# *uMzimkhulu Waste Landfill Site*

## Engineering Needs Assessment and Preliminary Closure Design Report

22 December 2017

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| *Project Name:* | ***Closure of uMzimkhulu Waste Disposal Site*** |
| *Report Title:* | ***Engineering Needs Assessment and Preliminary Closure Design Report*** |
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| *Prepared for:* | ***GA Environment*** |
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# Contents

# 1 Introduction

## 1.1 Project Background

As a result of numerous complaints about the state of poorly operated municipal landfills and the associated impacts on the biophysical and social environment, the Department of Environmental Affairs (DEA) has embarked on an initiative to assist various Municipalities in South Africa with the licensing of their illegal waste disposal sites. The existing uMzimkhulu landfill has been identified as one of the sites that will require a Waste Management Licence for Decommissioning. A new landfill site which has been issued with an operational licence is proposed approximately 5 km south west of the existing landfill

The uMzimkhulu landfill occupies an area of approximately 43 000m² (±4 Ha) and is located on Erf 152 uMzimkhulu within the uMzimkhulu Local Municipality located which is part of the Harry Gwala District Municipality. The landfill is approximately 5km west of the uMzimkhulu CBD and direct access to the site can be gained from the surfaced P601 Road to Franklin. The site is located about 500m south of a tributary of the Mvubukazi River and approximately 300m west of Mankofu village. The locality map is shown as **Figure 1**.


***Figure 1: Location of uMzimkhulu Landfill***

## 1.2 Scope of Work

GA Environment (Pty) Ltd was appointed by the DEA to undertake the waste management licence for the decommissioning of the uMzimkhulu landfill. RAPienaar Consulting (Pty) Ltd was in turn appointed by GA Environment (Pty) Ltd to undertake Engineering investigations at the site to assist with the license application.

The scope of work for this report is to:

- To assess the existing site against standard legislative requirements for landfill design and operations, and develop a suit of conceptual engineering recommendations, which must be considered as license conditions to ensure that the landfill site is designed and operated within legal compliance;
- Assess and evaluate the requirements for the landfill containment barrier system (geomembrane lining) in accordance with the current legal framework and make key recommendations in relation to the above site investigations;
- Provide preliminary engineering design for capping of facilities that will be licensed for closure;
- Develop a suit of site-specific recommendations for consideration during the detail engineering design of the proposed landfill site and associated infrastructure;
- Landfill Engineering Cost Estimate;
- Provide recommendations to incorporate into the Closure/End Use Plan;

It is anticipated that should the Licence be granted, the Municipality will be able to source funding for the compilation of detailed engineering designs for the landfill and to allow for all activities related to the decommissioning of the landfill in line with NEM: WA, 2008, requirements. This report will thus aim to provide preliminary designs to aid the licensing process and a detailed engineering design would be required and approved prior to construction.

## 1.3 Details and CV of Author

This report was compiled by Mr Reon Pienaar (PrEng) who is the owner and director of RAPienaar Consulting (Pty) Ltd. Mr Pienaar holds a University degree in Civil Engineering, a BEng Honours degree and an MEng (Masters) degree in Environmental Engineering (specializing in Waste Management) from the University of Pretoria in South Africa. He has more than 12 years' experience in solid waste management, environmental management and dam engineering. The majority of his experience was spent in charge of projects and project teams.

He is registered as a Professional Engineer with the Engineering Council of South Africa (ECSA Reg. Nr. 20100281), he is a full member of the South African Institute of Civil Engineers (SAICE), a member of the Geosynthetic Interest Group (GIGSA), a member of the International Solid Waste Association, a member of MENSA and sits on the Central Branch Committee of the Institute of Waste Management of South Africa (IWMSA) as vice chairman.

## 1.4 Methodology

The methodology followed to compile this report was for the Engineer to study all available background information on the site in order to familiarize himself with the history and requirements of the facility. In order to gain a full perspective of the requirements for closure, the Engineer then undertook a site visit in the presence of the Geotechnical expert to assess the actual site conditions, and evaluate a concept of the ultimate preliminary design. The site visit was undertaken on 2 November 2017.The Engineer was also present during the excavation of the test pits used for the geotechnical evaluation in order to familiarize himself with the available materials and actual site conditions.

After visually assessing the site the Engineer then used all available information obtained, and applied his mind in order to best compile engineering recommendations for closure of the site in accordance with the technical, legal and legislative requirements for landfill closures in South Africa.

Non-technical base data used for report compilation was solely based on the site visit, discussions with municipal officials and the project EAP.

# 2 Site Assessment

## 2.1 Site Description

The landfill site is located directly north of the surfaced P601 Road to Franklin. The site is located about 500m south of a tributary of the Mvubukazi River. The natural slope of the area from the surfaced P601 road to the river in the north is between 10% and 11%.

Discussions on site with the security guard and the TLB driver indicated that waste disposal had been taking place at the site since the year 2001. This is confirmed when looking at aerial imagery from 2001 when the site had no waste on it. It is thus assumed that development of the disposal site took place sometime between 2001 and 2002. According to the Municipality, the fence was erected during 2003. The uMzimkhulu landfill currently receives general waste from areas located within the uMzimkhulu Local Municipality and the Ubuhlebezwe Local Municipality. **Figure 2** shows a general layout of the site with elevations at key areas shown in the attached table. The image further shows areas where historic landfilling or dumping took place and the area where waste is currently being dumped. The western portion of the site contains a borrow area of sorts which has a near vertical face towards the west of between 2m and 6m. Current waste disposal takes place in a manner where waste is dumped on the plateau and pushed over the edge towards the river. This method of disposal has resulted in the fence to the north being slanted due to the pressure from the waste .In some areas and the slope was in the order of 45° and a height of up to 15m. Material possibly suitable as cover material is being brought into the site from construction activities in the uMzimkhulu area and it does appear that waste covering takes place, although not regularly. **Figure 2** further shows some images of what the site looked like in 2001, 2003 and 2013. Based on these images only, the following is assumed regarding waste disposal at the site:

**2001**

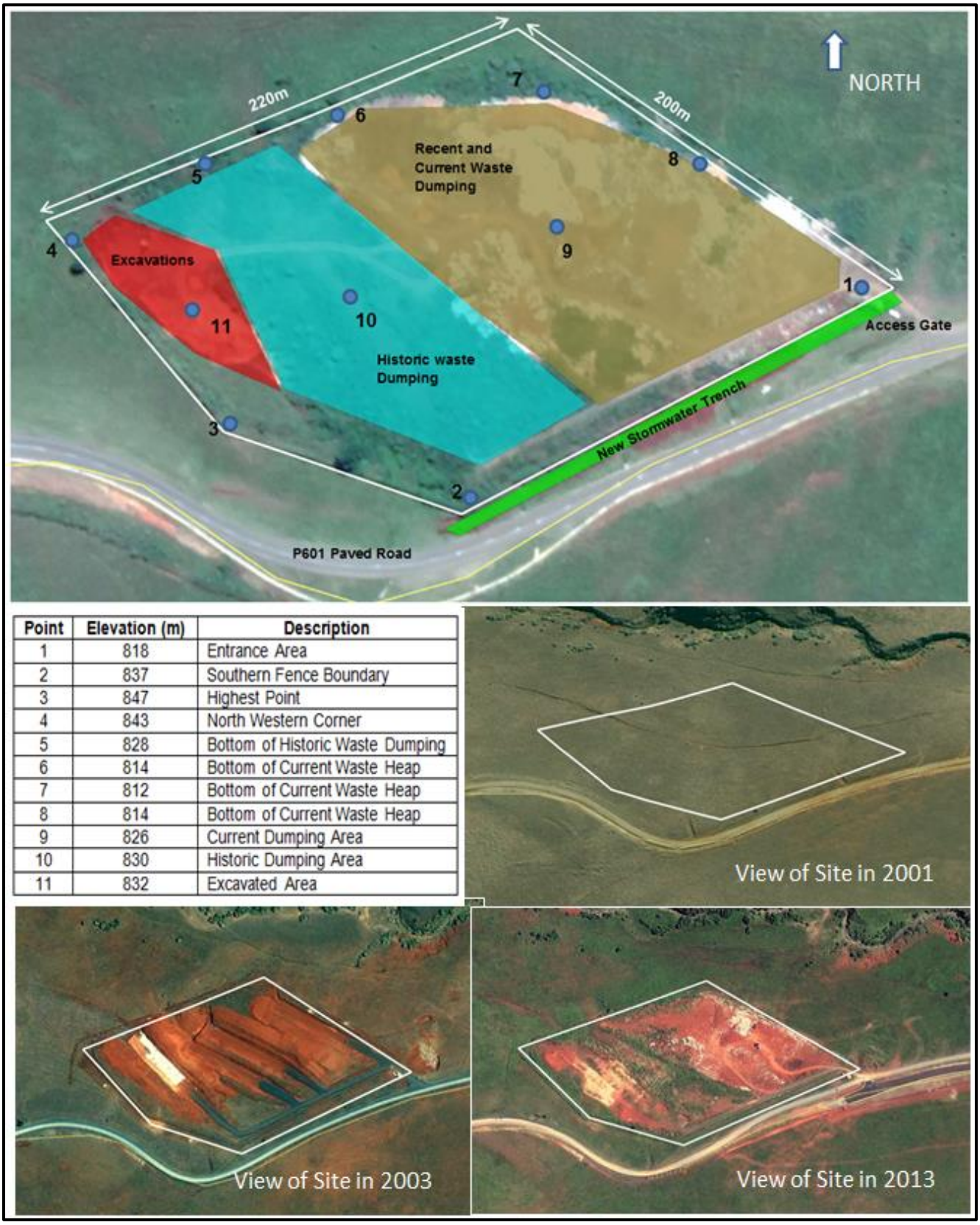
No waste disposal had taken place yet. The site might have contained a low lying area towards the north of the polygon which the municipality identified as a possible area for waste disposal. The natural slope of the site from the paved road to the river can be seen.

**2003**

It appears as if a number of trenches were dug for the purpose of waste disposal. Disposal started in the south western portion of the site with trenches to the north and east not yet filled.

**2013**

All trenches have been filled and waste was then placed on covered trenches until the current profile was reached.




| Point | Elevation (m) | Description |
|---|---|---|
| 1 | 818 | Entrance Area |
| 2 | 837 | Southern Fence Boundary |
| 3 | 847 | Highest Point |
| 4 | 843 | North Western Corner |
| 5 | 828 | Bottom of Historic Waste Dumping |
| 6 | 814 | Bottom of Current Waste Heap |
| 7 | 812 | Bottom of Current Waste Heap |
| 8 | 814 | Bottom of Current Waste Heap |
| 9 | 826 | Current Dumping Area |
| 10 | 830 | Historic Dumping Area |
| 11 | 832 | Excavated Area |

***Figure 2: Waste Site Layout***

**Figure 3** shows the rough cross section as would be expected at point 7 in the above figure. Waste is typically end pushed from point B to point A and left to stand at the natrual angle of repose which is in the order of 45º or 1V:1H. The elevation between point A and B ranges from 2m to about 15m in places.

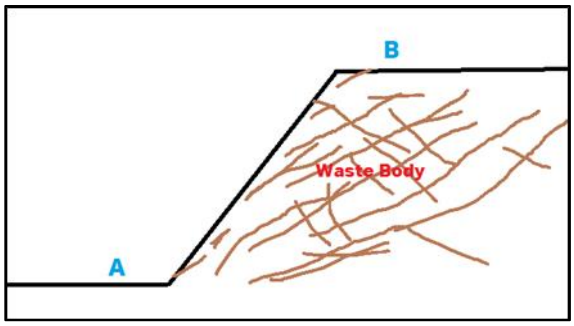



***Figure 3: General Cross Section through Waste Body***

The site receives general waste and based on the aerial images and recorded elevations obtained from site it is estimated that the site currently holds between 150,000m$^3$ and 180,000m$^3$ of waste. Using a compaction density of 0.75ton/m$^3$ this works out to between 21tons and 25tons of waste per day. A landfill receiving 25 tons of waste per day would have been classified as a Communal (C) or Small (S) site when using the Minimum Requirements classification system (the threshold between S and C is 25tons per day).

