GROBLERSHOOP WASTE DISPOSAL SITE
ENGINEERING NEEDS ASSESSMENT & CONCEPTUAL DESIGN REPORT

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DECLARATION OF INTEREST

This report has been professionally independently prepared by USK Environmental & Waste Engineering (Pty) Ltd, which is a South African Professional Consulting firm, with a team of professionals specializing in a number of environmental science and environmental engineering fields.

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DECLARATION INTEREST. I hereby declare that to the best of my knowledge USK Environmental & Waste Engineering (Pty) Ltd nor any of its members and consultants does not have any Interest in the project or associated projects. I undertake to inform the responsible representative of the client of any change in this information or any new information that needs to be reported, which occurs before or during the meeting or work itself and through the period up to the publication of the final report.

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1. INTRODUCTION

1.1. Project Background

USK Environmental & Waste Engineering were appointed by GA Environment (Pty) Ltd acting on behalf of the Department of Environmental Affairs (DEA), to undertake a engineering needs assessment and conceptual design input for the licensing of the existing unlicensed waste disposal facilities including the Groblershop Waste Disposal Site, located in Kheis Local Municipality in in the Northern Cape Province.

This report is part of a suite of supporting documentation which is required as part of an application for environmental authorization for the waste license application for the Groblershop Landfill Site sites, but also forms the basis for future detailed engineering design and development of the landfill site to ensure compliance with the current legal requirements.

1.2. Scope of Work

The main objectives of investigations comprised of the following:

- 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.
- Develop a suit of site-specific recommendations for consideration during the engineering design of the proposed landfill site and associated infrastructure.

2. LEGISLATIVE REVIEW

2.1. Legislation

The waste disposal facility must comply with the regulatory requirements of the National Environmental Management Waste Act (NEMWA), Act No 59. of 2008 as well as the EIA Regulations promulgated in terms of the National Environmental Management Act (NEMA), Act No. 107 of 1998, as amended.

All design recommendations and proposals are made and accordance with the following Acts, Standards and Guidelines:

- Notice 634 of 2013 National Environmental Management: Waste Act (59/2008): Waste Classification and Management Regulations;
- Notice 635 of 2013 National Norms and Standards for the Assessment of Waste for Landfill Disposal;
- Notice 636 of 2013 National Norms and Standards for Disposal of Waste to Landfill;

- Minimum Requirements for Waste Disposal by Landfill: Second Edition 1998: Department of Water Affairs and Forestry (Trilogy of documents); and
- The National Environmental Management Waste Act (NEMWA- Act 59 of 2008).

3. METHODOLOGY

3.1. Field Work

In order to assess the requirements for the licensing of a site it is essential to gain perspective on the current status of the site. A site visit was undertaken on the 5 August 2015.
During the site visit the following aspects were noted and considered in the costing analysis:

- The condition of the existing civil infrastructure; roads, cell and pond,
- Cover materials available on site;
- In-situ soil conditions; and
- The location of groundwater monitoring boreholes on or near the site.

4. SITE ASSESSMENT

4.1. Landfill Site Classification

Groblershop is a very small desert town in the Northern Cape Province with a population size of 4938 people (Stats SA, 2011). In terms of waste generation rate of 0.75 Kg per capita, this translates into a daily waste generation of 3.7 tons per day, however waste collection only sits at about 2.6 tons per week and hence the site is only classifiable as a communal landfill site a G:C:B- (General waste, communal size and non-leachate producing) based on Minimum Requirements for Waste Disposal by Landfill: Second Edition 1998 (DWAF,1998b). This would mean a rate of deposition far less than 25 Tons Per Annum.

Following the site inspection and assessment of the existing waste disposal, the types of waste disposed at the site generally categorized as:

1. General domestic waste
    - Organic Waste
    - Plastics
    - Paper and Cardboard
    - Tins/Can
2. Garden/Green Waste
3. Builders Rubble

All of the above waste streams classify as General waste hence the (G) classification. In terms of leachate generation, the region where the site is located is characterized by very low precipitation and extremely evaporation rates, without A-Pan[1] evaporation and annual precipitation data, it is reasonable to adjudge that that the site would be a negative climatic water balance site, and hence the (-ve) classification.

