

*ENVIRO LOGIC*

Environmental Impact Assessment, Planning and Management Services  
Omgewingsimpakbeoordeling, Beplanning- en Bestuursdienste

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**PROPOSED WASTE DISPOSAL SITE,  
LEKKERSING, NORTHERN CAPE**

***ENVIRONMENTAL MANAGEMENT PROGRAMME***



**PLAN OF CONSTRUCTION AND MANAGEMENT OF ACTIVITIES RELATING TO  
THE PROTECTION OF THE NATURAL ENVIRONMENT DURING THE  
CONSTRUCTION AND OPERATIONAL PHASE**

**Department of Environment and Nature Conservation**

Reference No: NC/NAM/RICHT/LEK/02/2011

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## **A. GENERAL**

### **1. INTRODUCTION**

*ENVIRO LOGIC* has been appointed by the Applicant as the independent environmental consultants to compile an Environmental Management Programme (EMP), for the proposed construction of a waste disposal site at Lekkersing, Northern Cape.

The proposed waste facility is on Lekkersing Portion 5 of Farm Richtersveld 11 (See **1:50 000 Topography Map: Appendix A**). The proposed development will encompass the ± 0,6 ha area identified for the waste disposal site. This site will be fenced off and trenches will be excavated in which the general waste will be disposed in. After a trench has reached its capacity it will be closed off by covering it with soil and a new trench will be opened up. A gravel access road will be constructed. (See **Site and Flood Line Layout Plan Alternative 2: Appendix B**).

- The Applicant for the proposed development is the **Richtersveld Municipality, Port Nolloth**.
- The Consulting Engineers are **BVi Consulting Engineers (Springbok)**.
- An Archaeological Impact Assessment was conducted by the **Agency for Cultural Resource Management (ACRM)**.
- A Hydrogeological Assessment was conducted by **SRK Consulting**
- The Environmental Assessment Practitioner ("EAP") is **ENVIRO LOGIC**.

### **2. ENVIRONMENTAL MANAGEMENT PROGRAMME**

This report serves as the Environmental Management Programme (Construction Phase and Operational Phase) for the proposed construction of a Waste Disposal Site on Farm Richtersveld 11, Portion 5, Lekkersing.

This EMP is to be used during the construction and operational phase associated with this development and has been drafted on the basis of recommendations made by independent consultants.

Conditions of Waste Management Licence set by the D: E&NC to be inserted upon receipt. (**Appendix J**)

Conditions of Environmental Authorisation set by the D: E&NC to be inserted upon receipt. (**Appendix K**)

The EMP is intended for use by the Environmental Control Officer (ECO); the Site Engineer; the Contractor(s); the competent authority (Department of Environment and Nature Conservation), and the Local Authority (Richtersveld Municipality).

### **2.2.3 Archaeological Impact Assessment**

Alternative site 1 is situated in a dry drainage channel and on sediments and it is expected that shallower groundwater conditions exist here. The possibility of a dyke being located beneath Alternative site 1 could also create a conduit for any leachate generated which could move off-site.

The 1:50 and 1:100 year flood lines for Alternative site 2 were determined by BVi Consulting Engineers and they have decided on the Alternative 2 site as the preferred alternative site.

An application for exemption from having to conduct an archaeological study for the proposed construction of a waste disposal facility at Lekkersing (Alternative Site 2) was submitted by ACRM to SAHRA.

ACRM stated that:

"It is the archaeologist's professional opinion, that the construction of a new waste disposal facility (i. e. Alternative 2), on Portion 5 of Farm Richtersveld 11, in Lekkersing is not considered to pose a serious threat to the archaeological heritage for the following reasons:

- Indications are that the receiving environment is not a sensitive archaeological landscape, and is in fact severely degraded.
- An AIA for the proposed Lekkersing Oxidation Dam (less than 400 m from the planned waste site) failed to document any archaeological heritage.

The following recommendations are therefore made:

1. An AIA is not required, since the probability of locating any significant archaeological remains is likely to be extremely low.
2. In the unlikely event of any unmarked human burials or buried ostrich eggshell caches being uncovered during construction, these must immediately be reported to the archaeologist (Jonathan Kaplan 082 321 0172), or the South African Heritage Resources Agency (Katie Smuts 021 462 4502)."

SAHRA supports the request for exemption and as there is apparently no evidence of any significant archaeological material in this area, the SAHRA Archaeological, Paleontological and Meteorites Unit has no objection to the development (in terms of the archaeological component of the heritage resources) on condition that, if any new evidence of archaeological sites or artefacts, paleontological fossils, graves or other heritage resources are found during development, construction or mining, SAHRA and an archaeologist and/or palaeontologist, depending on the nature of the finds, must be alerted immediately (See **Application for Exemption to Conduct an Archaeological Study: Alternative 2: Appendix D.1**)

Site Specific is given for Site 2. Site 2 is also situated at the current landfill site. The daily site operation is questionable and would probably need to be formalized. It would therefore be preferred if the new site be built at the site so that daily operation of waste disposal be regulated.

The magnitude of the impact of leachate in groundwater is Very Low and the significance is Very Low for both sites as the CWB is negative. No groundwater use was identified downstream of the sites. The town is supplied with water from boreholes located to the northeast of the town, which are all upstream from the proposed waste sites. The closets site (Waste Alternative 2) is approximately 1.3 km from the boreholes. Due to the distance and the proposed sites being downstream of the boreholes, no impact from pollution from the sites on the groundwater resources supplying the town is foreseen. No groundwater use or boreholes close to the sites (1 km radius) was found.

Both sites are situated in or next to dry drainage channels and their floodplains. It is outside the scope of this report, but 1:50 and 1:100 year flood lines for these channels would be important criteria in the placement of the footprint of the site.

The Waste Site Alternative 2 is preferred due to Site 1 being located in a drainage channel.

### **2.3 CONDITIONS OF AUTHORISATION**

The applicant shall be responsible for ensuring compliance with the conditions contained in the Waste Management Licence and Environmental Authorisation to be issued by the D: E&NC.

The applicant must obtain all the necessary approvals and permits from, and comply with any Conditions of Authorisation and requirements set by the relevant Authorities.

Contractors must investigate and comply with all existing regulations and laws / bylaws unless the Relevant Authority grants specific written authority waiving compliance with any legislation.

Conditions of Waste Management Licence to be inserted on receipt. **(Appendix J)**

Conditions of Environmental Authorisation to be inserted on receipt. **(Appendix K)**

Engineer and the ECO and must ensure that the works on site are conducted in an environmentally sensitive manner and fully in accordance with the requirements of the EMP, at all times. The Contractor must identify in consultation with the Site Engineer and ECO the necessary areas for contractor's campsite, storage of materials, ablutions, eating areas of contract workers, etc., and have these areas demarcated.

When the ECO is not on site the Site Engineer will be responsible for the EMP. Any problems that might lead to damage to the environment must be discussed with the ECO. The Contractor is responsible to fill in the "ENVIRONMENTAL WEEKLY CHECKLIST" for civil construction work (see **Appendix E**). The **Environmental Weekly Checklist's** must be kept together and must be available for assessment by the Site Engineer and the ECO.

## **2.4 THE ENVIRONMENTAL CONTROL OFFICER (ECO)**

The following applies to the ECO:

### **Requirements for the Posts:**

The designation is reserved for suitably qualified (National Diploma / Degree in Natural Science or an equivalent qualification), independent, environmental manager, with adequate environmental knowledge to understand and implement the EMP.

### **Site Visits:**

Due to the nature of this development the ECO will visit the site at least once a month, with additional visits at the professional, project-linked, discretion of the ECO.

### **Responsibilities of the ECO:**

- Is responsible for the environmental issues involved with the construction phase of the project;
- Co-ordinating any aspect of site activity that may have an effect on the environment;
- Must work in close conjunction with the Site Engineer and Contractor.
- Must approve areas for contractors campsite, storage of materials, ablutions, eating areas of contract workers, etc., and have these areas demarcated;
- Must identify 'no go' areas and areas sensitive to erosion and have these areas demarcated;
- Environmental awareness of the contractors and workers is essential. This must be in the form of an onsite talk and / or a written code of conduct (see **Appendix F**);
- Record keeping in the form of a checklist and / or diary entries and photographic records for visual reference.