It is assumed that the site has no base liner and that disposed waste had been placed in non-uniform layers over time with no direct purposeful compaction. A new concrete lined stormwater trench has been constructed along the south eastern boundary of the site in line with the paved access road. This will prevent stormwater from entering the site and it is recommended that the stormwater trench be extended to the western boundary of the site.

### 2.1.1 Climate

According to www.saexplorer.co.za the area receives in the order of 768mm of rain per year, ranging from an average low of 6mm in June to an average high of 122mm in January. This is significantly more than the national average of about 450mm. The average midday temperatures for uMzimkhulu range from 18.4°C in June to 25.1°C in February.

The site visit was undertaken for one day at the end of November 2017 which is in the summer season when temperatures and rainfall numbers are historically higher. It was a sunny and dry day on the day of the site visit with very little visual signs of leachate. With no leachate collection or detection system installed, it can be expected that leachate from rainwater falling on site will gradually make its way to the groundwater and/or the surface water bodies downstream. In winter it would be expected that the waste body would dry out slightly with higher risks of fires. The capping design measures proposed will be applicable for all seasons of the year since it works as a composite system.

## 2.2 Geotechnical Information

### 2.2.1 Site Geology

The geological map of Kokstad shows the site to be underlain by Sandstone, Shale and mainly the post-Karoo Dolerite. No major geological structures are expected in close proximity of the site.

Contrary to the geological map, the main geology exposed on the borrow pit shows shale horizons of fresh rock weathering into red residual soil. No groundwater or perched leachate tables were encountered within the test pits excavated.

Laboratory sieving results indicate that in general the soils tested comprise of gravel 3%, sand (12%), silt (43%) and clay (41%). The soil is therefore described as sandy clayey silt. In terms of the Unified Soil Classification system the soil classifies mainly as a “MH” soil type, these being clayey silt of high plasticity. The Grading Modulus of 0.23 seems to reflect the soils as fairly fine nature, as corroborated with the sieving analysis results.

The plasticity indices (a measure of the plasticity of the clay) recorded show medium values (17) which are indicative of high activity (medium expansiveness) for the soils. These should therefore be noted to constitute problems under conditions of moisture migration.

Permeability (hydraulic conductivity) tests conducted in the laboratory on disturbed samples indicate values of $3.5x10^{-9}$m/s ($3.5x10^{-7}$cm/s). This soil is therefore suitable to use as capping material subject to further consolidation at optimum density and moisture content.

### 2.2.2 Groundwater

Groundwater boreholes in this area are very deep with water strikes encountered between 40 and 93 mbgl. The water strikes seem to be in correlation with the contact between shale and dolerite. However, the uMzimkhulu site is underlain by dolerite which is expected to be an aquitard. Recharge values range between 50 and 75 mm/annum and the groundwater levels are expected between 21 and 30 mbgl.

### 2.2.3 Geotechnical Conclusions

Permeability (hydraulic conductivity) tests conducted in the laboratory on disturbed samples indicate values of $3.5x10^{-7}$cm/s. The red clay soil is suitable to use as capping material subject to further consolidation at optimum density and moisture content.

There is however not enough red clay cover material on site. The borrow pit inside the landfill seems to have run out of soil judging by its size. Cover Material will need to be sourced from a new borrow or one that exists nearby (which exposed slate and shale rock, not soil, but would still be suitable if crushed and compacted to specifications). Already some clayey material is being brought from an external source from a construction site in the CBD. This material is khaki colour clay seemingly from weathered shale. The quality and quantity of this material needs further investigation. Visual inspection of this material suggests that it is suitable to use as capping material together with the material on site.

The close proximity of the landfill to the river down slope presents a leachate pollution risk to surface water and possibly ground water. The current erosion and degradation of some sections of the slope have created erosion channels draining directly into the stream on the valley.

Slope failure due to the slope height and angles is a potential collapse risk, should wet conditions become excessive. Current instantaneous combustion on a section of a slope is a hazard. This is indicative of the composition of some portions of the landfill waste.

The site does not reflect any risk for the formation of sinkholes or subsidence caused by the presence of water-soluble rocks (dolomite or limestone) and no evidence of mining activity beneath the site.

# 3 Legislative Review

## 3.1 Minimum Requirements

The 1998 Department of Water Affairs and Forestry (now Department of Water and Sanitation) document called "*Minimum Requirements for Waste Disposal by Landfill*" (referred to as Minimum Requirements from here onward) is still very widely used today to provide guidelines for waste management in South Africa. Most of it has been replaced by the regulations of the 2008 Waste Act (more about that in the following section) but in terms of landfill capping and closure, the Minimum Requirements are still used extensively. The minimum requirements document promotes environmental protection and provides guidelines for waste management best practice. In terms of capping requirements it is most important to note section 8.4.7 which inter alia provides the following information on capping.

1. The main purpose of the capping layer is to separate the waste body from the atmospheric environment. It is intended for protection and isolation of the waste from the long term effects of wind and water erosion, burrowing animals etc.
2. It limits and controls the amounts of precipitation that enters the waste and should also allow water to leave the landfill by evapo-transpiration and vent landfill gas in a responsible manner.
3. The cap is intended to work in conjunction with the base liner by limiting the long term generation of leachate.

## 3.2 Waste Act

The National Environmental Management: Waste Act (Act 59 of 2008) and the subsequent National Environmental Management: Waste Amendment Act (Act 26 of 2014) then built on the principles described in the Minimum Requirements to provide sustainable regulation of waste management practices in South Africa. Through regulations 634, 635 and 636 the waste act further provided information on the classification, management, assessment of waste for disposal to landfill and although these regulations do not cover the capping of waste facilities, there are still principles of design, monitoring etc. that holds true for both lining and capping of landfills.

## 3.3 Capping Notes

Due to fact that the regulations in the waste act focussed more on waste disposal and lining, the guidelines for capping is still primarily derived from the 1998 minimum requirements document. For this reason the South African Institute of Waste Management (IWMSA) approached the Department of Water and Sanitation (DWS) to provide updated guidelines on the capping of landfills. This has been workshopped at more than one occasion and a DWS Technical Advisory Practice Note on capping and closure of waste management facilities and pollution point sources is being prepared.

The DWS practice note had not yet been officially released upon compilation of this report but the principles discussed are that of groundwater and environmental protection when capping landfills by assessing each facility on its own merits.

# 4 Specifications for Closure Design

## 4.1 Required Closure Principle

When assessing the uMzimkhulu landfill for closure and capping design, the information on site specific conditions and legislative requirements discussed in the preceding chapters were taken into full consideration. Since the facility has no basal liner, the minimum requirements capping design for Small (S) or Communal (C) landfills cannot be used.

For the capping design of this landfill it is proposed to use a restricted moisture cap without a HDPE barrier layer in order to minimize the ingress of rain water and isolate the waste body form the atmospheric environment. The materials used in the design shall aim to reduce the percolation through the cap to less than 15 litres per hectare per day. The design will aim to restore the site to the natural condition it was in prior to the start of waste disposal in 2001. This design principle is seen to have the least effect on the natural environment and will revert the area to its natural state as far as possible.

## 4.2 Site Geometrics

The final elevations of the capped landfill follows the natural contours of the site and is designed to tie in to the natural environment on all sides as shown on Drawing UMZ – 002 in **Annexure A**. Although a topographical survey was not done, the Geotechnical expert took GPS coordinates and elevations at key points on site as shown in **Figure 4**. These data points were used in the design of the final capping layout and elevations.

The natural slope of the site from the surfaced P601 road to the river in the north is between 10% and 11% and the capped waste body should then follow this natural slope with a stormwater drainage bench at elevations of 840m, 830m and 820m as shown on the drawings in **Annexure A**.

Merging the capping of the landfill into the natural topography of the area allows for maximum natural run off whilst maximizing slope stability. A cut to fill operation and landscaping would have to be done in order to obtain the final landform. Due to the current shape of the landfill, the waste and soil will have to be shaped, layered and compacted to achieve the desired natural landform. Initial cut to fill calculations give a cut to fill ration of about 1:1,3 indicating that there should be enough material on site to achieve the desired final landform. If more material is required it can be obtained from other sources.


**Figure 4: GPS Data Points taken during site visit**

# 4.3 Capping Design

The design of the capping layers was done to maximize natural run off and minimize ingress of water into the waste body. The proposed capping layerworks is shown on Drawing UMZ 007 in **Annexure A** and described in detail in this section.

## 4.3.1 Capping Layers Works

The description of the proposed design layers for the capping of the landfill is described here beginning from the waste body and ending at the final (top) layer. **Figure 5** shows the proposed capping layers and results in a maximum layer works thickness of about 1,250mm depending on the final geosynthetic options chosen. There is no HDPE Geomembrane barrier layer in the design of the capping since the inclusion of the GCL and Geocomposite Drainage Layer is deemed to provide an effective barrier against water ingress.

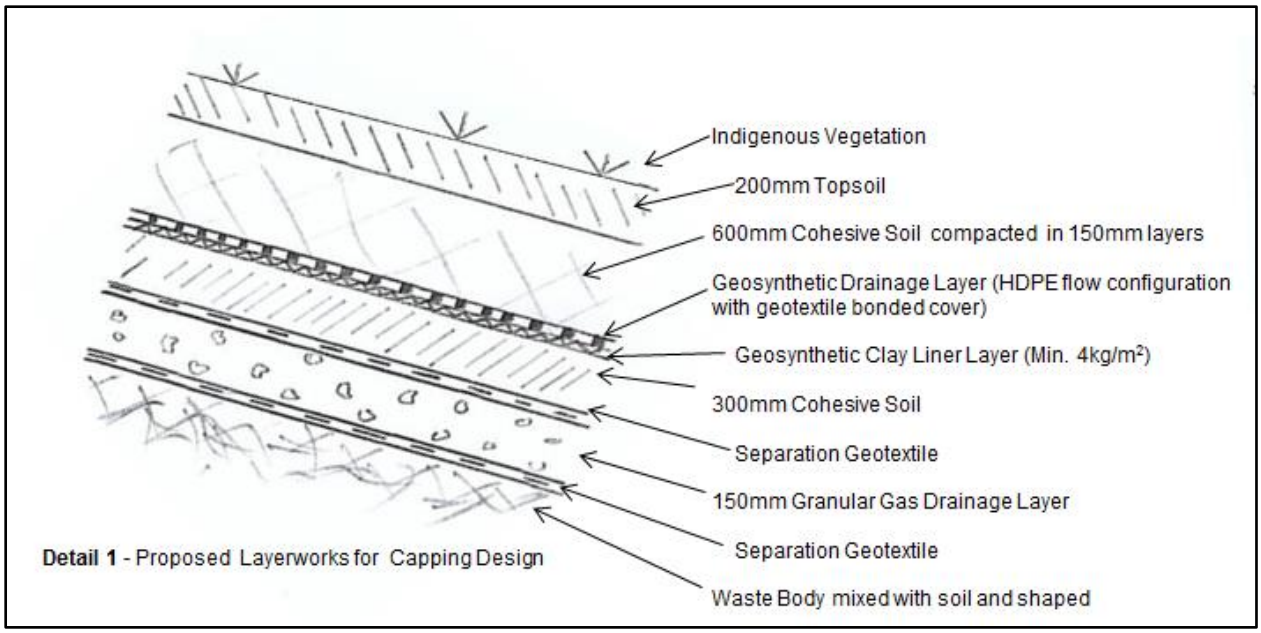



**Figure 6: Proposed capping design**

The various levels of the capping are described as follows:

- **Waste Body:** The final waste body is to be shaped as per the design drawings and compacted. It should be mixed with soil material and shaped to a final profile that is as smooth as practically possible.

- **Separation Geotextile:** The separation geotextile separates the waste body from the capping layers and should be a non-woven geotextile with a typical thickness of about 2.5mm and unit weight of at least 1.5kg/m$^2$. This layer assists in preventing fine particles from the layer works entering the waste body.

