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ENVIRONMENTAL AND OPERATIONAL MANAGEMENT PLAN

PROPOSED EXTENSION OF THE TUTUKA GENERAL WASTE DISPOSAL SITE FACILITY

APRIL 2010

Prepared For:

ESKOM GENERATION – TUTUKA POWER STATION

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1 INTRODUCTION

This Construction Environmental Management Plan (EMP) and Operational Management Plan (OMP) have been compiled based on the results of the Environmental Impact Assessment process undertaken for the proposed extension of the Tutuka General Waste Disposal Site (TGWDS). The EMP (CEMP and OMP) describe measures for proper environmental controls to be implemented during the construction, operation and closure of the waste disposal site. This document also contains guidelines against which environmental performance is to be measured. Upon approval of this document by the National Department of Environmental Affairs (DEA), Eskom as project owner (applicant), will be legally bound to ensure implementation of the CEMP and OEMP and maintenance of environmental performance. Eskom must also ensure that contractors involved in the implementation of the EMP, measure their environmental performance and demonstrate adherence to the guidelines.

This document must be read in conjunction with the suite of documents that make up the official contract between Eskom and the specific contractor.

There are a number of regulations and standards to which the EMP and OMP complies with as well as a number of principles and technical standards which have been used and cognizance taken of. These are as follows:

- National Environmental Management Act (NEMA) Act 107 of 1998;
- National Environmental Management: Waste Act (NEM: WA) Act 59 of 2008;
- The Public Health Bill 1999;
- Occupational Health and Safety Act (85 of 1993);
- Environment Conservation Act (Act 73 of 1989);
- The National Heritage Resources Act (No. 25 of 1999); and
- Principles and guidelines posed by the Minimum Requirements for Waste Disposal by Landfill & Monitoring at Waste Management Facilities distributed by the then Department of Water Affairs & Forestry South Africa (1998, 2005).

Important standards, which need to be taken account of, are those used for construction. The specifications to be used in the tender documents are to be based on the SABS standardised specification for civil engineering construction (SABS 1200 series).

2 THE ENVIRONMENTAL AND OPERATIONAL MANAGEMENT PLAN

In this section a plan is presented to implement the recommendations made in the assessment of likely environmental impacts as indicated in the Environmental Impact Report (EIR). This is to ensure that the environmental effects or consequences of the construction, operation, decommissioning and rehabilitation of the disposal site are adequately addressed to ensure minimisation of the negative impacts and enhancement of positive impacts. The purpose of this document, therefore, is to clearly state the scope and programme for mitigation measures to be implemented during the construction, operation and decommissioning phases of the project. The objectives of the EMP are therefore to:

- Summarise the negative and positive impacts that were identified;
- Identify the responsible person/party for implementing the recommendation; and
- Identify monitoring actions to ensure the recommendations are implemented.

A Responsible Person from Eskom will be appointed to ensure that the EMP is implemented according to the stipulations within this document. This document is considered to be a dynamic document, which is to be reviewed and continually updated based on actual site conditions. At this stage, it is recommended that the entire document be reviewed and/or revised after the first year of operation of the solid waste site.

Environmental impacts have been identified for all phases of the project (EIR) from planning and construction to decommissioning and hence the mitigation plan is broken down into three phases:

- Planning (design and pre-construction) and Construction phase
- Operational phase
- Decommissioning phase

2.1 Planning and Construction phase

To mitigate the permanent environmental impacts a number of measures would have to be addressed in the design of the waste disposal site during the planning phase. A professional engineer must carry out an inspection on the design before commencement of construction to ensure that the mitigation measures have been incorporated into the design. The project involves the construction and or upgrading of the following:

Site facilities including:

- Site office and ablution facilities;
- Fence; and
- Access and site roads.

Site preparation for the waste disposal site including:

- Shaping of existing waste body to flatten the slopes;
- Installation of the leachate collection and storm water drainage systems;
- Capping / lining the old waste body;
- Excavations and stockpiling the soil to be used later as cover material;
- Construction of the storm water and leachate collection ponds; and

Ancillary site works including:

- Lighting and power supply;
- Water supply; and
- Additional monitoring boreholes

To mitigate the adverse impacts during the construction phase of the project, mitigation measures must be implemented as shown in Table 1. These measures should be included in the relevant construction specifications as well as in the tender documentation (if done by outside contractors). Mitigation of the anticipated temporary impacts during construction can be achieved by the inclusion of suitable specification clauses and by ensuring that contractors comply with the specifications. The standard specification sections, which are included in SANS 1200, should be referred to and included in the tender document for the construction contractor.

The resident engineer and a responsible party from Eskom as well as the Environmental Control Officer (ECO) will monitor the activities of the construction team on site to ensure all mitigatory measures are implemented and to prevent any additional impacts from occurring.

2.2 Operational phase

Once construction is completed, the new waste disposal site is to be commissioned and operated according to sanitary waste disposal site principles as specified in the Operational Plan (Section 3).

As the impact of the waste disposal site on the environment is dependent on the standard of operation, the monitoring of environmental issues during the operational phase will take the form of operational and environmental monitoring. The mitigation measures and actions to be audited and monitored during the operation of the waste site are listed in Table 1. A number of critical monitoring objectives and targets, which need to be monitored quarterly throughout the operational life as well as after closure of the site, have been illustrated in Table 2.

2.3 Decommissioning phase

This entails the rehabilitation and closure of the waste disposal site and proposed end-use. During the construction and rehabilitation of the site in preparation for closure a Project Compliance Audit should be undertaken, which should focus on stability issues, erosion, vegetation, water and monitoring. Because this phase will only be undertaken well over 40 years time, monitoring and audit protocols should be set up then as issues such as change in legislation, waste types, etc. might have changed and could possibly effect how decommissioning is managed. However, mitigation and management issues that would need to be addressed and audited have been listed in Table 1 below.. It should be noted that monitoring should take place on a monthly basis during construction and quarterly during the operational phase.

Table 1: Impacts, Management and Monitoring Actions

IMPACTS/ ISSUES REQUIRING MITIGATION &/OR OPTIMISATION	MANAGEMENT ACTION/ MITIGATION ACTION	RESPONSIBILITY	MONITORING AND RESPONSIBLE PARTY FOR MONITORING
SOCIO-EM/ECONOMIC FACTORS			
ATTITUDES	<u>TARGET:</u> <ul style="list-style-type: none"> Waste disposal site and processes comply with authority requirements and relevant regulations. Concerns and issues regarding the waste disposal site are sufficiently addressed and resolved. 		
	<u>STANDARDS/ GUIDELINES/LEGISLATION:</u> <ul style="list-style-type: none"> Waste Disposal Site Licence conditions Environmental Authorisation (EA) conditions SA “Minimum Requirements for Waste Disposal by Landfill Volume II” NEMWA and NEMA 		
	<u>PLANNING AND CONSTRUCTION:</u> <ul style="list-style-type: none"> All authority requirements and relevant regulations must be met as per the EIA, design and construction phases. Take into account I&AP concerns in planning, design and construction phases. 	ESKOM EM/ECO	<u>PLANNING AND CONSTRUCTION:</u> <ul style="list-style-type: none"> EM/ECO to monitor addressing and resolving public concerns raised.
	<u>OPERATION:</u> <ul style="list-style-type: none"> Operate the waste disposal according to the operational plan 	ESKOM Environmental Manager (EM) Auditors	<u>OPERATION:</u> <ul style="list-style-type: none"> EM to inspect waste disposal operation on a regular basis. ESKOM to appoint independent waste disposal auditors to audit the site as prescribed in the waste license. Monthly site supervision checks have to be undertaken by Eskom.
	<u>CLOSURE AND REHABILITATION:</u> <ul style="list-style-type: none"> The waste disposal site closure is to be properly planned, with the waste stream diverted elsewhere effectively on closure. 	ESKOM EM/ECO Auditor	<u>CLOSURE AND REHABILITATION:</u> <ul style="list-style-type: none"> EM/ECO to monitor closure plan and rehabilitation process. Independent waste disposal auditor: Audit the waste disposal closure.

