DRAFT SCOPING REPORT

FOR THE PROPOSED TOWNSHIP ESTABLISHMENT ON PORTION OF FARM KLIPFONTEIN 716 AND FARM CERES 626 WITHIN THE MANGAUNG METROPOLITAN MUNICIPALITY

NOVEMBER 2019

Prepared For:

Department of Economic Small Business Development, Tourism and Environment Affairs (DESTEA).

Prepared By:

Inaluk Consulting Services

Report Tittle : Draft scoping report for the Proposed Mangaung Township

Place and Date : Pretoria November 2019

PROPONENT

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DECLARATION OF INDEPENDENCE
I, Kulani Nkuna as authorised representative of Inaluk Consulting Services hereby confirm my independence as an Environmental Assessment Practitioner and declare that neither I nor Inaluk Consulting Services have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which Inaluk Consulting Services was appointed as Environmental Assessment Practitioner in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), other than fair remuneration for worked performed, specifically in connection with the Environmental Authorisation process for the Ladysmith Township extension 61.

Signature……. **Date**…….

24 November 2019

destea
department of
economic, small business development,
tourism and environmental affairs
FREE STATE PROVINCE

(For official use only)

File Reference Number:	
Application Number:	
Date Received:	

Basic assessment report in terms of the Environmental Impact Assessment Regulations, 2014, promulgated in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended.

Kindly note that:

1. This **environmental impact assessment report** is a standard report that may be required by a competent authority in terms of the EIA Regulations, 2014 as amended and is meant to streamline applications. Please make sure that it is the report used by the particular competent authority for the activity that is being applied for.
2. This report format is current as of **07 April 2017**. It is the responsibility of the applicant to ascertain whether subsequent versions of the form have been published or produced by the competent authority
3. The report must be typed within the spaces provided in the form. The size of the spaces provided is not necessarily indicative of the amount of information to be provided. The report is in the form of a table that can extend itself as each space is filled with typing.
4. Where applicable **tick** the boxes that are applicable in the report.
5. An incomplete report may be returned to the applicant for revision.
6. The use of "not applicable" in the report must be done with circumspection because if it is used in respect of material information that is required by the competent authority for assessing the application, it may result in the rejection of the application as provided for in the regulations.
7. This report must be handed in at offices of the relevant competent authority as determined by each authority.
8. No faxed or e-mailed reports will be accepted.
9. The signature of the EAP on the report must be an original signature.
10. The report must be compiled by an independent environmental assessment practitioner.
11. Unless protected by law, all information in the report will become public information on receipt by the competent authority. Any interested and affected party should be provided with the information contained in this report on request, during any stage of the application process.
12. A competent authority may require that for specified types of activities in defined situations only parts of this report need to be completed.

13. Should a specialist report or report on a specialised process be submitted at any stage for any part of this application, the terms of reference for such report must also be submitted.
14. Two (2) colour hard copies and one (1) electronic copy of the report must be submitted to the competent authority.
15. Shape files (.shp) for maps must be included in the electronic copy of the report submitted to the competent authority.

SECTION A: ACTIVITY INFORMATION

Has a specialist been consulted to assist with the completion of this section?	YES	NO

If YES, please complete the form entitled "Details of specialist and declaration of interest" for the specialist appointed and attach in Appendix I.

1. PROJECT DESCRIPTION

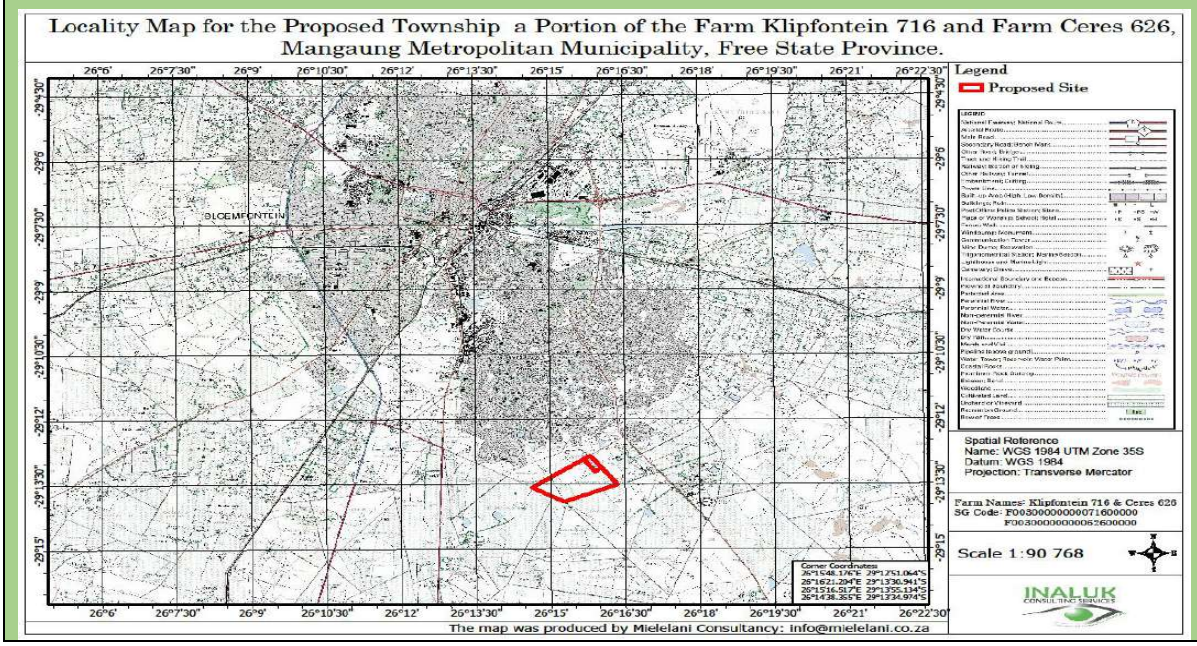
a) Describe the project associated with the listed activities applied for

The Mangaung Local Municipality is proposing to establish a new township development covering an area of approximately of 232,4 hectares in Mangaung, Free State Province. The proposed development is located on the Klipfontein 716 and farm Ceres 626. The site can be accessed from the Dewetsdorp Road and the M30, the said property is approximately 17 km outside Bloemfontein central with the following coordinates: 29° 12' 55.95" S and 26° 15' 51.58" E. The development will entail the provision of services to enable the proposed development of the Mangaung Mixes used Township which will consist of the following infrastructure:

- Residential stands
- Institutional stands
- Recreational
- Educational
- Municipal
- Place of worship
- Public open spaces

The Scoping and EIA Process is being undertaken in terms of the National Environmental Management Act (Act no. 107 of 1998) (NEMA) read with the Environmental Impact Assessment Regulations, 2017 (GNR 326 of 7 April 2017).

Locality Map



Layout Evaluated

Layout Alternative (Preferred Alternative)

Due to land availability and service connections, the proposed site is the only site that has been identified for establishing a township during the consultation process with the Local Municipality. Therefore, no alternative site has been identified or considered during this study.

b) Provide a detailed description of the listed activities associated with the project as applied for

Listed activity as described in GN 327,325 and 324	Description of project activity
Example: ***GN 327 Item xx xx): The construction of a bridge where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.***	***A bridge measuring 5 m in height and 10m in length, no wider than 8 meters will be built over the Orange river***
GNR 325 of 7 April 2017 The clearance of an area of 20 hectares or more of indigenous vegetation, where such clearance of indigenous vegetation is required for (i)Undertaking of a linear activity; or (ii)Maintenance purposes undertaken in accordance with a maintenance management plan	The clearance of more than 200 hectares of land for the establishment of the various land uses on 232,4 hectares of land on the farm Klipfontein 716 and Ceres 626. This clearance is for the development of a township and provision of serbices

2. FEASIBLE AND REASONABLE ALTERNATIVES

"alternatives", in relation to a proposed activity, means different means of meeting the general purpose and requirements of the activity, which may include alternatives to—

(a) the property on which or location where it is proposed to undertake the activity;
(b) the type of activity to be undertaken;
(c) the design or layout of the activity;
(d) the technology to be used in the activity;
(e) the operational aspects of the activity; and
(f) the option of not implementing the activity.

Describe alternatives that are considered in this application as required by Appendix 1 (3)(h) of GN 326, Regulation 2014 as amended. Alternatives should include a consideration of all possible means by which the purpose and need of the proposed activity (NOT PROJECT) could be accomplished in the specific instance taking account of the interest of the applicant in the activity. The no-go alternative must in all cases be included in the assessment phase as the baseline against which the impacts of the other alternatives are assessed.

The determination of whether site or activity (including different processes, etc.) or both is appropriate needs to be informed by the specific circumstances of the activity and its environment. After receipt of this report the, competent authority may also request the applicant to assess additional alternatives that could possibly accomplish the purpose and need of the proposed activity if it is clear that realistic alternatives have not been considered to a reasonable extent.

The identification of alternatives should be in line with the Integrated Environmental Assessment Guideline Series 11, published by the DEA in 2004. Should the alternatives include different locations and lay-outs, the co-ordinates of the different alternatives must be provided. The co-ordinates should be in degrees, minutes and seconds. The projection that must be used in all cases is the WGS84 spheroid in a national or local projection.

a) Site alternatives

Alternative 1 (preferred alternative)		
Description	Lat (DDMMSS)	Long (DDMMSS)
The proposed development is located on the Klipfontein 716 and farm Ceres 626. The site can be accessed from the Dewetsdorp Road and the M30, the said property is approximately 17 km outside Bloemfontein central with the following coordinates: 29° 12' 55.95" S and 26° 15' 51.58" E. Due to land availability and service connections, the proposed site is the only site that has been identified for establishing a township during the consultation process with the Local Municipality. Therefore, no alternative site has been identified or considered during this study.	**29° 12' 55.95" S**	**26° 15'51.58" E.**
Alternative 2		

Description	Lat (DDMMSS)	Long (DDMMSS)
Due to land availability and service connections, the proposed site is the only site that has been identified for establishing a township during the consultation process with the Local Municipality. Therefore, no alternative site has been identified or considered during this study.		
Alternative 3		
Description	Lat (DDMMSS)	Long (DDMMSS)
Due to land availability and service connections, the proposed site is the only site that has been identified for establishing a township during the consultation process with the Local Municipality. Therefore, no alternative site has been identified or considered during this study.		

In the case of linear activities:

Alternative: N/A	**Latitude (S):**	**Longitude (E):**
Alternative S1 (preferred)		
• Starting point of the activity		
• Middle/Additional point of the activity		
• End point of the activity		
Alternative S2 (if any)		
• Starting point of the activity		
• Middle/Additional point of the activity		
• End point of the activity		
Alternative S3 (if any)		
• Starting point of the activity		
• Middle/Additional point of the activity		
• End point of the activity		

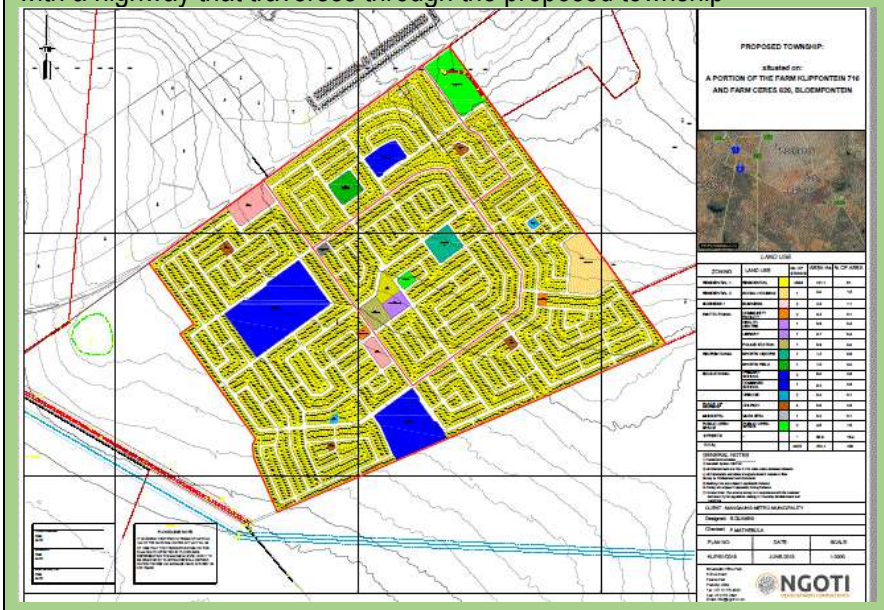
For route alternatives that are longer than 500m, please provide an addendum with co-ordinates taken every 250 meters along the route for each alternative alignment.

In the case of an area being under application, please provide the co-ordinates of the corners of the site as indicated on the lay-out map provided in Appendix A of this form.

b) Lay-out alternatives

Alternative 1 (preferred alternative)		
Description	Lat (DDMMSS)	Long (DDMMSS)
The below layout allows for 4001 development stands on 232,4 hectares with a highway that traverses through the proposed township	**29° 12' 55.95" S**	**26° 15'51.58" E.**

Alternative 2		
Description	Lat (DDMMSS)	Long (DDMMSS)
The below layout allows for 4022 development stands on 214,1 hectares with a highway that traverses through the proposed township	**29° 12' 55.95" S**	**26° 15'51.58" E.**



Alternative 3		
Description	Lat (DDMMSS)	Long (DDMMSS)
No third alternative considered for the project layout		

c) Technology alternatives

Alternative 1 (preferred alternative)
N/A

Alternative 2
N/A
Alternative 3
N/A

d) Other alternatives (e.g. scheduling, demand, input, scale and design alternatives)

Alternative 1 (preferred alternative)		
Scheduling alternative These are also known as sequencing or phasing alternative. In essence, this means rescheduling parts of an activity to occur at times when impacts are less. In this case an activity may comprise a number of components, which can be scheduled in a different order or at different times and as such produce different impacts. For example, activities that produce noise could be from 06:00 to 18:00 to minimise impacts. **Input alternative** Input alternative is most applicable where different raw materials or energy sources will be utilised. In this proposed project alternatives that could be considered could be using solar energy for power supply and using ground water for water supply to reduce the pressure from the Mangaung Metropolitan Municipality to supply service. **Design and Layout alternative** The design and the layout of the development must take into consideration the type of slope of the site, especially during the construction phase so that no excessive dust particles are emitted, as it may have serious negative impacts among workers and the local residents. The Mangaung Metropolitan Municipality has identified Engineering designers who will be responsible for designing the development so as to avoid unpleasant aesthetic impacts which may be unacceptable to the community. **Demand alternative** Demand Alternative occurs when the demand for housing can be met by alternative means. Establishment of township will reduce the demand of housing to people of Mangaung. If the demand of service increase beyond the capacity of housing then operational cost will also increase. **Process alternative**		

The process alternative is also an engineering issue, therefore the Mangaung Metropolitan Municipality has appointed a specialist to assist in identifying the process alternative and has considered both technology and equipment alternatives to achieve the same goal.		
Alternative 2		
N/A		
Alternative 3		
N/A		

e) No-go alternative

The no-go alternative is the option of not developing the proposed development and its associated infrastructure. The land on the portion of farm Klipfontein 716 and farm Ceres 626 will remain undeveloped. The no development option would result in a lost opportunity in terms of the employment opportunities associated with the construction and operation phase as well as the benefits associated with the provision of houses, schools and other much needed social facilities. A high negative socio-economic impact significance would occur if the proposed development is not constructed. The "no-go" alternative will however result in the negative visual environment staying the same with the natural character of the area contributing to the "sense of place". If the development proposal is not authorised the current natural parts will remain largely impacted by illegal waste dumping which is clearly a negative factor for the biodiversity in the area. The socio-economic benefits of this project however largely outweigh the impacts in an area The No-Go Alternative is therefore not recommended

Paragraphs 3 – 13 below should be completed for each alternative.

3. PHYSICAL SIZE OF THE ACTIVITY

a) Indicate the physical size of the preferred activity/technology as well as alternative activities/technologies (footprints):

Alternative:	**Size of the activity:**
Alternative A1[1] (preferred activity alternative)	232,4 Ha
Alternative A2 (if any)	214,1 Ha
Alternative A3 (if any)	m^2

or, for linear activities: N/A

Alternative:	**Length of the activity:**
Alternative A1 (preferred activity alternative)	N/A m
Alternative A2 (if any)	N/A m
Alternative A3 (if any)	N/A m

[1] "Alternative A.." refer to activity, process, technology or other alternatives.

b) Indicate the size of the alternative sites or servitudes (within which the above footprints will occur):

Alternative:	**Size of the site/servitude:**
Alternative A1 (preferred activity alternative)	232,4 Ha
Alternative A2 (if any)	214,1 Ha
Alternative A3 (if any)	m^2

4. SITE ACCESS

Does ready access to the site exist?	YES	NO
If NO, what is the distance over which a new access road will be built		N/A m

Describe the type of access road planned:

The site can be accessed from the Dewetsdorp Road and the R720/ M30. There are also three roads that have been proposed by SANRAL that will form part of the National roads, these roads traverse through the proposed township footprint and they have been accommodated for. the proposed roads will form part of the N6.

Include the position of the access road on the site plan and required map, as well as an indication of the road in relation to the site.

5. LOCALITY MAP

An A3 locality map must be attached to the back of this document, as Appendix A. The scale of the locality map must be relevant to the size of the development (at least 1:50 000. For linear activities of more than 25 kilometres, a smaller scale e.g. 1:250 000 can be used. The scale must be indicated on the map.). The map must indicate the following:

- an accurate indication of the project site position as well as the positions of the alternative sites, if any;
- indication of all the alternatives identified;
- closest town(s;)
- road access from all major roads in the area;
- road names or numbers of all major roads as well as the roads that provide access to the site(s);
- all roads within a 1km radius of the site or alternative sites; and
- a north arrow;
- a legend; and
- locality GPS co-ordinates (Indicate the position of the activity using the latitude and longitude of the centre point of the site for each alternative site. The co-ordinates should be in degrees and decimal minutes. The minutes should have at least three decimals to ensure adequate accuracy. The projection that must be used in all cases is the WGS84 spheroid in a national or local projection.

6. LAYOUT/ROUTE PLAN

A detailed site or route plan(s) must be prepared for each alternative site or alternative activity. It must be attached as Appendix A to this document.

The site or route plans must indicate the following:

- the property boundaries and numbers of all the properties within 50 metres of the site;
- the current land use as well as the land use zoning of the site;
- the current land use as well as the land use zoning each of the properties adjoining the site or sites;
- the exact position of each listed activity applied for (including alternatives);
- servitude(s) indicating the purpose of the servitude;
- a legend; and
- a north arrow.

7. SENSITIVITY MAP

The layout/route plan as indicated above must be overlain with a sensitivity map that indicates all the sensitive areas associated with the site, including, but not limited to:

- watercourses;
- the 1:100-year flood line (where available or where it is required by DWS);
- ridges;
- cultural and historical features;
- areas with indigenous vegetation (even if it is degraded or infested with alien species); and
- critical biodiversity areas.

The sensitivity map must also cover areas within 100m of the site and must be attached in Appendix A.

8. SITE PHOTOGRAPHS

Colour photographs from the centre of the site must be taken in at least the eight major compass directions with a description of each photograph. Photographs must be attached under Appendix B to this report**.** It must be supplemented with additional photographs of relevant features on the site, if applicable.

9. FACILITY ILLUSTRATION

A detailed illustration of the activity must be provided at a scale of at least 1:200 as Appendix C for activities that include structures. The illustrations must be to scale and must represent a realistic image of the planned activity. The illustration must give a representative view of the activity.