### **3.4 METHOD STATEMENTS**

Method statements from the Contractor will be required for specific sensitive actions on request of the authorities, SE and/ or ECO. A method statement forms the base line information on which sensitive area work takes place and is a "live document" in that modifications are negotiated between the Contractor, SE and ECO, as circumstances unfold. All method statements will form part of the CP EMP documentation and are subject to all terms and conditions contained within the CP EMP main document. (See **Standard Method Statement Sheet: Appendix H**).

A method statement describes the scope of the intended work in a step-by-step description in order for the SE and ECO to understand the Contractors intentions. This will enable them to assist in devising any mitigation measures, which would minimise environmental impact during these tasks. For each instance wherein it is requested that the Contractor submit a method statement to the satisfaction of the SE and ECO, the format should clearly indicate the following:

- **What** - a brief description of the work to be undertaken;
- **How** - a detailed description of the process of work, methods and materials;
- **Where** - a description/sketch map of the locality of work (if applicable); and
- **When** - the sequencing of actions with due commencement dates and completion date estimates.

The Contractor must submit the method statement before any particular construction activity is due to start. Work may not commence until the method statement has been approved by the ECO.

### **4. MANDATORY SITE EQUIPMENT**

Before any construction work is due to start the Contractor shall ensure that the following equipment is on site:

- Sufficient and suitable chemical toilet facilities.
- Refuse bins, which are weather and wind proof, with proper lids.
- One type ABC (all purpose) 12.5 kg fire extinguisher.
- Drip trays (where applicable).
- Leak proof container for the storage of oiled equipment (where applicable).

### **5. RECORD KEEPING**

All records relating to the implementation of this management plan (e.g. Declaration of Understanding, ECO Checklist and/or diary, Method Statements, etc.) must be kept together and can be retrieved easily. These records must be available for scrutiny by any relevant authorities.



Unauthorised persons should not be allowed to enter the premises.

### **7.3 FAUNA AND FLORA**

Indigenous plants or wild animals (including reptiles, birds' etc.) may not be damaged or harmed. Vegetation removals on demarcated construction sites (as part of the development requirements) are excluded.

All incidents of harm to any animal or natural vegetation (apart from the agreed areas) must be reported to the ECO.

Indigenous fauna in "development areas" that will be disturbed must be relocated to suitable adjacent habitats.

### **7.4 TOP MATERIAL REMOVAL AND STOCKPILING**

The natural vegetation must be stripped from demarcated construction sites only shortly before commencing with the construction and stockpiled with a minimum of 100 mm topsoil layer in heaps no higher than 1.5 m. (within the demarcated working area).

Surplus subsoil that becomes available during construction work and building operations must be used as fill material on designated areas.

### **7.5 DUST CONTROL**

The Contractor is to take appropriate measures to minimise the generation of dust as a result of construction works, to the satisfaction of the SE and the ECO.

Vegetation must be stripped from demarcated construction sites only shortly before commencing with the construction process. Dust production must be controlled by regular watering of roads and works area, should the need arise. Straw stabilisation can be used as a method of stabilisation and dust control. Seed bearing invasive vegetation must not be used for this purpose.

All vehicles transporting material that can be blown off (e.g. soil, rubble etc.) must be covered with a tarpaulin, and speed limits of 40 km/h must be adhered to.

Excessive dust conditions shall be reported to the SE and ECO.

Cigarette butts may not be thrown in the veld, but must be disposed of correctly in suitable receptacles.

#### **7.9 DRINKING WATER**

The Contractor must insure that drinking water (SABS standard) is available for all staff on site.

#### **7.10 TOILETS**

The Contractor is responsible for the provision of sufficient and suitable chemical toilets. A minimum of one chemical toilet shall be provided per 15 persons. The Contractor shall supply toilet paper at all toilets at all times. Toilet paper dispensers shall be provided in all toilets. Toilets shall be of a neat construction and shall be provided with doors and locks and shall be secured to prevent them from blowing over. Entrances to toilets should be adequately screened from public view. Sanitation facilities shall be located within 100 m from any point of work, but must not be closer than 50 m to any water body.

The Contractor (or reputable toilet servicing company) shall ensure that toilets are emptied at close of each working week. Waste must be disposed of at a registered waste disposal site

Sanitation provision and servicing must be to the satisfaction of the ECO and Site Engineer.

#### **7.11 DISCHARGE OF CONSTRUCTION WATER**

All cement effluent from washings (mixer, wheelbarrows, etc.) and run-off from batching areas and other work areas must be contained in suitable sedimentation ponds approved by the SE and the ECO. Sedimentation ponds must be lined with SABS approved HDPE liners.

Sedimentation ponds shall be allowed to dry out on a regular basis to allow for solid material to be removed. This material must be disposed of in a suitable manner, depending on the nature of the material, and to the discretion of the SE / ECO.

All solid waste material from the sedimentation ponds must be disposed of at the new waste facility.

Pollution prevention measures must be employed at all levels of the project. No surface, ground or storm water resources may be polluted due to any activity on the property. The relevant requirements of the National Water Act, 1998 (Act No. 36 of 1998) must be complied with at all times.

#### **7.12 WASTE DISPOSAL (REFUSE)**

The Contractor shall be responsible for the establishment of a refuse control system that is acceptable to the SE and the ECO.

Containers must be clearly marked to indicate contents as well as safety requirements. Quantities of fuels, oils, and hazardous materials stored on site should be appropriate to the requirement for these substances on site.

No fuel / oil containers may be left unattended within any drainage areas.

The contractor shall keep the necessary materials and equipment on site to deal with spills of the materials present should they occur. The Contractor must ensure that senior and other relevant members of the workforce are trained in dealing with spills and emergency spill kits. The contractor shall set up a procedure for dealing with spills, which will include notifying the SE, ECO and the relevant authorities prior to commencing with construction. In the case of pollution of any surface or groundwater, the Regional Representative of the Department of Water and Environmental Affairs must be informed immediately. The Contractor must keep a record of all spills and the corrective action taken. All spills and remediation measures taken are to be recorded in the ECO checklist/ diary.

All contaminated soil must be removed and placed in containers. Contaminated material can be taken to one central point where bio-remediation can be done. A specialist Contractor shall be used for the bio-remediation of contaminated soil where the required remediation material and expertise is not available on site. All spills of hazardous substances must be reported to the SE and ECO.

#### **7.14 PREPARATION OF CONSTRUCTION MATERIAL**

All construction materials are to be prepared at the Contractor's camp and / or within the demarcated working area at each construction site.

Construction material will be stored at the Contractors Camp, as well as on the construction site (within the demarcated area).

No building material may be sourced from the property (No quarrying or sand mining).

#### **7.15 CONCRETE WORKS**

Cement powder has a high alkalinity pH rating, which can contaminate and affect both soil and water pH dramatically. A shift in pH can have serious consequences on the functioning of soil and water organisms and plants. The following recommendations must be implemented to minimise impact.

- All cement mixing should take place in a cement mixer and then within a SABS approved HDPE plastic lined bund. **No cement may be mixed on the ground.**
- Mixing areas to be carefully placed in consultation with the SE and the ECO.

Noisy activities shall take place only during working hours. The residents of houses nearby to the development should be notified in writing 24 hours prior to any planned activities that will be unusually noisy or any other activities that could reasonably have an impact on the adjacent sites.

### 7.19 SAFETY

The access to the site must be controlled so as to restrict unauthorised personnel from entering the site. The Contractor is responsible for ensuring that only authorised personnel are on site at all times. Notices must be displayed at all entrances to the property, warning visitors that they are entering a construction site.

The Contractor must ensure that all emergency procedures are in place prior to commencing work. Emergency procedures shall include (but not be limited to) spills, contamination of the ground, accidents to employees, use of hazardous substances and materials, etc.

The contractor must ensure that lists of all emergency telephone numbers / contact persons are kept up to date and that all numbers and names are posted at relevant locations throughout the duration of the construction period.