- **150mm Granular Gas Drainage Layer:** This is a landfill gas venting layer having a minimum thickness of 150mm and consisting of single sized stone or gravel of between 25mm and 50mm in size. This layer needs to be connected to a gas management system with gas vents being installed in key areas.

- **Separation Geotextile:** The separation geotextile separates the drainage layer from the capping layers and should be a non-woven geotextile with a typical thickness of about 2.5mm and unit weight of at least 1.5kg/m$^2$. This layer assists in preventing fine particles from the layer works entering the drainage layer.

- **Cohesive Soil Layer:** This is a support layer to the below drainage system and should be 300mm thick consisting of in situ material compacted to a minimum density of 95% Standard Proctor maximum dry density at a water content of Proctor optimum to optimum +2%.

- **Geosynthetic Clay Liner (GCL):** A GCL is two geotextile layers with a layer of bentonite in the middle that acts as a containment barrier. The GCL should have minimum mass per unit area of 4kg/m2 and the permeability of the GCL must be such that an outflow rate of $1x10^{-6}$ cm/s will not be exceeded. These parameters are to be tested for the chosen material as per the construction Quality Assurance and Quality Control (QA/QC plan) that needs to form part of the detail design report before construction.

- **Geocomposite Drainage Layer:** There are a number of products on the market that could potentially be used here. The final design should replicate the specifications of a geocomposite drainage system similar to the ABG Pozidrain® product which consists of a high strength flexible polyethylene cuspated drainage core (at least 4mm thick) with a non-woven geotextile filter fabric bonded onto one or either side. The geotextile filters a wide range of materials and is bonded to the core to ensure that it does not deform into the drainage channels under the load of the backfill material. The drainage composite allows fluids and gases to percolate into the core whilst supporting the backfill material. The collected fluids are then transported along the core to the leachate collection system at the landfill toe.

- **Cohesive Soil Layer:** This is a support layer to the below drainage system and should be 600mm thick consisting of in situ material compacted to a minimum density of 95% Standard Proctor maximum dry density at a water content of Proctor optimum to optimum +2%. The layers are to be placed and compacted in 150mm layers and also assist in providing the required pressure for the GCL/HDPE composite to function optimally. As indicated in the Geotechnical report the soils on site are predominantly weathered shales with a clay content and fairly low permeability. This soil will work well in conjunction with the other layers of the capping system.

- **Topsoil Layer:** This needs to be a minimum of 200mm topsoil layer to assist in the establishment of vegetative cover as soon as possible. The layer needs to be optimally compacted to assist plant growth and can contain a mixture of hydro seeding if required.

- **Indigenous Vegetation:** The vegetation layer assists with stability and run off and needs to be established as soon after construction as possible. The vegetation needs to be indigenous to the area in order to ensure optimal sustainability of the capping system.

### 4.3.2 Properties of Capping Materials

The long term performance of the capping system will depend on the quality of the design and construction process. This preliminary design needs to be confirmed through a detail design

process after the issuing of the License. The detail design report should contain a full QA/QC plan to be followed during the construction process. Certain key material properties for the proposed capping layers are described here and must be confirmed during detail design.

In situ soil

The in situ-soil tested as part of the Geotechnical assessment is a clayey soil with very low permeability according to the results from the laboratory. This material, if well compacted, would be suited for use as capping for the facility. Due to the volume of material available however, legislative requirements and the nature of the site conditions, it is not recommended that this soil be used as a barrier layer for water ingress without combining it with geosynthetic layers as per the design.

Geosynthetic Clay Liner (GCL)

The stability of barriers composed of geomembranes and/or geosynthetic clay liners (GCLs) depends on the interface and/or internal shear resistances of the materials involved in the design materials. The internal resistance of stitch-bonded and needle-punched GCLs depends on the resistance of the core material (bentonite) and on the technique used to attach each geotextile layer of the GCL. When using a GCL in a slope, the evaluation of its internal shear strength is of fundamental importance for stability analysis, and for this reason it is recommended that a fully needlepunched GCL with nonwoven cover and either woven or nonwoven carrier geotextile be used on the slopes of the capping. The bentonite in the GCL should contain at least 75% Montmorillonite.

Although the stability of the rehabilitated waste body and specifically the slopes rely on many factors, the most important is proper moisture control and drainage. Capping failures tend to occur under saturated conditions and layer works thus need to be quality controlled and tested to ensure design parameters of drainage and permeability are adhered to.

## 4.4 Stormwater Management

Stormwater management is a critical component of sustainable capping and closure designs of landfills. The stormwater management infrastructure was designed to ensure clean and dirty water separation, to facilitate non critical flow and to prevent ponding. The main objectives of the proposed stormwater design are:

- Protection of the downstream water resources described in Chapter 1 by separating, collecting and discharging all stormwater runoff from the uMzimkhulu landfill site before contamination;
- Ensuring that stormwater management infrastructure is designed to handle a storm event equal to the 1:50 year storm event;

- Preventing of ponding of water on site that could penetrate the capping layers and waste body creating leachate and possible failures of the capping layer works.

The final shaping and capping of the landfill as described, is aimed at preventing stormwater from coming into contact with the waste and any contamination. Any stormwater on the rehabilitated site could thus be considered clean and runoff from the rehabilitated site will be discharged into the existing natural watercourse.

The proposed uMzimkhulu stormwater management system shall at least include:

- Catchwater banks at least 500mm high constructed of compacted in situ material at the top edge of the landfill to prevent erosion and control the runoff down the side slopes. This system needs to tie in with the existing stormwater management system;
- Drainage benches to be constructed as shown on the drawings in **Annexure A** to reduce the flow velocity and also assist in the prevention of erosion.

## 4.5 Gas Management

Waste materials contained in a closed landfill degrade at various rates and stages, producing a range of gases. Municipal waste found on the uMzimkhulu landfill is commonly known to produce methane and carbon dioxide gases which are considered dangerous greenhouse gases that need to be controlled. These gases could potentially result in gas bubbles beneath the capping layer if not fully captured by the gas drainage layer, and then cause uplift of the capping layers. It is thus recommended to install gas vents, connected to the gas drainage layer, at key areas to release these gases. Gas monitoring probes could also be installed for use during post closure monitoring to trace gas releases. If the probes are considered too expensive or deemed a target for theft, the monitoring team could use hand held gas monitoring devices during post closure gas monitoring.

# 5 Engineering Cost Estimate

## 5.1 Introduction

Capping designs that adhere to the legislative framework can be considered expensive and even with the best efforts of the design engineer and construction contractor, this could result in high budget allocations required from small municipalities. There are sources of funding that the municipality can use, other than its own funds and these have been widely used with great success. The reality is that most small municipal landfill sites have no base liner which is mostly due to the age of the facility (liners became a requirement from 1998) and /or the budgets of the municipality at the time. As described earlier in this report, the requirements of capping designs for landfills with no base liner is more strict than for facilities with operational base lining systems.

The costs given in this chapter is an estimate of construction costs for the establishment of the landfill cap and is not be considered a final value since it needs to be confirmed during the detail design stage prior to development of tender documentation for municipal procurement of construction contractors.

## 5.2 Engineering Estimate

The below table shows a summary of the construction estimate at the preliminary design stage, this would need to be confirmed during detail design. A full breakdown of the below amounts is given in **Annexure B**.

**Table 1: Preliminary Engineering Construction Cost Estimate**

| **SUMMARY OF BILL OF QUANTITIES** | | |
|---|---|---|
| **PART** | **DESCRIPTION** | **AMOUNT** |
| | | **R-c** |
| PART 1 | PRELIMINARY AND GENERAL | 2 560 000.00 |
| | | |
| PART 2 | EARTHWORKS: UMZIMKULU LANDFILL | 15 305 500.00 |
| | | |
| **SUB-TOTAL A** | | **17 865 500.00** |
| PART 3 | DAYWORKS | 345 000.00 |
| **SUB-TOTAL B** | | **18 210 500.00** |
| CONTINGENCIES<br>Add 10 % for Sub-total B (Provisional sum) | | **1 821 050.00** |
| **SUB-TOTAL C** | | **20 031 550.00** |
| VALUE ADDED TAX<br>Add 14 % for Sub-total C (Provisional sum based on current rate of VAT) | | 2 804 417.00 |
| **ESTIMATE TOTAL AMOUNT (INCL VAT)** | | **22 835 967.00** |

# 6 Closure and End Use Planning

## 6.1 Introduction

An integral part of the successful rehabilitation and closure of a landfill site is the closure and end use plan. Once capping and rehabilitation has been constructed, monitoring and maintenance of the site will be required to ensure that it remains effective. Rehabilitation cannot be regarded as completed until the vegetation has been suitably established across the site. Several years of management and maintenance may well be required,

Once the uMzimkhulu landfill has been formally closed, additional monitoring activities will be necessary to assess water quality around the landfill, monitor the landfill gas collection system and inspect the landfill for signs of disrepair. The Closure and End Use Plan Report is a separate document to be developed by the Environmental Assessment Practitioner, and is intended to serve a guide for the formal closure and end use planning for the future closure of the uMzimkhulu landfill site.

This section of the Preliminary Design Report will provide some key recommendations for future inclusion into closure and end use plan.

## 6.2 Recommendations for inclusion in Closure and End Use Plan

### 6.2.1 General

The following provides some general rehabilitation measures that may be implemented on the site.

- The site is cleaned up and all the residual waste, that cannot be compacted and included in the waste body that will be capped must be removed and stored in skips for final disposal at a licensed landfill site;
- The waste and cover material that has been placed on the site should be used to rehabilitate some of the areas, which have been damaged by soil erosion and loss of ground cover;
- A vegetative layer of approximately 200mm should be laid down in these scarred areas on the site and spread and lightly compacted;

- The site should then be grassed with the same type of indigenous grass mixtures as per specifications for the uMzimkhulu area;
- The detailed closure design needs to be prepared and supervised by a professional engineer working with an environmental scientist, and needs to be designed such that the site does not sharply contrast against the local geomorphology and background. The site shall have a slight cross-fall allowing easy drainage off the site away from any potential risk areas;
- The capping layer works provided in the engineering design should be conservatively constructed according to the specifications of the design and approved by the relevant authority to ensure compliance with the applicable legislation;

### 6.2.2 Cover Material

As reported in the engineering design of this report, the permeability of the in situ soil is in the order of $3.5x10^{-7}$cm/s which is a comparatively low permeability when compared to the minimum requirements for permeability of liner clay material of $1 \times 10^{-6}$cm/s. Thus, this material, even if used in a mixture of commercial material is well suited for cover material and the only additional material required over the capping would be a 200mm topsoil layer for facilitation of plant growth etc.

### 6.2.3 Erosion Control

Erosion is one of the major sources of damage to both natural and man-made slopes. Erosion on slopes can be caused by detachment and movement of soil particles due to raindrop impact and surface runoff. Some recommendations for protection of the site from erosion may include but not limited to the following:

- Cover the sloped edge of the waste body and the top of the waste body with the capping layers as per the engineering design;
- Cover the capping layer with the topsoil and compact;
- Seed all surfaces and banks with indigenous grass to allow vegetation growth and further protection and natural look;

Once the vegetation has established itself on the site possibilities of erosion are limited. Any signs of erosion should be reported and corrected immediately as part of the closure plan of the site.

### 6.2.4 Water Quality Monitoring

A Water Quality Monitoring Program should form part of the Closure Plan of the uMzimkhulu landfill site. The water quality monitoring program is expected to continue for at least 10 years following

closure due to the importance of water quality for the residents of the area. The program should involve quarterly monitoring of surface water, groundwater and leachate at and surrounding the landfill. The water quality results will be compared to the accepted local and national standards and should be reviewed and reported yearly. The report will provide information on the effectiveness of the landfill cap and surface water drainage system, and address any identified water quality issues.

After ten years, it is anticipated that the water quality at the landfill should stabilize and the water quality monitoring frequency will be reduced to semi-annually. After 25 years, the results should again be reviewed and if there is sufficient evidence that shows that the landfill has not had significant impact on the surrounding environment, the water quality monitoring program can be concluded.