IMPACTS/ ISSUES REQUIRING MITIGATION &/OR OPTIMISATION	MANAGEMENT ACTION/ MITIGATION ACTION	RESPONSIBILITY	MONITORING AND RESPONSIBLE PARTY FOR MONITORING
	<u>END-USE:</u> <ul style="list-style-type: none"> Waste disposal site must be properly monitored and maintained to prevent pollution, and to allow the waste disposal to be used for the intended end-use. 	ESKOM EM/ECO	<u>END-USE:</u> <ul style="list-style-type: none"> EM/ECO to monitor waste disposal condition following closure. Post closure audits to be undertaken as per the permit requirements
ACCESS CONTROL	<u>TARGET:</u> <ul style="list-style-type: none"> Access onto site is controlled during all waste disposal phases. Prevention of unauthorised entry on site To prevent the disposal of unauthorised waste on the site A rEM/ECOrd of all waste types entering the site is maintained REM/ECOrds are kept of all wastes removed from the site for disposal elsewhere or recycling. To prevent informal salvaging on site 		
	<u>STANDARDS/ GUIDELINES/LEGISLATION:</u> <ul style="list-style-type: none"> Waste Disposal Site Licence conditions EA conditions SA “Minimum Requirements for Waste Disposal by landfill Volume II” 		
	<u>PLANNING AND CONSTRUCTION:</u> <ul style="list-style-type: none"> Site boundary fence to be erected, upgraded and maintained Day time security must be employed to ensure that unauthorised persons do not enter the site. 	ESKOM	<u>PLANNING AND CONSTRUCTION:</u> <ul style="list-style-type: none"> ESKOM / construction contractor
	<u>OPERATION:</u> <ul style="list-style-type: none"> Access to the waste disposal site is to be strictly controlled. Site security may be required. All access to the site to be controlled through the security checkpoint. No hazardous or medical waste to be accepted for disposal. Gate controllers to be trained in identifying unauthorised wastes Types and quantities of all incoming wastes to be rEM/ECOrded Signs stating “Unauthorised entry” to be erected at the site as well as the type of waste accepted by the site and charges if any. 	ESKOM Auditor	<u>OPERATION:</u> <ul style="list-style-type: none"> ESKOM / Waste disposal Operator to ensure that controls are in place. Independent auditor

IMPACTS/ ISSUES REQUIRING MITIGATION &/OR OPTIMISATION	MANAGEMENT ACTION/ MITIGATION ACTION	RESPONSIBILITY	MONITORING AND RESPONSIBLE PARTY FOR MONITORING
	<u>CLOSURE AND REHABILITATION:</u> <ul style="list-style-type: none"> Security must be employed to ensure that unauthorised persons do not enter the site. Boundary fences to be maintained. 	Construction team Auditor	<u>CLOSURE AND REHABILITATION:</u> <ul style="list-style-type: none"> ESKOM ensure security and maintenance issues followed up Independent auditor
	<u>END-USE:</u> <ul style="list-style-type: none"> Unauthorised entry to be prevented. The single access point to be locked “No entry” signs must be erected. 	ESKOM	<u>END-USE:</u> <ul style="list-style-type: none"> ESKOM to ensure that access controls are in place
IMPACTS ON HEALTH AND SAFETY	<u>TARGET:</u> <ul style="list-style-type: none"> The waste disposal site and associated traffic do not impact upon the health and safety of those off site. The health and safety of those on site is not compromised, in accordance with current OHSA legislation. Any site fires arising on site are extinguished quickly, without fires spreading to adjacent properties. 		
	<u>STANDARDS/ GUIDELINES/LEGISLATION:</u> <ul style="list-style-type: none"> Waste Disposal Site Licence conditions EA conditions SA “Minimum Requirements for Waste Disposal by landfill Volume II” The Public Health Bill 1999 Occupational Health and Safety legislation 		
	<u>PLANNING AND CONSTRUCTION:</u> <ul style="list-style-type: none"> The construction team must draw up safety reporting structures and procedures specifically for the site prior to construction commencing. Construction contractor to draw up emergency plans which allocate specific responsibilities to respond appropriately to any foreseeable emergency situation such as fire, explosion, accident, fuel/oil spillage. The construction team must appoint or allocate a safety officer for the site in accordance with the relevant legislation. Construction staff must be given safety training, and must be aware of safety reporting structures and procedures, prior to construction commencing. These must be documented and 	ESKOM & EM	<u>PLANNING AND CONSTRUCTION:</u> <ul style="list-style-type: none"> EM/ECO to ensure that health and safety standards are met. ESKOM is responsible for monitoring the performance of their appointed contractors to this EMP. The contractor will be responsible for his team of people and any of their actions.

IMPACTS/ ISSUES REQUIRING MITIGATION &/OR OPTIMISATION	MANAGEMENT ACTION/ MITIGATION ACTION	RESPONSIBILITY	MONITORING AND RESPONSIBLE PARTY FOR MONITORING
	<p>filed</p> <ul style="list-style-type: none"> All construction activities should be detailed including, methods to be used, associated health and safety risks, and planned mitigation measures, must be drawn up by the construction team and be submitted and approved by the Resident Engineer before construction commences. “No entry” signs to be attached on all fences. Deep excavations must be fenced off where these occur. Site clearance must not be carried out by fire. The area cleared to be limited to the construction of the particular phase Health and safety aspects must be regularly checked and reported on by the Resident Engineer during construction. Construction workers are to be limited to the site area. Construction workers not to remove any indigenous vegetation for fire wood. PPE to be worn on site at all times. 		
	<p><u>CLOSURE AND REHABILITATION:</u></p> <ul style="list-style-type: none"> Contaminated water drainage structures must be safely dEM/ECOMmissioned if no longer required for other drainage. The construction team must appoint or allocate a safety officer specifically for the site in accordance with the relevant health and safety legislation. Construction team staff must be given safety training, and must be aware of safety reporting structures and procedures. A risk assessment, detailing closure and rehabilitation activities, methods to be used, associated health and safety risks, and planned mitigation measures, must be drawn up by the construction team and be submitted and approved by the ESKOM before construction commences. Health and safety aspects must be regularly checked by the Resident Engineer during construction. Gas must be suitably vented from the waste body through the design and construction of suitable gas vents, and must not be allowed to accumulate to dangerous levels. 	<p>ESKOM</p>	<p><u>CLOSURE AND REHABILITATION:</u></p> <ul style="list-style-type: none"> ESKOM to ensure that health and safety standards are met Independent auditor

