ENVIRONMENTAL IMPACT ASSESSMENT REPORT
FOR THE VLAKFONTEIN WASTE TREATMENT FACILITY

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EXECUTIVE SUMMARY

This environmental impact assessment report was compiled as a requirement to Regulation 718 of 3 July 2009 that lists waste management activities in terms of the National Environmental Management: Waste Act (No 59 of 2008), read in conjunction with Regulation 543 of 18 June 2010 that stipulates the environmental impact assessment regulations in terms of Sections 24(5), 24M and 44 of the National Environmental Management Act (No 107 of 1998).

This proposed activity envisaged the design, installation and operation of a waste treatment facility in a worked-out brown fields old brickworks. The key findings from the EIA were that the current condition of the site is not good and that a professionally installed and operated waste treatment facility will uplift the environmental conditions of the site. Excellent relationships were developed during the scoping phase of this project between the applicant and the local community with the future development of a nature conservancy, in combination with the local community’s planned nature conservancy on their adjoining properties, on the site the resultant outcome of negotiations between the two parties.

In addition, the urgent need for additional hazardous waste disposal facilities in the Gauteng province is reaching alarming proportions. The well-publicised debacle with illegal disposal of medical waste during 2010 is a symptom of this.

The positive implications of this activity can be summarised thus as the improvement of the site’s environmental conditions, the establishment of a nature conservancy together with a cooperative local community and the alleviating of the Gauteng province’s dire need for additional hazardous waste disposal facilities. With the complete implementation of mitigation measures, as prescribed in this report, very few negative implications will result from the proposed activity. Possible such implications relate to air quality, water quality, noise and odour impacts. However, with the implementation of correct mitigation measures these should all be negated.
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APPENDIX B - General site layout plan, Google image, site cadastral plan topographical maps, topographical survey.

APPENDIX C - Graphical presentations of environmental parameters.

APPENDIX D - Ecological survey report.

APPENDIX E - Air quality impact assessment report.

APPENDIX F - Public participation information.

APPENDIX G - Feedback received from stakeholders.

APPENDIX H - Consolidation of stakeholders' feedback and project team responses.

APPENDIX I - Draft environmental management programme.

APPENDIX J - Traffic impact study report.

APPENDIX K - Waste treatment facility design report.

APPENDIX L - Waste treatment facility design report drawings.
1. INTRODUCTION

Envitech Solutions (Pty) Ltd was appointed by Waste Giant Landfill (Pty) Ltd to assist with the site selection process, site investigations and technical design for a new integrated waste treatment and disposal facility in order to facilitate the application for a waste management license in terms of the National Environmental Management: Waste Act (No 59 of 2008). They subsequently requested Softchem to complete the environmental impact assessment (EIA) process required by Regulation 718 of 3 July 2009 that lists waste management activities in terms of the National Environmental Management: Waste Act (No 59 of 2008); read in conjunction with Regulation 543 of 18 June 2010 (EIA regulations) that stipulates the environmental impact assessment regulations in terms of Sections 24(5), 24M and 44 of the National Environmental Management Act (No 107 of 1998).

A scoping report required in terms of Section 28 of the EIA regulations to accompany the waste management licence application was completed in December 2010 (Friend et al., 2010). In accordance to Section 28(1)(n) of Regulation 543: Environmental Impact Assessment Regulations, 18 June 2010; read in conjunction with sections 24(5), 24M and 44 of the National Environmental Management Act (No 107 of 1998); the scoping report included a plan of study (terms of reference) that set out the proposed approach to the relevant environmental impact assessment. For the Vlakfontein waste treatment facility the plan of study included, inter alia, a description of tasks to be undertaken for the environmental impact assessment process, an indication of the stages for competent authority consultation, a description of the assessment methodology to be used and particulars of the public participation process to be followed. Finally, the plan of study also proposed the relevant investigations to be completed for this EIA. The various aspects that were to be addressed to make an objective assessment of the proposed activity and any related alternatives, including the no-go option, were as follows (Friend et al., 2010):

- climate,
- geology,
- topography,
- land use capabilities,
- hydrology,
- air quality,
- natural vegetation,
- animal life,
- archaeological, heritage and cultural aspects,
- sensitive landscapes and visual aspects,
- noise and odour,
- social and economic environment, and
- occupational health and safety.

The scoping report as a whole and the plan of study for this EIA in particular, as summarised above and set out in the scoping report, was accepted by the Department of Environmental Affairs on 9 February 2011 (reference No 12/9/11/L444/3) and the documentation to this effect presented in Appendix A.
In terms of Section 31 of the EIA regulations the components of this environmental impact assessment report are set out below, with references to the relevant sections within this report:

- details and expertise of the EAP who prepared this report (Section 11);
- description of the proposed activity (Section 3);
- description of the property on which the activity is to be undertaken and the activity’s location on the property (Section 2);
- description of the environment that may be affected by the activity (Section 5) and the manner in which the physical, biological, social, economic and cultural aspects of the environment may be affected by the proposed activity (Sections 5 and 8);
- details of the public participation process (Section 9);
- description of the need and desirability of the proposed activity (Section 4);
- identified potential alternatives, inclusive of associated advantages and disadvantages (Section 6);
- indication of the methodology used in determining significance of potential environmental impacts (Section 7);
- description and comparative assessment of alternatives (Section 6);
- summary of findings and recommendations of specialists (Sections 5 and 8);
- environmental issues identified during the EIA process, assessments of significance and mitigation measures (Section 8);
- assessment of identified potentially significant impacts (Section 8);
- description of assumptions, uncertainties and gaps in knowledge (Section 13);
- reasoned opinion of whether activity should be authorised and any prescriptive conditions (Section 13);
- an environmental impact statement (Section 13);
- draft environmental management programme (Section 12);
- copies of specialist’s reports (relevant appendices);
- any specific information required by the competent authority (Section 13);
- any other required matters (Section 13); and
- either proof or motivation with regard an investigation into feasible alternatives (Sections 6 and 13).
2. PROPERTY DESCRIPTION

The proposed project site is located on the disused De Deur Brickworks site, which is located some 12 km north of Vereeniging in Gauteng (see Google image in Appendix B and aerial photograph in Figure 1). In cadastral terms, the site comprises Portions 32, 84, 93 and 107 of the Farm Vlakfontein 546 IQ (see site cadastral plan in Appendix B). Access to the site is via a gravel road (Cronje Road), which is off the R82 (Vereeniging/Johannesburg Road).

The site has previously been used as a brickworks (for clay brick manufacturing) and an associated large, open pit excavation, from which residual dolerite clays were mined, occurs centrally within the site. Remnants of the brickworks infrastructure are located to the east of the open pit excavation, while the site offices are situated just off the main entrance, which is to the northeast. The site has also been used as a source of selected soil materials, and several shallow borrow pits exist adjacent to the large open pit excavation from which quartzite gravels and weathered bedrock have been excavated. Several borrow pits are also located along the southwestern site boundary, from which weathered shale bedrock has been previously sourced.

Water has accumulated at the base of the large, open pit excavation on the site as well as in the above-mentioned borrow pits along the southwestern site boundary. Site surveys have shown that the surface water level of the standing water is 1 504 m above mean sea level (mamsl) in the open pit excavation, and varies between 1 507 mamsl and 1 515 mamsl within the borrow pits.

The remainder of the site is undeveloped and relatively undisturbed. Electrical power lines, however, traverse the site in several places. The vegetative cover across the site comprises mainly grassland, with some dense thorn veldt in places. Across much of the southwestern portion of the site, particularly along the crest and slopes of the elevated ridge, quartzite boulders are heavily scattered across the surface.

![Figure 1 Aerial photograph of the site.](image-url)
The natural elevation of the site ranges from approximately 1506 masl in the southeastern corner to approximately 1565 masl at the highest point of the ridge in the southwest. The minimum elevation at the base of the open pit excavation is some 1504 masl.

Drainage at the site is controlled by a stream flowing towards the east, and which is located approximately 300 m from the northeastern boundary of the site. Several small dams are located along this stream. No other surface water bodies were observed within or near to the site.

The site is substantially scarred and can therefore be considered as a “brown fields” site for development purposes. Substantial and costly remedial measures would be required to render to site suitable for any other use. See also the 1:50 000 topography maps and a topographical survey in Appendix B.
3. DESCRIPTION OF THE PROPOSED ACTIVITY

Waste Giant Landfill (Pty) Ltd is an established waste management company with operations including both the collection and disposal of general and hazardous wastes. The company is considered to be the fourth largest waste management company in South Africa and has been in existence since 1994.

In terms of the development and growth of the Waste Giant group, the need was identified for a comprehensive, integrated waste treatment and disposal facility, which would meet the requirements of the National Environmental Management: Waste Act (No 59 of 2008) and the new National Waste Management Strategy (NWMS) that has been developed in accordance with the Waste Act. Adherence to the waste management hierarchy as described in the NWMS is of particular importance in this project.

A site selection process was carried out in accordance with the Minimum requirements for waste disposal by landfill (DWAF, 1998). Various sites were identified and evaluated to determine their suitability for the intended use as described above (see also Section 6). After due consideration of all the relevant criteria, it was decided that the existing De Deur Brickworks site (now disused) met with the required criteria in terms of the technical aspects of site selection. The existing De Deur Brickworks site (Vlakfontein) is considered to be a “brown fields” site due to the substantial disturbance of the land arising from significantly deep excavations for clay materials, stockpiling of brick wastes and derelict brick kilns and buildings that were used during the brick making operations.

The proposed development will therefore enable the rehabilitation of the existing site through properly engineered landfill, closure and rehabilitation procedures, which form part of the proposed development. In accordance with the proposed new National Waste Management Strategy, the proposed waste treatment and disposal facility will include the following:

- materials recovery facility (MRF) for the recovery of recyclables,
- hazardous waste treatment plants,
- health care risk wastes (HCRW) treatment facilities (for both infectious and pathological wastes), and
- an engineered landfill (classification “Type 1”) developed in a series of cells.

The proposed facility is intended to accept the following waste streams for treatment and disposal:

- general wastes comprising domestic, commercial and industrial wastes;
- hazardous wastes (extreme and high risk wastes); and
- health care risk wastes.

A general site layout plan of the proposed activity is presented in Appendix B. It is envisaged that the proposed development will consist of the following facilities and infrastructure:

**Entrance area with access control** – security gate with boom control to control all vehicles entering the facility.

**Weighbridges** – to record all incoming and outgoing vehicles and their loads.

**Administration building with parking** – sufficient on-site parking will be provided for all site staff and visitors to the facility.
**Waste acceptance control** - the strict application of a waste acceptance procedure is critical to ensuring that unacceptable waste types do not enter the site and worker health and safety are not endangered. This is illustrated in Figure 2 (EVT, 2011).

**Laboratory facilities** - a suitably equipped site laboratory will be provided to undertake confirmatory testing of hazardous wastes accepted at the facility for treatment. A quality management system will also be implemented for the laboratory.

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**Figure 2** Waste acceptance control procedures.
Standing/parking area for incoming trucks – parking area will be provided on site for trucks whilst confirmatory testing is carried out at the laboratory.

Materials recovery facility (MRF) - materials recovery facilities are facilities at which components of a mixed waste stream are extracted by the use of manual and mechanical separation techniques. MRFs may be high and low technology facilities, depending on the sophistication of plant and equipment employed and the numbers of staff working in the operation of the process. Typically, metals, mixed plastics, paper, glass, card and textiles are removed for recycling through the operation.

Waste treatment plant – incoming hazardous wastes will be classified in accordance with the new National Standards for Waste Classification and Management. These wastes will be treated accordingly to meet the new regulations.

Health care risk waste treatment – a hydroclave process will be used to treat all infectious wastes whilst a high temperature thermal process will be used to treat pathological wastes. All processes will be designed to the latest standards and will meet all the latest emission requirements.

Landfill facility – an engineered landfill will be constructed and operated in accordance with the Minimum requirements for waste disposal to landfill (DWAF, 1998). The landfill will also be lined in accordance with the latest standards in terms of the revised waste classification system (2010).

The overall hazardous waste treatment system is illustrated in Figure 3, and described in detail in the design report presented in Appendix K (EVT, 2011), with associated drawings provided in Appendix L.

![Hazardous waste treatment system diagram](image)

**Figure 3** Hazardous waste treatment system.

Weather station – will be provided to monitor and record all meteorological data. This information will be used to manage all operations on the site in order to control any potential emissions from the site.

Security – the site will be provided with a suitable security system including fencing, access control and guarding to control and manage all access to the facility.
**Roads** – all on-site roads will be paved and maintained to minimise the generation of dust. Temporary or permanent gravel roads will be wetted to ensure proper dust suppression.

As part of the greening of the site, the undeveloped areas on the property will be appropriately fenced off and stocked with suitable game. Appropriate indigenous vegetation will also be planted on the site. The intention is to register the entire site as a nature conservancy and to utilise the site for educational purposes, both in terms of nature conservation and the industrial application of proper waste treatment and disposal. A precedent for this approach already exists and was successfully implemented at the Mariannhill landfill site near Pinetown in KwaZulu-Natal. The lead engineer of Envitech Solutions (Pty) Ltd for this project was directly responsible for all facets of the development of the Mariannhill landfill, from site selection, through to design, permitting and finally construction. He has also been involved in the successful implementation of a landfill gas to electricity project on the Mariannhill landfill site.