### 6.2.5 Gas Management

It is proposed in the preliminary engineering design that a landfill gas management system will be constructed prior to closure. The details of required operation, maintenance and monitoring of this system is to be include in the detail design phase and carried through tot eh closure plan. After closure, a remote monitoring system could be utilized and maintenance staff will be contacted for emergencies. A quarterly inspection and monitoring program will likely have to be established to evaluate landfill gas generation for a minimum of 25 years.

### 6.2.6 Inspections and Maintenance

After closure, a regular inspection and maintenance program must be initiated to maintain the integrity of the landfill. Allow for a maintenance period of one year following practical completion, (unless otherwise specified) and implement the following.

- Maintain the integrity of the fence around the site to ensure that there is no access for any people and/or livestock.
- Re-vegetation must match the vegetation type which previously existed so it blends in well with the natural environment;
- A minimum grass cover of 80% is required, and individual plants must be strong and healthy growers at the end of the Maintenance Period;
- In the case of sodding, acceptable cover entails that 100% cover is attained by the specified vegetation;

- Bare areas that show no specified vegetation growth after three months of the Rehabilitation Work are to be spread with additional topsoil, ripped to a depth of 100mm and re-planted, re-sodded, re-hand sown or re-hydro seeded.

Regular inspections are to be undertaken at the landfill and must include evaluation of the:

- landfill cap by noting any significant erosion, cracking, settlement or seepage;
- fence for structural integrity and performance;
- landfill cap for evidence of wildlife or rodent impacts; and,
- leachate collection system components for containment.

The inspection reports should identify if maintenance activities are required. Inspections are anticipated to be monthly for the first year and quarterly for the years following.

### 6.2.7 Stormwater and Leachate Management

Stormwater management shall be by means of proper landscaping, allowing the surface run off to flow naturally away off the site in accordance with the design measures proposed. Once the site is properly vegetated the management of stormwater becomes less problematic. The site does not generate any significant amount of leachate at this stage but the proposed leachate management system of collection, trenching and storage should be monitored regularly and the leachate sump cleaned out at regular intervals.

### 6.2.8 Post Closure Monitoring

A post closure monitoring plan shall be developed to ensure that certain critical aspects are monitored continuously even after closure as may be required by the waste license for the site. These aspects may include but are not limited to the matters described above. Following each site inspection, a brief internal site audit report must be prepared with mitigation or recommended actions for mitigating any observed negative impacts on the site. Such measures may include but not be limited to the following:

- Any eroded material on site will have to be excavated;
- The eroded area must be filled with excavated material and re-compacted;
- Cover with capping impermeable material, compacted and top soiled as per specification;

- Seeded with indigenous grass and vegetation;
- Cover with netting and protected until vegetation blanked re-established

Generally the mitigation measures will depend on the nature, extent and significance of the impacts observed during the site audits.

# 7 Conclusion

As a result of numerous complaints about the state of poorly operated municipal landfills and the associated impacts on the biophysical and social environment, the Department of Environmental Affairs (DEA) has embarked on an initiative to assist various Municipalities in South Africa with the licensing of the existing illegal waste disposal sites. The existing uMzimkhulu landfill has been identified as one of the sites that will require a Waste Management License for decommissioning.

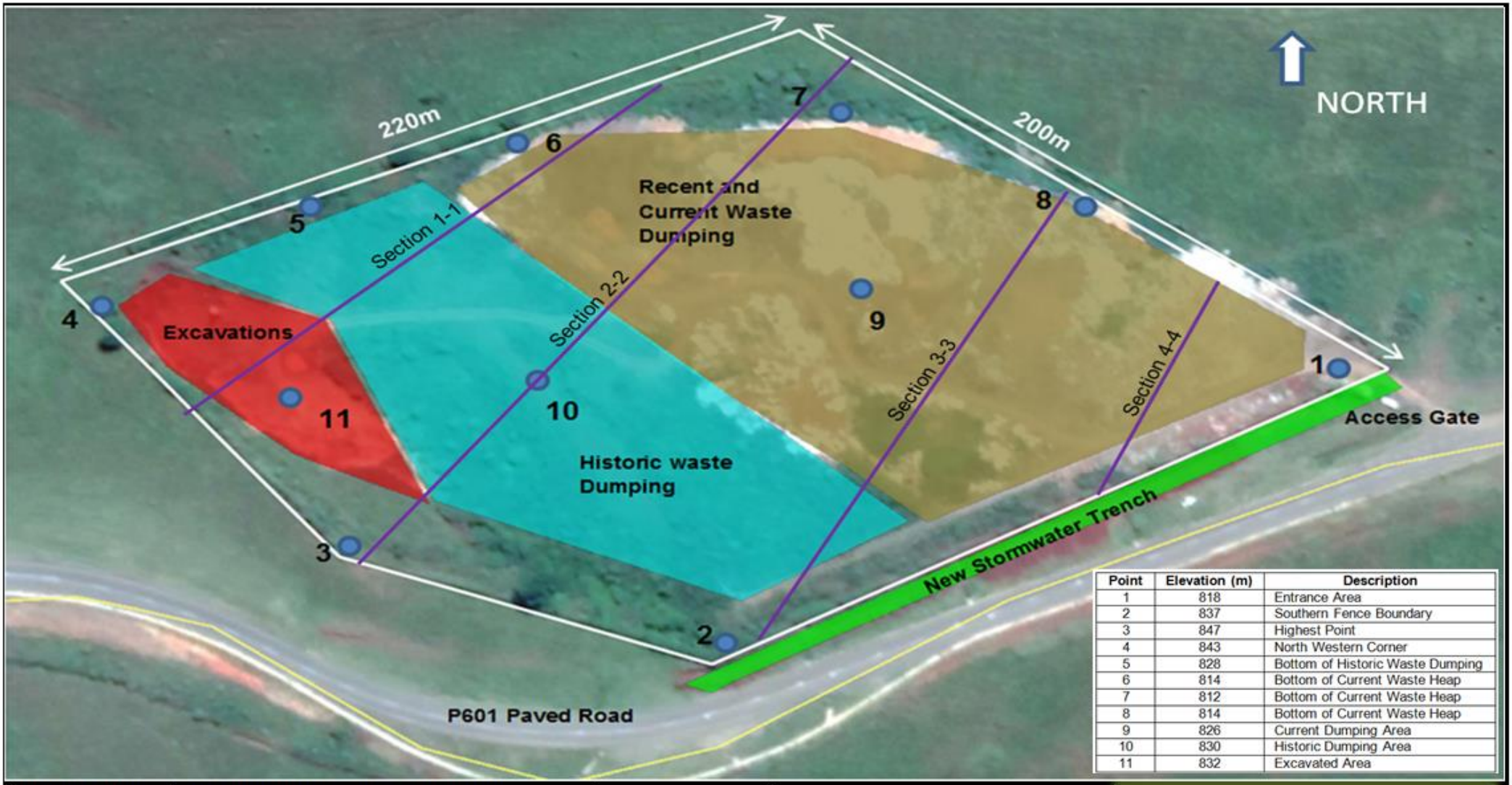
The closure of the uMzimkhulu Landfill site is subject to the requirements described in this report and the Closure and End Use Plan. The final shaping and capping of the landfill should be carried out as per the capping design and on-going monitoring of the groundwater and landfill gas should continue according to the requirements given. The site should be fenced off to prevent unauthorized access and further dumping.

For the capping design of this landfill it is proposed to use a restricted moisture cap without a HDPE barrier layer in order to minimize the ingress of rain water and isolate the waste body form the atmospheric environment. The materials used in the design aimed to reduce the percolation through the cap to less than 15 litres per hectare per day. The final shape of the rehabilitated landfill needs to tie in the natural contours of the area in order to revert the landscape back to its original state prior to the start of waste disposal in 2001.

It is recommended that this report be used as basis for the detail design phase of the landfill capping process once a waste license is issued for closure of the landfill.

# ANNEXURE A:

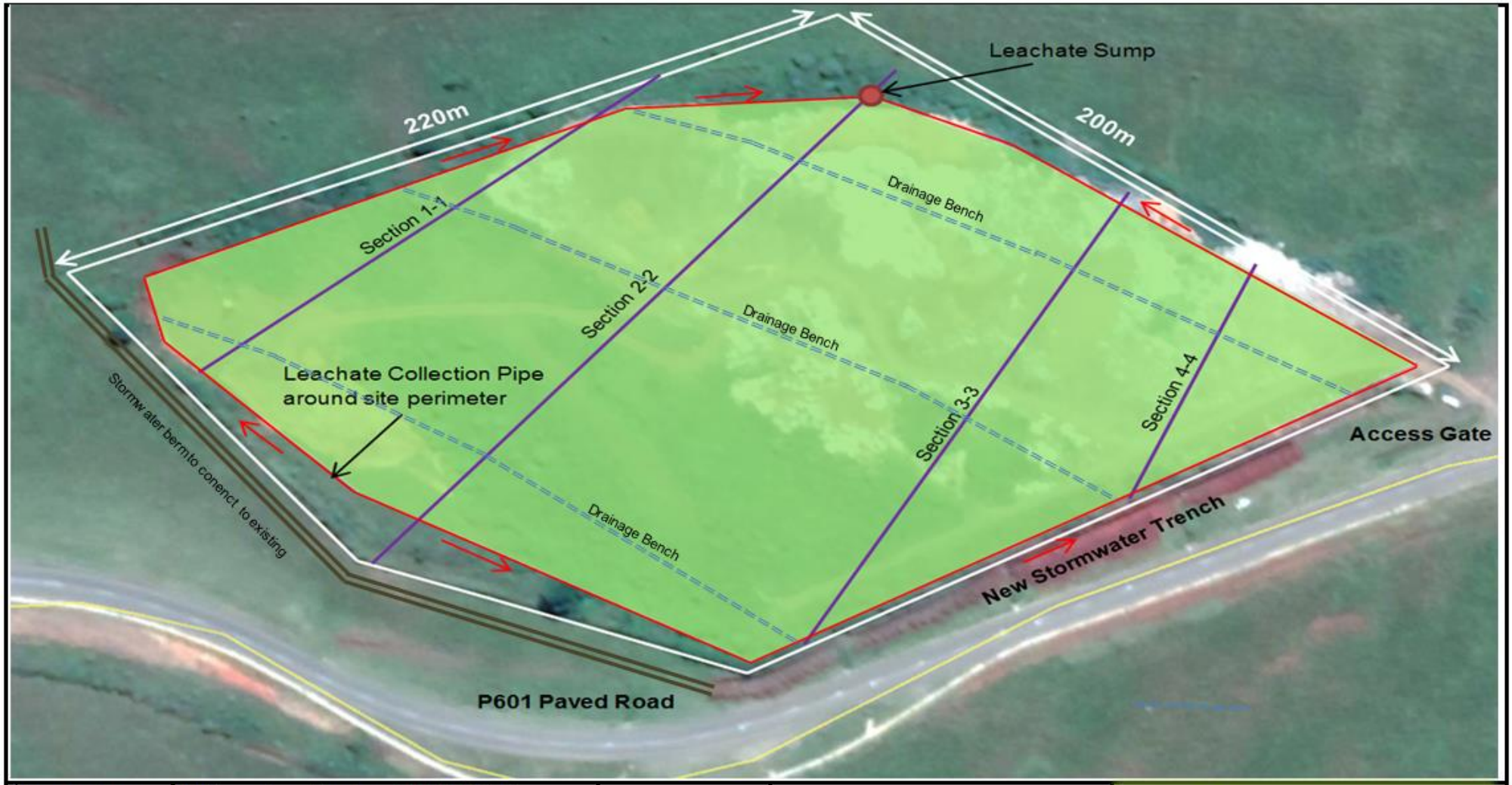
# Preliminary Engineering Design Drawings




| Point | Elevation (m) | Description |
|---|---|---|
| 1 | 818 | Entrance Area |
| 2 | 837 | Southern Fence Boundary |
| 3 | 847 | Highest Point |
| 4 | 843 | North Western Corner |
| 5 | 828 | Bottom of Historic Waste Dumping |
| 6 | 814 | Bottom of Current Waste Heap |
| 7 | 812 | Bottom of Current Waste Heap |
| 8 | 814 | Bottom of Current Waste Heap |
| 9 | 826 | Current Dumping Area |
| 10 | 830 | Historic Dumping Area |
| 11 | 832 | Excavated Area |

| | | | |
|---|---|---|---|
| **Drawing Owner:** | RAPienaar Consulting Reg: 2017/174192/07 | | |
| **Project Name:** | Kwazulu Natal Landfill Licenses | **Drawing Number:** | UMZ - 001 |
| **Drawing Title:** | Existing Landfill Layout | **Revision:** | 1 |
| **Date:** | 30 November 2017 | **Client:** | GA Environment |
| **Drawing By:** | Reon Pienaar (PrEng Nr. 20100281) | **Approved By:** | Reon Pienaar (PrEng Nr. 20100281) |