10. ACTIVITY MOTIVATION

Motivate and explain the need and desirability of the activity (including demand for the activity):

1. Is the activity permitted in terms of the property's existing land use rights?	YES	NO	Please explain
The current land zoning for the area is currently for agriculture. A SPLUMA application is being lodged by Ngoti Town planners for the zoning to change in the with the various land uses for the proposed development			
2. Will the activity be in line with the following?			
(a) Provincial Spatial Development Framework (PSDF)	YES	NO	Please explain
This project is in line with PSDF Pillar 2: Spatial Planning - Integrated spatial planning and land use management in line with Category D of the special planning categories (Dm) Mixed used developments			
(b) Urban edge / Edge of Built environment for the area	YES	NO	Please explain
(c) Integrated Development Plan (IDP) and Spatial Development Framework (SDF) of the Local Municipality (e.g. would the approval of this application compromise the integrity of the existing approved and credible municipal IDP and SDF?).	YES	NO	Please explain
The MLM believes the principles call for the emergence of settlement patterns which create benefits accessible to the people of Mangaung. For this approach to be realised all settlements in Mangaung should strive to achieve the following qualities: • To generate a wide range of economic opportunities; • To be convenient to inhabitants to conduct their daily activities, easily and as inexpensively as possible, • To offer a choice of living conditions to all, • To be equitable in the sense that all inhabitants have reasonable access to the opportunities and facilities which support living in settlements, • To promote the efficient use of resources, and • To give dignity to people through the quality of the public spatial environment. The proposed development meets all the principles mentioned above for settlements opportunities			
(d) Approved Structure Plan of the Municipality	YES	NO	Please explain
The municipality aims to improve the following Housing backlogs and incomplete housing projects; Illegal settlements and land invasions in areas/lands Accelerating development of seven (7) land parcels with mixed development trajectory ;			

(e) An Environmental Management Framework (EMF) adopted by the Department (e.g. Would the approval of this application compromise the integrity of the existing environmental management priorities for the area and if so, can it be justified in terms of sustainability considerations?)	YES	NO	Please explain
The priority areas for Free state include the following areas large area of Mesic Highveld Grasslands and Drakensberg Grasslands in the eastern Free State which are important for ecosystem service delivery. There is a central and southern band of priority areas targeting very under-protected Dry Highveld Grasslands, and then a smaller set of areas in the west targeting the upper Nama-Karoo and Eastern Kalahari Bushveld.			
(f) Any other Plans (e.g. Guide Plan)	YES	NO	Please explain
3. Is the land use (associated with the activity being applied for) considered within the timeframe intended by the existing approved SDF agreed to by the relevant environmental authority (i.e. is the proposed development in line with the projects and programmes identified as priorities within the credible IDP)?	YES	NO	Please explain
This proposed development is in line with the IDP and the area has no critical environmental sensitivities. the project is also funded by a grand to fulfil the commitments of the IPD by the municipality to address issues of informal settlements and access to housing and other institutional areas			
4. Does the community/area need the activity and the associated land use concerned (is it a societal priority)? (This refers to the strategic as well as local level (e.g. development is a national priority, but within a specific local context it could be inappropriate.)	YES	NO	Please explain
The proposed development will aim at addressing the need for social housing and formal settlements from the adjacent informal settlements			
5. Are the necessary services with adequate capacity currently available (at the time of application), or must additional capacity be created to cater for the development? (Confirmation by the relevant Municipality in this regard must be attached to the final Basic Assessment Report as Appendix I.)	YES	NO	Please explain
The proposed water demand for the proposed development is estimated to be 6060.90 KL/day and 4416.64 KL and the municipality is still in the process of confirming available capacity for the proposed demands. should there be inadequate capacity there will be a need to improve			

6. Is this development provided for in the infrastructure planning of the municipality, and if not what will the implication be on the infrastructure planning of the municipality (priority and placement of services and opportunity costs)? (Comment by the relevant Municipality in this regard must be attached to the final Basic Assessment Report as Appendix I.)	YES	NO	Please explain
The MLM in their IDP have identified infrastructure programmes as follows that will improve services Adequate budgeting for implementation to Water Demand Management; • Partnering with government to embark on a project to ensure reliable water supply _ explore a pipeline sourcing water from Gariep Dam • Water Conservation and harvesting of water			
7. Is this project part of a national programme to address an issue of national concern or importance?	YES	NO	Please explain
The project aims at addressing issue address in the national development plan			
8. Do location factors favour this land use (associated with the activity applied for) at this place? (This relates to the contextualisation of the proposed land use on this site within its broader context.)	YES	NO	Please explain
The current proposed land use will be beneficial as currently the land is degraded by illegal dumping of waste from the informal settlements. the development of this land will improve the state of the environment as it is as well as visual impacts associated with the waste dumping in close proximity to the R702 road			
9. Is the development the best practicable environmental option for this land/site?	YES	NO	Please explain
Yes, the development has created buffers to areas high sensitivity in the area being the dam and the wetland area on the south western boundary of the development. with the protection of these resources then all other proposed land uses within this area will be best for the larger environment. the area has no other sensitivities other than the wetland area			
10. Will the benefits of the proposed land use/development outweigh the negative impacts of it?	YES	NO	Please explain
The proposed development will address the following issues with the development being approved • Social housing • Access to schools • Access to government institutions • Reduce littering • Reduce land invasion through informal settlements evident in the surrounding area • Improved infrastructure system through the proposed N6 highway by SANRAL			

11. Will the proposed land use/development set a precedent for similar activities in the area (local municipality)?	YES	NO	Please explain
The proposed development will prompt other developments in the area as there will be decentralisation of services into the main central business areas of the Mangaung metropolitan area which will benefit the society in having access to services in close proximity. it will also improve and aid in more business opening in the areas			
12. Will any person's rights be negatively affected by the proposed activity/ies?	YES	NO	Please explain
The development will benefit the local residents as they will have better access to school and other institutional areas proposed with this development. there will also be job opportunities with the development of this project during the construction phase of the development.			
13. Will the proposed activity/ies compromise the "urban edge" as defined by the local municipality?	YES	NO	Please explain
14. Will the proposed activity/ies contribute to any of the 17 Strategic Integrated Projects (SIPS)?	YES	NO	Please explain
The project contributes to SIP 7 Integrated urban space and public transport programme Coordinate planning and implementation of public transport, human settlement, economic and social infrastructure and location decisions into sustainable urban settlements connected by densified transport corridors. This will focus on the 12 largest urban centres of the country, including all the metros in South Africa. Significant work is underway on urban transport integration.			
15. What will the benefits be to society in general and to the local communities?			Please explain
The community will benefit from access to better social housing and basic services such as schools			
16. Any other need and desirability considerations related to the proposed activity?			Please explain
The development will address the issue of resettlement of people in informal settlements. there is also a high risk of encroachment on this land should the development not be approved as planned for by the MLM.			

17. How does the project fit into the National Development Plan for 2030?	Please explain
This project fits into the NDP for 2030 as the MLM plans on the following as part of the NDP • Upgrade all informal settlements on suitable, well located land by 2030. • Reform the current planning system for improved coordination. • Develop a strategy to densify cities, promote better located housing and settlements. • Ensure safe, reliable and affordable public transport. • Provide SDF norms, including improving the balance between location of jobs and people. • Review of the grant and subsidy regime for housing • Provide incentives for citizen participation for local planning and development of spatial compacts. • Introduce mechanisms that would make land markets work more effectively for the poor and support rural and urban livelihoods.	
18. Please describe how the general objectives of Integrated Environmental Management as set out in section 23 of NEMA have been considered.	
All possible impacts that may both form a positive and negative ROD have been considered in the impact assessment of the project (see section F) impact assessment. the public participation process has also been initiated to identify all parties that me be affected or have an interest to the prosed development through sending a request to register on local newspaper as well as placement of site notices where the general public would be engaged and issues that they may have discussed in detail. Specialist have also been appointed to conduct impact assessments that would advise on sensitive areas of the development and where impacts arise advise on mitigation measures to be implemented throughout the project lifecycle .	
19. Please describe how the principles of environmental management as set out in section 2 of NEMA have been considered.	
Specialist have been considered in the various subject matters of the proposed development as well as relevant legislation governing the proposed development so that all statutory requirements are fulfilled	

11. APPLICABLE LEGISLATION, POLICIES AND/OR GUIDELINES

List all legislation, policies and/or guidelines of any sphere of government that are applicable to the application as contemplated in the EIA regulations, if applicable:

Title of legislation, policy or guideline	Applicability to the project	Administering authority	Date
Constitution of the Republic of South Africa 108 of 1996	Constitution makes provision for access to safe environment, housing and education	Mangaung Metropolitan municipality	
Municipal Systems Act 32 of 2000	Provision of proper settlements and utilities infrastructure	Mangaung Metropolitan municipality	
Spatial Planning and Land	Provision of land for township	Mangaung	

Use Management Act 16 of 2013	establishment	Metropolitan municipality	
Mangaung Metropolitan Municipality draft built environment performance plan (BEPP	Township development	Metropolitan municipality	2019/2020 – 2020/21
Metropolitan Spatial Development Framework	Township development	Metropolitan municipality	
Spatial Development Framework	Township development	Metropolitan municipality	2005 –06

12. WASTE, EFFLUENT, EMISSION AND NOISE MANAGEMENT

a) Solid waste management

Will the activity produce solid construction waste during the construction/initiation phase?	YES	NO
If YES, what estimated quantity will be produced per month?	Not able to predict at this stage of the project	

How will the construction solid waste be disposed of (describe)?

All construction waste such as building rubble, general waste will be disposed off in the correct waste skips with proper waste separation for disposal at the various landfill sites. Where possible any waste that must be recycled will be recycled at licenced facilities

Where will the construction solid waste be disposed of (describe)?

The construction rubble will be disposed at the rubble disposal facility located in mangaung . other waste streams such as general waste will be diposed at the general landfill sites

Will the activity produce solid waste during its operational phase?	YES	NO
If YES, what estimated quantity will be produced per month?	m^3	

How will the solid waste be disposed of (describe)?

All solid waste that will be generated during the operation phase of the project will be directed to the Mangaung municipality landfill sites

If the solid waste will be disposed of into a municipal waste stream, indicate which registered landfill site will be used.

Southern Landfill

Where will the solid waste be disposed of if it does not feed into a municipal waste stream (describe)?

All waste during operation phase will be taken to municipal landfill site

If the solid waste (construction or operational phases) will not be disposed of in a registered landfill site or be taken up in a municipal waste stream, then the applicant should consult with the competent authority to determine whether it is necessary to change to an application for scoping and EIA.

Can any part of the solid waste be classified as hazardous in terms of the NEM:WA?	YES	NO

If YES, inform the competent authority and request a change to an application for scoping and EIA. An application for a waste permit in terms of the NEM:WA must also be submitted with this application.

Is the activity that is being applied for a solid waste handling or treatment facility?	YES	NO

If YES, then the applicant should consult with the competent authority to determine whether it is necessary to change to an application for scoping and EIA. An application for a waste permit in terms of the NEM:WA must also be submitted with this application.

b) Liquid effluent

Will the activity produce effluent, other than normal sewage, that will be disposed of in a municipal sewage system?	YES	NO
If YES, what estimated quantity will be produced per month?		m^3
Will the activity produce any effluent that will be treated and/or disposed of on site?	YES	NO

If YES, the applicant should consult with the competent authority to determine whether it is necessary to change to an application for scoping and EIA.

Will the activity produce effluent that will be treated and/or disposed of at another facility?	YES	NO

If YES, provide the particulars of the facility:

Facility name:			
Contact person:			
Postal address:			
Postal code:			
Telephone:		**Cell:**	
E-mail:		**Fax:**	

Describe the measures that will be taken to ensure the optimal reuse or recycling of waste water, if any:

All waste water that will be generated will be in the form of sewerage from the operational phase of the proposed development. This waste will be connected and disposed to municipal sewer system .

c) Emissions into the atmosphere

Will the activity release emissions into the atmosphere other that exhaust emissions and dust associated with construction phase activities?	YES	NO
If YES, is it controlled by any legislation of any sphere of government?	YES	NO

If YES, the applicant must consult with the competent authority to determine whether it is necessary to change to an application for scoping and EIA.

If NO, describe the emissions in terms of type and concentration:

The only emission that will result form the construction phase of the proposed development which will be dust from movement of heavy machinery .

d) Waste permit

Will any aspect of the activity produce waste that will require a waste permit in terms of the NEM:WA?	YES	~~NO~~

If YES, please submit evidence that an application for a waste permit has been submitted to the competent authority

e) Generation of noise

Will the activity generate noise?	YES	~~NO~~
If YES, is it controlled by any legislation of any sphere of government?	YES	NO

Describe the noise in terms of type and level:

There will be no noise generating activities other than noise from the movement of construction equipment . this noise will not be for prolonged periods.

13. WATER USE

Please indicate the source(s) of water that will be used for the activity by ticking the appropriate box(es):

~~Municipal~~	Water board	Groundwater	River, stream, dam or lake	Other	The activity will not use water

If water is to be extracted from groundwater, river, stream, dam, lake or any other natural feature, please indicate the volume that will be extracted per month:		litres
Does the activity require a water use authorisation (general authorisation or water use license) from the Department of Water Affairs?	YES	~~NO~~

If YES, please provide proof that the application has been submitted to the Department of Water Affairs.

14. ENERGY EFFICIENCY

Describe the design measures, if any, which have been taken to ensure that the activity is energy efficient:

Energy measures such as LED lights and solar power will be considered for some of the institutional facilities of the project.

Describe how alternative energy sources have been considered or been built into the design of the activity, if any:

The services report which details the enegy requirements was not yet available during the compilation of this draft scoping report

SECTION B: SITE/AREA/PROPERTY DESCRIPTION

Important notes:

1. For linear activities (pipelines, etc) as well as activities that cover very large sites, it may be necessary to complete this section for each part of the site that has a significantly different environment. In such cases please complete copies of Section B and indicate the area, which is covered by each copy No. on the Site Plan.

Section B Copy No. (e.g. A): **N/A**

2. Paragraphs 1 - 6 below must be completed for each alternative.

3. Has a specialist been consulted to assist with the completion of this section? YES | NO

If YES, please complete the form entitled "Details of specialist and declaration of interest" for each specialist thus appointed and attach it in Appendix I. All specialist reports must be contained in Appendix D.

Property description/physical address:

Province	Free State
District Municipality	Mangaung Metropolitan Municipality
Local Municipality	Mangaung Metropolitan Municipality
Ward Number(s)	Ward 7
Farm name and number	farm Klipfontein 716 and farm Ceres 626,
Portion number	N/A
SG Code	F00300000000071600000 F00300000000062600000

Where a large number of properties are involved (e.g. linear activities), please attach a full list to this application including the same information as indicated above.

Current land-use zoning as per local municipality IDP/records:

The current land-use zoning as per Local Municipality is the farm land

In instances where there is more than one current land-use zoning, please attach a list of current land use zonings that also indicate which portions each use pertains to, to this application.

Is a change of land-use or a consent use application required? YES | NO

1. GRADIENT OF THE SITE

Indicate the general gradient of the site.

Alternative S1:

~~Flat~~	1:50 – 1:20	1:20 – 1:15	1:15 – 1:10	1:10 – 1:7,5	1:7,5 – 1:5	Steeper than 1:5

Alternative S2 (if any):

~~Flat~~	1:50 – 1:20	1:20 – 1:15	1:15 – 1:10	1:10 – 1:7,5	1:7,5 – 1:5	Steeper than 1:5

Alternative S3 (if any):

Flat	1:50 – 1:20	1:20 – 1:15	1:15 – 1:10	1:10 – 1:7,5	1:7,5 – 1:5	Steeper than 1:5

2. LOCATION IN LANDSCAPE

Indicate the landform(s) that best describes the site:

2.1 Ridgeline		2.4 Closed valley		2.7 Undulating plain / low hills	
2.2 Plateau		2.5 Open valley		2.8 Dune	
2.3 Side slope of hill/mountain		2.6 Plain	x	2.9 Seafront	
2.10 At sea					

3. GROUNDWATER, SOIL AND GEOLOGICAL STABILITY OF THE SITE

Is the site(s) located on any of the following?

	Alternative S1:		**Alternative S2 (if any):**		**Alternative S3 (if any):**	
Shallow water table (less than 1.5m deep)	YES	~~NO~~	YES	NO	YES	NO
Dolomite, sinkhole or doline areas	YES	~~NO~~	YES	NO	YES	NO
Seasonally wet soils (often close to water bodies)	~~YES~~	NO	~~YES~~	NO	YES	NO
Unstable rocky slopes or steep slopes with loose soil	YES	~~NO~~	YES	~~NO~~	YES	NO
Dispersive soils (soils that dissolve in water)	YES	~~NO~~	YES	~~NO~~	YES	NO
Soils with high clay content (clay fraction more than 40%)	YES	~~NO~~	YES	~~NO~~	YES	NO
Any other unstable soil or geological feature	YES	NO	YES	~~NO~~	YES	NO
An area sensitive to erosion	YES	NO	YES	~~NO~~	YES	NO

If you are unsure about any of the above or if you are concerned that any of the above aspects may be an issue of concern in the application, an appropriate specialist should be appointed to assist in the completion of this section. Information in respect of the above will often be available as part of the project information or at the planning sections of local authorities. Where it exists, the 1:50 000 scale Regional Geotechnical Maps prepared by the Council for Geo Science may also be consulted.

4. GROUNDCOVER

Indicate the types of groundcover present on the site. The location of all identified rare or endangered species or other elements should be accurately indicated on the site plan(s).

Natural veld - good condition[E]	~~Natural veld with scattered aliens[E]~~	Natural veld with heavy alien infestation[E]	Veld dominated by alien species[E]	Gardens
Sport field	Cultivated land	Paved surface	Building or other structure	~~Bare soil~~

If any of the boxes marked with an "[E] "is ticked, please consult an appropriate specialist to assist in the completion of this section if the environmental assessment practitioner doesn't have the necessary expertise.

5. SURFACE WATER

Indicate the surface water present on and or adjacent to the site and alternative sites?

Perennial River	YES	NO	UNSURE
Non-Perennial River	YES	NO	UNSURE
Permanent Wetland	~~YES~~	NO	UNSURE
Seasonal Wetland	YES	NO	UNSURE
Artificial Wetland	YES	~~NO~~	UNSURE
Estuarine / Lagoonal wetland	YES	~~NO~~	UNSURE

If any of the boxes marked YES or UNSURE is ticked, please provide a description of the relevant watercourse.

The sensitivity map indicated two (2) NFEPA wetland areas to be present on site. The National Wetland map5 (NWM5) and Free State Wetland Probability map data were used in determining the wetland areas during the desktop study. However, an additional artificial watercourse (Artificial watercourse 2) was identified during the site visit. The latter falls outside the scope area of the project.

6. LAND USE CHARACTER OF SURROUNDING AREA

Indicate land uses and/or prominent features that currently occur within a 500m radius of the site and give description of how this influences the application or may be impacted upon by the application:

Natural area	Dam or reservoir	Polo fields
Low density residential	Hospital/medical centre	Filling station [H]
Medium density residential	School	Landfill or waste treatment site
High density residential	Tertiary education facility	Plantation
Informal residential[A]	Church	Agriculture
Retail commercial & warehousing	Old age home	River, stream or wetland
Light industrial	Sewage treatment plant[A]	Nature conservation area
Medium industrial [AN]	Train station or shunting yard [N]	Mountain, koppie or ridge
Heavy industrial [AN]	Railway line [N]	Museum
Power station	Major road (4 lanes or more) [N]	Historical building
Office/consulting room	Airport [N]	Protected Area
Military or police base/station/compound	Harbour	Graveyard
Spoil heap or slimes dam[A]	Sport facilities	Archaeological site
Quarry, sand or borrow pit	Golf course	Other land uses (describe)

If any of the boxes marked with an "N "are ticked, how will this impact / be impacted upon by the proposed activity? Specify and explain:

N/A

If any of the boxes marked with an "An" are ticked, how will this impact / be impacted upon by the proposed activity? Specify and explain:

N/A

If any of the boxes marked with an "H" are ticked, how will this impact / be impacted upon by the proposed activity? Specify and explain:

N/A

Does the proposed site (including any alternative sites) fall within any of the following:

Critical Biodiversity Area (as per provincial conservation plan)	YES	~~NO~~
Core area of a protected area?	YES	~~NO~~
Buffer area of a protected area?	YES	~~NO~~
Planned expansion area of an existing protected area?	YES	~~NO~~
Existing offset area associated with a previous Environmental Authorisation?	YES	~~NO~~
Buffer area of the SKA?	YES	~~NO~~

If the answer to any of these questions was YES, a map indicating the affected area must be included in Appendix A.

