo Signed:
TECHNICAL SIGNATORY	Sarah Newton Signed:
STATUS	FINAL
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Residential area	D < 600	Two within a year, not sequential months
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The method to be used for measuring dustfall rate and the guideline for locating sampling points shall be ASTM D1739: 1970, or equivalent method approved by any internationally recognized body.

3.2 Residential and Non- residential areas

A residential area means any area classified for residential use in terms of local town planning scheme;

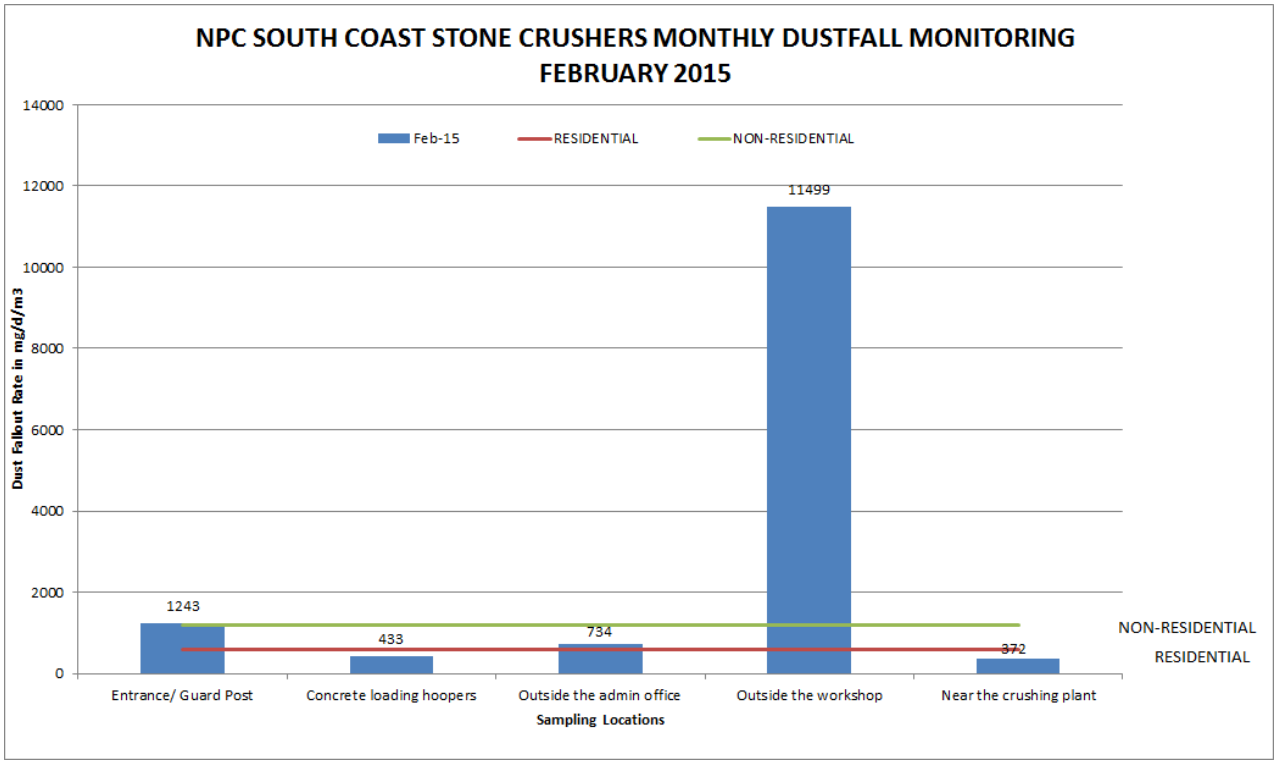
A Non-residential area means any area not classified for residential use as per local town planning scheme

4 RESULTS

4.1 Operational Aspects

The sampling period was from 09 February – 09 March 2015. Samples were exposed for 28 days. The exposure period does comply with the standard operating procedure of 30 ± 3 days. A valid sample return of 100% was achieved.

Figure 4.1: Single bucket dustfall results for NPC South Coast Stone Crushers during February 2015



4.2 Single Bucket Results

During the month in review, Site 3 (Entrance/Guard Post) and Site 2 (Outside Workshop) recorded Dustfalls that exceeded the NON-RESIDENTIAL threshold, with dustfalls of **1243** mg/m^2/day and **11499** mg/m^2/day respectively. Site 1 (Admin Office) recorded a NON-RESIDENTIAL dustfall of **734** mg/m^2/day. All remaining sites recorded dustfall rates within the RESIDENTIAL threshold.

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5 CONCLUSION

- Site 3 (Entrance/Guard Post) and Site 2 (Outside Workshop) recorded Dustfalls that exceeded the NON-RESIDENTIAL threshold, with dustfalls of **11499** mg/m^2/day and **1243** mg/m^2/day respectively. This is the second consecutive month of an exceedance at Site 2 (Outside Workshop). Investigation and mitigation measures should be put in place to avoid reoccurrence of such results.
- Site 1 (Admin Office) recorded a NON-RESIDENTIAL dustfall of **734** mg/m^2/day. Since this site is classified as a NON-RESIDENTIAL site, this is acceptable.
- All remaining monitoring sites recorded dustfall rates that fell within the RESIDENTIAL range. This is regarded as satisfactory.

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APPENDIX 1

Results

NPC SOUTH COAST STONE CRUSHERS SINGLE BUCKET DUSTFALL MONITORING			Month: February 2015 Sampling period: 09 February -09 March 2015		
SITE DESCRIPTION	**SITE CLASSIFICATION**	**FILTER No.**	**NETT MASS (mg)**	**No. DAYS**	**DUST FALLOUT (mg/m^2/day)**
• Entrance/Guard Post	NON-RESIDENTIAL	03	790	28	**1243**
Concrete Loading Hoopers	NON-RESIDENTIAL	05	276	28	433
Outside The Admin Office	NON-RESIDENTIAL	01	467	28	**734**
Outside The Workshop	NON-RESIDENTIAL	02	8353	28	**11499**
Near The Crushing Plant	NON-RESIDENTIAL	04	237	28	372

BLACK BOLD – RESIDENTIAL EXCEEDANCE

RED BOLD – NON- RESIDENTIAL EXCEEDANCE

Please note that compliance with respect to the National Dust Control Regulations is provisional as the site classifications in terms of these regulations will need to be confirmed by the client by considering the town planning of the area of operation

Test Report: Monthly Dust Deposition Monitoring

December 2015

Prepared for

South Coast Stone Crushers (PTY) Ltd

AS1248

AS1248 35.891 M_SCSC

Sampling period: 17 December 2015 – 15 January 2016

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Durban

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E-mail: info@sgs.com

REPORT DETAILS

REFERENCE	AS1248 35.891 M_SCSC
CLIENT REFERENCE	**4300024161**
REPORT TITLE	South Coast Stone Crushers December 2015 Monthly Dust Deposition Report
DATE SUBMITTED:	27 January 2016
CLIENT:	Deepa Seepersad South Coast Stone Crushers Tel: +27 (31) 450 4434 E-mail: Dseepersad@intercement.com
PREPARED BY:	Luvuyo Dlamini Unit 406 Ground Floor Block 4 35/37 Island Circle Office Park Riverhorse Valley Durban Tel:+27 (0)31 534 0700 E-mail: Luvuyo.dlamini@sgs.com
SIGNED:	Luvuyo Dlamini Signed:
TECHNICAL SIGNATORY	Mathew Weedman Signed:
STATUS	FINAL
NOTICE	**This document is issued by SGS under its General Conditions of Service accessible at http://www.sgs.com/terms_and_conditions.htm. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.** **Any holder of this document is advised that information contained hereon reflects SGS's findings at the time of its intervention only and within the limits of Client's instructions, if any. SGS's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorised alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.**

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ABBREVIATIONS

l	Litres
m	Metres
mg/m^2/day	Milligrams per metre squared per day
ml	Millilitres
mm	Millimetres

1 INTRODUCTION

1.1 Scope of work

The SGS understanding of the scope of work at South Coast Stone Crushers is as follows:

- SGS changes dust samples on a monthly basis.
- Gravimetric analysis of dust samples by SGS on a monthly basis.
- Reporting of results.

The dust deposition monitoring was based on the ASTM International standard method for collection and analysis of dust fall (ASTM D1739 -1970), with certain modifications.

The results presented in this report are compared to the South African National Dust Control Regulations, 2013.

2 METHODOLOGY

Dustfall monitoring at South Coast Stone Crushers began in July 2014. Windblown settleable dust fall-out is monitored based on the ASTM International standard method for collection and analysis of dustfall (ASTM D1739), with certain modifications. This method employs a simple device consisting of a cylindrical 5 l container half-filled with de-ionised water exposed for one calendar month (30 ± 3 days). The water is treated with an inorganic algaecide to prevent algal growth in the buckets. The most common reagent used for this is a 5 % copper sulphate solution.

Figure 1: Single bucket monitoring unit, showing a sampling bucket with bird ring and security clamp.

The bucket stand comprises a ring that is raised above the rim of the bucket to prevent contamination from perching birds (Figure 1). The bucket holder is connected to a 2.1 m galvanised steel pole, which is either directly attached to a fence post or can be attached to a galvanised steel base plate, which is buried to a depth of 500 mm. This allows for a variety of placement options for the fallout samplers. Exposed buckets, when returned to the SGS Environmental laboratories, are rinsed with de-ionised water to remove residue from the sides of the bucket, and the bucket contents filtered through a 1mm sieve to remove insects and other coarse organic detritus. The sample is then filtered through a pre-weighed paper filter to remove the insoluble fraction, or dust fallout. This residue and filter are dried, and gravimetrically analysed to determine the insoluble fraction (dust fallout).

3 STANDARDS FOR DUST DEPOSITION

3.1 National Environmental Management: Air Quality Act, 2004; (Act No. 39 of 2004) National Dust Control Regulations

Table 3 Extract from the National Dust Control Regulations, No. 36974 Government Gazette, 1 November 2013

Restriction Areas	Dust fall rate (D) (mg/m2/day, 30-days average)	Permitted frequency of exceeding dust fall rate
Residential area	D < 600	Two within a year, not sequential months
Non-residential area	600 < D < 1200	Two within a year, not sequential months

The method to be used for measuring dustfall rate and the guideline for locating sampling points shall be ASTM D1739: 1970, or equivalent method approved by any internationally recognized body.

3.2 Residential and Non- residential areas

A residential area means any area classified for residential use in terms of local town planning scheme;

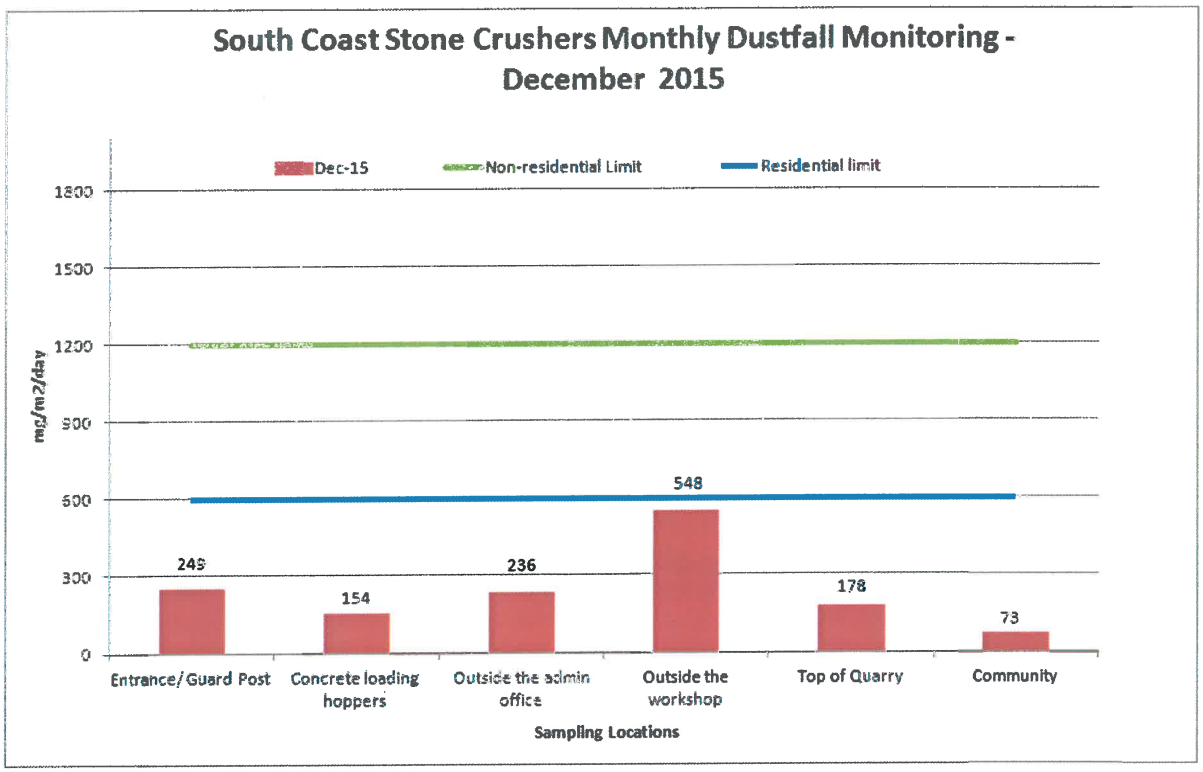
A Non- residential area means any area not classified for residential use as per local town planning scheme

4 RESULTS

4.1 Operational Aspects

The sampling period was from 17 December 2015 – 15 January 2016. Samples were exposed for 29 days. The exposure period does comply with the standard operating procedure of 30 ± 3 days. A valid sample return of 100% was thus achieved.

Figure 4.1: Single bucket dustfall results for South Coast Stone Crushers during December 2015



4.2 Single Bucket Results

During the month in review all monitoring sites recorded dustfalls within the RESIDENTIAL threshold.

5 CONCLUSION

- During the month in review all NON-RESIDENTIAL monitoring sites recorded dustfalls within the NON-RESIDENTIAL threshold, these results are considered satisfactory.
- The only RESIDENTIAL site, Site 6 (Community) recorded a RESIDENTIAL Dustfall which is considered satisfactory.

APPENDIX 1

Results

SOUTH COAST STONE CRUSHERS SINGLE BUCKET DUSTFALL MONITORING				Month: December 2015 Sampling period: 17 December 2015 – 15 January 2016		
SITE DESCRIPTION	SITE CLASSIFICATION	SITE NO.	FILTER No.	NETT MASS (mg)	No. DAYS	DUST FALLOUT (mg/m^2/day)
Entrance/Guard post	NON-RESIDENTIAL	3	15D14	164	29	249
Concrete loading hopper	NON-RESIDENTIAL	5	15D15	102	29	154
Outside admin office	NON-RESIDENTIAL	1	14K16	155	29	236
Outside the workshop	NON-RESIDENTIAL	2	15D18	361	29	548
Top of Quarry	NON-RESIDENTIAL	7	15D17	117	29	178
Community	RESIDENTIAL	6	15D16	48	29	73

BLACK BOLD – RESIDENTIAL EXCEEDANCE

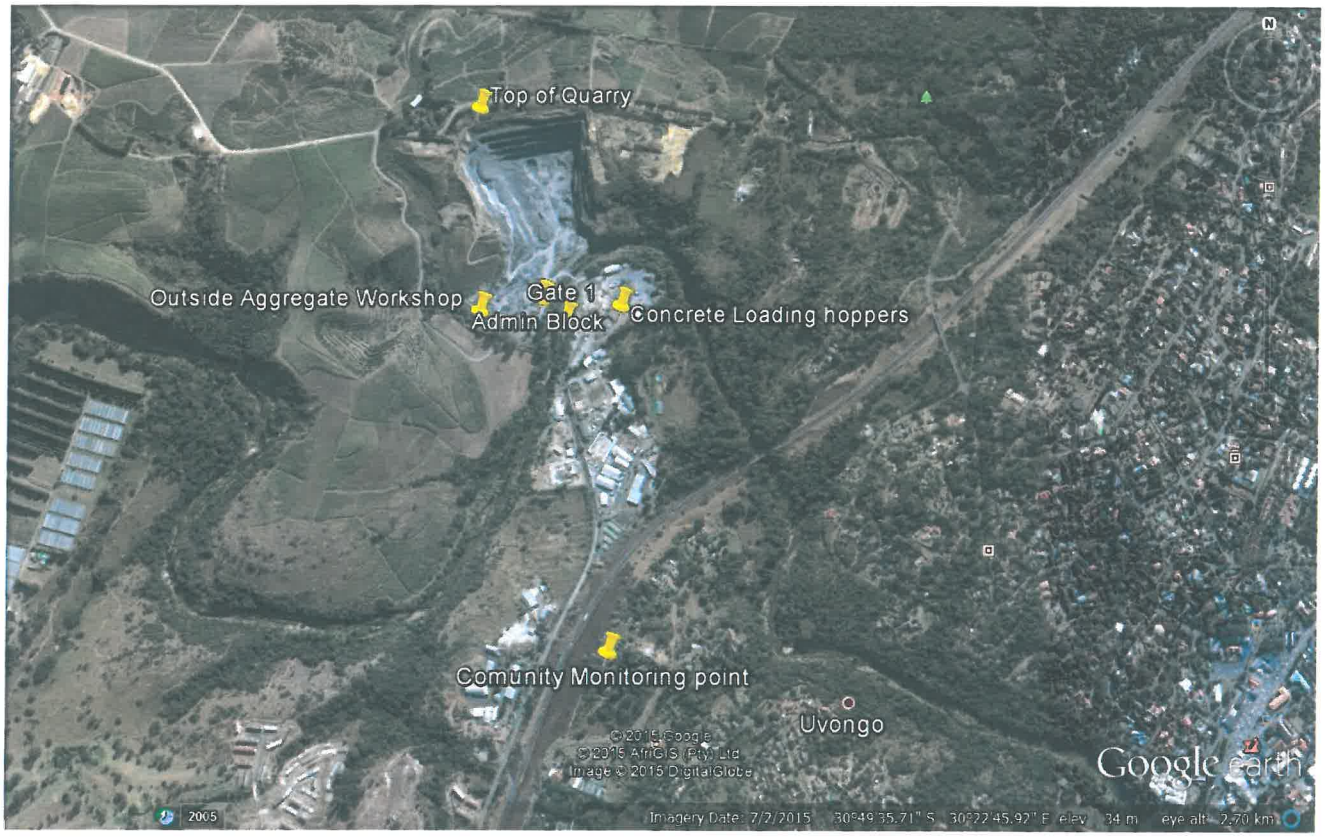
RED BOLD – NON- RESIDENTIAL EXCEEDANCE

Please note that compliance with respect to the National Dust Control Regulations is provisional as the site classifications in terms of these regulations will need to be confirmed by the client by considering the town planning of the area of operation.

Specific Test Conditions	Samples stored at room temperature prior to analysis. Filters weighed at constant mass
Deviations From Method	None.
Measurement Uncertainty	± 5%

Appendix 2

Site Map and GPS Co-ordinates



Site No.	Site Name:	South Co-ordinates	East Co-ordinates
1	Outside admin office	30°49'27.52"S	30°22'34.33"E
2	Outside the workshop	30°49'28.51"S	30°22'28.78"E
3	Gate 1	30°49'29.15"S	30°22'36.49"E
7	Top of Quarry	30°49'12.53"S	30°22'28.45"E
5	Concrete loading hoppers	30°49'28.06"S	30°22'41.48"E
6	Community	30°49'54.35"S	30°22'40.81"E

Test Report: Monthly Dust Deposition Monitoring

November 2015

Prepared for

South Coast Stone Crushers (PTY) Ltd

AS1248

AS1248 35.809 M_SCSC

Sampling period: 18 November – 17 December 2015

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REPORT DETAILS

REFERENCE	AS1248 35.809 M_SCSC
CLIENT REFERENCE	**4300024161**
REPORT TITLE	South Coast Stone Crushers November 2015 Monthly Dust Deposition Report
DATE SUBMITTED:	11 January 2016
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PREPARED BY:	Luvuyo Dlamini Unit 406 Ground Floor Block 4 35/37 Island Circle Office Park Riverhorse Valley Durban Tel:+27 (0)31 534 0700 E-mail: Luvuyo.dlamini@sgs.com
SIGNED:	Luvuyo Dlamini Signed:
TECHNICAL SIGNATORY	Mathew Weedman Signed:
STATUS	FINAL
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$mg/m^2/day$	Milligrams per metre squared per day
ml	Millilitres
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1 INTRODUCTION

1.1 Scope of work

The SGS understanding of the scope of work at South Coast Stone Crushers is as follows:

- SGS changes dust samples on a monthly basis.
- Gravimetric analysis of dust samples by SGS on a monthly basis.
- Reporting of results.

The dust deposition monitoring was based on the ASTM International standard method for collection and analysis of dust fall (ASTM D1739 -1970), with certain modifications.

The results presented in this report are compared to the South African National Dust Control Regulations, 2013.

2 METHODOLOGY

Dustfall monitoring at South Coast Stone Crushers began in July 2014. Windblown settleable dust fall-out is monitored based on the ASTM International standard method for collection and analysis of dustfall (ASTM D1739), with certain modifications. This method employs a simple device consisting of a cylindrical 5 l container half-filled with de-ionised water exposed for one calendar month (30 ± 3 days). The water is treated with an inorganic algaecide to prevent algal growth in the buckets. The most common reagent used for this is a 5 % copper sulphate solution.

Figure 1: Single bucket monitoring unit, showing a sampling bucket with bird ring and security clamp.

The bucket stand comprises a ring that is raised above the rim of the bucket to prevent contamination from perching birds (Figure 1). The bucket holder is connected to a 2.1 m galvanised steel pole, which is either directly attached to a fence post or can be attached to a galvanised steel base plate, which is buried to a depth of 500 mm. This allows for a variety of placement options for the fallout samplers. Exposed buckets, when returned to the SGS Environmental laboratories, are rinsed with de-ionised water to remove residue from the sides of the bucket, and the bucket contents filtered through a 1mm sieve to remove insects and other coarse organic detritus. The sample is then filtered through a pre-weighed paper filter to remove the insoluble fraction, or dust fallout. This residue and filter are dried, and gravimetrically analysed to determine the insoluble fraction (dust fallout).

3 STANDARDS FOR DUST DEPOSITION

3.1 National Environmental Management: Air Quality Act, 2004; (Act No. 39 of 2004) National Dust Control Regulations

Table 3 Extract from the National Dust Control Regulations, No. 36974 Government Gazette, 1 November 2013

Restriction Areas	Dust fall rate (D) (mg/m2/day, 30-days average)	Permitted frequency of exceeding dust fall rate
Residential area	D < 600	Two within a year, not sequential months
Non-residential area	600 < D < 1200	Two within a year, not sequential months

The method to be used for measuring dustfall rate and the guideline for locating sampling points shall be ASTM D1739: 1970, or equivalent method approved by any internationally recognized body.

3.2 Residential and Non- residential areas

A residential area means any area classified for residential use in terms of local town planning scheme;

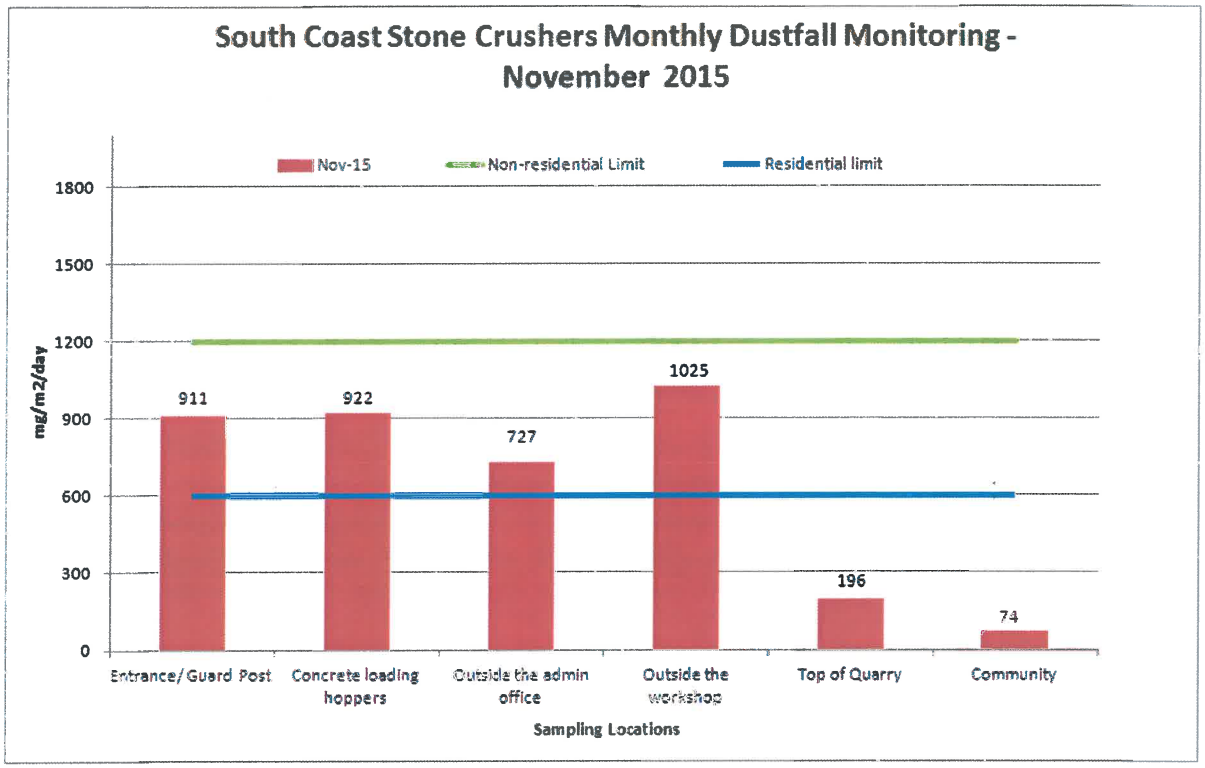
A Non- residential area means any area not classified for residential use as per local town planning scheme

4 RESULTS

4.1 Operational Aspects

The sampling period was from 18 November – 17 December 2015. Samples were exposed for 29 days. The exposure period does comply with the standard operating procedure of 30 ± 3 days. A valid sample return of 100% was thus achieved.

Figure 4.1: Single bucket dustfall results for South Coast Stone Crushers during November 2015



4.2 Single Bucket Results

During the month in review Sites 3 (Entrance/Guard Post), 5 (Concrete Loading Hoppers), 1 (Outside the Admin Office) and site 2 (Outside the Workshop) recorded dustfalls of **911** mg/m^2/day, **922** mg/m^2/day, **727** mg/m^2/day and **1025** mg/m^2/day respectively. The remaining sites all recorded dustfalls within the NON-RESIDENTIAL threshold.

5 CONCLUSION

- During the month in review all NON-RESIDENTIAL monitoring sites recorded dustfalls within the NON-RESIDENTIAL threshold, these results are considered satisfactory.
- The only RESIDENTIAL site, Site 6 (Community) recorded a RESIDENTIAL Dustfall which is considered satisfactory.

APPENDIX 1

Results

SOUTH COAST STONE CRUSHERS SINGLE BUCKET DUSTFALL MONITORING				Month: November 2015 Sampling period: 18 November – 17 December 2015		
SITE DESCRIPTION	SITE CLASSIFICATION	SITE NO.	FILTER No.	NETT MASS (mg)	No. DAYS	DUST FALLOUT (mg/m^2/day)
Entrance/Guard post	NON-RESIDENTIAL	3	13K22	599	29	**911**
Concrete loading hopper	NON-RESIDENTIAL	5	13K20	607	29	**922**
Outside admin office	NON-RESIDENTIAL	1	13K27	479	29	**727**
Outside the workshop	NON-RESIDENTIAL	2	13K25	675	29	**1025**
Top of Quarry	NON-RESIDENTIAL	7	13K26	129	29	196
Community	RESIDENTIAL	6	13K24	48	29	74

BLACK BOLD – RESIDENTIAL EXCEEDANCE

RED BOLD – NON- RESIDENTIAL EXCEEDANCE

Please note that compliance with respect to the National Dust Control Regulations is provisional as the site classifications in terms of these regulations will need to be confirmed by the client by considering the town planning of the area of operation.

Specific Test Conditions	Samples stored at room temperature prior to analysis. Filters weighed at constant mass
Deviations From Method	None.
Measurement Uncertainty	± 5%

Appendix 2

Site Map and GPS Co-ordinates

Site No.	Site Name:	South Co-ordinates	East Co-ordinates
1	Outside admin office	30°49'27.52"S	30°22'34.33"E
2	Outside the workshop	30°49'28.51"S	30°22'28.78"E
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6	Community	30°49'54.35"S	30°22'40.81"E

Test Report: Monthly Dust Deposition Monitoring

March 2015

Prepared for

NPC South Coast Stone Crushers

AS1107

Sampling period: 9 March 16 April 2015

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REPORT DETAILS

REFERENCE	AS1107
CLIENT REFERENCE	To be confirmed
REPORT TITLE	NPC South Coast Stone Crushers March 2015 Monthly Dust Deposition Report
DATE SUBMITTED:	24 April 2015
CLIENT:	Deepa Seepersad NPC Margate (South Coast Stone Crushers) Tel: +27 (31) 450 4434 E-mail: Dseepersad@intercement.com
PREPARED BY:	Mia Antoni-Naidoo Unit 406 Ground Floor Block 4 35/37 Island Circle Office Park Riverhorse Valley Durban Tel:+27 (0)31 534 0700 E-mail: Delvin.Govender@sgs.com
SIGNED:	Mia Antoni-Naidoo Signed:
TECHNICAL SIGNATORY	Sarah Newton Signed:
STATUS	FINAL
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The SGS understanding of the scope of work at NPC South Coast Stone Crushers is as follows:

- SGS changes dust samples on a monthly basis.
- Gravimetric analysis of dust samples by SGS on a monthly basis.
- Reporting of results.