The complete proposed waste treatment facility, inclusive of various options, assumptions and uncertainties, as well as appropriate alternatives, is described in detail in the design report (EVT, 2011) presented in Appendix K (the associated drawings are provided in Appendix L).
4. NEED AND DESIRABILITY OF THE PROPOSED ACTIVITY

At present in South Africa there is an immediate need for appropriate waste treatment facilities for both hazardous wastes and health care risk wastes (HCRW). In particular, there would appear to be a shortage of HCRW treatment facilities on a national scale that comply with current air quality regulations. It is an acknowledged fact that the HCRW industry is in crisis with numerous incidents being reported nationally in the media, of illegal dumping and disposing of HCRW. This has resulted in a number of prosecutions that are still ongoing. Waste Giant has been involved in the cleanup of a significant number of these illegal disposal sites.

As a result of the above and the need to provide modern waste treatment and disposal facilities for many of their industrial clients, it was determined that a waste disposal facility was required to be located in the Johannesburg/Sasolburg/Vereeniging area.

The present site can be classified as a brown field site and the proposed development on the disused brickworks site can therefore be seen to not only provide a waste treatment facility, which is in serious demand - particularly when considering the rigorous requirements of the new Waste Act, but also effecting a rehabilitation process for the significantly disturbed site to be included in an environmental conservancy. As mentioned in Section 3, part of the greening of the site will involve appropriately fencing off the area, stocking it with suitable game and planting of appropriate indigenous vegetation to ultimately register the entire site as a nature conservancy and to utilise the site for educational purposes, both in terms of nature conservation and the industrial application of proper waste treatment and disposal. (As was the case with the successful implementation of a similar scenario at the Mariannhill landfill site near Pinetown in KwaZulu-Natal.)

Although the site is currently not being used for agricultural purposes, the areas not disturbed by the brick making operations, would appear to be only suitable for grazing on a very limited scale. Due to the geology of the site, the soils would not appear to be suitable for crop farming. The final rehabilitated site would therefore only be suitable for agriculture in terms of grazing and would be best suited for use as a nature conservancy.

The proposed project will lead also to social benefits in the form of significant increased employment opportunities on the project itself, particularly, with respect to waste separation and recycling. It will also create some multiplier spin-offs through the civil engineering construction and other inputs required.

The company will provide an undertaking to employing all of the labour required for the project from within nearby disadvantaged communities. A number of opportunities will also prevail for the training of skilled operators with respect to the management and operations of the treatment plants and landfill. It is anticipated that this project will generate in excess of 90 new jobs. The final figure could be higher, depending on the final sizing and configuration of the various treatment plants.
5. DESCRIPTION OF THE ENVIRONMENT

Apart from the detailed descriptions given in the proceeding sections, graphical presentations of the environment for the Vlakfontein site are given in Appendix C for the following parameters:

- agricultural potential - given as moderate for approximately half the site area,
- ridges - Class 1 ridge identified in the western area of the site,
- land cover - majority of the area presented by quarrying,
- hydrology - no major significant entities identified,
- vegetation map - site identified as Soweto Highveld grassland,
- ecological processes,
- sensitive features, and
- urban edge.

5.1 Climate

The climate for the Vlakfontein area is characteristic of the Highveld region. In general the climate is typified by warm summers, with showers and thunderstorms commonly occurring in the late afternoon with rainfall that vary between 700 mm and 800 mm, and cool and dry winters (MLM, 2011). Various sources were used to compile the climatic data given below, with the associated relevant recording periods.

5.1.1 Rainfall

A typical Highveld region rainfall pattern is evident in the data. The average, minimum and maximum rainfall for the Vereeniging area is presented in Figure 4 for the period January 2009 to December 2009 (SAWB, 2010).

![Rainfall graph](image-url)

**Figure 4** Rainfall for the Vereeniging area for the period January 2009 to December 2009.
5.1.2 Temperature
The temperature variation between warm summers and cold winters is typical for the Highveld region. Average, minimum and maximum temperatures for the Vereeniging area are presented in Figure 5 for the period January 2009 to December 2009 (SAWB, 2010).

![Temperature chart](image)

Figure 5 Temperatures for the Vereeniging area for the period January 2009 to December 2009.

5.1.3 Humidity
The average, minimum and maximum relative humidity for the Vereeniging area are presented in Figure 6 for the period January 2009 to December 2009 (SAWB, 2010).

![Humidity chart](image)

Figure 6 Relative humidity for the Vereeniging area for the period January 2009 to December 2009.
5.1.4 Wind

A wind rose for the Vereeniging area is depicted in Figure 7 for the period January 2007 to December 2009 (Lakes Environmental, 2010). A wind rose is a graphic tool used to give a view of how wind speed and wind direction are typically distributed at a particular location. Using a polar coordinate system of gridding, the frequency of wind speed occurrence is plotted by wind direction, with colour bands showing wind ranges. The directions of the rose with the longest spoke show the direction with the greatest frequency of wind speed. (Prinsloo and Friend, 2009)

For the period 2007 to 2009 the wind direction was mostly north-northeasterly. However, random fluctuations of the wind assist in plume spread (Cooper and Alley, 2002) and these fluctuations for the Vlakfontein site is illustrated for 6-hourly periods in Figures 8 to 11 (Lakes Environmental, 2010).

Figure 7  Periodic wind rose for the Vereeniging area for the period 1 January 2007 to 31 December 2009.
Figure 8  Periodic wind rose for the Vereeniging area for the period 1 January 2007 to 31 December 2009, 00:00 – 06:00.

Figure 9  Periodic wind rose for the Vereeniging area for the period 1 January 2007 to 31 December 2009, 06:00 – 12:00.
Figure 10  Periodic wind rose for the Vereeniging area for the period 1 January 2007 to 31 December 2009, 12:00 – 18:00.

Figure 11  Periodic wind rose for the Vereeniging area for the period 1 January 2007 to 31 December 2009, 18:00 – 00:00.
5.2 Geology

The geology of the site is very diverse and the general area is characterised by eight different substrates, as illustrated in Figure 12 (GPSA, 1986; Van Riet et al., 1997; Van Rooyen, 2010). The lowlands and drainage line in the north comprises alluvial soils of Quaternary origin. Quartzite and conglomerate of the Boshoek Formation, Pretoria Group, Transvaal Sequence are the substrates in the north of the site, with Ferruginous shale and hornfels of the Timeball Hill Formation, Pretoria Group covering the northern and central parts of the site. The southern rocky ridges and hills comprise ferruginous quartzite of the Timeball Hill Formation, while sandstone and shale of the Vryheid Formation, Ecca Group are found on the plains in the southern parts of the site. Small areas in the eastern part of the site consist of dolomite and chert of the Malmani Subgroup, Chuniespoort Group. The central part of the site where the excavations occurred for the brickworks are characterised by red clayey soils derived from diabase and lava. (Van Rooyen, 2010)

![Figure 12 Geology of the Vlakfontein site.](image)

No major faults are indicated in the immediate vicinity of the site (EVT, 2011). Based on the boreholes drilled during the hydrogeological investigation and the test pits excavated and exposures profiled during the geotechnical investigation, the geology at the site can be broadly divided into geological zones (EVT, 2011). The first is the dolerite geological zone and comprises portions of the site into which the dolerite (or diabase) intrusion has occurred, while the second is the quartzite geological zone and comprises portions of the site where no intrusion of dolerite has taken place (EVT, 2011). A more detailed description of the two geological zones and the subsoil characteristics of each is given in the proceeding sections - all referenced from EVT (2011) and explained in more detail in the design report presented in Appendix K.
5.2.1 Dolerite geological zone

The dolerite geological zone extends roughly across the northern “half” of the site. This geological zone essentially comprises residual and/or weathered Timeball Hill Formation quartzite overlying residual dolerite clays with weathered dolerite bedrock in places.

The lower residual quartzite clay, which was not always present, was found to achieve a maximum thickness of 0.5 m and was typically described as slightly moist, reddish brown, firm, medium to fine gravelly, fine and medium sandy clay with trace to abundant, hard rock quartzite gravels, cobbles and boulders.

In places, the Timeball Hill quartzite unit remains in much less weathered form, and was typically described as (W4/3) reddish to pale pink or grey blotched reddish, highly to medium weathered, closely jointed/fractured, medium to thinly bedded, medium hard to hard rock quartzite. Bedding of the quartzite was recorded dipping at 10° towards the north in test pit TP13, while major sub-vertical joint/fracture sets were noted to be aligned E/W, NE/SW, NNE/SSW and N/S.

Beneath the Timeball Hill quartzite unit, and within the dolerite geological zone, residual dolerite clays were generally encountered. The residual dolerite clays were typically described as very slightly moist, reddish to reddish brown to yellow brown to pale red/reddish orange blotched orange yellow, brown, dark orange, red and blackish, stiff to very stiff, fine and medium sandy clay to sandy silty clay. Slickensiding was observed in places within the residual dolerite clays. Soil profiles SP1 and SP2 indicated the presence of occasional to minor extremely soft to very soft rock corestones and/or scattered very soft to soft rock dolerite inclusions at depth within the residual dolerite clays.

Weathered dolerite bedrock, typically described as (W5/4) greyish yellow speckled black, completely to highly weathered, very closely jointed, extremely soft rock with very soft rock corestones, medium to fine grained dolerite, was observed at 7.5 m depth in soil profile SP1. Weathered dolerite bedrock was also recorded in boreholes VF1 and VF2 at depths of 14 m and 17 m respectively.

In borehole VF1 the dolerite bedrock varied from (W5) greenish yellow grey streaked dark grey and yellow, completely weathered, extremely soft rock dolerite at 14 m to (W2) dark grey and dark greenish grey, slightly weathered, highly fractured, hard rock dolerite from 17 m to greater than 30 m depth while in borehole VF2 the dolerite bedrock was described as (W5) yellow brown, completely weathered, closely jointed, extremely soft rock dolerite with residual clay pockets from 17 m to 22 m depth.

Borehole VF2 revealed that typically (W3/2) pinkish purple to brown to grey to greenish grey, medium to slightly weathered, medium hard to hard rock, fine grained quartzite considered to be of the Rooihoogte Formation underlies the residual and/or weathered dolerite from a depth of 22 m.

5.2.2 Quartzite geological zone

The quartzite geological zone extends roughly across the southern “half” of the site. This geological zone essentially comprises hillwash and/or residual quartzite overlying weathered Timeball Hill Formation quartzite and/or ferruginous shale. Rooihoogte Formation quartzites, sandstones, siltstones and shales underlie the Timeball Hill Formation conformably.
Hillwash materials generally cap the quartzite geological zone, and were found to extend to between 1.4 m and in excess of 2.7 m depth, being typically described as very slightly moist, brown, loose to medium dense, slightly clayey, sandy, fine medium to coarse subrounded gravel with scattered hard rock boulders.

Beneath the hillwash materials, Timeball Hill quartzites and/or ferruginous shale are described as (W4/3) red to reddish grey to grey, highly to medium weathered, openly fractured, medium hard to hard rock, ferruginous quartzite with abundant residual clay pockets and (W3) dusky yellow blotched red and stained orange brown, medium weathered, thinly bedded, medium to closely jointed, medium hard to hard rock, ferruginous shale respectively.

Borehole BH VF3 revealed that Rooihoogte Formation units underlie the Timeball Hill Formation units from approximately 11 m depth.

5.3 Geotechnical evaluation

5.3.1 Material distribution
Within the dolerite geological zone, the near-surface Timeball Hill quartzite unit generally comprises upper residual quartzite clays, gravelly ferricrete clays and lower “bouldery” residual soils. The thickness of this unit varies considerably; however, an average thickness of 2.0 m is inferred. In places, the Timeball Hill quartzite unit is in much less weathered form, and occurs as medium hard to hard rock quartzite (test pit TP13 and soil profile SP1 refer). It is inferred that this weathered quartzite rock has been targeted by the present land owners as a source of select material. Hence the shallow borrow pits adjacent and to the north of the large, open pit excavation on the site.

Within the quartzite geological zone, hillwash materials typically occur near-surface to depths in excess of 2.7 m. Timeball Hill Formation quartzites or ferruginous shales and Rooihoogte Formation quartzites, sandstones, siltstones and shales underlie the hillwash material successively.

5.3.2 Excavatability
Excavation of the residual clay materials is considered to classify as soft excavation in terms of SANS/SABS 1200. Excavations up to approximately 10 m depth are therefore expected to be easily achieved with a TLB or similar excavation plant. Where less weathered quartzite bedrock is encountered in places throughout the site, limited intermediate to hard rock excavation should however be expected.

5.3.3 Slope stability
Based on a preliminary appraisal of the residual clay subsoils, it is recommended that cuts within these materials should not exceed 1 vertical : 2 horizontal (26°).