IMPACTS/ ISSUES REQUIRING MITIGATION &/OR OPTIMISATION	MANAGEMENT ACTION/ MITIGATION ACTION	RESPONSIBILITY	MONITORING AND RESPONSIBLE PARTY FOR MONITORING
	<u>END-USE:</u> <ul style="list-style-type: none"> Settlement and erosion must be monitored and repaired where required on the final landform, so that the health and safety of those participating in any end-use is not compromised. If waste disposal gas does arise in large quantities on the site (which is not expected), such gas must be suitably vented from the waste body through suitable gas vents, and must not be allowed to accumulate to dangerous levels. 	ESKOM	<u>END-USE:</u> <ul style="list-style-type: none"> ESKOM to ensure that health and safety standards are met.
BIOLOGICAL FACTORS			
IMPACTS ON FLORA AND FAUNA	<u>TARGET:</u> <ul style="list-style-type: none"> Natural fauna and flora are not significantly impacted upon. Flora and fauna regimes on site are improved from their current state by waste disposal closure and rehabilitation. 		
	<u>STANDARDS/ GUIDELINES/LEGISLATION:</u> <ul style="list-style-type: none"> NEM: Biodiversity Act Waste Disposal Site Licence conditions EA conditions SA “Minimum Requirements for Waste Disposal by landfill Volume II” 		
	<u>PLANNING AND CONSTRUCTION:</u> <ul style="list-style-type: none"> Specify indigenous plant lists and landscaping plans for screening and ongoing rehabilitation. Identify any potential sensitive species and relocate them prior to the start of construction work (Search and Rescue) Disturb flora and fauna as little as possible during construction, particularly by clearing the minimum required for construction (at the bottom near the wetland in particular) Establish indigenous flora as vegetating screening berms, as part of the construction phase. Provision for overflows and capacity of the leachate pond addressed in design and construction Areas for vegetation and topsoil removal to be clearly specified and demarcated before commencement of operations Areas for topsoil stockpiles to be clearly demarcated and kept to a minimum 	ESKOM	<u>PLANNING AND CONSTRUCTION:</u> <ul style="list-style-type: none"> ESKOM and EM/ECO to ensure that plant species chosen and landscaping plans are acceptable. Site Engineer to monitor construction activities closely.

IMPACTS/ ISSUES REQUIRING MITIGATION &/OR OPTIMISATION	MANAGEMENT ACTION/ MITIGATION ACTION	RESPONSIBILITY	MONITORING AND RESPONSIBLE PARTY FOR MONITORING
	<u>OPERATION:</u> <ul style="list-style-type: none"> Disturb surrounding flora and fauna as little as possible during operation and extension of phases. Plant indigenous flora as specified as part of screening and ongoing rehabilitation. Good housekeeping procedures to be in place Flora established is to be maintained and kept in such a way to minimise the spread of fires. Establishment and maintenance of flora to be audited regularly. Put in place measures (check pumps, liquid volumes) to prevent spills or overflow from the leachate/contamination pond. 	ESKOM and EM/ECO	<u>OPERATION:</u> <ul style="list-style-type: none"> ESKOM to ensure that landscaping plans are adhered to. ESKOM to appoint independent auditors.
	<u>CLOSURE AND REHABILITATION:</u> <ul style="list-style-type: none"> Suitable final landscaping plans must be drawn up and confirmed prior to closure, if required. Flora chosen for vegetating final landform must have shallow root system, so that final capping layers are not damaged or penetrated, and must be suitable for the end-use chosen. Indigenous grass to be established as part of waste disposal rehabilitation. 	ESKOM	<u>CLOSURE AND REHABILITATION:</u> <ul style="list-style-type: none"> ESKOM and EM/ECO to ensure that landscaping is acceptable.
	<u>END-USE:</u> <ul style="list-style-type: none"> Flora establishment to be monitored and maintained. 	ESKOM	<u>END-USE:</u> <ul style="list-style-type: none"> ESKOM and EM/ECO to ensure that landscaping is acceptable.
ENVIRONMENTAL FACTORS			
DUST, ODOUR, GAS AND SMOKE	<u>TARGETS:</u> <ul style="list-style-type: none"> There are no odour impacts from the waste body off site. There are limited odour impacts from the open waste body at working face. There is limited dust on the waste disposal site in extreme conditions. There is no smouldering or burning of waste on site 		
	<u>STANDARDS/ GUIDELINES/LEGISLATION:</u> <ul style="list-style-type: none"> Waste Disposal Site Licence conditions EA conditions SA “Minimum Requirements for Waste Disposal by landfill Volume II” 		

IMPACTS/ ISSUES REQUIRING MITIGATION &/OR OPTIMISATION	MANAGEMENT ACTION/ MITIGATION ACTION	RESPONSIBILITY	MONITORING AND RESPONSIBLE PARTY FOR MONITORING
	<p><u>PLANNING AND CONSTRUCTION:</u></p> <ul style="list-style-type: none"> Dust from construction must be minimised by dust control, and planning of operations. Topsoil stockpiles and completed earthworks to be vegetated as soon as possible after completion Construction workers adhere to that rules of conduct, with regard to the making of fires. If excessive dust is generated by construction traffic utilise water carts to suppress the dust. 	<p>ESKOM & EM/ECO</p>	<p><u>PLANNING AND CONSTRUCTION:</u></p> <ul style="list-style-type: none"> EM/ECO must monitor dust and other environmental issues of concern during construction.
	<p><u>OPERATION:</u></p> <ul style="list-style-type: none"> The waste disposal site must be operated to high standards, to minimise impacts from dust and odour. The operation must therefore include daily compaction and covering, dust control such as wetting (if required), litter collection and screening of the operation. Access road to the site must be maintained to ensure that dust generation is kept to a minimum. The making of fires and burning of waste is prohibited on site, during the entire operational period of the site. Dust & odour must be monitored as part of the auditing process. If any problems arise notify the station manager and identify actions to resolve the matter 	<p>ESKOM & EM</p>	<p><u>OPERATION:</u></p> <ul style="list-style-type: none"> EM/ECO to monitor standard of operation and compliance with waste disposal licence conditions. Regular auditing of standard of operation is to be commissioned by ESKOM.
	<p><u>CLOSURE AND REHABILITATION:</u></p> <ul style="list-style-type: none"> Dust from closure and rehabilitation must be minimised by dust control and planning of operations. If waste disposal gas does arise in large quantities on the site (which is not expected), such gas must be suitably vented from the waste body through the design and construction of gas vents, and must not be allowed to accumulate to dangerous levels. Because of the safety aspect, the lighting of fires will not be allowed on site. 	<p>ESKOM & EM</p>	<p><u>CLOSURE AND REHABILITATION:</u></p> <ul style="list-style-type: none"> EM/ECO must monitor dust and other nuisance issues from closure and rehabilitation. EM/ECO must ensure that waste disposal gas is considered prior to closure.