The nearest emergency service provider must be identified and the contact details of this emergency centre, as well as the police and ambulance services must available at prominent locations around the construction site and the construction camp.

No unauthorised firearms are permitted on site.

### 7.20 PENALTIES

The SE can impose spot fines on the Contractor for any contraventions of the CP EMP. By imposing spot fines on individuals guilty of contravening the CP EMP, the SE will be able to ensure that the requirements of the CP EMP are taken seriously not only by the management personnel on site, but also by labour. Below is a range of spot fines for different contraventions of the CP EMP. The SE should use these as a guide and use his/her own judgment in determining the severity of the contravention and thus the value of the spot fine:

- An individual driving a vehicle outside the defined boundaries of the site R300 – 1000
- An individual driving any earthmoving machine outside the boundaries of the site R300 – 3000
- A machine operator ignoring a verbal warning to have an oil leak from his  
• machinery repaired R200 – 400
- An individual littering on site R50
- An individual not making use of the ablution facilities R50

#### **7.24 CRIME**

Crime and in particular theft associated with construction sites is a reality. Contractors need to be proactive in order to curtail theft and crime on and resulting from the construction site. On site security personnel should have the necessary means of contacting the proper authorities when needed. All incidents of theft or other crime should be reported the South African Police Service.

#### **8. UPDATING OF CONSTRUCTION PHASE EMP**

Although care has been taken to address all known relevant environmental issues for the construction phase, it might become necessary to add or amend certain procedures or instructions to improve the efficiency of the CP EMP.

Only those additions to, or amendments of, this CP EMP that will either improve environmental protection or can be proved not to have any negative effect would be considered.

Any environmentally significant additions or amendments will be submitted by the ECO to the D: E&NC for approval, after the ECO has consulted the SE and the Applicant.

#### References:

Mucina, L & Rutherford, M.C. (eds) 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria.

Permanent weather proof notices in at least three applicable official languages must be brought on at each site entrance. These notices should display the nature of the facility, the prohibition of unauthorised entry, the operational hours of the facility and the contact details of the Licence holder (Richtersveld Municipality).

The Richtersveld Municipality must ensure that all emergency procedures are in place. Emergency procedures shall include (but not be limited to) spills, contamination of the ground, accidents to employees, use of hazardous substances and materials, etc.

Lists of all emergency telephone numbers / contact persons must be kept up to date and all numbers and names must be posted at relevant locations. The nearest emergency service provider must be identified and the contact details of this emergency centre, as well as the police and ambulance services must available at prominent locations around the site.

### **3. ENVIRONMENTAL AUDITING / MONITORING**

Quarterly environmental auditing is to be instituted by the Richtersveld Municipality and maintained as a fundamental mechanism for revising the environmental management programmes and procedures required for ensuring sustainability.

### **4. ROAD MAINTENANCE AND EROSION CONTROL**

Hard, gravel based, road surfaces are recommended, as this would limit dust pollution. Provision must be made for the management / handling of storm-water if and where required.

### **5. FENCING AND SECURITY**

Fences and gates must be checked on a regular basis and be maintained. Fencing should be kept neat and all windblown waste should be removed on a regular basis. No unauthorized persons should be allowed on the premises. Gates should be kept locked unless personnel are on site during operating hours.

**APPENDICES**

**Appendix A:** 1:50 000 Topography Map

**Appendix B:** Site and Flood Line Layout Plan Alternative 2

**Appendix C:** Google Earth Image Alternative 2

**Appendix D: Specialist reports**

Appendix D.1: Application for Exemption to Conduct an Archaeological Study: Alternative 2

Appendix D.2: Hydrogeological Assessment

**Appendix E:** Environmental Weekly Checklist

**Appendix F:** Code of conduct for Contractors / Workers

**Appendix G:** Declaration of Understanding

**Appendix H:** Standard Method Statement: (Blank example; actual Method Statements to be inserted if / when required)

**Appendix I:** ECO Checklists & Photographs (to be inserted upon completion by ECO)

**Appendix J:** Conditions of Waste Management Licence (to be inserted upon receipt)

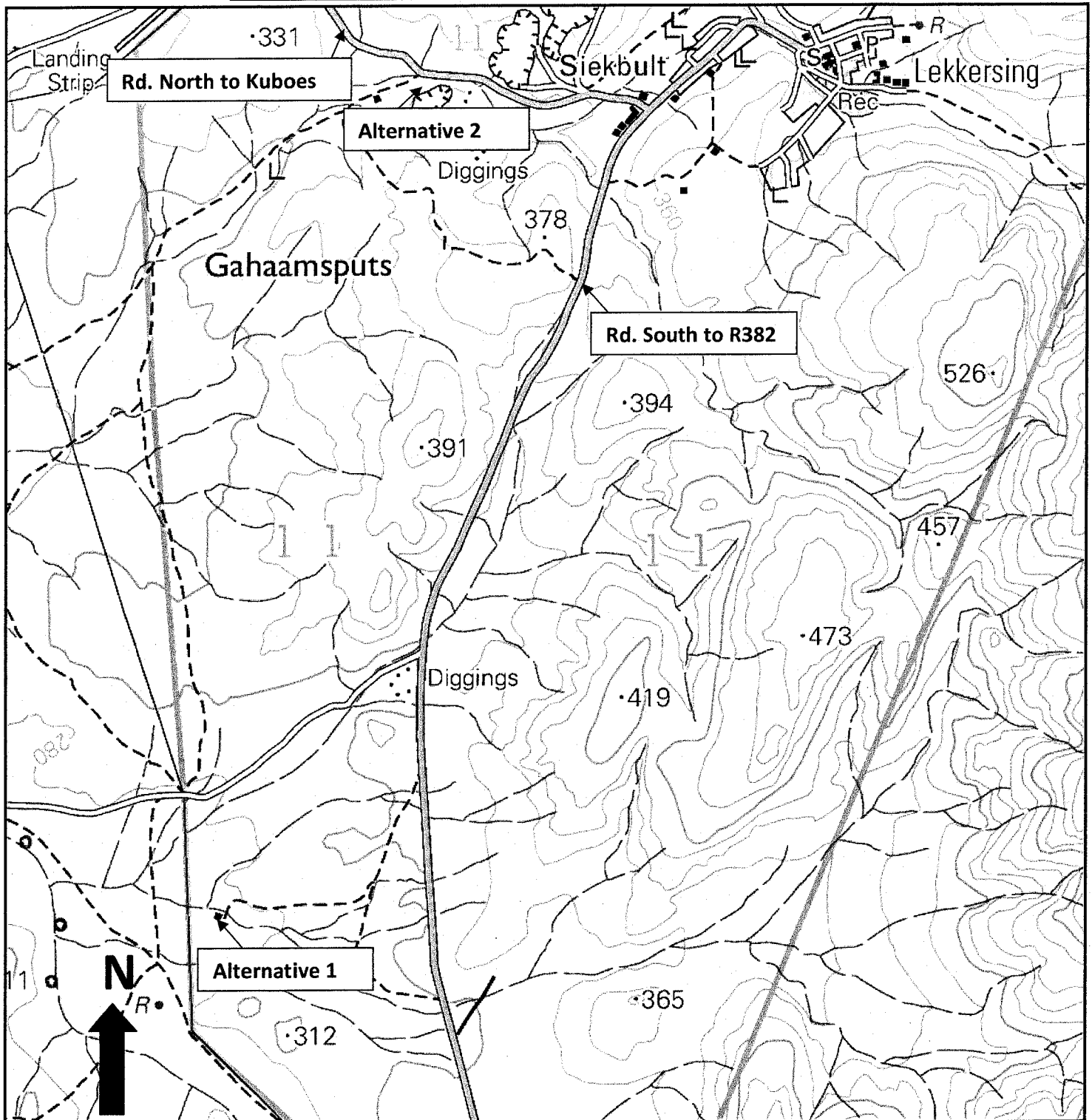
**Appendix K:** Conditions of Environmental Authorisation (to be inserted upon receipt)