5.3.4 Material usage
Laboratory tests have indicated that the residual clay materials that occur at the site will be suitable for berm construction as well as covering layers. Furthermore, the permeability’s in the order of $10^{-7}$ to $10^{-8}$ when compacted to 95% of Natural Mod AASHTO indicate that these soils are suitable for use as a natural clay liner or for use as a final capping. The plasticity indices of between 10% and 16% exceed the 10% requirement in the DWAF Minimum Requirements for compacted clay liners.

Natural materials suitable for constructing subsoil drains (for example, free draining sands or gravels) were not encountered on the site during the geotechnical or hydrogeological investigations. Materials for this purpose will therefore need to be imported from off the site.
The weathered quartzite bedrock as well as the hillwash materials should provide good selected material for road and/or pavement subgrade and sub-base materials.

5.3.5 Shallow or perched groundwater seepage
The variable and inconsistent levels at which surface water was recorded in the open pit excavation and various borrow pits on site suggests that the source of this water is not groundwater seepage, but from the accumulation of surface water runoff. It is anticipated, however, that the water in the main open pit excavation is linked to groundwater. This pit will need to be filled in with compacted selected materials to ensure an adequate barrier between the landfill liner and the groundwater table.

5.3.6 Undermining and subsidence
The area is not underlain by dolomitic rocks and mining activity has not been undertaken in the immediate vicinity. Undermining and/or subsidence are therefore not considered to be likely at the site.

5.4 Topography
The topography of the area is gentle with the elevation above sea level varying from 1500m to over 1800m at the top of the Suikerbosrand, in the adjacent Midvaal Local Municipality area and which is also the highest point in Gauteng (MLM, 2011). See also the 1:50 000 topography maps and a topographical survey in Appendix B.

5.5 Land use capabilities
Apart from geological features through, for example, mineral depositions, land use capabilities are dictated to by the relevant land types of a particular area. Land types are areas with a uniform climate, terrain form and soil pattern, as illustrated in Figure 13 for the Vlakfontein area (GPSA, 1979; Van Rooyen, 2010). A terrain unit is any part of the land surface with homogeneous form and slope. Examples of terrain units are crest (1), scarp (2), midslope (3), footslope (4), valley bottom and floodplain (5). A scarp is usually steeper than 70° (up to 100%). (Van Rooyen, 2010)

![Figure 13](image)

Figure 13 Land types of the Vlakfontein area.
The site falls in the Ba Land Type (Figure 13) and indicates land in which red and/or yellow apedal soils that are dystrophic and/or mesotrophic, predominate over red and/or yellow soils that are eutrophic, and where red soils occupy more than a third of the area. Depending on the extent to which water tables have been operative over the landscape, grey and yellow soils may predominate, even to the exclusion of red soils. (Van Rooyen, 2010)

Land Type Ba1 is characterised by fine- to medium textured sandy clay loam, sandy clay to clayey soils. Terrain units 1, 3, 4 and 5 characterise this land type and covers 30%, 55%, 10% and 5% of the unit respectively. The slopes vary from 0-8% in terrain unit 1, 3-8% in terrain unit 2, 0-5% in terrain unit 4 and 0-1% in terrain unit 5. Rocks cover up to 5% of terrain unit 1. The clay content in the A- and B-horizons ranges from 12% to 25% in most areas, and up to 55% locally. The soils are shallow (<450 mm) in places and dominated by the Mispah soil form, with deeper Hutton and Clovelly soils on the plains. The lowlands and wetlands are characterised by relatively deep Rensburg and Avalon soil forms. (Van Rooyen, 2010)

5.6 Hydrology

5.6.1 Site hydrogeology

Groundwater seepage was recorded at a depth of 13 m in borehole BH VF1. Significant groundwater strikes, however, were recorded at depths of 17 m and 49 m in boreholes BH VF1 and BH VF3 respectively. No water seepages or groundwater strikes were recorded in borehole BH VF2 during the drilling of this borehole. (EVT, 2011)

Average measurements of the static water depths in each of the boreholes taken between 20 May 2010 and 3 August 2010 indicate that the static groundwater table beneath the site varies between approximately 10 m and 30 m depth. This translates to average static water levels of between 1 500 m amsl and 1 509 m amsl. (EVT, 2011)

Although groundwater flow direction was not measured, the static water levels recorded as well as the anticipated surface water movement (movement of groundwater generally mirrors that of surface water) indicate that groundwater flows beneath the site are expected to be in a northeasterly direction. (EVT, 2011)

5.3.2 Water quality

In terms of physical, organoleptic and chemical requirements, drinking water quality is typically classified in accordance with SANS 241:2006 (Table 2). Two classes are identified viz. Class I and Class II. Class I water is deemed “acceptable for lifetime consumption” while Class II water is deemed “maximum allowable” in terms of the parameter limits and may be subject to consumption periods. Any parameter exceeding the limits of Class II water is deemed a failure (i.e. unacceptable quality) and poses a health risk to consumers. (EVT, 2011)

A water quality analysis was undertaken on water samples retrieved from the two (2No) boreholes during the hydrogeological investigation. A classification of water quality in terms of SANS 241:2006 (Table 2) has been made, and it appears that the water quality in boreholes BH VF1 and BH VF32 is typically Class I. The exception to this being total chromium, the quantity of which fell within the Class II range in the sample from BH VF1 and exceeded the Class II limits in borehole BH VF3. (EVT, 2011)
5.3.3 Aquifer classification
Based on the blow yields of the boreholes recorded during drilling, the potential sustained yield of the aquifer at the site is low. The water quality test results from the boreholes indicate that the aquifer beneath the site is of good quality (typically Class I water in terms of SANS 241:2006). In terms of significance, the aquifer is thus considered to be moderately yielding. (EVT, 2011)

5.3.4 Groundwater contamination potential
The naturally occurring low permeability, residual clays at the site are expected to provide good attenuation and retardation to any surface water infiltration. (EVT, 2011)

5.7 Air quality
High levels of air pollution is prevalent in the area as a result of the area being highly industrialised and the fact that the majority of the population make use of the burning of fossil fuels for space heating and food preparation (ELM, 2007). Adverse meteorological conditions prevailing in the winter months are also a major contributing factor (ELM, 2007).

5.8 Natural vegetation
A summary of the vegetation study conducted on site is given below - all referenced from Van Rooyen (2010) and the complete report presented in Appendix D. The study site is situated in the *cymbopogon-themeda* veld (sandy) pure grassveld Veld Type, as described by Acoks (1988). Low and Rebelo (1998) classified the area as the Rocky Highveld Grassland. According to Mucina and Rutherford (2006), the study site occurs in the Soweto Highveld Grassland, as illustrated in Figure 14 (Mucina and Rutherford, 2006).

![Figure 14 Vegetation types of the Vlakfontein area.](image-url)
The landscape of the Highveld plateau is gentle to moderately undulating supporting short to medium-high, dense, tufted grassland dominated almost entirely by *Themeda triandra*. The following plant communities were distinguished on site (as illustrated in Figure 15 and shown in Figures 16 to 25):

- *acacia caffra-mundulea sericea* open bushveld [community 1],
- *searsia pyroides-ziziphus mucronata* dense bushveld [community 2],
- *vangueria infausta-hyparrhenia hirta-tristachya rehmannii* wooded grassland and bushveld [community 3],
- *seriphium plumosum-eragrostis chloromelas* old field grasslands and open bushveld [community 4],
- *heteropogon contortus-hebenstreitia angolensis* grassland [community 5],
- *acacia caffra-triraphis andropogonoides* dense bushveld [community 6],
- *acacia karroo-cortaderia jubata* disturbed areas [community 7],
- *acacia karroo-hyparrhenia hirta* dense thorny bushveld [community 8],
- *eragrostis curvula-themeda triandra* old fields [community 9], and
- *berkheya radula-sporobolus africanus* wetlands [community 10].

A total of 160 indigenous and 14 alien species (9% of all species) was recorded on site. Eight of these exotic species are declared invader and weedy species (5% of all plant species on site). The number of plant species ranges from 13 to 65 per community.


No listed threatened and protected plant species were recorded. A number of other species found on site is listed as least concern (LC), e.g. *albuca setosa*, *aloe greatheadii* subsp. *davyana*, *bulbine abyssinica*, *hypoxis* spp. and *ledebouria* spp. CITES controls trade in plant species such as *aloe* species. *Aloe greatheadii* subsp. *davyana* occurs on site. One protected tree species occur on site: *boscia albitrunca* (National Forest Act). No endemic species were listed by Mucina and Rutherford (2006) for the Soweto Highveld Grassland (Gm8). The tree *cussonia paniculata* was recorded on site (community 6). It is listed as a Schedule 2: protected plant. No specially protected plants were recorded on site.

Of the 160 indigenous and exotic plant species recorded on the site, 24 species with medicinal properties were found (15%) and 21 poisonous species were recorded (13%).

The vegetation types on site were evaluated in terms of sensitivity and a sensitivity map was compiled based on the sensitivity analysis of the area. The quartzite ridges of Gauteng should be regarded as one of the most important natural assets in the northern provinces of South Africa. The ridges on site are fairly undisturbed and may be classified as Class 1 ridges. The quartzite rocky ridges and koppies in the south, as well as the wetlands in the north of the site are considered to be sensitive and as such indicated on the sensitivity map. These areas should be excluded from any development.
Figure 15 Vegetation map of the proposed Vlakfontein landfill site.
Figure 16 Vlakfontein vegetation community 1.

Figure 17 Vlakfontein vegetation community 2.
Figure 18  Vlakfontein vegetation community 3.

Figure 19  Vlakfontein vegetation community 4.
Figure 20  Vlakfontein vegetation community 5.

Figure 21  Vlakfontein vegetation community 6.
Figure 22  Vlakfontein vegetation community 7.

Figure 23  Vlakfontein vegetation community 8.
Figure 24  Vlakfontein vegetation community 9.

Figure 25  Vlakfontein vegetation community 10.
5.9 Animal life

A summary of the animal life/fauna study conducted on site is given below - all referenced from Van Rooyen (2010) and the complete report presented in Appendix D. This study consisted of a desktop study and a superficial field survey of mammals, birds, reptiles and amphibians that are likely to occur at the site. The field survey consisted of identifying the different habitats and sensitive areas for fauna, record the types of animal in the area, identify possible impacts and consider possible alternatives and recommend mitigation measures. The field survey was done in the dry season in mid-September, limited to a day-time visual assessment of the immediate area where the development is proposed. Large areas on site were also burnt, limiting the extent of the surveys.

The diversity in the natural vegetation of the site creates suitable habitat for a variety of animals. The faunal desktop analysis and site survey included mammals, carnivores, rock hyrax, insectivores, lagomorphs, primates, rodents, avifauna, reptiles and invertebrates. The area is perceived to be suitable for 11 herbivore species, 17 carnivore species, the rock hyrax, 3 bat species, 7 other insectivore species, 2 lagomorphs, 1 primate, 14 rodent species, the rock elephant shrew, aardvark, and a large number of avifauna.

According to the Gauteng list of priority Red Data bird species and based on the habitat preferences and nesting requirements of the birds, the following bird species may occur in the area:

- African marsh harrier,
- blue crane,
- Cape vulture,
- grass owl,
- lesser kestrel,
- martial eagle,
- melodious lark,
- secretarybird, and the
- white-bellied korhaan.

None of these species were recorded during the site visit.

All species of reptiles are classified as Schedule 2 – protected game (Gauteng Nature Conservation Ordinance, No 22 of 1983, as amended in 1995), except the water leguan, rock leguan, and all species of snake that are classified as Schedule 5 - wild animals. Rocky outcrops, open grassland, woodland, rivers and dams are consistent in attracting their own particular reptile and amphibian fauna. The African rock python (python natalensis) and the striped harlequin snake (homoroselaps dorsalis) are priority red data herpetofauna (GDACE information). None were recorded during the present survey.

There is seasonally open water in small dams along the drainage lowlands on site. Whether the wetland is suitable for the giant bullfrog (pyxicephalus adspersus) needs to be investigated during the rainy season. The giant bullfrog is classified as Schedule 2 – protected game.

A survey of invertebrate species should be done under optimal conditions by a specialist entomologist. Most invertebrates are threatened by habitat loss.
The vulnerable marsh sylph *metisella meninx* occurs in marshy areas with the grass *leersia hexandra* as the host plant. Although the wetland on site is seasonal, a dam with permanent water is located on the eastern side just outside the site boundary, which may be suitable habitat for this butterfly.

The scorpion *opistophthalmus pugnax* is a very common species on rocky outcrops and ridges in Gauteng and immediate areas. The rock scorpion *hadogenes gunningi* occurs on mountains and on rocky ridges in Gauteng and immediate regions. It inhabits cracks and rock exfoliations. It is in special need of protection from urbanisation and habitat destruction. It was not recorded on site but a detailed survey is recommended.

All species of baboon spiders belonging to the genera *ceratgyrus*, *harpactira* and *pterinochilus* are classified as Schedule 7: Invertebrata (Gauteng Nature Conservation Ordinance, No 22 of 1983, as amended in 1995). The baboon spider *harpactira hamiltoni* was not recorded on site but a detailed survey is recommended.

5.10 Archaeological, heritage and cultural aspects
No archaeological, heritage or cultural places of interest in terms of the National Heritage Resources Act (No 25 of 1999) were either found on site or information to such places given by the local community.