IMPACTS/ ISSUES REQUIRING MITIGATION &/OR OPTIMISATION	MANAGEMENT ACTION/ MITIGATION ACTION	RESPONSIBILITY	MONITORING AND RESPONSIBLE PARTY FOR MONITORING
	<u>END-USE:</u> <ul style="list-style-type: none"> Monitoring and maintenance of final landform integrity and vegetation must be undertaken to limit dust and odours. If waste disposal gas does arise in large quantities on the site, (which is not expected), such gas must be suitably vented from the waste body through gas vents, and must not be allowed to accumulate to dangerous levels. Gas vents must be maintained. Warning signs of possible danger due to gas generation must be indicated on the waste disposal. 	ESKOM & EM	<u>END-USE:</u> <ul style="list-style-type: none"> ESKOM and EM/ECO must ensure that maintenance is undertaken as and when required.
NOISE AND VERMIN	<u>TARGETS:</u> <ul style="list-style-type: none"> To minimise the impact of construction and operation noise on workers and the nearby community No vermin found on site. 		
	<u>STANDARDS/ GUIDELINES/LEGISLATION:</u> <ul style="list-style-type: none"> Waste Disposal Site Licence conditions EA conditions SA “Minimum Requirements for Waste Disposal by landfill Volume II” 		
	<u>PLANNING AND CONSTRUCTION:</u> <ul style="list-style-type: none"> Contractor's equipment to be silenced within limits Construction operations to be restricted to normal working hours (No Sunday or night working). Operators and workers close to noisy equipment to be provided with ear muffs or plugs. Uncovered waste on site is not allowed to accumulate, attracting vermin 	ESKOM& EM/ECO	<u>PLANNING AND CONSTRUCTION:</u> <ul style="list-style-type: none"> EM/ECO must monitor noise and vermin from construction.
	<u>OPERATION:</u> <ul style="list-style-type: none"> Waste disposal must be operated to high standards, to minimise the attraction of vermin. The operation must therefore include daily compaction and covering, and litter collection 	ESKOM& EM/ECO	<u>OPERATION:</u> <ul style="list-style-type: none"> EM/ECO to monitor standard of operation and compliance with waste disposal licence conditions. Regular auditing of standard of operation is to be commissioned by ESKOM.

IMPACTS/ ISSUES REQUIRING MITIGATION &/OR OPTIMISATION	MANAGEMENT ACTION/ MITIGATION ACTION	RESPONSIBILITY	MONITORING AND RESPONSIBLE PARTY FOR MONITORING
	<p><u>CLOSURE AND REHABILITATION:</u></p> <ul style="list-style-type: none"> Contractor's equipment to be silenced within limits Construction operations to be restricted to normal working hours (No Sunday or night working). That on site uncovered waste is not allowed to accumulate, attracting vermin 	<p>ESKOM</p>	<p><u>CLOSURE AND REHABILITATION:</u></p> <ul style="list-style-type: none"> ESKOM to ensure that noise restrictions are upheld and that vermin numbers are monitored.
<p>IMPACTS ON AESTHETICS (VISUAL)</p>	<p><u>TARGET:</u></p> <ul style="list-style-type: none"> To reduce the visual and environmental impact of the contractor's temporary facilities and construction works The waste disposal does not significantly compromise the aesthetics of the area. 		
	<p><u>STANDARDS/ GUIDELINES/LEGISLATION:</u></p> <ul style="list-style-type: none"> Waste Disposal Site Licence conditions EA conditions SA "Minimum Requirements for Waste Disposal by landfill Volume II" 		
	<p><u>PLANNING AND CONSTRUCTION:</u></p> <ul style="list-style-type: none"> The waste disposal development plan is to be developed so that waste disposal operation is screened from view at all times. Specify and establish indigenous flora by landscaping entrance facilities, vegetating screening berms, planting of trees as part of the construction phase. 	<p>ESKOM& EM/ECO?</p>	<p><u>PLANNING AND CONSTRUCTION:</u></p> <ul style="list-style-type: none"> EM/ECO to ensure that plant species chosen and landscaping plans are acceptable. EM/ECO to ensure that landscaping proposed is established and mitigation measures are enforced.

IMPACTS/ ISSUES REQUIRING MITIGATION &/OR OPTIMISATION	MANAGEMENT ACTION/ MITIGATION ACTION	RESPONSIBILITY	MONITORING AND RESPONSIBLE PARTY FOR MONITORING
	<p><u>OPERATION:</u></p> <ul style="list-style-type: none"> • Operation is to be screened from view by working behind screening berms (a “rising green wall”), vegetating the site and exercising strict control on the working area and illegal dumping. • The waste disposal is operated according to sanitary waste disposal practice, such as daily compaction and cover, to limit windblown litter. • Windblown litter collection is to be undertaken daily or as required depending on wind behaviour. • Indigenous flora (trees and shrubs) is to be planted as specified as part of screening and ongoing rehabilitation, and maintained • Entrance facility and on site buildings are to be maintained. • The aesthetic impacts of waste disposal are to be audited regularly. 	<p>ESKOM & EM</p>	<p><u>OPERATION:</u></p> <ul style="list-style-type: none"> • ESKOM to ensure that landscaping plans are adhered to. • ESKOM and EM/ECO to inspect waste disposal operation to determine standards. • ESKOM to appoint independent auditors.
	<p><u>CLOSURE AND REHABILITATION:</u></p> <ul style="list-style-type: none"> • Waste disposal site rehabilitation is to take place progressively as each phase is completed, so that the waste disposal has minimal visual impact, and as little nuisance as possible is caused by final rehabilitation. • Suitable final landscaping plans in line with the desired end-use must be drawn up and confirmed prior to closure, if required. • Indigenous flora specified is to be established as part of waste disposal rehabilitation. • Waste disposal infrastructure that will fall into disuse, such as the office buildings, must be dEM/ECOmissioned. 	<p>ESKOM& EM</p>	<p><u>CLOSURE AND REHABILITATION:</u></p> <ul style="list-style-type: none"> • ESKOM and EM/ECO to ensure that aesthetics of waste disposal rehabilitation is acceptable.
	<p><u>END-USE:</u></p> <ul style="list-style-type: none"> • Flora establishment to be monitored and maintained. • Any remaining site infrastructure must be maintained in an acceptable state. 	<p>ESKOM</p>	<p><u>END-USE:</u></p> <ul style="list-style-type: none"> • ESKOM and EM/ECO to ensure that aesthetics of the final landform are acceptable.