The dust deposition monitoring was based on the ASTM International standard method for collection and analysis of dust fall (ASTM D1739-98 (Reapproved 2010)), with certain modifications.

The results presented in this report are compared to the South African National Dust Control Regulations, 2013.

South Coast Stone Crushers perform their own samples changes and deliver buckets to SGS on a monthly basis.

2 METHODOLOGY

Dustfall monitoring at NPC South Coast Stone Crushers began in July 2014. Windblown settleable dust fall-out is monitored based on the ASTM International standard method for collection and analysis of dustfall (ASTM D1739 - 98), with certain modifications. This method employs a simple device consisting of a cylindrical 5 l container half-filled with de-ionised water exposed for one calendar month (30 ± 3 days). The water is treated with an inorganic algaecide to prevent algal growth in the buckets. The most common reagent used for this is a 5 % copper sulphate solution.

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The method to be used for measuring dustfall rate and the guideline for locating sampling points shall be ASTM D1739: 1970, or equivalent method approved by any internationally recognized body.

3.2 Residential and Non- residential areas

A residential area means any area classified for residential use in terms of local town planning scheme;

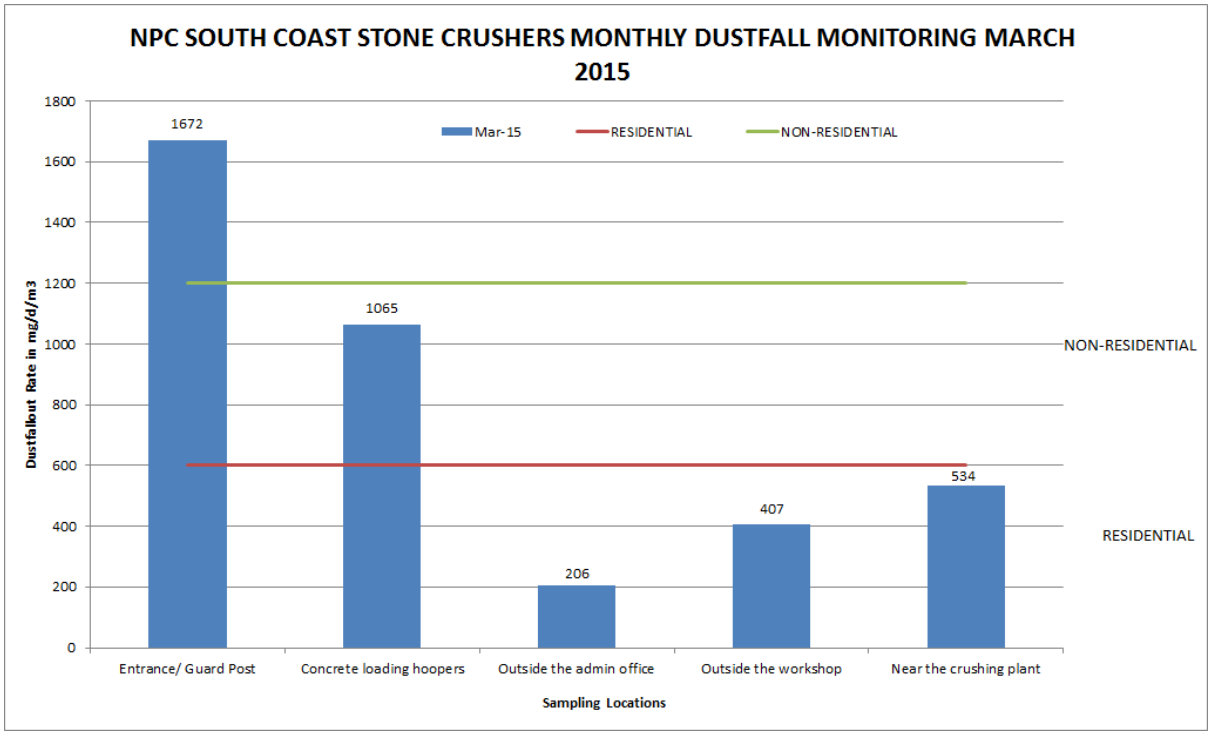
A Non-residential area means any area not classified for residential use as per local town planning scheme

4 RESULTS

4.1 Operational Aspects

The sampling period was from 09 March – 16 April 2015. Samples were exposed for 38 days. The exposure period does not comply with the standard operating procedure of 30 ± 3 days. These results are therefore flagged and cannot be used for compliance purposes. A valid sample return of 100% was achieved.

Figure 4.1: Single bucket dustfall results for NPC South Coast Stone Crushers during March 2015



4.2 Single Bucket Results

During the month in review, Site 3 (Entrance/Guard Post) recorded dustfalls that exceeded the NON-RESIDENTIAL threshold, with a dustfall rate of **1672** mg/m^2/day. Site 5 (Concrete loading hoopers) recorded a NON-RESIDENTIAL dustfall rate of **1065** mg/m^2/day. All remaining sites recorded dustfall rates within the RESIDENTIAL threshold.

.

5 CONCLUSION

- Site 3 (Entrance/Guard Post) recorded a dustfall rate that exceeded the NON-RESIDENTIAL threshold, with dustfalls of **1672** mg/m^2/day. This is the second consecutive month of an exceedance at Site 3 (Entrance/Guard Post). Investigation and mitigation measures should be put in place to avoid reoccurrence of such results.
- Site 5 (Concrete loading hoopers) recorded a NON-RESIDENTIAL dustfall rate of **1065** mg/m^2/day. Since this site is classified as a NON-RESIDENTIAL site, this is acceptable.
- All remaining monitoring sites recorded dustfall rates that fell within the RESIDENTIAL range. This is regarded as satisfactory.

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APPENDIX 1

Results

NPC SOUTH COAST STONE CRUSHERS SINGLE BUCKET DUSTFALL MONITORING			Month: March 2015 Sampling period: 09 March – 16 April 2015		
SITE DESCRIPTION	**SITE CLASSIFICATION**	**FILTER No.**	**NETT MASS (mg)**	**No. DAYS**	**DUST FALLOUT (mg/m^2/day)**
Entrance/Guard Post	NON-RESIDENTIAL	03	38*	1442	**1672**
Concrete Loading Hoopers	NON-RESIDENTIAL	05	38*	918	**1065**
Outside The Admin Office	NON-RESIDENTIAL	01	38*	178	206
Outside The Workshop	NON-RESIDENTIAL	02	38*	351	407
Near The Crushing Plant	NON-RESIDENTIAL	04	38*	461	534

*** denotes that the 30 day limit of exposure has been exceeded and these results are flagged**

BLACK BOLD – RESIDENTIAL EXCEEDANCE

RED BOLD – NON- RESIDENTIAL EXCEEDANCE

Please note that compliance with respect to the National Dust Control Regulations is provisional as the site classifications in terms of these regulations will need to be confirmed by the client by considering the town planning of the area of operation

Test Report: Monthly Dust Deposition Monitoring

January 2016

Prepared for

South Coast Stone Crushers (PTY) Ltd

AS1248

AS1248 36.69 M_SCSC

Sampling period: 15 January – 15 February 2016

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REPORT DETAILS

REFERENCE	AS1248 36.69 M_SCSC
CLIENT REFERENCE	**4300024161**
REPORT TITLE	South Coast Stone Crushers January 2016 Monthly Dust Deposition Report
DATE SUBMITTED:	18 February 2016
CLIENT:	Deepa Seepersad South Coast Stone Crushers Tel: +27 (31) 450 4434 E-mail: Dseepersad@intercement.com
PREPARED BY:	Luvuyo Dlamini (Cand.Nat.Sci) Unit 406 Ground Floor Block 4 35/37 Island Circle Office Park Riverhorse Valley Durban Tel:+27 (0)31 534 0700 E-mail: luvuyo.dlamini@sgs.com
SIGNED:	Luvuyo Dlamini Signed: pp MCN
TECHNICAL SIGNATORY	Mathew Weedman Signed:
STATUS	FINAL
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mg/m^2/day	Milligrams per metre squared per day
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1 INTRODUCTION

1.1 Scope of work

The SGS understanding of the scope of work at South Coast Stone Crushers is as follows:

- SGS changes dust samples on a monthly basis.
- Gravimetric analysis of dust samples by SGS on a monthly basis.
- Reporting of results.

The dust deposition monitoring was based on the ASTM International standard method for collection and analysis of dust fall (ASTM D1739 -1970), with certain modifications.

The results presented in this report are compared to the South African National Dust Control Regulations, 2013.

2 METHODOLOGY

Dustfall monitoring at South Coast Stone Crushers began in July 2014. Windblown settleable dust fall-out is monitored based on the ASTM International standard method for collection and analysis of dustfall (ASTM D1739), with certain modifications. This method employs a simple device consisting of a cylindrical 5 l container half-filled with de-ionised water exposed for one calendar month (30 ± 3 days). The water is treated with an inorganic algaecide to prevent algal growth in the buckets. The most common reagent used for this is a 5 % copper sulphate solution.

Figure 1: Single bucket monitoring unit, showing a sampling bucket with bird ring and security clamp.

The bucket stand comprises a ring that is raised above the rim of the bucket to prevent contamination from perching birds (Figure 1). The bucket holder is connected to a 2.1 m galvanised steel pole, which is either directly attached to a fence post or can be attached to a galvanised steel base plate, which is buried to a depth of 500 mm. This allows for a variety of placement options for the fallout samplers. Exposed buckets, when returned to the SGS Environmental laboratories, are rinsed with de-ionised water to remove residue from the sides of the bucket, and the bucket contents filtered through a 1mm sieve to remove insects and other coarse organic detritus. The sample is then filtered through a pre-weighed paper filter to remove the insoluble fraction, or dust fallout. This residue and filter are dried, and gravimetrically analysed to determine the insoluble fraction (dust fallout).

3 STANDARDS FOR DUST DEPOSITION

3.1 National Environmental Management: Air Quality Act, 2004; (Act No. 39 of 2004) National Dust Control Regulations

Table 3 Extract from the National Dust Control Regulations, No. 36974 Government Gazette, 1 November 2013

Restriction Areas	Dust fall rate (D) (mg/m2/day, 30-days average)	Permitted frequency of exceeding dust fall rate
Residential area	D < 600	Two within a year, not sequential months
Non-residential area	600 < D < 1200	Two within a year, not sequential months

The method to be used for measuring dustfall rate and the guideline for locating sampling points shall be ASTM D1739: 1970, or equivalent method approved by any internationally recognized body.

3.2 Residential and Non- residential areas

A residential area means any area classified for residential use in terms of local town planning scheme;

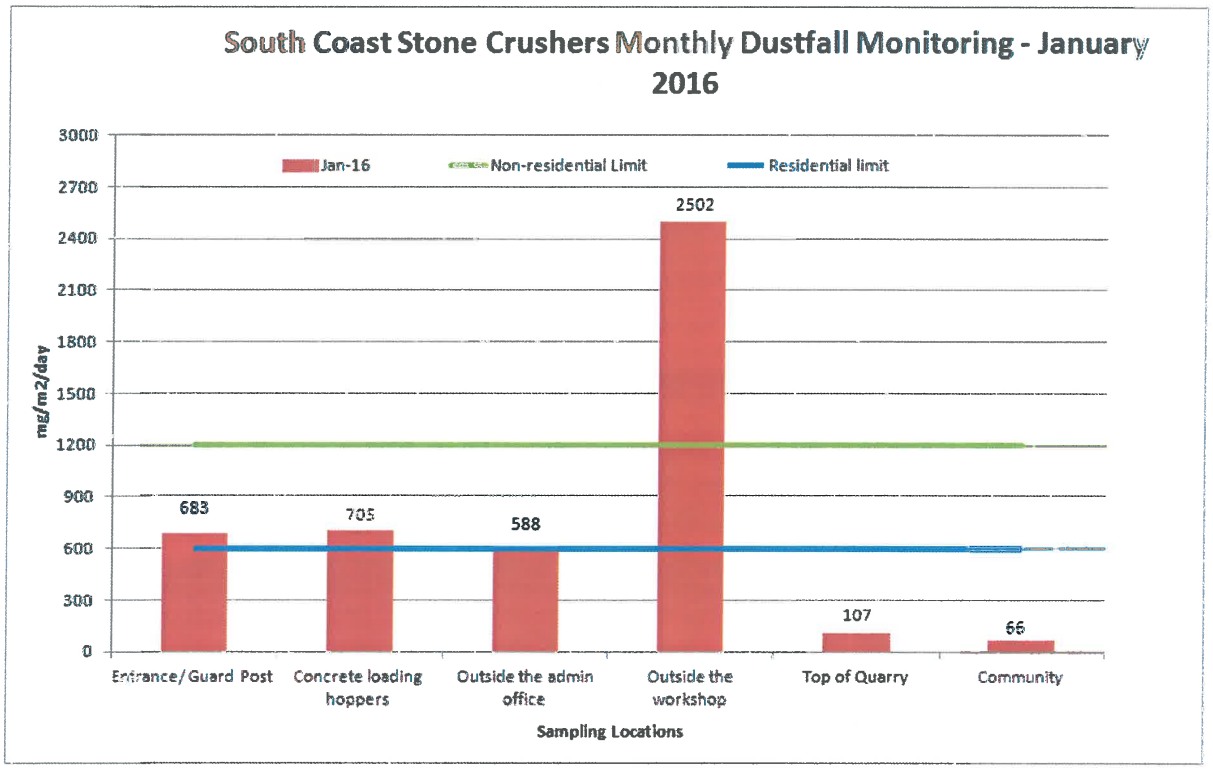
A Non- residential area means any area not classified for residential use as per local town planning scheme

4 RESULTS

4.1 Operational Aspects

The sampling period was from 15 January – 15 February 2016. Samples were exposed for 31 days. The exposure period does comply with the standard operating procedure of 30 ± 3 days. A valid sample return of 100% was thus achieved.

Figure 4.1: Single bucket dustfall results for South Coast Stone Crushers during January 2016



4.2 Single Bucket Results

During the month in review Site 2 (Outside The Workshop) recorded a dustfall which exceeded the NON-RESIDENTIAL threshold, with a dustfall rate of **2502** mg/m^2/day. The remaining sites recorded dustfalls within the NON-RESIDENTIAL threshold.

5 CONCLUSION

- During the month in review Site 2 (Outside The Workshop) recorded a dustfall which exceeded the NON-RESIDENTIAL threshold, investigation and mitigation measures should be put in place avoid reoccurrences.
- All remaining sites recorded dustfall levels that were within the NON-RESIDENTIAL threshold, this is considered satisfactory.

APPENDIX 1

Results

SOUTH COAST STONE CRUSHERS SINGLE BUCKET DUSTFALL MONITORING				Month: January 2016 Sampling period: 15 January – 15 February 2016		
SITE DESCRIPTION	SITE CLASSIFICATION	SITE NO.	FILTER No.	NETT MASS (mg)	No. DAYS	DUST FALLOUT (mg/m^2/day)
Entrance/Guard post	NON-RESIDENTIAL	3	13K24	480	31	**683**
Concrete loading hopper	NON-RESIDENTIAL	5	13K26	496	31	**705**
Outside admin office	NON-RESIDENTIAL	1	13K22	414	31	588
Outside the workshop	NON-RESIDENTIAL	2	13K25	1761	31	**2502**
Top of Quarry	NON-RESIDENTIAL	7	13K27	75	31	107
Community	RESIDENTIAL	6	13K20	47	31	66

BLACK BOLD – RESIDENTIAL EXCEEDANCE

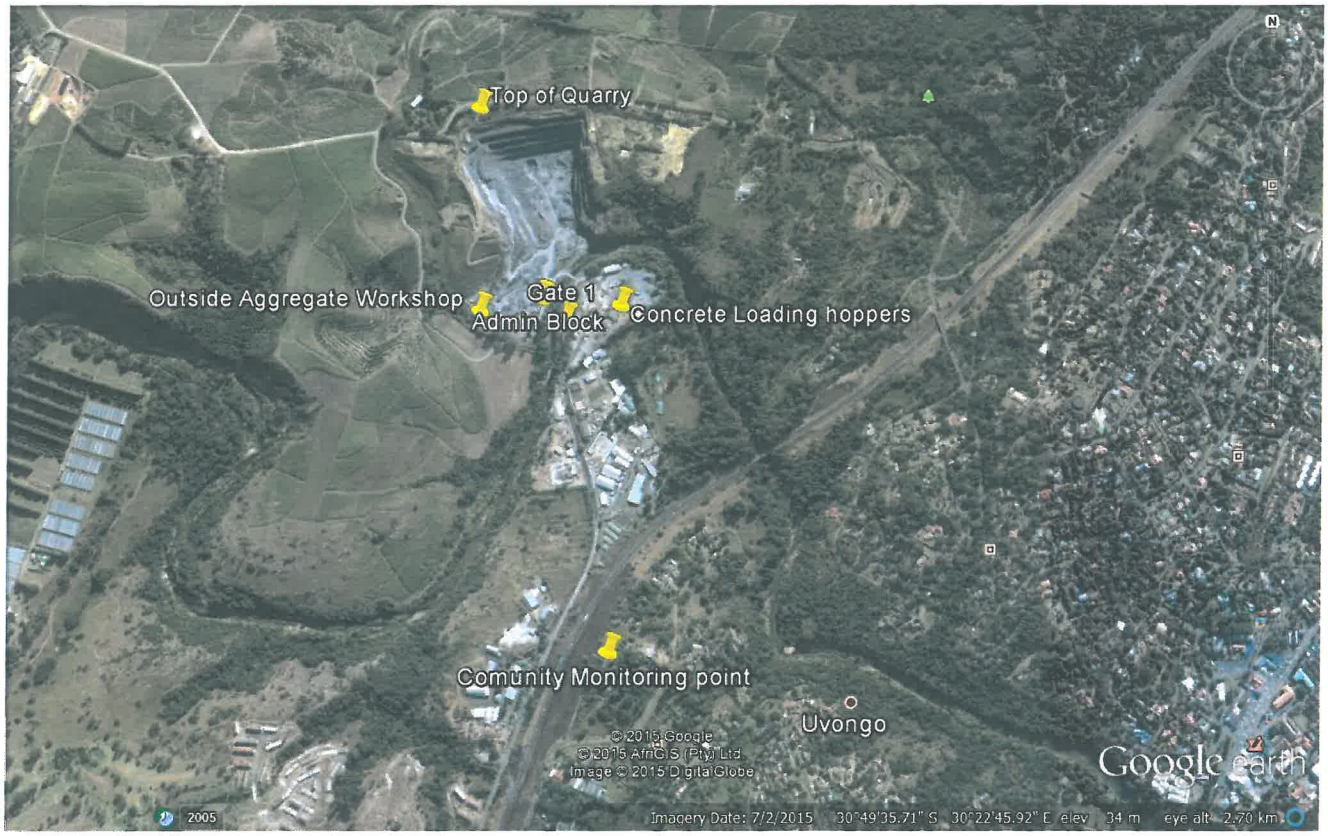
RED BOLD – NON- RESIDENTIAL EXCEEDANCE

Please note that compliance with respect to the National Dust Control Regulations is provisional as the site classifications in terms of these regulations will need to be confirmed by the client by considering the town planning of the area of operation.

Specific Test Conditions	Samples stored at room temperature prior to analysis. Filters weighed at constant mass
Deviations From Method	None.
Measurement Uncertainty	± 5%

Appendix 2

Site Map and GPS Co-ordinates



Site No.	Site Name:	South Co-ordinates	East Co-ordinates
1	Outside admin office	30°49'27.52"S	30°22'34.33"E
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7	Top of Quarry	30°49'12.53"S	30°22'28.45"E
5	Concrete loading hoppers	30°49'28.06"S	30°22'41.48"E
6	Community	30°49'54.35"S	30°22'40.81"E

Test Report: Monthly Dust Deposition Monitoring

September 2015

Prepared for

South Coast Stone Crushers (PTY) Ltd

AS1248

AS1248 35.629 M_SCSC

Sampling period: 23 September – 20 October 2015

Dustfall levels exceeded NON-RESIDENTIAL level – INVESTIGATION AND INTERVENTION REQUIRED

Unit 406, Ground floor Block 4
35/37 Island Circle Office Park
Riverhorse Valley
Durban

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Fax: +27 31 534 0735
Internet: www.sgs.com
E-mail: info@sgs.com

REPORT DETAILS

REFERENCE	AS1248 35.629 M_SCSC
CLIENT REFERENCE	**4300024161**
REPORT TITLE	South Coast Stone Crushers September 2015 Monthly Dust Deposition Report
DATE SUBMITTED:	28 October 2015
CLIENT:	Deepa Seepersad South Coast Stone Crushers Tel: +27 (31) 450 4434 E-mail: Dseepersad@intercement.com
PREPARED BY:	Mathew Weedman Unit 406 Ground Floor Block 4 35/37 Island Circle Office Park Riverhorse Valley Durban Tel:+27 (0)31 534 0700 E-mail: Luvuyo.dlamini@sgs.com
SIGNED:	Mathew Weedman Signed: 
TECHNICAL SIGNATORY	Mia Antoni-Naidoo Signed:
STATUS	FINAL
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The results presented in this report are compared to the South African National Dust Control Regulations, 2013.

2 METHODOLOGY

Dustfall monitoring at South Coast Stone Crushers began in July 2014. Windblown settleable dust fall-out is monitored based on the ASTM International standard method for collection and analysis of dustfall (ASTM D1739), with certain modifications. This method employs a simple device consisting of a cylindrical 5 l container half-filled with de-ionised water exposed for one calendar month (30 ± 3 days). The water is treated with an inorganic algaecide to prevent algal growth in the buckets. The most common reagent used for this is a 5 % copper sulphate solution.

Figure 1: Single bucket monitoring unit, showing a sampling bucket with bird ring and security clamp.

The bucket stand comprises a ring that is raised above the rim of the bucket to prevent contamination from perching birds (Figure 1). The bucket holder is connected to a 2.1 m galvanised steel pole, which is either directly attached to a fence post or can be attached to a galvanised steel base plate, which is buried to a depth of 500 mm. This allows for a variety of placement options for the fallout samplers. Exposed buckets, when returned to the SGS Environmental laboratories, are rinsed with de-ionised water to remove residue from the sides of the bucket, and the bucket contents filtered through a 1mm sieve to remove insects and other coarse organic detritus. The sample is then filtered through a pre-weighed paper filter to remove the insoluble fraction, or dust fallout. This residue and filter are dried, and gravimetrically analysed to determine the insoluble fraction (dust fallout).

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Restriction Areas	Dust fall rate (D) (mg/m2/day, 30-days average)	Permitted frequency of exceeding dust fall rate
Residential area	D < 600	Two within a year, not sequential months
Non-residential area	600 < D < 1200	Two within a year, not sequential months

The method to be used for measuring dustfall rate and the guideline for locating sampling points shall be ASTM D1739: 1970, or equivalent method approved by any internationally recognized body.

3.2 Residential and Non- residential areas

A residential area means any area classified for residential use in terms of local town planning scheme;

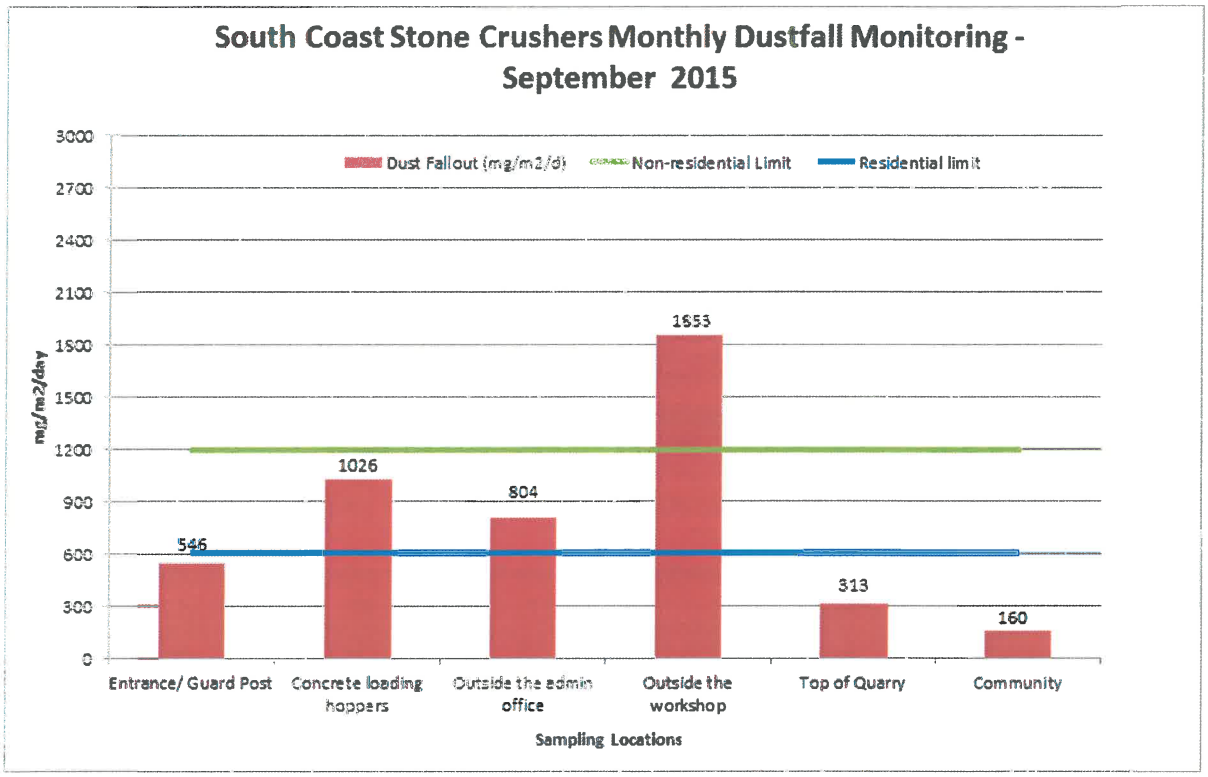
A Non- residential area means any area not classified for residential use as per local town planning scheme

4 RESULTS

4.1 Operational Aspects

The sampling period was from 23 September – 20 October 2015. Samples were exposed for 27 days. The exposure period does comply with the standard operating procedure of 30 ± 3 days. A valid sample return of 100% was thus achieved. A new site was commissioned on 23 September, this is site 6 (community) and is a residential site. Site 4 (EME Parking) was decommissioned and a new site commissioned to the north of the mining activities, this site will be known as Site 7 (Top of Quarry).

Figure 4.1: Single bucket dustfall results for South Coast Stone Crushers during September 2015



4.2 Single Bucket Results

During the month in review Site 2 (Outside Workshop) recorded a dustfall which exceeded the NON-RESIDENTIAL threshold, with dustfalls of **1853** mg/m^2/day. The remaining sites recorded dustfalls within the NON-RESIDENTIAL threshold.

5 CONCLUSION

- During the month in review Site 2 (Outside Workshop) recorded a dustfall which exceeded the NON-RESIDENTIAL threshold, investigation and mitigation measures should be put in place to avoid reoccurences.
- The remaining NON-RESIDENTIAL monitoring sites recorded dustfalls within the NON-RESIDENTIAL threshold, these results are considered satisfactory.
- The only RESIDENTIAL site, Site 6 (Community) recorded a RESIDENTIAL Dustfall which is considered satisfactory.

APPENDIX 1

Results

SOUTH COAST STONE CRUSHERS SINGLE BUCKET DUSTFALL MONITORING				Month: September 2015 Sampling period: 23 September – 20 October 2015		
SITE DESCRIPTION	SITE CLASSIFICATION	SITE NO.	FILTER No.	NETT MASS (mg)	No. DAYS	DUST FALLOUT (mg/m^2/day)
Entrance/Guard post	NON-RESIDENTIAL	3	13K24	334	27	546
Concrete loading hopper	NON-RESIDENTIAL	5	13K25	629	27	1026
Outside admin office	NON-RESIDENTIAL	1	13K20	493	27	804
Outside the workshop	NON-RESIDENTIAL	2	13K26	1136	27	**1853**
EME Parking	NON-RESIDENTIAL	7	13K22	192	27	313
Community	RESIDENTIAL	6	13K27	98	27	160

BLACK BOLD – RESIDENTIAL EXCEEDANCE

RED BOLD – NON- RESIDENTIAL EXCEEDANCE

Please note that compliance with respect to the National Dust Control Regulations is provisional as the site classifications in terms of these regulations will need to be confirmed by the client by considering the town planning of the area of operation.