R.A. PIENAAR
CONSULTING (PTY) LTD
Tel: 0721235517, Monumentpark, Pretoria




| | | | |
|---|---|---|---|
| **Drawing Owner:** | RAPienaar Consulting Reg: 2017/174192/07 | | |
| **Project Name:** | Kwazulu Natal Landfill Licenses | **Drawing Number:** | UMZ - 002 |
| **Drawing Title:** | Rehabilitated Landfill Layout | **Revision:** | 1 |
| **Date:** | 30 November 2017 | **Client:** | GA Environment |
| **Drawing By:** | Reon Pienaar (PrEng Nr. 20100281) | **Approved By:** | Reon Pienaar (PrEng Nr. 20100281) |

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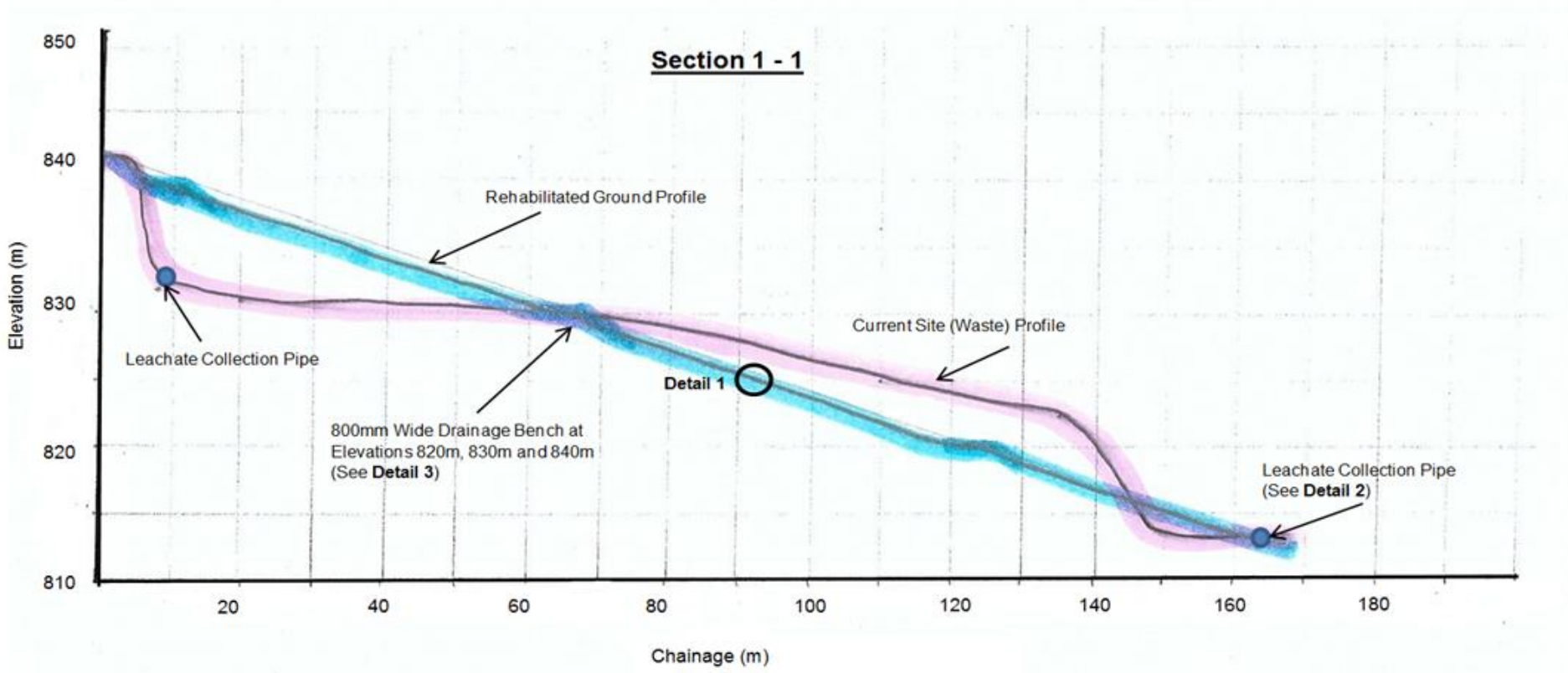


| | | | |
|---|---|---|---|
| **Drawing Owner:** | RAPienaar Consulting Reg: 2017/174192/07 | | |
| **Project Name:** | Kwazulu Natal Landfill Licenses | **Drawing Number:** | UMZ - 003 |
| **Drawing Title:** | Section 1 - 1 showing existing and capped landfill | **Revision:** | 1 |
| **Date:** | 30 November 2017 | **Client:** | GA Environment |
| **Drawing By:** | Reon Pienaar (PrEng Nr. 20100281) | **Approved By:** | Reon Pienaar (PrEng Nr. 20100281) |

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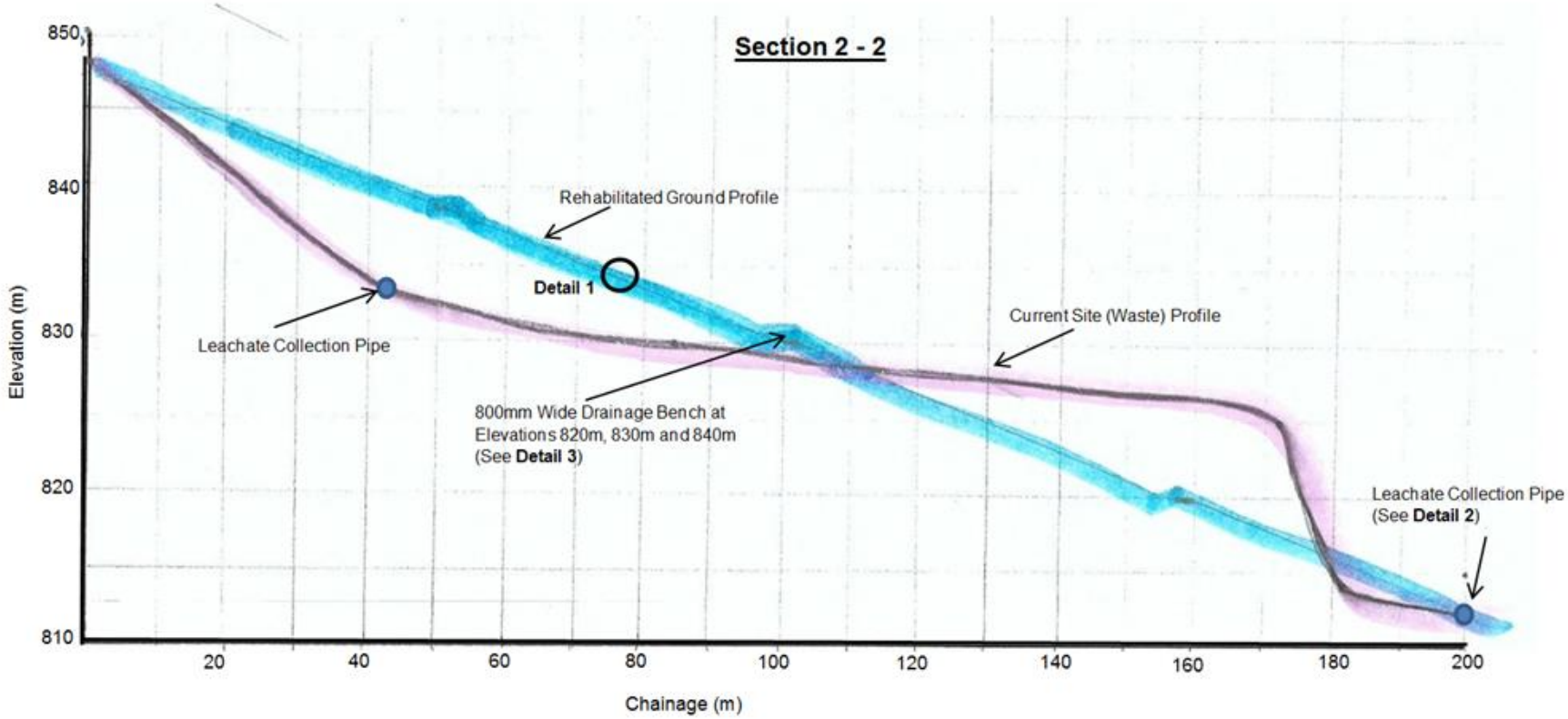


| | | | |
|---|---|---|---|
| **Drawing Owner:** | RAPienaar Consulting Reg: 2017/174192/07 | | |
| **Project Name:** | Kwazulu Natal Landfill Licenses | **Drawing Number:** | UMZ - 004 |
| **Drawing Title:** | Section 2 - 2 showing existing and capped landfill | **Revision:** | 1 |
| **Date:** | 30 November 2017 | **Client:** | GA Environment |
| **Drawing By:** | Reon Pienaar (PrEng Nr. 20100281) | **Approved By:** | Reon Pienaar (PrEng Nr. 20100281) |