5.11 Sensitive landscapes and visual aspects
Sensitive features of the area are presented in Appendix C. Due to the nature of past excavation activities, few such features are evident on the actual proposed activity site and only the quartzite ridges/koppies in the western and southern parts of the property can be ascribed as sensitive landscapes.

Visual aspects are normally closely related to the *sense of place* concept identified in Barnard *et al.* (2006). Sense of place is an environmental concern that can be impacted upon by development and should be considered accordingly. Impacts from the development of mines and industries can destroy the sense of place of an area and thus the spiritual, aesthetic and therapeutic qualities of an area will also be eliminated (Barnard *et al.*, 2006).

Two essential requirements for an appreciation of sense of place are that it must be a *person* experiencing the sensation and it must be a *place* that is experienced. Sense of place therefore cannot exist in isolation, but requires an interaction between the affected individual and the place where it happens. The importance of the sense of place is thus determined not only by the place itself, but by the value that the individual gives it. (Barnard *et al.*, 2006)

5.12 Noise and odours
The only sources of noise at present will be that pertaining to the current *ad hoc* quarry activities and vehicular movement on the nearby R82 (Vereeniging/Johannesburg Road). No adverse odour sources are currently present at the site.

5.13 Social and economic environment
The proposed Vlakfontein waste treatment facility lies in the Emfuleni local municipality, part of the Sedibeng district municipality in the Gauteng Province. Emfuleni is a largely urbanised municipality with high population concentrations and density compared to other municipalities making up the Sedibeng district. In fact, the municipality houses around 80% of the population in Sedibeng district. The demographic composition of Emfuleni population is indicted in the Table 1. (ELM, 2007)
Table 1  Demographic composition of Emfuleni local municipality.

<table>
<thead>
<tr>
<th>Population</th>
<th>African</th>
<th>Coloured</th>
<th>Indian/Asian</th>
<th>White</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>271 011</td>
<td>3 416</td>
<td>3 010</td>
<td>45 254</td>
<td>322 691</td>
</tr>
<tr>
<td>Female</td>
<td>282 296</td>
<td>3 595</td>
<td>2 881</td>
<td>46 959</td>
<td>335 731</td>
</tr>
<tr>
<td>Total</td>
<td>553 307</td>
<td>7 011</td>
<td>5 891</td>
<td>92 213</td>
<td>658 422</td>
</tr>
</tbody>
</table>

There are more women than men in the municipality and significantly more aged women than men (women comprise 10.5% of the population over 55 years old, while men only comprise 8.43%). Table 2 depicts the age distribution for the municipality. (ELM, 2007)

Table 2  Age distribution for the Emfuleni local municipality.

<table>
<thead>
<tr>
<th>Age group</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 4</td>
<td>26 661</td>
<td>27 079</td>
<td>53 740</td>
<td>8.16</td>
</tr>
<tr>
<td>5 – 14</td>
<td>57 377</td>
<td>58 886</td>
<td>116 263</td>
<td>17.66</td>
</tr>
<tr>
<td>15 - 34</td>
<td>130 235</td>
<td>129 027</td>
<td>259 262</td>
<td>39.38</td>
</tr>
<tr>
<td>35 – 64</td>
<td>97 796</td>
<td>104 040</td>
<td>201 836</td>
<td>30.65</td>
</tr>
<tr>
<td>65+</td>
<td>10 623</td>
<td>16 698</td>
<td>27 321</td>
<td>4.15</td>
</tr>
<tr>
<td>Total</td>
<td>322 692</td>
<td>335 730</td>
<td>658 422</td>
<td>100</td>
</tr>
</tbody>
</table>

Sesotho is the highest spoken official language within the municipality comprising of 53% of the total population. IsiZulu is the second spoken language with 14% of the entire population. Afrikaans is the third and isiXhosa being the fourth official spoken language. Tshivenda is the least spoken language with 0.3%. The language distribution within the municipality is given in Table 3. (ELM, 2007)

Table 3  Language distribution within the Emfuleni local municipality.

<table>
<thead>
<tr>
<th>Languages</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afrikaans</td>
<td>13.37</td>
</tr>
<tr>
<td>English</td>
<td>3.03</td>
</tr>
<tr>
<td>isiNdebele</td>
<td>0.21</td>
</tr>
<tr>
<td>isiXhosa</td>
<td>9.21</td>
</tr>
<tr>
<td>isiZulu</td>
<td>14.26</td>
</tr>
<tr>
<td>Sepedi</td>
<td>1.58</td>
</tr>
<tr>
<td>Sesotho</td>
<td>53.01</td>
</tr>
<tr>
<td>Setswana</td>
<td>3.02</td>
</tr>
<tr>
<td>SiSwati</td>
<td>0.49</td>
</tr>
<tr>
<td>Tshivenda</td>
<td>0.32</td>
</tr>
<tr>
<td>Xitsonga</td>
<td>1.02</td>
</tr>
<tr>
<td>Other</td>
<td>0.48</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

There are 463 642 economically active people within the municipality, of which 33% are employed. Table 4 shows the employment profile for Emfuleni. The Emfuleni economy is located within the Sedibeng economy, part of the Gauteng economy that accounts for 33% of South Africa’s GDP. The municipality consists of two major nodes, namely Vereeniging and Vanderbijlpark. The annual income per capita is given in Table 5 for the province, district and the towns of Vereeniging and Vanderbijlpark. The employment sector contribution to the local economy is shown in Table 6. (ELM, 2007)
Table 4  Employment profile for the Emfuleni local municipality.

<table>
<thead>
<tr>
<th>Labour market status</th>
<th>Persons</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employed</td>
<td>153 655</td>
<td>33.14</td>
</tr>
<tr>
<td>Unemployed</td>
<td>137 110</td>
<td>29.57</td>
</tr>
<tr>
<td>Not economically active</td>
<td>172 877</td>
<td>37.29</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>463 642</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 5  Annual per capita income.

<table>
<thead>
<tr>
<th>Area/population</th>
<th>African</th>
<th>Coloured</th>
<th>Indian/Asian</th>
<th>White</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gauteng</td>
<td>81 740</td>
<td>159 015</td>
<td>230 070</td>
<td>271 515</td>
<td>130 982</td>
</tr>
<tr>
<td>Sedibeng</td>
<td>40 606</td>
<td>83 156</td>
<td>166 522</td>
<td>147 011</td>
<td>58 029</td>
</tr>
<tr>
<td>Vereeniging</td>
<td>49 487</td>
<td>90 870</td>
<td>166 739</td>
<td>161 829</td>
<td>72 618</td>
</tr>
<tr>
<td>Vanderbijlpark</td>
<td>35 293</td>
<td>54 250</td>
<td>-</td>
<td>128 219</td>
<td>47 329</td>
</tr>
</tbody>
</table>

Table 6  Employment sector contribution to local economy.

<table>
<thead>
<tr>
<th>Sector</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>0.7</td>
</tr>
<tr>
<td>Community services</td>
<td>20.0</td>
</tr>
<tr>
<td>Construction</td>
<td>2.9</td>
</tr>
<tr>
<td>Electricity/gas/water</td>
<td>3.0</td>
</tr>
<tr>
<td>Financing</td>
<td>9.9</td>
</tr>
<tr>
<td>Mining</td>
<td>1.1</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>42.1</td>
</tr>
<tr>
<td>Trade</td>
<td>13.9</td>
</tr>
<tr>
<td>Transport</td>
<td>6.4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100</td>
</tr>
</tbody>
</table>

The primary economic sector consists of two sub-sectors, namely agriculture and mining, while secondary activities in Emfuleni consist of three sub-sectors, namely manufacturing, electricity/gas/water and construction. The Emfuleni manufacturing sector is largely dominated by metals, metal products, machinery and equipment industries. The dominant company is iron and steel and Emfuleni is considered to be the biggest steel sector agglomeration within the country. The metals and metal products industry has undergone major restructuring in the past few years, resulting in job shedding. It has been growing at a relatively low 1.2% per annum. The petrochemical industry is the second major manufacturing sub sector. Unlike the steel industry, it has been growing at a relatively fast pace in recent years. (ELM, 2007)

Finally, looking at infrastructure in terms of distribution networks major portions of the Emfuleni local municipality distribution networks have been in service for more than 50 years and much of the networks are approaching or have exceeded their design life span. The existing networks have begun to exhibit degradation in reliability and general deterioration. (ELM, 2007)
6. ALTERNATIVES

In terms of Sections 28(1)(c) and 28(1)(j) of Regulation 543: Environmental Impact Assessment Regulations, 18 June 2010; read in conjunction with sections 24(5), 24M and 44 of the National Environmental Management Act (No 107 of 1998); it is a requirement to provide a description of any feasible and reasonable alternatives that have been identified. Alternatives are different means of meeting the general purpose and need of a proposal (DEAT, 2006) and can be categorised into the following (DEAT, 1998):

- demand alternatives (for example, using energy more efficiently rather than building more generating capacity),
- activity alternatives (for example, providing public transport rather than increasing road capacity),
- location alternatives (for example, either for the entire proposal or for components of the proposal, like the location of a processing plant for a mine),
- process alternatives (for example, the re-use of process water in an industrial plant, waste minimising or energy efficient technology, different mining methods),
- scheduling alternatives (for example, staggering the travelling to and from a plant during off peak times), and
- input alternatives (for example, use of alternative raw materials or energy sources).

The no-go alternative is the option of not undertaking the proposed activity or any of its alternatives. The no-go alternative also provides the baseline against which the impacts of other alternatives should be compared. It should be noted that the no-go alternative may sometimes not be a “real” or “implementable” alternative (for example, where the capacity of a sewage pipeline has to be increased to cope with current demand). It should, however, remain the default option and must always be included to provide the baseline for assessment of the impacts of other alternatives and also to illustrate the implications of not authorising the activity. (DEAT, 2006)

In this case the no-go alternative will result in lengthy and protracted legal proceedings between the community, the current owner and the government in an effort to rehabilitate the existing site. The potential consequences of this alternative could include, inter alia, the following:

- an extended period of time before any feasible rehabilitation of the site can/will take place;
- during such extended period the possibility of accidents and injury to man and animal due to the depth of actual excavated area and the related lack of sufficient fencing;
- further environmental degradation of the site in its current condition;
- increased risk of informal settlements taking place in the disused area with the resultant increase in crime and related activities;
- most likely decrease in property values due to the aforementioned scenario’s; and
- possible legal proceedings against the state as the ultimate custodian of land, security and wellbeing of its citizens.

This particular site and the proposed activity together negate the no-go alternative as a suitable baseline condition based entirely on its current brown field’s status.
With all the categorised alternatives, the location (site) alternative normally plays the biggest role in assessment of an activity and its related impacts. As mentioned in Section 3 of this report, a site selection process was carried out in accordance with the Minimum Requirements for Waste Disposal by Landfill (DWAF, 1998) and is included in the design report presented in Appendix K. Four sites were identified as candidate landfill sites, namely Blignautsrus, Meydustria, Walkerville and Vlakfontein (De Deur Brickworks). The outcome of this assessment is presented in Table 7 for the four sites (EVT, 2011).

In terms of the remainder of the categorised alternatives, the relevant processes employed at the proposed facility, together with scheduling and input variables; will play the next major role and was assessed during the final design stages and are discussed in the design report (Appendix K).

Table 7 Candidate landfill site ranking matrix.

<table>
<thead>
<tr>
<th>Candidate site</th>
<th>Economic criteria</th>
<th>Environmental criteria</th>
<th>Public acceptance criteria</th>
<th>Total score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Distance</td>
<td>Size</td>
<td>Access</td>
<td>Existing impact</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>M</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>W</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>V</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

B - Blignautsrus, M - Meydustria, W - Walkerville, V - Vlakfontein.
Ratings of 1 - 4 with 1 as low acceptance and 4 as high acceptance.
7. ASSESSMENT METHODOLOGY

The objective of the assessment of impacts is to identify and assess all the significant impacts that may arise from the undertaking of an activity and the findings used to inform the competent authority’s decision as to whether the activity should be either authorised, authorised subject to conditions that will mitigate the impacts to within acceptable levels, or should be refused (DEAT, 2006). In this sense impacts are defined by DEAT (2006) as the changes in an environmental parameter that result from undertaking an activity. These changes are the difference between effects on an environmental parameter where the activity is undertaken compared to that where the activity is not undertaken, and occur over a specific period and within a defined area (DEAT, 2006).

7.1 Impact types

Different types of impacts may occur from the undertaking of an activity, which may be positive or negative, and can be categorised as being either direct (primary), indirect (secondary) or cumulative impacts. Direct impacts are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity (for example, dust generated by blasting operations on the site of the activity).