Specific Test Conditions	Samples stored at room temperature prior to analysis. Filters weighed at constant mass
Deviations From Method	None.
Measurement Uncertainty	± 5%

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Site Map and GPS Co-ordinates

Site No.	Site Name:	South Co-ordinates	East Co-ordinates
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Test Report: Monthly Dust Deposition Monitoring

October 2015

Prepared for

South Coast Stone Crushers (PTY) Ltd

AS1248

AS1248 35.724 M_SCSC

Sampling period: 20 October – 18 November 2015

Dustfall levels exceeded NON-RESIDENTIAL level – INVESTIGATION AND INTERVENTION REQUIRED

Unit 406, Ground floor Block 4
35/37 Island Circle Office Park
Riverhorse Valley
Durban

Tel: +27 31 534 0700
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Internet: www.sgs.com
E-mail: info@sgs.com

REPORT DETAILS

REFERENCE	AS1248 35.724 M_SCSC
CLIENT REFERENCE	**4300024161**
REPORT TITLE	South Coast Stone Crushers October 2015 Monthly Dust Deposition Report
DATE SUBMITTED:	24 November 2015
CLIENT:	Deepa Seepersad South Coast Stone Crushers Tel: +27 (31) 450 4434 E-mail: Dseepersad@intercement.com
PREPARED BY:	Luvuyo Dlamini Unit 406 Ground Floor Block 4 35/37 Island Circle Office Park Riverhorse Valley Durban Tel:+27 (0)31 534 0700 E-mail: Luvuyo.dlamini@sgs.com
SIGNED:	Luvuyo Dlamini Signed:
TECHNICAL SIGNATORY	Mia Antoni-Naidoo Signed:
STATUS	FINAL
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Dustfall monitoring at South Coast Stone Crushers began in July 2014. Windblown settleable dust fall-out is monitored based on the ASTM International standard method for collection and analysis of dustfall (ASTM D1739), with certain modifications. This method employs a simple device consisting of a cylindrical 5 l container half-filled with de-ionised water exposed for one calendar month (30 ± 3 days). The water is treated with an inorganic algaecide to prevent algal growth in the buckets. The most common reagent used for this is a 5 % copper sulphate solution.

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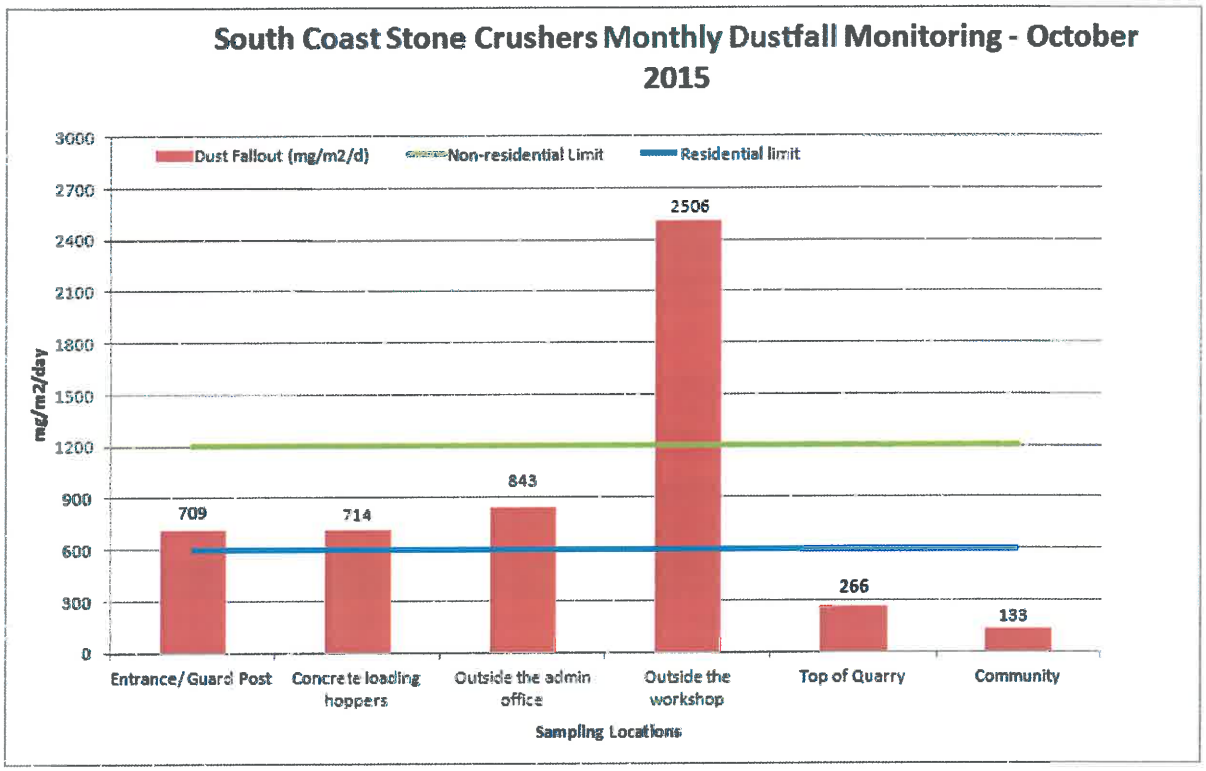
4 RESULTS

4.1 Operational Aspects

The sampling period was from 20 October – 18 November 2015. Samples were exposed for 29 days. The exposure period does comply with the standard operating procedure of 30 ± 3 days. A valid sample return of 100% was thus achieved.

Figure 4.1: Single bucket dustfall results for South Coast Stone Crushers during October 2015



4.2 Single Bucket Results

During the month in review Site 2 (Outside Workshop) recorded a dustfall which exceeded the NON-RESIDENTIAL threshold, with dustfalls of **2506** mg/m^2/day. The remaining sites recorded dustfalls within the NON-RESIDENTIAL threshold.

5 CONCLUSION

- During the month in review Site 2 (Outside Workshop) recorded a dustfall which exceeded the NON-RESIDENTIAL threshold, investigation and mitigation measures should be put in place to avoid reoccurences.
- The remaining NON-RESIDENTIAL monitoring sites recorded dustfalls within the NON-RESIDENTIAL threshold, these results are considered satisfactory.
- The only RESIDENTIAL site, Site 6 (Community) recorded a RESIDENTIAL Dustfall which is considered satisfactory.

APPENDIX 1

Results

SOUTH COAST STONE CRUSHERS SINGLE BUCKET DUSTFALL MONITORING				Month: October 2015 Sampling period: 20 October – 18 November 2015		
SITE DESCRIPTION	SITE CLASSIFICATION	SITE NO.	FILTER No.	NETT MASS (mg)	No. DAYS	DUST FALLOUT (mg/m^2/day)
Entrance/Guard post	NON-RESIDENTIAL	3	15D17	467	29	709
Concrete loading hopper	NON-RESIDENTIAL	5	15D18	470	29	714
Outside admin office	NON-RESIDENTIAL	1	14K16	555	29	843
Outside the workshop	NON-RESIDENTIAL	2	15D14	1649	29	**2506**
Top of Quarry	NON-RESIDENTIAL	7	15D15	175	29	266
Community	RESIDENTIAL	6	15D16	88	29	133

BLACK BOLD – RESIDENTIAL EXCEEDANCE

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Specific Test Conditions	Samples stored at room temperature prior to analysis. Filters weighed at constant mass
Deviations From Method	None.
Measurement Uncertainty	± 5%

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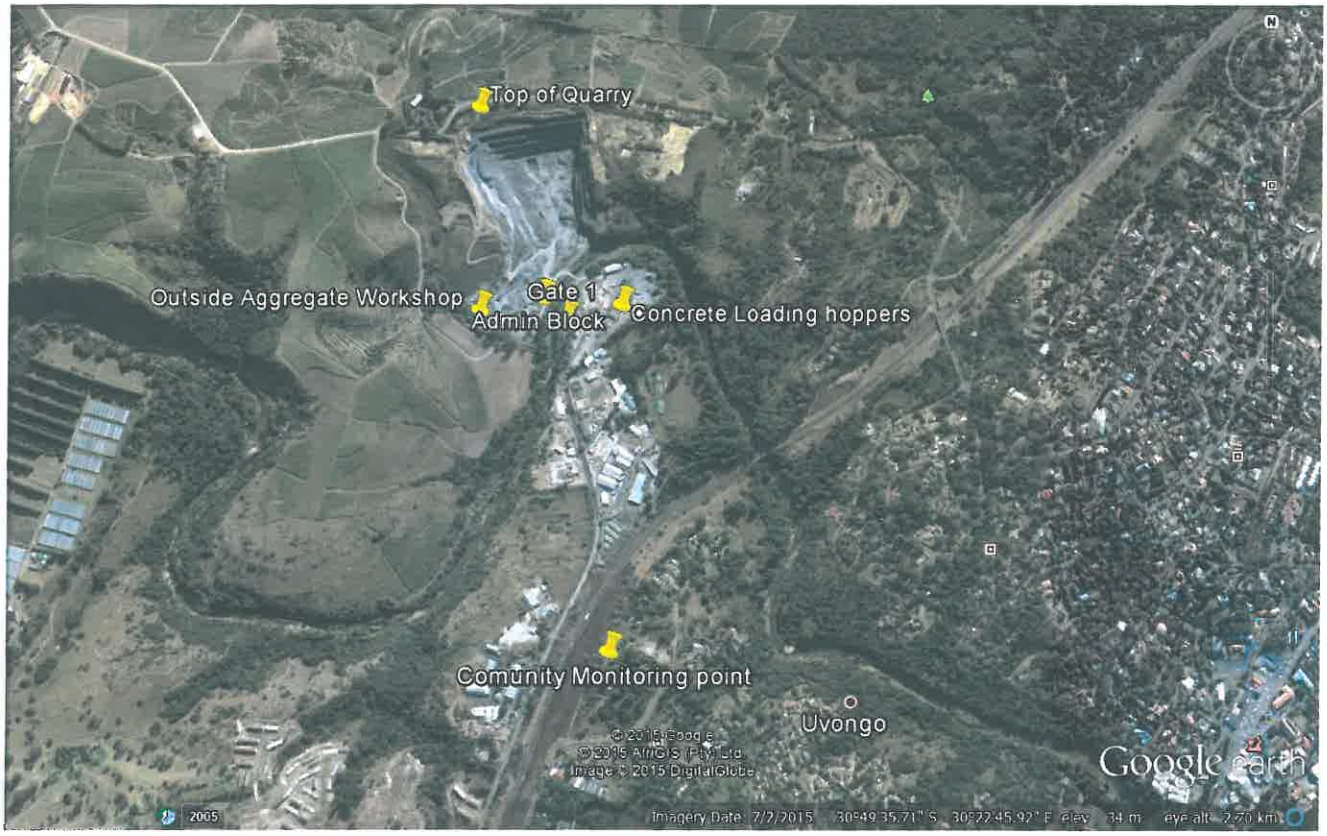

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6	Community	30°49'54.35"S	30°22'40.81"E

Test Report: Monthly Dust Deposition Monitoring

May 2015

Prepared for

South Coast Stone Crushers (PTY) Ltd

AS1107

Sampling period: 19 May – 19 June 2015

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35/37 Island Circle Office Park
Riverhorse Valley
Durban

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Internet: www.sgs.com
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REPORT DETAILS

REFERENCE	AS1107
CLIENT REFERENCE	
REPORT TITLE	South Coast Stone Crushers May 2015 Monthly Dust Deposition Report
DATE SUBMITTED:	16 July 2015
CLIENT:	Deepa Seepersad South Coast Stone Crushers Tel: +27 (31) 450 4434 E-mail: Dseepersad@intercement.com
PREPARED BY:	Delvin Govender Unit 406 Ground Floor Block 4 35/37 Island Circle Office Park Riverhorse Valley Durban Tel:+27 (0)31 534 0700 E-mail: Delvin.Govender@sgs.com
SIGNED:	Delvin Govender Signed:
TECHNICAL SIGNATORY	Mathew Weedman Signed:
STATUS	FINAL
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4 RESULTS

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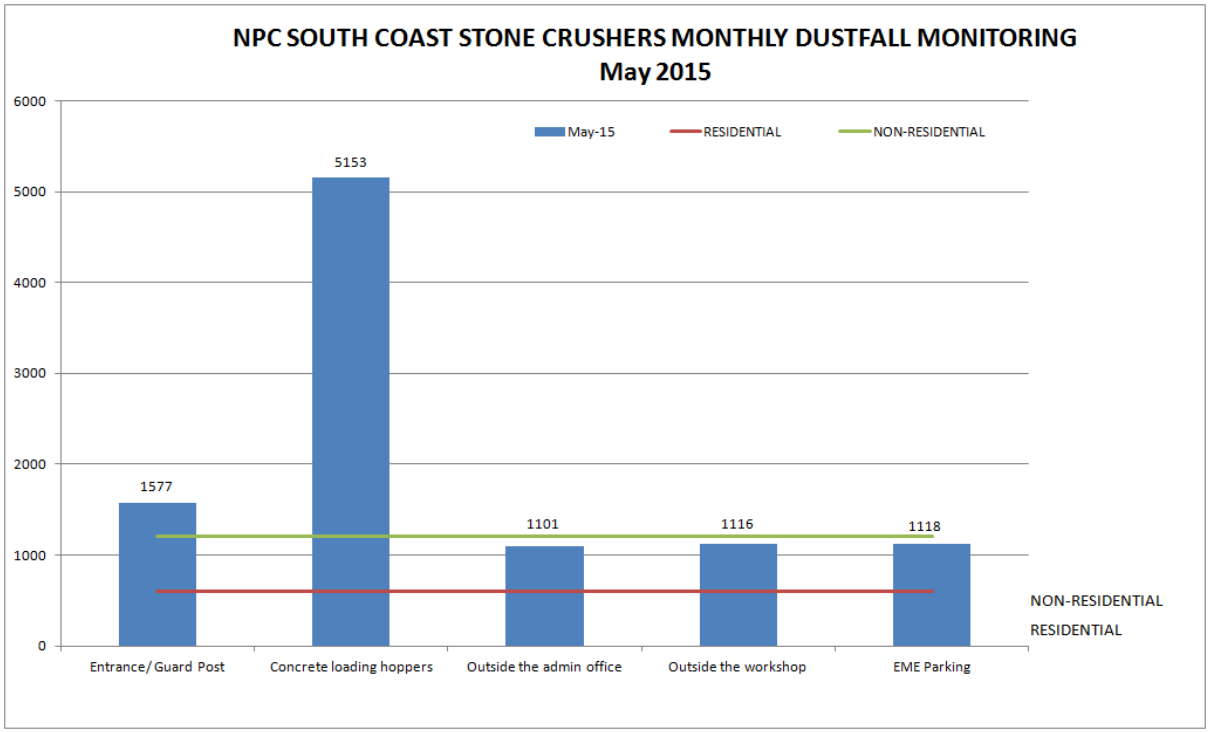
The sampling period was from 19 May - 19 June 2015. Samples were exposed for 31 days. The exposure period does comply with the standard operating procedure of 30 ± 3 days. A valid sample return of 100% was thus achieved.

Figure 4.1: Single bucket dustfall results for South Coast Stone Crushers during May 2015



4.2 Single Bucket Results

During the month in review Site 3 (Entrance/Guard Post) and Site 5 (Concrete loading hopper) recorded a dustfall which exceeded the NON-RESIDENTIAL threshold, with dustfalls of **1577** mg/m^2/day and **5153** mg/m^2/day respectively. The remaining sites recorded dustfalls within the NON-RESIDENTIAL threshold.

5 CONCLUSION

- During the month in review Site 3 (Entrance) and Site 5 (Concrete loading hopper) recorded a dustfall which exceeded the NON-RESIDENTIAL threshold, investigation and mitigation measures should be put in place to avoid reoccurences.
- The remaining monitoring sites recorded dustfalls within the NON-RESIDENTIAL threshold. Since these sites are classified as NON-RESIDENTIAL these results are considered satisfactory.

APPENDIX 1

Results

SOUTH COAST STONE CRUSHERS SINGLE BUCKET DUSTFALL MONITORING			Month: May 2015 Sampling period: 19 May - 19 June 2015		
SITE DESCRIPTION	**SITE CLASSIFICATION**	**FILTER No.**	**NETT MASS (mg)**	**No. DAYS**	**DUST FALLOUT (mg/m^2/day)**
Entrance/Guard post	NON-RESIDENTIAL	3	110	31	**1577**
Concrete loading hopper	NON-RESIDENTIAL	5	3626	31	**5153**
Outside admin office	NON-RESIDENTIAL	1	775	31	**1101**
Outside the workshop	NON-RESIDENTIAL	2	785	31	**1116**
EME Parking	NON-RESIDENTIAL	4	787	31	**1118**

BLACK BOLD – RESIDENTIAL EXCEEDANCE

RED BOLD – NON- RESIDENTIAL EXCEEDANCE

Please note that compliance with respect to the National Dust Control Regulations is provisional as the site classifications in terms of these regulations will need to be confirmed by the client by considering the town planning of the area of operation.

Test Report: Monthly Dust Deposition Monitoring

March 2016

Prepared for

South Coast Stone Crushers (PTY) Ltd

AS1248 36.237 M_SCSC

Sampling period: 17 March – 18 April 2016

sanas Testing Laboratory T0107

259 Kent Avenue
Ferndale
Randburg

Tel: +27 11 590 3000
Internet: www.sgs.com
E-mail: info@sgs.com

REPORT DETAILS

REFERENCE	AS1248_36.237 M_SCSC
CLIENT REFERENCE	4300024161
REPORT TITLE	South Coast Stone Crushers March 2016 Monthly Dust Deposition Report
DATE SUBMITTED	19 April 2016
CLIENT	Deepa Seepersad South Coast Stone Crushers Tel: *+27 (31) 450 4434* E-mail: Dseepersad@intercement.com
PREPARED BY	Luvuyo Dlamini (Cand.Sci.Nat) Suite 406 Ground Floor, Block 4 Island Office Park, 35/37 Island Circle, Riverhorse Valley, Durban, 4071 Tel: +27 (0)31 534 0700 E-mail: Luvuyo.dlamini@sgs.com
SIGNED	Luvuyo Dlamini Signed:
TECHNICAL SIGNATORY	Mathew Weedman Signed:
STATUS	FINAL
NOTICE	**This document is issued by SGS under its General Conditions of Service accessible at http://www.sgs.com/terms_and_conditions.htm. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.** **Any holder of this document is advised that information contained hereon reflects SGS's findings at the time of its intervention only and within the limits of Client's instructions, if any. SGS's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorised alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.** **SGS Environmental Services is accredited by SANAS and conforms to the requirements of ISO/IEC 17025 for specific tests as indicated on the scope of accreditation to be found at http://sanas.co.za**

TABLE OF CONTENTS

ABBREVIATIONS

l	Litres
m	Metres
mg/m²/day	Milligrams per metre squared per day
ml	Millilitres
mm	Millimetres
EHS	Environment Health and Safety

1 INTRODUCTION

1.1 Scope of work

SGS's understanding of the scope of work at South Coast Stone Crushers is as follows:

- SGS changes dust samples on a monthly basis.
- Gravimetric analysis of dust samples by SGS on a monthly basis.
- Reporting of results.

The dust deposition monitoring was based on the ASTM International standard method for collection and analysis of dust fall (ASTM D1739 - 1970), with certain modifications.

The results presented in this report are compared to the South African National Dust Control Regulations, 2013.

2 METHODOLOGY

Dustfall monitoring at South Coast Stone Crushers began in July 2014. Windblown settleable dust fall-out is monitored based on the ASTM International standard method for collection and analysis of dustfall (ASTM D1739 - 1970), with certain modifications. This method employs a simple device consisting of a cylindrical 5 l container half-filled with deionised water exposed for one calendar month (30 ± 3 days). The water is treated with an inorganic algaecide to prevent algal growth in the buckets. The reagent used for this is a 5 % copper sulphate solution.

Figure 1: Single bucket monitoring unit, showing a sampling bucket with bird ring and security clamp.

The bucket stand comprises a ring that is raised above the rim of the bucket to prevent contamination from perching birds (Figure 1). The bucket holder is connected to a 2.1 m galvanised steel pole, which is either directly attached to a fence post or can be attached to a galvanised steel base plate, which is buried to a depth of 500 mm. This allows for a variety of placement options for the fallout samplers. Exposed buckets, when returned to the SGS Environment Health and Safety laboratories, are rinsed with deionised water to remove residue from the sides of the bucket, and the bucket contents filtered through a 1 mm sieve to remove insects and other coarse organic detritus. The sample is then filtered through a pre-weighed paper filter to remove the insoluble fraction, or dust fallout. This residue and filter are dried, and gravimetrically analysed to determine the insoluble fraction (dust fallout).

3 STANDARDS FOR DUST DEPOSITION

3.1 National Environmental Management: Air Quality Act, 2004; (Act No. 39 of 2004) National Dust Control Regulations

Table 3 Extract from the National Dust Control Regulations, No. 36974 Government Gazette, 1 November 2013

Restriction Areas	Dust fall rate (D) (mg/m2/day, 30- days average)	Permitted frequency of exceeding dust fall rate
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The method to be used for measuring dustfall rate and the guideline for locating sampling points shall be ASTM D1739: 1970, or equivalent method approved by any internationally recognized body.

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A residential area means any area classified for residential use in terms of local town planning scheme;

A Non- residential area means any area not classified for residential use as per local town planning scheme

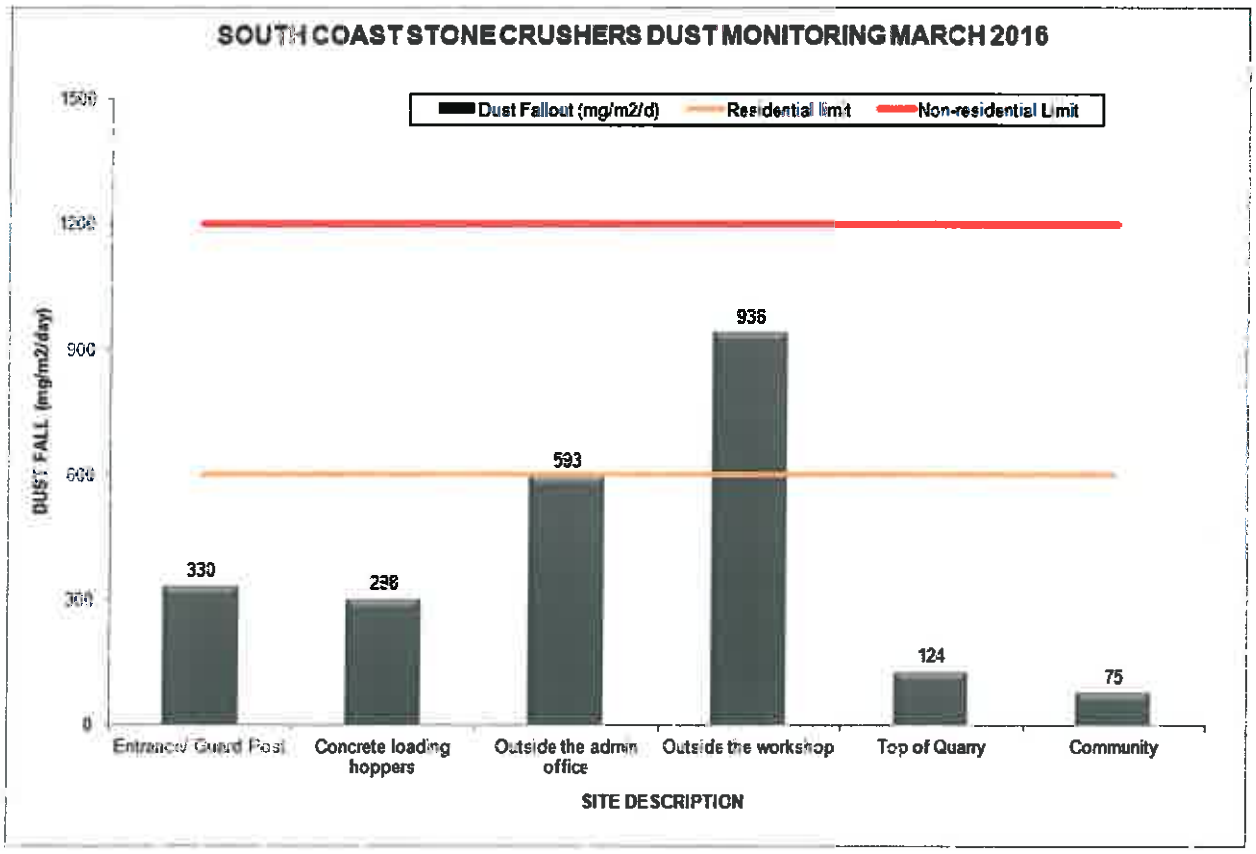
4 RESULTS

4.1 Operational Aspects

The sampling period was from 17 March – 18 April 2016. Samples were exposed for 32 days; this exposure period does comply with the standard operating procedure of 30 ± 3 days. A valid sample return of 100% was achieved for single buckets.

4.2 Single Bucket Results

Figure 2: Single bucket dustfall results for South Coast Stone Crushers during March 2016



- During the month in review, site 2 (Outside the Workshop) recorded the highest dust fall with a rate of **936** mg/m^2/day. All the monitoring sites recorded dust fall rates within the NON-RESIDENTIAL threshold.

4.3 Exceedance Reporting

Table 4.3.1 Exceedances for April 2015 to March 2016

Period	Number of sites that have exceeded dust fall limits	Site Description
Current month	0	-----
Previous 11 months	7	Entrance/Guard Post, Outside Workshop
Consecutive months	4	Outside Workshop

Please note that compliance with respect to the National Dust Control Regulations is provisional as the site classifications in terms of these regulations will need to be confirmed by the client by considering the town planning of the area of operation.

5 CONCLUSION

- All single buckets classified as NON-RESIDENTIAL sites recorded results that were within the NON-RESIDENTIAL threshold, these results are considered satisfactory.
- The only site classified as a RESIDENTIAL site recorded a RESIDENTIAL dustfall, this is considered satisfactory.

APPENDIX 1

Results

SOUTH COAST STONE CRUSHERS DUSTFALL MONITORING			Month: March 2016 Sampling period: 17 March – 18 April 2016		
SITE DESCRIPTION	SITE CLASSIFICATION	FILTER No.	NETT MASS (mg)	No. DAYS	DUST FALLOUT ($mg/m^2/day$)
Entrance/Guard post	NON-RESIDENTIAL	13K26	240	32	330
Concrete loading hopper	NON-RESIDENTIAL	13K24	216	32	298
Outside admin office	NON-RESIDENTIAL	13K20	431	32	593
Outside the workshop	NON-RESIDENTIAL	13K25	680	32	**936**
Top of Quarry	NON-RESIDENTIAL	13K22	90	32	124
Community	RESIDENTIAL	13K27	54	32	75

BLACK BOLD – RESIDENTIAL EXCEEDANCE

RED BOLD – NON- RESIDENTIAL EXCEEDANCE

Please note that compliance with respect to the National Dust Control Regulations is provisional as the site classifications in terms of these regulations will need to be confirmed by the client by considering the town planning of the area of operation.

Specific Test Conditions	Samples stored at room temperature prior to analysis. Filters weighed at constant mass
Deviations From Method	None.
Measurement Uncertainty	± 5%

APPENDIX 2

Sampling Locations

Figure A2.1: Map illustrating the location of the bucket monitoring sites at South Coast Stone Crushers

SITE DESCRIPTION	LATITUDE	LONGITUDE
Outside admin office	30°49'27.52"S	30°22'34.33"E
Outside the workshop	30°49'28.51"S	30°22'28.78"E
Gate 1	30°49'29.15"S	30°22'36.49"E
Top of Quarry	30°49'12.53"S	30°22'28.45"E
Concrete loading hoppers	30°49'28.06"S	30°22'41.48"E
Community	30°49'54.35"S	30°22'40.81"E

Test Report: Monthly Dust Deposition Monitoring

June 2015

Prepared for

South Coast Stone Crushers (PTY) Ltd

AS1107

Sampling period: 19 June – 19 July 2015

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REPORT DETAILS

REFERENCE	AS1107
CLIENT REFERENCE	
REPORT TITLE	South Coast Stone Crushers June 2015 Monthly Dust Deposition Report
DATE SUBMITTED:	17 August 2015
CLIENT:	Deepa Seepersad South Coast Stone Crushers Tel: +27 (31) 450 4434 E-mail: Dseepersad@intercement.com
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TECHNICAL SIGNATORY	Mathew Weedman Signed:
STATUS	FINAL
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1.1 Scope of work

The SGS understanding of the scope of work at South Coast Stone Crushers is as follows:

- SGS changes dust samples on a monthly basis.
- Gravimetric analysis of dust samples by SGS on a monthly basis.
- Reporting of results.

The dust deposition monitoring was based on the ASTM International standard method for collection and analysis of dust fall (ASTM D1739-1970), with certain modifications.

The results presented in this report are compared to the South African National Dust Control Regulations, 2013.

2 METHODOLOGY

Dustfall monitoring at South Coast Stone Crushers began in July 2014. Windblown settleable dust fall-out is monitored based on the ASTM International standard method for collection and analysis of dustfall (ASTM D1739), with certain modifications. This method employs a simple device consisting of a cylindrical 5 l container half-filled with de-ionised water exposed for one calendar month (30 ± 3 days). The water is treated with an inorganic algaecide to prevent algal growth in the buckets. The most common reagent used for this is a 5 % copper sulphate solution.

Figure 1: Single bucket monitoring unit, showing a sampling bucket with bird ring and security clamp.