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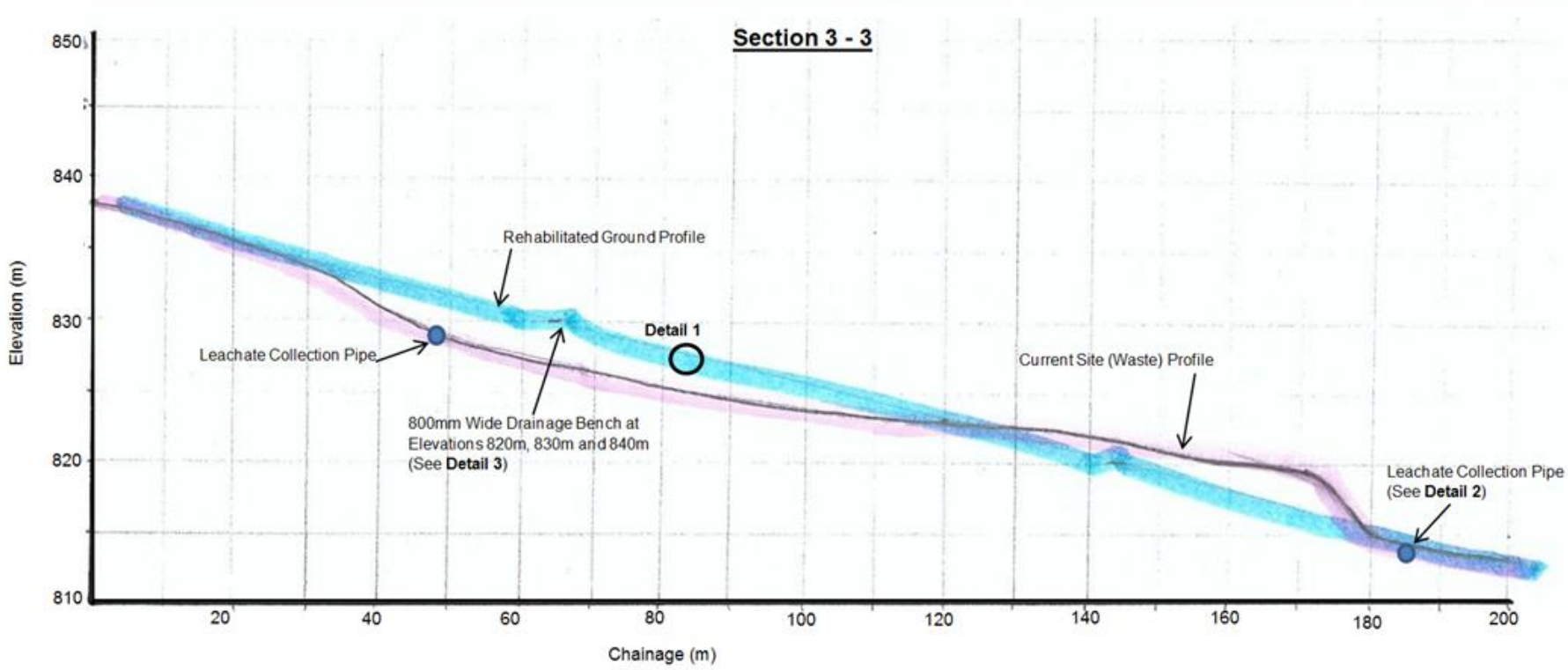
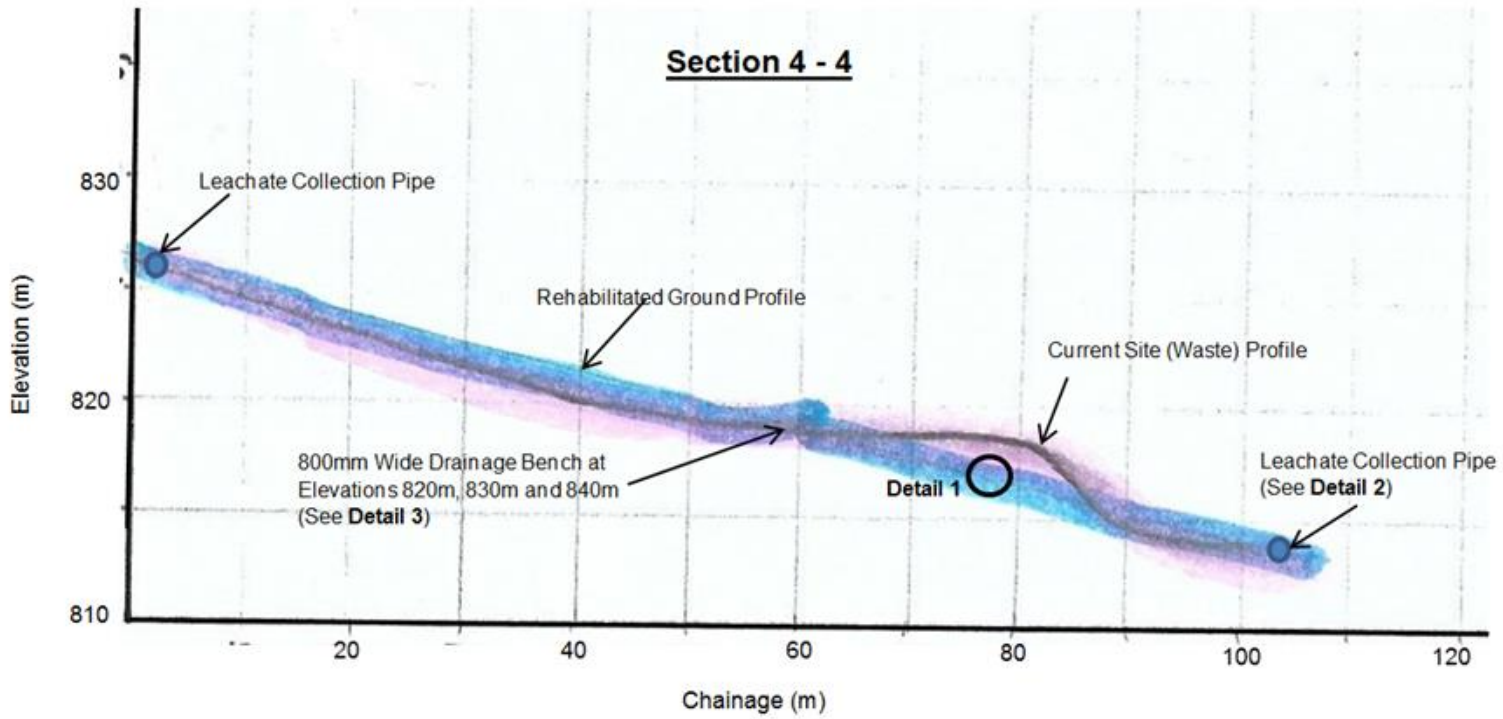


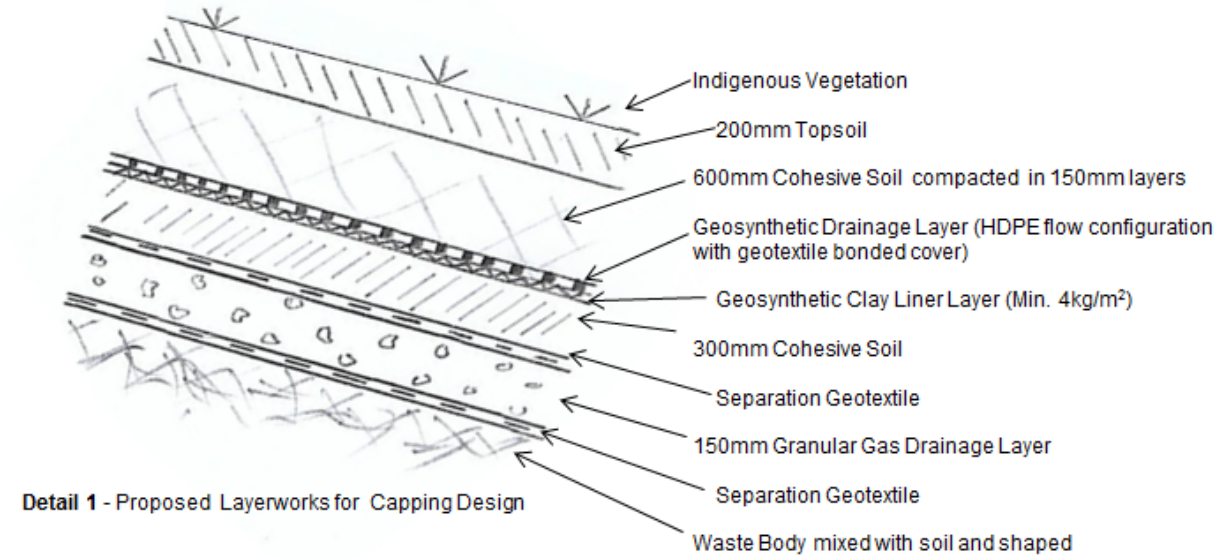

| | | | |
|---|---|---|---|
| **Drawing Owner:** | RAPienaar Consulting Reg: 2017/174192/07 | | |
| **Project Name:** | Kwazulu Natal Landfill Licenses | **Drawing Number:** | UMZ - 005 |
| **Drawing Title:** | Section 3 - 3 showing existing and capped landfill | **Revision:** | 1 |
| **Date:** | 30 November 2017 | **Client:** | GA Environment |
| **Drawing By:** | Reon Pienaar (PrEng Nr. 20100281) | **Approved By:** | Reon Pienaar (PrEng Nr. 20100281) |

R.A.PIENAAR CONSULTING (PTY) LTD
Tel: 0721235517, Monumentpark, Pretoria

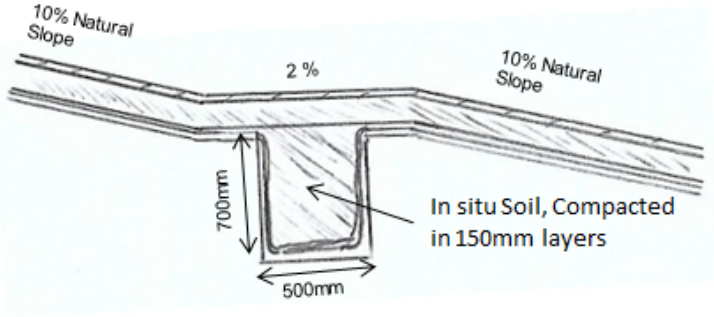



| | | | |
|---|---|---|---|
| **Drawing Owner:** | RAPienaar Consulting Reg: 2017/174192/07 | | |
| **Project Name:** | Kwazulu Natal Landfill Licenses | **Drawing Number:** | UMZ - 006 |
| **Drawing Title:** | Section 4 - 4 showing existing and capped landfill | **Revision:** | 1 |
| **Date:** | 30 November 2017 | **Client:** | GA Environment |
| **Drawing By:** | Reon Pienaar (PrEng Nr. 20100281) | **Approved By:** | Reon Pienaar (PrEng Nr. 20100281) |

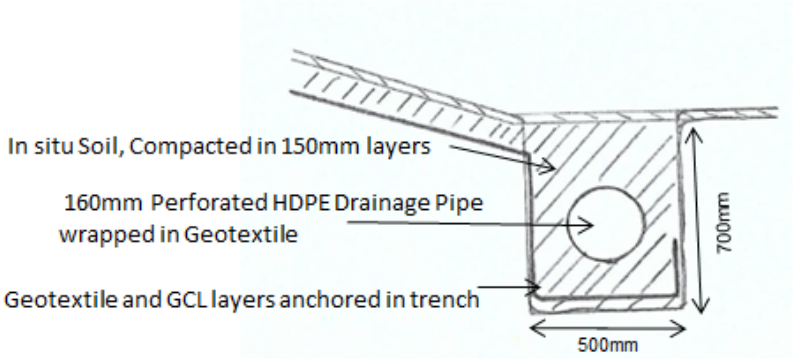
R.A.PIENAAR CONSULTING (PTY) LTD
Tel: 0721235517, Monumentpark, Pretoria




**Detail 1** - Proposed Layerworks for Capping Design




**Detail 3:** Drainage Bench with Anchor Trench




**Detail 2:** Anchor Trench and Leachate cut off drain

| | | | |
|---|---|---|---|
| **Drawing Owner:** | RAPienaar Consulting Reg: 2017/174192/07 | | |
| **Project Name:** | Kwazulu Natal Landfill Licenses | **Drawing Number:** | UMZ - 007 |
| **Drawing Title:** | Capping of uMzimkhulu Landfill - Details | **Revision:** | 2 |
| **Date:** | 22 December 2017 | **Client:** | GA Environment |
| **Drawing By:** | Reon Pienaar (PrEng Nr. 20100281) | **Approved By:** | Reon Pienaar (PrEng Nr. 20100281) |