7. CULTURAL/HISTORICAL FEATURES

Are there any signs of culturally or historically significant elements, as defined in section 2 of the National Heritage Resources Act, 1999, (Act No. 25 of 1999), including Archaeological or paleontological sites, on or close (within 20m) to the site? If YES, explain:	YES	NO
	Uncertain	

A water cistern, troughs and other modern ruins in the centre of the study area were noted. More modern ruins along the southern boundary of the study area was also identified. None of these are considered to be historically significant.

If uncertain, conduct a specialist investigation by a recognised specialist in the field (archaeology or palaeontology) to establish whether there is such a feature(s) present on or close to the site. Briefly explain the findings of the specialist:

A heritage Impact Assessment was conducted and no structures of heritage importance were found in the area

Will any building or structure older than 60 years be affected in any way?	YES	NO
Is it necessary to apply for a permit in terms of the National Heritage Resources Act, 1999 (Act 25 of 1999)?	YES	NO

If YES, please provide proof that this permit application has been submitted to SAHRA or the relevant provincial authority.

8. SOCIO-ECONOMIC CHARACTER

a) Local Municipality

Please provide details on the socio-economic character of the local municipality in which the proposed site(s) are situated.

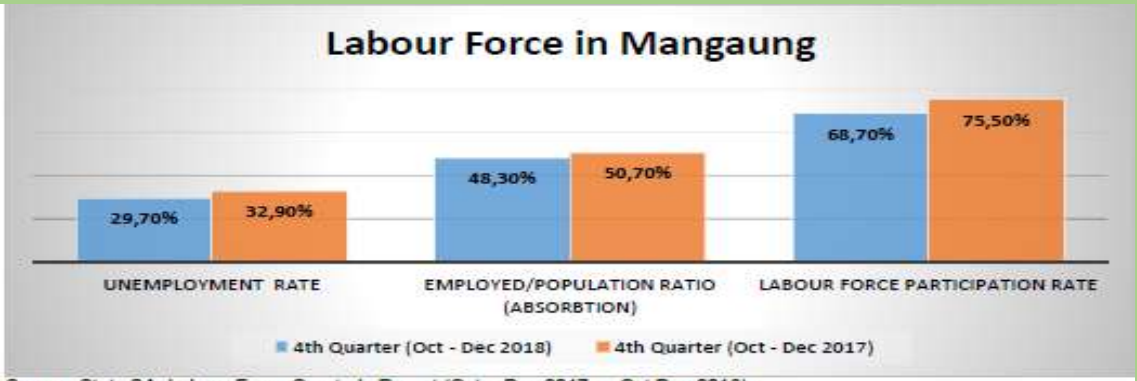
Level of unemployment:

In the case of Mangaung the following Table is key as a guide of how many people from which district are working on a gender basis. A note should be taken that there has not been any rigorous attempt to calculate the numbers since the incorporation of outlying towns in 2016.

Area	Male	Female	Total
Botshabelo	51 026	54 758	105 784
Bloemfontein	103 270	103 198	206 468
ThabaNchu	34 084	34 557	68 641
Soutpan	1 003	895	1 898
Dewetsdorp	14 297	13 200	27 497
Wepener	13 288	10 998	24 286
vanStadensrus	2 945	1 900	4 845

The above Table shows that in Mangaung more men are working than women and the biggest centre of employment remains Bloemfontein followed by Botshabelo. Approximately 439 500 people or 49%

of the population in Mangaung are economically active. This number is twice the number of 260 900 that was recorded two decades ago and was 38% of the total population.

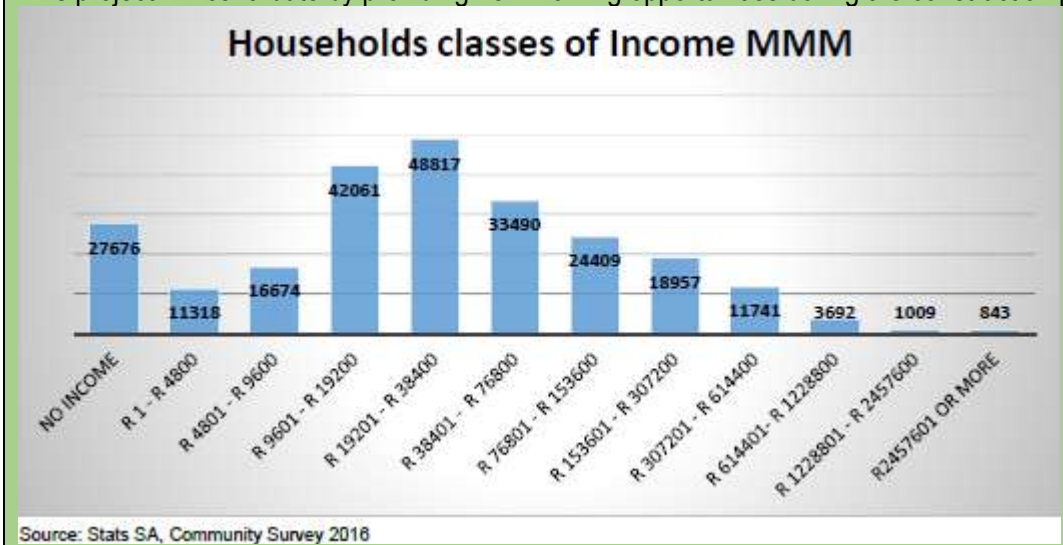


Source: Stats SA. Labour Force Quarterly Report (Oct – Dec 2017 vs Oct Dec 2018)

The unemployment rate fell by 3.2% in 2018 from 32.9% in 2017 which is encouraging, however the job loses where also recorded at 2.4% from the 50.7% in 2017 and economically active or looking for work fell by 6.8% from 75.5% in 2017.

Economic profile of local municipality:

In line with the merging of other towns the city has a total number of 265 414 households in Mangaung. The Economic Profile of the Mangaung metropolitan Municipality is summarized below. This project will contribute by providing new working opportunities during the construction phase.



Source: Stats SA, Community Survey 2016

Level of education:

According to the Community Survey, 2016, Mangaung Metropolitan Municipality has a population of approximately 787 930, and as far as the population distribution is concerned, more than half of the population is concentrated in the Bloemfontein area (63%), followed by Botshabelo (24%), Thaba

Nchu (9%), Dewetsdorp and Wepener (1.5%) respectively with Soutpan (0.8%) and Van Stadensrus at (0.2%).

In this Case the project is situated at Dewetsdorp, ward 7.

Distribution of population (20 years and above) by level of education,340 have no schooling, 778 completed some primary education, 315 have completed primary,2385 have completed the secondary education, 1884 have completed Grdae 12/ std 10, 402 have completed higher education and 7 others have completed tertiary education.

b) Socio-economic value of the activity

What is the expected capital value of the activity on completion?	R TDB	
What is the expected yearly income that will be generated by or as a result of the activity?	R TDB	
Will the activity contribute to service infrastructure?	~~YES~~	NO
Is the activity a public amenity?	YES	~~NO~~
How many new employment opportunities will be created in the development and construction phase of the activity/ies?	TDB	
What is the expected value of the employment opportunities during the development and construction phase?	R TDB	
What percentage of this will accrue to previously disadvantaged individuals?	% TDB	
How many permanent new employment opportunities will be created during the operational phase of the activity?	TDB	
What is the expected current value of the employment opportunities during the first 10 years?	R TDB	
What percentage of this will accrue to previously disadvantaged individuals?	% TDB	

9. BIODIVERSITY

Please note: The Department may request specialist input/studies depending on the nature of the biodiversity occurring on the site and potential impact(s) of the proposed activity/ies. To assist with the identification of the biodiversity occurring on site and the ecosystem status consult http://bgis.sanbi.org or BGIShelp@sanbi.org. Information is also available on compact disc (cd) from the Biodiversity-GIS Unit, Ph (021) 799 8698. This information may be updated from time to time and it is the applicant/ EAP's responsibility to ensure that the latest version is used. A map of the relevant biodiversity information (including an indication of the habitat conditions as per (b) below) and must be provided as an overlay map to the property/site plan as Appendix D to this report.

a) Indicate the applicable biodiversity planning categories of all areas on site and indicate the reason(s) provided in the biodiversity plan for the selection of the specific area as part of the specific category)

Systematic Biodiversity Planning Category	If CBA or ESA, indicate the reason(s) for its selection in biodiversity plan

Critical Biodiversity Area (CBA)	Ecological Support Area (ESA)	Other Natural Area (ONA)	No Natural Area Remaining (NNR)	

b) Indicate and describe the habitat condition on site

Habitat Condition	Percentage of habitat condition class (adding up to 100%)	Description and additional Comments and Observations (including additional insight into condition, e.g. poor land management practises, presence of quarries, grazing, harvesting regimes etc).
Natural	60%	The footprint of the land on the proposed development is bare natural exposed soil, with little vegetation as some of the areas are used as grazing field. there is also a wetland area that present on the site property. A dam on the boundary area is also noted close to an old farm dam
Near Natural (includes areas with low to moderate level of alien invasive plants)	30%	On the boundary near the main road invader plants can be noted with a lot of litter from the informal settlements. This waste consists of general household waste and few rubble materials within the project area.
Degraded (includes areas heavily invaded by alien plants)	0%	
Transformed (includes cultivation, dams, urban, plantation, roads, etc)	10%	A gravel road is present through that site from the southern to northern boundary of the property that is currently being used

c) Complete the table to indicate:

(i) the type of vegetation, including its ecosystem status, present on the site; and

(ii) whether an aquatic ecosystem is present on site.

Terrestrial Ecosystems		Aquatic Ecosystems						
Ecosystem threat status as per the National Environmental Management: Biodiversity Act (Act No. 10 of 2004)	Critical	Wetland (including rivers, depressions, channelled and unchanneled wetlands, flats, seeps pans, and artificial wetlands)			Estuary		Coastline	
	Endangered							
	Vulnerable							
	Least Threatened	YES	NO	UNSURE	YES	NO	YES	NO

d) Please provide a description of the vegetation type and/or aquatic ecosystem present on site, including any important biodiversity features/information identified on site (e.g. threatened species and special habitats)

Vegetation Type

The study area and project site is situated within the Grassland Biome and Dry Highveld Grassland bioregion. The proposed project area forms part of the (Gh5) Bloemfontein Dry Grassland vegetation type (Mucina & Rutherford, 2006).

The proposed project area also falls inside an area categorised by the Provincial Spatial Biodiversity Plan as 'Other" and "Degraded". 'Other Natural Areas' are production landscapes with the objectiveto manage land to optimize sustainable utilization of natural resources (Adapted from the guidelines for bioregional plans (Anon 2008)). See sensitivity and vegetation maps (Appendix A).

The distribution of the vegetation type as found on the site is limited to the Free State Province and can mainly be found at altitudes of 1250-1480m. This vegetation type has been described by Mucina and Rutherford (2009) to usually occur in landscape types such as undulating bottomland landscapes covered with tall, dense grassland alternating with patches of karroid schrubs.

The area is not ecologically important and sensitive at any scale. Biodiversity is usually ubiquitous and not sensitive to flow and habitat modifications. It is classified as a Degraded Area although the vegetation type (when in pristine condition) is classified as Endangered. At a local scale the site is degraded and poses very little significance ecologically. No species of conservation concern were found present or are likely expected to be present. The property is surrounded by transformed land cover, mainly housing and previous agricultural activities, making recovery to a functional and representative ecosystem unlikely and very slow.

Wetlands on site:

The sensitivity map indicated two (2) NFEPA wetland areas to be present on site. The National Wetland map5 (NWM5) and Free State Wetland Probability map data were used in determining the wetland areas during the desktop study. However, an additional artificial watercourse (Artificial watercourse 2) was identified during the site visit. The latter falls outside the scope area of the project.

Fauna evaluation and found on site:

No fauna other than Suricata suricatta (meerkat) was found at the site. Evaluating the area showed signs of animals present (manure and footprints). The latter mainly refer to introduced animals grazing on the premises.No listed dung beetles are found (DungBeetleMAP, 2019) in the QDS. No Neoroptera, Megaloptera, butterflies nor Odonata of conservation concern are known from the QDS (LacewingMAP, 2019; OdonataMAP, 2019; LepiMAP, 2019). Insects are mobile and can relocate from the development footprint to the adjacent intact vegetation. No listed spiders or scorpions are known to occur in the area and these species are presumed to move away from the construction site due to increased disturbance (ScorpionMAP & SpiderMAP, 2019). No amphibians or reptile of conservation concern are known from the QDS (FrogMAP, 2019; ReptileMAP, 2019).

Several mammals of conservation concern are known from the QDS (MammalMAP, 2019), but due to the agricultural and transformed matrix which surrounds the property there is a lack of suitable habitat for the species listed in Table 7. It is very unlikely that the property will provide a suitable habitat for these species. The grassland on the property can however by used by domestic animals and smaller roaming mammals, as seen from evidence of their presence, i.e. a small burrow, cow dung and small droppings. The property and direct surrounds has a relatively low habitat diversity. The impacts on fauna life is likely to be low because of the already degraded and surrounding areas. Grassland habitat of similar quality is available on the farm adjacent to the proposed development area.

SECTION C: PUBLIC PARTICIPATION

1. ADVERTISEMENT AND NOTICE

Publication name	Volksblad Local Newspaper. Notice of Environmental Impact Assessment (Scoping Process) for the proposed Township Establishment Development, Within Mangaung Metropolitan Municipality, Bloemfontein, Free State Province.	
Date published	Friday 22nd November 2019	
Site notice position	**Latitude**	**Longitude**
	29° 13'22,69'' S	26° 15'02,49''E
Date placed	08th November 2019	

Include proof of the placement of the relevant advertisements and notices in Appendix E1.

2. DETERMINATION OF APPROPRIATE MEASURES

Provide details of the measures taken to include all potential I&APs as required by Regulation 41(2)(e) and 41(6) of GN 326

Key stakeholders (other than organs of state) identified in terms of Regulation 41(2)(b) of GN 326

Title, Name and Surname	**Affiliation/ key stakeholder status**	**Contact details (tel number or e-mail address)**
Mrs M. Ramongalo	I&APs. Mangaung Metropolitan Municipality	**Tel:** 015 405 8429/ 051 405 8577 **Email:** Mpolokeng.Ramangalo@mangaung.co.za
Crl Rampai (Chabeli Frank)	I&APs. Mangaung Metropolitan Municipality Councilor	**Tel:** 083 5910 512 /063 6993 527 **Email:** frankrampaifr6@gmail.com
Mr Jack Morton	I&APs. Department of Agriculture Forestry and Fisheries	**Tel**:051 861 8369 /083 302 0703 **Email**: jack@fs.agric.za
Dr Redelstorf	I&APs. SAHRA	**Tel:** 021 462 4502 **Email**: rredelstorff@sahra.org.za

Include proof that the key stakeholder received written notification of the proposed activities as Appendix E2. This proof may include any of the following:

- e-mail delivery reports;
- registered mail receipts;
- courier waybills;
- signed acknowledgements of receipt; and/or
- or any other proof as agreed upon by the competent authority.

3. ISSUES RAISED BY INTERESTED AND AFFECTED PARTIES

Summary of main issues raised by I&APs	Summary of response from EAP
Comments from Circulated BID	
Ragna Redelstorff Dated 15 November 2019. SAHRA Thank you for the notification. You are kindly reminded that SAHRA does not accept hardcopies, emails or website links as submissions. Please submit an application on the South African Heritage Resources Information System (SAHRIS). Please follow the step-by-step tutorial videos on the SAHRIS homepage (https://sahris.sahra.org.za) and upload all documents to the case file.	Noted.
Mrs. M. Ramongalo. Dated: 02 December 2019. Mangaung Metropolitan Municipality. Reference is made to your letter received by this office regarding the above-mentioned application. This office requests more information concerning the proposed activity on Farm Klipfontein 716 and farm Ceres 626 in order to give meaningful comments. A hard copy of the environmental reports must be submitted to this office for review and comments. In the report to be submitted it must clearly be demonstrated in which way the proposed development will meet the requirements of sustainable development. It must also consider energy efficient technologies and water saving devices and technologies for the proposed development. This could include measures such as recycling of waste, the use of low voltage or compact fluorescent light instead of incandescent globes, management of storm water, the capture and use of rainwater from gutter and roof and the use of locally indigenous vegetation during landscaping and the training of staff to implement good housekeeping technique light pollution, air quality, water use and solid waste management.	Noted The Draft Scoping and specialist Report will be send with all the information that you requested.
Comments from public meeting	
The site notice was placed on the 17th of November 2019, and the newspaper advert was published on the 22nd of November 2019 on the Volksblad Local Newspaper for the public meeting that was held on the 30th of November 2019. The community did not raise any comments nor attend the public meeting on the 30th of November 2019.	

4. COMMENTS AND RESPONSE REPORT

The practitioner must record all comments received from I&APs and respond to each comment before the Draft Scoping Report is submitted. The comments and responses must be captured in a comments and response report as prescribed in the EIA regulations and be attached to the Final BAR as Appendix E3.

5. AUTHORITY PARTICIPATION

Authorities and organs of state identified as key stakeholders:

Authority/Organ of State	Contact person (Title, Name and Surname)	Tel No	Fax No	e-mail	Postal address
Mangaung Metropolitan Municipality	Mrs M. Ramongalo	015 405 8429/ 051 405 8577		Mpolokeng.Ramangalo@mangaung.co.za	P O Box 3704 Bloemfontein 9300
Mangaung Metropolitan Municipality –Ward 7 Councillor	Crl Rampai (Chabeli Frank)	083 5910 512 /063 6993 527		frankrampaifr6@gmail.com	P O Box 3704 Bloemfontein 9300
Department of Agriculture Forestry and Fisheries	Mr Jack Morton	083 302 0703	086 234 6758	jack@fs.agric.za	Private Bag X01 Glen 9360
SAHRA	Dr Redelstorf	021 462 4502		rredelstorff@sahra.org.za	

Include proof that the Authorities and Organs of State received written notification of the proposed activities as appendix E4.

In the case of renewable energy projects, Eskom and the SKA Project Office must be included in the list of Organs of State.

6. CONSULTATION WITH OTHER STAKEHOLDERS

Note that, for any activities (linear or other) where deviation from the public participation requirements may be appropriate, the person conducting the public participation process may deviate from the requirements of that sub-regulation to the extent and in the manner as may be agreed to by the competent authority.

Proof of any such agreement must be provided, where applicable. Application for any deviation from the regulations relating to the public participation process must be submitted prior to the commencement of the public participation process.

A list of registered I&APs must be included as appendix E5.

Copies of any correspondence and minutes of any meetings held must be included in Appendix E6.

SECTION D: IMPACT ASSESSMENT

The assessment of impacts must adhere to the minimum requirements in the EIA Regulations, 2014 as amended and should take applicable official guidelines into account. The issues raised by interested and affected parties should also be addressed in the assessment of impacts.

1. IMPACTS THAT MAY RESULT FROM THE PLANNING AND DESIGN, CONSTRUCTION, OPERATIONAL, DECOMMISSIONING AND CLOSURE PHASES AS WELL AS PROPOSED MANAGEMENT OF IDENTIFIED IMPACTS AND PROPOSED MITIGATION MEASURES

Provide a summary and anticipated significance of the potential direct, indirect and cumulative impacts that are likely to occur as a result of the planning and design phase, construction phase, operational phase, decommissioning and closure phase, including impacts relating to the choice of site/activity/technology alternatives as well as the mitigation measures that may eliminate or reduce the potential impacts listed. This impact assessment must be applied to all the identified alternatives to the activities identified in Section A(2) of this report.