**Appendix A**

**1:50 000 Topography Map**



**Lekkersing: Proposed Waste Disposal Site**



**Lekkersing: 1:50 000 Topography Map**

Proposed Waste Disposal sites  
Scale 1:50 000  
Alternative 1, 29° 1'54.84"S / 17° 4'31.18"E  
Alternative 2, 29° 0'10.76"S / 17° 5'1.21"E

**Appendix B**

**Site and Flood Line Layout Plan Alternative 2**



**Appendix C**

**Google Earth Image Alternative 2**



**Appendix D**

**Specialist Studies**

**Appendix D.1**

**Application for Exemption to Conduct an Archaeological  
Study: Alternative 2**

# Agency for Cultural Resource Management

Specialists in Archaeological Studies and Heritage Resource Management

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05 December, 2012

**Att:** Ms Katie Smuts  
South African Heritage Resources Agency  
PO Box 4637  
Cape Town  
8000

Dear Ms Smuts,

## **RECOMMENDED EXEMPTION FROM HAVING TO CONDUCT AN ARCHAEOLOGICAL STUDY: THE PROPOSED CONSTRUCTION OF A WASTE DISPOSAL FACILITY AT LEKKERSING (ALTERNATIVE 2), NORTHERN CAPE PROVINCE**

### **1. Introduction**

Lekkersing is a small Nama settlement located about 60 kms east of Port Nolloth in Northern Cape Province (Figure 1).

A Phase 1 Archaeological Impact Assessment (AIA) for the proposed Lekkersing Waste Disposal Facility (Alternative 1) was conducted in 2011 (Kaplan 2011a). This site has now been found to be unsuitable for development and a new site (Alternative 2) has subsequently been identified (Figure 2).

The proposed activity includes the digging of trenches (4m - 5m wide & 2m - 3m deep), in which general waste will be disposed. After a trench has reached its capacity it will be closed off by covering it with a final layer of soil and a new trench will be opened up. The footprint area for the proposed Alternative 2 waste site is about 1.5 ha. The proposed activities are to be located on Portion 5 of Farm Richtersveld 11, Namaqualand.

### **2. Archaeology in the Lekkersing area**

Some archaeological work has taken place in Lekkersing (Kaplan 2011a, b), but no remains were documented. No graves sites were located, either.

### **3. Description of the environment.**

An aerial photograph indicating the layout of the proposed Lekkersing Waste Site (Alternative 2) is illustrated in Figure 3. The proposed site is located about 1 km northwest of the village, more or less in the same area in which an AIA for the proposed Lekkersing Oxidation Dam was done (Kaplan 2011a).