R.A. PIENAAR CONSULTING (PTY) LTD
Tel: 0721235517, Monumentpark, Pretoria

# ANNEXURE B:

# Preliminary Engineering Design Cost Estimate

| ITEM NO | PAYMENT | DESCRIPTION | UNIT | QTY | RATE | AMOUNT |
|---|---|---|---|---|---|---|
| | | | | | | |
| **1.0** | | **PART 1: PRELIMINARY AND GENERAL** | | | | |
| | | | | | | |
| **1.1** | **SANS 1200A** | **GENERAL** | | | | |
| | | | | | | |
| | **8.3** | **Scheduled Fix-charge and Value-related Items** | | | | |
| 1.1.1 | 8.3.1 | Contractual Requirements | Sum | | | 1 600 000.00 |
| | 8.3.2 | Establishment of Facilities on the Site | | | | |
| 1.1.2 | PSA- 8.3.2.2 | Facilities for Contractor | Sum | | | |
| | | | | | | |
| 1.1.3 | 8.3.3 | Other Fixed-charge Obligations | Sum | | | |
| 1.1.4 | 8.3.4 | Removal of Site Establishment | Sum | | | |
| | | | | | | |
| | **8.4** | **Scheduled Time-related Items** | | | | |
| | | | | | | |
| 1.1.5 | 8.4.1 | Contractual Requirements | Sum | | | 900 000.00 |
| | 8.4.2 | Operation and Maintenance of Facilities on Site, for Duration of Contruction, except where otherwise stated | | | | |
| | | | | | | |
| 1.1.6 | PSA- 8.4.2.2 | Facilities for the Contractor | Sum | | | |
| | | | | | | |
| 1.1.7 | 8.4.3 | Supervision for Duration of Construction | Sum | | | |
| | | | | | | |
| 1.1.8 | 8.4.4 | Company and Head Office Overhead Costs for the Duration of the Contract | Sum | | | |
| | | | | | | |
| 1.1.9 | 8.4.5 | Other Time-related Obligations | Sum | | | |
| | | | | | | |
| | **8.5** | **Sums Stated Provisionally by Engineer** | | | | |
| | | | | | | |
| | (PSA) | (c) Additional Tests | | | | |
| 1.1.10 | | 1) Additional tests ordered by the Engineer | Prov Sum | 1 | | 20 000.00 |
| | | | | | | |
| 1.1.11 | | 2) Handling cost and charges on (c)(1) | % | 20 000 | | |
| | | | | | | |
| | | (d) Survey in terms of Land Survey Act | | | | |
| | | | | | | |
| 1.1.12 | | 1) Provisonal allowance for survey | Prov Sum | 1 | | 40 000.00 |
| | | | | | | |
| 1.1.13 | | 2) Handling cost and charges on (d)(1) | % | 40 000 | | |
| | | | | | | |
| | | | | | | |
| **TOTAL CARRIED FORWARD TO SUMMARY** | | | | | | **2 560 000.00** |

| ITEM NO | PAYMENT | DESCRIPTION | UNIT | QTY | RATE | AMOUNT |
|---|---|---|---|---|---|---|
| **2.0** | | **PART 2: EARTHWORKS: EMADLANGENI** | | | | |
| **2.1** | **SANS 1200D** | **SECTION: EARTHWORKS** | | | | |
| | 8.3.1 | Site Preparation | | | | |
| 2.1.1 | 8.3.1.1 | Clear and Strip Site | $m^2$ | 38 000 | 7 | 266 000.00 |
| | 8.3.2 | Bulk Excavation | | | | |
| 2.1.3 | PSD 8.3.2 | a) Excavate in all materials and use for embankment or backfill or dispose, as ordered | $m^3$ | 10 000 | 20 | 200 000.00 |
| | | b) Extra over for | | | | |
| 2.1.4 | | 1) Intermediate Excavation | $m^3$ | 80 | 500 | 40 000.00 |
| | PSD 8.3.4 | Importing of Materials | | | | |
| 2.1.5 | | a) Extra over for importing materials from commercial sources or from Borrow pits for use in capping | $m^3$ | 20 000 | 80 | 1 600 000.00 |
| 2.1.6 | | b) Opening up and closing down designated borrow pits | Sum | 1 | 50000 | 50 000.00 |
| | 8.3.6 | Overhaul | | | | |
| 2.1.7 | | a) Limited Overhaul | $m^3$ | 200 | 100 | 20 000.00 |
| 21.8 | PSD 8.3.14 | Stormwater chutes as shown on drawings | m | 200 | 1500 | 300 000.00 |
| **2.2** | **SANS 1200 DE** | **PART 2: SECTION : SMALL EARTH DAMS** | | | | |
| | PSDE-8.3.5 | Forming embankment | | | | |
| | | (i) Cut from excavation and/or stockpile | | | | |
| 2.2.1 | | (1) Suitable as fill material for stormwater berm | $m^3$ | 500 | 120.00 | 60 000.00 |
| | PSDE- 8.3.11 | Forming Site Capping | | | | |
| 2.2.2 | | (a) Shape and Compact In situ Waste Material | $m^3$ | 140 000 | 15.0 | 2 100 000.00 |
| 2.2.3 | | (b) Cut to fill from commercial sources a Drainage layer comprising of single sized crushed stone or gravel having a size of between 38 mm and 50 mm as shown on drawings | $m^3$ | 5 250 | 250.00 | 1 312 500.00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2.2.4 | | (c) Cut to fill from commercial sources silty sand material for use in protection layer as shown on drawings | $m^3$ | 7 000 | 300.00 | 2 100 000.00 |
| 2.2.5 | | (d) Cut to fill from commercial sources Topsoil layer as shown on drawings | $m^3$ | 7 000 | 120.00 | 840 000.00 |
| 2.2.6 | PSDE- 8.3.12 | 160 mm dia perforated HDPE pipes placed inside leachate collection system as shown on drawings including all bends, tees, corrections etc. | m | 780 | 250.00 | 195 000.00 |
| **2.3** | **PART SPEC PCI** | **PARTICULAR SPECIFICATION PCI: GEOTEXTILES** | | | | |
| | PCI-5.1 | Supply and install geotextile | | | | |
| 2.3.1 | | (a) Seperation Geotextiles in capping works as shown on drawings, 2.5mm thick, minimum 1.5kg/$m^2$ | $m^2$ | 70 000 | 12.00 | 840 000.00 |
| 2.3.2 | | (b) Around drainage pipes | $m^2$ | 1 000 | 12.00 | 12 000.00 |
| **2.4** | **PART SPEC PDI** | **PARTICULAR SPECIFICATION PDI : GEOSYNTHETIC MEMBRANES** | | | | |
| | PDI-15.1 | Supply and Installation of geosynthetic membranes | | | | |
| 2.4.1 | | (a) Geocomposite Drainage Layer (ABG Pozidrain® or similar) | $m^2$ | 35 000 | 65.00 | 2 275 000.00 |
| 2.4.2 | | (b) Geosynthetic Clay Liner (GCL) as per drawings | $m^2$ | 35 000 | 60.00 | 2 100 000.00 |
| 2.4.3 | PDI-15.2 | Geomembrane Guarantee | Sum | 1 | 20 000.00 | 20 000.00 |
| **2.5** | **PART SPEC PNE** | **SECTION: ESTABLISHMENT OF VEGETATION ON LANDFILL** | | | | |
| 2.5.1 | PNE-7.1 | The preparation, application and maintenance of vegetation | $m^2$ | 39 000 | 25 | 975 000.00 |
| **TOTAL CARRIED FORWARD TO SUMMARY** | | | | | | **15 305 500.00** |

| ITEM NO | PAYMENT | DESCRIPTION | UNIT | QTY | RATE | AMOUNT |
|---|---|---|---|---|---|---|
| **3.0** | | **PART 3: DAYWORKS** | | | | |
| **3.1** | DW-1 | Labour | | | | |
| 3.1.1 | | (a) Net cost of labour | Prov Sum | 1 | | 100 000 |
| 3.1.2 | | (b) Contractor's charges and profit associated with administration of the above item 3.1.1 | % | 100 000 | 15 | 15 000 |
| **3.2** | DW-2 | Plant | | | | |
| 3.2.1 | | (a) Net cost of plant (including operator, assistance, fuel, oil, maintenance, etc) | Prov Sum | 1 | | 100 000 |
| 3.2.2 | | (b) Contractor's charges and profit associated with administration of the above item 3.2.1 | % | 100 000 | 15 | 15 000 |
| **3.3** | DW-3 | Material | | | | |
| 3.3.1 | | (a) Net cost of material | Prov Sum | 1 | | 100 000 |
| 3.2.2 | | (b) Contractor's charges and profit associated with administration of the above item 3.3.1 | % | 100 000 | 15 | 15 000 |
| **TOTAL CARRIED FORWARD TO SUMMARY** | | | | | | **345 000.00** |

**SUMMARY OF BILL OF QUANTITIES**

| PART | DESCRIPTION | AMOUNT R-c |
|---|---|---|
| PART 1 | PRELIMINARY AND GENERAL | 2 560 000.00 |
| PART 2 | EARTHWORKS: EMADLANGENI LANDFILL | 15 305 500.00 |
| **SUB-TOTAL A** | | **17 865 500.00** |
| PART 3 | DAYWORKS | 345 000.00 |
| **SUB-TOTAL B** | | **18 210 500.00** |
| CONTINGENCIES<br>Add 10 % for Sub-total B (Provisional sum) | | **1 821 050.00** |
| **SUB-TOTAL C** | | **20 031 550.00** |
| VALUE ADDED TAX<br>Add 14 % for Sub-total C (Provisional sum based on current rate of VAT) | | 2 804 417.00 |
| **ESTIMATE TOTAL AMOUNT (INCL VAT)** | | **22 835 967.00** |

edtea

**Department :**
Economic Development, Tourism and Environmental Affairs
**PROVINCE OF KWAZULU-NATAL**

# Details of specialist and declaration of interest

## in terms of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008), and the Environmental Impact Assessment Regulations, 2014

| | |
|---|---|
| Reference number: | DC43/WML/0022/2017 |
| Project title: | *Basic Assessment for the proposed Decommissioning (Closure) of the uMzimkhulu Landfill, uMzimkhulu Local Municipality, KwaZulu Natal Province* |

| | | | |
|---|---|---|---|
| Specialist: | CIVIL ENGINEER | | |
| Name of company: | RAPIER Consulting (Pty) Ltd. | | |
| Postal address: | 635 Boeseperwer St Nouvertpark | | |
| Postal code: | 0181 | Cell: | 0721235517 |
| Telephone: | 0721235517 | Fax: | - |
| E-mail: | ream@rapier.co.za. | | |
| Qualifications: | BEng; BEng(Hons); MEng; Pr. | | |
| Professional affiliations: | ECSA, SAICE (Pr.Eng 20100281) | | |
| Expertise: | 13 years (waste management) | | |

| | | | |
|---|---|---|---|
| EAP: | Nyaladzi Nleya | | |
| Name of company: | GA Environment (Pty) Ltd | | |
| Postal address: | P.O Box 6723, Halfway House | | |
| Postal code: | 1685 | Cell: | 0761479451 |
| Telephone: | 011 312 2537 | Fax: | 27 11 805 1950 |
| E-mail: | environment@gaenvironment.com / nyaladzin@gaenvironment.com | | |

**Declaration by the specialist**

I, REON PIENAAR , declare that --

- I act as the independent specialist in this application;
- I do not have and will not have any vested interest (either business, financial, personal or other) in the undertaking of the proposed activity, other than remuneration for work performed in terms of the EIA Regulations, 2014;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Waste Act and NEMA, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Waste Act and NEMA, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I am aware that a person is guilty of an offence in terms of Regulation 48 (1) of the EIA Regulations, 2014, if that person provides incorrect or misleading information. A person who is convicted of an offence in terms of subregulation 48(1) (a)-(e) is liable to the penalties as contemplated in section 49B(1) of the National Environmental Management Act, 1998 (Act 107 of 1998).

Signature of the specialist

REPienaar Consulting (Pty) Ltd

Name of company

11/12/17

Date

**Professional Civil Engineer** **Curriculum Vitae**

# Reon Pienaar, PrEng

### Education

- MEng (Environmental Engineering), University of Pretoria, 2015
- BEng Hons (Environmental Engineering), University of Pretoria, 2007
- BEng Civil, University of Pretoria, 2004
- Lichtenburg High School, 1999
- Mafikeng Primary School, 1994

### Professional Registration

Professional Engineer with ECSA, Reg Nr. 20100281

### Experience

With BKS / AECOM: 12 Years

With Other Firms: 5 months

### Professional Memberships

- Registered as Member of SAICE, Nr 205479
- Vice Chair of Institute of Waste Management of South Africa (IWMSA) Central Branch, Member Nr 10114089
- Member of International Solid Waste Association (ISWA), Nr 14-1081
- Member of the Geosynthetics Interest Group of South Africa (GIGSA), Nr 9738

### Date of Birth

10 March 1981 ID: 8103105137081

### Nationality & HDI Status

South African

White male, no disabilities

## Key Technical Qualifications

Reon Pienaar holds a University degree in Civil Engineering, a BEng Honours degree and an MEng (Masters) degree in Environmental Engineering (specializing in Waste Management) from the University of Pretoria in South Africa. He has more than 12 years' experience in solid waste management, environmental management and dam engineering. The majority of his experience was spent in charge of projects and project teams.