Activity	Impact summary	Significance rating of impact before mitigation	Proposed mitigation	Significance rating of impact after mitigation
		Alternative 1 (preferred alternative)		
Identified Impacts- Planning and Design				
	Direct impacts:			
	Water Resources: The design of the township needs to consider the sensitive areas near water resources such as wetlands, dams and rivers**.**	**Medium (Negative)**	The design must incorporate buffers around these resources acceptable by the relevant guideline documents. the designs must ensure wherever applicable that these resources are not damaged, or degraded by the development	**Low**
	Cultural and Heritage Artefacts : the design of and subdivision on the stands must incorporate the heritage of the area that is of cultural importance or one that has or must be protected	**Medium**	A heritage impact assessment must be done in order to assess any artefacts that may be worth preservation as per the Heritage Act. The area is determined to have a high paleontological sensitivity and as such the mitigation measures must be incorporated into the environmental Managent plan to be a guiding document	**Low**

Activity	Impact summary	Significance rating of impact before mitigation	Proposed mitigation	Significance rating of impact after mitigation
			during the construction phase of the project	
	Socio-Economic: The area where the proposed development will take place is adjacent an informal settlement, the project areas already is at risk of invasion by the adjacent development. This will cause degradation in land value	**High**	The proposed development has accommodated for social housing that will minimise the risk of land invasion and will also make provision of basic services and amenities	**Medium**
Identified Impacts- Construction Phase				
	Direct impacts:			
	Noise: Residents in the vicinity of the proposed development site will be subjected to increased noise nuisance (noise and vibration caused by construction machinery and equipment)	Medium(Negative)	Construction and other noise generating activities should be restricted to between 06h00 and 18h00 Monday to Friday, unless otherwise approved by the appropriate competent person in consultation with adjacent landowners/affected persons and ECO. During the operational phase all activities must take place in a manner that will allow as little noise as possible. Activities, which are deemed to generate high levels of noise, will be restricted to normal working hours.	Low (Negative)
	Soil Erosion: Exposed soil resulting from construction	Medium (Negative)	Mitigation measures include reducing the amount of exposed soil by means of selective soil stripping.	Low (Nagative)

Activity	Impact summary	Significance rating of impact before mitigation	Proposed mitigation	Significance rating of impact after mitigation
	activities is prone to erosion by water or wind. Stripping and stockpiling of topsoil could lead to erosion and degradation of soil quality.		Susceptible soil surfaces can be protected with mulch. Drainage channels must be monitored to ensure erosion doesn't occur. Only the minimal vegetation must be cleared.	
	Air Pollution: The proposed construction phase activities will affect air quality as a result of emissions caused by exhaust fumes and dust generation.	Medium (Negative)	The speed of vehicles within the site to be strictly controlled to between 30 - 45km/h. Areas generating dust particles should be sprinkled with water to reduce dust blowing out over the area and should be enclosed where possible to mitigate effects of wind on them. The clearing of vegetation should be limited to the development area and should be undertaken prior to the commencement of construction activities	Low (Negative)
	Soil Pollution The presence of machinery and vehicles on site during the construction phase may result in the occurrence of hydrocarbon spills or leakages. Improper practices when conducting maintenance on vehicles/machinery may also result in hydrocarbon spills contaminating the soil	Medium (Negative)	Vehicles and machinery must be well-maintained to ensure they do not result in oil or fuel leaks. Should maintenance of vehicles/machinery take place on site, this should be undertaken in a designated area that is paved.	Low (Negative)

Activity	Impact summary	Significance rating of impact before mitigation	Proposed mitigation	Significance rating of impact after mitigation
	Safety During the construction phase heavy machinery will be employed. The potential for accidents among operators exists if machinery is not handled properly. This is likely to have a negative impact on the health of the workers.	Medium (Negative)	Safety equipment must be provided to all employees to prevent personal injury during construction activities. This includes equipment such as protective eye and ear wear and protective clothing where necessary. Staff should be appropriately trained in all assigned activities. To limit the risk of accidents, safety procedures must be put in place and enforced by the foremen to ensure that vehicles and machinery only drive in designated places and are only driven by authorized personnel.	Low (Negative)
	Visual Impact Construction activities that, without mitigation, could give rise to visual impacts. The following temporary activities are included: •Presence of storage and stockpile areas, •Movements of construction machinery.	Medium (Negative)	The visual impacts of construction activities will be temporary	Low to Moderate (Negative)
	Waste Waste generation and disposal	Medium (Negative)	A waste management plan to be developed for the construction site. A plan to ensure that all waste is contained in suitable containers to prevent waste being washed into water	Low (Negative)

Activity	Impact summary	Significance rating of impact before mitigation	Proposed mitigation	Significance rating of impact after mitigation
			bodies. Containers for waste to ensure that any fluids generated by waste are trapped and can be disposed of in a suitable.	
	Fire	Medium (Negative	Contractor must make sure that there is supervision for all fires that are used in the construction camp. Smoking should be prohibited in the vicinity of flammable substances. The contractor should ensure that fire-fighting equipment is available on site, in particular where flammable substances are stored. Fires started for comfort (warmth) should be discouraged by the contractor, due to the risk of vegetation fires and risk to adjacent property. Fire-fighting equipment and emergency plans must be in place prior to the construction phase. The contractor will plan and implement a fire prevention programs and develop a contingency plan in the event of any	Low to Moderate (Negative)
	Indirect impacts:			
	Socio-economic impact: The proposed township	Low(Positive)	Employment opportunities should be offered to locals especially where non-skilled labour is concerned, this will	Medium (Positive)

Activity	Impact summary	Significance rating of impact before mitigation	Proposed mitigation	Significance rating of impact after mitigation
	establishment will have a positive impact on the local economy by supplying employment opportunities to locals and working there would supply them with skill development		give the locals some form of ownership of the project. Equal opportunities should be given to females, males, youth and the disabled. Payment should comply with applicable Labour Law legislation in terms of minimum wages	
	Cumulative impacts:			
	Identified Impacts Operational and maintenance Phase			
	Direct impacts:			
	Storm water management:		It is recommended that proper storm water drainage system be ensured during operation and maintenance phase. Storm water should not be allowed to discharge onto bare soil but must be diverted to the surrounding grasslands or to the landscaped gardens during the operational phase.	
	Waste generation and disposal	High (Negative)	Solid waste generated during operation and maintenance phase must be removed in a continuous and efficient manner to the satisfaction of the local municipality. A waste management plan to be developed and maintained for the construction site. No solid waste should be dumped on the site. All domestic waste generated on the site should be disposed	Low (Negative)

Activity	Impact summary	Significance rating of impact before mitigation	Proposed mitigation	Significance rating of impact after mitigation
			of in a proper manner off site i.e. no burial on site.	
	Maintenance of access roads:	Medium (Negative)	Maintenance of access roads: Access/ alternate roads to be maintained with an acceptable free of erosion, and no surface water ponding.	Low (Negative)
	Traffic:	High (Negative)	Any traffic disruptions due to the movement of heavy machinery should be undertaken with the approval of all relevant authorities and in accordance with all relevant legislation.	Low (Negative)
	Indirect impacts*:*			
	Socio-economic Impact: The proposed township establishment will have a positive impact on the local economy by supplying employment opportunities to locals and working there would supply them with skill development	Low (Positive)	Employment opportunities should be offered to locals especially where non-skilled labour is concerned, this will give the locals some form of ownership of the project. Equal opportunities should be given to females, males, youth and the disabled. Payment should comply with applicable Labour Law legislation in terms of minimum wages	Medium (Positive)
	Cumulative impacts:			
		Alternative 2		
N/A	***Direct impacts:***			
	Indirect impacts:			
	Cumulative impacts:			
	Direct impacts:			

Activity	Impact summary	Significance rating of impact before mitigation	Proposed mitigation	Significance rating of impact after mitigation
N/A	***Indirect impacts:***			
	Cumulative impacts:			
		Alternative 3		
N/A	***Direct impacts:***			
	Indirect impacts:			
	Cumulative impacts:			
N/A	***Direct impacts:***			
	Indirect impacts:			
	Cumulative impacts:			
No-go option				
	Direct impacts: The no-go alternative is the option of not developing the proposed development and its associated infrastructure. The potential topsoil loss, vegetation loss and erosion potential from earthworks will be eliminated **Indirect impacts:** No indirect impacts for the project for the no-go option. **Cumulative impacts:** No Cumulative impact to be expected, due to the no-go alternative is the option of not developing the proposed development and its associated infrastructure, therefore no Cumulative impacts for the no-go option.			

A complete impact assessment in terms of Regulation 19(3) of GN 326 must be included as Appendix F.

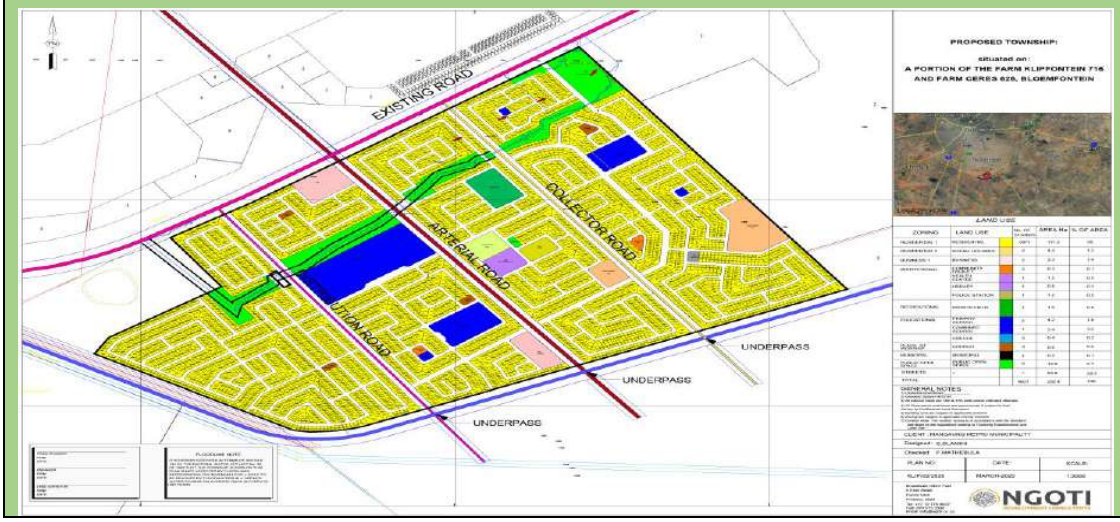
2. ENVIRONMENTAL IMPACT STATEMENT

Taking the assessment of potential impacts into account, please provide an environmental impact statement that summarises the impact that the proposed activity and its alternatives may have on the environment after the management and mitigation of impacts have been taken into account, with specific reference to types of impact, duration of impacts, likelihood of potential impacts actually occurring and the significance of impacts.

Alternative A (preferred alternative)

Site alternative can be either for the entire development where the activity is proposed on a totally different site, or for certain components of it. In terms of the proposed development, the site alternative will not be further investigated since the applicant is the landowner and has no other land available for residential development in the area, which results in the proposed development occurring on portion of farm Klipfontein 716 and farm Ceres 626 JR or not occurring at all in such instances the no-go alternative will play an important role.

Layout Plan (Preferred Alternative)



Alternative B

Due to land availability and service connections, the proposed site is the only site that has been identified for establishing a township during the consultation process with the Local Municipality. Therefore, no alternative site has been identified or considered during this study.

Alternative C

N/A

No-go alternative (compulsory)

The no-go alternative is the option of not developing the proposed development and its associated infrastructure. The land on the portion of farm Klipfontein 716 and farm Ceres 626 will remain undeveloped. The no development option would result in a lost opportunity in terms of the employment opportunities associated with the construction and operation phase as well as the benefits associated with the provision of houses, schools and other much needed social facilities. A high negative socio-economic impact significance would occur if the proposed development is not constructed.

The “no-go” alternative will however result in the visual environment staying the same with the natural

character of the area contributing to the “sense of place”. If the development proposal is not authorised the vegetation in the current natural parts will remain largely intact which is clearly a positive factor for the biodiversity in the area. The socio-economic benefits of this project however largely outweigh the impacts in an area The No-Go Alternative is therefore not recommended

SECTION E. RECOMMENDATION OF PRACTITIONER

Is the information contained in this report and the documentation attached hereto sufficient to make a decision in respect of the activity applied for (in the view of the environmental assessment practitioner)?	YES	NO

If "NO", indicate the aspects that should be assessed further as part of a Scoping and EIA process before a decision can be made (list the aspects that require further assessment).

N/A

If "YES", please list any recommended conditions, including mitigation measures that should be considered for inclusion in any authorisation that may be granted by the competent authority in respect of the application.

GENERAL ENVIRONMENTAL MANAGEMENT STATEMENT

Roles and Responsibilities

•An EMPr for site establishment, construction and operational phase must be finalized and approved by EDTEA prior to the contractor moving onto site

•The Environmental Control Officer (ECO) must be appointed prior to site development and construction to prevent contravention of the approved EMPr and Environmental Authorization.

•An Environmental Liaison Officer (ELO) must inspect the site during the construction phase on a weekly basis.

•The working areas must be clearly demarcated by the ECO prior to commencement of the construction and no access is to be allowed in sensitive areas.

•The ECO is to conduct monthly audits and prepare monthly audit reports. Copies of these reports are to be provided by the ECO to the developer and EDTEA. The ECO duties extend to the end of the construction phase.

•The proponent will ultimately be responsible for the implementation of the operational EMPr.

DESIGN PHASE

Engineering Design

•Must accommodate spills containment slabs to assist in the containment of accidental spillage during construction phase (concrete and cement batching on site)

•A storm water management plan must be prepared once the engineering design of the site has been finalized.

CONSTRUCTION PHASE

Noise pollution

•Regular maintenance of machinery must be done, as per the manufacturer's instruction

•Working hours should be limited from 07:00 to 17:00 on weekdays, from 07:00 to 13:00 on Saturday and no work must be conducted on Sundays

•Construction employees should be encouraged to not generate noise, which is not essential to construction

•In the event of employment being noisy during lunch breaks It could impact neighboring properties

Air Pollution
•Water should be sprayed on the construction access road during the dry/windy periods
•Construction phase stockpiles which have the potential of generating dust must be covered with tarpaulin/plastic sheeting
•Maintain construction vehicles and machinery to control exhaust emissions.

Water Pollution
•Construction activities must remain within the footprint of the development
•Construction machinery must be maintained by a suitably qualified mechanic, at an appropriately lined site, during working hours, so that diesel and /or oil leaks are avoided
•Prevent run-off by constructing diversion berms and / or placing straw bales on denuded areas.

Erosion Measures
•Should erosion become a problem during the construction phase then diversion berms and drains shall be constructed to divert run-off away from exposed area.
•During this phase, bales can be used as filters across run-off pathways

Accidental Spillage
•Spills shall be cleared up immediately
•The contaminated soils and the spilled material shall be taken to the nearest registered landfill site capable of receiving such spills
•A registered of all incidents shall be kept on site showing measures taken to clear up the spillages

Heritage Issues
•During construction ,if heritage findings are made (graves, archaeological objects,etc), SAHRA should be contacted and works to be stopped immediately

Health and Safety
•Traffic signage shall be erected to advice people of machinery/ construction vehicles, driving in the area.
•Pollution that could be detrimental to humans, flora and fauna shall be prevented as much as possible.
•Construction employees must be restricted to the development area; they must be warned not to trespass on the neighbouring properties
•Point's men must be used at areas where children will be crossing to ensure their safety to school or their homes/households
•Emergency contact numbers must be available on site, and an emergency kit to assist if someone get injured before help arrives
•Fire protection equipment such as, fire extinguisher and hose.

Is an EMPr attached?	YES	NO

The EMPr must be attached as Appendix G.

The details of the EAP who compiled the EIAR and the expertise of the EAP to perform the Basic Assessment process must be included as Appendix H.

If any specialist reports were used during the compilation of this EIAR, please attach the declaration of interest for each specialist in Appendix I.

Any other information relevant to this application and not previously included must be attached in Appendix J.

Kulani Nkuna

_____

NAME OF EAP

_____  _____ __24 November 2019_____

SIGNATURE OF EAP DATE

SECTION F: APPENDIXES

The following appendixes must be attached:

Appendix A: Maps

Appendix B: Photographs

Appendix C: Facility illustration(s)

Appendix D: Specialist reports (including terms of reference)

Appendix E: Public Participation

Appendix F: Impact Assessment

Appendix G: Environmental Management Programme (EMPr)

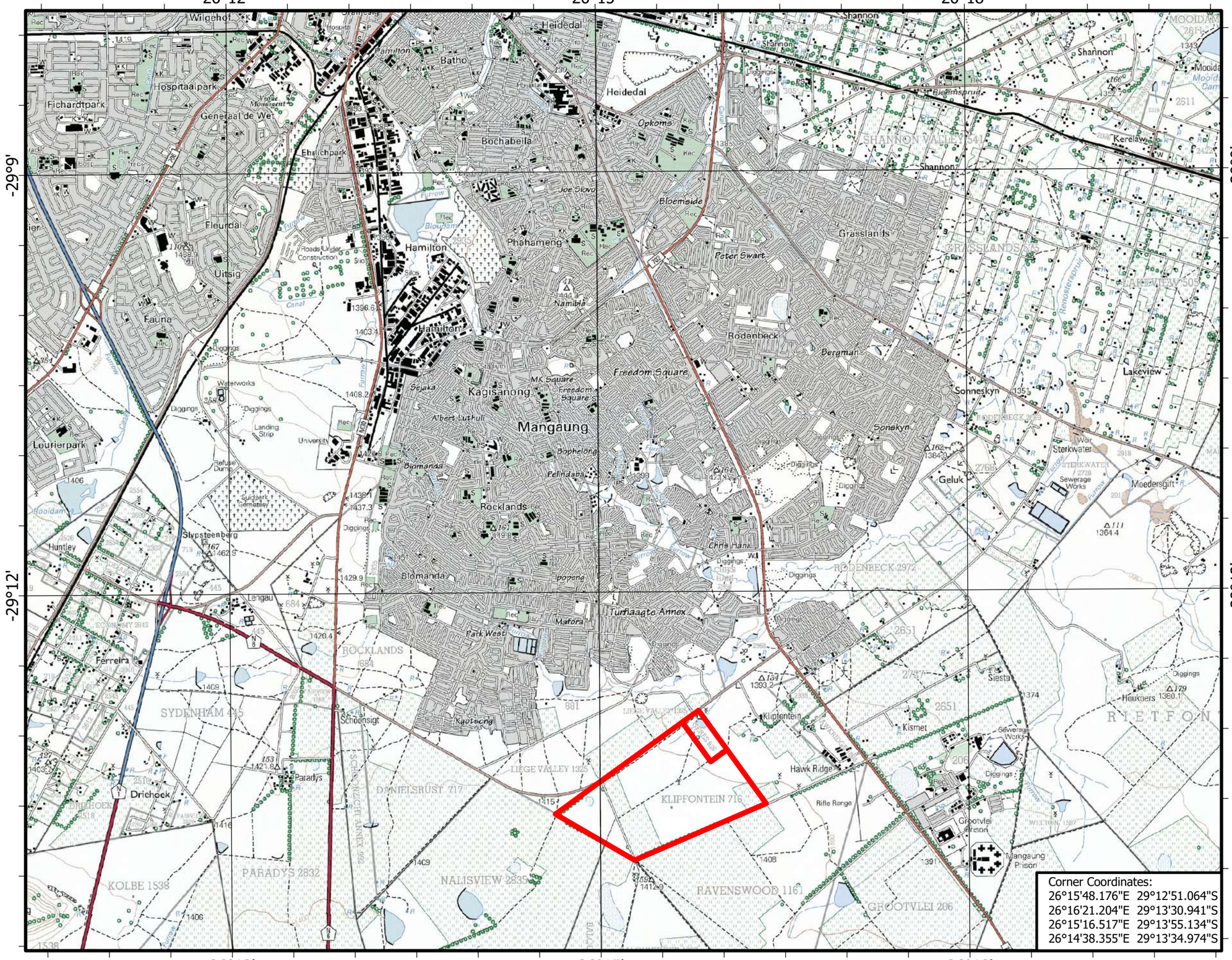
Appendix H: Details of EAP and expertise

Appendix I: Specialist's declaration of interest

Appendix J: Additional Information

APPENDIX A: MAPS

Locality Map for the Proposed Township a Portion of the Farm Klipfontein 716 and Farm Ceres 626, Mangaung Metropolitan Municipality, Free State Province.