Given the above, old classification, this class of landfill would have only required a 150mm base preparation layer.

4.2. General Site Desription

The current Groblershop waste disposal site is basically an unlicensed dumpsite with neither operational nor engineered mitigation controls. The main method of landfilling has been trench method and open area dumping with regular burning of waste to reduce surface volumes. There is hardly any cover material on site, and therefore no daily cover is applied.

[1] [1] **Class A pan coefficients (Kp) is used to estimate daily reference evapotranspiration (ETo)**

5. UPGRADES AND DESIGN SPECIFICATIONS

In order for the site to meet legal requirements for licensing, a few minimum upgrades and engineering design specifications must be implemented.

5.1. Landfill Site Classification and Containment Barrier Design

The containment barriers of landfills for the disposal of waste in terms of section 4 of the Norms and Standards must comply with the minimum engineering design requirements specified in the norms and standards.

As described in section 4 above, given the classification of the in-coming waste streams at the site, the site must be design with a Class C Containment barrier (Liner system) in accordance with Section 3(1) and (2) of the Norms and Standards.

(c) Class C Landfill:

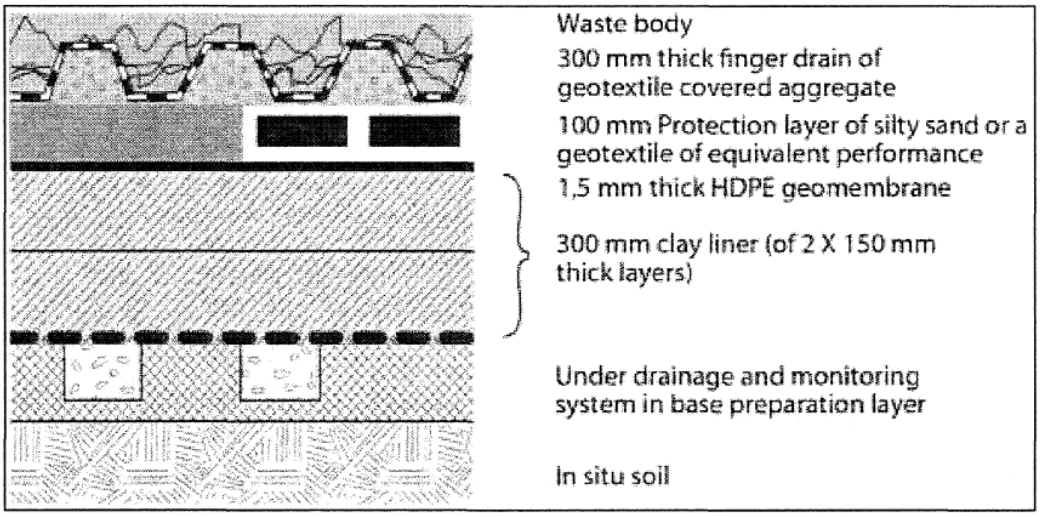

Figure 1 Liner System for a Class C Landfill (WCMR, GNR 636, 2013)

There is currently no groundwater monitoring well at or near the site, and so information regarding groundwater conditions on site was available at the time of this investigation. However there was no evidence of water in the excavated pond or channels during the site visit. The lack of surface water indicates that there aren't shallow ground water conditions.

The site is largely characterized by sandy soils, which were evident during the site visit. From a geotechnical standpoint the site is not ideal due to the sandy soil make for poor base layers for landfill and make excavation and trenching difficult and thus limiting airspace and availability of cover material This matter may need to be addressed and investigated further during the detailed engineering and geotechnical design phase.

The presence of clay (suitable for the Compacted Clay Liner (CCL) in the basal lining system) in the area immediately surrounding the proposed facility is assumed to be limited. The proposed basal liner system presented in the conceptual design substitutes the required CCL with a Geosynthetic Clay Liner (GCL) of equivalent or better performance.