He has experience in project management, planning, design and procurement as well as construction supervision of projects related to all types of waste management as well as dams. He has experience with the feasibility and viability of alternative waste treatment technologies and has presented papers on the topic at waste management conferences. He has experience in working with the Public Finance Management Act and Treasury Regulations and has spent a great deal of his recent time on PPP projects. His work within the South African Institute of Waste Management as vice chair of the Central Branch committee, has also given him experience in the intricacies of the circular economy as well as waste minimization and beneficiation and ultimate resource efficiency.

Reon worked for AECOM SA until May 2017 on various projects in South Africa; and has experience working in Lesotho. He has travelled on business to the United Kingdom, Turkey, Canada, Austria, Hungary and the Czech Republic. He started his own company, RAPienaar Consulting (Pty) Ltd, in May 2017 focussing on waste management and environmental engineering consulting. He has a very good understanding of the work and policies of the South African Government through his liaison with government clients and projects over the years.

He is registered as a Professional Engineer with the Engineering Council of South Africa (ECSA Reg. Nr. 20100281), he is a full member of the South African Institute of Civil Engineers (SAICE), a member of the Geosynthetic Interest Group (GIGSA), a member of the International Solid Waste Association, a member of MENSA and sits on the Central Branch Committee of the Institute of Waste Management of South Africa (IWMSA) as vice chairman.

## Key Non-Technical Qualifications

Reon is a person that gets along very well with his peers. He likes to have fun and work hard. In his role at AECOM he was responsible for managing staff and finances on a range of large projects. He is very well spoken and communicates well with his staff, peers and managers. He is very skilled in technical report writing and always looks for creative ways to solve problems. He is a team player who demonstrates an adaptability and willingness to seek and implement new solutions wherever possible. He is an emotionally intelligent person who cares for others and is aware of his own shortcomings and willing to work on them. He enjoys a challenge and is not afraid to work hard.

## General

He is a very good home cook, a music lover and an average but passionate golf player. He also enjoys other outdoor activities and sports like cricket, rugby, camping, hiking etc. He lives in Monumentpark, Pretoria, with his family. He has been married to Su-Marie (Primary School Maths Teacher) since 8 December 2007 and they have three daughters. Karla (6), Jani (4) and Nina (2). He has a code B South African Driver's License and is willing to travel.

## Work Experience

| Employer | Post Held | From | To | Reason for Leaving |
|---|---|---|---|---|
| RAPienaar Consulting (Pty) Ltd | Director and Owner | May 2017 | Present | N/A |
| AECOM SA (Pty) Ltd | Associate | Sep 2013 | May 2017 | Restructuring |
| AECOM SA (Pty) Ltd | Senior Manager/Engineer | Sep 2009 | Sep 2013 | Promotion |
| BKS (Pty) Ltd (later AECOM) | Engineer | March 2005 | Sep 2009 | Promotion |
| Jenkins & Potter Consulting (in the UK) | Engineer | Nov 2004 | March 2005 | Contract Ended |

## Professional Project Related Experience

**RAPienaar Consulting (Pty) Ltd**
May 2017 to Present

- **Project:** Engineering Investigation and Reporting for Sappi Enstra H:H Landfill in Springs
  **Client:** Sappi Enstra
  **Approx. Project Value:** R26,000
  **Date:** June 2017
  **Position:** Engineer responsible for site investigation and reporting on facility audit for Sappi Enstra Landfill in Springs.

- **Project:** Waste Company and Facility Audits on behalf of Betha Waste
  **Client:** Betha Waste
  **Approx. Project Value:** R25,000
  **Date:** July 2017
  **Position:** Engineer responsible for Audits on Betha Waste company and sub contract on behalf of Prominent Paints (PPG Group)

**AECOM (Pty) Ltd (formerly BKS (Pty) Ltd)**
October 2009 – May 2017

- **Project:** Feasibility Study on Development of Alternative Waste Treatment Technologies for the Ekurhuleni Metropolitan Municipality
  **Client:** Gauteng Infrastructure Financing Agency
  **Approx. Project Value:** ± R 5 Million
  **Date:** 2015 - present
  **Position:** Project Manager and Waste Engineer for lead transaction advisor team comprising technical, financial and legal specialists. Working with Treasury and PFMA.
- **Project:** Tshwane Regional Landfill Facility
  **Client:** Interwaste (Pty) Ltd
  **Approx. Project Value:** ± R 2.5 Million
  **Date:** 2014 - 2017
  **Position:** Project Manager and Lead Engineer. Responsible for client liaison and project management as well as designs required to obtain a waste license from authorities.
- **Project:** Landfill Master Planning
  **Client:** Ekurhuleni Metropolitan Municipality
  **Approx. Project Value:** ± R 2.5 Million
  **Date:** 2014 - 2016
  **Position:** Engineer and Project Manager responsible for updating the City's Landfill Master Planning and development of materials recovery facility master
  planning.

- **Project:** Franschhoek Waste Drop Off
  **Client:** Stellenbosch Municipality
  **Approx. project value:** ± R 2 Million
  **DATE:** 2015 - 2017

**POSITION:** Project Manager and Engineer responsible for site selection, design and construction monitoring of a major waste drop off facility in the Franschhoek area.

- **Project:** Stilfontein and Orkney Landfill Closures
  **Client:** City of Matlosana
  **Approx. Project Value:** ± R 3 Million
  **Date:** 2010 - 2014
  **Position:** Engineer responsible for Design, Tender Documentation and Construction Monitoring for the closure and rehabilitation of the Old Orkney and Stilfontein Landfill sites.

- **Project:** GIBELA Train Manufacturing Facility
  **Client:** GIBELA
  **Approx. Project Value:** ± R 100 Million
  **Date:** 2014 - 2017
  **Position:** Engineer responsible for planning and design of waste management requirements of the GIBELA train manufacturing facility in Gauteng, South Africa.

- **Project:** Mkuze Regional Landfill
  **Client:** Jozini Local Municipality
  **Approx. Project Value:** ± R 4 Million
  **Date:** 2013 - 2016
  **Position:** Engineer responsible for Design, Tender Documentation and Construction Monitoring for the upgrading of the Mkuze landfill site (project cancelled prior to construction).

- **Project**: Arnot Ash Water Return Dam
  **Client**: ESKOM
  **Approx. Project Value:** ± R 25 Million
  **Date:** 2013 - Present
  **Position:** Engineer responsible for Tender Documentation, Project Management and Construction Supervision of HDPE lined ash water return dam.

- **Project:** Municipal Landfill Audits
  **Client:** Masilonyana / Maquassi Hills Local Municipality
  **Approx. Project Value:** ± R 100 000
  **Date:** 2012 - 2014
  **Position:** Project Manager and engineer responsible for auditing and reporting on condition of landfill facilities in the Municipality.

- **Project:** De Beers (Mothusi) Dam Safety Inspections
  **Client:** Letseng Diamond Mine in Lesotho
  **Approx. Project Value:** ± R 500 000
  **Date:** 2011 - 2014
  **Position:** Responsible for the safety inspections at the De Beers (Mothusi) Dam at the Letseng Diamond Mine in Lesotho. Reon assisted Mr Danie Badenhorst (APP) with the initial inspection after which he was responsible to compile the report and undertake further inspections.

- **Project:** Western Cape Waste Licenses

  **Client:** Department of Environmental Affairs

  **Approx. Project Value**: ± R 10 Million

  **Date:** 2013 - 2015

  **Position:** Engineer responsible for Preliminary Design inputs into the closure or operations license applications for 50 waste disposal facilities in the Western Cape Province.

- **Project:** Construction Monitoring - North and South Dams
  **Client:** NCP Chlorchem
  **Approx. Project Value:** ± R 500 000
  **Date:** 2010 - present

**Position:** Engineer responsible to assist the APP with the Safety Inspection. Reon was then responsible for compilation of report and subsequently responsible or design and tender process to implement the recommended rehabilitation work. He was then also responsible for construction monitoring and project management at the Dams.

- **Project:** Rustenburg Waste Disposal Strategy and Transfer Stations
  **Client:** Rustenburg Local Municipality
  **Approx. Project Value:** ± R 40 million
  **Date:** 2010 – present
  **Position:** Responsible for planning and design of Solid Waste Transfer Stations as part of the municipality's plan to expand the waste services in the Rustenburg area.

- **Project:** Msukaligwa & Albert Luthuli Regional Landfill
  **Client:** Gert Sibande District Municipality
  **Approx. Project Value:** ± R 15 million
  **Date:** 2009 - 2010
  **Position:** Project Manager for the Feasibility Study and Waste License Application for a regional landfill site near Ermelo in Mpumalanga. Waste license was successfully obtained. Study included Site Selection and conceptual design. Reon was also responsible for the detail design of the facility as well as the compilation of the Tender Document and the management of the tender process.
- **Project:** Govan Mbeki Regional Landfill
  **Client:** Mpumalanga Department of Environment, Economic Development and Toursim
  **Approx. Project Value:** ± R 15 million
  **Date:** 2009 - 2014
  **Position:** Project Manager for the Feasibility Study and Waste License Application for a regional landfill site near Secunda in Mpumalanga (project stopped before completion).
- **Project:** Klinkerstene Regional Landfill
  **Client:** Interwaste (Pty) Ltd
  **Approx. Project Value:** ± R 5 million
  **Date:** 2009 - 2014
  **Position:** Project Manager for the Feasibility Study and Waste License Application for a regional landfill site near Delmas in Mpumalanga. Responsible for client liaison and project management as well as designs required to obtain a waste license from authorities.
- **Project:** Polihali Gauging Weir
  **Client:** Lesotho Highlands Development Authority
  **Approx. Project Value:** ± R 20 million
  **Date:** 2011 - 2014
  **Position:** Engineer responsible for the design, tender and construction monitoring of a gauging weir in the Senqu River in Lesotho as part of the second phase of the Lesotho Highlands Water Project to provide Water to South Africa.
- **Project:** Acid Mine Drainage (Witwatersrand)
  **Client:** TCTA (DWAF)
  **Approx. Project Value:** ± R 200 million
  **Date:** 2011 - 2013
  **Position:** Responsible for Waste Classification, wayleave Liaison and land acquisition in order to implement the Acid Mine Drainage project in the Witwatersrand area of Gauteng.
- **Project:** Exxaro Pollution Control Dams
  **Client:** EXXARO
  **Approx. Project Value:** ± R 70 000
  **Date:** 2012
  **Position:** Engineer responsible for Conceptual Design Report for the development of two pollution control dams at the Mooifontein Colliery.

**BKS (Pty) Ltd**
March 2005 – October 2009 (Candidate Engineer)

- **Project:** Rietfontein Weir

**Client:** Department of Water Affairs
**Approx. Project Value:** ± R 10 Million
**Date:** 2007 - 2008
**Position:** Engineer responsible for the preliminary design, final design, tender documentation and construction monitoring of the raising of the Rietfontein Weir near Kriel in Mpumalanga. Reon was also responsible for the design and tender process of a hazardous waste lagoon near the Rietfontein Weir that was never built due to budget constraints.

- **Project:** Orkney Solid Waste Transfer Station
  **Client:** Southern District Municipality
  **Approx. Project Value:** ± R 10 million
  **Date:** 2007
  **Position:** Design Engineer for the development of the Orkney Solid Waste Transfer Station.
- **Project:** Felophepha Waste Disposal Site
  **Client:** Potchefstroom Local Municipality
  **Approx. Project Value:** ± R 800 000
  **Date:** 2009
  **Position:** Engineer responsible for design, tender and (part time) construction monitoring of the second cell at the Felophepha landfill site near Potchefstroom.
- **Project:** Gert Sibande Integrated Waste Management Plan
  **Client:** Gert Sibande District Municipality
  **Approx. Project Value:** ± R 1 Million
  **Date:** 2004 - 2006
  **Position:** Engineer responsible for technical inputs and report writing to develop an integrated waste management plan for the Gert Sibande District Municipality.

Signed: ……. Date:12 September 2017

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