Legend

Proposed Site

LEGEND

- National Freeway; National Route
- Arterial Route
- Main Road
- Secondary Road; Bench Mark
- Other Road; Bridge
- Track and Hiking Trail
- Railway; Station or Siding
- Other Railway; Tunnel
- Embankment; Cutting
- Power Line
- Built-up Area (High, Low Density)
- Buildings; Ruin
- Post Office; Police Station; Store
- Place of Worship; School; Hotel
- Fence; Wall
- Windpump; Monument
- Communication Tower
- Mine Dump; Excavation
- Trigonometrical Station; Marine Beacon
- Lighthouse and Marine Light
- Cemetery; Grave
- International Boundary and Beacon
- Provincial Boundary
- Protected Area
- Perennial River
- Perennial Water
- Non-perennial River
- Non-Perennial Water
- Dry Water Course
- Dry Pan
- Marsh and Vlei
- Pipeline (above ground)
- Water Tower; Reservoir; Water Point
- Coastal Rocks
- Prominent Rock Outcrop
- Erosion; Sand
- Woodland
- Cultivated Land
- Orchard or Vineyard
- Recreation Ground
- Row of Trees

Spatial Reference
Name: WGS 1984 UTM Zone 35S
Datum: WGS 1984
Projection: Transverse Mercator

Farm Names: Klipfontein 716 & Ceres 626
SG Code: F0030000000071600000
F0030000000062600000

Scale 1:50 000

N W E S

INALUK CONSULTING SERVICES
ENVIRO-SUSTAINABLE SOLUTIONS

The map was produced by Mielelani Consultancy: info@mielelani.co.za

APPENDIX B: PHOTOGRAPHS

SITE PICTURES

APPENDIX C: FACILITY ILLUSTRATION(S)

EXISTING ROAD

COLLECTOR ROAD

ARTERIAL ROAD

DISTRIBUTION ROAD

UNDERPASS

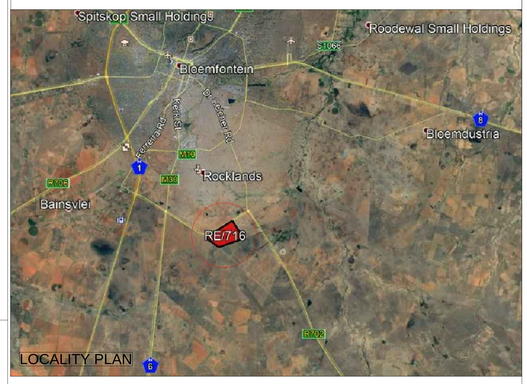
UNDERPASS

UNDERPASS

PROPOSED TOWNSHIP:

situated on:

A PORTION OF THE FARM KLIPFONTEIN 716 AND FARM CERES 626, BLOEMFONTEIN



LAND USE

ZONING	LAND USE		No. OF STANDS	AREA Ha	% OF AREA
RESIDENTIAL 1	RESIDENTIAL		3973	131.2	56
RESIDENTIAL 2	SOCIAL HOUSING		2	4.4	1.2
BUSINESS 1	BUSINESS		2	3.3	1.4
INSTITUTIONAL	COMMUNITY FACILITY		2	0.3	0.1
	HEALTH CENTRE		1	1.2	0.5
	LIBRARY		1	0.8	0.3
	POLICE STATION		1	1.2	0.5
RECREATIONAL	SPORTS FIELD		1	1.9	0.8
EDUCATIONAL	PRIMARY SCHOOL		2	4.2	1.8
	COMBINED SCHOOL		1	7.4	3.2
	CRECHE		3	0.4	0.2
PLACE OF WORSHIP	CHURCH		3	0.5	0.2
MUNICIPAL	MUNICIPAL		1	0.2	0.1
PUBLIC OPEN SPACE	PUBLIC OPEN SPACE		8	12.6	5.4
STREETS	*		*	53.8	28.3
TOTAL			4001	232.4	100

GENERAL NOTES

1) Cadastral Boundaries _ _ _ _ _ _ _ _
2) Geodetic System WGS 84
3) All internal roads are 16m & 12m wide unless indicated otherwie
4) All Dimensions and areas are approximate & subject to final Survey by Proffesional Land Surveyors
5) Building Line are subject to applicable Scheme
6) Zoning are subject to appicable Zoning Scheme
7) Contour Note: The contour survey is in accordance with the standard laid down by the regulations relating to Township Establishment and Land Use

CLIENT : MANGAUNG METRO MUNICIPALITY

Designed: S.DLAMINI

Checked: F.MATHEBULA

PLAN NO:	DATE:	SCALE:
KLIP/02/2020	MARCH-2020	1:3000

TOWN PLANNER
FIRM:
DATE:

ENGINEER
FIRM:
DATE:

LAND SURVEYOR
FIRM:
DATE:

FLOODLINE NOTE

IT IS HEREBY CERTIFIED IN TERMS OF ARTICLE 144 OF THE NATIONAL WATER ACT (ACT No. 36 OF 1998 THAT THE TOWNSHIP SHOWN ON THIS PLAN IS NOT AFFECTED BY FLOODLINES REPRESENTING THE MAXIMUM LEVEL LIKELY TO BE REACHED BY FLOODWATERS IN A DEFINED WATER COURSE ON AVERAGE ONCE IN EVERY 50 /100 YEARS.

Broadwalk Office Park
6 Eros Road
Faerie Glen
Pretoria, 0004
Tel: +27 12 770 4022
Cell: 072 573 2390
Email: info@ngoti.co.za

NGOTI DEVELOPMENT CONSULTANTS

APPENDIX D: SPECIALIST REPORTS (INCLUDING TERMS OF REFERENCE)

APPENDIX D1: ECOLOGICAL REPORT

ECOLOGICAL IMPACT ASSESSMENT

PROPOSED TOWNSHIP SITUATED ON A PORTION OF THE FARM KLIPFONTEIN 716 AND FARM CERES 626, BLOEMFONTEIN, MANGAUNG METROPOLITAN MUNICIPALITY, FREE STATE PROVINCE

September 2019

Prepared for:

Prepared by:

Marius Venter

marius@enviroworks.co.za

TABLE OF CONTENTS

LIST OF FIGURES

CONTENT CROSS-REFERENCE CHECKLIST

Table 1 As stated per Government Notice (GN) Regulation 326 of 7 April 2017, Appendix 6, a Specialist Report should contain the information listed in the table, with corresponding section names.

Requirement	Section

(a) details of— (i) the specialist who prepared the report; and (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae	Details of the Specialist
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority	Declaration of Independence
(c) an indication of the scope of, and the purpose for which, the report was prepared	Objective
(cA) an indication of the quality and age of base data used for the specialist report	Methodology; Date and Season of Site Visit
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Risk Ratings of Potential Impacts
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Date and Season of Site Visit
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Methodology
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives	Sensitivity map (Study Area)
(g) an identification of any areas to be avoided, including buffers	Description of Potential Ecological Impacts and their Recommended Mitigation Measures
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers	Sensitivity map (Study Area)
(i) a description of any assumptions made and any uncertainties or gaps in knowledge	Assumptions, Uncertainties and Gaps in Knowledge
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities	Description of Potential Ecological Impacts and their Recommended Mitigation Measures

(k) any mitigation measures for inclusion in the EMPr	Description of Potential Ecological Impacts and their Recommended Mitigation Measures
(l) any conditions for inclusion in the environmental authorisation	Recommendation and Conclusion
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation	Monitoring, Recommendation and Conclusion
(n) a reasoned opinion— (i) whether the proposed activity, activities or portions thereof should be authorised (iA) regarding the acceptability of the proposed activity or activities; and (ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Recommendation and Conclusion
(o) a description of any consultation process that was undertaken during the course of preparing the specialist report	Methodology
(p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
(q) any other information requested by the competent authority	None up to date

i DETAILS OF THE SPECIALIST

Name:	Marius
Surname:	Venter
Highest qualification:	BSc Conservation Ecology and Entomology (SU)
IAIA registered:	No. 10458590

SACNASP Candidate Scientist:	No. 117708
Postal address:	Enviroworks Suite 116 Private Bag X01 Brandhof 9324
Physical address:	103 Donald Murray Avenue Park West Bloemfontein 9301
Cell phone:	072 286 6683
E-mail:	marius@enviroworks.co.za

Relevant Qualifications

- BSc Conservation Ecology and Entomology (SU)
- Currently completing MSc in Environmental Management at the University of the Free State (2017-present)
- LLB University of the Free State (2nd year student)

Registrations and Affiliations

- SACNASP: 117708
- IAIA International Registration: 10458590
- IAIAsa Registration: 6293
- South African Green Industries Council (SAGIC)

Short Courses

2018: Intermediate GIS

2017: Wetland Management: Introduction and Delineation – WLID1502S

Introduction to GIS and GPS – GISA1500S

2016: SAGIC Invasive Species Training. Module 1: Introduction and Legislation and Module 2: Deveoping and Implementing Control Plans – SAWC 2582 & 2741

Work experience

- January 2017 - June 2018: Research assistant, University of the Free State (UFS)
- July 2018 - present: Environmental Consultant and legal assistant at Enviroworks

Key project experience

- Experience in 1) Compilation of documentation and report writing 2) Legal compliance and notices 3) Conducting ecological studies and reviews 4) Environmental Audits 5) Environmental Authorisations.

Basic Assessment Applications

- Karan Beef-Proposed extension and construction of a new feedlot–Aliwal North, Free State Province.

Section 24G Application for Rectification:

- Section 24G Application for Authorisation, Supreme Chicken, Portion 1285, Farm Belgie.

Ecological Impact Assessment Specialist Report Experience

- Ecological Impact Assessment: Patrick Mofokeng: The proposed development of an oil recycling plant, near Lakeview, Mangaung, Free State;
- Ecological impact assessment: Supreme Poultry, Bloemfontein, Free State;
- Review Ecological Studies: 8 Ecological Studies reviewed for establishment of borrow pits for road construction by SANRAL;
- Ecological Impact Assessment: Karan Beef-Proposed extension and construction of a new feedlot–Aliwal North, Free State Province;
- Ecological Impact Assessment: Proposed construction of an iron/steel smelter at the Botshabelo industrial area on erf 173 and erf 188 within the Mangaung Metropolitan Municipality, Free State Province; and,
- Ecological Impact Assessment: Proposed Township situated on a Portion of the farm Klipfontein 716 and farm Ceres 626, Bloemfontein, Mangaung Metropolitan Municipality, Free State Province.

Environmental Authorisation amendment

- Establishment of Vista Park ext 3 township, Bloemfontein, Free State Province.

Wetland Delineation

- Wetland delineation and risk assessment for water use license application for the proposed Zachtevlei dam and bulk conveyance infrastructure, Lady Grey, Eastern Cape.

Legal Queries and Due Diligence reports

- The construction of a 9 km steel pipeline for irrigation at Witbank, Namakwa District Municipality, Northern Cape;
- Proposed development of a waste water treatment works and associated pipeline on the remaining extent of erf no 424, Britsown, Northern Cape Province;
- Request for conformation that the existing carpe diem farm operations is lawful / or not and if a section 24g rectification application will be required, Northern Cape Province;
- Environmental subservices for the improvement of National Route 7 Section 2 between Rooidraai (km 7.49) and Moorreesburg (km 33.90);
- Environmental subservices for the improvement of National Route 7 Section 3 between Piketberg (km 31.53) and Piekenierskloof Pass (km 65.3);
- The construction of a pipeline to pump water from a river into two dams at the Krugers Post Farm

- Proposed development of a security village and associated infrastructure on Erf 3952 & 3975, Hartswater, Northern Cape Province;
- 8 (eight) Development Option/Due Diligence Reports for Phunga Consulting Engineers in the Northern Cape Province;
- Applicability of the NEMA EIA Regulations, 2014 (as amended) for the proposed development of a twenty five meter (25 m) lattice mast on Erf 994, Danielskuil, Northern Cape Province.
- Applicability of the NEMA EIA Regulations, 2014 (as amended) for the proposed development of an outdoor advertising billboard in Bloemfontein, Free State Province.

ECO - Environmental audits

- Mission Point Mine – Free State province;
- The construction of a 132kv powerline between Tweespruit and Driedorp, Free State Province;
- Road Construction – Molpro;
- External Water Use Licence audit – Letsatsi PV solar power plant;
- REH External Environmental Authorisation compliance audit - Stortemelk and Bethelehem Hydro power plants, Free State Province;
- Monthly ECO audit: Establishment of Vista Park Ext 3 township, Bloemfontein, Free State Province; and,
- LaFarge Olive Hill: Environmental Management programme review and update, Free State Province.

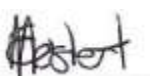
- **DECLARATION OF INDEPENDENCE**

I, Marius Venter, ID 9401115136088, declare that I:

- am an Environmental Consultant at Enviroworks;
- act as an independent specialist consultant in the field of Botany and Ecology;
- am assigned as specialist consultant by Enviroworks (Pty) Ltd for this proposed project;
- I do not have or will not have any financial interest in the undertaking of the activity other than remuneration for work as stipulated in the terms of reference;
- remuneration for services by the proponent in relation to this proposal is not linked to approval by decision-making authorities responsible for permitting this proposal;
- the consultancy has no interest in secondary or downstream developments as a result of the authorisation of this project;
- have no and will not engage in conflicting interests in the undertaking of the activity;
- undertake to disclose to the client and the competent authority any material, information that have or may have the potential to influence the decision of the competent authority required in terms of the Environmental Impact Assessment Regulations 2017; and,
- will provide the client and competent authority with access to all information at my disposal, regarding this project, whether favourable or not.

Marius Venter

Signature

Report compiled by	Marius Venter Bsc Conservation Ecology and Entomology	
Report reviewed by	Elana Mostert MSc Botany (SU)	
Report signed off by	Elbi Bredenkamp MSc Botany (UFS) SACNASP – 400238/11	

ii DETAILS OF THE SPECIALIST FOR REVIEW

Name:	Elana
Surname:	Mostert
Highest qualification:	MSc Botany (SU)
IAIAsa registered:	No. 5631
Botanical Society of South Africa:	No. 79489
South African Association of Botanists	No. 649
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RELEVANT QUALIFICATIONS

- MSc Botany (SU): Specialising in Invasion Biology & Fynbos Restoration
- BSc Hons Plant Sciences- Ecology (UP)
- BSc Environmental Sciences (UP)
- Section 21 (c) and (i) Training: Roodeplaat (November 2017)
- SASS5 Aquatic Biomonitoring Training (November 2018)

WORK EXPERIENCE

- March 2016 - May 2017: Field assistant, Plant Ecologist at Department of Environmental Affairs (Oceans & Coasts)
- June 2017 - current: Environmental Consultant & Ecological Specialist at Enviroworks
- January 2019 – current: Office manager for Enviroworks, Cape Town

Published popular Science article:

- Mostert, E., Gaertner, M., Hall, S., Mukundamago, M., Holmes, P. 2015. *Solving the puzzle of restoring the missing fynbos*. Quest, Volume 11, Number 3.

Publication accepted for journal publication:

- Mostert, E., *et al*., Impacts of invasive alien trees on threatened lowland vegetation types in the Cape Floristic Region, South Africa, South African Journal of Botany 108 (2017) 209–222.
- Mostert E., et al, A multi-criterion approach for prioritizing areas in urban ecosystems for active restoration following invasive plant control, Environmental Management, (In production), 1-20, **DOI** 10.1007/s00267-018-1103-9

FRESHWATER ECOLOGICAL ASSESSMENTS

- Wetland delineation and DWS Section 21 (c) & (i) Water Use Risk Matrix for the proposed development of 100 erven on Erf 210 in Sutherland, Karoo Hoogland Local Municipality, Northern Cape, COGHSTA.
- Wetland delineation and DWS Section 21 (c) & (i) Water Use Risk Matrix for the proposed Zachtevlei Dam And Bulk Conveyance Infrastructure, Lady Grey, Eastern Cape, Indwe Environmental Consulting for Joe Gqabi District Municipality.
- DWS Section 21 (c) & (i) Water Use Risk Matrix for the proposed development of Erf 3976 for a mixed use development in Hartswater, Phokwane Municipality, Northern Cape, Makespace Architects.
- DWS Section 21 (c) & (i) Water Use Risk matrix for the proposed construction of a cellular telecommunications base station and associated infrastructure in Roodekrans, Gauteng, Coast to Coast Towers (Pty) Ltd.
- Wetland delineation for the proposed development of the Sarah Baartman Agricultural Hub, Eastern Cape, FemPlan.
- Wetland delineation for the proposed development of the Alfred Nzo Agricultural Hub, Eastern Cape, FemPlan.
- Wetland delineation for the proposed development of the OR Tambo Agricultural Hub, Eastern Cape, FemPlan.
- DWS Section 21 (c) & (i) Water Use Risk Matrix for the proposed expansion of a granite mine in Biesjesfontein, Springbok, Northern Cape, Greenmined.
- DWS Section 21 (c) & (i) Water Use Risk Matrix for the proposed development of new sports grounds at Waterstone College, Olifantsvlei, Gauteng, CURRO.
- Wetland delineation and DWS Section 21 (c) & (i) Water Use Risk Matrix for the 24G Application for the unlawful clearing of indigenous vegetation and construction of chicken lay houses, Molote City, North West Province, Baramakama Poultry (Pty) Ltd.
- Freshwater specialist study for the extension of a canal by 10 metres at km0.1 along Minor Road 6924, Western Cape Province, Garden Route District Municipality.
- Wetland delineation and DWS Section 21 (c) & (i) Water Use Risk Matrix for the 24G Application for the unlawful construction of a poultry farm, Belgie, Thaba 'Nchu, Free State, Country Bird Holdings.
- Freshwater Study and DWS Section 21 (c) & (i) Water Use Risk Matrix for the the periodic maintenance of TR1/2, TR1/3, TR44/1, TR88/1, MR401, MR402 and DR1834, near Uniondale, Western Cape Province, Western Cape Department of Transport and Public Works.
- DWS Section 21 (c) & (i) Water Use Risk Matrix for the rehabilitation of Divisional Road 1688 from Calitzdorp (KM 1.00) to the Calitzdorp Spa Turnoff (KM 15.64), Western Cape Province, BVi Consulting Engineers.

WATER USE LICENCE APPLICATIONS

- General Authorization for the rehabilitation of Divisional Road 1688 from Calitzdorp (KM 1.00) to the Calitzdorp Spa Turnoff (KM 15.64), Western Cape Province, BVi Consulting Engineers.

- General Authorization for the the periodic maintenance of TR1/2, TR1/3, TR44/1, TR88/1, MR401, MR402 and DR1834, near Uniondale, Western Cape Province, Western Cape Department of Transport and Public Works.
- Water Use Licence Application for chicken lay houses, Molote City, North West Province, Baramakama Poultry (Pty) Ltd.

SECTION 24G RECTIFICATION APPLICATION

- Section 24G Application for the unlawful clearing of indigenous vegetation and construction of chicken lay houses, Molote City, North West Province, Baramakama Poultry (Pty) Ltd.

ENVIRONMENTAL CONTROL OFFICER

- Environmental Control Officer for the rehabilitation of Divisional Road 1688 from Calitzdorp (KM 1.00) to the Calitzdorp Spa Turnoff (KM 15.64), Western Cape Province, BVi Consulting Engineers.