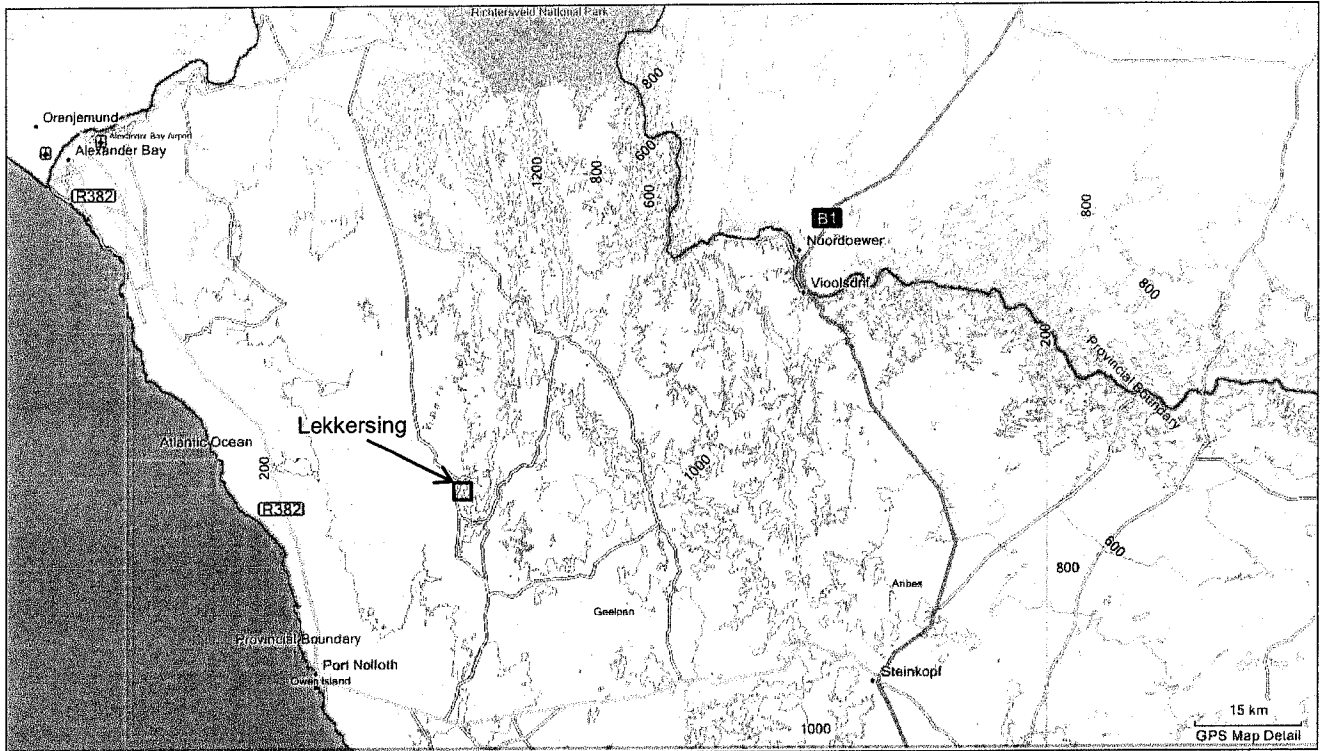


Figure 1. Locality map: Regional context

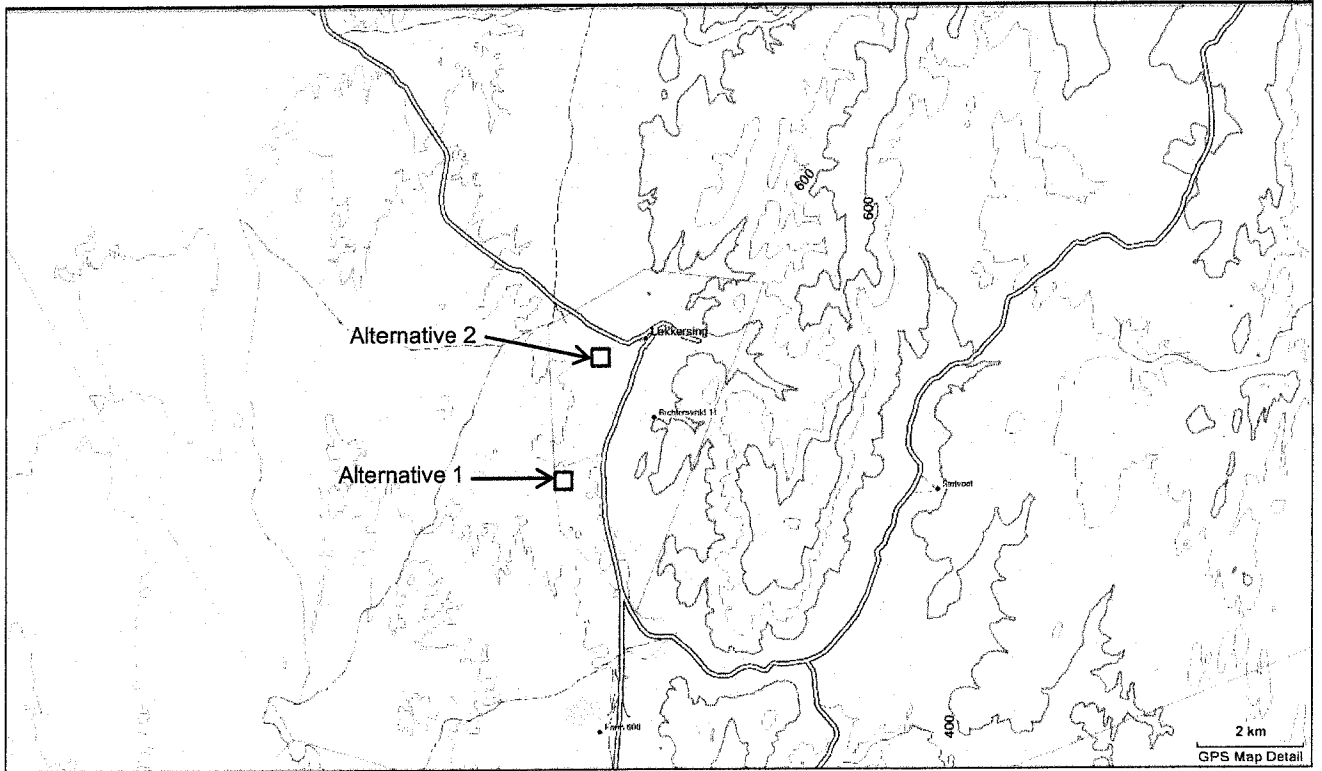


Figure 2. Locality map: Local context

**Appendix D.2**

**Hydrogeological Assessment**

# HYDROGEOLOGICAL ASSESSMENT OF SITES PROPOSED FOR SOLID WASTE DISPOSAL AT LEKKERSING IN THE RICHTERSVELD MUNICIPALITY

Report Prepared for  
**BVi Consulting Engineers**  
Report Number 434931/3a



Report Prepared by



November 2011

# **HYDROGEOLOGICAL ASSESSMENT OF SITES PROPOSED FOR SOLID WASTE DISPOSAL AT LEKKERSING IN THE RICHTERSVELD MUNICIPALITY**

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**SRK Project Number 434931**

**November 2011**

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## Glossary

**Abstraction:** The act of removing groundwater from an aquifer.

**Aquifer:** A formation, group of formations, or part of a formation that contains sufficient saturated permeable material to store and transmit water; and to yield economical quantities of water to boreholes or springs. An aquifer is the storage medium from which groundwater is abstracted.

**Blow yield:** The volume of water per unit of time blown from the borehole during drilling. Blow yield gives an indication of the rate at which groundwater can be abstracted from a borehole.

**Collar:** Top of borehole casing.

**Electrical conductivity (EC):** Electrical conductivity is a measure of how well a material accommodates the transport of electric charge. The more salts dissolved in the water, the higher the EC value. It is used to estimate the amount of total dissolved salts, or the total amount of dissolved ions in the water.

**Fault:** A zone of displacement in rock formations resulting from forces of tension or compression in the earth's crust. Faults can form conduits for groundwater movement and groundwater contamination; as well as impermeable zones where metamorphism of the rocks have taken place.

**Formation:** A body of rock identified by lithic characteristics and stratigraphic position. Different formations have different geohydrological properties.

**Fracture:** Any break in a rock including cracks, joints and faults. Fractures can form the main conduits for groundwater flow. They can also form pathways for the movement of contamination.

**Geophysics:** The study of the earth's physical characteristics by the use of instruments to determine physical properties such as relative density, electrical conductivity, magnetic susceptibility, seismic wave propagation, electrical and gravitational fields, etc.

**Groundwater:** Water found in the subsurface in the saturated zone below the water table. Groundwater is an integral part of the hydrological system.

**Hydrogeology:** In South Africa the term geohydrology and hydrogeology are used interchangeably. In theory hydrogeology is the study of geology from the perspective of its role and influence in hydrology, while geohydrology is the study of hydrology from the perspective of the influence on geology.

**Kersantite:** A type of intrusive igneous rock and consisting mostly of biotite and plagioclase feldspar.

**pH:** pH is the negative logarithm of the hydrogen ion concentration in solution. pH is the measure of the acidity or alkalinity of a solution.

**Quaternary Catchment:** A fourth order catchment in a hierarchal classification system in which a primary catchment is the major unit. Catchments are a basic hydrological unit. The Quaternary Catchments are the basic unit for water resource management in South Africa.

**Recharge area:** An area over which recharge occurs. Recharge is crucial for the ongoing replenishment of aquifers and their sustainable use, and recharge areas thus require protection.

**Recharge:** The addition of water to the saturated zone, either by the downward percolation of precipitation or surface water and/or the lateral migration of groundwater from adjacent aquifers. Recharge is crucial for the ongoing replenishment of aquifers.

# 1 Introduction

## 1.1 Appointment

SRK Consulting Engineers and Scientists (SRK) submitted a proposal to BVI Consulting Engineers dated 16 May 2011 for conducting a hydrogeological study for new landfill sites and waste water oxidation ponds at five towns in the Richtersveld Municipality. SRK was subsequently appointed to carry out this work on 24 May 2011.

The five towns (**Figure 1**) referred to are:

- Port Nolloth;
- Lekkersing;
- Eksteenfontein;
- Kuboes; and
- Sandrift.

At each town the project consisted of two landfill site and two oxidation pond site alternatives. This report details the results of the investigation on sites proposed for Waste Sites for Lekkersing.

## 1.2 Terms of Reference

No formal Terms of Reference were provided, however, SRK proposed the following tasks to be completed:

1. Collect all hydrogeological data and information for the area – Department of Water Affairs (DWA) National Groundwater Archive (NGA), DWAF 1: 500 000 hydrogeological map, published geological maps, completed Environmental Impact Assessment (EIA) reports for surrounding developments (if any), Consultancy Reports, etc;
2. Collect all geotechnical information (depth of sand, clay, hard rock, etc.) if available, to enable a more comprehensive assessment of the local aquifer systems (primary sandy aquifer, secondary hard rock aquifer). Information includes thicknesses of different horizons, any *in situ* permeability tests, etc;
3. Collect and collate all GIS / CAD files and prepare maps for inclusion in the Draft hydrogeological report. These maps include the general geology, groundwater flow directions, groundwater quality, groundwater use, recharge, hydrogeological cross-sections and a conceptual aquifer model;
4. Identify and map all geological lineaments and potential groundwater-bearing formations and structures on aerial photographs and existing geological maps;
5. Conduct a site reconnaissance/hydrocensus of groundwater users on adjacent properties and developments to obtain / assess the local hydrogeological conditions; and
6. Prepare a hydrogeological specialist report which documents the following:
  - Findings of initial study;
  - Recommendations regarding further work (if any).

## 2 Climatic Balance

Toens and Partners conducted a hydrogeological study for new waste sites in the study area in 1996 (Toens, 1996). To calculate the Climatic Water Balance (CWB), Toens used data, i.e. rainfall and A-pan evaporation data, from a weather station in Alexander Bay. The CWB is determined by using the following formula (DWAF, 1996):

$$B = R - E$$

Where B = climatic water balance in mm of water

R = rainfall in mm

E = evaporation from soil surface (0,7 x A - Pan evaporation)

B is calculated for the wet season of the wettest year on record. B is then recalculated for successively drier years, because the wettest year on record may only be so on account of unseasonal rainfall.

The calculation is repeated to establish:

- If B is positive for less than one year. If this is the case no significant leachate generation is expected. The site is classified as B- and leachate management is usually unnecessary;
- If B is positive for more than one year in five. In this case, significant leachate can be expected. The site is classified as B+ and leachate management is a minimum requirement.

**Table 1: CWB obtained for the study area**

Wettest years on record	CWB
Wettest year 1900	$B = 135,2 - (0,7 \times 886) = - 485,0$
2nd Wettest year 1982	$B = 119,8 - (0,7 \times 921) = - 524,9$
3rd Wettest year 1963	$B = 116,2 - (0,7 \times 957) = - 553,7$
4th Wettest year 1985	$B = 111,8 - (0,7 \times 935) = - 542,7$
5th Wettest year 1976	$B = 100,9 - (0,7 \times 1004) = - 601,9$

The CWB for each catchment was calculated using average rainfall and S-pan evaporation data from the WR2005 datasets (Middleton *et al*, 2005). The results are discussed in the relevant sections on each town.



**Figure 2: Lekkersing site localities**

### 3.1.2 Geology

The geology underlying the Lekkersing sites consist mainly of quartzite, lava and tuff of the Vredefontein Formation with dolerite intrusions. A summary of the geology is presented in **Table 2** and in **Figure 5** with further discussions under the relevant site.