The bucket stand comprises a ring that is raised above the rim of the bucket to prevent contamination from perching birds (Figure 1). The bucket holder is connected to a 2.1 m galvanised steel pole, which is either directly attached to a fence post or can be attached to a galvanised steel base plate, which is buried to a depth of 500 mm. This allows for a variety of placement options for the fallout samplers. Exposed buckets, when returned to the SGS Environmental laboratories, are rinsed with de-ionised water to remove residue from the sides of the bucket, and the bucket contents filtered through a 1mm sieve to remove insects and other coarse organic detritus. The sample is then filtered through a pre-weighed paper filter to remove the insoluble fraction, or dust fallout. This residue and filter are dried, and gravimetrically analysed to determine the insoluble fraction (dust fallout).

3 STANDARDS FOR DUST DEPOSITION

3.1 National Environmental Management: Air Quality Act, 2004; (Act No. 39 of 2004) National Dust Control Regulations

Table 3 Extract from the National Dust Control Regulations, No. 36974 Government Gazette, 1 November 2013

Restriction Areas	Dust fall rate (D) (mg/m2/day, 30-days average)	Permitted frequency of exceeding dust fall rate
Residential area	D < 600	Two within a year, not sequential months
Non-residential area	600 < D < 1200	Two within a year, not sequential months

The method to be used for measuring dustfall rate and the guideline for locating sampling points shall be ASTM D1739: 1970, or equivalent method approved by any internationally recognized body.

3.2 Residential and Non- residential areas

A residential area means any area classified for residential use in terms of local town planning scheme;

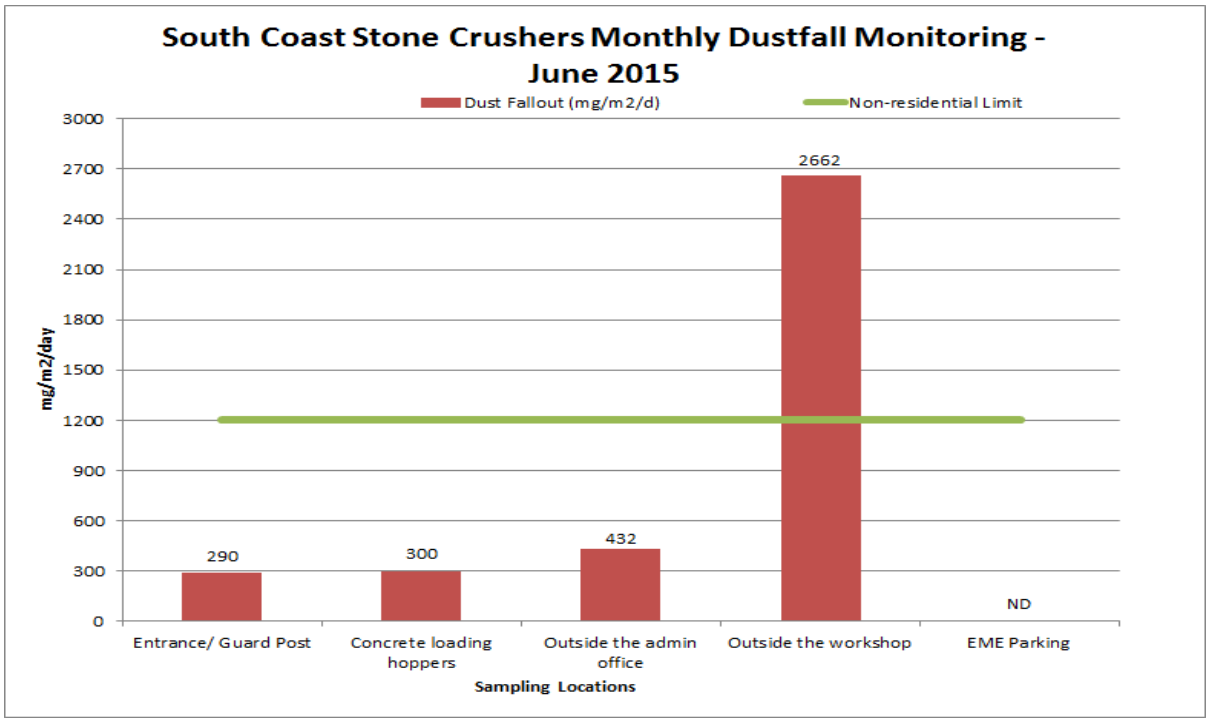
A Non- residential area means any area not classified for residential use as per local town planning scheme

4 RESULTS

4.1 Operational Aspects

The sampling period was from 19 June – 19 July 2015. Samples were exposed for 30 days. The exposure period does comply with the standard operating procedure of 30 ± 3 days. A valid sample return of 80% was thus achieved. Site 4 (EME Parking) recorded no data since the sample was missing.

Figure 4.1: Single bucket dustfall results for South Coast Stone Crushers during June 2015



4.2 Single Bucket Results

During the month in review Site 2 (Outside The Workshop) recorded a dustfall which exceeded the NON-RESIDENTIAL threshold, with dustfalls of **2662** mg/m^2/day. The remaining sites recorded dustfalls within the NON-RESIDENTIAL threshold.

5 CONCLUSION

- During the month in review Site 2 (Outside the Workshop) recorded a dustfall which exceeded the NON-RESIDENTIAL threshold, investigation and mitigation measures should be put in place to avoid reoccurences.
- The remaining monitoring sites recorded dustfalls within the NON-RESIDENTIAL threshold. Since these sites are classified as NON-RESIDENTIAL these results are considered satisfactory.

APPENDIX 1

Results

SOUTH COAST STONE CRUSHERS SINGLE BUCKET DUSTFALL MONITORING			Month: June 2015 Sampling period: 19 June – 19 July 2015		
SITE DESCRIPTION	**SITE CLASSIFICATION**	**FILTER No.**	**NETT MASS (mg)**	**No. DAYS**	**DUST FALLOUT (mg/m^2/day)**
Entrance/Guard post	NON-RESIDENTIAL	14K14	197	30	290
Concrete loading hopper	NON-RESIDENTIAL	14K15	204	30	300
Outside admin office	NON-RESIDENTIAL	14K13	294	30	432
Outside the workshop	NON-RESIDENTIAL	14K16	1813	30	**2662**
EME Parking	NON-RESIDENTIAL	ND	ND	30	ND

BLACK BOLD – RESIDENTIAL EXCEEDANCE

RED BOLD – NON- RESIDENTIAL EXCEEDANCE

Please note that compliance with respect to the National Dust Control Regulations is provisional as the site classifications in terms of these regulations will need to be confirmed by the client by considering the town planning of the area of operation.

Test Report: Monthly Dust Deposition Monitoring

July 2015

Prepared for

South Coast Stone Crushers (PTY) Ltd

AS1248

Sampling period: 19 July – 21 August 2015

Dustfall levels exceeded NON-RESIDENTIAL level – INVESTIGATION AND INTERVENTION REQUIRED

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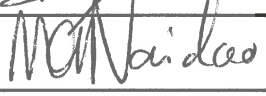
Internet: www.sgs.com
E-mail: info@sgs.com

REPORT DETAILS

REFERENCE	AS1248
CLIENT REFERENCE	**4300024161**
REPORT TITLE	South Coast Stone Crushers July 2015 Monthly Dust Deposition Report
DATE SUBMITTED:	28 October 2015
CLIENT:	Deepa Seepersad South Coast Stone Crushers Tel: +27 (31) 450 4434 E-mail: Dseepersad@intercement.com
PREPARED BY:	Mathew Weedman Unit 406 Ground Floor Block 4 35/37 Island Circle Office Park Riverhorse Valley Durban Tel:+27 (0)31 534 0700 E-mail: mathew.weedman@sgs.com
SIGNED:	Mathew Weedman Signed: 
TECHNICAL SIGNATORY	Mia Antoni-Naidoo Signed: 
STATUS	FINAL
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ml	Millilitres
mm	Millimetres

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1.1 Scope of work

The SGS understanding of the scope of work at South Coast Stone Crushers is as follows:

- South Coast Stone Crushers staff to do monthly sample changes
- Gravimetric analysis of dust samples by SGS on a monthly basis.
- Reporting of results.

The dust deposition monitoring was based on the ASTM International standard method for collection and analysis of dust fall (ASTM D1739: 1970), with certain modifications.

The results presented in this report are compared to the South African National Dust Control Regulations, 2013.

2 METHODOLOGY

Dustfall monitoring at South Coast Stone Crushers began in July 2014. Windblown settleable dust fall-out is monitored based on the ASTM International standard method for collection and analysis of dustfall (ASTM D1739), with certain modifications. This method employs a simple device consisting of a cylindrical 5 l container half-filled with de-ionised water exposed for one calendar month (30 ± 3 days). The water is treated with an inorganic algaecide to prevent algal growth in the buckets. The most common reagent used for this is a 5 % copper sulphate solution.

Figure 1: Single bucket monitoring unit, showing a sampling bucket with bird ring and security clamp.

The bucket stand comprises a ring that is raised above the rim of the bucket to prevent contamination from perching birds (Figure 1). The bucket holder is connected to a 2.1 m galvanised steel pole, which is either directly attached to a fence post or can be attached to a galvanised steel base plate, which is buried to a depth of 500 mm. This allows for a variety of placement options for the fallout samplers. Exposed buckets, when returned to the SGS Environmental laboratories, are rinsed with de-ionised water to remove residue from the sides of the bucket, and the bucket contents filtered through a 1mm sieve to remove insects and other coarse organic detritus. The sample is then filtered through a pre-weighed paper filter to remove the insoluble fraction, or dust fallout. This residue and filter are dried, and gravimetrically analysed to determine the insoluble fraction (dust fallout).

3 STANDARDS FOR DUST DEPOSITION

3.1 National Environmental Management: Air Quality Act, 2004; (Act No. 39 of 2004) National Dust Control Regulations

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Restriction Areas	Dust fall rate (D) (mg/m2/day, 30-days average)	Permitted frequency of exceeding dust fall rate
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The method to be used for measuring dustfall rate and the guideline for locating sampling points shall be ASTM D1739: 1970, or equivalent method approved by any internationally recognized body.

3.2 Residential and Non- residential areas

A residential area means any area classified for residential use in terms of local town planning scheme;

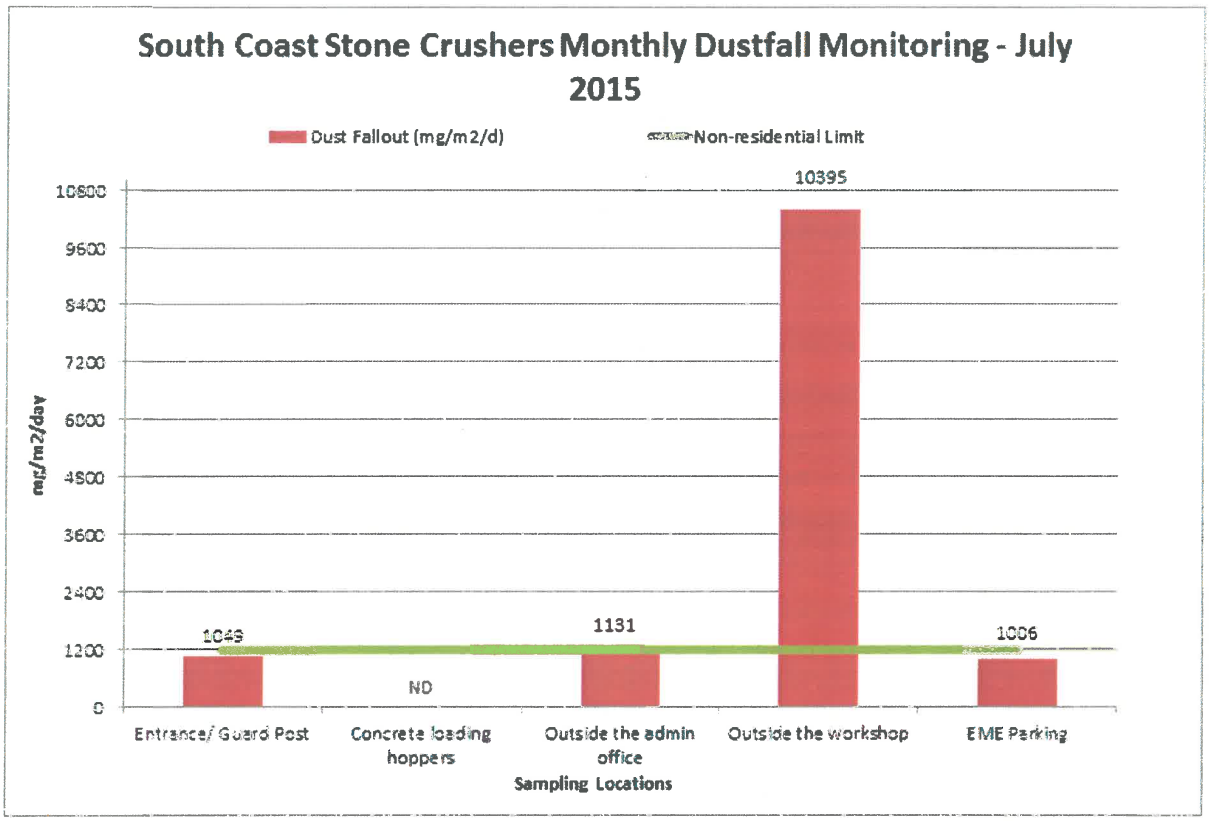
A Non- residential area means any area not classified for residential use as per local town planning scheme

4 RESULTS

4.1 Operational Aspects

The sampling period was from 19 July – 21 August 2015. Samples were exposed for 33 days. The exposure period does comply with the standard operating procedure of 30 ± 3 days. Site 5 (Concrete Loading Hoppers) recorded no data as the sample was missing, a valid sample return of 80% was thus achieved

Figure 4.1: Single bucket dustfall results for South Coast Stone Crushers during July 2015



4.2 Single Bucket Results

During the month in review Site 2 (Outside The Workshop) recorded a dustfall which exceeded the NON-RESIDENTIAL threshold, with dustfalls of **10395** mg/m^2/day. The remaining sites recorded dustfalls within the NON-RESIDENTIAL threshold.

5 CONCLUSION

- During the month in review Site 2 (Outside the Workshop) recorded a dustfall which exceeded the NON-RESIDENTIAL threshold, investigation and mitigation measures should be put in place to avoid reoccurences.
- The remaining monitoring sites recorded dustfalls within the NON-RESIDENTIAL threshold. Since these sites are classified as NON-RESIDENTIAL these results are considered satisfactory.

APPENDIX 1

Results

SOUTH COAST STONE CRUSHERS SINGLE BUCKET DUSTFALL MONITORING			Month: July 2015 Sampling period: 19 July – 21 August 2015		
SITE DESCRIPTION	SITE CLASSIFICATION	FILTER No.	NETT MASS (mg)	No. DAYS	DUST FALLOUT (mg/m^2/day)
Entrance/Guard post	NON-RESIDENTIAL	15D3	786	33	**1049**
Concrete loading hopper	NON-RESIDENTIAL		0	33	ND
Outside admin office	NON-RESIDENTIAL	15	848	33	**1131**
Outside the workshop	NON-RESIDENTIAL	15D31	7787	33	**10395**
EME Parking	NON-RESIDENTIAL	14K23	754	33	**1006**

BLACK BOLD – RESIDENTIAL EXCEEDANCE

RED BOLD – NON- RESIDENTIAL EXCEEDANCE

Please note that compliance with respect to the National Dust Control Regulations is provisional as the site classifications in terms of these regulations will need to be confirmed by the client by considering the town planning of the area of operation.

Specific Test Conditions	Samples stored at room temperature prior to analysis. Filters weighed at constant mass
Deviations From Method	None.
Measurement Uncertainty	± 5%

Test Report: Monthly Dust Deposition Monitoring

February 2016

Prepared for

South Coast Stone Crushers (PTY) Ltd

AS1248 36.155 M_SCSC

Dustfall levels exceeded NON-RESIDENTIAL level – INVESTIGATION AND INTERVENTION REQUIRED

Sampling period: 15 February – 17 March 2016

sanas Testing Laboratory
T0107

259 Kent Avenue
Ferndale
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Tel: +27 11 590 3000
Internet: www.sgs.com
E-mail: info@sgs.com

REPORT DETAILS

REFERENCE	AS1248_36.155 M_SCSC
CLIENT REFERENCE	4300024161
REPORT TITLE	South Coast Stone Crushers February 2016 Monthly Dust Deposition Report
DATE SUBMITTED	30 March 2016
CLIENT	Deepa Seepersad South Coast Stone Crushers Tel: *+27 (31) 450 4434* E-mail: Dseepersad@intercement.com
PREPARED BY	Luvuyo Dlamini (Cand.Sci.Nat) Suite 406 Ground Floor, Block 4 Island Office Park, 35/37 Island Circle, Riverhorse Valley, Durban, 4071 Tel: +27 (0)31 534 0700 E-mail: Luvuyo.dlamini@sgs.com
SIGNED	Luvuyo Dlamini Signed:
TECHNICAL SIGNATORY	Mathew Weedman Signed:
STATUS	FINAL
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A Non- residential area means any area not classified for residential use as per local town planning scheme

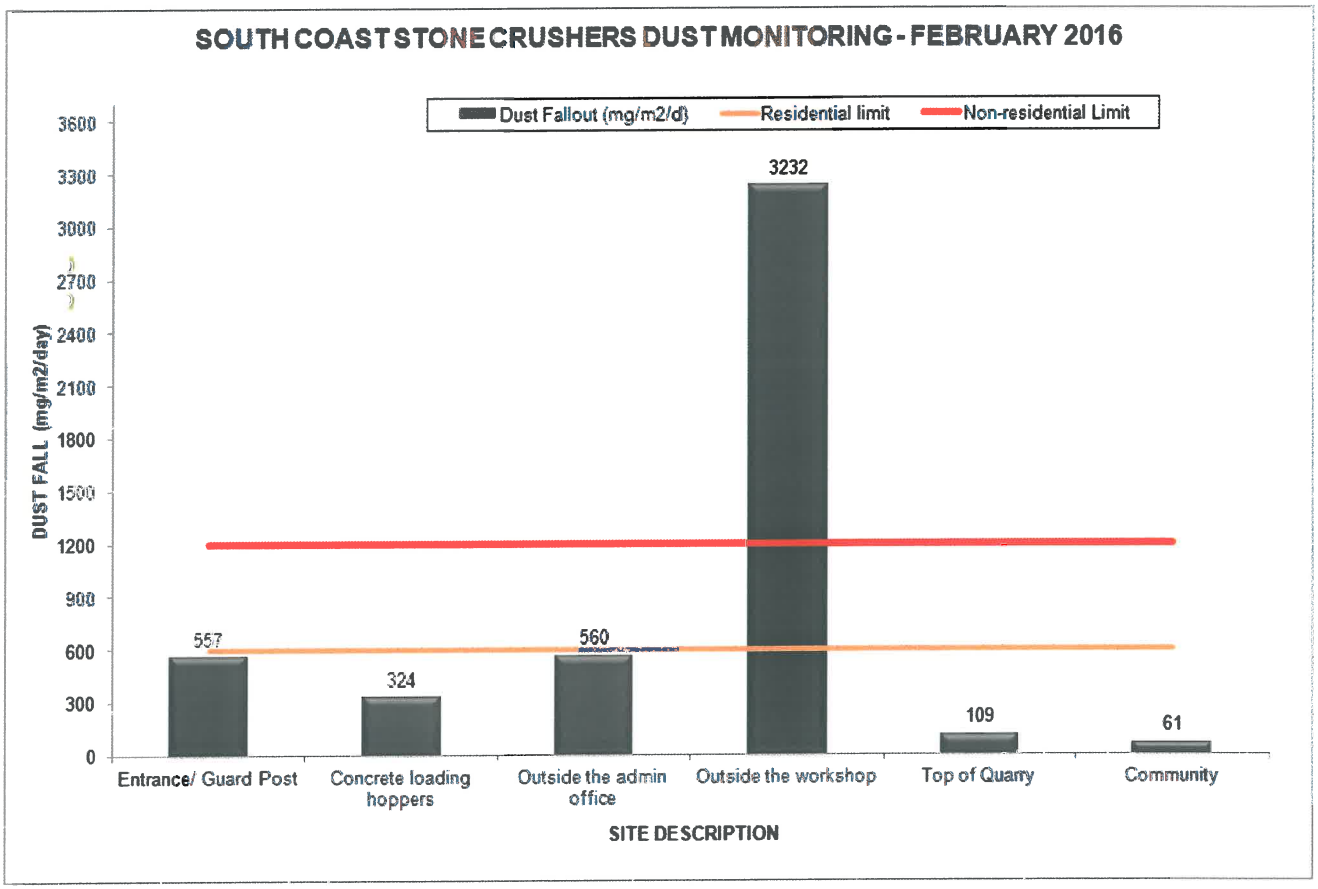
4 RESULTS

4.1 Operational Aspects

The sampling period was from 15 February – 17 March 2016. Samples were exposed for 31 days; this exposure period does comply with the standard operating procedure of 30 ± 3 days. A valid sample return of 100% was achieved for single buckets.

4.2 Single Bucket Results

Figure 2: Single bucket dustfall results for South Coast Stone Crushers during February 2016



- During the month in review, Site 2 (Outside the Workshop) recorded a dustfall that exceeded the NON-RESIDENTIAL threshold, with a rate of **3232** mg/m^2/day. All the remaining sites recorded dustfall rates within the RESIDENTIAL threshold.

Number of Exceedances	Number of sites	Site Description
Current month	1	NON-RESIDENTIAL
Previous 11 months	7	NON-RESIDENTIAL
Consecutive months	1	NON-RESIDENTIAL

Please note that compliance with respect to the National Dust Control Regulations is provisional as the site classifications in terms of these regulations will need to be confirmed by the client by considering the town planning of the area of operation.

5 CONCLUSION

- During the month in review Site 2 (Outside the Workshop) recorded a dustfall which exceeded the NON-RESIDENTIAL threshold, this is a consecutive occurrence of an exceedance for this site for 2016, investigation and mitigation measures should be put in place to avoid reoccurrences.
- All single bucket results were within the RESIDENTIAL threshold, these results are considered satisfactory.

APPENDIX 1

Results

SOUTH COAST STONE CRUSHERS DUSTFALL MONITORING			Month: February 2016 Sampling period: 15 February – 17 March 2016		
SITE DESCRIPTION	SITE CLASSIFICATION	FILTER No.	NETT MASS (mg)	No. DAYS	DUST FALLOUT (mg/m^2/day)
Entrance/Guard post	NON-RESIDENTIAL	15D15	392	31	557
Concrete loading hopper	NON-RESIDENTIAL	15D16	228	31	324
Outside admin office	NON-RESIDENTIAL	15D18	394	31	560
Outside the workshop	NON-RESIDENTIAL	14K16	2274	31	**3232**
Top of Quarry	NON-RESIDENTIAL	15D14	76	31	109
Community	RESIDENTIAL	15D17	43	31	61

BLACK BOLD – RESIDENTIAL EXCEEDANCE

RED BOLD – NON- RESIDENTIAL EXCEEDANCE

Please note that compliance with respect to the National Dust Control Regulations is provisional as the site classifications in terms of these regulations will need to be confirmed by the client by considering the town planning of the area of operation.

Specific Test Conditions	Samples stored at room temperature prior to analysis. Filters weighed at constant mass
Deviations From Method	None.
Measurement Uncertainty	± 5%

APPENDIX 2

Sampling Locations

Figure A2.1: Map illustrating the location of the bucket monitoring sites at South Coast Stone Crushers

SITE DESCRIPTION	LATITUDE	LONGITUDE
Outside admin office	30°49'27.52"S	30°22'34.33"E
Outside the workshop	30°49'28.51"S	30°22'28.78"E
Gate 1	30°49'29.15"S	30°22'36.49"E
Top of Quarry	30°49'12.53"S	30°22'28.45"E
Concrete loading hoppers	30°49'28.06"S	30°22'41.48"E
Community	30°49'54.35"S	30°22'40.81"E

Test Report: Monthly Dust Deposition Monitoring

August 2015

Prepared for

South Coast Stone Crushers (PTY) Ltd

AS1248

AS1248.35.547 M_SCSC

Sampling period: 21 August – 23 September 2015

Dustfall levels exceeded NON-RESIDENTIAL level – INVESTIGATION AND INTERVENTION REQUIRED

Unit 406, Ground floor Block 4
35/37 Island Circle Office Park
Riverhorse Valley
Durban

Tel: +27 31 534 0700
Fax: +27 31 534 0735
Internet: www.sgs.com
E-mail: info@sgs.com

REPORT DETAILS

REFERENCE	AS1248 35.547 M_SCSC
CLIENT REFERENCE	**4300024161**
REPORT TITLE	South Coast Stone Crushers August 2015 Monthly Dust Deposition Report
DATE SUBMITTED:	28 October 2015
CLIENT:	Deepa Seepersad South Coast Stone Crushers Tel: +27 (31) 450 4434 E-mail: Dseepersad@intercement.com
PREPARED BY:	Mathew Weedman Unit 406 Ground Floor Block 4 35/37 Island Circle Office Park Riverhorse Valley Durban Tel:+27 (0)31 534 0700 E-mail: mathew.weedman@sgs.com
SIGNED:	Mathew Weedman Signed:
TECHNICAL SIGNATORY	Mia Antoni-Naidoo Signed:
STATUS	FINAL
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ABBREVIATIONS

l	Litres
m	Metres
mg/m^2/day	Milligrams per metre squared per day
ml	Millilitres
mm	Millimetres

1 INTRODUCTION

1.1 Scope of work

The SGS understanding of the scope of work at South Coast Stone Crushers is as follows:

- SGS staff to collect samples on a monthly basis
- Gravimetric analysis of dust samples by SGS on a monthly basis.
- Reporting of results.

The dust deposition monitoring was based on the ASTM International standard method for collection and analysis of dust fall (ASTM D1739: 1970), with certain modifications.

The results presented in this report are compared to the South African National Dust Control Regulations, 2013.

2 METHODOLOGY

Dustfall monitoring at South Coast Stone Crushers began in July 2014. Windblown settleable dust fall-out is monitored based on the ASTM International standard method for collection and analysis of dustfall (ASTM D1739), with certain modifications. This method employs a simple device consisting of a cylindrical 5 l container half-filled with de-ionised water exposed for one calendar month (30 ± 3 days). The water is treated with an inorganic algaecide to prevent algal growth in the buckets. The most common reagent used for this is a 5 % copper sulphate solution.

Figure 1: Single bucket monitoring unit, showing a sampling bucket with bird ring and security clamp.

The bucket stand comprises a ring that is raised above the rim of the bucket to prevent contamination from perching birds (Figure 1). The bucket holder is connected to a 2.1 m galvanised steel pole, which is either directly attached to a fence post or can be attached to a galvanised steel base plate, which is buried to a depth of 500 mm. This allows for a variety of placement options for the fallout samplers. Exposed buckets, when returned to the SGS Environmental laboratories, are rinsed with de-ionised water to remove residue from the sides of the bucket, and the bucket contents filtered through a 1mm sieve to remove insects and other coarse organic detritus. The sample is then filtered through a pre-weighed paper filter to remove the insoluble fraction, or dust fallout. This residue and filter are dried, and gravimetrically analysed to determine the insoluble fraction (dust fallout).

3 STANDARDS FOR DUST DEPOSITION

3.1 National Environmental Management: Air Quality Act, 2004; (Act No. 39 of 2004) National Dust Control Regulations

Table 3 Extract from the National Dust Control Regulations, No. 36974 Government Gazette, 1 November 2013

Restriction Areas	Dust fall rate (D) (mg/m2/day, 30-days average)	Permitted frequency of exceeding dust fall rate
Residential area	D < 600	Two within a year, not sequential months
Non-residential area	600 < D < 1200	Two within a year, not sequential months

The method to be used for measuring dustfall rate and the guideline for locating sampling points shall be ASTM D1739: 1970, or equivalent method approved by any internationally recognized body.