ENVIRONMENTAL REHABILITATION PLAN

- Environmental rehabilitation plan for all the areas affected by the continuous spillage of raw sewage in and around Upington, Northern Cape Province, Dawid Kruiper Local Municipality.

BASIC ASSESSMENT EXPERIENCE

- The proposed construction of a cellular telecommunications base station and associated infrastructure on Portion 76 of Farm No. 106, Robertson, Western Cape Province, Coast to Coast Towers (Pty) Ltd.
- The proposed construction of a cellular telecommunications base station and associated infrastructure on Portion 1 of Farm No. 178, Fisantekraal, City of Cape Town, Western Cape Province, Coast to Coast Towers (Pty) Ltd.
- The proposed development of a telecommunication base station and associated infrastructure on Portion 8 of the Farm Delta no. 1003, Groot Drakenstein, Western Cape Province, Coast to Coast Towers (Pty) Ltd.
- Proposed development of a free standing cellular communication base station and associated infrastructure on Portion 7 of the Farm Haane Kuil no. 335, Beaufort West, Western Cape Province, Warren Petterson Planning (Pty) Ltd.

INTEGRATED ENVIRONMENTAL AUTHORISATIONS

- Amendment of the Environmental Integrated Authorisation for the Continuous Ash Disposal at Matimba Power Station, Lephalale, Limpopo Province, Eskom Holdings SOC Ltd.

ENVIRONMENTAL MANAGEMENT PLANS

- The proposed construction of a cellular telecommunications base station and associated infrastructure on Portion 76 of Farm No. 106, Robertson, Western Cape Province, Coast to Coast Towers (Pty) Ltd.
- The proposed construction of a cellular telecommunications base station and associated infrastructure on Portion 1 of Farm No. 178, Fisantekraal, City of Cape Town, Western Cape Province, Coast to Coast Towers (Pty) Ltd.
- The proposed development of a telecommunication base station and associated infrastructure on Portion 8 of the Farm Delta no. 1003, Groot Drakenstein, Western Cape Province, Coast to Coast Towers (Pty) Ltd.

- Proposed development of a free standing cellular communication base station and associated infrastructure on Portion 7 of the Farm Haane Kuil no. 335, Beaufort West, Western Cape Province, Warren Petterson Planning (Pty) Ltd.

EXPERIENCE IN PERMITS AND LICENCING

- Flora removal permit and translocation guidelines for the periodic maintenance of National Route 2 Section 4 between Riviersonderend (km 0.0) and Swellendam (km 56.9), Western Cape Province, SANRAL.
- Flora removal permit for the re-surfacing of the Donkergat Access Road located within the Langebaan 4 Special Forces Regiment Base, Langebaan, Western Cape, Department of Public Works**.**
- Fauna and flora removal permits for the upgrading of intersections and resealing of road sections between Hotazel and Black Rock, Northern Cape, SMEC.
- Flora removal permit for the rehabilitation of Divisional Road 1688 from Calitzdorp (KM 1.00) to the Calitzdorp Spa Turnoff (KM 15.64), Western Cape Province, BVi Consulting Engineers.

ECOLOGICAL IMPACT ASSESSMENT EXPERIENCE

- Ecological Impact Assessment for the proposed development of 100 erven on Erf 210 in Sutherland, Karoo Hoogland Local Municipality, Northern Cape, COGHSTA Northern Cape.
- Ecological Impact Assessment for the periodic maintenance of National Route 2 Section 4 between Riviersonderend (km 0.0) and Swellendam (km 56.9), Western Cape Province, SANRAL.
- Flora identification study for the re-surfacing of the Donkergat Access Road located within the Langebaan 4 Special Forces Regiment Base, Langebaan, Western Cape, Department of Public Works.
- Quarterly monitoring assessment for the rehabilitation efforts on Portion 5 of Farm 830 Doornekraal, Malmesbury, Western Cape.
- Botanical inspection and recommendations for vegetation rehabilitation at 13 Duikerweg, Melkbosstrand, Western Cape.
- Botanical inspection along R60 selected road crossing and road widening between Worcester and Ashton, Western Cape, BVi Consulting Engineers.
- Ecological Impact Assessment for the proposed development of the Mapungubwe Visitor Interpretation Centres and Overnight Facilities, Limpopo Province, SANParks.
- Ecological Impact Assessment for the proposed development of Erf 3976 for a mixed use development in Hartswater, Phokwane Municipality, Northern Cape, Makespace Architects.
- Ecological Impact Assessment for the proposed construction of a cellular telecommunications base station and associated infrastructure in Roodekrans, Gauteng, Coast to Coast Towers (Pty) Ltd.
- Ecological Impact Assessment for the proposed construction of six lay houses and two new production (hen) houses at Frans Dam Farm, No. 803 Portion 3 in Brandfort, Free State, Moreson Pluimvee Boerdery (Pty) Ltd.
- Ecological Impact Assessment for the 24G Application for the unlawful clearing of indigenous vegetation and construction of chicken lay houses, Molote City, North West Province, Baramakama Poultry (Pty) Ltd.
- Ecological Impact Assessment for the proposed construction of a composting facility on Farm No. 1136 Terugval Portion 1 in Brandfort, Free State, Moreson Pluimvee Boerdery (Pty) Ltd.
- Ecological Impact Assessment for the 24G Application for the unlawful construction of a poultry farm, Belgie, Thaba 'Nchu, Free State, Country Bird Holdings.

- Ecological Impact Assessment for the the periodic maintenance of TR1/2, TR1/3, TR44/1, TR88/1, MR401, MR402 and DR1834, near Uniondale, Western Cape Province, Western Cape Department of Transport and Public Works.
- Botanical Survey for the proposed 20m monopole mast and base station on Erf 455, Simon's Town, Western Cape Province, Atlas Tower (Pty) Ltd.

ALIEN INVASIVE SPECIES MANAGEMENT EXPERIENCE

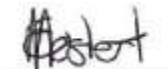
- Preparation of a plan to control and eradicate invasive species as contemplated in Section 76 of the Act, National Environmental Management: Biodiversity Act, 2004 (Act No.10 Of 2004) (NEMBA) for Theewaterskloof Local Municipality**.**
- Baseline Biodiversity Database and Alien Management Strategy Recommendations, Drakenstein, Western Cape, Drakenstein Municipality.
- Review and presentation of Lafarge Saldanha Alien Invasive Species Management Plan, Saldanha, Western Cape Province, Lafarge South Africa.
- Alien Invasive Species Training for staff and management, Saldanha, Western Cape Province, Lafarge South Africa.

iii DECLARATION OF INDEPENDENCE

I, Elana Mostert, ID 910523 0099 085, declare that I:

- am an Environmental Consultant at Enviroworks;
- act as an independent specialist consultant in the field of Botany and Ecology;
- am assigned as specialist consultant by Enviroworks (Pty) Ltd. for this proposed project;
- I do not have or will not have any financial interest in the undertaking of the activity other than remuneration for work as stipulated in the terms of reference;
- remuneration for services by the proponent in relation to this proposal is not linked to approval by decision-making authorities responsible for permitting this proposal;
- the consultancy has no interest in secondary or downstream developments as a result of the authorisation of this project;
- have no and will not engage in conflicting interests in the undertaking of the activity;
- undertake to disclose to the client and the competent authority any material, information that have or may have the potential to influence the decision of the competent authority required in terms of the Environmental Impact Assessment Regulations 2017; and,
- will provide the client and competent authority with access to all information at my disposal, regarding this project, whether favourable or not.

Elana Mostert



Signature

1. Indemnity and Conditions Relating to this Report

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken and Enviroworks and its staff reserve the right to modify aspects of the report including the recommendations if and when new information becomes available from ongoing research or further work in this field, or pertaining to this investigation.

Although Enviroworks exercises due care and diligence in rendering services and preparing documents, Enviroworks accepts no liability, and the client, by receiving this document, indemnifies Enviroworks and its directors, managers, agents and employees against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by Enviroworks and by the use of the information contained in this document.

This report must not be altered or added to without the prior written consent of the author. This also refers to electronic copies of this report which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements or conclusions drawn from or based on this report must make reference to this report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

2. Introduction

Enviroworks (Pty) Ltd has been appointed by Inaluk Consulting Services to conduct an Ecological Impact Assessment for the proposed construction of a township situated on a Portion of the Farm Klipfontein 716 and Farm Ceres 626, Bloemfontein, Mangaung Metropolitan Municipality, Free State Province (Figure 1). The proposed project area has a development footprint of approximately 193 ha.

This project will entail the clearing of vegetation and construction of the proposed Township. The proposed township area is situated across an existing township. In Figure 1 the preliminary layout of the proposed township can be seen. As per client information a proposed township together with all the construction activities related thereto is proposed.

The proposed township development will entail construction of numerous infrastructure, listed in Table 1 below. Planned infrastructure on site are listed according to their respective functional categories:

Table 1 - Proposed development structures.

Zoning	Land Use	No. of stands	Area (Ha)	% of area
Residential 1	Residential stands	4000	125	65
Business 1	Business	2	2.4	1.2
Institutional	Social Facility	2	1.3	0.67
	Community facility	2	0.4	0.2
	Health centre	1	0.8	0.4
Educational	Primary School	3	9.5	4.9
	Secondary School	1	4.8	2.4
	Creche	2	0.42	0.2
Place of worship	Church	2	0.39	0.2
Municipal	Municipal	1	0.23	1.1
Public Open space	Public Open space	3	4.47	2.3
Streets	Streets	-	40.79	21.43
Total	-	4019	192.9	100

Infrastructure and activities usually associated with a township includes, but is not limited to the following:

- Bulk infrastructure services;
- Water pipelines (Storm water and sewer);
- Telecommunication;
- Electrical; and,
- Housing and facility construction.

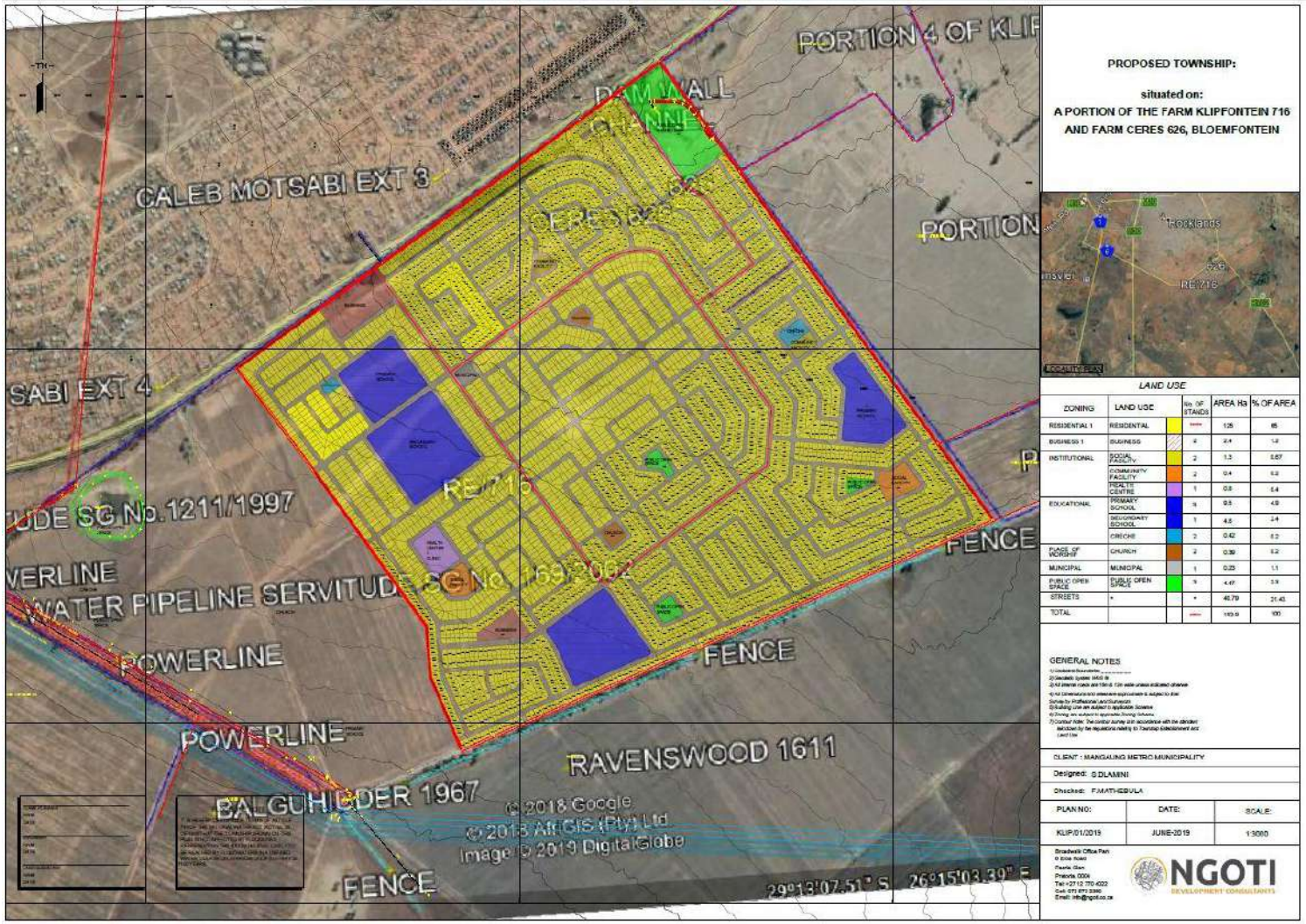


Figure 1 - Proposed layout of the township development. Map provided by Inaluk Consulting Services

2.1. Approach overview

An Ecological Impact Assessment was conducted for the site proposed for the township development as well as the activities related to such construction, operation and decommissioning phases in order to determine and evaluate the nature, significance and extent of the potential impacts that the proposed project will have on the natural environment. This was required in order to determine the potential presence of ecologically significant species or habitats within the proposed project footprint. Proposed mitigation and management measures are also recommended in order to attempt to reduce/alleviate these identified potential impacts. A site visit/assessment was therefore conducted on the proposed construction footprint on 23 July 2019 in order to fulfil this requirement. Preliminary preparations conducted prior to the site visit/assessment were as follows:

- Geo-referenced spatial information was obtained of the outer perimeter of the proposed project site in order to determine the direct impact footprint; and,
- A desktop study was conducted to review the information available on the vegetation types as well as ecological sensitivity of the area in order to determine the ecological significance of the area as well as vegetation structure and potential species to be expected.

3. Objectives

The Ecological Impact Assessment included a vegetation and habitat survey in order to meet the following objectives:

- Identify and list significant species encountered on the proposed project area and list any protected and/or Red Data Listed species;
- Determine and discuss the condition and extent of degradation and/or transformation of the vegetation on the proposed project area;
- Determine and discuss the ecological sensitivity and significance of the proposed project area;
- Identify, evaluate and rate the potential impacts of the proposed project on the natural environment; and,
- Provide recommendations on mitigation and management measures in order to attempt to reduce/alleviate these identified potential impacts.

Wetland delineation:

The protection of wetlands is of utmost importance to the Department of Environmental Affairs (DEA) and Department of Water and Sanitation (DWS). A wetland delineation and assessment was not included in the scope of works. A recommendation is to conduct a thorough wetland delineation and Risk Matrix to establish the extent of any wetland present on site and determine the present ecological

state (PES) and Environmental Importance and Sensitivity (EIS) of the wetland to ensure protection of the wetland. The Risk Matrix can be submitted as part of the General Authorisation process when applying for the Water Use License Application (WULA).

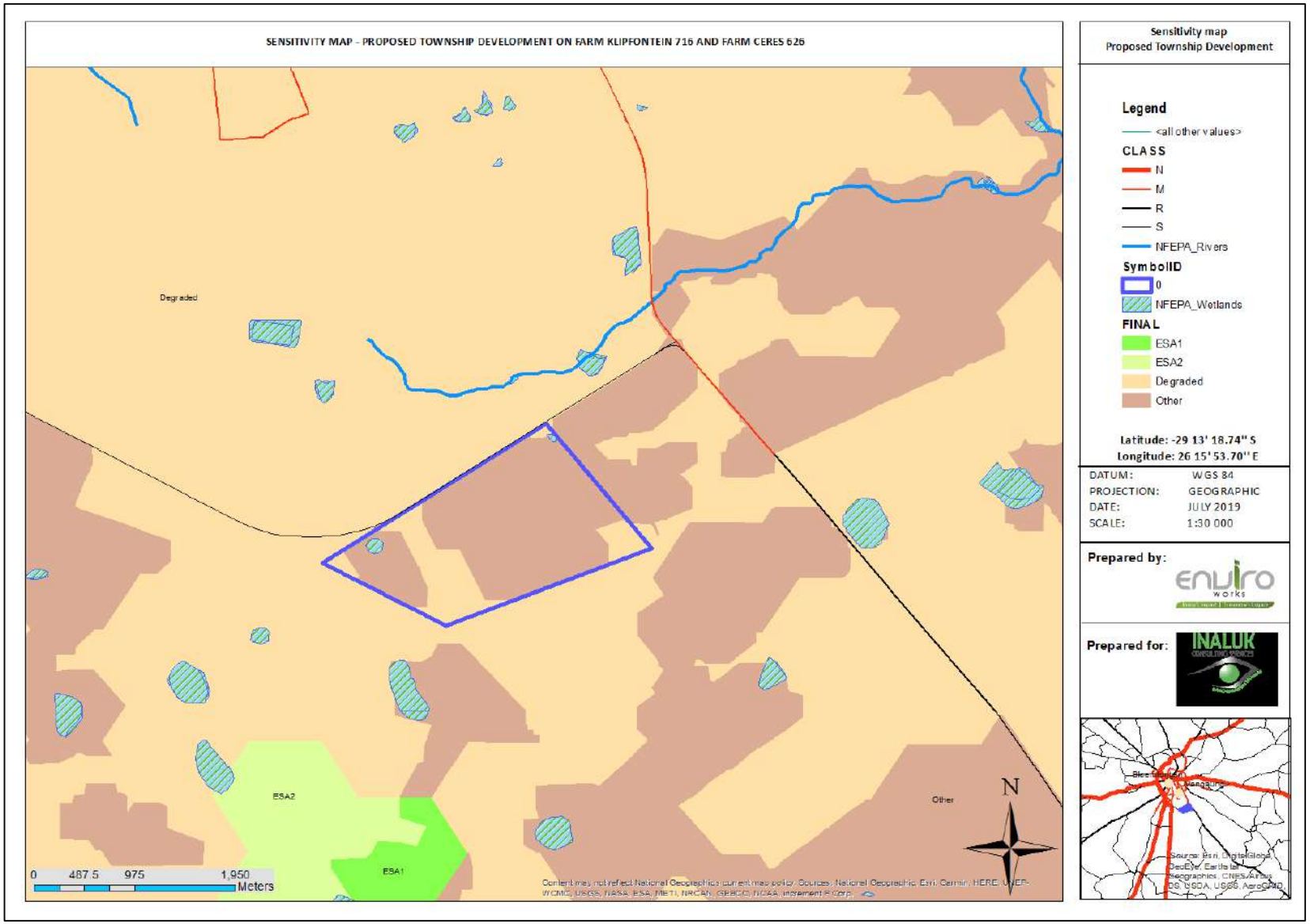


Figure 2 – Sensitivity map, indicating the development footprint of the proposed township