These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable. However, indirect impacts are induced changes that may occur as a result of the activity (for example, the use of water from a natural source at the activity will reduce the capacity for supply to other users). These types of impacts include all the potential impacts that either do not manifest immediately when the activity is undertaken, or which occur at a different place as a result of the activity. (Jain et al., 1993; Fuggle and Rabie, 1994; DEAT, 2006)

Cumulative impacts are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities (for example, removal of vegetation may cause soil erosion, leading to excessive sediments in a receiving stream, leading to reduced sunlight penetrating the water and thus reducing dissolved oxygen in the water and adversely affecting aquatic life and water quality). Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts. (Jain et al., 1993; DEAT, 2006)

7.2 Identification of impacts

The identification of the potential impacts of an activity on the environment should include impacts that may occur during the start/construction, operation and decommissioning/rehabilitation phases of an activity (DEAT, 2006). The process of identification and assessment of impacts includes, inter alia, the (Jain et al., 1993; DEAT, 2006):

- determination of current environmental conditions in sufficient detail so that there is a baseline against which impacts can be identified and measured;
- determination of future changes to the environment that will occur if the proposed activity does not take place;
- understanding of the activity in sufficient detail to understand its consequences; and
- identification of significant impacts that is likely to occur if the activity is undertaken.

7.3 Impact mitigation

Once impacts have been identified and predicted for a particular activity, appropriate mitigation measures need to be established (DEAT, 2006). Mitigation measures are the modification of certain activities in such a way as to reduce the impacts on the environment (Jain et al., 1993). The objectives of mitigation are to (DEAT, 2006):
find more environmentally sound ways of doing things;
enhance the environmental benefits of a proposed activity;
avoid, minimise or remedy negative impacts; and
ensure that residual negative impacts are within acceptable levels.

When mitigation is considered for (certain) impacts, it should be organised in a hierarchy of actions, namely (DEAT, 2006):

- avoid negative impacts as far as possible though the use of preventative measures,
- minimise or reduce negative impacts to "as low as practicable" levels, and
- remedy or compensate for negative residual impacts that are unavoidable and cannot be reduced further.

### 7.4 Impact assessment methodology

The concepts for environmental impact assessments in this report will relate to risk assessment (the process whereby certain impacts to the environment are identified), risk valuation (by using a stipulated assessment criteria whereby impacts are given a rating or weighting and obtaining an overall rating or significance of an impact) and risk management (relating directly to applicable mitigation measures to be implemented to manage a risk of an impact in the "best" interest of a society; Shogren, 1990). Such an assessment is also a requirement in terms of Section 31(2)(l) of Regulation 543: Environmental Impact Assessment (EIA) Regulations, 18 June 2010; read in conjunction with sections 24(5), 24M and 44 of the National Environmental Management Act (No 107 of 1998). The guideline criteria set out in the EIA regulations, in conjunction with assessment criteria from DEAT (1998), Friend et al. (2005), DEAT (2006) and Friend and Van Rooyen (2009); will be followed in this report and are presented in the following sections.

#### 7.4.1 Nature or status of the impact

An appraisal of the type of effect the activity would have on the affected environment; rated as either positive (beneficial impact on the environment), neutral (no impact on the environment), or negative (adverse impact on and at a cost to the environment).

#### 7.4.2 Extent or scale of the impact

Indicates whether the impact will be either site specific (impacting within the boundaries of the site), local (within an area of 5 km of the site), regional (Gauteng Province), on a national scale (South Africa) or across international borders (Southern Africa).

#### 7.4.3 Duration of the impact

Indicates whether the lifetime of the impact will be either short term (0 - 5 years), medium term (5 - 15 years), long term (where the impact will cease after the operational life of the activity, either because of natural process or human intervention), or permanent (where mitigation either by natural process or human intervention will not occur in such a way or in such a time span that the impact can be considered transient).

#### 7.4.4 Intensity or magnitude of the impact

Establishes whether the impact is destructive or benign and is indicated as either low (where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected), medium (where the affected environment is altered but natural, cultural and social functions and processes continue, albeit in a modified way), high (natural, cultural or social functions or processes are altered to the extent that it will temporarily cease); or very high (natural, cultural or social functions or processes are altered to the extent that it will permanently cease).
7.4.5 Probability of the impact
Describes the likelihood of the impact actually occurring and is indicated as either improbable (the possibility of the impact to materialise is very low, either because of design, historic experience or implementation of adequate corrective actions), probable (there is a distinct possibility that the impact will occur), highly probable (it is most likely that the impact will occur), or definite (the impact will occur regardless of any prevention or corrective actions).

7.4.6 Determination of significance
After assessment of an impact in accordance to the preceding five criteria, the significance of an impact can be determined through a synthesis of the aspects produced in terms of their nature, extent, duration, intensity and probability. In Table 8 various ratings are accorded to these criteria. These ratings are now used to calculate a significance (S) rating and are formulated by adding the sum of ratings given to the extent (E), duration (D) and intensity (I) and then multiplying the sum with the probability (P) of an impact as follows:

$$\text{Significance (S)} = (E + D + I) \times P$$

The resultant ratings are now described as follows (see also Table 8):

- S < 25 implies a low impact (meaning this impact would not have a direct influence on the decision to develop in the area),
- S = (25 - 50) implies a medium impact (where the relevant impact could influence the decision to develop in the area unless it is effectively mitigated), and
- S > 50 implies a high impact (this impact must have an influence on the decision process to develop in the area).

Table 8 Ratings used for determining impact significance.

<table>
<thead>
<tr>
<th>Nature of impact (N)</th>
<th>Extent of impact (E)</th>
<th>Duration of impact (D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>positive</td>
<td>site specific</td>
<td>short term</td>
</tr>
<tr>
<td>neutral</td>
<td>local</td>
<td>medium term</td>
</tr>
<tr>
<td>negative</td>
<td>regional</td>
<td>long term</td>
</tr>
<tr>
<td></td>
<td>national</td>
<td>permanent</td>
</tr>
<tr>
<td></td>
<td>international</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intensity of impact (I)</th>
<th>Probability of impact (P)</th>
<th>Significance of impact (S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>low</td>
<td>improbable</td>
<td>low</td>
</tr>
<tr>
<td>medium</td>
<td>probable</td>
<td>medium</td>
</tr>
<tr>
<td>high</td>
<td>highly probable</td>
<td>high</td>
</tr>
<tr>
<td>very high</td>
<td>definite</td>
<td></td>
</tr>
</tbody>
</table>

7.4.7 Additional evaluation criteria
Apart from the assessment criteria presented in the preceding sections; impacts will also be evaluated and assessed based on cumulative impacts, relevant reversibility, potential for irreplaceable loss of resources and level of confidence.

Cumulative impacts (see Table 9) can arise from one or more activities and can be defined as being either an additive impact, that is where it adds to the impact caused by other similar impacts; or an interactive impact, that is where a cumulative impact is caused by different impacts that combine to form a new impact.
Interactive impacts may cause either countervailing (the nett adverse cumulative impact is less than the sum of the individual impacts), or synergistic (the nett adverse cumulative impact is greater than the sum of the individual impacts). (DEAT, 2006)

The reversibility of an impact simply indicates to what degree its influence on the relevant environment can be negated and is presented in Table 9. The potential for irreplaceable loss of resources, based on a relevant impact, indicates the degree to which the impact may cause such loss and is presented in Table 9.

<table>
<thead>
<tr>
<th>Cumulative impacts</th>
<th>Reversibility of impacts</th>
<th>Potential for resource loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>none expected</td>
<td>complete</td>
<td>will not take place</td>
</tr>
<tr>
<td>additive</td>
<td>intermediate</td>
<td>there is a possibility of</td>
</tr>
<tr>
<td></td>
<td></td>
<td>this happening</td>
</tr>
<tr>
<td>interactive countervailing</td>
<td>not possible</td>
<td>no</td>
</tr>
<tr>
<td>interactive synergistic</td>
<td></td>
<td>yes</td>
</tr>
</tbody>
</table>

Table 9 Additional assessment criteria.

<table>
<thead>
<tr>
<th>Level of confidence</th>
<th>No uncertainty is associated with the prediction of the impact and all necessary information was available.</th>
<th>The prediction was based on virtually all necessary information being available, with the exception of insignificant information that will not materially affect the outcome of the prediction.</th>
<th>Although the majority of the necessary information was available, there is some uncertainty associated with the impact predicted.</th>
<th>There is a high degree of uncertainty associated with the impact predicted as certain key information was unavailable at the time of the prediction.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>definite</td>
<td>high</td>
<td>medium</td>
<td>low</td>
</tr>
</tbody>
</table>

The level of confidence indicates the level of certainty that specialists have in the accuracy of their predictions with regard to a relevant assessment and its related determined significance. This will be based on any factors that could bring into doubt the accuracy of their relevant predictions, (for example, an investigation undertaken during a non-ideal season, key research data being unavailable) and thus compromise the level of confidence in the assessment of an impact. The levels of confidence used in this report are presented in Table 9 and for levels with either a medium or low level applicable, an additional explanation will be provided as to what the relevant impacting factors were.

7.4.8 Impact assessment presentation
All relevant impacts on the environment are rated and evaluated as set out in the preceding sections and presented via impact tables. It should be noted that impacts are evaluated after mitigation measures, where relevant and indicated as such in the impact tables, have been taken into account. The project impacts are further subdivided into the following three phases*, from which impacting activities can be identified (DEAT, 1998):

- construction phase [CP] – all activities on and off site, including the transport of material,
- operational phase [OP] – all activities, including operation and maintenance of structures, and
- decommissioning/rehabilitation phase [DP] – any activity related to the physical dismantling of the structures and/or restoring of process/mining land to some degree of its former state.

* note that while planning and design is recognised as a project phase, it is for this project and generally for most projects, of no negative impact significance.
8. ENVIRONMENTAL IMPACTS AND MITIGATION

8.1 Geology
For this particular activity and selected site there will be minimal further detrimental impact on the physical composition of the environment as the site can be classed as a “brown fields” site due to the substantial disturbance of the land from deep excavations for clay materials. The proposed development will therefore act as a mitigation measure in itself by enabling the rehabilitation of the existing site through properly engineered landfill, closure and rehabilitation procedures. In addition to the rehabilitation of the existing quarry site through landfiling, it should be noted that an alternative option to rehabilitate the existing quarry would require establishing another quarry or borrow pit to source the necessary materials for backfilling and rehabilitation. This would obviously have a significant impact on the environment and the location of such borrow pit would have to be located at some distance from the site. The environmental impact assessment table for geology is presented below.

<table>
<thead>
<tr>
<th>Environmental aspect</th>
<th>Geology</th>
<th>Phase</th>
<th>CP/OP/DP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>Existing excavation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mitigation:</td>
<td>Implementation of a properly engineered landfill, closure and rehabilitation.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Confidence level | Mitigation required | Evaluation of impacts | |
|------------------|---------------------|-----------------------|
| high             | yes                 | Nature: positive      |
|                  | 1                   | Duration: 2            |
|                  | 2                   | Intensity: 2           |
|                  | 4                   | Probability: 4         |
|                  | 20                  | Significance: 20       |
| Potential for irreplaceable loss of resources | no | Cumulative impacts: no |
|                  | 0                   | Reversibility: yes     |

8.2 Land use capabilities
Based on the present condition of the site ex-quarrying, no additional degradation is foreseen and the rehabilitation of worked out areas will benefit the environment. The present site does not lend itself to any beneficial use in its current excavated condition, with landfiling being the only economically viable solution. The intention of collaboration with the local community in the establishment of a nature conservancy only further strengthen the activity proposal in recreating another land use to the benefit of the region. The environmental impact assessment table for land use capabilities is presented below.

<table>
<thead>
<tr>
<th>Environmental aspect</th>
<th>Land use capabilities</th>
<th>Phase</th>
<th>CP/OP/DP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>Excavated condition unsuitable for any beneficial use at present.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mitigation:</td>
<td>Implementation of a properly engineered landfill, closure and rehabilitation with simultaneous establishment of a nature conservancy on the property as part of the community’s development proposal.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Confidence level</th>
<th>Mitigation required</th>
<th>Evaluation of impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>high</td>
<td>yes</td>
<td>Nature: positive</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Duration: 2</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Intensity: 2</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Probability: 4</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>Significance: 20</td>
</tr>
<tr>
<td>Potential for irreplaceable loss of resources</td>
<td>no</td>
<td>Cumulative impacts: no</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>Reversibility: yes</td>
</tr>
</tbody>
</table>

8.3 Hydrology
By the very nature of the proposed waste treatment facility the probability of pollution of surface and groundwater is high if suitable treatment and design measures are not implemented. This possible pollution of ground and surface water should be negated by adherence to present and proposed legislation with regard to liner systems and water management principles. Liner design in accordance with the latest revised waste classification system for the landfill facility and appropriate water treatment systems must be implemented, as set out in the design report (Appendix K).
Only implementation of these measures will effectively mitigate any possible water pollution from/on the site. The environmental impact assessment table for hydrology is presented below.