**Table 2: Summary of the geology around Lekkersing**

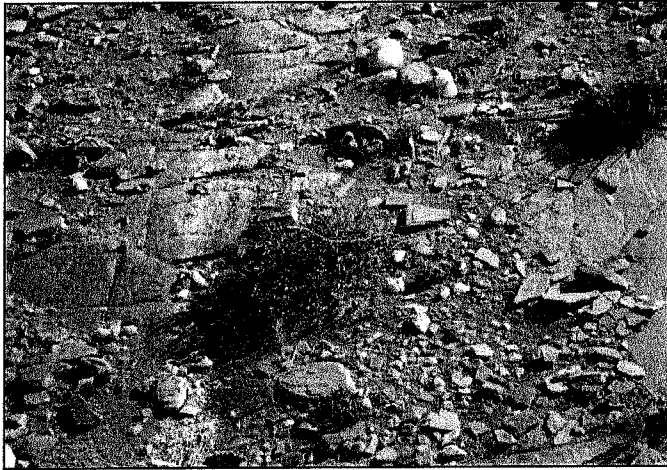
Super Group	Group	Subgroup	Formation/System	Description
			Quaternary	Red aeolian sand, pediment deposits
Gariep Supergroup	Port Nolloth	Stinkfontein	Vredefontein	Quartzite, lava and tuff
			Lekkersing	Orthoquartzite and flagstone
Gannakouriep Suite				Dolerite

### Waste Site Alternative 1

The site is mainly underlain by Quaternary-age sediments and flagstone of the Lekkersing Formation. An outcrop of the flagstone was found some 160 m to the northeast of the site (**Figure 6**). The flagstones are dipping steeply to the west at an angle of  $\sim 40^\circ$ . The flagstone outcrop is close to the site and it is expected that the sand thickness at the site is thin.

An outcrop of a dolerite dyke was also located  $\sim 150$  m to the north of the site (**Figure 7**). No outcrops were, however, found at the site and it is unknown if the dyke extends under the site. The dyke could be a conduit for contaminants to flow along. If this site is selected a geophysical survey is needed to establish if the dyke extends underneath the site.

**Figure 6: Orthoquartzites of the Lekkersing Formation**



**Figure 7: Dolerite Dyke at Waste Site Alternative 1**

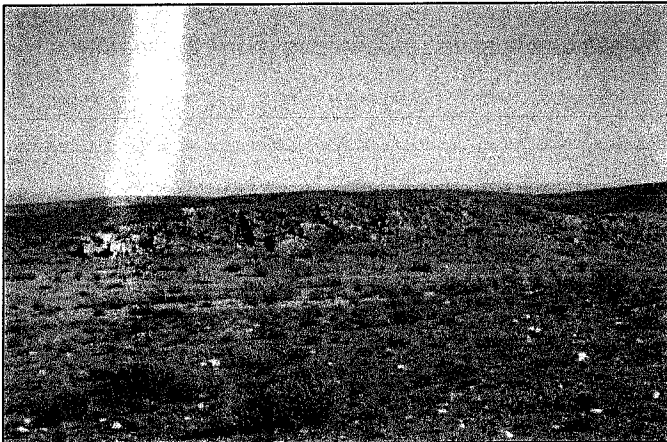
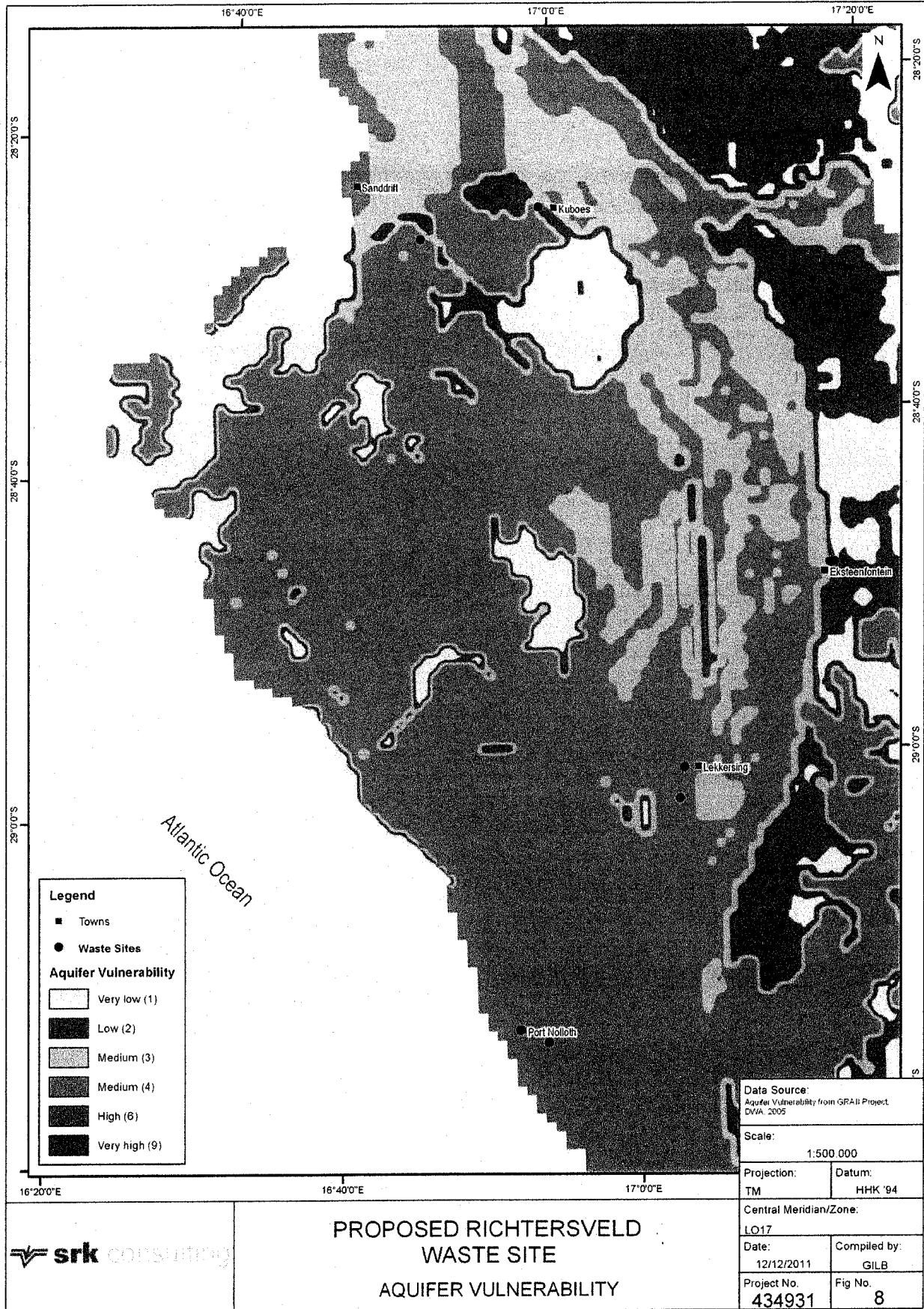


Figure 8: Aquifer vulnerability map



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Revision: A Date: 12 12 2011

## 4 Minimum Requirements for Waste Disposal

The section below provides a summary of important issues from the DWAF's Minimum requirements for the disposal of waste by landfill (DWAF, 1998).

The minimum requirements state that leachate management is needed for landfill sites that would generate significant volumes of leachate. Landfills that only generate leachate on a sporadic basis i.e. areas with a negative CWB, do not need a formal leachate management system.

### ***Sporadic Leachate Generation***

Sporadic leachate generation is typical of arid climates like that experienced in the Richtersveld. Leachate is only generated under exceptional conditions such as a succession of excessively wet periods during which poor site drainage would play a major role. Thus, site specific factors such as waste moisture content and ingress of runoff and groundwater into the waste body, must be taken into account.

The minimum requirements specify that for a site classified as B- for all 5 years no leachate management system is required if requirements are met for the siting, design and operation of the landfill and if dry waste is disposed of.