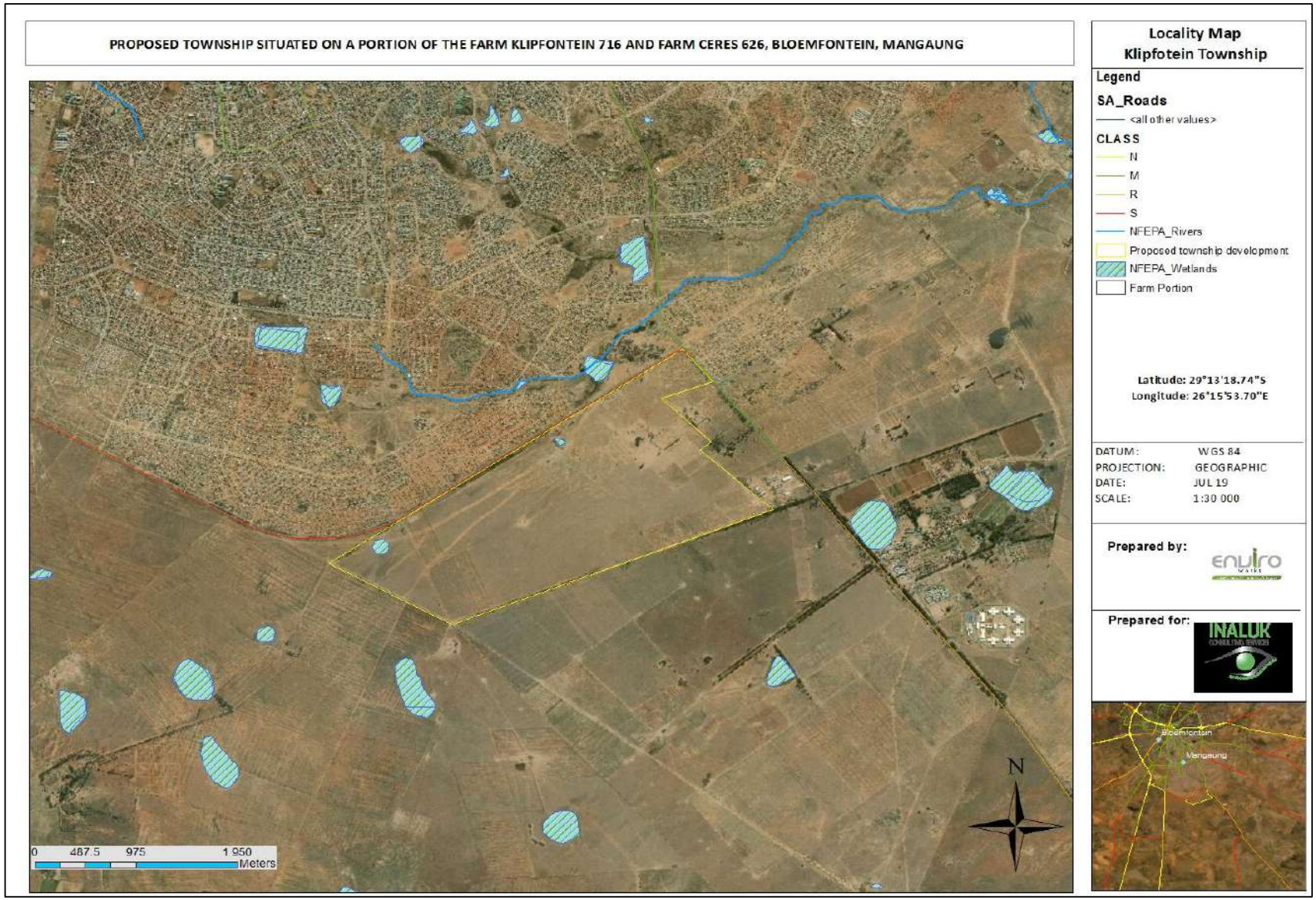


Figure 3 - Locality Map for the area evaluated for the proposed township development

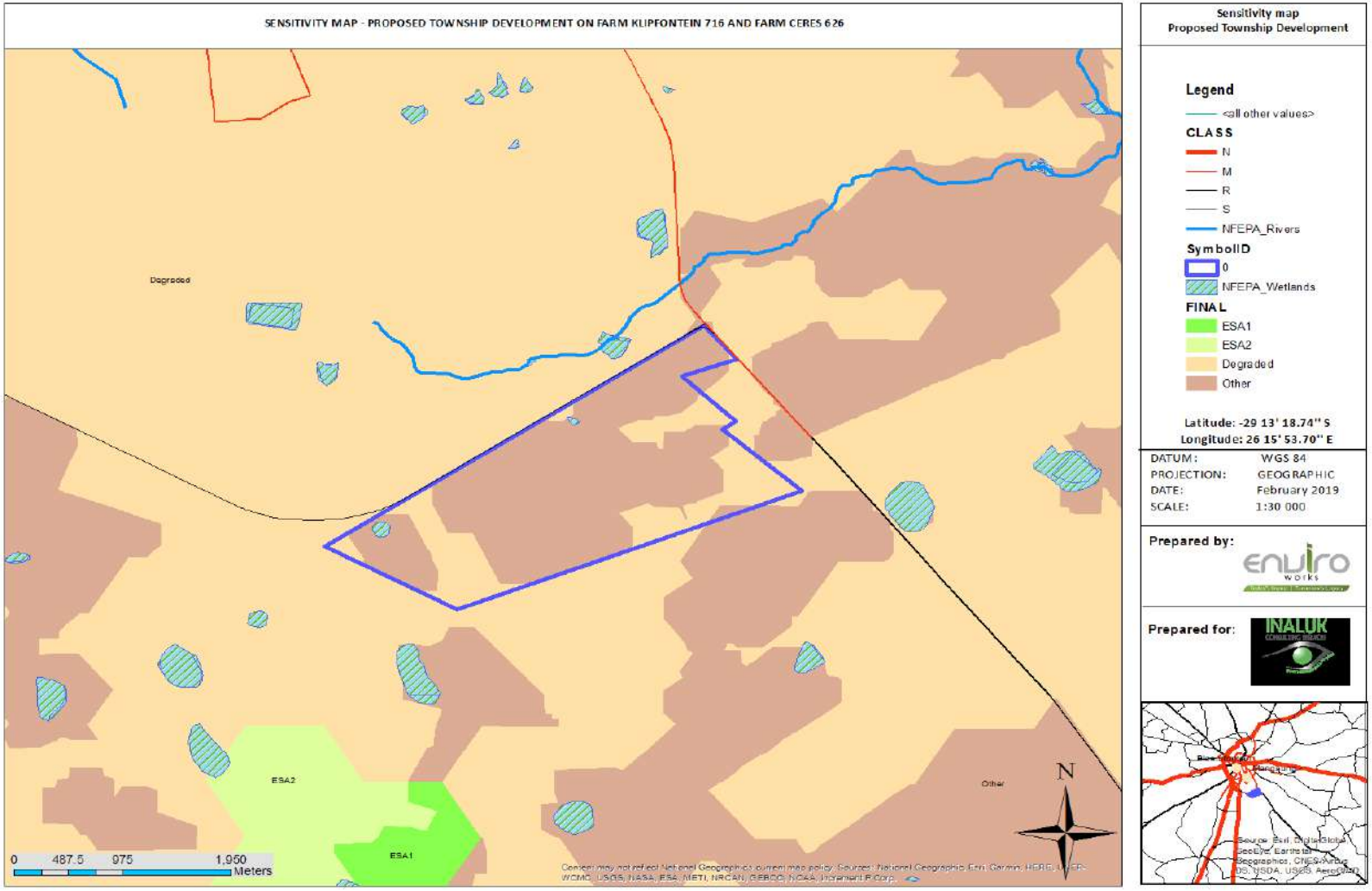


Figure 4 - Sensitivity Map for the area evaluated for the proposed township development.

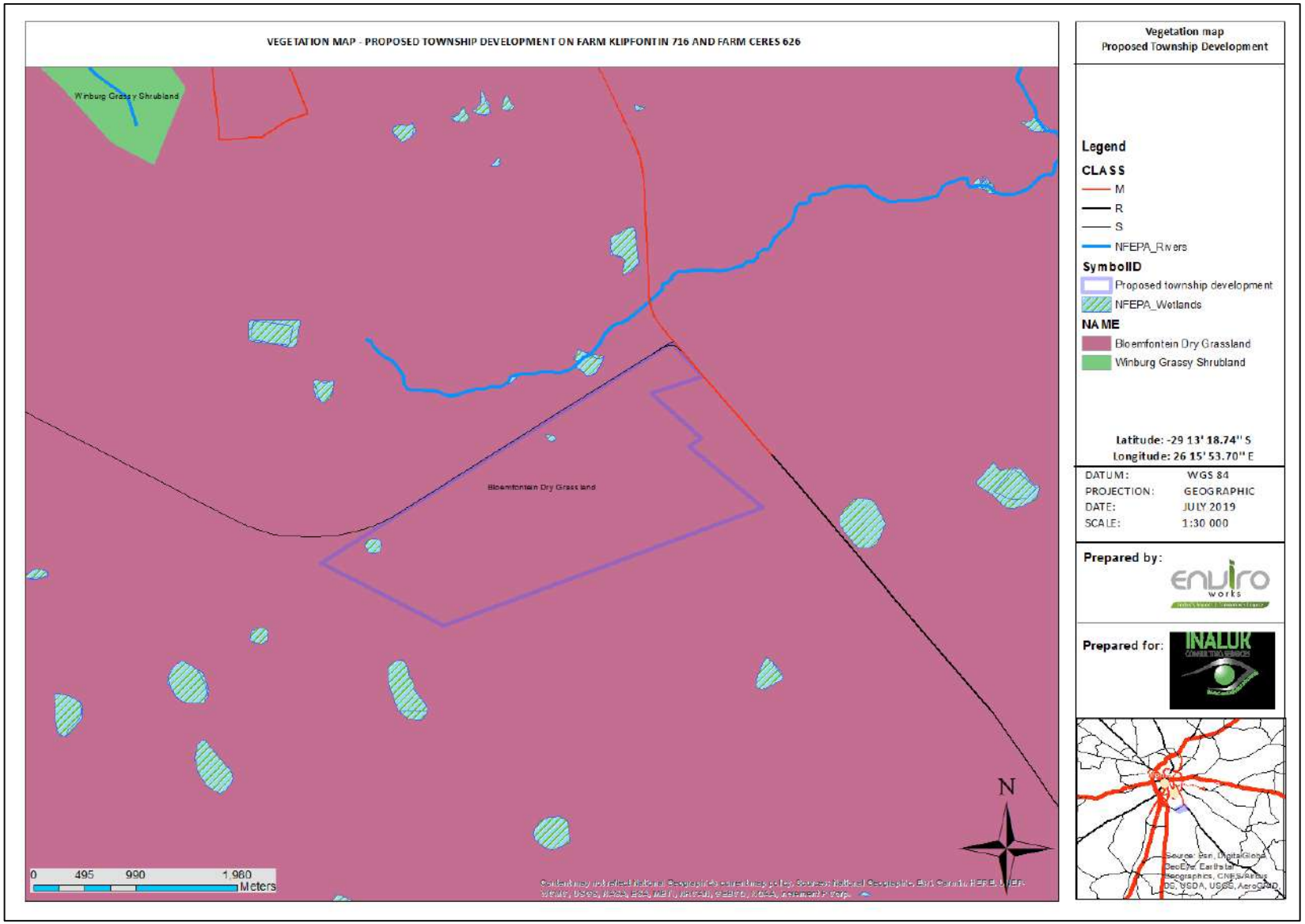


Figure 5 - Vegetation map of the proposed township development and surrounds

4. Assessment Rational

The protection and maintenance of the integrity of our natural resources in South Africa is essential when it comes to the wellbeing of the environment. Continued development however also forms a pillar stone in the socio-economic improvement of society and the livelihoods of communities and individuals. Socio-economic progress can therefore not simply be completely discarded for the sake of environmental conservation but solutions rather need to be determined in order to achieve a sustainable balance between the needs for environmental conservation without unreasonably jeopardising the requirements of socio-economic development. Adequate, sustainable and responsible utilisation and management of our natural resources is crucial and finding these essential environmental/socio-economic balances to achieve sustainability should therefore always be a priority focus point during any proposed project development.

Various environmental legislation in South Africa makes provision for the protection of our natural resources and the functionality of ecological systems in order to ensure sustainability. Such acts include the National Environmental Management: Biodiversity Act (Act 10 of 2004), National Forests Act (Act 84 of 1998), Conservation of Agricultural Resources Act (Act 43 of 1983) and framework legislation such as the National Environmental Management Act (Act 10 of 2004) and Free State Nature Conservation Ordinance (No 8 of 1969).

The various components of ecological systems are all interrelated and it is therefore important that specialist studies of all such components be conducted prior to the commencement of any proposed project development. Only once the potential impacts and outcomes of proposed developments on the ecological systems of an area are understood, can informed decisions be made regarding the viability of projects to address and achieve the environmental and socio-economic needs of an area.

An Ecological Impact Assessment of the proposed project area was therefore conducted in order to determine and quantify the potential impacts of the proposed development on the natural environment.

5. Methodology

The whole proposed footprint area was evaluated (in transects) for the scope of this ecological study. The proposed project area was walked on foot and visual observations/identifications of species in the footprint were conducted.

In order to analyse the significance of species observations, data sources from literature were consulted and include the following:

5.1. Vegetation types:

- Vegetation types and their conservation status were extracted from the South African National Vegetation Map (Mucina and Rutherford, 2006) and the National List of Ecosystems that are Threatened and in Need of Protection (GN 1002 of 9 December 2012).
- A brief discussion on the vegetation type in which the study area is situated, using available literature, in order to place the study area in context (Mucina and Rutherford, 2006).
- A broad-scale map was generated of the vegetation and habitat sensitivity of the site using available GIS data (BGIS, 2018).
- List of plant species were recorded during the survey. Plants were identified from photographs and specimens taken on site.
- The conservation status of the species in the list was also extracted from the Threatened Species Programme, Red List of South African Plants version 2017.1 database (SANBI, 2016).
- Wetland areas were identified by conducting a desktop study before the site visit using National Wetland Map 5 (NWM5) (van Deventer et al. 2019) and Free State Wetland Probability map. The wetlands on site will was mentioned, but not delineated as part of this scope of works.

5.2. Date, season and identification of transects of the site visit:

The site visit took place on Thursday 23 July 2019 (Winter). A walkthrough was done, assessing environmental conditions and pictures were taken of the proposed footprint and plant species occurring on site. During the desktop study, transect lines were identified after dividing the area into homogenous habitat areas in order to sample the proposed construction area as thorough as possible. As the site visit was conducted in the winter, and therefore not in flowering season, a recommendation will be made that a botanical walkthrough be conducted in the rain season (Summer), before the commencement of construction activities in order to detect if any plant species might have been missed during the initial site visit.

The transect lines that was sampled can be seen in Figure 6.

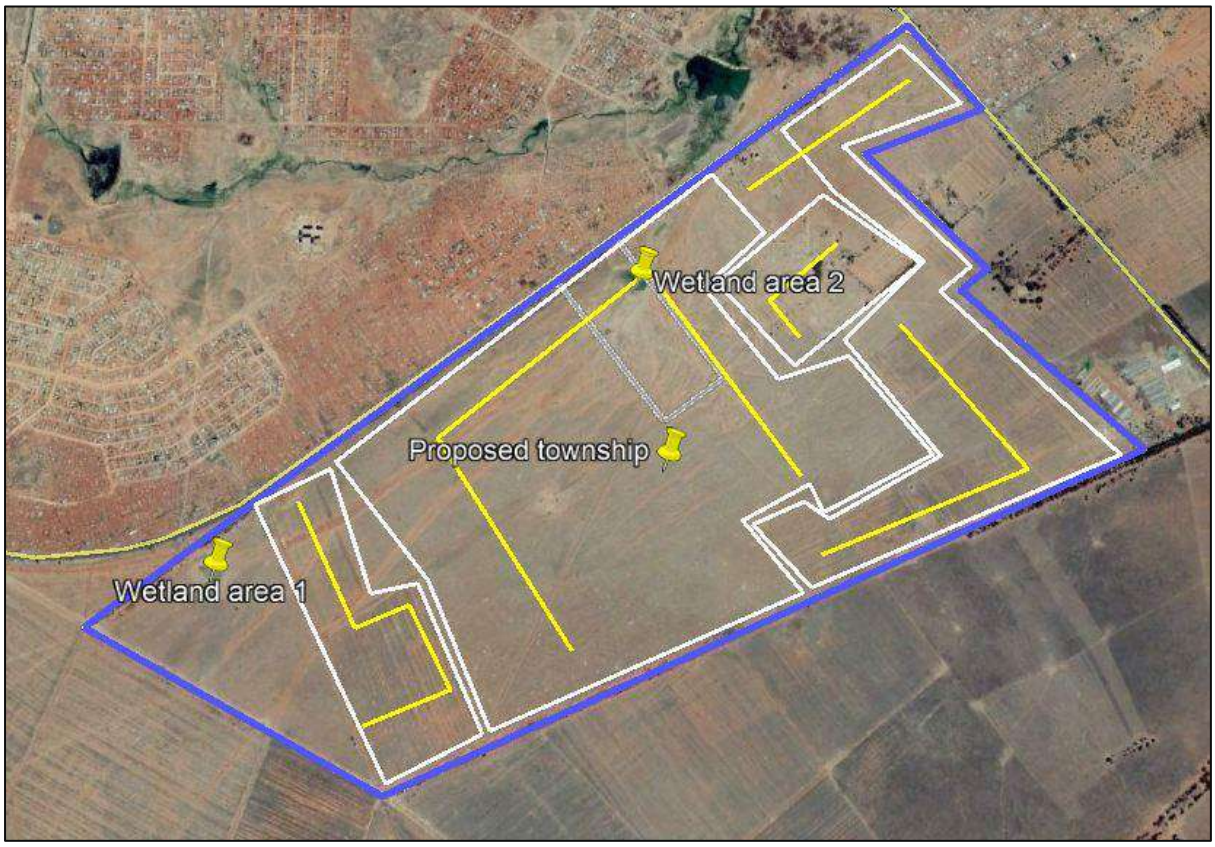


Figure 6 - Transect lines (yellow) and homogenous areas (white) were identified

5.3. Fauna:

- Lists of avifauna, mammals, reptiles and amphibians which are likely to occur at the site were based on distribution records from literature and various spatial databases available from The Virtual Museum (ADU, 2019) and South African Bird Atlas Project (SABAP2, 2019).
- The faunal species lists provided are based on species which are known to occur in the broad geographical area (QDS 2926AB), as well as an assessment of the availability and quality of suitable habitat at the site.
- The conservation status of each species is listed, based on the IUCN Red List Categories and Criteria version 2014.2. These lists are adequate for mammals and amphibians, the majority of which have been assessed, however the majority of reptiles have not been assessed and therefore, it is not adequate to assess the potential impact of the development on reptiles, based on those with a listed conservation status alone. The conservation status of avifauna was checked against an international database (Birdlife, 2019).

5.4. Impact ratings Methodology:

Potential impacts of the proposed project on the surrounding natural environment were identified, evaluated and rated as per the methodology described below.

The tables below indicate and explain the methodology and criteria used for the evaluation of the **Environmental Risk Ratings** as well as the calculation of the final **Environmental Significance Ratings** of the identified potential ecological impacts.

Each potential environmental impact is scored for each of the **Evaluation Components** as per the Table 4 below.