IMPACTS/ ISSUES REQUIRING MITIGATION &/OR OPTIMISATION	MANAGEMENT ACTION/ MITIGATION ACTION	RESPONSIBILITY	MONITORING AND RESPONSIBLE PARTY FOR MONITORING
<p>GROUND AND SURFACE WATER, DRAINAGE AND WATER BALANCE</p>	<p><u>TARGETS:</u></p> <ul style="list-style-type: none"> • Groundwater and surface runoff are not contaminated by construction or the waste facility. • Contaminated surface water arising on site is evaporated or drained to the contaminated water dam. • The water balance on site is monitored to ensure that no leachate is generated. • That leachate is contained so that surface and groundwater are not polluted. • That downstream water users are not impacted upon by the waste disposal. • Onsite ablution facilities must be in working order and should be used by all workers 		
	<p><u>STANDARDS/ GUIDELINES/LEGISLATION:</u></p> <ul style="list-style-type: none"> • Waste Disposal Site Licence conditions • EA conditions • SA “Minimum Requirements for Waste Disposal by landfill Volume II” 		
	<p><u>PLANNING AND CONSTRUCTION:</u></p> <ul style="list-style-type: none"> • Maintenance of construction vehicles is not to be allowed on site, and conditions in this regard should be written into all tender documents. • No refuelling to take place on-site. • Background monitoring of ground water at new and existing boreholes must be undertaken. 	<p>ESKOM</p>	<p><u>PLANNING AND CONSTRUCTION:</u></p> <ul style="list-style-type: none"> • EM/ECO to ensure that drainage is designed in accordance with drainage principles as set out in the South African Minimum Requirements and according to the approved licence. • EM/ECO to ensure mitigation measures area in place, to monitor for pollution during construction and take necessary steps to prevent a reoccurrence, and ensure that pollution occurrences are rehabilitated if required.
	<p><u>OPERATION:</u></p> <ul style="list-style-type: none"> • Upslope runoff must be diverted around the site, to prevent contamination of such water from occurring. • Contaminated water is to be collected in well-maintained drains, and drained into the contaminated water pond, from where such water is to evaporate or be pumped or tankered to the sewer, to prevent contaminated water from entering the environment. 	<p>ESKOM & EM</p>	<p><u>OPERATION:</u></p> <ul style="list-style-type: none"> • ESKOM to ensure that waste disposal is operated according to sanitary waste disposal practice. • Pond levels to be checked daily, rEM/ECOrded and reported by ESKOM to ensure that water is pumped to sewer when required and that the contaminated water pond/leachate pond does not overflow.

IMPACTS/ ISSUES REQUIRING MITIGATION &/OR OPTIMISATION	MANAGEMENT ACTION/ MITIGATION ACTION	RESPONSIBILITY	MONITORING AND RESPONSIBLE PARTY FOR MONITORING
	<ul style="list-style-type: none"> • Drainage systems are to be checked prior to the rainy season and following large rainfall events and must be regularly maintained. • Drainage systems must be considered holistically prior to each waste disposal extension, and constructed in accordance with the principles as given in the waste disposal site licence. • Any work undertaken in the vicinity of the contaminated water pond must be planned and supervised, so that the pond is not damaged. • The waste disposal must be operated according to sanitary waste disposal principles, with daily compaction and covering occurring, so that infiltration into the waste is limited. • The waste disposal site is to be operated such that water drains away from the waste, and does not pond against it. • Ongoing rehabilitation is to be undertaken as phases of the waste disposal site are completed, so that the quantities of contaminated runoff are limited at any one time. • Ground and surface water monitoring must be undertaken and results interpreted as part of the larger Tutuka water monitoring program. 		<ul style="list-style-type: none"> • EM/ECO to inspect the waste disposal operation regularly. • EM/ECO to ensure that the licence conditions are complied with. • ESKOM is to appoint independent auditors to monitor the waste disposal operation.
	<p><u>CLOSURE AND REHABILITATION:</u></p> <ul style="list-style-type: none"> • Construction is to be planned so that limited erosion occurs. • Pollution from the maintenance of construction vehicles, such as oil spills, is not to be allowed on site, and conditions in this regard should be written into any tender documents. • Efficient drainage of the site following rehabilitation must be considered and existing drainage systems adapted for this. • Capping is to be designed and constructed to limit infiltration of water into the waste. 	<p>ESKOM</p>	<p><u>CLOSURE AND REHABILITATION:</u></p> <ul style="list-style-type: none"> • Resident Engineer is to ensure mitigation measures are implemented, to monitor for pollution during rehabilitation and take necessary steps to prevent a reoccurrence, and ensure that pollution occurrences are rehabilitated. • EM/ECO to approve rehabilitation.
	<p><u>END-USE:</u></p> <ul style="list-style-type: none"> • Drainage systems are to be monitored and maintained on a regular basis. • Integrity of the capping is to be monitored. 	<p>ESKOM</p>	<p><u>END-USE:</u></p> <ul style="list-style-type: none"> • ESKOM is to ensure that the drainage systems are operative following closure. • EM/ECO to inspect the waste disposal.

IMPACTS/ ISSUES REQUIRING MITIGATION &/OR OPTIMISATION	MANAGEMENT ACTION/ MITIGATION ACTION	RESPONSIBILITY	MONITORING AND RESPONSIBLE PARTY FOR MONITORING
SOILS	<u>TARGET:</u> <ul style="list-style-type: none"> To limit use and degradation of soil resources on and off site. 		
	<u>STANDARDS/ GUIDELINES/LEGISLATION:</u> <ul style="list-style-type: none"> Waste Disposal Site Licence conditions EA conditions SA “Minimum Requirements for Waste Disposal by landfill Volume II” 		
	<u>PLANNING AND CONSTRUCTION:</u> <ul style="list-style-type: none"> Once the material for lining has been confirmed in the detailed design phase, a detailed material balance must be calculated for the site, indicating quantities and areas for lining material, final cover, for the use of the construction team and the waste disposal operator (Eskom). Soils must be conserved in the construction process, by controlling borrow sources and depths of excavation closely. Topsoil coming onto site should be stockpiled separately for future use when constructing the waste disposal, to avoid additional excavation of virgin areas, and associated costs. 	ESKOM& EM/ECO?	<u>PLANNING AND CONSTRUCTION:</u> <ul style="list-style-type: none"> The EM/ECO must monitor the use of soils closely.
	<u>OPERATION:</u> <ul style="list-style-type: none"> Cover use must be optimised, so that sufficient cover is used to contain the waste body, but cover material is not wasted, to avoid additional excavation of virgin areas & associated costs. Topsoil coming onto site should be stockpiled separately for future use when constructing the waste disposal, to avoid additional excavation of virgin areas, and associated costs. Stockpiles must be audited Topsoil stockpiles for final cover should not be disturbed or used for any other purpose. 	ESKOM& EM	<u>OPERATION:</u> <ul style="list-style-type: none"> ESKOM and the EM/ECO to inspect waste disposal operation. ESKOM to appoint independent auditors.
	<u>CLOSURE AND REHABILITATION:</u> <ul style="list-style-type: none"> Soils must be conserved in the construction process, by controlling borrow sources and depths of excavation closely. 	ESKOM& EM	<u>CLOSURE AND REHABILITATION:</u> <ul style="list-style-type: none"> The Resident Engineer must monitor the use of soils closely.
STABILITY, DRAINAGE & EROSION	<u>TARGET:</u> <ul style="list-style-type: none"> No instability problems occur on the site. Minimal erosion occurs on site. 		