3.2 Residential and Non- residential areas

A residential area means any area classified for residential use in terms of local town planning scheme;

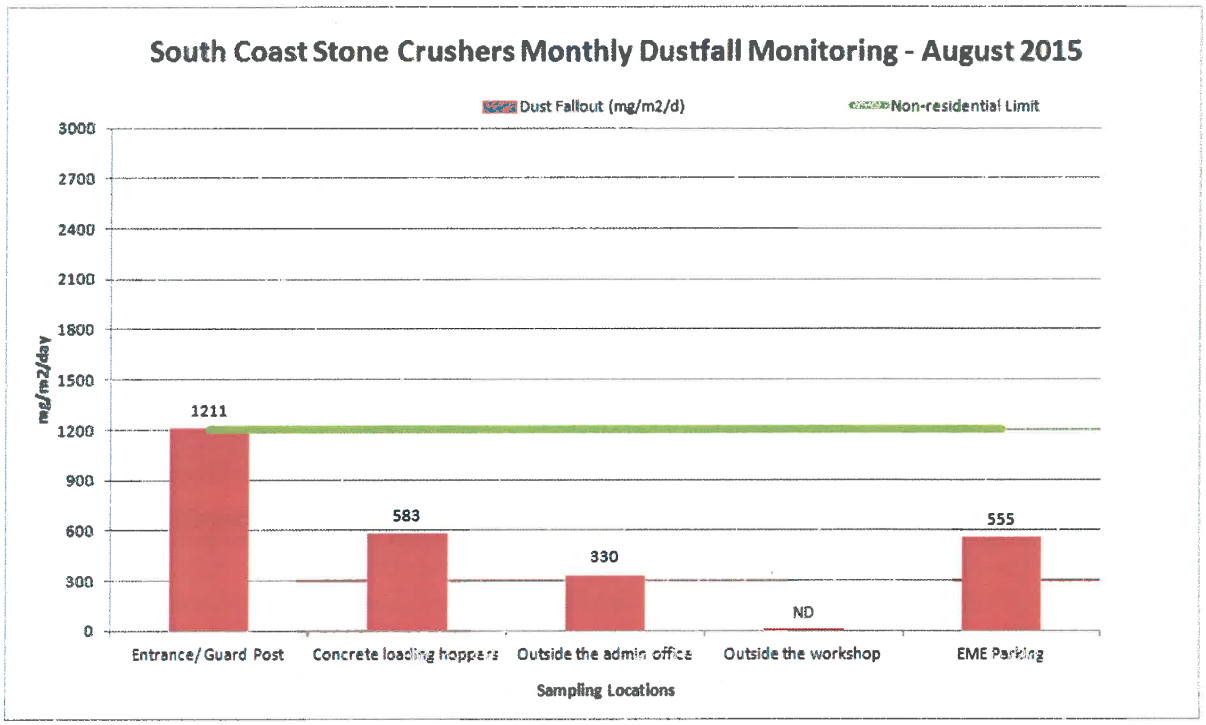
A Non- residential area means any area not classified for residential use as per local town planning scheme

4 RESULTS

4.1 Operational Aspects

The sampling period was from 21 August – 23 September 2015. Samples were exposed for 33 days. The exposure period does comply with the standard operating procedure of 30 ± 3 days. A valid sample return of 80% was thus achieved. Site 2 (Outside Workshop) recorded no data as the sample was missing.

Figure 4.1: Single bucket dustfall results for South Coast Stone Crushers during August 2015



4.2 Single Bucket Results

During the month in review Site 3 (Entrance/ Guard Post) recorded a dustfall which exceeded the NON-RESIDENTIAL threshold, with dustfalls of **1211** mg/m^2/day. The remaining sites recorded dustfalls within the NON-RESIDENTIAL threshold.

5 CONCLUSION

- During the month in review Site 3 (Entrance/ Guard Post) recorded a dustfall which exceeded the NON-RESIDENTIAL threshold, investigation and mitigation measures should be put in place to avoid reoccurences.
- The remaining monitoring sites recorded dustfalls within the NON-RESIDENTIAL threshold. Since these sites are classified as NON-RESIDENTIAL these results are considered satisfactory.

APPENDIX 1

Results

SOUTH COAST STONE CRUSHERS SINGLE BUCKET DUSTFALL MONITORING			Month: August 2015 Sampling period: 21 August – 23 September 2015		
SITE DESCRIPTION	SITE CLASSIFICATION	FILTER No.	NETT MASS (mg)	No. DAYS	DUST FALLOUT (mg/m^2/day)
Entrance/Guard post	NON-RESIDENTIAL	15D16	907	33	**1211**
Concrete loading hopper	NON-RESIDENTIAL	15D14	437	33	583
Outside admin office	NON-RESIDENTIAL	15D18	247	33	330
Outside the workshop	NON-RESIDENTIAL	15D15	0	33	ND
EME Parking	NON-RESIDENTIAL	15D17	416	33	555

BLACK BOLD – RESIDENTIAL EXCEEDANCE

RED BOLD – NON- RESIDENTIAL EXCEEDANCE

Please note that compliance with respect to the National Dust Control Regulations is provisional as the site classifications in terms of these regulations will need to be confirmed by the client by considering the town planning of the area of operation.

Specific Test Conditions	Samples stored at room temperature prior to analysis. Filters weighed at constant mass
Deviations From Method	None.
Measurement Uncertainty	± 5%

Appendix I: Noise Studies

REPORT

APEX ENVIRONMENTAL

South Coast Stone Crushers (Pty) Ltd – Uvongo

Environmental Noise Measurement & Rating Survey

Date of Survey: 3rd October 2014

AIA consultants t/a Apex / CK No. 2004/044939/23
Approved Inspection Authority
DoL Cert. No: CI0840H

SOUTH COAST STONE CRUSHERS (PTY) LTD – UVONGO

ENVIRONMENTAL NOISE MEASUREMENT & RATING SURVEY

Date of Survey: 3rd October 2014

QUICK REFERENCE GUIDE	
Assessment Title:	Environmental Noise Measurement & Rating Survey
Date/s of Assessment:	3rd October 2014
Date Report Issued:	3rd November 2014
Contract Number (our reference):	A7274R2/S
Order Number (your reference):	4300020811
Company Name:	South Coast Stone Crushers
Assessment Physical Address:	Lot 2000, Quarry Road, Uvongo
Client Contact/s:	Deepa Seepersad
Version:	01
APEX REFERENCES	
Approved Inspection Authority Name & DoL Certificate Number:	AIA Consultants cc. T/A Apex Environmental Certificate Number CI 084 OH
Physical Address:	Unit 4, 40 Beechgate Crescent, Southgate Business Park, Umbogintwini, 4126
Postal Address:	P.O. Box 2079, Amanzimtoti, 4125
Contact Details:	Tel: +27 (0)31 9141004 Fax: +27 (0)31 9142199 www.apexenviro.co.za
Your Consultant:	Mr. L. Pretorius: leon@apexenviro.co.za Division Head: Environmental BSocSc (Hons) Environmental Management Occupational Hygiene Technologist (SAIOH)
Supervised & Checked By:	..... Mr. S.J. Chester: sean@apexenviro.co.za MPH: Occupational Hygiene (Wits) Registered Occupational Hygienist (SAIOH)

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LIST OF DEFINITIONS AND ABBREVIATIONS

AMBIENT NOISE: The totally encompassing sound in a given situation at a given time, and usually composed of sound from many sources, both near and far.

DISTANT SOURCE: A sound source that is situated more than 500 m from the point of observation.

MEASUREMENT TIME INTERVAL: That time interval over which measurements are made or can be made.

NEARBY SOURCE: A sound source that is situated at a distance of 500 m or less from the point of observation.

REFERENCE TIME INTERVAL: The time interval to which an equivalent continuous A-weighted sound level $L(A)eq_{,T}$ can be referred.

Note: Reference time intervals can be specified to cover typical human activities and variations in the operation of noise sources and, in the absence of contrary indications, are interpreted as follows:

- Day-time : 06:00 to 22:00
- Night-time : 22:00 to 06:00

RESIDUAL NOISE: The ambient noise that remains at a given position in a given situation when one or more specific noises are suppressed.

SPECIFIC NOISE: A component of the ambient noise which can be specifically identified by acoustical means and which may be associated with a specific source.

dB(A): Decibels on A-weighted network.

A-WEIGHTED NETWORK: An electronic filter in a sound level meter, which approximates under defined conditions the frequency response of the human ear.

1. EXECUTIVE SUMMARY

An environmental noise monitoring assessment was undertaken at the South Coast Stone Crushers (Pty) Ltd, Uvongo premises in order to assess whether potential noise emissions generated from their operations could constitute community complaints.

All results obtained from the Day Time monitoring was observed to be ***below*** the SANS guideline rating levels for *Industrial Districts*. The data therefore represents a picture of ***Compliance*** with guideline standards. No night time operations are undertaken at the South Coast Stone Crushers premises.

The nearest sensitive receptor (residential property) was observed to be located less than 100 metres to the North north-west of the northern boundary. It should however be noted that noise buffers in the form of natural surrounding vegetation and steep surface gradients aid in the reduction of noise transmission through direct line of sight to potential sensitive receptors as well as the climatic conditions in terms of temperature gradients and temperature inversions which would alter noise transmission through the topographical area where the South Coast Stone Crushers premises is located.

With all the information and monitoring data evaluated, it can be seen that possibility of complaints received as a result of the operations at the South Coast Stone Crushers is considered unlikely.

Various recommendations to further reduce the environmental noise impact on surrounding communities from the operations are outlined in Paragraph 8 of this report.

2. PURPOSE

To determine if the environmental noise levels produced at the South Coast Stone Crushers (Pty) Ltd, Uvongo premises, constitute a potential annoyance to the surrounding community as defined by the SANS code 10103:2008 - *The measurement and rating of environmental noise with respect to annoyance and to speech communication*.

Figure 1: **Annotated aerial photo showing the locality of South Coast Stone Crushers with related monitored positions. Image source: Google Earth.**

3. RESULTS

TABLE 1 – MONITORED RESULTS

POS.	RON'S WORKSHOP – ENTRANCE GATE	DAY TIME NRL (06H00 – 22H00) (RATING LEVEL 70)					EVALUATION / NOISE SOURCES DAY : D
		L(A)EQ	L(A)10	L(A)90	L(A)MIN	L(A)MAX	
1	Day Time Monitoring	49.4	51.6	46.3	45.2	62.0	**D:** The main noise source was noted as distant and passing vehicular traffic.
POS.	**BEHIND RON'S WORKSHOP**	**DAY TIME NRL (06H00 – 22H00) (RATING LEVEL 70)**					**EVALUATION / NOISE SOURCES DAY : D**
		L(A)EQ	**L(A)10**	**L(A)90**	**L(A)MIN**	**L(A)MAX**	
2	Day Time Monitoring	48.5	50.8	43.7	42.2	61.5	**D:** Distant on-site noise sources included the loading of dump trucks and excavator operation.

TABLE 1 – MONITORED RESULTS (Continued...)

POS.	TOP OF QUARRY – CLAY AREA	DAY TIME NRL (06H00 – 22H00) (RATING LEVEL 70)					EVALUATION / NOISE SOURCES DAY : D
		L(A)EQ	L(A)10	L(A)90	L(A)MIN	L(A)MAX	
3	Day Time Monitoring	55.5	58.4	51.7	50.5	63.2	D: The main noise source was noted as excavator operation, loading the dump trucks.
POS.	NEAR THE UVONGO ROAD	DAY TIME NRL (06H00 – 22H00) (RATING LEVEL 70)					EVALUATION / NOISE SOURCES DAY : D
		L(A)EQ	L(A)10	L(A)90	L(A)MIN	L(A)MAX	
4	Day Time Monitoring	50.6	52.3	47.1	45.5	62.7	D: Distant noise emissions related to dump trucks transporting material.

TABLE 1 – MONITORED RESULTS (Continued...)

POS.	SUGAR CANE – BEHIND THE WORKSHOP	DAY TIME NRL (06H00 – 22H00) (RATING LEVEL 70)					EVALUATION / NOISE SOURCES DAY : D
		L(A)EQ	L(A)10	L(A)90	L(A)MIN	L(A)MAX	
5	Day Time Monitoring	57.6	58.8	55.1	53.9	65.9	**D:** Operations at the plant (screens) were noted as the main noise source.
POS.	**PARKING AREA**	**DAY TIME NRL (06H00 – 22H00) (RATING LEVEL 70)**					**EVALUATION / NOISE SOURCES DAY : D**
		L(A)EQ	**L(A)10**	**L(A)90**	**L(A)MIN**	**L(A)MAX**	
6	Day Time Monitoring	69.0	70.3	67.7	67.1	74.5	**D:** Operations at the plant (screens) along with vehicular traffic were noted as the main noise source.

TABLE 1 – MONITORED RESULTS (Continued...)

POS.	AT THE MOBILE WORKSHOP	DAY TIME NRL (06H00 – 22H00) (RATING LEVEL 70)					EVALUATION / NOISE SOURCES DAY : D
		L(A)EQ	L(A)10	L(A)90	L(A)MIN	L(A)MAX	
7	Day Time Monitoring	66.4	67.5	65.2	64.0	68.8	**D:** The main noise source was attributed towards the operation of the National Asphalt operations.
POS.	**MAIN GATE**	**DAY TIME NRL (06H00 – 22H00) (RATING LEVEL 70)**					**EVALUATION / NOISE SOURCES DAY : D**
		L(A)EQ	**L(A)10**	**L(A)90**	**L(A)MIN**	**L(A)MAX**	
8	Day Time Monitoring	65.9	70.7	59.9	58.8	73.6	**D:** Cars and trucks entering and exiting the site was noted as the main noise source.

4. SITUATION, ZONING & RATING LEVELS AND CATEGORIES OF COMMUNITY / GROUP RESPONSE

4.1 Situation

4.1.1 South Coast Stone Crushers (Pty) Ltd, Uvongo premises is situated at Lot 2000, Quarry Road, Uvongo, KwaZulu-Natal.

Four Boundaries are as shared as follows:

a) **Northern Boundary** – Uvongo Road and Agricultural land
b) **Eastern Boundary** – Natural vegetation, Ron's Workshop and scattered residential properties
c) **Southern Boundary** – Neighbouring industrial properties and activities and the R61
d) **Western Boundary** – Agricultural land and natural vegetation

4.1.2 From the above it can be seen that the potential for environmental noise impacts on nearby residential communities is considered unlikely result in community complaints.

4.1.3 Potential Noise Sources include:

- Driven Machinery – Pay loaders, excavators, Dump trucks etc.
- Screening Machines
- Crusher Machines
- Wash Plant
- Concrete Plant
- Blasting Activities
- Vehicular traffic

4.2 Zoning & Rating Levels

South Coast Stone Crushers (Pty) Ltd, Uvongo premises is zoned as an Industrial District. The SANS rating levels for *Industrial Districts* therefore applies to the monitoring position at South Coast Stone Crushers. (See Table 2 below for selected criteria)

TABLE 2: 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

a 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.

NOTE: Reference time intervals can be specified to cover typical human activities and variations in the operation of noise sources and, in the absence of contrary indications, are interpreted as follows:

- Day-time : 06:00 to 22:00
- Night-time : 22:00 to 06:00

4.3 Categories of Community / Group Response

The SANS guidelines outline the categories of community /group response to 'annoying or otherwise intrusive noise' (see Table 3 below):

TABLE 3 – CATEGORIES OF COMMUNITY/ GROUP RESPONSE

Excess Noise $\Delta L_{Req,T}$ (dBA)	Estimated community/group response	
	Category	Description
0 – 10	Little	Sporadic complaints
10 – 15	Medium	Widespread complaints
15 – 20	Strong	Threats of community/group action
>20	Very Strong	Vigorous community/group action

$\Delta L_{Req,T} = L_{Req,T}$ of the ambient noise under investigation minus the acceptable rating level for the applicable district as determined from Table 3.

5. EVALUATION OF RESULTS

5.1 Day Time

5.1.1 All Day Time monitoring results were found to be ***below*** the SANS guideline rating level for Industrial Districts. The data therefore represents a picture of ***Compliance*** with guideline standards.

5.1.2 Although the South Coast Stone Crushers operations are deemed as Industrial Zone / district, the location of the plant is considered as a rural to suburban district with little road traffic. The noise levels beyond the boundary of the South Coast Stone Crushers operations are however considered to be below both the above mentioned districts.

5.2 Night Time

5.2.1 It should be noted that NO night time operations are undertaken at the South Coast Stone Crushers (Pty) Ltd premises.

5.3 General Evaluations

5.3.1 The nearest sensitive receptors identified (Residential property) was noted to be located less than 100 metres to the North north-west of northern boundary.

5.3.2 Noise buffers in the form of natural surrounding vegetation and steep surface gradients aid in the reduction of noise transmission through direct line of sight to potential sensitive receptors.

5.3.3 Due to the operations at the South Coast Stone Crushers only occurring during the day time, noise impacts on surrounding sensitive receptors are not considered significant and with all the information and monitoring data evaluated, it can be seen that possibility of complaints received as a result of the operations at the South Coast Stone Crushers are considered unlikely.

5.4 Technical Evaluations

Interrogation of the ratio of L_{10} to L_{90} values for both day time and night time was undertaken in order to establish the absolute sound pressure variation of the readings at the monitoring location. A ratio of 1 indicates that there was no variation (fluctuation) in sound pressure level during the measurement. A ratio with a value greater than 1 indicates that there were certain fluctuations in sound pressure during the measurement.

In practical terms these ratios could be explained by describing the following two potential scenarios. A measurement taken in close proximity to a constant speed motor would return a L_{10}:L_{90} ratio close to 1 (low variability), while a measurement taken at the side of a roadway would have a high ratio on account of relatively low sound levels interspersed with peaks associated with passing vehicles.

The monitoring results indicated variation in results for all the monitoring positions. Intermittent noise sources such as driven machinery and vehicular traffic can be attributed towards this variation.

6. SOUND REDUCTION BY DISTANCE

6.1 Sound spreading in open air and measured at a certain distance from the source is reduced by about 6 dB for each doubling of that distance. Sound is reduced less when spreading inside a room.

6.2 If a small sound source produces a sound level of 90 dB at a distance of 1 meter, the sound level at a 2 meter distance is 84 dB, at 4 meters 78dB, etc. (Figure 2).

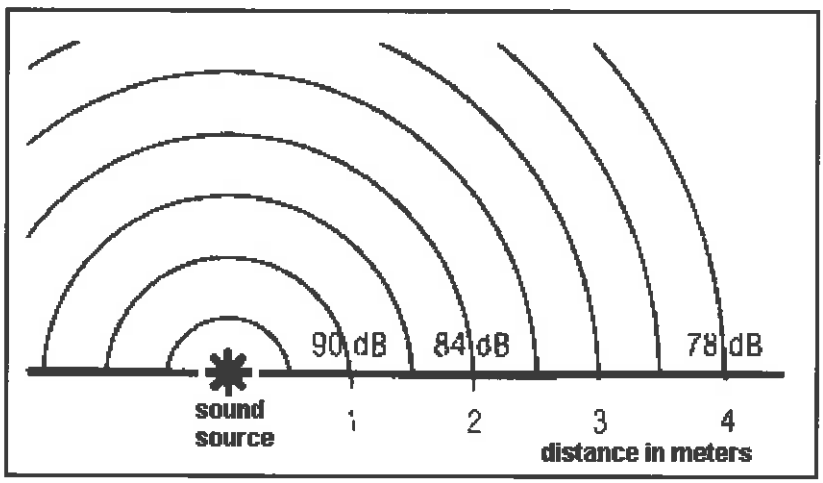

FIGURE 2: SOUND TRANSMISSION LOSS

(http://www.nohsc.gov.au/OHSInformation/OHSSolutions/noise/NOISECONT.HTM)

6.3 When a wall is struck by sound, only a small portion of the sound is transmitted through the wall, while most of it is reflected. The wall's ability to block transmission is indicated by its transmission loss (TL) rating, measured in decibels. The TL of a wall does not vary regardless of how it is used.

7. LIMITATIONS

The results obtained were indicative of the conditions that prevailed during the test period. Changes in production rate, process and other factors which effect noise transmission may cause a variation in the environmental noise level readings.

8. RECOMMENDATIONS

8.1 Although compliant results were obtained from this assessment, continual improvement should be maintained. Generally, the most effective means of reducing off-site noise impacts is by reducing the noise at its source. Continual maintenance should be undertaken on all moving parts, rollers, bearings etc. in order to minimize noise emissions as a result of the moving parts.

8.2 Further recommendations include that all driven machinery should be serviced and maintained on a regular basis as to ensure that optimal usage is maintained.

8.3 Wherever possible and/or reasonably practicable, however, particularly noisy equipment should be contained or screened off using acoustically absorbent material. Other examples may include the construction of a barrier around a noisy pump bay or Compressor Room to prevent line-of-sight noise transmission to receptors. This could be applicable to the operations at the Concrete Plant.

8.4 If not already in place, a complaints register which is accessible to all members of the public should be maintained. A formalised procedure which describes the recording and investigation of complaints, as well as subsequent feedback to the complainant should be implemented.

TECHNICAL DATA

Details of recommended requirements, specifications and conditions that are to be contained in written reports issued in terms of SABS ISO/IEC 17025 -"General requirements for the competence of calibration and testing laboratories".

9. DESCRIPTION OF MEASURING PROCEDURE

Each measurement was taken in accordance with the SANS 10103: 2008 Code of Practice, ***The measurement and rating of environmental noise with respect to annoyance and speech communication***. Each measurement was taken for a minimum period of 10 minutes at each monitoring location.

10. EQUIPMENT SPECIFICATIONS

10.1 Sound Level Meter

a)	Description:	Type 1 Precision Integrating Sound Level Meter, which complies with the accuracy requirements described in SANS 61672-1 and SANS 61672-2
b)	Manufacturer:	Rion
c)	Model Number:	NL-32
d)	Serial Number:	00403213
e)	Date of Calibration:	16th May 2013
f)	Due date of Next Calibration:	16th May 2015 (Two yearly, in terms of section 8.2.1 of SANS 10083:2012)
h)	Compliance Rating	Complies with the IEC 651, 804 & 942 for TYPE 1

10.2 Calibrator

a)	Description:	Sound Level Calibrator, which complies with the requirements described in SANS 60942
b)	Manufacturer:	QUEST
c)	Model Number:	QC-10
d)	Serial Number:	QE 5120165
e)	Date of Calibration:	20th January 2014
f)	Due date of Next Calibration:	January 2015 (Annually, in terms of section 8.2.1 of SANS 10083:2012)
g)	Calibration Certif. No:	L58081
h)	Compliance Rating:	Complies with the IEC 942.

11. UNCERTAINTIES OF MEASUREMENT

In accordance with the uncertainties of measurement, the estimate for a 95% confidence level are as follows:-

Sound Level Meter	± 0.3dB
Microphone	± 0.8dB
Sound Level Calibrator	± 1.0 %

12. CLIMATIC CONDITIONS

DATE & TIME OF SAMPLE	TEMP. °C	% RELATIVE HUMIDITY
03 / 10 / 2014	16°C - 19°C	62 – 83 %

13. CALIBRATION RESULTS

DATE & TIME OF CALIBRATION	BEFORE	AFTER
03 / 10 / 2014 08H00	114.0	114.0
03 / 10 / 2014 16H30	114.0	114.0

14. CERTIFICATION STATEMENT

This is to certify that the attached report has been compiled and issued under the authority, direction and the responsibility of an Apex Occupational Hygienist.

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in terms of the Occupational Health and Safety Act, 1993, for the monitoring of

Physical Stress Factors and Chemical Stress Factors (including Lead and Asbestos)

2004-09-09

DATE

CI 084 OH

CERTIFICATE NUMBER

CHIEF INSPECTOR

Technology Solutions
Measurement Science Laboratory

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ACCREDITED ISO/IEC 17025
Certificate # L2347.01 Calibration

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American Standard Calibration Laboratory
Measurement Science Laboratory

GOLDILUX

Certificate No	L58081			
Manufacturer	Quest Technologies			
Description	Acoustic Calibrator			
Model No	QC-10			
Serial No	QE5120165			
Plant No	None			
Calibrated for	Apex Environmental Unit 4, 40 Beechgate Cresent, Southgate Business Park, Umbogintwini, 4126			
Temperature	22.5	°C		
Relative humidity	34	% RH	Barometric Pressure	857.9 mbar
Date of calibration	20 January 2014			
Expiry date	20 January 2015		Issue Date	20 January 2014
Calibrated by	I Jooste		Checked by	

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Technical Signatory *Luke W. Hards*

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American Standard Calibration Laboratory
Measurement Science Laboratory

Certificate No	L56649			
Manufacturer	Rion			
Description	Sound Level Meter			
Model No	NL-32			
Serial No	00403213			
Plant No	Yellow Kit			
Calibrated for	Apex Environmental Unit 4, 40 Beechgate Cresent, Southgate Business, Umbogintwini			
Temperature	22.3	° C		
Relative humidity	27	% RH	Barometric Pressure	856.4 mbar
Date of calibration	16 May 2013			
Expiry date	16 May 2015		Issue Date	16 May 2013
Calibrated by	I Jooste		Checked by	

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The Southern African Institute for Occupational Hygiene

This is to certify that

SJ Chester

ID No. 690513 5196 08 1

Has satisfied the requirements of section 3.4
of the Constitution of the Institute
and on recommendation of the Professionals Certification
Board is registered as an

Occupational Hygienist

Registration No. 0161

.....
Chairman: Professionals Certification Board

IOHA Recognised
Certification Scheme

IOHA

valid until **2015/01/31**

The Manager
South Coast Stone Crushers (Pty) Ltd.
P.O. Box 15245
Bellair
4006

9th September 2015.

Sir

ENVIRONMENTAL NOISE and PARTICULATE MATTER (PM10): SEPTEMBER 2015.

Herewith the environmental noise and Particulate Matter (PM10) report for your Concern conducted during the month of September 2015.

Should you require more information regarding this report please do not hesitate to contact our Centurion office.

Yours faithfully

P. H Meyer
IMEC (MVS), P.Grad. OH (USQ), MSHE (USQ), Nat. Dip. IT (TUT)

SURVEY: ENVIRONMENTAL NOISE & PM10

REPORT No: HL/NPC003/09/15.

1 Introduction.

1.1 Surveyors.

P H Meyer of Health and Occupational Hygiene Laboratory CC.

1.2 Purpose.

The purpose of this survey was to determine the environmental impact plant operations from South Coast Stone Crushers - Margate on the surrounding areas. Dust and sound pressure levels were measured at 7 test sites selected and demarcated to ensure that repeated readings were taken at the same positions around the plant and local community. These measurements were necessary to assess the dust and sound pressure levels.

1.3 Reason for survey.

Management of NPC Intercement requested HOHL to conduct a dust and noise survey to determine environmental impact of SCSC - Margate operations.

1.4 Method employed.

SANS Code SABS 10103:2008 6th Edition for Environmental Noise, and SANS 10083-2012.

SANS 1929-2011 – 4.4 Particulate Matter *(PM10)

***PM10** Particulate matter, which passes through a size-selective inlet with a 50 % efficiency cut-off at 10 µm aerodynamic diameter

1.5 Background.

Name and address of Concern.

South Coast Stone Crushers (Pty) Ltd.
P.O. Box 15245
Bellair
4006

1.6 Equipment used.

Real-time environmental dust monitoring was performed using a TSI DusTrak™ instrument. The instrument was placed 1.4 meters above ground level away from any obstructions.

Svanteck fully integrating sound level meter Calibration date: 26/02/15. Complies with the accuracy requirements specified for a Type 1 instrument in IEC 651 and IEC 804. Use was made of a windscreen of a type specified and supplied by the manufacturer for the microphone used which do not detectably influence the accuracy of the meter under ambient conditions of the survey. Microphone frequency response: 31.5 Hz – 16 kHz.

The sound level meter was checked prior to and immediately after the survey for calibration and was within the 1 dB limit prescribed for this type of survey. The microphone was positioned 1.4 m above ground level as required in the Code. In all instances the microphone was more than 3.5 m away from any walls or other flat surfaces, which could have had an influence on the readings obtained.

1.7 Sampling Areas

2. Dust Sampling.

Method employed.

Static sampling was done with TSI Dust-Track real-time monitor. This survey was conducted over a 24 -hour period to cover all three periods as described in the Code.