<table>
<thead>
<tr>
<th>Environmental aspect</th>
<th>Hydrology</th>
<th>Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Surface and groundwater pollution.</td>
<td></td>
</tr>
<tr>
<td><strong>Mitigation:</strong></td>
<td>Implementation of a properly engineered landfill in accordance to latest revised waste classification system and associated water treatment plant/system for capture and effective treatment of any leachate/discharges from the facility.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Confidence level</th>
<th>Mitigation required</th>
<th>Evaluation of impacts</th>
<th>Nature</th>
<th>Extent</th>
<th>Duration</th>
<th>Intensity</th>
<th>Probability</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>high</td>
<td>yes</td>
<td></td>
<td>negative</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>28</td>
</tr>
<tr>
<td>Potential for irreplaceable loss of resources</td>
<td>no</td>
<td>Cumulative impacts</td>
<td>yes</td>
<td>Reversibility</td>
<td>yes</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 8.4 Air quality

Air quality in the region can be impacted by dust creation from additional transport to the region based on increased levels of vehicles on the existing access road if mitigation measures are not implemented. Botha (2011) estimate as a worst case up to 106 additional peak hour trips during a typical weekday. (A complete traffic impact study was completed for the proposed activity and is included in this report in Appendix J). Mitigation as a minimum through watering of the current gravel road (Cronje Road) is an option; however, the preferred option would be tarring of the Cronje access road to the property. The environmental impact assessment table for air quality impact through dust creation is presented below.

<table>
<thead>
<tr>
<th>Environmental aspect</th>
<th>Air quality – dust creation</th>
<th>Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Increased traffic can lead to excessive dust creation.</td>
<td></td>
</tr>
<tr>
<td><strong>Mitigation:</strong></td>
<td>Watering of the gravel access road should be seen as a minimum requirement. However, tarring of the access road is the preferred option and the subsequent assessment below is based on the preferred mitigation option.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Confidence level</th>
<th>Mitigation required</th>
<th>Evaluation of impacts</th>
<th>Nature</th>
<th>Extent</th>
<th>Duration</th>
<th>Intensity</th>
<th>Probability</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>high</td>
<td>yes</td>
<td></td>
<td>negative</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>Potential for irreplaceable loss of resources</td>
<td>no</td>
<td>Cumulative impacts</td>
<td>no</td>
<td>Reversibility</td>
<td>yes</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Air quality in the region may also be impacted upon by potentially harmful airborne emissions from thermal waste treatment. A summary of the air quality impact assessment for the proposed waste treatment facility is given below - all referenced from Prinsloo et al. (2010) and the complete report presented in Appendix E.

The air quality assessment determined site specific atmospheric dispersion potential based on meteorological data, identified sensitive receptors, typical stack characteristics for a medical waste incinerator and expected emission rates for criteria pollutants. The results are illustrated through concentration isopleths in the proceeding figures and the maximum expectant pollutant concentration for a given averaging period given in Table 10. In Figures 26 and 27 the daily and annual PM$_{10}$ ground level concentrations are presented respectively. The hourly and 8-hourly ground level concentrations of CO are presented in Figures 28 and 29; with the hourly and annual NO$_2$ ground level concentrations in Figures 30 and 31, the daily and annual SO$_2$ ground level concentrations in Figures 32 and 33, and the annual lead ground level concentration in Figure 34.
From these figures the impact of the prevalent north-northeastern wind direction on dispersion of pollutants in a south-southwestern direction is evident. The resultant ground level concentrations of PM$_{10}$ for both the daily and annual simulations are well below the national ambient air quality standards presented in Table 11. Similar observations with regard CO, NO$_2$, SO$_2$ and Pb ground level concentrations and the relevant national ambient air quality standards are evident. The dispersion of pollutants towards the northeast on the hourly and daily ground level concentrations is due to the diurnal wind variation, as seen in Figure 10 (Section 5.1).

**Table 10** Maximum expected pollutant concentration for a given averaging period.

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Simulation period</th>
<th>Max ground level concentration (µg/m$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM$_{10}$</td>
<td>24 hours</td>
<td>3.7</td>
</tr>
<tr>
<td>CO</td>
<td>1 hour</td>
<td>6.0</td>
</tr>
<tr>
<td>NO$_2$</td>
<td>1 hour</td>
<td>7.1</td>
</tr>
<tr>
<td>SO$_2$</td>
<td>24 hours</td>
<td>1.8</td>
</tr>
<tr>
<td>Pb</td>
<td>1 year</td>
<td>0.13</td>
</tr>
</tbody>
</table>

**Table 11** National ambient air quality standards.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Average period</th>
<th>Concentration</th>
<th>Frequency of exceedance</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM$_{10}$</td>
<td>24 hours</td>
<td>120 µg/m$^3$</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>annual</td>
<td>50 µg/m$^3$</td>
<td>0</td>
</tr>
<tr>
<td>CO</td>
<td>1 hour</td>
<td>30 µg/m$^3$ (26 ppm)</td>
<td>88</td>
</tr>
<tr>
<td></td>
<td>8-hour run ave</td>
<td>10 µg/m$^3$ (8.7 ppm)</td>
<td>11</td>
</tr>
<tr>
<td>NO$_2$</td>
<td>1 hour</td>
<td>200 µg/m$^3$ (106 ppb)</td>
<td>88</td>
</tr>
<tr>
<td></td>
<td>annual</td>
<td>40 µg/m$^3$ (21 ppb)</td>
<td>0</td>
</tr>
<tr>
<td>O$_3$</td>
<td>8-hour run ave</td>
<td>120 µg/m$^3$ (61 ppb)</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>10 minutes</td>
<td>500 µg/m$^3$ (191 ppb)</td>
<td>526</td>
</tr>
<tr>
<td>SO$_2$</td>
<td>1 hour</td>
<td>350 µg/m$^3$ (134 ppb)</td>
<td>88</td>
</tr>
<tr>
<td></td>
<td>24 hours</td>
<td>125 µg/m$^3$ (48 ppb)</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>annual</td>
<td>50 µg/m$^3$ (19 ppb)</td>
<td>0</td>
</tr>
<tr>
<td>C$_6$H$_6$</td>
<td>annual</td>
<td>10 µg/m$^3$ (3.2 ppb)</td>
<td>0</td>
</tr>
<tr>
<td>Pb</td>
<td>annual</td>
<td>0.5 µg/m$^3$</td>
<td>0</td>
</tr>
</tbody>
</table>

Using the results obtained from the site specific atmospheric dispersion potential, suitable buffer zones can be recommended for the proposed activity. With no set distances legislated in South Africa the present practice is that of setting relevant buffer zones per activity and related environment. Based on the recommended buffer zones and the results from the air dispersion modelling Prinsloo et al. (2010) recommended that a buffer zone of at least 200 m be followed in the non-downwind areas around the proposed waste treatment facility, and one of at least 500 m in the downwind area (direction south-southeast of the boundary).
Figure 26  Daily average predicted PM$_{10}$ ground level concentration.

Figure 27  Annual average predicted PM$_{10}$ ground level concentrations.
Figure 28  Hourly average predicted CO ground level concentrations.

Figure 29  Eight-hourly average predicted CO ground level concentrations.
Figure 30  Hourly average predicted NO₂ ground level concentrations.

Figure 31  Annual average predicted NO₂ ground level concentrations.
Figure 32 Daily average predicted SO₂ ground level concentrations.

Figure 33 Annual average predicted SO₂ ground level concentrations.
The air quality impact assessment completed for the proposed waste treatment facility at Vlakfontein indicates that no adverse effects are expected outside of the activity boundary for the criteria pollutants. However, the study was based on pre-designed parameters included in the air dispersion modelling and it is recommended that a similar study be completed once final design parameters are in place.

Based on the results of the impact study and numerous literature reviews, a buffer zone around the proposed facility of at least 200 m in the non-downwind direction and 500 m in the downwind direction is recommended. The actual buffer zone area should be further augmented with screening via indigenous vegetation.

In order to negate any possible detrimental environmental impacts from the proposed facility, world class equipment with associated abatement technologies should be used. Furthermore, adherence to the recommended buffer zones as a minimum will further assist in mitigating any future air quality impacts associated with potentially harmful airborne emissions from thermal waste treatment. The environmental impact assessment table for air quality impact through potential thermal waste treatment pollutants is presented below.

<table>
<thead>
<tr>
<th>Environmental aspect</th>
<th>Air quality – thermal waste treatment pollutants</th>
<th>Phase</th>
<th>CP/OP/DP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>The thermal destruction of waste produces potentially harmful airborne emissions.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mitigation:</strong></td>
<td>Using world class equipment with associated abatement technologies should negate any adverse impacts. Adherence to the recommended buffer zones should be seen as a minimum requirement.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Confidence level</strong></td>
<td>high</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mitigation required</strong></td>
<td>yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Evaluation of impacts</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nature</td>
<td>Extent</td>
<td>Duration</td>
<td>Intensity</td>
</tr>
<tr>
<td>negative</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Potential for irreplaceable loss of resources</td>
<td>no</td>
<td>Cumulative impacts</td>
<td>no</td>
</tr>
</tbody>
</table>
8.5 Natural vegetation
The ten vegetation types on site were subjectively evaluated in terms of sensitivity and the resultant distribution given in Table 12. The following categories of sensitivity were used based on a number of parameters that is, low, low-medium, medium, medium-high and high. Low and low-medium sensitivity means the sensitivity is not significant enough and should not have an influence on the decision about the project. However, any protected trees and other scheduled rare species may not be removed/destroyed without a permit. Medium means a sensitivity rating that is real and sufficiently important to require management, for example, management or protection of the rare/threatened flora, protection of the specific habitat on the property and/or rehabilitation. Medium-high means a sensitivity rating where the habitat should be excluded from any development. High means a sensitivity rating that should influence the decision whether or not to proceed with the project. (Van Rooyen, 2010)

### Table 12 Vegetation sensitivity distribution.

<table>
<thead>
<tr>
<th>Community</th>
<th>Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>medium-high</td>
</tr>
<tr>
<td>2</td>
<td>medium</td>
</tr>
<tr>
<td>3</td>
<td>medium</td>
</tr>
<tr>
<td>4</td>
<td>low</td>
</tr>
<tr>
<td>5</td>
<td>low</td>
</tr>
<tr>
<td>6</td>
<td>low</td>
</tr>
<tr>
<td>7</td>
<td>low</td>
</tr>
<tr>
<td>8</td>
<td>low</td>
</tr>
<tr>
<td>9</td>
<td>low</td>
</tr>
<tr>
<td>10</td>
<td>medium-high</td>
</tr>
</tbody>
</table>

As little as possible of the indigenous vegetation should be removed. Although the protected tree species occur in low numbers on site, they should not be removed without a permit. Exotic plant species should be destroyed. The establishment of alien weeds in the disturbed areas should be prevented by means of mechanical and/or chemical control. A rehabilitation plan should be prepared for disturbed areas outside the development footprint and only indigenous plant species should be used for re-establishment. (Van Rooyen, 2010)

The establishment of declared weeds and invasive plants after construction should be prevented by rehabilitation of the area. The planting of alien plants on site should be discouraged. The relatively large areas of undisturbed vegetation and habitats on site (ridges, koppies, woodlands and wetlands) may act as biodiversity offset areas to compensate for the loss of habitat due to the proposed development. The drainage lines/wetlands in the northern part of the site and the quartzite ridges/koppies in the western and southern parts should be excluded from any development. (Van Rooyen, 2010)

The setting of buffer zones is a requirement by the Gauteng Department of Development, Conservation and Environment (GDACE). A buffer zone is a collar of land that filters out inappropriate influences from surrounding activities, also known as edge effects, including the effects of invasive plant and animal species, physical damage and soil compaction caused through trampling and harvesting, abiotic habitat alterations and pollution. It is accepted that a minimum buffer zone of 200 meters is required for a Red List plant population in grassland, which is predominant in Gauteng. Rural parts of the province should be given more protection from fragmentation, habitat transformation and urban sprawl. (Van Rooyen, 2010)
The removal of all exotic plants, including declared weeds and invaders, will be a positive 
result of the proposed development. The environmental impact assessment table for 
natural vegetation impacts is presented below.

<table>
<thead>
<tr>
<th>Environmental aspect</th>
<th>Natural vegetation</th>
<th>Phase</th>
<th>CP/OP/DP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong> With required construction and operational activities of the proposed facility certain vegetation will have to be removed and disturbed.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mitigation:</strong> As little as possible of the indigenous vegetation should be removed. Large trees should be retained if they are not in the pathway of the pipeline. Exotic plant species should be removed. The establishment of alien weeds in the disturbed areas should be prevented by means of mechanical and/or chemical control. The drainage lines/wetlands in the northern part of the site and the quartzite ridges/koppies in the western and southern parts should be excluded from any development.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Confidence level</th>
<th>Mitigation required</th>
<th>Evaluation of impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Nature</td>
</tr>
<tr>
<td>high</td>
<td>yes</td>
<td>negative</td>
</tr>
<tr>
<td>Potential for irreplaceable loss of resources</td>
<td>probably</td>
<td>Cumulative impacts</td>
</tr>
</tbody>
</table>

8.6 Animal life
The literature survey indicated that at least 42 mammal species could potentially occur in the area. No threatened species were observed during the survey. More intensive field surveys targeting specific threatened species may well reveal their presence, for example, the South African hedgehog, white-tailed rat and Highveld golden mole. In this regard, it is improbable that the proposed landfill site will have a significant negative impact on the mammalian fauna of the area, the reptile fauna, the avifauna and the amphibian fauna, provided that the quartzite ridges and the wetlands are excluded from any development or other disturbances. In conclusion it is unlikely that the proposed development will have any significant negative impact on the faunal communities, and in particular of any threatened species, at the proposed waste treatment facility. (Van Rooyen, 2010)

The environmental impact assessment table for animal life impacts is presented below.