The proposed liner system is:

- A Non-Woven Geotextile (Kaytech A4 or similar)
- 150mm Stone Layer
- 1.5mm High Density Polyethylene (HDPE) Geosynthetic Layer
- Geosynthetic Clay Liner (GCL)
- Cuspated Drain
- 1mm Linear Low Density Polyethylene (LLDPE) layer A similar lining system is required for the contaminated stormwater collection pond. The feasibility of this liner system should be investigated further at detail design phase.

5.2. Leachate Management System

As presented in Figure 2, legislation requires a basal collection system and a monitoring system (leak detection system) for leachate collection. Currently there is no leachate collection system on site and no leak detection system on site. A leachate manage system would need to be installed to meet licencing requirements.

As a concept, a herring-bone slotted pipe system is proposed to be installed within the final stone aggregate layer to facilitate leachate flow and disposal.

The cell basin is proposed to be constructed in a series of troughs and berms as illustrated in Figure 2. This design ensures that there is an adequate slope (>2%) for gravity flow drainage. In addition, a longitudinal grade of 1V:120H along the basin of the cell further assists in promoting the gravity flow of the leachate (See Figure 3).

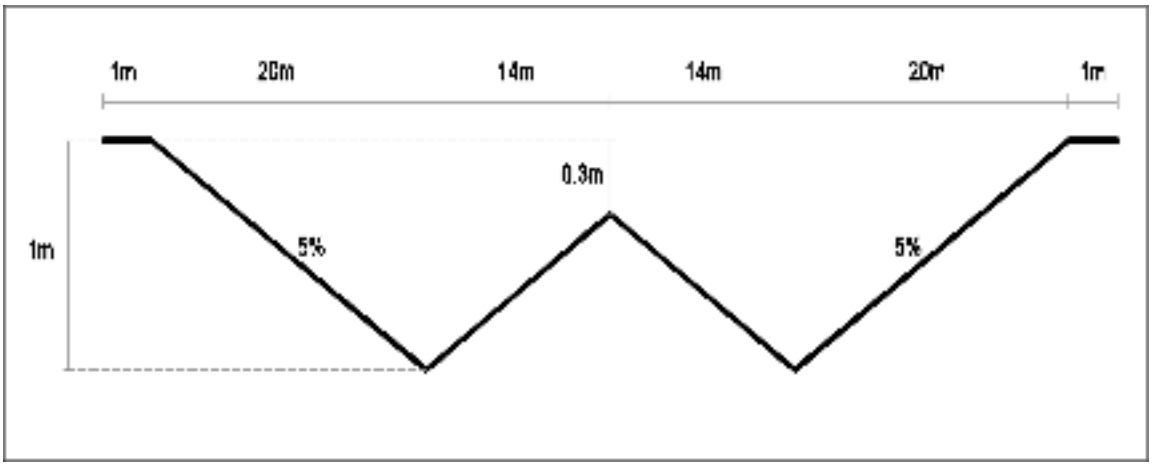

Figure 2 Example of a cross Section through Landfill Floor Layout

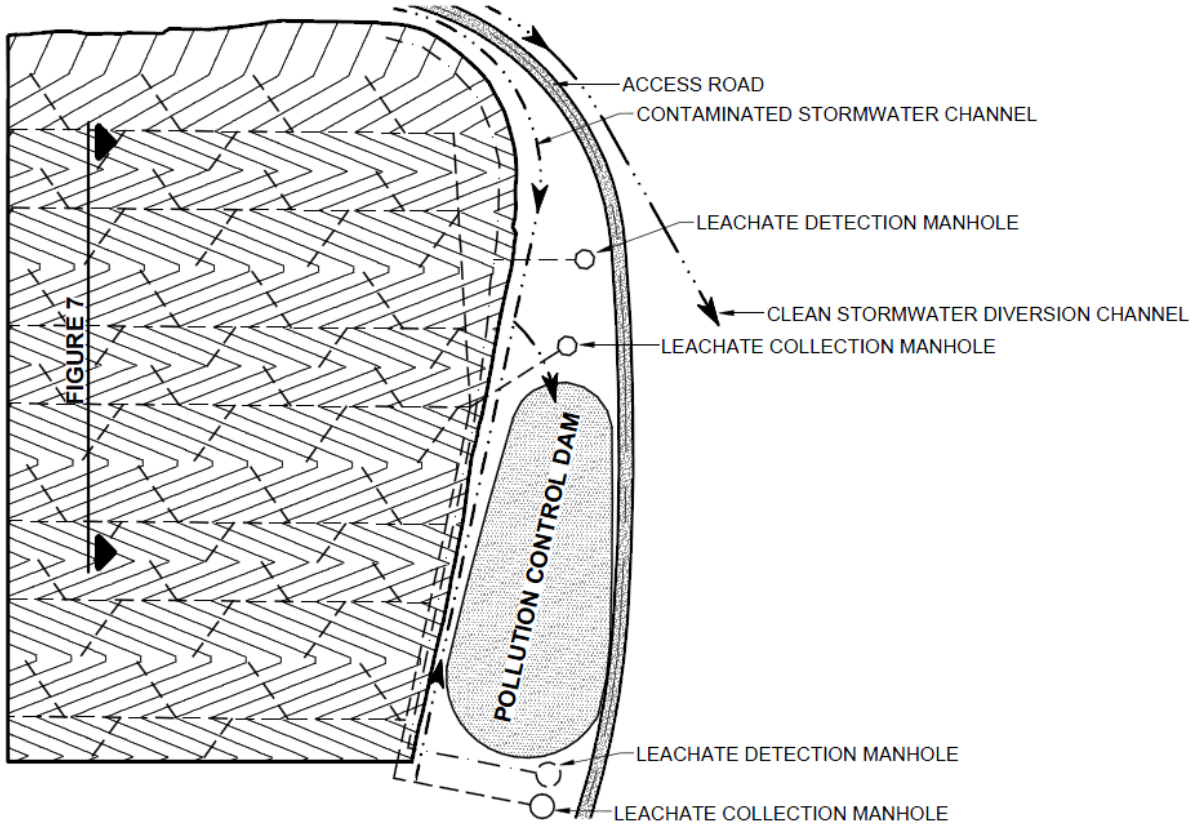

Figure 3 Example of a herringbone leachate collection system

Any leachate or contaminated stormwater which may form in the cell will be collected in the leachate collection layer of the basal lining system and will be directed toward one leachate collection manhole. One leakage detection manhole is also proposed to detect any leakage indicating failure in the liner system.

It is proposed that the site be developed a single cell with one intermediate berm in its centre.