Any landfill where the co-disposal of liquids is permitted must be lined and equipped with leachate management systems that can contain, extract and treat the resultant leachate flow.

### **Elimination of Areas with Inherent Fatal Flaws**

It is a Minimum Requirement that no landfill site may be developed in an area with an inherent **Fatal Flaw**. The following situations may represent Fatal Flaws (not all related to groundwater):

- 3 000 m from the end of any airport runway or landing strip in the direct line of the flight path and within 500 m of an airport or airfield boundary. This is because landfills attract birds, creating the danger of aircraft striking birds;
- Areas below the 1 in 50 year flood line. This eliminates wetlands, vleis, pans and flood plains, where water pollution would result from waste disposal;
- Areas in close proximity to significant surface water bodies, e.g. water courses or dams;
- Unstable areas. These could include fault zones, seismic zones and dolomitic or karst areas where sinkholes and subsidence are likely.
- Sensitive ecological and/or historical areas. These include nature reserves and areas of ecological and cultural or historical significance.
- Catchment areas for important water resources. Although all sites ultimately fall within a catchment area, the size and sensitivity of the catchment may represent a Fatal Flaw, especially if it feeds a water resource.
- Areas characterised by flat gradients, shallow or emergent ground water, e.g. vleis, pans and springs, where a sufficient unsaturated zone separating the waste body and the ground water would not be possible.
- Areas characterised by steep gradients, where stability of slopes could be problematic.
- Areas of ground water recharges on account of topography and/or highly permeable soils.
- Areas overlying or adjacent to important or potentially important aquifers

**Table 3: Proposed assessment criteria for the evaluation of impacts**

Criteria	Category	Description
Extent or spatial influence of impact	Regional	Beyond 5 km of the proposed development
	Local	Within 5 km of the proposed development
	Site specific	On site or within 100 m of the site boundary
Magnitude of impact (at the indicated spatial scale)	High	Natural and/or social functions and/or processes are severely altered
	Medium	Natural and/or social functions and/or processes are notably altered
	Low	Natural and/or social functions and/or processes are slightly altered
	Very low	Natural and/or social functions and/or processes are negligibly altered
	Zero	Natural and/or social functions and/or processes remain unaltered
Duration of impact	Construction	Up to 2 years
	Short term	0–5 years (after construction)
	Medium term	5–15 years (after construction)
	Long term	More than 15 years (after construction)

The SIGNIFICANCE of an impact is derived by taking into account the assessed extent, magnitude and duration of each identified impact. The proposed means of arriving at the different significance ratings is explained in **Table 4**, below.

**Table 5: Definition of proposed probability ratings**

Probability Ratings	Criteria
Definite	Estimated greater than 95% chance of the impact occurring
Possible	Estimated 5 to 95% chance of the impact occurring
Unlikely	Estimated less than 5% chance of the impact occurring

**Table 6: Definition of proposed confidence ratings**

Confidence ratings	Criteria
Certain	Wealth of information on and sound understanding of the environmental factors potentially influencing the impact
Sure	Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact
Unsure	Limited useful information on and understanding of the environmental factors potentially influencing this impact

The impacts an activity could have on groundwater can broadly be grouped into the following:

- Impact on groundwater quality;
- Impact on yields of existing boreholes; and
- Impact on groundwater levels.

For each of the alternatives the following impacts will be assessed;

- Groundwater pollution during the construction phase
- Leachate development from waste; and
- Reduction in recharge.

**Table 7: Assessment of Lekkersing Waste Site Alternative 1**

	Source of impact	Nature of impact	Extent	Magnitude	Duration	Probability	Confidence	Significance
Construction	Clearance of land for construction and construction of landfill site	Contamination of groundwater due to spillage of fuel used in heavy machinery	Site Specific	Very low	Construction	Possible	Sure	Low
	Portable Toilets	Contamination of groundwater due to leachate from toilets	Site Specific	Very low	Construction	Possible	Sure	Low
Operation	Leachate development from waste	Impact on groundwater quality	Local	Very low	Long term	Unlikely	Sure	Low
	Reduction in recharge due to lining of landfill site	Impact on groundwater quantity	Site Specific	Zero	Long term	Definite	High	Very Low

**Table 8: Assessment of Lekkersing Waste Site Alternative 2**

	Source of impact	Nature of impact	Extent	Magnitude	Duration	Probability	Confidence	Significance
Construction	Clearance of land for construction and construction of landfill site	Contamination of groundwater due to spillage of fuel used in heavy machinery	Site Specific	Very low	Construction	Possible	Sure	Low
	Portable Toilets	Contamination of groundwater due to leachate from toilets	Site Specific	Very low	Construction	Probable	Sure	Low
Operation	Leachate development from waste	Impact on groundwater quality	Site Specific	Very low	Long term	Unlikely	Sure	Very Low
	Reduction in recharge due to lining of landfill site	Impact on groundwater quantity	Site Specific	Zero	Long term	Definite	High	Very Low



Both sites are situated in or next to dry drainage channels and their floodplains. It is outside the scope of this report, but 1:50 and 1:100 year flood lines for these channels would be important criteria in the placement of the footprint of the site.

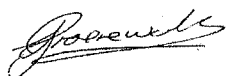
## 6 Conclusions and Recommendations

Based on the work done and discussion in this report the following conclusions and recommendations are made:

### Lekkersing

The Waste Site Alternative 2 is preferred due to Site 1 being located in a drainage channel.

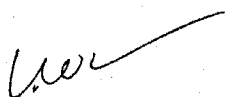
### Prepared by



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L Groenewald Pr Sci Nat  
Senior Hydrogeologist

### Reviewed by



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D Visser Pr Sci Nat & P Rosewarne Pr Sci Nat  
Principal Hydrogeologists

## SRK Report Distribution Record

Report No.

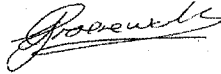
434931/3a-Final

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Name/Title	Company	Copy	Date	Authorised by
Winston Cloete	BVI Engineers	1	November 2011	LJ Groenewald
Project File	SRK Consulting Cpt	2	November 2011	LJ Groenewald
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Approval Signature:



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**Appendix E**

**Environmental Weekly Checklist**

ENVIRONMENTAL WEEKLY CHECKLIST:  
LEKKERSING WASTE SITE

Contractor:.....

ENVIRONMENTAL ASPECT	YES / NO	COMMENTS
Contractor's camp is neat and tidy.		
The construction sites are free of day-to-day litter.		
Sufficient and suitable refuse containers are on site.		
Waste removal system is being maintained.		
Sanitation provision and servicing are being maintained.		
Wastewater control system is being maintained.		
The concrete batching areas are well maintained.		
Cement effluent from washing (mixers, wheelbarrows, etc.) areas is well maintained.		
Demarcated working areas are being maintained.		
Markers (posts and danger tape) are being maintained.		
Stockpiles of plant material and topsoil are located within the boundary of the work area and do not exceed 1,5 m in height.		
No go areas and remaining natural features have not been damaged.		
All drivers (local & delivery) are informed of all procedures and restrictions (access roads, speed limits, demarcated areas, etc.).		
All construction and delivery vehicles are in good working order and no leakages are visible.		
Dust control measures (if necessary) are in place and are effectively controlling dust.		
Erosion control measures (if necessary) are in place and are effective in controlling erosion.		
Sufficient fire-fighting equipment is available on site and is in good working order.		
Have any wildlife species been found on the site? If so what measures were taken for relocation?		
Have any archaeological or palaeontological material been found? If so what measures were taken?		

Completed by:.....

Signature:.....

Date:.....

**Appendix F**

**Code of conduct for Contractors/ Workers**

## LEKKERSING WASTE SITE

### ENVIRONMENTAL CODE OF CONDUCT

Contractors shall ensure that all of its sub-contractors, employees, suppliers, agents, etc., are fully aware of the environmental issues detailed in the EMP.

The following list represents the basic Do's and Don'ts towards environmental awareness, which all participants in this project must consider whilst carrying out their tasks.