IMPACTS/ ISSUES REQUIRING MITIGATION &/OR OPTIMISATION	MANAGEMENT ACTION/ MITIGATION ACTION	RESPONSIBILITY	MONITORING AND RESPONSIBLE PARTY FOR MONITORING
	<u>STANDARDS/ GUIDELINES/LEGISLATION:</u> <ul style="list-style-type: none"> Waste Disposal Site Licence conditions EA conditions SA “Minimum Requirements for Waste Disposal by landfill Volume II” 		
	<u>PLANNING AND CONSTRUCTION:</u> <ul style="list-style-type: none"> Take into account in the design the need to prevent erosion, protect underlying soils, and for efficient drainage. Provide for temporary drainage Site needs to be inspected after heavy rains to remedy areas of soil erosion. 	ESKOM& EM/ECO?	<u>PLANNING AND CONSTRUCTION:</u> <ul style="list-style-type: none"> Design and any tender documents and construction to be checked and approved? by EM/ECO
	<u>OPERATION:</u> <ul style="list-style-type: none"> Ensure that drainage is continually considered and adapted during the operation, to ensure efficient drainage of surface water away from the waste and off site, and to minimise erosion. Ensure that contaminated water pond does not overflow. Pond levels to be checked regularly Maintain all drainage and plumbing on site in good working order. Audit operation quarterly to ensure required actions are carried out. 	ESKOM& EM	<u>OPERATION:</u> <ul style="list-style-type: none"> Quarterly site audits to be commissioned by ESKOM Site inspections to be carried out by the EM/ECO
	<u>CLOSURE AND REHABILITATION:</u> <ul style="list-style-type: none"> Minimum gradients of 1 in 3 to be achieved by final landform, to ensure efficient drainage following settlement. Drainage systems are to be left in good condition, with all clean runoff draining off site in a controlled manner. Erosion of final landform to be considered. 	ESKOM& EM	<u>CLOSURE AND REHABILITATION:</u> <ul style="list-style-type: none"> EM/ECO to approve design, closure and rehabilitation. EM/ECO to monitor conditions on site
	<u>END-USE:</u> <ul style="list-style-type: none"> Site drainage systems to be checked for what elements? every two months, and following large rainfall events, and drains maintained in good order. Erosion of the final landform to be checked every two months, and following large rainfall events, and cover maintained in good order. 	ESKOM& EM	<u>END-USE:</u> <ul style="list-style-type: none"> ESKOM and the EM/ECO to ensure that post-closure monitoring and maintenance occur.

IMPACTS/ ISSUES REQUIRING MITIGATION &/OR OPTIMISATION	MANAGEMENT ACTION/ MITIGATION ACTION	RESPONSIBILITY	MONITORING AND RESPONSIBLE PARTY FOR MONITORING
CULTURAL HISTORICAL RESOURCES	<u>TARGET:</u> <ul style="list-style-type: none"> No impact to any cultural / historical features that may be found as part of site excavations 		
	<u>STANDARDS/ GUIDELINES/LEGISLATION:</u> <ul style="list-style-type: none"> Waste Disposal Site Licence conditions EA conditions SA “Minimum Requirements for Waste Disposal by landfill Volume II” South African Heritage Resources Act (SAHRA) Act 		
	<u>PLANNING AND CONSTRUCTION:</u> The following indicators of unmarked sub-surface sites could be encountered; <ul style="list-style-type: none"> Bone concentrations, either animal or human Ceramic fragments such as pottery shards either historic or pre-contact 	ESKOM Construction manager?	Construction manager to inspect any such features in found and notify ESKOM and the authorities if required.
	Although no sites of heritage significance were identified within the proposed study area, the following rEM/ECOMmendations are given should any sub-surface remains of heritage sites be identified; <ul style="list-style-type: none"> All operators of excavation equipment should be made aware of the possibility of the occurrence of sub-surface heritage features and the following procedures should they be encountered. All construction in the immediate vicinity (50m radius) of the site should cease. A heritage practitioner should be informed as soon as possible. In the event of obvious human remains the SAPS should be notified as well?. Mitigative measures (such as refilling etc.) should not be attempted. The area in a 50m radius of the find should be cordoned off with hazard tape. Public access should be limited. The area should be placed under guard. No media statements should be released until such time as the heritage practitioner has had sufficient time to analyze the finds. 	ESKOM & contractors?	ESKOM to ensure that no impacts occur to any potential cultural or heritage site that could be excavated.

2.4 Monitoring programme

It is vital that the current established monitoring programme be extended to include the extended waste disposal site. The current monitoring program stipulates quarterly monitoring to be undertaken as per the Minimum Requirements, and the same is suggested for the operational phase of the project. During the construction period monthly audits should be undertaken to ensure that impacts over the short time span can still be addressed. This should be set up to monitor the critical parameters related to environmental degradation and health and safety issues. These will include surface, dust and ground water monitoring. The monitoring for the factors should never be compromised as they can at an early stage indicate if pollution of the water resources is taking place or if dangerous levels of gas are being emitted. This will allow the Eskom as the operator of the site to do immediate investigations to see where the problem lies and rectify the situation as soon as possible thereby limiting the danger posed to the environment and to human health and safety. Table 2 lists the monitoring parameters and what objectives should be met as a result of implementing the monitoring actions.

Table 2: Critical monitoring parameters which need to be monitored at the waste disposal site development.

Element	Targets / objective	Objectives and Targets
Surface water monitoring	Objective	<ul style="list-style-type: none"> To detect any contamination of the adjacent streams as a result of the waste disposal operation. To provide an early warning system to downstream users of possible water contamination. To facilitate timeous implementation of remedial measures in the event of surface water contamination.
	Target	<ul style="list-style-type: none"> No contamination of adjacent streams. No consumption of contaminated water from the streams which is unfit for human consumption.
Ground water monitoring	Objective	<ul style="list-style-type: none"> To detect any contamination of ground water beneath the site resulting from the waste disposal operation. To provide an early warning system to ground water users in the area of potential ground water contamination. To facilitate timeous implementation of ground water remediation measures if deemed necessary. To determine if there is a leak in the liner.
	Target	<ul style="list-style-type: none"> No contamination of underlying ground water. Limited use of contaminated ground water.
Leachate monitoring	Objective	<ul style="list-style-type: none"> To prevent the spillage or leakage of leachate from the leachate pond into the adjacent stream or ground water. To monitor the effectiveness of the leachate management system in terms of quality and quantity of leachate.
	Target	<ul style="list-style-type: none"> No spillage or leakage of leachate into the environment.
Gas monitoring	Objective	<ul style="list-style-type: none"> To prevent the accumulation of waste disposal gas, particularly methane, to concentrations higher than 5%. To prevent any fires or explosions resulting from waste disposal gas concentrations.

Element	Targets / objective	Objectives and Targets
	Target	<ul style="list-style-type: none"> No injuries or accidents resulting from waste disposal gas.

2.5 Project compliance reporting

Regular monitoring of all the environmental management measures and components shall be carried out by ESKOM and the ECO to ensure that the provisions of this programme are adhered to. Ongoing and regular reporting to the Environmental and Station Managers of the progress of implementation of this programme should be done. Various points of compliance will be identified with regard to the various impacts that the operations will have on the environment. As mentioned above the compliance reporting should be undertaken on a monthly basis during construction and a quarterly basis during the operational phase.

Inspections and monitoring shall be carried out on both the implementation of the programme and the impact on plant and animal life. Visual inspections on erosion and physical pollution shall be carried out on a regular basis.

3 OPERATING PLAN

3.1 Introduction

This section provides an Operating Plan, in terms of which the Tutuka landfill facility will be operated. The objective of the Operating Plan is to ensure that all waste is disposed of in a manner that is environmentally acceptable. In this way, the negative impacts normally associated with waste disposal operations would be avoided or minimized. This implies that the operation must conform to the “Minimum Requirements for Waste Disposal by Landfill” and the “Minimum Requirements for Monitoring at Waste Management Facilities” Volumes II associated with the site classification.

The Operating Plan is site specific and describes the way in which the facility should be operated, addressing aspects such as access, controls, drainage, landfilling, etc.