The material from the removed berms can be moved to the stockpile area to be used as fill material for the pond or as daily cover or even as final cover (depending on test results proving the material to be suitable for this application).

The Minimum Requirements for Waste Disposal by Landfill: Second Edition (DWAF, 1998b) is the presiding legislation for the capping requirements for a landfill site. Based on this legislation, a class G:C:B- landfill would only require a 200mm topsoil layer above the waste body. It is believed that new legislation is pending for the capping system of landfill sites. It is envisaged that a clay like layer will be required and that the properties of the capping layer for a Class C landfill are likely to be similar to those required of a “V-layer” as specified in The Minimum Requirements for Waste Disposal by Landfill: Second Edition (DWAF,1998b) for a G:M:B- landfill class. Any soil used in a “V layer” must have a Plasticity Index of between 5 and 15 and a maximum particle size of 25mm. The maximum density must be at least 85% of the Proctor maximum dry density at a water content of Proctor optimum to Proctor optimum +2%. The saturated steady state infiltration rate into a compacted soil “V layer” should not exceed 0,5m/y, as measured by means of an in situ double ring infiltrometer test.

As a control measure a lined contaminated stormwater pond should be designed to hold at least a 1:50 year flood of the waste cell surface area.

An appropriately sized stormwater drain or channel should be constructed around the cell to divert runoff into the contaminated stormwater pond. This channel is only useful on completion of the full cell development.

One leakage detection manhole at the pond is recommended to monitor the lining system.

The water collected in this pond would then be used for recirculation onto the waste pile (done manually by the operator of the site using pumps/tankers/bowser) or left to evaporate.