<table>
<thead>
<tr>
<th>Environmental aspect</th>
<th>Animal life</th>
<th>Phase</th>
<th>CP/OP/DP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong> With required construction and operational activities of the proposed facility certain fauna will be disturbed in their natural habitat.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mitigation:</strong> As little as possible of the indigenous vegetation should be removed. The drainage lines/wetlands in the northern part of the site and the quartzite ridges/koppies in the eastern and southern parts should be excluded from any development.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Confidence level</th>
<th>Mitigation required</th>
<th>Evaluation of impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Nature</td>
</tr>
<tr>
<td>high</td>
<td>yes</td>
<td>negative</td>
</tr>
<tr>
<td>Potential for irreplaceable loss of resources</td>
<td>no</td>
<td>Cumulative impacts</td>
</tr>
</tbody>
</table>

8.7 Archaeological, heritage and cultural impacts
With no archaeological, heritage or cultural places of interest in terms of the National Heritage Resources Act (No 25 of 1999) identified on site, no impacts are recognised at present.
8.8 Sensitive landscapes and visual impacts

Only quartzite ridges/koppies in the western and southern parts of the property can be ascribed as sensitive landscapes due to past excavation activities eliminating any other possible such features on the actual proposed activity site. No development should take place on these parts of the property.

With regard visual impacts minimal are foreseen based on the lay of the land and the location of the proposed activity being visually well protected from the normal travel routes. However, further augmentation of the actual buffer zone with screening via indigenous vegetation, as recommended in Section 8.4, is recommended.

The environmental impact assessment table for sensitive landscapes and visual impacts is presented below.

<table>
<thead>
<tr>
<th>Environmental aspect</th>
<th>Sensitive landscapes and visual impacts</th>
<th>Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong>: Impact on sensitive landscapes and visual impacts during construction and operational activities of the proposed activity.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mitigation</strong>: No development should take place on the quartzite ridges/koppies and screening via indigenous vegetation to augment the buffer zones is recommended.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Confidence level</th>
<th>Mitigation required</th>
<th>Evaluation of impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>high</td>
<td>yes</td>
<td>Nature: negative</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Extent: 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Duration: 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intensity: 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Probability: 4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Significance: 20</td>
</tr>
</tbody>
</table>

8.9 Noise and odours

The increase in traffic to the site, as estimated by Botha (2011), will proportionally increase noise levels in the region. Noise levels around the waste treatment facility will also be impacted upon by the use of trucks and other equipment. Both these noise sources will be affected by operating hours of the facility. Operating hours are typically determined by the expected waste streams’ characteristics and volumes, the needs of the industries disposing of waste at the site, as well as potential impacts on the local community. It is recommended that noise abatement technologies be implemented where feasible, and that operating hours are restricted from 07:00 to 19:00 during weekdays, and for limited periods on weekends and public holidays. The environmental impact assessment table for noise impacts is presented below.

<table>
<thead>
<tr>
<th>Environmental aspect</th>
<th>Noise impacts</th>
<th>Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong>: Adverse noise levels due to increased traffic and operational activities.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mitigation</strong>: Make use of noise abatement technologies where feasible, and restrict operating hours from 07:00 to 19:00 during weekdays, and for limited periods on weekends and public holidays.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Confidence level</th>
<th>Mitigation required</th>
<th>Evaluation of impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>high</td>
<td>yes</td>
<td>Nature: negative</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Extent: 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Duration: 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intensity: 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Probability: 4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Significance: 16</td>
</tr>
<tr>
<td>Potential for irreplaceable loss of resources</td>
<td>no Cumulative impacts</td>
<td>no Reversibility</td>
</tr>
</tbody>
</table>
Similar to noise impacts odours can be classified as nuisance impacts. According to Prinsloo et al. (2010), odour impact distances can vary from 200 m to 5 km, depending on facility management. However, EVT (2011) states that no odour threshold exceedances are predicted to occur due to on-site concentrations of odoriferous gases and off site odour impacts are predicted to be far below the 3 odour unit level at all the sensitive receptors.

Odours can result from (EVT, 2011):
- uncovered wastes,
- odorous wastes,
- open leachate surfaces,
- mixing of leachate,
- excavations into the waste body, and
- landfill gas.

In order to manage and mitigate possible odours from a waste disposal facility, the following is recommended (EVT, 2011):
- Sanitary landfill principles must be applied, including daily compaction and covering of waste, to reduce odours originating from uncovered waste.
- Cracks in the landfill cover must be identified and rectified to avoid exposing the waste body.
- Odorous wastes must be limited to times of the day when weather conditions are favourable for effective odour dispersion. Such wastes must be blended and covered as soon as possible, to minimise odours. Certain waste types can also be chemically treated to reduce the odour before or during disposal.
- Chemical and/or biological treatment of leachate is possible to reduce odours from open leachate surfaces.
- Flow into the leachate dam, and extraction of leachate from the leachate dam, should be managed such that sudden mixing of the dam is avoided.
- Excavations into and reshaping of the waste body should be avoided if possible.
- Landfill gas should be actively managed if concentrations result in safety and/or odour problems.

The environmental impact assessment table for odour impacts is presented below.

<table>
<thead>
<tr>
<th>Environmental aspect</th>
<th>Odour impacts</th>
<th>Phase CP/OP/DP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong> Adverse odour levels due to operational activities.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mitigation:</strong> Make use of odour abatement technologies and mitigation measures to restrict possible odour releases.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Confidence level</strong></td>
<td><strong>Mitigation required</strong></td>
<td><strong>Evaluation of impacts</strong></td>
</tr>
<tr>
<td>high</td>
<td>yes</td>
<td>Nature: negative</td>
</tr>
<tr>
<td>Potential for irreplaceable loss of resources</td>
<td>no</td>
<td>Cumulative impacts: no</td>
</tr>
</tbody>
</table>


8.10 Social and economic environment
The proposed project will lead to social benefits in the form of significant increased employment opportunities on the project itself, particularly, with respect to waste separation and recycling. It will also create some multiplier spinoffs through the civil engineering construction and other inputs required. The company will provide an undertaking to employing all of the labour required for the project from within nearby disadvantaged communities. A number of opportunities will also prevail for the training of skilled operators with respect to the management and operations of the treatment plants and landfill. It is anticipated that this project will generate in excess of 90 new jobs. The final figure could be higher depending on the final sizing and configuration of the various treatment plants. (EVT, 2011)

The projected potential revenue for the proposed activity is difficult to predict at this stage as this will depend on actual volumes received at the facility. However, based on say 500 t/d of waste received, revenues could be in the order of R 5 million to R 7.5 million per month. Increased revenue for the Waste Giant group will give rise to higher taxes being paid to the national government and higher/additional rates and taxes to the Emfuleni local municipality will benefit from higher/additional rates etc

The environmental impact assessment table for social and economic impacts is presented below.

<table>
<thead>
<tr>
<th>Environmental aspect</th>
<th>Social and economic impacts</th>
<th>Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>Increased employment opportunities and increased government revenues and local business community multiplier spinoffs.</td>
<td></td>
</tr>
</tbody>
</table>

| Mitigation: None. |

<table>
<thead>
<tr>
<th>Confidence level</th>
<th>Mitigation required</th>
<th>Evaluation of impacts</th>
<th></th>
<th></th>
<th></th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>high</td>
<td>yes</td>
<td>Nature</td>
<td>Extent</td>
<td>Duration</td>
<td>Intensity</td>
<td>Probability</td>
</tr>
<tr>
<td>Potential for irreplaceable loss of resources</td>
<td>no</td>
<td>Cumulative impacts</td>
<td>yes</td>
<td>Reversibility</td>
<td>n/a</td>
<td></td>
</tr>
</tbody>
</table>
9. PUBLIC PARTICIPATION PROCESS

In terms of Section 28(1)(h) of Regulation 543: Environmental Impact Assessment Regulations, 18 June 2010; read in conjunction with sections 24(5), 24M and 44 of the National Environmental Management Act (No 107 of 1998); it is a requirement to provide details of the public participation process conducted in accordance with Section 54 of the EIA regulations. Although the term stakeholder engagement is gaining acceptance worldwide as a replacement for the term public participation (DEAT, 2002), this is still the terminology used within the EIA regulations and will be utilised throughout the report where relevant. Clarification of the term public versus stakeholder is provided in Figure 35 (DEAT, 2002).

![Figure 35 Clarification of the term "public" versus "stakeholder".](image)

Public participation forms an integral part of any present day environmental assessment process. The objectives of public participation can be summarised as follows (Lakhani, 2000):

- informing stakeholders;
- presentation of views, concerns and values;
- maximising benefits and minimising risks;
- influencing project design;
- obtaining local knowledge;
- increasing public confidence;
- better transparency and accountability in decision-making; and
- less conflict (decision-making through consensus).

In order to address these objectives, an information exchange meeting was held between representatives of the Emfuleni Local Municipality and the Vlakfontein waste treatment facility project team on 23 August 2010 at the offices of the Department of Development and Planning in Vanderbijlpark. During this meeting the project team gave a presentation of the proposed activity, and obtained feedback and suggestions from representatives of the Emfuleni Environmental, Health, Waste Management and Development and Planning departments representatives present at the meeting. In addition to the above, the various other actions required for public participation, in terms of Section 54 of the EIA regulations, are set out in the following sections.

9.1 Notification of potentially interested and affected parties

The requirements for the notification of potentially interested and affected parties of this application are set out in detail in Section 54(2)(b) of Regulation 543: Environmental Impact Assessment Regulations, 18 June 2010. These requirements have been addressed and include, *inter alia*,

[Continued on the next page]
- forwarding a letter to the owner of the land in terms Sections 15(1) and 54(2)(b) of the EIA Regulations (see Appendix F for letter and proof of receipt);
- hand delivery and posting of written notices to owners and occupiers of land adjacent to the site (see Appendix F for the written notice forwarded);
- forwarding letters to Emfuleni Local Municipality Departments of Environmental, Health, Waste Management and Development and Planning (see Appendix F for copies of these letters);
- fixing of notice boards at places conspicuous to the public;
- placing of advertisements in one local and one provincial newspaper;
- making a hard copy of the scoping report available in the Vanderbijlpark library (see Appendix F for proof of receipt); and
- placing the scoping report on the internet for complete downloadable soft copy (see Figure 36 for example of first placement).

9.2 Proof of notice boards, advertisements and notices
Proof of the placement of notice boards is given in Figures 37 and 38. The advertisements placed in the Vaal Weekblad local newspaper on 22 September 2010 and The Star provincial newspaper on 17 September 2010 are presented in Figures 39 and 40 respectively. The register of all parties that were informed of the activity is given in Appendix F, as well as a signed affidavit proving delivery of said notices.

9.3 Register of interested and affected parties
Together with the written notification register, an interested and affected parties register has been opened, as required in terms of Section 55(1) of the EIA regulations, and the present edition is presented in Appendix F.

9.4 Summary of issues raised by interested and affected parties
Written comments on the project and the draft scoping report were received from interested and affected parties (stakeholders), with the written comments received presented in Appendix G, and a consolidation of stakeholder’s feedback and project team responses provided in Appendix H.
Figure 37  Site notice placed at entrance to site.

Figure 38  Site notice placed at entrance road to site.
Figure 39  Actual advertisement placed in the Vaal Weekblad of 22 - 24 September 2010.
Figure 40
Actual advertisement placed in The Star newspaper of 17 September 2010.
10. HEALTH AND SAFETY

Compliance with the Occupational Health and Safety Act (No 85 of 1993) and regulations promulgated in terms of the act is required for the operation of a waste treatment facility. The Department of Water Affairs’ Minimum requirements for waste disposal by landfill (Second Edition, 1998) further state that “In terms of the Occupational Health and Safety Act, the Employer is responsible for the health and safety of the people under his or her jurisdiction”. Whenever workers or waste reclaimers are exposed to waste on a regular basis, a health risk may exist. This risk is, however, greater at a hazardous waste landfill than at a general waste landfill. The Responsible Person must therefore use his or her discretion in applying the act and monitoring the health of workers - in the case of hazardous waste landfill sites, this will involve medical examinations. It is further recommended that health and safety at the proposed facility be managed using the OHSAS 18001 system and that regular audits on health and safety aspects be carried out. (EVT, 2011)

The Responsible Person for the operation at the proposed waste treatment facility shall operate the site so as to avoid, or if unavoidable, reduce to a minimum, health risks such as (EVT, 2011):

- **Airborne contaminants**: incompatible wastes are not to be disposed of in the same area, pre-treatment processes are to be strictly controlled, and appropriate personal protective equipment (PPE) such as respirators is to be worn in specified areas on site if air quality monitoring indicates this as required.

- **Exposure to hazardous substances**: suitable PPE is to be worn on site and incompatible wastes are not be disposed of in the same area.

- **Ergonomic stresses** (thermal, illumination, repetitive manual task injuries, etc): monitoring of worker conditions to be undertaken and ergonomic stresses to be managed.

- **Odour**: the main control shall be by using approved sanitary landfill procedures of compaction and covering, supplemented by odour control if necessary. Odorous wastes shall neither be received after 15:00 on weekdays, nor on weekends and public holidays.