In order to ensure that the operation complies with the aforementioned requirements, resources such as funds, suitable facilities, equipment and staff, including a Responsible Person, are required.

It is noted that this is a preliminary Operating Plan and that it is to be superseded by a comprehensive Operating and Maintenance Manual to be prepared as part of the detailed engineering phase.

3.2 Access

Vehicle access must always be limited to a single entrance, to facilitate control. During hours of operation, this entrance must be manned and it must be locked when the facility is not in operation, to prevent unauthorised entry. A notice board must be erected at the entrance, stating the name, address, and telephone number of the operator, the hours of operation and an emergency telephone number. Suitable signs must also be erected on-site, to direct drivers and to control speed.

Road access to the landfill working face must be maintained at all times in a manner suitable to accommodate vehicles normally expected to utilise the facility. All on-site roads must be surfaced and maintained so as to ensure that waste can reach the working face with minimum inconvenience in all weather. Roads must also be graded and wetted to control dust, when necessary.

3.3 Control

3.3.1 Waste reclaimers

Informal waste reclamation (or scavenging) is a feature of many landfills in developing countries. Such reclamation has security and public health risks associated with it, and for this reason it is recommended that it be strictly forbidden at the facility.

3.3.2 Waste acceptance

Prior to waste being accepted at the gate, it must be verified as general waste by visual inspection by the gatekeeper and confirmed with the transporter. Industrial wastes, liquids, sludges, and drummed wastes should be regarded as potentially hazardous. In the event of such wastes being intercepted, the site operator should be informed and hazardous waste must not be accepted at the landfill site. It must be directed back to the generator for subsequent disposal at a permitted hazardous waste facility, as appropriate. The operator at the landfill working face must also ensure that no hazardous wastes are disposed of in this area.

At all times the precautionary principle should apply, i.e. any consignment of waste suspected of being hazardous, must be considered hazardous unless proven otherwise by means of laboratory testing.

No hazardous or medical waste may be accepted at the landfill site.

3.3.3 Records

Accurate and comprehensive records must be kept of all waste entering the site. Waste must be categorised by the number of loads, defined by mass, type and origin. Records must be

kept on both a daily and a cumulative basis. The following systems could be used for record keeping:

- A simple record system where entries are made by hand onto pre-prepared forms in such a way that it can be collated manually or introduced into a computer. Office personal computers inclusive of appropriate software should be provided.

In addition, meteorological records should be kept, including rainfall, evaporation, wind, etc.

3.3.4 Auditing

Regular auditing of the site should be carried out during the operation, to ensure that the site design and the development plans are implemented, and that an acceptable standard is adhered to. The audit team should typically consist of the site operator, representatives from Tutuka Power Station and the appropriate environmental authorities. It may also be appropriate to include representatives of the interested and affected public on the audit team. The frequency of the audits must be agreed to by all the parties concerned, but intervals should not exceed 12 months.

3.3.5 Landfill gas monitoring

During routine audits, detection for landfill gas at the landfill should be carried out to determine the need for gas management.

3.4 Water Quality Monitoring

To ensure adequate environmental protection, a long term water quality monitoring programme for the site is required. This would involve background analyses, routine detection monitoring, investigative monitoring and post closure monitoring.

The objectives of the water quality monitoring system are:

- To indicate any escape of leachate into the environment and to quantify its effect
- To serve as an early warning system so that pollution problems that arise can be timeously identified and rectified.

The water quality monitoring system therefore includes the monitoring of surface water bodies, groundwater, leachate and contaminated water in the pond. Water and leachate samples are to be collected and analysed for the water quality parameters as required in the “Minimum Requirements for Monitoring at Waste Management Facilities”. Eskom has appointed specialist groundwater consultants GHT Consulting Scientists for all the water quality monitoring on and around the Tutuka Power Station complex. The details of the water quality monitoring system for the landfill would include the following:

3.4.1 Background analyses

Groundwater samples should be taken from all the monitoring wells installed over the life of the landfill. These include one upstream borehole (DMB35) and 6 downstream boreholes (DMB33, DMB34, DMB86, DMB87, DMB88, DMB89). These samples must be analysed to obtain background water quality data. A complete background analysis of the groundwater should be taken before the construction of the landfill extension.

3.4.2 Surface water

There are three surface water bodies in the vicinity of the site. The monitoring points are in the two dams on the ephemeral stream both upstream and downstream of the landfill site, and the ponded water in the borrow pit to the west of the site. Samples should be taken and analysed four times per year.

3.4.3 Ground water

The monitoring wells installed as part of the plant monitoring programme are to be used for ground water monitoring. Ground water is to be sampled and analysed at three monthly intervals.

3.4.4 Leachate and contaminated water

Leachate in the leachate sump and the existing leachate detection well, as well as water in the contaminated water pond, is to be sampled and analysed for control purposes. Samples are to be taken and analysed at three monthly intervals together with the surface and ground water monitoring.

3.4.5 Reporting

The analyses of all samples should be interpreted to identify any trends or deterioration of water quality that could result from the operations of the waste management facility. The water quality monitoring report should be submitted to Tutuka Power Station environmental management and the relevant regulatory authorities.

3.5 Recycling

If deemed feasible, controlled salvaging may be implemented at the landfill working face, provided that it is carried out in a safe and hygienic manner, and provided that it does not create a litter problem.

3.6 Landfilling operation

Incoming general waste can be discharged directly into the working cell of the landfill. The landfill must, as far as possible, be operated in accordance with the following sanitary landfill operating principles:

- Waste must be spread and compacted in cells, and
- Covered at the end of each day's operation.

3.6.1 Cell Operation

The landfill operation is based on the construction of a series of cells, which are prepared to receive the waste. The basic landfill unit is thus a cell of compacted solid waste which, when completed at the end of each day, is entirely contained by cover material. The sides may be formed by 1 m high soil or rubble berms, or sloped waste covered by daily cover. The width of the cell is determined by the working face, which is determined by the manoeuvring needs of the vehicles depositing waste. This must be sufficiently wide to avoid traffic congestion, but not so wide that waste is unnecessarily left exposed. There must always be sufficient cell capacity on site to accommodate at least one week's waste.

"End tipping", where waste is pushed over the edge of an advancing face, is not permitted. Waste must be deposited at the bottom of the working face, spread, and worked up a 1 in 3 slope up the working face within the cell. Compaction is best achieved if the waste is spread in layers not exceeding 500mm thick (uncompacted) and passed over a minimum of five times by the landfill compactor or loader.

3.6.2 Cover

The sanitary landfill definition specifies daily or more frequent cover. The material to be used for cover will be excavated and loaded up from the nearby dolerite borrow pit, but may also be imported soil, builders' rubble, or other approved covering. In all cases, a strategic stockpile of cover, enough for at least three days, should be maintained close to the working face for use in emergencies. Suitable equipment and resources must also be available to ensure that there is sufficient cover material, so that no area is left uncovered at the end of the day's operation. In order to facilitate this, incoming cover should be deposited along the top of the cell, either on the completed portion of the current cell, or on the adjacent cell.

Putrescible waste, such as food waste should be deposited and covered immediately with soil. Alternatively, such waste can be deposited at the base of the working face and covered immediately with other waste.