3. Sampling process.

Test stations were selected around the mine and measurements were conducted at each station to determine average levels at each sampling point as per section 1.7

4. Results

Airborne particulates (PM 10) were measured with the TSI Dust-Track real-time monitor.

a) Dust Results:

Daytime 2015/09/08 (06h00 – 18h00)

		PM10			Limit	Wind	
	Location	Max mg/m^3	Average mg/m^3	*Min mg/m^3	mg/m^3	Direction from	Speed (m/s)
1	Plant Entrance	0.102	**0.067**	0.035	0,075	S	1.6
2	Western Boundary	0.075	**0.058**	0.045	0,075	SSW	1.7
3	North Western Boundary	0.073	**0.051**	0.039	0,075	SSW	1.6
4	Eastern Boundary	0.178	**0.071**	0.052	0,075	S	1.5
5	Alamein Rd. (Moving Company)	0.068	**0.048**	0.010	0,075	S	1.7
6	End of Peter Rd.	0.072	**0.051**	0.014	0,075	SSW	1.6
7	Riveira Cres.	0.045	**0.037**	0.009	0,075	SSW	1.6

Evening 2015/09/08 (18h00 – 00h00)

		PM10			Limit	Wind	
	Location	Max mg/m^3	Average mg/m^3	*Min mg/m^3	mg/m^3	Direction from	Speed (m/s)
1	Plant Entrance	0.097	**0.055**	0.027	0,075	S	0.8
2	Western Boundary	0.084	**0.039**	0.012	0,075	S	0.9
3	North Western Boundary	0.062	**0.038**	0.014	0,075	SSW	0.8
4	Eastern Boundary	0.049	**0.045**	0.021	0,075	SSW	0.8
5	Alamein Rd. (Moving Company)	0.054	**0.030**	0.009	0,075	SSW	0.7
6	End of Peter Rd.	0.056	**0.031**	0.010	0,075	S	0.6
7	Riveira Cres.	0.042	**0.017**	0.009	0,075	SSW	0.9

5. Sound Pressure Levels.

Daytime (06:00 – 18:00)

	Location	Peak dB (A)	Max dB (A)	Min dB (A)	Laeq dB (A)	Industrial Limit	Source
1	Plant Entrance	139.2	95.6	42.7	**69.1**	70	Plant activity
2	Western Boundary	135.6	84.7	39.8	**68.5**	70	Plant activity
3	North Western Boundary	100.4	84.5	35.6	**67.7**	70	Plant activity
4	Eastern Boundary	102.9	86.1	37.7	**60.3**	70	Plant activity
	Location	**Peak dB (A)**	**Max dB (A)**	**Min dB (A)**	**Laeq dB (A)**	**Urban Limit**	**Source**
5	Alamein Rd. (Moving Company)	135.6	83.5	30.7	**57.9**	55	Public / Natural Environment
6	End of Peter Rd.	128.7	82.7	30.6	**56.8**	55	Public / Natural Environment
7	Riveira Cres.	110.4	81.3	29.8	**54.2**	55	Public / Natural Environment

Evening (18:00 – 00:00)

	Location	Peak dB (A)	Max dB (A)	Min dB (A)	Laeq dB (A)	Industrial Limit	Source
1	Plant Entrance	103.2	83.5	27.1	**58.9**	60	Plant activity
2	Western Boundary	100.4	79.6	26.2	**58.3**	60	Plant activity
3	North Western Boundary	99.8	76.7	24.9	**50.6**	60	Plant activity
4	Eastern Boundary	99.1	77.7	25.0	**50.2**	60	Plant activity
	Location	**Peak dB (A)**	**Max dB (A)**	**Min dB (A)**	**Laeq dB (A)**	**Urban Limit**	**Source**
5	Alamein Rd. (Moving Company)	89.4	73.1	25.1	**45.2**	50	Public / Natural Environment
6	End of Peter Rd.	88.7	70.1	24.8	**44.9**	50	Public / Natural Environment
7	Riveira Cres.	85.1	65.6	23.9	**40.6**	50	Public / Natural Environment

6 Typical rating levels for ambient noise in districts.

(SANS 10103:2008 Table 2)

Type of district	Outdoors			In-doors, with open windows.		
	Day	Evenings /weekends	Night	Day	Evenings /weekends	Night
Rural	45	40	35	35	30	25
Suburban with little road traffic	50	45	40	40	35	30
Urban	55	50	45	45	40	35
Urban with some workshops, business premises and main roads	60	55	50	50	45	40
Central business	65	60	55	55	50	45
Industrial	70	65	60	60	55	50

7 Estimated community/group response. ΔL_r[1)] dB

(SANS 10103:2008 Table 5)

1	2	3
Excess ΔL_r[1)] dB	**Category**	**Description**
0 ≤ 5	None	No observed action
> 5 ≤ 10	Little	Sporadic complaints
> 10 ≤ 15	Medium	Widespread complaints
> 15 ≤ 20	Strong	Threats of community/group action
> 20	Very strong	Vigorous community/group action.

8 Description of operational process.

This factory is in operation from 06h00 to 22h00 each day.

Deliveries and collecting takes place by means of road transport.

9 Conclusions.

Sound Pressure Levels

a) Sound Pressure Levels from the natural environment (traffic from public roads and highway R61.) exceed the recommended levels stated in SABS Code 0103 for Industrial areas;

b) The jaw crusher was not in operation at the time of the survey and tests will be done again to include the noise levels once the jaw crusher is in operation.

c) The primary plant was in full operation and was not audible during any of the daytime samples.

d) Plant was audible during night time at the residential areas when the traffic from the R61 subsided. Main source of audible noise were from the reverse hooters of plant vehicles. Noise did not add to the dB rating and can be considered as white or nuisance noise.

e) It is our considerate opinion that Sound Pressure levels from activities from South Coast Stone Crushers operations does not exceed the prescribed SPL's for industrial areas at the boundaries but does add a nuisance factor as plant noises were audible during night time.

f) Peaks recorded during this survey at the residential areas were from traffic from public roads and R61 highway in the area;

Particulate Matter (PM10) Levels

a) The limits for particulate matter as prescribed by SANS 1929 4.4.2 Table 4 indicate an average daily limit of 75 µg/m^3 (0.075mg/m^3).

Limits as per Table 4 – SANS 1929:2011

Period	Limit (mg/m^3)	Frequency of Exceedances
24 Hours	0,075	4

b) The operations of South Coast Stone Crushers did not exceed the daily average as per SANS 1929;

c) It was observed that traffic on the road that leads to the industrial area and plant added to the dust levels due to a large area being unpaved.

d) Dust from the plant was visible and added to ambient dust levels during the cooler night time as well as early morning when the inversion layer was low and airborne particles ae caught above the plant

10 Recommendations.

Sound Pressure Levels

- The reverse hooters of vehicles must be replaced to a type with different frequency that will reduce the distance that the sound will travel (The “duck call” type hooters) This will allow for the reverse hooters being efficient in the plant but not audible at the residential areas
- Acoustic screening methods can be implemented to try and reduce noise levels of the jaw crusher once it is back in operation
- Survey must be done once the jaw crusher is back in operation

Particulate Matter (PM10)

- Dust levels in the plant must be controlled. Visible dust adds to community complaints.
- Dust from the public road can be reduced by fixing the roads (Municipality function)

11 General

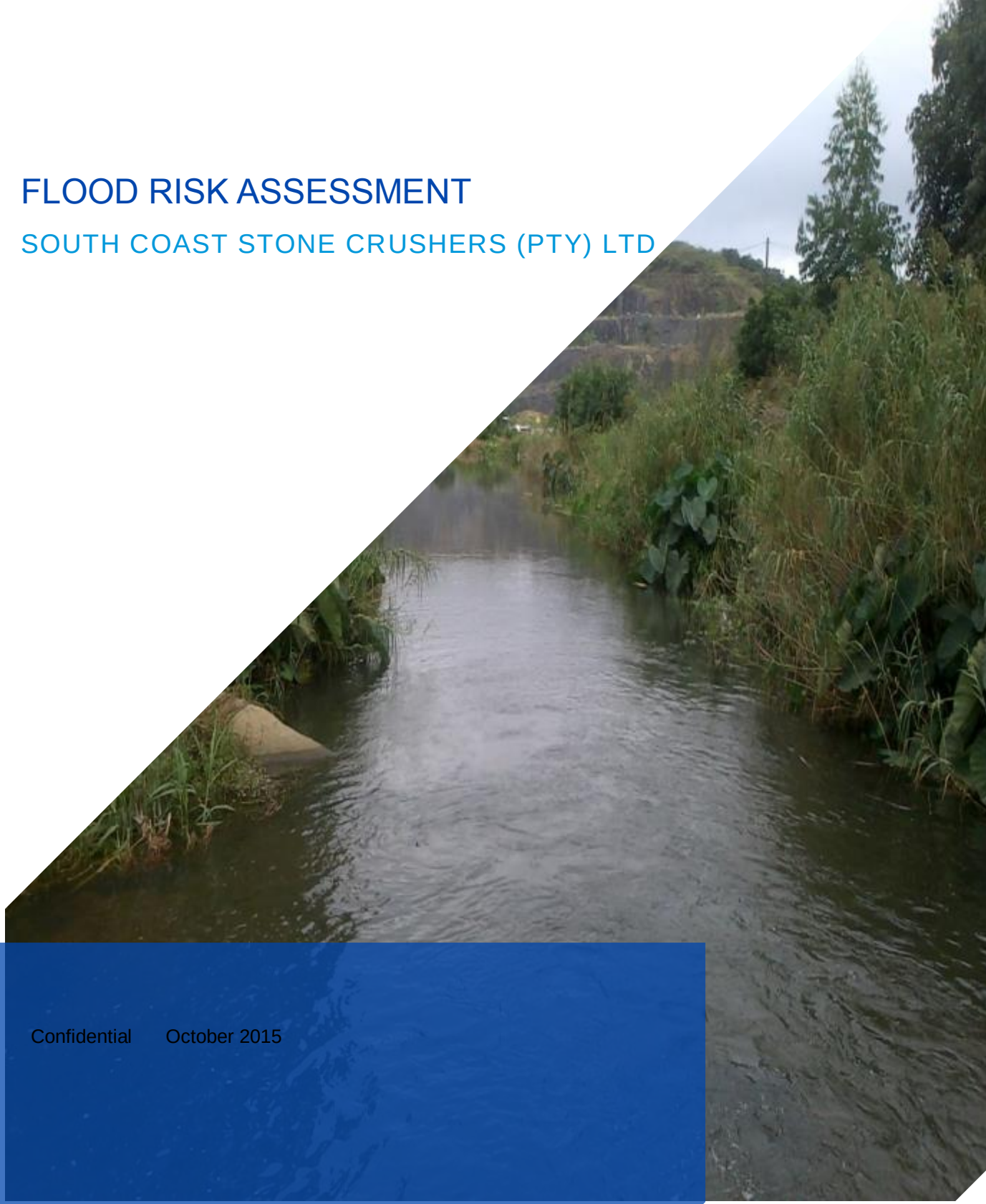
Results reflected in this report are correct for the day and times this survey was conducted, should conditions change results will alter accordingly.

P. H Meyer
Occupational Hygienist

Appendix J: Flood Risk Assessment

FLOOD RISK ASSESSMENT

SOUTH COAST STONE CRUSHERS (PTY) LTD



Confidential October 2015

WSP | PARSONS BRINCKERHOFF

FLOOD RISK ASSESSMENT

South Coast Stone Crushers (Pty) Ltd

Confidential

Project no: 46708
Date: October 2015

WSP | Parsons Brinckerhoff

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QUALITY MANAGEMENT

ISSUE/REVISION	FIRST ISSUE	REVISION 1	REVISION 2	REVISION 3
Remarks	Final Draft			
Date	October 2015			
Prepared by	M Becker			
Signature				
Checked by	A Pickles			
Signature				
Authorised by	G Matthews			
Signature				
Project number	46708			
Report number	R01			
File reference	46708_R01 - South Coast Stone Crushers_Flood Risk Assessment_Final Draft_20151026			

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APPENDICES

1 INTRODUCTION

WSP Environment & Energy (WSP) was invited by South Coast Stone Crushers (SCSC) to submit a proposal for the provision of specialist services to develop an Integrated Water and Waste Management Plan (IWWMP) for their South Coast Stone Crusher aggregate operations located near Uvongo, KwaZulu-Natal.

The offer to carry out the work was contained in the WSP Proposal No. 46708 *'Proposal for the Development of an Integrated Water and Waste Management Plan'*, dated 3 February 2015 and was accepted by Natal Portland Cement (NPC) via a Purchase Order (PO Number: 4300022166) on 26 February 2015.

The intention of the IWWMP will be to support the Integrated Water Use Licence Application (IWULA) for the Quarry. This document serves to form the supporting documentation for a WULA under Section 21 of the National Water Act (Act 36 of 1998) in the form of a flood risk assessment.

2 SITE DESCRIPTION

The SCSC quarry is located directly inland from the coastal town of Uvongo. The area predominantly comprises gentle hillslope topography. Agricultural land is located to the north and west of the site; and urban areas lie to the east and south east of the site.

The Vungu River bisects the quarry (northwest) from the operational building on the site (southeast) and continues its course for 2.7km until the mouth on the coast **Figure 1**. The topography of the site is primarily rolling hills, with the average gradient along the river reach is 3.3% as is typically associated with rolling hill topography. The catchment is predominantly comprised of agriculture with a small section of residential housing.

The aggregate plant and associated crushing and stockpiling activity infrastructure are located on the northern bank of the Vungu River. This area comprises of mechanical crushing equipment and stormwater management infrastructure as well as the quarry pit. Access to the aggregate plant is by a gravel road passing through the concrete plant and over the Vungu River using a low level bridge.

The concrete plant is located on the southern bank of the Vungu River and comprises of various raw material stockpiles as well as workshops, mixing silos and a weighbridge. The stormwater management infrastructure currently reports dirty stormwater to a sump below the weighbridge from where it is pumped to the pollution control facilities at the aggregate plant.

3 CATCHMENT INFORMATION

The site is located within quaternary catchment T40G, receiving 1 055mm of rainfall annually and an annual rate of evaporation of 1 150mm; regionally the area experiences 248mm of runoff annually (The Surface Water Resources of South Africa 1990, Volume II, Water Research Commission (WRC) Report Numbers 298/2.1/94 and 298/2.2/94).

The contributing catchment area for the Vungu River Catchment is depicted in **Figure 2**. Catchment information that was used in generating the design flood estimates from the contributing catchment is summarised in **Table 1**.

Table 1 Vungu River Catchment Parameters

CATCHMENT PARAMETER	VALUE
Catchment Area (km^2)	81
Length of Longest Water Course (km)	32
Centroid of Catchment (km)	11.76
Mean Annual Precipitation (mm)	1 055
Average Water Course Slope (10:85 Method) (m)	395
Equal Area Slope Alt. Difference (m)	399
Days on which Thunder was heard	25
Percentage of Area Underlain by Dolomite (%)	0
Kovacs K Region	K7
Generalised Veld Type Region	8
Standard Design Flood Basin Number	24

4 FLOOD PEAK CALCULATIONS

The design flood peaks for the site were evaluated using the Utility Programme for Drainage (UPD) developed by the Centre for Engineering, Research, Education and Technology (Sinotech CC). The UPD incorporates a design flood calculation option that uses various deterministic, empirical and statistical methods to determine the design flood. The following methodologies are included in the UPD:

- Rational Method;
- Alternative Rational Method;
- Unit Hydrograph;
- Standard Design Flood; and

- Empirical Method.

The application of each of the methodologies is described in the sections that follow.

4.1 RATIONAL METHOD

The Rational Method uses storm rainfall and catchment characteristics to generate flood peaks. The Rational Method formula indicates that Q = CiA, where the product of rainfall intensity (i) and catchment area (A) is equal to the inflow rate of the system (iA) and C is the runoff co-efficient. Design rainfall intensity is based on the time of concentration for the catchment.

The Rational Method yields a design peak only and the flood response is a function of the catchment slope, landuse, land cover, mean annual precipitation (MAP) (i.e. point precipitation) and return interval (RI). The time of concentration of the flood peak is a function of the catchment dimensions; specifically the watercourse length and slope.

The Rational Method does not factor in a rainfall areal reduction factors (ARF) in its calculations. As a result the Rational Method has generally been attributed to catchments with an area less than 15km^2.

4.2 ALTERNATIVE RATIONAL METHOD

The Alternative Rational Method is based on the Rational Method with point precipitation being adjusted to take into account local South African Condition using an ARF. The Alternative Rational Method is not limited by catchment area.

4.3 UNIT HYDROGRAPH

The Unit Hydrograph (UH) method was developed by the Hydrological Research Unit (HRU) at the University of the Witwatersrand. The Unit Hydrograph is applicable to catchments of up to 5 000km^2. The UH is quantified for the catchment of concern in three steps:

- Firstly, Basin Lag (i.e. time related) considerations are determined, which are a function of the length of the longest water course, the average slope of the watercourse, distance along the water course to the point nearest the catchment centroid and a Veld Zone coefficient;
- Secondly, a discharge consideration is determined which is a function of the catchment area, basin lag and Veld Zone coefficients based on the region specific 1-hour unit hydrograph for each veld type region; and
- Design rainfall depth based on the depth-duration-frequency relationship as proposed by Midgley and Pitman (1978).

4.4 STANDARD DESIGN FLOOD

The standard design flood method (SDF) specifically addresses the uncertainty in flood prediction under South African conditions. The runoff coefficient (C) used in the Rational Method is replaced by a calibrated value based on the sub division of the country into 29 regions or water

management areas WMAs by the 2-year mean of the annual daily maxima rainfall and average number of days per year on which thunder was heard.

The method is generally a more conservative estimate than the rational method or unit hydrograph methods. Results from the SDF method are generally overestimated by 50% – 200% due to the engineering safety factors that are incorporated. The SDF can be applied to catchments from 10km^2 to 40 000km^2.

4.5 EMPIRICAL METHOD

The empirical formula is based on the statistical correlation of observed peak flows in the region and the catchment properties to generate regional constants. The accuracy of the predictions is dependent on the similarity of the catchment characteristics to the generalised Kovacs K region constant.

5 ASSUMPTIONS AND LIMITATIONS

Numerical and hydrological models are based on user input and are therefore limited by the data that is available. Further to this, most models are designed on small scale parameters and then factored up to accommodate large scale. The assumptions and limitations that were adopted as part of the assessment therefore included the following:

- The Mean Annual Precipitation (MAP) of the SCSC catchment was obtained from the Daily Rainfall Extraction Utility and utilised as representative value for the entire catchment.
- The land use inputs for the catchments were based on desktop interpretation of broad based GIS data.
- A detailed bridge survey was not provided and therefore the bridge dimensions used in the backwater calculations were based on interpretation of photographic data, aerial imagery and rudimentary measurements.
- Modelling of flood conditions assumes that there are no artificial blockages within the watercourse caused by debris mobilised by the flood conditions. Only formal, in-line permanent structures have had their backwater effect quantified.
- The climatic parameters do not take into consideration any possible changes as a result of global climate change.

6 DESIGN FLOOD PEAKS

The climatic data and catchment parameters associated with the contributing catchments as reflected in **Section 3** were used as inputs into the UPD and the design floods were calculated for the 50- and 100 year RI events using all of the methodologies listed in **Section 4**.

The Rational, Alternative Rational, Unit Hydrograph, Standard Design Flood and Empirical methods use generalised regional constants specific to the catchment response and land cover characteristics. The suitability of each of these methods is subject to the correlation of the constants to the actual catchment parameters.

Standard Design Flood was excluded from the calculations as this method has been proven to provide excessively conservative estimates due to the engineering safety factors that are incorporated.

The design flood peaks that were used in the HEC-RAS backwater calculations were calculated using the average of the Rational, Alternative Rational, Unit Hydrograph and Empirical methods. This combination of methods is a conservative calculation chosen to exclude possible future flood peak increases brought about by climate change variations which are generally accepted in the area to be in the region of 15%.

The relevant flood peaks for the 50- and 100 year RI for each catchment are shown in **Table 2**. The results obtained were analysed and representative averages were obtained for each of the catchments based on the suitability of the catchment parameters required by the methodologies. The average peak flows from the two catchments were subsequently combined to give a total flow used in the backwater calculations.

Table 2 Design Flood Values (m^3/s)

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

7 BACKWATER CALCULATIONS

The US Army Corp of Engineers (USACE) Hydrologic Engineering Centre River Analysis System (HEC-RAS) model was used to calculate the relevant flood levels for the 50- and 100 year flood events. HEC-RAS undertakes hydraulic calculations between user-defined, consecutive river

cross-sections along the defined length of the river channel to quantify the backwater effects of channel variations and in-line structures.

Flood peaks calculated for the 50- and 100 year storm events provided modelling inputs to the HEC-RAS model. The flood peak events calculated represent worst case scenario floods that assume events are distributed across the entire area of all contributing catchments under consideration. The model is able to determine the influence of various control points/obstructions such as bridges, culverts, weirs and structures that traverse the water course.

7.1 TOPOGRAPHICAL SURVEY

The elevation data used in the numerical modelling was obtained through a topographical survey undertaken by Dave Mountain Surveyors in June 2015. The survey defined the current status of the river reach under consideration, that being the Vungu River. Cross sections were generated along the river reach at regular intervals (**Figure 3**).

A low level bridge located centrally within the site provides access between the sites on either side of the Vungu River (**Figure 4**). This bridge was not comprehensively surveyed although the bridges general dimensions were measured in order to generate sufficient data to model the backwater effects sufficiently.

7.2 NUMERICAL MODELLING

The relevant Manning's roughness coefficient's (n) were estimated by comparing the riparian and bank vegetation as well as channel characteristics with the data published in HEC-RAS River Analysis System – Hydraulic Reference Manual Version 4.1 (January 2010).

For the Vungu River, the Manning's n values of 0.045 were allocated to the channel and the river banks were given a value of 0.06. These values are higher than normal due to the boulders that dominate the channel and immediate river banks as well as the dense natural vegetation along the banks of the river that occurs downstream of the access bridge.

The associated results output table, showing calculated parameters, is included in **Appendix A**.

8 DISCUSSION AND CONCLUSION

Figure 5 shows the 50- and 100 year floodlines as calculated using the HEC RAS model. The final lines were determined by the outer edges of the zones that will be inundated. Low points that flood water will gravitate towards were included in the zone as the water surface level of the floods will enable water to flow towards these points.

Flood levels will encroach upon the open area outside the SCSC admin buildings as well as the access road and portion of the crushing plant on the western side of the Vungu River. This will

also result in the inundation of the stormwater / recycled process water channel that runs from the crushing plant to the settlement ponds.

The concrete plant on the eastern side of the Vungu River will experience inundation along the access road and the weighbridge facility which currently includes a dirty stormwater drainage sump. This is the only facility on the eastern side of the river that will be inundated.

Downstream of the access bridge the flood levels will be contained naturally by the topography of the river course and have no further impact on either the aggregate or concrete plants.

FIGURES

South Coast Stone Crushers (Pty) Ltd - Margate Quarry

South Coast Stone Crushers Location

Data Source:
South African Department of
Rural Development and Land Reform -
Chief Directorate: National Geo-spatial Information

Projection Geographic - WGS1984

Project:	SCSC - Flood Risk Assessment
Project No:	46708
Drawn by:	Matthew Becker
Reviewed by:	Ayanda Mthalane

Date: August 2015

Figure No. 1

WSP

www.wspenvironmental.co.za

South Coast Stone Crushers (Pty) Ltd - Margate Quarry

Vungu River Contributing Catchment

Data Source:
South African Department of
Rural Development and Land Reform -
Chief Directorate: National Geo-spatial Information

Projection Geographic - WGS1984

Project:	SCSC - Flood Risk Assessment
Project No:	46708
Drawn by:	Matthew Becker
Reviewed by:	Ayanda Mthalane

Date: August 2015

Figure No. 2

WSP

www.wspenvironmental.co.za

South Coast Stone Crushers (Pty) Ltd - Margate Quarry

Cross Section Survey Lines

Data Source:
South African Department of
Rural Development and Land Reform -
Chief Directorate: National Geo-spatial Information

Projection Geographic - WGS1984

Project:	SCSC - Flood Risk Assessment
Project No:	46708
Drawn by:	Matthew Becker
Reviewed by:	Ayanda Mthalane

Date: August 2015

Figure No. 3

WSP

www.wspenvironmental.co.za

South Coast Stone Crushers (Pty) Ltd - Margate Quarry

Bridge Location

Data Source:
South African Department of
Rural Development and Land Reform -
Chief Directorate: National Geo-spatial Information

Projection Geographic - WGS1984

Project:	SCSC - Flood Risk Assessment
Project No:	46708
Drawn by:	Matthew Becker
Reviewed by:	Ayanda Mthalane

Date: August 2015

Figure No. 4

WSP

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South Coast Stone Crushers (Pty) Ltd - Margate Quarry

Floodlines

Data Source:
South African Department of
Rural Development and Land Reform -
Chief Directorate: National Geo-spatial Information

Projection Geographic - WGS1984

Project:	SCSC - Flood Risk Assessment
Project No:	46708
Drawn by:	Matthew Becker
Reviewed by:	Ayanda Mthalane

Date: August 2015

Figure No. 5

WSP

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Appendix A

HEC RAS MODEL OUTPUTS

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Vungu	532.47	1:50	266.37	22.9	26.73		26.98	0.002593	2.69	158.68	96.26	0.44
Vungu	532.47	1:100	335.07	22.9	27.31		27.53	0.001974	2.59	221.83	112.6	0.4
Vungu	452.048	1:50	266.37	22.44	26.62		26.81	0.001483	2.14	174.98	110.19	0.34
Vungu	452.048	1:100	335.07	22.44	27.23		27.39	0.001162	2.08	261.96	159.27	0.31
Vungu	412.359	1:50	266.37	22.34	26.27		26.7	0.003321	3.09	106.61	49.27	0.5
Vungu	412.359	1:100	335.07	22.34	26.94	25.45	27.31	0.002518	2.99	185.18	148.48	0.45
Vungu	374.915	1:50	266.37	22.61	25.73	25.54	26.51	0.009162	4.44	80.07	56.04	0.81
Vungu	374.915	1:100	335.07	22.61	25.91	25.61	27.08	0.012655	5.43	90.64	57.22	0.96
Vungu	328.959	1:50	266.37	21.67	25.85	24.44	26.18	0.002481	2.8	132.29	68.65	0.44
Vungu	328.959	1:100	335.07	21.67	26.19	24.82	26.59	0.002723	3.09	158.17	86.36	0.47
Vungu	277.773		Bridge									
Vungu	267.337	1:50	266.37	20.94	24.73		25.55	0.007887	4.57	80.3	39.03	0.77
Vungu	267.337	1:100	335.07	20.94	25.01	24.46	26.12	0.009854	5.37	94.07	62.37	0.87
Vungu	225.599	1:50	266.37	21.2	24.25	24.06	25.15	0.011577	4.93	72.09	31.54	0.91
Vungu	225.599	1:100	335.07	21.2	24.59	24.43	25.66	0.012175	5.43	82.92	32.52	0.95
Vungu	175.466	1:50	266.37	20.34	24.12		24.6	0.006199	4.04	99.98	46.35	0.67
Vungu	175.466	1:100	335.07	20.34	24.59		25.09	0.005499	4.13	122.66	48.92	0.65
Vungu	133.688	1:50	266.37	20.12	23.95		24.37	0.004474	3.55	109.25	46.53	0.59
Vungu	133.688	1:100	335.07	20.12	24.43		24.88	0.004111	3.69	132.36	48.05	0.58
Vungu	98.177	1:50	266.37	19.61	23.96		24.23	0.002093	2.66	134.08	49.44	0.41
Vungu	98.177	1:100	335.07	19.61	24.44		24.75	0.002109	2.87	158.52	51.8	0.42
Vungu	66.844	1:50	266.37	19.42	24		24.15	0.000896	1.79	178.41	57.42	0.27
Vungu	66.844	1:100	335.07	19.42	24.49		24.66	0.000945	1.97	207.16	60.53	0.28
Vungu	43.866	1:50	266.37	19.43	24.03		24.12	0.000513	1.38	222.23	69.66	0.21
Vungu	43.866	1:100	335.07	19.43	24.52		24.63	0.000552	1.53	258.39	76.39	0.22
Vungu	0	1:50	266.37	19.31	22.93	22.93	23.96	0.009724	4.96	71.26	34.8	0.84
Vungu	0	1:100	335.07	19.31	23.3	23.3	24.46	0.009867	5.34	84.55	35.89	0.86

Appendix K: Stormwater Management Plan

STORMWATER MANAGEMENT PLAN

SOUTH COAST STONE CRUSHERS (PTY) LTD

CONFIDENTIAL

JANUARY 2016

WSP | PARSONS BRINCKERHOFF

STORMWATER MANAGEMENT PLAN

South Coast Stone Crushers (Pty) Ltd

Type of document
Confidential

Project no: 46708-01
Date: January 2016

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QUALITY MANAGEMENT

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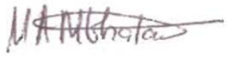
Signature				
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APPENDICES

1 INTRODUCTION AND TERMS OF REFERENCE

WSP Environment & Energy (WSP) was commissioned by South Coast Stone Crushers Pty (Ltd) (SCSC) to compile an Integrated Water and Waste Management Plan (IWWMP) for their Margate Quarry operation located near Uvongo, KwaZulu-Natal.

The offer to carry out the work was contained in the WSP Proposal No. 46708 *'Proposal for the Development of an Integrated Water and Waste Management Plan'*, dated 3 February 2015 and was accepted by South Coast Stone Crushers Pty (Ltd) via a Purchase Order (PO Number: 4300022166) on 26 February 2015.

The intention of the IWWMP will be to support the Integrated Water Use Licence Application (IWULA) under Section 21 of the National Water Act (Act 36 of 1998) for the Quarry. As part of the WULA submission, a Stormwater Management Plan (SWMP) is required by Department of Water and Sanitation (DWS).

This report serves to fulfil this requirement, also outlining both the methodology in developing the conceptual SWMP, as well as the associated infrastructure requirements.

2 APPROACH

The objective of a SWMP is to prevent contamination of receiving watercourses through surface water runoff, as a result of operational activities at SCSC, through the appropriate separation and containment of clean and dirty water processes. The development of the SWMP for the site took into account the following guidelines:

- Department of Water Affairs and Forestry (DWAF) Government Notice No.704 (GN704) Guideline Document for the Implementation of Regulations on use of Water for Mining and Related Activities Aimed at the Protection of Water Resources.
- DWAF Best Practice Guidelines (BPG's):
  - BPG G1 – Stormwater Management;
  - BPG A4 – Pollution Control Dams; and,
  - BPG A5 – Water Management for Surface Mines.

These documents support Section 26 of the National Water Act (Act No. 36 of 1998) which regulates any activity that may have an impact on a water resource, and the conservation and protection of this water resource. The main principles adopted in these documents include:

- Confine or divert any unpolluted water to a clean water system, and polluted water to a dirty water system;
- Clean and dirty water systems should be designed and constructed to prevent cross-contamination between the clean and dirty water systems;

- Clean and dirty water systems should contain the 50 year storm event, and should not lie within the 100 year flood line or within a horizontal distance of 100m from any watercourse; and
- Appropriate maintenance and management of stormwater related infrastructure.