- **Dust**: this shall be controlled by means of wetting access roads, as well as the waste body when necessary, and appropriate PPE is to be worn in specified areas on site to protect workers from dust if necessary.

- **Flies and rodents**: shall be controlled by applying sanitary landfill procedures of compaction and covering, as well as using fly traps or other appropriate means.

- **Noise**: must be controlled in accordance with any noise control regulations.

Similarly the Responsible Person for the operation at the proposed facility shall be responsible for ensuring the safety of all site users. Due regard shall be paid to NOSA guidelines and compliance with applicable safety regulations, particularly those encompassed by the Occupational Health and Safety Act (No 85 of 1993, as amended), and any waste license holder specified safety requirements for employees, contractors and visitors. (EVT, 2011)

A short site induction programme should also be developed highlighting the risks on the proposed site. This should be communicated to all employees, contractors and visitors in the site office before entering the site for the first time, and on an annual basis. A register must be kept on site of the names, identity numbers and organisations who have attended induction. (EVT, 2011)
The site operator and the waste license holder are responsible for training their staff and visitors to be aware of the safety risks on the landfill site. In particular, staff must be aware of the following (EVT, 2011):

- dangers of leachate;
- dangers of landfill gas;
- dangers of chemical reactions;
- fire prevention and control procedures;
- no smoking is permitted on site;
- awareness of vehicles and plant, particularly on or near the working face, is essential;
- protective clothing requirements (safety shoes, overalls, high visibility vests, dust masks, respirators, hard hats, earplugs, as well as any other requirements the operator may specify, to be determined on an area by area basis);
- all access roads must be clear of mud and potentially slippery wastes;
- dust suppression is required;
- the vehicles at the working face require a firm trafficking surface;
- the stability of permanent and temporary embankments must be ensured; and
- first aid and accident procedures.

It should be noted that accumulations of landfill gas can be extremely dangerous. Methane gas in concentrations of between 5% and 15% can result in fires and explosions and landfill gas can also cause suffocation and poisoning. Extreme care should therefore be taken when working in confined spaces such as leachate manholes and boreholes that penetrate the waste body. (EVT, 2011)

Leachate can also be dangerous depending on the constituents and concentrations thereof. It is also possible for diseases to be transmitted to those coming into contact with leachate. (EVT, 2011)

Chemical reactions occurring on site also pose a safety risk and fatalities have occurred on hazardous waste sites where incompatible waste types have been disposed of in the same area. Careful planning and awareness of the dangers of uncontrolled chemical reactions occurring on site are required. (EVT, 2011)

Comprehensive signposting on and around the site is essential for traffic safety, as well as worker and visitor safety. Signage on the perimeter fence must indicate that the site is hazardous and that access is restricted. A site notice board adhering to the minimum requirements must be erected at each site entrance. A signpost indicating PPE requirements for each area, as well as any special instructions (such as limited access), should be erected at the entrance(s) to that area. Traffic routes should be clearly marked with warning signs and speed limit signs in place, as required. The use of speed bumps in critical areas is recommended. Signage must be updated regularly as the facility develops. (EVT, 2011)

The development of a wet weather cell, that is, an area for deposition that is easily accessible in wet weather conditions, should be considered, particularly if clayey material is used for cover. This would improve road safety on site and should allow the operation to continue during wet weather. (EVT, 2011)
Given the inherent risks associated with a hazardous waste disposal site it is recommended that, where possible, two access points are developed for each cell. This would allow a cell to be evacuated, or for assistance to access a cell, when there is an incident close or on one of the access ramps. (EVT, 2011)

In case of an emergency the relevant and local emergency services are to be contacted for assistance. These contact details should be easy available and accessible on site. In case of emergency on site, a comprehensive emergency plan should be developed and implemented addressing scenarios such as spillages, riots, fires, drowning or any other event that might occur on site placing human life or the environment in jeopardy. (EVT, 2011)

Detailed health and safety issues for the proposed waste treatment facility is described in detail in the design report (EVT, 2011) presented in Appendix K.
11. DETAILS OF THE ENVIRONMENTAL ASSESSMENT PRACTITIONER

In terms of Section 28(1)(a) of Regulation 543: Environmental Impact Assessment Regulations, 18 June 2010; read in conjunction with sections 24(5), 24M and 44 of the National Environmental Management Act (No 107 of 1998); it is a requirement to provide details of the environmental assessment practitioner (EAP) who prepared the report and the expertise of the EAP to carry out scoping procedures. This is provided in the following sections under general information, experience and related publications.

11.1 General information

**Name:** John Francois Curling Friend  
**Education:**  
- BEng (Chem) Pretoria 1986  
- MSc (Eng) Cape Town 1991  
- Dip MktM IMM 1995

**Affiliations:**  
- FSAIChE (Fellow, South African Institution of Chemical Engineers)  
- FIChemE (Fellow, United Kingdom Institution of Chemical Engineers)  
- FWISA (Fellow, Water Institute of South Africa)  
- FIWM(SA) (Fellow, Institute of Waste Management of Southern Africa)

**Registrations:**  
- PrEng (Professional Engineer, Engineering Council of South Africa)  
- CEng (Chartered Engineer, United Kingdom Engineering Council)

**Specialisation:** Water management, treatment and recycling. Air quality and waste management. Environmental management, economics, assessments and auditing. Technical audits and effluent treatment. Specialised computer applications.

11.2 Experience

**1991 - Present**  
Softchem, founder member. Waste management (Eloptro), water management (Sasol Mining and Eskom), water treatment dedicated software (Anglo American Research Laboratories and Veolia Eau in France), functional specifications and operating manuals for water treatment plants (Saldanha Steel as subcontractor to DB Thermal), technical and environmental auditing (Eskom), environmental impact assessments (including public participation meetings) and evaluations (ABI/Coca-Cola, Deep Yellow/Reptile Uranium Namibia, Gautrans, Ncsa, Paladin Resources/ Langer Heinrich Uranium and Waste Giant), environmental management programme report (Eurocoa), environmental consulting and ISO 14001 environmental system implementation (Eskom, Midvaal Water Company and Vametco Alloys).

**2005 - Present**  
SI Analytics (Pty) Ltd., Director Operations and Projects. Supplying air monitoring equipment to industry and government.

**1997 - Present**  
Waterops (Pty) Ltd., Director: Operations and Marketing. Water treatment plant operations and troubleshooting, through Thermax representation supply of various chemicals and ion exchange resins.

**1998 - 2007**  
University of Pretoria, Department of Chemical Engineering, Senior Lecturer. Responsible for the Environmental Engineering Group lecturing environmental engineering and postgraduate courses in environmental management, air quality management, waste management, air pollution control and water management.

**1992 - 1998**  

**1990 - 1992**  
Eskom Chemical Engineering Division, Design Engineer. Water management studies at numerous power stations and external to Eskom, eg Soda Ash Botswana. Effluent treatment plant design.
1988 - 1990
Koeberg Nuclear Power Station, Engineer in Training. Water treatment plant operation and troubleshooting, sodium hypochlorite production, sewage treatment and water chlorination plants, ion exchange resins.

1985 - 1986

11.3 Related publications*


12. ENVIRONMENTAL MANAGEMENT PROGRAMME

In terms of Section 31(2)(p) of Regulation 543 of 18 June 2010 (EIA regulations) it is a requirement to complete an environmental management programme report containing the aspects contemplated in Section 33 of the EIA regulations. This is best utilised and formerly developed by the implementation of an environmental management system.

12.1 Environmental management system

Waste Giant (Pty) Ltd will strive to align its environmental management system (EMS) in accordance with the ISO 14001:2004 standard (even if not accredited under the standard). ISO 14001 is the world's most recognised EMS framework, enabling organisations to demonstrate sound environmental management by minimising harmful effects on the environment and achieving continual improvement through a formal environmental management system, which is subject to external audit verification.

12.2 Development of the environmental management system

In order to address all relevant environmental impacts and to assist in the development of a practical environmental management programme, Waste Giant (Pty) Ltd will implement the following four level documented environmental management system:

Level 1 - this level of documentation will consist of the company's environmental policy and the environmental management system manual (roadmap to the complete EMS);

Level 2 - environmental specific and company related documentation;

Level 3 - environmental and related registers and activity specific work instructions; and

Level 4 - records (for example, analyses and monthend reports) and related documentation (for example, feedback reports to authorities, management reviews and audit reports).

The following four EMS procedures will be developed, approved, authorised and implemented at the proposed waste treatment facility (ISO 14001, 2004):

- Environmental policy and management review procedure;

- Environmental management system planning procedure (addressing environmental aspects; legal and other requirements; and objectives, targets and programmes);

- Environmental management system implementation and operation procedure (addressing resources, roles, responsibility and authority; competency, training and awareness; communication; documentation; control of documents; operational control; and emergency preparedness and response); and

- Environmental management system checking procedure (addressing monitoring and measurement; evaluation of compliance; nonconformity, corrective and preventive action; control of records; and internal audit).

The following Level 3 documents are, inter alia, envisaged for the proposed waste treatment facility, for ISO 14001 alignment:

- environmental aspects and impacts register,

- environmental legal register,

- environmental objectives, targets and programme,

- environmental training register,

- environmental complaints register, and

- EMS audit schedule.
The company will strive to have the proposed environmental management system, with related documentation and practical requirements, implemented during/prior to the construction phase of the proposed project.

12.3 Development of the environmental management programme
The environmental impacts identified in Section 8, proposed measures for mitigation of these impacts, monitoring actions and methods required for implementation of these mitigated measures, responsibilities and resources required for implementation form the basis of compiling a suitable environmental management programme in terms of the requirements stipulated by Section 33 of the EIA regulations. The required draft environmental management programme is set out in Appendix I.
13. SPECIFIC INFORMATION REQUIRED BY COMPETENT AUTHORITY

13.1 Assumptions and uncertainties
In terms of Section 31(2)(m) of Regulation 543 of 18 June 2010 (EIA regulations) it is required to give a description of any assumptions, uncertainties and gaps in knowledge encountered in the completion of this environmental impact assessment report. These were all addressed in individual specialist reports presented in the attached appendices, and where relevant, in Sections 3, 5 and 8 of this EIA report.

13.2 Reasoned opinion
It is the reasoned opinion of the EAP that compiled this report, based on his professional qualifications and experience, that the proposed activity be authorised. As further requested in Section 31(2)(n) of Regulation 543 of 18 June 2010 for stipulating any conditions that should be made in respect of such an authorisation, no further conditions are prescribed apart from the recommended mitigation measures stated in Section 8 of this report.

13.3 Other matters
At this stage no specific information is required by the relevant authority, as requested by Section 31(2)(r) of the EIA regulations. Requirements in terms of the waste licence application were met during the handing in of the application during the scoping phase of this project, and will be augmented as required with this EIA report submission.

No other matters are outstanding as required by Section 31(2)(s) of Regulation 543 of 18 June 2010 in terms of Sections 24(4)(a) and 243(4)(b) of the National Environmental Management Amendment Act (No 62 of 2008).

Finally, Section 31(3) of the EIA regulations was suitably addressed in Section 6 of this EIA report and its referenced documentation.

13.4 Environmental impact statement
This proposed activity envisaged the design, installation and operation of a waste treatment facility in a worked-out brown fields old brickworks. The key findings from the EIA were that the current condition of the site is not good and that a professionally installed and operated waste treatment facility will uplift the environmental conditions of the site. Excellent relationships were developed during the scoping phase of this project between the applicant and the local community with the future development of a nature conservancy, in combination with the local community’s planned nature conservancy on their adjoining properties, on the site the resultant outcome of negotiations between the two parties.

In addition, the urgent need for additional hazardous waste disposal facilities in the Gauteng province is reaching alarming proportions. The well-publicised debacle with illegal disposal of medical waste during 2010 is a symptom of this.

The positive implications of this activity can be summarised thus as the improvement of the site’s environmental conditions, the establishment of a nature conservancy together with a cooperative local community and the alleviating of the Gauteng province’s dire need for additional hazardous waste disposal facilities. With the complete implementation of mitigation measures, as prescribed in this report, very few negative implications will result from the proposed activity. Possible such implications relate to air quality, water quality, noise and odour impacts. However, with the implementation of correct mitigation measures these should all be negated.
In this case the preferred site, based on an alternative site selection investigation, resulted in a very similar situation as is the case with mineral deposits and related mining activities, namely a near negation of any other site for the proposed activity due to the current degraded condition of the proposed site. This nullifies positive implications of identified alternative sites and thus makes any negative implications irrelevant with regard site alternatives. The negative implications related to selection of the no-go alternative to this proposed activity on the proposed site at present far outweigh any likely positive implications with selecting the no-go alternative. Major negative implications of the no-go option include, *inter alia*, possible long period of time prior to site rehabilitation, related safety and security risks, devaluation of properties and possible legal proceedings against the government. Possible positive implications will naturally be the eliminating the possible negative implications of the proposed activity.

With the major alternative category being that of site (location) alternatives addressed, any other alternative categories (demand, activity, process, scheduling and input) can be suitably managed through mitigation measures to negate any negative implications.
13. REFERENCES