Daily or periodic cover must be sufficient to isolate the waste from the environment. A minimum thickness of 100 mm of compacted soil or other appropriate inert material is usually

required. If there is a problem with odours from the landfill, the thickness of the cover might have to be increased. Final cover must be as thick as possible, using construction rubble and gravel.

3.6.3 Wet weather cell

An easily accessible wet weather cell must be constructed close to the haul road, for use under abnormally wet weather conditions. The wet weather cell must have sufficient capacity to accommodate two weeks' waste. The wet weather cell should be constructed in the same manner as the standard cell, except that it should have a well-drained base using construction rubble or similar material to ensure vehicle access in wet weather. As far as possible, the wet weather cell should be operated in the same manner as the standard cell.

3.7 Landfill Drainage

The underlying principles of landfill site drainage are as follows:

- All run-off water must be diverted away from the waste, to prevent water contamination and minimise leachate generation.
- Where contaminated water or leachate does arise on site, it must be managed and kept out of the environment.
- Clean, uncontaminated run-off water must not be permitted to mix with and increase the volumes of contaminated water.

A drainage system which achieves the above is presented in the design section of this report. Once constructed, this system must be maintained. As part of the leachate management procedure, the quality of both leachate and contaminated water should be monitored on a regular basis to determine the suitability for discharge to the sewage treatment plant or other disposal methods.

Detailed on-site drainage at the working faces must continuously be adapted and developed as the landfill develops. Detailed on-site drainage must also be properly managed as follows:

- All clean, uncontaminated water must be allowed to flow off the site into the natural drainage system, under controlled conditions.
- The base of the site at the working face must be so graded that water drains away from the deposited waste.
- All water contaminated by contact with waste must be contained and discharged into the run-off water pond.
- All leachate collected must be discharged into the leachate sump.

- All temporarily and finally covered areas must be graded and maintained to promote run-off and eliminate ponding or standing water.

3.8 Resources

Suitable equipment and resources must be made available to ensure that the waste is properly spread, compacted and covered at the end of each day's operation. The equipment must therefore have the versatility to execute several functions, including grading and shaping, as well as mixing and blending of wastes. Backup plant must also be available in case of breakdowns.

3.8.1 Plant

Normally, a purpose built landfill compactor would be recommended as the main item of plant, together with other items of plant. However, in this case a small tracked loader or TLB with solid tyres would be recommended as the main item of plant, as it is considered to provide more flexibility for cover operations. In addition, there should be access to a second TLB as backup.

Other items of plant would include a small water tanker or trailer for dust control, and a tipper truck for handling cover material.

3.8.2 Staffing

For the operation of the facility, the following staff compliment is recommended to ensure that the site is operated to a high standard:

- One Site Supervisor. This person is responsible for the proper operation of the entire facility. The site supervisor must ensure that all the facility requirements are fully complied with.
- One Plant operator. This person is responsible for operating the waste disposal area and hence the TLB. The plant operator will also be responsible for operating the tractor-trailer, tractor-water cart and other landfill equipment.
- One gate controller to control access and record waste loads during operating hours. The gate controller can also act as the spotter to direct vehicles to the correct tipping area.
- One litter picker and general worker.
- One security guard for general site security.

3.9 Control of Nuisances

In order to control nuisances, sanitary landfilling principles must be used. This is a method of disposing of waste on land without causing nuisances or hazards to public health or safety, by

utilising the principles of engineering to compact the waste and to cover it with a layer of soil at the conclusion of each day's operation, or at more frequent intervals as may be necessary.

To ensure that the waste management facility is operated to these standards, environmental management and control of the operation are essential. Some of the common short-term problems associated with landfill operations and their possible solutions, are listed below:

- **Dust:** On-site roads should be wetted in hot dry weather to reduce dust from traffic.
- **Odours:** Odours are generated as a result of biological degradation of waste. Daily covering of the waste and the maintenance of this cover should ensure that odours from both "fresh" and decomposed waste do not become a problem. Putrescible waste should be covered immediately.
- **Fires:** Burning of waste is prohibited. Compaction and covering of waste minimises the fire risk by minimising oxygen and exposure. Where fires do occur, the burning waste should be exposed, spread, and smothered with cover material. On no account is water to be added.
- **Flies and Rodents:** Immediate compaction and daily covering of waste reduces the likelihood of this becoming a nuisance. Nevertheless, flies are commonly associated with landfill sites and fly traps should be used to control if this becomes a problem.
- **Litter:** Compaction and covering of the waste reduces the risk of windblown litter. Litter screens can also be used to control litter. All windblown litter should be collected from around the site on a regular basis.
- **Aesthetics:** The rehabilitation of completed areas would improve the general appearance of the site.
- **Health:** Medical waste should be handled with the appropriate care and stored and incinerated properly. Other putrescible waste should be covered immediately.
- **Drainage:** Waste deposition should be such that it ensures that water runs away from the waste body, and does not form ponds on top of the waste, from where it might infiltrate.

3.10 Development Plan

The aim of the Development Plan is to develop the landfill site from its constructed state as indicated on the drawings to the intended final landform. The intention is that controlled development should take place, and that all the operating principles in the preceding sections should be implemented and controlled through site audits.

The first aspect of the Development Plan is the site preparation. This includes fencing, gate control, site clearance, and the preparation of the first phase for waste deposition (i.e., cover excavation, stockpiling, and construction of berms). In the landfill, a pioneering layer of waste at least 600 mm thick is to be placed over the constructed liner before any landfilling is to proceed. This is to be carried out by end-tipping and spreading the waste ahead of the

equipment, so as to create a bed of waste on which to operate, and so protect the installed liner systems.

The detailed development of the landfill should follow the development plan, and adapted if necessary based on site specific circumstances as they arise.

3.11 Rehabilitation

All final levels and slopes must be in conformance with the landfill design and the end-use plan, with slopes not steeper than 1 in 3. Once the final level is achieved, the area must be capped/covered with the final cover in accordance with the plan. Rehabilitation is to commence as soon as practically possible after the final level has been reached in order to rehabilitate on an ongoing basis and to prevent wind exposure of waste.

3.12 Closure plan

As the landfill approaches final levels, more accurate levels will have to be surveyed to ensure that the final gradients and drainage are correct.

Immediately on completion of an area, final cover must be applied. Completed areas also require ongoing maintenance, including the repair of cracks and areas exposed by wind, and the filling of any settlement depressions. The rehabilitated areas should be controlled by ongoing monitoring after site closure, which should be complemented by water pollution monitoring.

3.13 Discussion

The preliminary Operating Plan outlined above should, if properly implemented, prevent the possible negative impacts normally associated with waste disposal from becoming a nuisance or an environmental threat. It must be stressed, however, that to ensure environmentally acceptable waste disposal, the resources outlined in this plan, such as funds, suitable facilities, equipment and staff, must be made available.

4 CONCLUSION

Having studied the Environmental Impact Assessment, which was carried out for the waste disposal facility, it is concluded that all impacts can be adequately addressed through the implementation of appropriate mitigation measures. Regular inspection of the construction and operation would confirm compliance with the required mitigation measures, and would be recorded in appropriate Project Compliance Reports and Audit Reports. Only by introducing frequent auditing, will the operation on the waste disposal improve and if operation is at a high level it will ensure that it remains there.