2.1 DESKTOP REVIEW AND GAP ANALYSIS

A desktop review was conducted to determine the local and regional geo-environmental setting of SCSC. This review included the following sources:

- Available information sources to define the hydrological and climatic conditions:
  - Water Research Commission (WRC), 1994. The Surface Water Resources of South Africa, 1990, Volume V.
- Relevant mapping of the area to define soils:
  - Department of Agriculture, Forestry and Fisheries (DAFF), 2006 Landuse and Land-Type Mapping in GIS Shapefile Format.
- Dave Mountain Surveys, July 2015. Topographical survey map of SCSC South Coast (WG31.DR4 Plan 1).
- Dave Mountain Surveys, July 2015. Topographical survey map of SCSC South Coast (WG31.DR4 Plan 2).

2.2 SITE WALKOVER

A site walkover was conducted by Ayanda Mthalane and Andrew Pickles on 14 April 2015 and again, by Ayanda Mthalane on 12 August 2015, accompanied by Lindani Mkungo and Dave Round of the SCSC operations. The objective of the site walkover was to groundtruth the information gathered during the desktop review, assess existing stormwater management practices and to conceptualise the stormwater management requirements for the site.

Key aspects associated with site specific and regional setting of SCSC considered during the site assessment included the following:

- Topography and expected flow directions;
- Land use and surface cover;
- Soils; and
- Potential surface water contamination sources.

A full topographical survey of the Quarry was undertaken by Dave Mountain Surveys on 2 June 2015. The objective was to obtain accurate topographical information, layout of the key infrastructure and location of existing drainage network (i.e. pipes and channels). The outcome of the survey was a site layout survey map of 1m contour intervals. The surveyed information was used for the purposes of developing the conceptual stormwater model and supporting the infrastructure design.

2.3 CONCEPTUAL STORMWATER MANAGEMENT LAYOUT

Based on the information gathered during the desktop review, site walkover and topographical survey a conceptual stormwater management plan was developed for SCSC. “Dirty” and “clean” contributing catchments were discretised based on topographical fall, associated activities and key areas of concern identified by WSP during the site walkover. Furthermore the discretisation of the catchments factored in the overall functionality and the most practical and feasible implementation of the final stormwater management plan.

Based on the discretised catchments, the required stormwater management drainage elements (including channels, pipes, berms, and pollution control dams) were defined to ensure appropriate stormwater management according to the requirements outlined in the GN704 guideline and BPGs.

2.4 NUMERICAL MODELLING

The *HydroCube* Stormwater drainage model was used to size the proposed stormwater management infrastructure. *HydroCube* is a hydrological rainfall-runoff numerical simulation model suitable for application to both rural and urban environments and has been verified using data from several test catchments. It can be used to determine the design requirements for various drainage elements as well as analyse the performance of existing drainage systems. *HydroCube* requires a number of input parameters for each of the elements, including:

- Mean Annual Precipitation (MAP);
- Catchment characteristics including:
  - Catchment area;
  - Overland flow length;
  - Slope;
  - Impervious area;
  - Surface cover; and
  - Soil characteristics.
- Proposed design characteristics of the drainage infrastructure, including:
  - Channels;
  - Pipes; and
  - Pollution control dams.

The conceptual SWMP was assessed in terms of the 50 year recurrence interval storm event (as per the GN704 requirements) to define the required capacity of the stormwater infrastructure (i.e. channels, pipes and pollution control dam).

3 BACKGROUND INFORMATION

3.1 SITE LOCATION AND DESCRIPTION

The Margate Quarry is centred at global coordinates 30°49’23.25” south and 30°22’33.27” east, located approximately 1.3km north east of Uvongo town (**Figure 1**). It occupies a total area of approximately 27ha (**Figure 2**). As a result of the Vungu river bisection, SCSC is divided up into two areas. These are formally known as the Aggregate Plant (Northern quarry) and Concrete Plant (South of the quarry). The site infrastructure can be summarised as follows (**Figure 3** and **4**).

Table 1 gives the breakdown of the facilities, from the Aggregate Plant to the Concrete Plant, identifies potential contaminants of concern based on the activity and classifies the areas in terms of “clean” and “dirty” stormwater generation areas.

Table 1 Discretisation of Concrete Plant Facilities

Facilities	Figure References	Description	Potential Contaminants	Classification
Security Room	1	The area is under roof cover. Runoff generated from the roof drains onto the surface and flows in a westerly directions reporting to the river.	None	**Clean**
Concrete Plant Parking Area	2	Area comprises of gravel (**Plate 1**). Runoff generated from this area flows in a westerly direction and reports to the river.	None	**Clean**
Weigh Bridge and Offices	3	This area comprises of hardstanding and roof cover (**Plate 2**). Runoff generated on the roof drains onto the gutter system reporting to the existing channel (**Plate 3**). This channel also captures runoff generated from the hardstanding (weigh bridge) and discharges directly to the river.	**Sediment load**	**Dirty**
Stockpiles (i.e. Reclaimed Asphalt and Gravel)	4	Area comprises of aggregate stockpiles with and without bitumen coating. The area is not bunded and located on soft standing (**Plate 4**). Runoff generated from this area flow in a westerly directions towards the river.	**Sediment load Hydrocarbons**	**Dirty**
Sand Stockpile	5	Stockpile with no bunding (**Plate 5**), allowing for easy access for the front end loader to transport sand to the cold feed bins. Runoff generated from this area flow in a westerly directions towards the river.	**Sediment load**	**Dirty**
Storage Shed	6	Lime and stone dust Storage Shed (**Plate 6**), comprises of gravel and is under a roof. Runoff generated on the roof drains onto the surface and flows in north-westerly direction towards to the river.	**Sediment load**	**Dirty**
Aggregate Stockpiles	7	Various sizes of aggregate stockpiles to be transported to the cold feed bins of the Asphalt Plant, with no bunding in place (**Plate 7**).	**Sediment load**	**Dirty**
Cold Feed Bins and Ramp Up	8 and 13	Gravel ramp up to allow for the front end loader to deliver materials to the cold feed bins. Cold feed bins which receive, store and supply aggregates and sand to the concrete mixer via a conveyor (**Plate 8** and **9**).	**Sediment load**	**Dirty**
Bitumen Storage	9	These areas are all located within an appropriately bunded area on hardstanding (**Plate 10 and 11**). Runoff generated in this area is contained within the bunds.	**Hydrocarbons**	**Dirty**
Asphalt Storage Tanks	9			**Dirty**
Diesel-Above Ground Storage Tank (AST)	9			**Dirty**
Bag House	9	A metal housing, for collecting fines during the mixing process of the asphalt mixture. Runoff generated from this area flows in a westerly direction towards the river.	**Sediment Load**	**Dirty**
Drum Mix Plant	10	Receives aggregates from cold feed conveyor for drying, blending, heating and mixing to produce asphalt mixture. Runoff generated from this area flows in a westerly direction towards the river.	**Sediment Load**	**Dirty**

Facilities	Figure References	Description	Potential Contaminants	Classification
Control Cabin	10	Roof covered container which houses the control panels for the plant. Runoff generated from the roof reports onto the surface and gets captured onto an existing channel reporting to the concrete recycle chamber (recycling plant).	**Sediment Load**	**Dirty**
Generator	11	This area contains the generator used for the asphalt plant, on hardstanding within a bund and under roof cover (**Plate 12**). Runoff generated within this area is contained within the bunds. Runoff generated from the roof drains onto the surface and flows in a westerly direction towards the river. The option of rainfall harvesting from the roofed area should be investigated by National Asphalt.	None	**Clean**
Silo	12	Asphalt storage silos containing finished product that is dispatched to trucks for delivery. Loading of trucks results in minor spillage of product to gravel surface.	**Sediment load Hydrocarbons**	**Dirty**
Concrete Batch Plant	14	This area consists of two powder feeding silos, weighing hopper and control cabin; on hardstanding (**Plate 13**). Runoff generated from this area drains onto the existing channel reporting to the slump traps and contained within the concrete pond.	**Sediment load**	**Dirty**
Substation	15	Facility is under roof cover contain substation. Runoff generated on the roofs report onto the ground surfaces and flows west towards the river.	**Sediment load**	**Dirty**
Recycling Plant Storage Tanks	16	Consists of 5 water storage tanks. Runoff generated in this area flows west towards the river.	**Sediment load**	**Dirty**
Recycling Plant Pump House	16	Facility is under roof cover, runoff generated from the roof drains onto the surface and reports to the river.	**Sediment load**	**Dirty**
Concrete Water Recycling area	17	Comprises of slump traps and concrete settlement pond for containment, with hardstanding and bunding in place (**Plate 14**). Runoff generated in the concrete plant is contained for settlement and water is harvested for re-use in concrete plant.	**Sediment load**,	**Dirty**
Concrete Sampling Area	17	This area consists of a mixer for sampling the concrete product, hardstanding is in place, and the area is not bunded.	**Sediment load**	**Dirty**
Concrete Waste Stockpile Area	18	The area comprises stockpiles of concrete waste material. Runoff generated from this area reports to the road surface and flows in a westerly direction towards the river.	**Sediment load**	**Dirty**
General Storage Area	19	General storage area is under roof cover, runoff generated from roof reports onto the surface resulting in potential contamination (**Plate 15**). Runoff generated from this area flows in a westerly direction towards the river.	**Sediment load**	**Dirty**
Wet Fix and Econat Storage Area	19	Area comprises of Wet Fix and Econat storage drums, on hardstanding with bunding in place (**Plate 15**). Runoff generated in this area is contained within the bund.	**Chemicals**	**Dirty**
Laboratory and Kitchen	20	This area consists of two roof covered containers which house the laboratory and staff kitchen. Runoff from the roof drains onto the surface reporting to the river.	None	**Clean**

Facilities	Figure References	Description	Potential Contaminants	Classification
Store Area	21	Facility is under roof cover contains materials used in the quarry for blasting. Runoff from the roof drains onto the surface reporting to the river.	None	**Clean**
Workshop	22	This facility is mainly under roof cover with hardstanding. Runoff generated from the roofs drains the surface and reports to river.	None	**Clean**
Concrete Slab	22	Concrete slab located outside the workshop area, with hardstanding, and cut off trench to capture and direct spillages to the oil trap system (**Plate 16** and **17**).	**Hydrocarbons**	**Dirty**
Oil Trap	22	This area contains a ground level oil trap system, effluent generated from the workshop reports to the oil trap system for containment. This area is concrete covered with a bunded storage tank for containment of effluent.	None.	**Clean**
Filing Station	23	This area is on hardstanding with bunding in place, the runoff generated within the area is contained within the bund (**Plate 18**).	**Hydrocarbons**	**Dirty**

Table 2 Discretisation of Aggregate Plant Facilities

Facilities	Figure References	Description	Potential Contaminants	Classification
Settling Ponds	24	A series of 3 settling ponds for containment of runoff generated in the wash plant and quarry mining pit area. Water is abstracted at the final settlement pond for use in dust suppression (**Plate 19** and **20**).	**Sediment load**	**Dirty**
Quarry Mining Pit	25	This area is predominantly an aggregate mining area which includes rock fragments as well as stockpiles of aggregate material (**Plate 21**). The slope of the mining pit is towards the river, runoff generated on surface of the mining pit flows in an easterly direction reporting to an existing channel. Runoff captured onto the channel continues to flow in a northerly direction reporting to the Final Settlement Pond.	**Sediment load**	**Dirty**
Quarry Sump	26	The quarry sump is located in this area; seepage from the cliff faces is contained in the sump.	**Sediment load**	**Dirty**
Aggregate Plant	27	This area contains conveyors, stackers and control room which houses control panels. Runoff generated from this area flows in an easterly direction reports to the existing channel and discharges to the Settling Ponds.	**Sediment load**	**Dirty**
Wash Plant	28	Facility contains water storage tanks for washing aggregates (**Plate 22**), runoff generated during the wash process reports to the existing channel flows in a north easterly direction reporting to the settling ponds.	**Sediment load**	**Dirty**
Main Offices Building	29	This area is under roof cover. Runoff generated on the roof drains onto the ground and flows in an easterly direction towards the river.	None	**Clean**
Parking Area	30	Comprises of gravel, runoff generated flows in an easterly direction towards the river.	None	**Clean**
Salvage Yard	31	Rubber and metal storage area with separated by skips, on gravel with limited bunding in place.	None	**Clean**
Maintenance Building	32	These areas are under roof cover, clean runoff generated from the roof drains onto ground surface. Runoff continues to flow in south easterly direction, picking up sediment load and reports to the existing drainage channel and discharges to stream running along the south western boundary of the aggregate plant.	**Sediment load**	**Dirty**
Staff Showers and Toilets	33		**Sediment load**	**Dirty**

3.2 HYDROLOGICAL CHARACTERISTICS

The site falls within the lower Mtamvuna catchment (i.e. Quaternary Catchment T40G). The typical climatic conditions associated with rainfall and runoff volumes for the quaternary catchment are presented in **Table 2**.

Table 2 Quaternary Catchment Information (WRC, 1990)

QC	QC Area (km^2)	MAP (mm)	MAE (mm)	MAR (mm)	MAR (m^3)
T4OG	300	1 055	1 150	248	74 500 000

Rainfall gauging stations located in close proximity to the site were selected from database compiled by the Institute for Commercial Forestry (ICFR). The Uvongo rainfall gauging station (0182710W) was considered representative based on reliability of the data, altitude, distance from site and record length. Data pertaining to the rainfall gauging station is given in **Table 3**.

Table 3 Rainfall gauging station summary (Kunz, 2004)

Rainfall Station	Station Number	Latitude	Longitude	Distance from site (km)	Record (years)	Reliable data (%)	MAP (mm)
Uvongo	0182710W	30.834	30.401	2.442	111	50.4	1 082
Penrolton	0182618W	30.801	30.351	3.687	93	8.4	1 091
Izotsha	0182647S	30.784	30.367	4.025	110	13.8	919
Margate Airport	0182621W	30.851	30.351	4.882	111	15.4	951

The expected monthly rainfall distribution for the Uvongo Raingauge is represented in **Table 4**. The wet season for the site runs from October to March (i.e. summer rainfall region).

Table 4 Rainfall monthly averages of Uvongo Rainfall gauging station (Midgley *et al*., 1994)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	125	126	133	70	52	33	33	41	77	114	125	127

3.3 WATER HARVESTING AND RECYCLING

SCSC currently practices recycling of waste water contained within the settlement pond and Concrete pond. Waste water and dirty runoff contained in the final Settlement Pond is abstracted for dust suppression across the site. The waste water contained in the Concrete Pond is pumped out and re-used at the Concrete Mixing Plant and for washing truck mix drums.

To reduce surface water abstraction from the Vungu River, SCSC has proposed putting in place infrastructure aligned with stormwater management to harvest dirty storm water for process use. The proposed process water harvesting is expected from the following areas Quarry Sump, Short Term Sump and Weigh Bridge Area. Water from the Quarry Sump will be pumped to the Quarry Storage Tanks located upslope of the mine cliff faces, using a submersible pump and the gravity piped to the Wash Plant for aggregate washing. As this water is only contaminated with high sediment load it is considered suitable for use in the aggregate washing process.

A Short Term Sump is proposed for containment of stormwater generated on the Concrete Plant. Retention infrastructure is proposed around the weigh bridge area to contain runoff generated around the area for process water harvesting. A submersible pump is proposed to pump water from the Short Term Sump and Weigh Bridge Area to the Recycling Plant for use in the Concrete Plant and for washing truck mix drums. Flow routing of the proposed water harvesting system is presented in **Appendix A**. The proposed water harvesting system was considered and incorporated into the conceptual stormwater management plan developed for SCSC.

4 CONCEPTUAL STORMWATER PLAN

The key contaminants of concern associated with the site are predominantly sediment loads, as well as limited hydrocarbons associated with the asphalt and vehicular activities. These contaminants are considered pose a limited environmental risk.

Although the stormwater management for the site was assessed in accordance to GN704 guideline, the requirement of diversion and containment for a 50 year storm is considered unwarranted for SCSC site setting and associated activities. It is therefore proposed that diversion and containment infrastructure take the form of a first flush system to ensure appropriate stormwater management at the site, thereby eliminating impacts to the receiving environment.

In order to ensure that clean and dirty water generated from the SCSC site is adequately contained and routed, a conceptual stormwater management plan has been developed for the site (**Figure 5**).

The proposed plan includes the use of the berms/channels (prefix "**C**"), pipes (prefix "**P**") and pollution control dams (**PCD**) to manage the runoff from the various catchment areas (prefix "**K**"). The stormwater management infrastructure for the clean and dirty areas discretised have been tabulated and discussed in **Section 3.1** and **Table 4**.

5 NUMERICAL MODELLING

In order to motivate for the required sizing of the conceptual stormwater management infrastructure, storm event modelling using the *HydroCube* model was undertaken for the 2, 5, 10, 20 and 50 year return periods. Owing to the expected response time for the proposed catchments, a 60 minute storm duration was utilised in the modelling to determine the infrastructure sizing.

The MAP utilised in the modelling was 1 082mm based on the Uvongo rainfall raingauge. The catchment characteristics utilised in the modelling are outlined in **Table 6**. The model outputs for each of the catchments is summarised in **Appendix B**.

5.1 ASSUMPTIONS AND LIMITATIONS

The following key assumptions and limitations were assumed as part of the numerical modelling:

- The modelling is based on the current infrastructure and layout associated with the quarry including the proposed mining expansion. Should there be a change in infrastructure the stormwater conceptual plan and modelling results may need to be updated.
- For modelling purposes, **Berm 2**, **Berm 4** and **Berm 9** were modelled as channels **C2**, **C4** and **C9** to allow for stormflow routing. The outputs of these channels can be utilised to formulate berm sizes required to divert stormflow to the **Short Temp Sump**.
- It is assumed that the berms mentioned above will be constructed to allow for vehicle access.
- For modelling purposes inlet channel **C4.2** for the **Short Term Sump** was formulated to allow a single inlet to report to the sump, as well as inlet channel **C8.3** for the **PCD**.

Table 5 Proposed stormwater infrastructure

SUB-CATCHMENT	FACILITIES	PROPOSED INFRASTRUCTURE
	Clean Areas	
K1	→ Security Room; and → Parking Area.	Runoff generated from this catchment is considered clean and will flow in a westerly direction towards the Vungu River. To prevent cross contamination a berm is proposed to run along the northern boundary of the catchment (i.e. **K1**).
K5	→ Workshop; → Concrete Slab; → Oil Trap; and → Store Area.	Runoff generated from the rooftops of the facilities drain onto the ground surface and flow in a northerly direction towards the Vungu River. Runoff generated from the concrete slab is captured onto cut off trenched and diverted to the oil trap for containment (**Plate 17**), due to presence of potential contaminants arising from oil spills. Current stormwater management within this area is considered suitable and requires no change.
K6	→ Main Offices Building; → Parking Area; and → Salvage Yard.	Runoff generated from this catchment is considered clean and will flow in a westerly direction towards Vungu River.
K10	→ Grass vegetation area upslope of mining area	Runoff generated from **K10** is considered clean. To prevent cross contamination, a berm has been constructed along the edge of the cliff faces.
K11	→ Grass vegetation upslope of quarry mining area	Runoff generated from **K11** is considered clean. To prevent cross contamination, a berm has been constructed along the edge of the cliff faces, diverting and directing runoff away from quarry mining area.
	Dirty Areas	
K2	→ Weigh Bridge and Offices; → Reclaimed Asphalt; → Gravel; → Sand Stockpile; → Substation; and → Recycling Plant Storage Tanks.	→ A berm is proposed along the western boundary of the catchment (i.e. along the road) (i.e. **Berm 2**) to divert and direct to the proposed **Short Temp Sump**. → Berm should be constructed in such a manner as to allow for vehicle access.
K3	→ Concrete Mixer Plant; and → Cement Water Settlement Facility.	Runoff generated from this area is captured into existing channel (**Plate 23**), diverted to the slumps traps for initial settlement and discharge into the cement pond for containment (**Plate 24**). Current stormwater management within this area is considered suitable and requires no change.

SUB-CATCHMENT	FACILITIES	PROPOSED INFRASTRUCTURE
K4	→ Sand Stockpile; → Storage Shed; → Aggregate Stockpiles; → Cold Feed Bins and Ramp Up; → Bitumen Storage Area; → Asphalt Storage Tanks; → Diesel AST; → Bag House; → Drum Mix Plant; → Control Cabin; → Generator; → Silo; → Concrete Sampling; → Concrete Waste Stockpile Area; → General Storage Area; → Wet Fix and Econat Storage Area; → Laboratory and Kitchen; and → Filling Station.	Runoff generated from this catchment flows in north-westerly direction and is expected to contain sediments. The following stormwater management infrastructure is proposed for this catchment: → A berm (i.e. **Berm 4**) is proposed to run along the northern boundary of the catchment directing runoff and discharging to sump. → A **Short Term Sump** is proposed for temporal containment of stormwater. → Berm should be constructed in such a manner as to allow for vehicle access.
K7	→ Aggregate Plant; → Wash Plant; → Maintenance Building; and → Staff Showers and Toilets.	Runoff generated from this catchment flows in an easterly direction and is expected to contain sediments. The following stormwater management infrastructure is proposed: → Channel **C7** is proposed to capture runoff generated within this area. → **C7** continues to flow in a north easterly direction and discharging to existing channel **C8.1**. → **C8.1** has a wide channel to allow for initial settlement (**Plate 24**). → **C8.1** in turn discharges to existing pipe **P8**, which discharges to existing channel **C8.2**. → **C8.2** in turn discharges to the existing **1st** and **2nd Settlement Pond**, for further settlement of sediments (**Plate 24**). → **2nd Settlement Pond** in turn discharges into the proposed **PCD**, located on the north eastern corner of the catchment **K8**. → **PCD** then overflows into the existing **3rd Settlement Pond**, prior to discharging to the river.

Sub-Catchment	Facilities	Proposed Infrastructure
K8	→ Aggregate Plant; and → Quarry Mining Area.	Runoff generated from this area flows in a south easterly direction, reporting to the existing channel **C8.2**. **C8.2** in turn discharges to the existing **1st** and **2nd Settlement Pond**, for initial settlement of sediments. **2nd Settlement Pond** in turn discharges into proposed **PCD**, located on the north eastern corner of the catchment **K8**.
K9	→ Settling Ponds; → Quarry Mining Area; and → Quarry Sump.	Runoff generated from this area flows in a south easterly direction and is expected to have sediment load. A berm is proposed at the bottom of the eastern mining cliff face, to run along the area directing runoff to the proposed **PCD**. **PCD** then overflows into the existing **3rd Settlement Pond**, prior to discharging to the river.

Table 6 Catchment characteristics utilised in the numerical modelling

Aspect	K2	K4	K7	K8
Area (ha)	1.133	1.749	1.398	2.755
Catchment Length (m)	152	187.8	132.2	199
Average Slope (m/m)	0.026	0.021	0.045	0.055
Impervious Area (%)	65	65	65	65
Pervious Surface	Grass/Gravel			Gravel
Impervious Surface	Hard standing/Roof			Gravel

5.2 POLLUTION CONTROL DAM

Table 7 outlines the discharge volume for the entire 60 minute storm duration for the various return periods.

For the Concrete Plant, it is proposed that the first 20 minutes of the 20 year storm event (i.e. 102.22m^3) be contained in the **Short Term Sump**. It is understood that SCSC wishes to harvest the runoff for the Recycling Plant and as such consideration in maximisation of containment of water within the first flush above the specified value can be considered. Taking into account the proposed harvesting system around the Weigh Bridge Area, the volume of runoff expected to report to the **Short Term Sump** will be less. Therefore the containment size of the first 20 minutes of a 20 year storm even is considered adequate to contain and prevent relevant contaminant loads discharging to the water course.

In the Aggregate Plant, there are three existing settlement ponds with an approximate cumulative volume of 380m^3; therefore it is proposed that the first 15 minutes of the 20 year be contained in the proposed PCD (i.e. 386.99m^3). The routing of runoff via the existing three Settlement Ponds will result in adequate deposition of suspended load thereby protecting the adjacent water course.

Table 7 Stormwater Discharge Volumes for the 2/5/10/20/50 Year Return Storm Event

TIME (MIN)	C4.2					C8.3				
	2YR	5YR	10YR	20YR	50YR	2YR	5YR	10YR	20YR	50YR
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
3	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02
4	0.01	0.01	0.01	0.01	0.01	0.03	0.03	0.02	0.02	0.40
5	0.01	0.01	0.01	0.01	0.01	0.03	0.03	0.52	0.72	2.68
6	0.01	0.01	0.01	0.14	0.41	0.36	0.53	2.85	3.96	9.41
7	0.01	0.01	0.23	0.90	1.90	1.67	2.76	8.59	11.95	24.18
8	0.01	0.20	1.07	2.61	4.82	4.56	7.79	19.28	26.76	50.09
9	0.17	0.87	2.77	5.44	9.38	9.63	16.55	36.11	50.01	89.41
10	0.63	2.13	5.40	9.47	15.66	17.37	29.77	59.93	82.74	143.40
11	1.52	4.08	8.99	14.73	23.68	28.14	47.92	91.14	125.40	212.37
12	2.90	6.72	13.52	21.17	33.34	42.12	71.17	129.75	177.91	295.81
13	4.79	10.03	18.93	28.72	44.53	59.35	99.47	175.42	239.70	392.51
14	7.17	13.99	25.16	37.28	57.09	79.70	132.53	227.54	309.80	500.73
15	10.03	18.52	32.11	46.72	70.82	102.95	169.85	285.24	386.99	618.42
16	13.32	23.55	39.69	56.90	85.53	128.74	210.83	347.52	469.83	743.28
17	17.00	29.02	47.78	67.69	101.02	156.64	254.74	413.25	556.79	872.93
18	21.03	34.84	56.27	78.94	117.08	186.17	300.77	481.26	646.27	1004.99
19	25.35	40.94	65.04	90.50	133.50	216.81	348.11	550.37	736.70	1137.15
20	29.92	47.28	73.98	102.22	150.09	248.01	395.91	619.43	826.54	1267.24
21	34.66	53.78	83.01	114.00	166.70	279.37	443.54	687.56	914.70	1393.75
22	39.53	60.39	92.07	125.76	183.23	310.53	490.51	754.14	1000.38	1515.63
23	44.47	67.06	101.11	137.43	199.60	341.26	536.46	818.71	1083.03	1632.23
24	49.45	73.74	110.10	148.97	215.74	371.37	581.12	880.97	1162.29	1743.17
25	54.44	80.41	119.01	160.33	231.60	400.70	624.32	940.72	1237.98	1848.26
26	59.42	87.03	127.80	171.50	247.15	429.16	665.93	997.85	1309.97	1947.49
27	64.36	93.57	136.47	182.46	262.38	456.69	705.88	1052.31	1378.26	2040.94
28	69.24	100.03	144.98	193.19	277.25	483.24	744.14	1104.11	1442.90	2128.76
29	74.07	106.38	153.32	203.68	291.75	508.78	780.70	1153.28	1503.97	2211.18
30	78.81	112.61	161.48	213.92	305.89	533.31	815.57	1199.88	1561.60	2288.43

5.3 CHANNELS AND PIPE

Based on the modelling, the pipe and channel designs requirements to transfer runoff generated for the various return periods are outlined in **Table 8** and **9**. It is recommended that the channel and pipe conveyance be designed to the 50 year storm event requirements.

The constructed channel depth should be at least the maximum flow depth expected for the proposed storm event. The channel dimensions (i.e. width, wall slope and depth) can be varied, as long as the capacity can contain the peak flow expected. To allow ease of access for housekeeping and cleaning of sediments, channels should be constructed as Trapezoidal (i.e. 45° degree side walls).

6 RECOMMENDATIONS

Based on observations made during the development of the SWMP, the following recommendations can be made; incorporating measures outlined in the DWA GN704 and Best Practice Guidelines:

- To prevent cross-contamination, it must be ensured there is no handling of materials (aggregates and reclaimed asphalts) within the designated “clean areas”.
- All channels must be checked monthly and cleared after any major rainfall events, to ensure that there are no blockages and that the water flow will not be restricted in anyway.
- Stone pitching channels are recommended to reduce high runoff velocity on channels.
- Sediment that accumulates within the channels, ponds and retention facility (i.e. PCD/Short Term Sump) 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).
- The following criteria in relation to the PCD need to be considered in the final engineered design:
  - Appropriate lining (e.g. concrete) to prevent subsurface contamination;
  - Access for removal of sediments by hand or by small front end loader (e.g. Bob Cat);
  - Compaction of materials during placements;
  - Capacity of the PCD needs to be available at all times (i.e. kept empty);
  - Water contained within the PCD can only be used in designated dirty area; and
  - Spillway of the PCD needs to be appropriately designed to reduce discharge flow velocity to the existing Settlement Pond.
- The required containment within the PCD may be rationalised with the relevant authorities based on the expected risk posed (e.g. the use of the first flush system or the use of an alternative storm return interval).