#### **DO:**

- Clear your work areas of litter and building rubbish at the end of each day – use the waste bins provided and ensure that litter will not blow away.
- Maintain waste removal system.
- Dispose of cigarettes and matches carefully (littering is an offence.)
- Use the toilet facilities provided and keep it clean.
- Report dirty or full toilet facilities.
- Prevent pollution of the environment.
- Report injured animals.
- Report heritage remains immediately.
- Ensure that vehicles and machinery do not leak fuel or oils.
- Report all fuel or oil spills immediately & stop the spill continuing.
- Confine work and storage of equipment to within the immediate work area.
- Prevent excessive dust and noise.
- Use safety equipment and comply with all safety procedures.
- Ensure a working fire extinguisher is immediately at hand if any "hot work" is undertaken e.g. welding, grinding, gas cutting etc.
- Drive on designated routes only.
- Respect existing services at all times.

#### **DO NOT:**

- Remove or damage vegetation without direct instruction.
- Injure, trap, feed or harm any animals – this includes birds, frogs, snakes, lizards etc.
- Remove any heritage remains.
- Make fires.
- Allow cement or cement bags to blow around.
- Litter or leave food lying around.
- Enter any fenced off or marked area.
- Overnight on site.
- Speed or drive recklessly.

## LEKKERSING AFVAL STORTINGS TERREIN

### OMGEWINGS GEDRAGSKODE

Die onderstaande lys verteenwoordig die Moets en Moenies vir omgewingsbewustheid wat alle deelnemers aan hierdie projek in ag moet neem tydens die uitvoer van hul take. Hierdie lys is nie volledig nie en dien slegs as 'n vinnige verwysing.

#### MOET:

- U werkplek skoonmaak van rommel en bourommel aan die einde van elke dag – gebruik beskikbare vullisdromme en verseker dat rommel nie rondwaai nie.
- Versigtig wees met die wegdoen van sigarette en vuurhoutjies. (rommelstrooi is 'n oortreding.).
- Beschikbare toilet geriewe gebruik en dit skoon hou.
- Vuil of vol toilet geriewe rapporteer.
- Besoedeling van omgewing voorkom.
- Beseerde diere rapporteer.
- Erfenis en fossiel oorblyfsels onmiddellik rapporteer.
- Verseker dat voertuie en masjiene nie olie of brandstof lek nie.
- Alle brandstof- en olie stortings onmiddellik rapporteer– stop verdere storting.
- Brandstof aanvulling en voertuigonderhoud binne die onderhoudsarea in die kontrakteurskamp doen.
- Werksaktiwiteite en die stoor van toerusting tot die onmiddellike werksarea beperk.
- Oormatige stof en geraas voorkom.
- Veiligheidstoerusting gebruik en aan alle veiligheids maatreëls voldoen.
- Verseker dat 'n brandblusser in werkende toestand byderhand is wanneer "warm" werk verrig word bv. sweis, wegslyp, gasny, ens.
- Slegs op aangewese roetes ry.
- Bestaande dienste ten alle tye repekter.

#### MOENIE:

- Plantegroei verwyder of beskadig sonder direkte instruksies nie.
- Enige diere doodmaak, beseer, vang of voer nie, insluitende voëls, paddas, slange, akkedisse, ens.
- Enige erfenis of fossiel oorblyfsels verwyder nie.
- Vure op ongemagtigde plekke maak nie.
- Sement of sementsakke laat rondwaai nie.
- Rommelstrooi of kos laat rondlê nie.
- Enige rommel, afval, olie of enige vreemde materiaal in die see laat beland nie.
- Enige omheinde of afgesperde areas betree nie.
- Op die terrein oornag nie.
- Vinnig of roekeloos bestuur nie.

**Appendix G**

**Declaration of Understanding**



## DECLARATION OF UNDERSTANDING

I, \_\_\_\_\_  
representing \_\_\_\_\_

declare that I have read and understood the contents of the Environmental Management Programme

**Contract:** Lekkersing Waste Site

I also declare that I understand my responsibilities in terms of enforcing and implementing the Environmental Specifications as set out in the various documents for the aforementioned Contract.

**I also undertake to inform all persons under my supervision of such specifications and contents of the documents.**

Signed: \_\_\_\_\_

Place: \_\_\_\_\_

Date: \_\_\_\_\_

Witness 1: \_\_\_\_\_

Witness 2: \_\_\_\_\_

## Appendix H

### **Standard Method Statement:**

(blank example; actual Method Statements to be inserted if / when required)

## LEKKERSING WASTE SITE

### INFORMATION ON METHOD STATEMENTS

Method Statements are to be completed by the person undertaking the work (i.e. the Contractor). The Method Statement will enable the potential negative environmental impacts associated with the proposed activity to be assessed.

The Method Statement can only be implemented once approved by the ECO.

The Contractor (and, where relevant, any sub-contractors) must also sign the Method Statement, there by indicating that the works will be carried out according to the methodology contained in the approved Method Statement.

The ECO will use the Method Statement to audit compliance by the Contractor with the requirements of the approved Method Statement.

Changes to the way the works are to be carried out must be reflected by amendments to the original approved Method Statement; amendments require the signature of the ECO, denoting that the changed methodology or works are necessary for the successful completion of the works, and are environmentally acceptable. The Contractor will also be required to sign the amended Method Statement thereby committing him/herself to the amended Method Statement.

This Method Statement **MUST** contain sufficient information and detail to enable the ECO to apply his mind to the potential impacts of the works on the environment. The Contractor will also need to thoroughly understand what is required of him/her in order to undertake the works.

**THE TIME TAKEN TO PROVIDE A THOROUGH, DETAILED METHOD STATEMENT IS TIME WELL SPENT. INSUFFICIENT DETAIL WILL RESULT IN DELAYS TO THE WORKS WHILE THE METHOD STATEMENT IS REWRITTEN TO THE ENGINEER'S AND ECO'S SATISFACTION.** The page overleaf provides a *pro forma* method statement sheet, which needs to be completed for each activity requiring a method statement in terms of the EMP.

**METHOD STATEMENT**

CONTRACT:.....DATE:.....

**PROPOSED ACTIVITY (give title of method statement and reference number):**

**WHAT WORK IS TO BE UNDERTAKEN (give a brief description of the works):**

**WHERE ARE THE WORKS TO BE UNDERTAKEN (where possible, provide an annotated plan and a full description of the extent of the works):**

**START AND END DATE OF THE WORKS FOR WHICH THE METHOD STATEMENT IS REQUIRED:**

Start Date:

End Date:

**HOW ARE THE WORKS TO BE UNDERTAKEN (provide as much detail as possible, including annotated maps and plans where possible):**

**Note: please attach extra pages if more space is required.**

## DECLARATIONS

### 1) ENVIRONMENTAL CONSULTANT AND/OR ECO

The work described in this Method Statement, if carried out according to the methodology described, is satisfactorily mitigated to prevent avoidable environmental harm.

\_\_\_\_\_  
(signed)

\_\_\_\_\_  
(print name)

\_\_\_\_\_  
(signed)

\_\_\_\_\_  
(print name)

Dated: \_\_\_\_\_

### 2) PERSON UNDERTAKING THE WORKS

I understand the contents of this Method Statement and the scope of the works required of me. I further understand that this Method Statement may be amended on application to other signatories and that the ECO will audit my compliance with the contents of this Method Statement.

\_\_\_\_\_  
(signed)

\_\_\_\_\_  
(print name)

Dated: \_\_\_\_\_

### 3) APPLICANT

The works described in this Method Statement are approved.

\_\_\_\_\_  
(signed)

\_\_\_\_\_  
(print name)

\_\_\_\_\_  
(designation)

Dated: \_\_\_\_\_

### 4) APPROVING AUTHORITY

The works described in this Method Statement are approved.

\_\_\_\_\_  
(signed)

\_\_\_\_\_  
(print name)

\_\_\_\_\_  
(designation)

Date: \_\_\_\_\_

**Appendix I**

**ECO Checklists & Photographs**

(to be inserted upon completion by ECO)

**Appendix J**

**Conditions of Waste Management Licence  
(To be inserted upon receipt)**

**Appendix K**

**Conditions of Environmental Authorisation  
(to be inserted upon receipt)**