The recommended number of monitoring boreholes are prescribed by the Minimum Requirements for Water Monitoring at Waste Management Facilities (DWAF, 1998a) and in the case of this landfill site, only one appropriate located monitoring well would be sufficient.

5.3. Other Infrastructure

5.3.1. Weighbridge

There is no weighbridge, however the incoming volumes are so small and as such it does not warrant installing a weighbridge, however, small weigh pads would be recommended to ensure that accurate records of incoming waste are kept and manual record keeping must be done and data transferred to South African Waste Information System (SAWIS).

5.3.2. Recycling Facility

It is recommended that a recycling shed facility be considered as a potential small scale material recovery centre to promote the separation of recyclables out of the general waste stream. It may serve as a centralised facility where source separation of recyclables and garden refuse can take place. It is proposed to provide the community with sorting tables and a hand baler and investigate the possibility of a hand chipper/grinder for garden waste. Recyclables can then be separated, baled and sold; and green garden waste can be chipped and used to produce compost for the adjacent gardening activities. These two activities alone will assist in reducing the volume of waste disposed (resulting in reduced loss of airspace) and will provide a potential source of income in the sale of recyclables, and provide compost feedstock for the local subsistence farmers/gardeners. The viability of such an opportunity should be investigated as legislation is either in place or imminent which impose such material management operations on the local municipalities.

5.3.3. Fence

A flat rope fence of 1.8 meters should be constructed around the landfill site.

5.3.4. Boom Gate

A 7m long boom gate should be erected at the site entrance to allow access control.

5.3.5. Store Room

A small storeroom for equipment used at the landfill site should be erected.

5.3.6. Monitoring borehole

A single monitoring borehole drilled to at least the first significant water strike is proposed to act as an early warning system for potential groundwater impacts at the site.

5.4. Conceptual Layout

A conceptual layout showing the proposed basic infrastructure layout at the Groblershop Landfill Site is attached as an appendix. The drawing shows that access to the site is off the gravel road that runs into the site from the north of the site. The proposed waste cell development plan is to divide the area into 2 independent waste cells approximately 54,750m^2 and 46 381m^2. The advantage of this waste cell division is to ensure progressive waste placement within the cells and to minimize contaminated water runoff during the operations of the site as only one part of the cell should be used for disposal at a given time.

5.5. Financial Estimation

The following provides an estimation of direct costs as well as indirect costs (such as professional fees) for implementing the above engineering recommendations to bring the site into compliance with legal requirements for licensing. This cost analysis applies likely current-day construction rates. The rates were based on projects of a similar nature and projects currently underway. It must be noted that high-level cost estimates done are highly susceptible to inaccuracies as the current market place is experiencing huge fluctuations and competitive pricing. Equally so, the Site is relatively remote, so the risk of less-experienced Contractors bidding to undertake the work and more-experienced bidders wanting to reduce risk. Other indirect issues such as labour costs, oil price and transportation costs are also currently impacting in varying degrees on the pricing for construction contracts.

Table 1 Cost Estimate for landfill engineering

ITEM	ESTIMATED COST
Site Clearing	28,000.00 R
Earthworks	1,300,000.00 R
Lining System	3,000,000.00 R
Leachate Management System	530,000.00 R
Signage	3,000.00 R
Fencing	81,000.00 R
Groundwater Monitoring	50,000.00 R
Minor Infrastructure Costs	400,000.00 R
Indirect Costs	200,000.00 R
Contractor P&Gs	900,000.00 R
Professional Engineering Fees	714,120.00 R
Recoverable Expenses	40,000.00 R
Contingencies	840,000.00 R
TOTAL	**8,086,120.00 R**
VAT (14%)	1,132,056.80 R
GRAND TOTAL	9,218,176.80 R

6. CONCLUSIONS

The following conclusions are made:

- Based on the assessment undertaken at the existing Groblershop waste disposal site, given the above recommended engineering upgrades, the site can be licensed and operated within the legal requirements for landfill design in South Africa.
- The site does not currently pose a major environmental risk however it is important that from an engineering point of view, the appropriate mitigation measures must be put in place.

7. DISCLAIMER

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted engineering practices. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the consultants review the changes and either verify or modify the conclusions of this report in writing.

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