Table 8 Characteristics and capacity of channels for the 2/5/10/20/50 Year Return Storm Event

ASPECT	C2					C4					C7					C8.1					C8.2					C9				
Channel Length (m)	136					159					150					52					105					184				
Channel Slope (m/m)	0.0294					0.0189					0.0200					0.0192					0.0095					0.0054				
Material	Gravel					Gravel					Gravel					Concrete					Concrete					Gravel				
Return Period Channel Dimensions	2	5	10	20	50	2	5	10	20	50	2	5	10	20	50	2	5	10	20	50	2	5	10	20	50	2	5	10	20	50
Base Width (m)	0.50	0.50	0.50	0.50	0.50	1.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	0.80	0.80	0.80	0.80	1.80	1.80	1.80	1.80	1.80	1.40	1.40	1.40	1.40	1.40
Max Flow Depth (m)	0.16	0.20	0.24	0.36	0.36	0.40	0.25	0.30	0.36	0.45	0.20	0.25	0.30	0.35	0.44	0.29	0.37	0.45	0.53	0.66	0.40	0.51	0.62	0.74	0.93	0.46	0.59	0.71	0.85	1.06
Velocity (m/s)	0.88	0.96	1.03	1.07	1.15	1.01	0.89	0.95	0.99	1.05	0.83	0.91	0.98	1.07	1.06	1.01	1.10	1.17	1.23	1.30	1.01	1.12	1.20	1.27	1.37	0.75	0.83	0.88	0.92	0.97
Peak Flow (m^3/s)	0.08	0.12	0.16	0.20	0.28	0.83	0.16	0.22	0.28	0.39	0.11	0.16	0.22	0.28	0.39	0.29	0.41	0.56	0.73	1.03	0.83	1.21	1.59	2.10	3.00	0.57	0.83	1.09	1.44	2.13
Channel Capacity (m^3/s)	0.08	0.12	0.16	0.21	0.29	0.83	0.17	0.22	0.29	0.41	0.12	0.17	0.23	0.29	0.40	0.29	0.42	0.56	0.73	1.03	0.83	1.22	1.60	2.12	3.02	0.58	0.84	1.13	1.49	2.06

Table 9 Pipe characteristics for the 2/5/10/20/50 Year Return Storm Event

ASPECT	P8				
Pipe Length (m)	10.43				
Pipe Slope (m/m)	0.0959				
Material	Concrete				
Return Period Pipe Dimensions	2	5	10	20	50
Design diameter	0.375	0.375	0.450	0.450	0.525
Peak Flow (m^3/s)	0.29	0.41	0.56	0.73	1.03
Velocity (m/s)	4.46	4.80	5.25	5.47	6.02

PHOTOGRAPHS

Plate 1: Concrete parking area for trucks and cars.

Plate 2: Weigh Bridge offices.

Plate 3: Runoff from weigh bridge and offices reporting to existing channel, at the Weigh bridge area.

Plate 4: Reclaimed Asphalt Gravel, with no bunding.

Plate 5: Sand Stockpile for use in concrete batch plant.

Plate 6: Storage Shed for Lime and Stone Dust.

Plate 7: Aggregate stockpiles of various sizes.

Plate 8: Ramp Up to Cold feed bins of Concrete Batch Plant.

Plate 9: Ramp Up to Cold feed bins of the Asphalt Plant.

Plate 10: Bunded Bitumen Storage area.

Plate 11: Bunded Asphalt and Diesel AST tanks.

Plate 12: Generator for asphalt plant, under roof cover and bunded.

Plate 13: Concrete Batch Plant area.

Plate 14: Cement water settlement facility

Plate 15: General Storage area under roof cover, with bunded storage area for Wet Fix and Econat.

Plate16 : Cut off trench outside the workshop

Plate 17: Cut off trench reporting to the Oil Trap system

Plate 18: Filling Station on hardstanding and bunding in place.

Plate 19: 2nd Settlement Pond, overflows to 3rd settlement pond (final settlement pond)

Plate 20: Final Settlement Pond, water abstracted for dust suppression.

Plate 21: Quarry mining area with aggregate stockpiles

Plate 22: Wash Plant Facility with washed aggregate stockpiles.

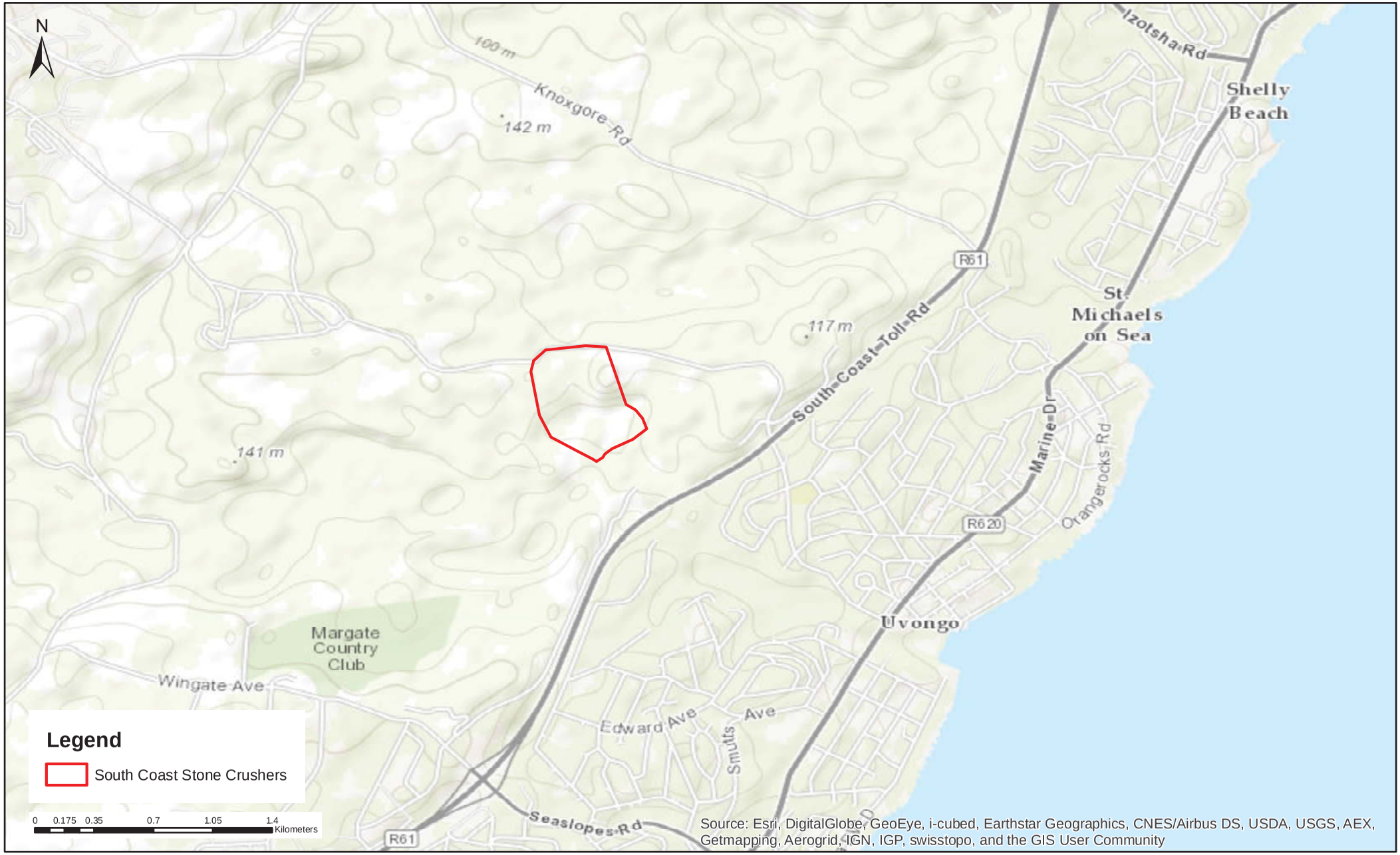
Plate 23: Concrete plant drainage channel, reporting to the treatment facility.

Plate 23: Concrete Pond, containment of water from the Concrete Batch Plant

Plate 23: Initial settlement of sediments in existing Channel **C8.1**.

Plate 24: Runoff from **channel C8.2** reporting to the **1st settlement pond**.

FIGURES



South Coast Stone Crushers (Pty) Ltd - Margate Quarry Regional Setting	**Data Source:** Bing Maps (2013) **Projection**	**Project:** SCSC - Stormwater Management Plan **Project No:** 46708 **Drawn by:** A. Mthalane **Reviewed by:** A. Pickles	**Date:** September 2015 **Figure No.** 1	WSP www.wspenvironmental.co.za

South Coast Stone Crushers (Pty) Ltd - Margate Quarry

Site Boundary

Data Source:
South African Department of
Rural Development and Land Reform -
Chief Directorate: National Geo-spatial Information

Projection Geographic - WGS1984

Project:	SCSC - IWWMP
Project No:	46708
Drawn by:	A. Mthalane
Reviewed by:	A. Pickles

Date: October 2015

Figure No. 2

WSP

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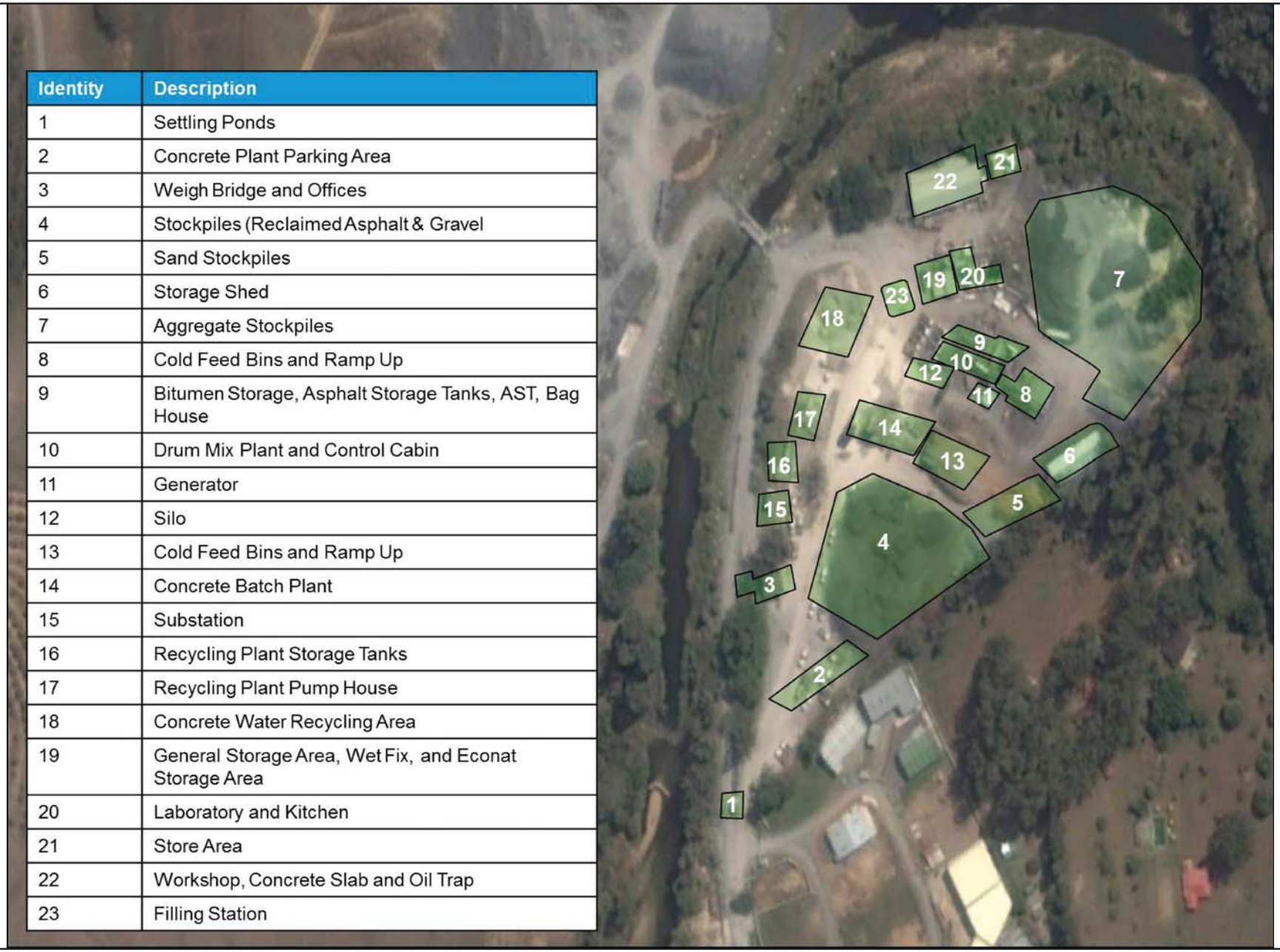
N

Identity	Description
1	Settling Ponds
2	Concrete Plant Parking Area
3	Weigh Bridge and Offices
4	Stockpiles (Reclaimed Asphalt & Gravel
5	Sand Stockpiles
6	Storage Shed
7	Aggregate Stockpiles
8	Cold Feed Bins and Ramp Up
9	Bitumen Storage, Asphalt Storage Tanks, AST, Bag House
10	Drum Mix Plant and Control Cabin
11	Generator
12	Silo
13	Cold Feed Bins and Ramp Up
14	Concrete Batch Plant
15	Substation
16	Recycling Plant Storage Tanks
17	Recycling Plant Pump House
18	Concrete Water Recycling Area
19	General Storage Area, Wet Fix, and Econat Storage Area
20	Laboratory and Kitchen
21	Store Area
22	Workshop, Concrete Slab and Oil Trap
23	Filling Station



South Coast Stone Crushers (Pty) Ltd - Margate Quarry

Site Layout (Zoom 1) - Concrete Plant (Southern Quarry)

Data Source: Google Earth, 2015

Projection

Project: SCSC - Stormwater Management Plant

Project No: 46708

Drawn by: A. Mthalane

Reviewed by: A. Pickles

Date: November 2015

Figure No. 3

WSP

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Identity	Description
24	Settling Ponds
25	Quarry Mining Pit
26	Quarry Sump
27	Aggregate Plant
28	Wash Plant
29	Main Offices Building
30	Parking Area
31	Salvage Yard
32	Maintenance Building
33	Staff Showers and Toilets

South Coast Stone Crushers (Pty) Ltd - Margate Quarry

Site Layout (Zoom 2) - Aggregate Plant (Northern Quarry)

Data Source: Google Earth, 2012

Projection

Project: SCSC - Stormwater Management Plant

Project No: 46708

Drawn by: A. Mthalane

Reviewed by: A. Pickles

Date: November 2015

Figure No. 4

WSP

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South Coast Stone Crushers (Pty) Ltd - Margate Quarry Conceptual Stormwater Management Plan	**Data Source:** Google Earth, 2015 **Projection**	**Project:** SCSC - Stormwater Management Plant **Project No:** 46708 **Drawn by:** A. Mthalane **Reviewed by:** A. Pickles	**Date:** September 2015 **Figure No.** 3

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Appendix A

PROPOSED WATER HARVESTING SYSTEM AT SCSC

AGGREGATE QUARRY: SOUTH COAST STONE CRUSHERS

InterCement

Appendix B

MODEL OUTPUTS

Model:Professional HQ3.005 **H3 Simulation Maxima** Report Date: 2015/09/13

Rainfall Type: Triangular Areal Red: Not Spec M.A.P: 665 (mm) Project No/Name: CPY-15/09000565

I.D.F Type: HRU/78 Time To Peak: 0.35 Total Area(ha): 15.823 NPC South Coast

Multiple RI used for Analysis - The Simulation Maxima can ONLY be used to Identify Problem Areas

Node ID	Inlet Peak(m3)	Store(m3)	Velocity (m/s)	Haz Rate Factor	MaxDepth(m)	Ex Q(m/s)	Resize	Resize Cap	St Dur
Output Summary for year recurrence Interval 1: 2									
Element Type: Catchments									
K2	0.08			Low					30
K4	0.11			Low					30
K7	0.12			Low					20
K8	0.18			Low					40
K9	0.58			Low					40
Element Type: Channels									
C2	0.00		0.88	9 Low	0.1578		0.158	0.082	30
C4	0.00		0.81	11 Low	0.1980		0.198	0.114	30
C4.2	0.00		2.12	28 Medium	0.1789		0.179	0.192	30
C7	0.00		0.83	11 Low	0.1973		0.197	0.117	20
C8.1	0.00		1.01	20 Low	0.2892		0.289	0.286	40
C8.2	0.00		0.73	8 Low	0.2043		0.204	0.285	40
C8.3	0.00		2.72	136 High	0.4600		0.460	0.847	40
C9	0.00		0.75	23 Low	0.4571		0.457	0.576	40
Element Type: Pipes									
P8	0.00		4.46	Low			0.375	0.506	40
Element Type: Reservoirs									
R1	0.00	432		Low					60
R3	0.00	2061		Low					60
Output Summary for year recurrence Interval 1: 5									
Element Type: Catchments									
K2	0.12			Low					30
K4	0.17			Low					30
K7	0.17			Low					20
K8	0.27			Low					40
K9	0.84			Low					40
Element Type: Channels									
C2	0.00		0.96	14 Low	0.2008		0.201	0.119	30
C4	0.00		0.89	16 Low	0.2527		0.253	0.167	30
C4.2	0.00		2.29	42 High	0.2277		0.228	0.279	30

Rainfall Type: Triangular Areal Red: Not Spec M.A.P: 665 (mm) Project No/Name: CPY-15/09000565

I.D.F Type: HRU/78 Time To Peak: 0.35 Total Area(ha): 15.823 NPC South Coast

Multiple RI used for Analysis - The Simulation Maxima can ONLY be used to Identify Problem Areas

Node ID	Inlet Peak(m3)	Store(m3)	Velocity (m/s)	Haz Rate Factor	MaxDepth(m)	Ex Q(m/s)	Resize	Resize Cap	St Dur
C7	0.00		0.91	16 Low	0.2471		0.247	0.166	20
C8.1	0.00		1.10	30 Medium	0.3685		0.368	0.416	30
C8.2	0.00		0.82	12 Low	0.2583		0.258	0.414	30
C8.3	0.00		2.86	198 High	0.5777		0.578	1.232	40
C9	0.00		0.83	35 Medium	0.5854		0.585	0.844	40
Element Type: Pipes									
P8	0.00		4.80	Low			0.375	0.506	30
Element Type: Reservoirs									
R1	0.00	608		Low					60
R3	0.00	2884		Low					60

Output Summary for year recurrence Interval 1: 10

Element Type: Catchments									
K2	0.16			Low					20
K4	0.22			Low					20
K7	0.23			Low					20
K8	0.36			Low					30
K9	1.13			Low					30
Element Type: Channels									
C2	0.00		1.03	19 Low	0.2445		0.245	0.161	20
C4	0.00		0.95	22 Low	0.3037		0.304	0.221	20
C4.2	0.00		2.40	57 High	0.2729		0.273	0.370	30
C7	0.00		0.98	22 Low	0.3018		0.302	0.226	20
C8.1	0.00		1.17	42 High	0.4464		0.446	0.559	30
C8.2	0.00		0.90	16 Low	0.3115		0.312	0.556	30
C8.3	0.00		2.96	262 High	0.6829		0.683	1.635	30
C9	0.00		0.88	48 High	0.7058		0.706	1.127	30
Element Type: Pipes									
P8	0.00		5.25	Low			0.450	0.823	30
Element Type: Reservoirs									
R1	0.00	771		Low					60
R3	0.00	3650		Low					60

Output Summary for year recurrence Interval 1: 20

Rainfall Type: Triangular Areal Red: Not Spec M.A.P: 665 (mm) Project No/Name: CPY-15/09000565

I.D.F Type: HRU/78 Time To Peak: 0.35 Total Area(ha): 15.823 NPC South Coast

Multiple RI used for Analysis - The Simulation Maxima can ONLY be used to Identify Problem Areas

Node ID	Inlet Peak(m3)	Store(m3)	Velocity (m/s)	Haz Rate Factor	MaxDepth(m)	Ex Q(m/s)	Resize	Resize Cap	St Dur
Element Type: Catchments									
K2	0.21			Low					20
K4	0.29			Low					20
K7	0.29			Low					20
K8	0.47			Low					30
K9	1.49			Low					30
Element Type: Channels									
C2	0.00		1.07	25 Low	0.2875		0.288	0.207	20
C4	0.00		0.99	29 Medium	0.3589		0.359	0.287	20
C4.2	0.00		2.51	75 High	0.3215		0.321	0.478	30
C7	0.00		1.07	29 Medium	0.3530		0.353	0.287	20
C8.1	0.00		1.23	56 High	0.5312		0.531	0.732	30
C8.2	0.00		0.97	22 Low	0.3706		0.371	0.730	30
C8.3	0.00		3.05	342 High	0.8016		0.802	2.158	30
C9	0.00		0.92	65 High	0.8465		0.846	1.492	30
Element Type: Pipes									
P8	0.00		5.47	Low			0.450	0.823	30
Element Type: Reservoirs									
R1	0.00	979		Low					60
R3	0.00	4610		Low					60

Output Summary for year recurrence Interval 1: 50

Element Type: Catchments									
K2	0.29			Low					20
K4	0.41			Low					20
K7	0.40			Low					20
K8	0.68			Low					30
K9	2.13			Low					30
Element Type: Channels									
C2	0.00		1.15	36 Medium	0.3594		0.359	0.293	20
C4	0.00		1.05	42 High	0.4502		0.450	0.408	20
C4.2	0.00		2.64	107 High	0.3992		0.399	0.674	20
C7	0.00		1.06	42 High	0.4385		0.438	0.403	20

Model:Professional HQ3.005

H3 Simulation Maxima

Report Date: 2015/09/13

Rainfall Type: Triangular Areal Red: Not Spec M.A.P: 665 (mm) Project No/Name: CPY-15/09000565

I.D.F Type: HRU/78 Time To Peak: 0.35 Total Area(ha): 15.823 NPC South Coast

Multiple RI used for Analysis - The Simulation Maxima can ONLY be used to Identify Problem Areas

Node ID	Inlet Peak(m3)	Store(m3)	Velocity (m/s)	Haz Rate Factor	MaxDepth(m)	Ex Q(m/s)	Resize	Resize Cap	St Dur
C8.1	0.00		1.30	81 High	0.6624		0.662	1.034	30
C8.2	0.00		1.06	31 Medium	0.4624		0.462	1.031	30
C8.3	0.00		3.19	475 High	0.9756		0.976	3.063	30
C9	0.00		0.97	95 High	1.0646		1.065	2.133	30
Element Type: Pipes									
P8	0.00		6.02	Low			0.525	1.242	30
Element Type: Reservoirs									
R1	0.00	1330		Low					60
R3	0.00	6214		Low					60

Appendix L: Heritage Scoping Report

eTHEMBENI CULTURAL HERITAGE

Amafa aKwazulu-Natali
195 Jabu Ndlovu Street Pietermaritzburg 3200 August
Telephone 033 3946 543
bernadetp@amafapmb.co.za

26 May 2016

Attention **Bernadet Pawandiwa**

Dear Ms Pawandiwa

Heritage Scoping Report
South Coast Stone Crushers Quarry near Margate, UGU DISTRICT, KwaZulu-Natal

Project description

South Coast Stone Crushers (SCSC) operates a quarry near Margate. SCSC is proposing to expand the mining operations onto the adjacent Lots 1997, 1998 and a portion of Lot 1994. The Department of Mineral Resources (DMR) has requested that the existing Environmental Management Programme Report (EMPR) be updated and amended to make provision for the new Lots to be mined.

The proposed extension of the quarry will allow the applicant to mine further tillite resources located within the subsurface of the above mentioned Lots. The SCSC quarry is mined by open cast mining methods, comprising blasting of the hard rock followed by excavation of the loosened rock by excavators. The rock material is then crushed into desirable grades dependant on end usage and sold to the construction and road industries.

The mining of the extension will make use of existing facilities, plant and access roads; with haul roads obviously being extended into the new area. The existing fence surrounding the mining area has been extended to enclose the proposed extension area according to DMR Safety Health and Environment (SHE) requirements.

FIGURE 1 **EXISTING SCSC DWYKA TILLITE QUARRY**

Site assessment and recommendations

FIGURE 2 VIEW OF THE SCSC QUARRY WITH THE PROPOSED EXPANSION AREA MARKED IN RED

The Draft EMPR was revised and submitted to all interested and affected parties – Amafa has commented requesting that an Heritage Impact Assessment (HIA) be undertaken for the project (which must include an archaeological field based survey and a palaeontological desktop-study.

eThembeni staff conducted a site inspection on 24 May 2016. The immediate area surrounding the quarry has been subjected to commercial sugar cultivation since the mid 20th Century and latterly, to banana and macadamia plantations (Fig.2). These agrarian activities, including contour ploughing of the steeply sloped topography and the movement and stockpiling of quarry spoil material, has removed any archaeological material that may have been present, out of primary context.

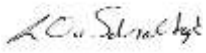
FIGURE 3 QUARRY SPOIL STOCKPILED ON SLOPES PREVIOUSLY UNDER SUGAR CANE CULTIVATION

The material being quarried is Dwyka tillite. This formation is considered moderately sensitive in terms of its palaeontology (Groenewald 2012)[1]. However, the formation being quarried is massive, undifferentiated material of low to no palaeontological significance and no desktop study is required (per.comm. Dr John Almond [Palaeontologist *Natura Viva* cc. naturaviva@universe.co.za])

Accordingly, we request that Amafa allow the proposed quarry expansion to proceed with no further heritage resource mitigation.

In this regard, please can you notify us timeously via the loaded SAHRIS case file as to the decision of Amafa.

Yours sincerely



Len van Schalkwyk
Principle Investigator

[1] Groenewald, G. 2012. Paleontological Technical Report for KwaZulu-Natal. Metsi Metseng Geological and Environmental Services.

Appendix M: Spill Contingency Plan

Title:

HANDLING OF HAZARDOUS SPILLAGES

1. OBJECTIVE

To prevent hazardous chemicals and oil spillages from leeching into the soil and/ or running into the water system and river by identifying the correct method of cleaning up hazardous spillage and disposal of any contaminated material at each plant.

2. RESPONSIBILITIES AND ASSIGNMENTS

Not applicable

3. DEFINITIONS AND ABBREVIATIONS

Not applicable

4. TASK DESCRIPTION

- By containing a spillage on a hard or concreted surfaces with the designated material identified at each plant. Rags, Sawdust, Peatsorb/Abzorbit maybe used at the various operations to absorb and clean up any oil and spillages.

Type of Oil/Chemical Absorber	Disposal	Duration of storage
Rags	The rags shall be placed into a waste bin that is provided specially and labeled for rags. oily rags will be collected by a waste management company (i.e. Enviroserv) for disposal at a licensed hazardous waste site. A waste disposal waybill is to be retained.	Hazardous waste should not be stored on site for more than 90 days. Should waste material be stored on site for more than 90 days, a waste licence is required.
Sawdust	Soiled Sawdust must be collected by a waste management company (i.e. Enviroserv) for disposal at a licensed hazardous waste site. A waste disposal waybill is to be retained.	
Peatsorb/Abzorbit	The peatsorb must be collected into a plastic bag and suitably disposed of by a the waste service provider at a licensed landfill site.	

Storage

- Containers of the respective absorbent material shall be placed at high potential spillage sites identified by the respective foreman and the Environmental Officer.
- These containers must be labelled accordingly.
- Hazardous waste material must be stored in containers and drums labelled accordingly awaiting disposal at a licensed waste disposal site. Waybills illustrating disposal must be retained.
- Oil spillages on the ground shall be picked up as soon as possible. All traces of soil with oil shall be

picked up and disposed. Refer to the above table for disposal measures.

- In the event of any notable and significant spillages the Environmental Officer is to be contacted immediately. The Environmental officer will notify the relevant authorities as required.
- In the event of large spillages that cannot be handled by our staff, then Drizit must be called out immediately. Contact details can be found in "Emergency Numbers" on the NPC Portal.

I. Emergency numbers Mgt III F7A – Z01
II. Emergency numbers Mbg III F7A – Z01
III. Emergency numbers PkrIII F7A – Z01
IV. Emergency numbers Stk III F7A – Z01
V. Emergency numbers Phx III F7A – Z01
VI. Emergency numbers Tgt III F7A – Z01
VII. Emergency numbers Uml III F7A – Z01

- A SHE Incident report is to be generated for all spillages.

If there are any doubts or queries contact the Environmental Officer.

5. OCCUPATIONAL HEALTH SAFETY

Handle all spillages as hazardous chemicals. Wear appropriate personal protective equipment. When handling any spillage that is hazardous please refer to the MSDS as stored on the Portal. NPC - Cimpor Portal Home > Divisions > **S.H.E.Q>MSDS.** On concrete and aggregate sites, every substance stored at a plant must have an MSDS filed in an accessible location. A file containing these MSDS must be clearly labeled. All workers are to know of the location of this file.

6. ENVIRONMENT

Under no circumstance shall spilled oil or hazardous chemicals be washed into the storm water drainage system or septic tank.
When performing maintenance, repairs or clean up operations, all precautions are to be taken to prevent the spillage of any hazardous material and/or liquid. The use of drip trays, working in bunded areas are exmaples of measures that should be taken.

7. RECORDS

3.1 The Constitution of the Republic of South Africa (No.108 of 1996)

Section 24: Everyone has the right-

(a) to an environment that is not harmful to their health or well-being;
(b) and to have the environment protected, for the benefit of present and future generations.

3.2 National Environmental Management Act, 1998 (Act No.107 Of 1998)

Section 28: Duty of care and remediation of environment damage.

Section 30: Control of emergency incidents

3.3 Mine Health and Safety Act, 1996 (Act No.29 of 1996)

Section 11: Employer to assess and respond to the risk.3.4 National Water Act, 1998 (Act No. 36 of 1998)

Section 19: Prevention and remedying effects of that pollution.

Section 20: Control of emergency incidents.

8. ANOMALIES

Not applicable