Table 2 Scale utilised for the evaluation of the Environmental Risk Ratings

Evaluation Component	Rating Scale and Description/criteria
MAGNITUDE of NEGATIVE IMPACT (at the indicated spatial scale)	**10 - Very high**: Bio-physical and/or social functions and/or processes might be *severely* altered. **8 - High**: Bio-physical and/or social functions and/or processes might be *considerably* altered. **6 - Medium**: Bio-physical and/or social functions and/or processes might be *notably* altered. **4 - Low** : Bio-physical and/or social functions and/or processes might be *slightly* altered. **2 - Very Low**: Bio-physical and/or social functions and/or processes might be *negligibly* altered. **0 - Zero**: Bio-physical and/or social functions and/or processes will remain *unaltered.*
MAGNITUDE of POSITIVE IMPACT (at the indicated spatial scale)	**10 - Very high (positive)**: Bio-physical and/or social functions and/or processes might be *substantially* enhanced. **8 - High (positive)**: Bio-physical and/or social functions and/or processes might be *considerably* enhanced. **6 - Medium (positive)**: Bio-physical and/or social functions and/or processes might be *notably* enhanced. **4 - Low (positive)**: Bio-physical and/or social functions and/or processes might be *slightly* enhanced. **2 - Very Low (positive)**: Bio-physical and/or social functions and/or processes might be *negligibly* enhanced. **0 - Zero (positive)**: Bio-physical and/or social functions and/or processes will remain *unaltered.*
DURATION	**5 - Permanent** **4 - Long term**: Impact ceases after operational phase/life of the activity > 60 years. **3 - Medium term**: Impact might occur during the operational phase/life of the activity – 60 years. **2 - Short term**: Impact might occur during the construction phase - < 3 years. **1 - Immediate**
EXTENT (or spatial scale/influence of impact)	**5 - International**: Beyond National boundaries. **4 - National**: Beyond Provincial boundaries and within National boundaries. **3 - Regional**: Beyond 5 km of the proposed development and within Provincial boundaries. **2 - Local**: Within 5 km of the proposed development.

	1 - Site-specific: On site or within 100 m of the site boundary. **0 -** None
IRREPLACEABLE loss of resources	**5 – Definite** loss of irreplaceable resources. **4 – High** potential for loss of irreplaceable resources. **3 – Moderate** potential for loss of irreplaceable resources. **2 – Low** potential for loss of irreplaceable resources. **1 – Very low** potential for loss of irreplaceable resources. **0 - None**
REVERSIBILITY of impact	**5 –** Impact **cannot** be reversed. **4 – Low** potential that impact might be reversed. **3 – Moderate** potential that impact might be reversed. **2 – High** potential that impact might be reversed. **1 –** Impact **will be** reversible. **0 –** No impact.
PROBABILITY (of occurrence)	**5 - Definite**: >95% chance of the potential impact occurring. **4 - High probability**: 75% - 95% chance of the potential impact occurring. **3 - Medium probability**: 25% - 75% chance of the potential impact occurring **2 - Low probability**: 5% - 25% chance of the potential impact occurring. **1 - Improbable**: <5% chance of the potential impact occurring.
CUMULATIVE impacts	**High**: The activity is one of several similar past, present or future activities in the same geographical area, and might contribute to a very significant combined impact on the natural, cultural, and/or socio-economic resources of local, regional or national concern. **Medium**: The activity is one of a few similar past, present or future activities in the same geographical area, and might have a combined impact of moderate significance on the natural, cultural, and/or socio-economic resources of local, regional or national concern. **Low**: The activity is localised and might have a negligible cumulative impact. **None**: No cumulative impact on the environment.

Once the **Environmental Risk Ratings** have been evaluated for each potential ecological impact, the **Significance Score** of each potential ecological impact is calculated by using the following formula:

- **SS (Significance Score) = (magnitude + duration + extent + irreplaceable + reversibility) x probability.**

The maximum **Significance Score** value is 150.

The **Significance Score** is then used to rate the **Environmental Significance** of each potential ecological impact as per Table 5 below. The **Environmental Significance** rating process is completed for all identified potential ecological impacts both before and after implementation of the recommended mitigation measures.

Table 3 Scale used for the evaluation of the Environmental Significance Ratings

Significance Score	Environmental Significance	Description/criteria

125 – 150	**Very high (VH)**	An impact of very high significance will mean that the project cannot proceed, and that impacts are irreversible, regardless of available mitigation options.
100 – 124	**High (H)**	An impact of high significance which could influence a decision about whether or not to proceed with the proposed project, regardless of available mitigation options.
75 – 99	**Medium-high (MH)**	If left unmanaged, an impact of medium-high significance could influence a decision about whether or not to proceed with a proposed project. Mitigation options should be relooked.
40 – 74	**Medium (M)**	If left unmanaged, an impact of moderate significance could influence a decision about whether or not to proceed with a proposed project.
<40	**Low (L)**	An impact of low is likely to contribute to positive decisions about whether or not to proceed with the project. It will have little real effect and is unlikely to have an influence on project design or alternative motivation.
+	**Positive impact (+)**	A positive impact is likely to result in a positive consequence/effect, and is likely to contribute to positive decisions about whether or not to proceed with the project.

6. Assumptions, uncertainties and gaps in knowledge

A part of the assessment depends on the desktop study to determine what important and endemic species are known to occur in the area and which are most likely to occur in the proposed sites' vegetation. A site visit was also done to confirm the species that occur in the proposed development area.

The processes of investigation which have led to the production of this report, harbours several assumptions, which include the following:

- All information provided by the applicant to the environmental specialist was correct and valid at the time that it was provided;
- The proposed project footprint as provided is correct and will not be significantly deviated from;
- Strategic level investigations undertaken by the applicant prior to the commencement of the EIA process, determined that the development site represents a potentially suitable and technically acceptable location;
- The public will receive a fair and reoccurring opportunity to participate and comment during the EIA process, through the provision of adequate public participation timeframes stipulated in the Regulations;
- The need and desirability of the project is based on strategic national, provincial and local plans and policies which reflect the interests of both statutory and public viewpoints;

- The EIA process is a project-level framework and the specialists are limited to assessing the anticipated environmental impacts associated with the construction and operational phases of the proposed project;
- Strategic level decision making is conducted through cooperative governance principles with the consideration of sustainable and responsible development principles underpinning all decision making;
- Given that an EIA involves prediction, uncertainty forms an integral part of the process. Two types of uncertainty are associated with the EIA process, namely process-related and prediction-related:
    - Uncertainty of prediction is critical at the data collection phase as final certainty will only be obtained upon implementation of the proposed development. Adequate research, experience and expertise may minimise this uncertainty;
    - Uncertainty of values depicts the approach assumed during the EIA process, while final certainty will be determined at the time of decision making. Enhanced communication and widespread/comprehensive coordination can lower uncertainty;
- Uncertainty of related decision relates to the interpretation and decision making aspect of the EIA process, which shall be appeased once monitoring of the project phases is undertaken;
- The significance/importance of widespread/comprehensive consultation towards minimising the risk/possibility of omitting significant impacts is further stressed. The use of quantitative impact significance rating formulas (as utilised in this document) can further standardise the interpretation of results and limit the occurrence and scale of uncertainty;
- The initial study was undertaken as a desktop assessment and as such, the information gathered must be considered with caution, as inaccuracies and data capturing errors are often present within these databases; and,
- Global Positioning System (GPS) technology is inherently inaccurate and some inaccuracies due to the use of handheld GPS instrumentation may occur.
- Some plant species might have been missed during the site visit due to the fact that the assessment was done in winter. It is recommended that a botanical walkthrough be conducted before construction commences, to detect any flowering species that were missed before, if any.

Gaps in knowledge can be attributed to:

The ecological study process is being undertaken prior to the availing of certain information which would be derived from the final project design and layout.

- The principle of human nature provides for uncertainties with regards to the identified socio-economic impacts of the proposed development.
- Enviroworks is an independent environmental consulting firm and as such, all processes and attributes of the specialist investigations and EIA are addressed in a fair and unbiased/objective manner. It is believed that through the running of a transparent and participatory process, risks associated with assumptions, uncertainties and gaps in knowledge can be and have been acceptably reduced.

7. Receiving Environment

The proposed development footprint is located across the road from an already established township area (near Kopanong) and approximately 193 ha in surface size, situated within the Mangaung Metropolitan Municipality, Free State Province. The site is situated partly adjacent to Dewetsdorp Road and the M30, approximately 17 km outside Bloemfontein central with the following coordinates: 29° 12’ 55.95” S and 26° 15’ 51.58” E. The proposed footptint is situated on a Portion of the Farm Klipfontein 716 and Farm Ceres 626.

A brief discussion on the vegetation type in which the study area is situated follows, using available literature, in order to place the study in context where after a broad-scale map was generated of the vegetation and habitat sensitivity of the site using available GIS data. The surrounding areas are mostly affected and degraded by anthropogenic activities such as farming activities, housing developments, cattle grazing and clearing of vegetation. Adjacent to the proposed footprint there are existing buildings and various construction activities, including an existing township within close vicinity of the proposed site. Further, a shooting range is also established on the adjacent premises to the south-eastern side of the site. Illegal dumping, grazing activities and alien invasive infestation occurs on the site.

7.1. Vegetation:

The study area and project site is situated within the Grassland Biome and Dry Highveld Grassland bioregion. The proposed project area forms part of the (Gh5) Bloemfontein Dry Grassland vegetation type (Mucina & Rutherford, 2006).

The proposed project area also falls inside an area categorised by the Provincial Spatial Biodiversity Plan as ‘Other” and “Degraded”. ‘Other Natural Areas’ are production landscapes with the objective

to manage land to optimize sustainable utilization of natural resources (Adapted from the guidelines for bioregional plans (Anon 2008)). See sensitivity and vegetation maps (Figures 4 and 5).

The distribution of the vegetation type as found on the site is limited to the Free State Province and can mainly be found at altitudes of 1250-1480m. This vegetation type has been described by Mucina and Rutherford (2009) to usually occur in landscape types such as undulating bottomland landscapes covered with tall, dense grassland alternating with patches of karroid schrubs.

The geology consists out of sedimentary mudstones and layers of sandstone mainly of the Adelaide subgroup (Beaufort Group, Karoo Supergroup). The Volksrust Formation mudstones of the Ecca Group dominate the western part while a deep layer of red sand (300 mm) covers the clayey B-horizon. Ca and Ae types are nearly equally represented. This vegetation type is situated in a summer rainfall area with MAP of about 450mm. Important taxa include Graminoids such as *Anthephora pubescens, Aristida congesta, A. Diffusa, Cynodon dactylon, Digitaria argyrograpta* to name a few. Also found in this area are herbs, geophytic herbs, succulent herbs, low shrubs and succulent shrubs.

Table 4: Conservation status of the vegetation type occurring in and around the study area

Vegetation Type	Target (%)	Conserved (%)	Transformed (%)	Conservation Status Driver *et al.*, 2005; Mucina & Rutherford, 2006
Bloemfontein Dry Grassland	24%	Small portion	40%	Endangered

According to Mucina and Rutherford (2006) the vegetation type (i.e Bloemfontein Dry Grassland) has a very small portion that is conserved statutorily in Soetdoring Nature reserve. Some 40% are already transformed, mainly due to crop production. The conservation status is classified as Endangered.

The land cover of the proposed development site currently consists of large areas of bare compacted soil with little to medium vegetation cover present on site. The area has been degraded in the past by clearance of the natural vegetation. By evaluating historical images of the year 2000 it is evident that a large part of the proposed area was utilized for crop production (Figure 7). Due to the transformation of natural land cover in the surrounding areas, the likelihood of the area restoring to an important ecological functioning unit is highly unlikely, if not impossible, considering the surrounding construction, degradation and disturbances on the proposed site. See vegetation and sensitivity maps (Figures 4 and 5). However, there are some areas on the site which still contains characters of the natural vegetation type characterising the area.

7.2. Climate:

The project area normally receives about 450mm of rain per year, with most rainfall occurring mainly during summer. It receives the lowest rainfall in July and the highest in March. The mean annual temperature (MAT) of the region is approximately 15.7°C. The region is the coldest during July with high incidence of frost in the winter.

7.3. Topography and Drainage:

The proposed site for the township is located in quaternary catchment C52F. The general flow of water on site will be in a north eastern direction, when evaluating the positions of the dam walls and site topography. The topography found at the proposed construction area is relatively flat. As this is a large area, slopes occur towards various directions, however, the overall slope tends towards the north eastern direction.

7.4. Fauna of conservation concern

Species known to occur from the Quarter Degree Square (QDS, 2926AB) were extracted from the Animal Demography Unit website (ADU, 2019) and the Second South African Bird Atlas (SABAP2, 2019). Reporting rates for birds observed in the QDS are listed below (Table 6). No species of conservation concern have been observed in the QDS.

Figure 7 – Google Earth screenshot of the proposed area in the year 2000 showing agricultural activities, including cultivated fields

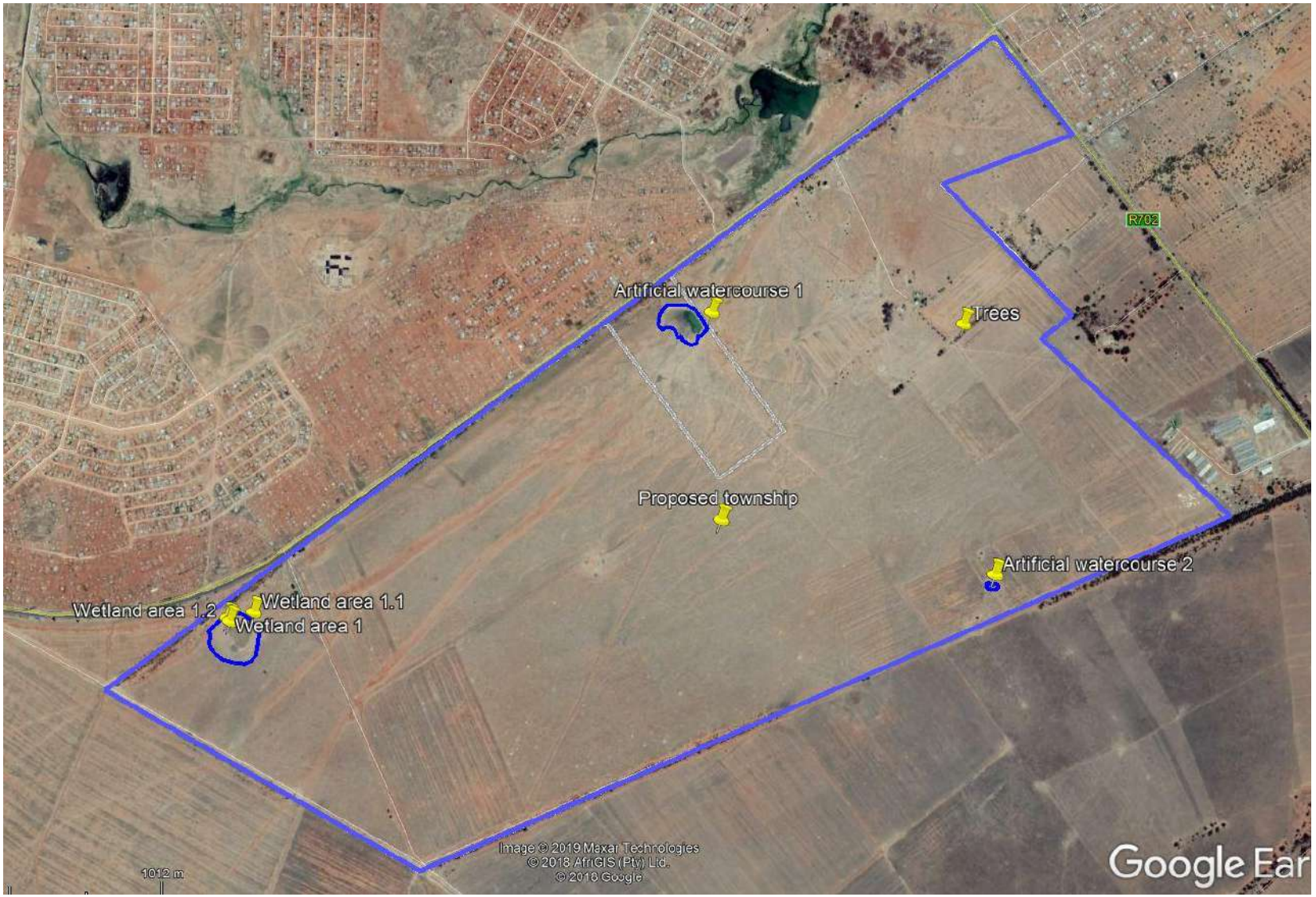


Figure 8 - Wetland area 1, Artificial watercourse 1 and Artificial watercourse 2 (artificial watercourses) as identified on the proposed township development area

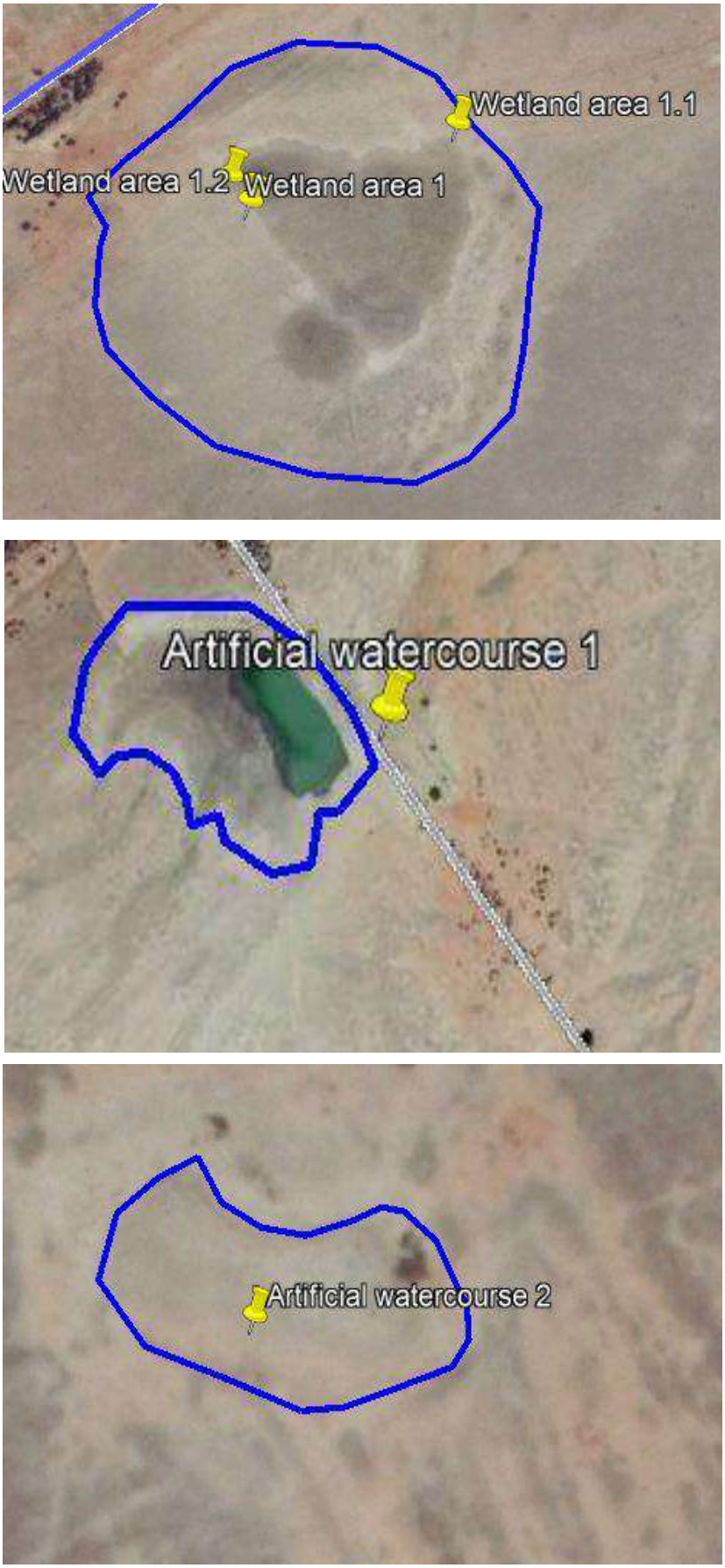


Figure 9 - Google Earth images showing the wetland areas

8. Results

8.1. Vegetation:

The proposed footprint forms part of an area classified by the Critical Biodiversity Area map of the Free State Province as partly 'Degraded' and partly 'Other natural areas' (Figure 4). The vegetation present on site is not typically representative of the Bloemfontein Dry Grassland vegetation type, although some areas (small parts) appears to show signs of the natural vegetation type representation. The vegetation as found on site are dominated by grasses while indigenous, non-indigenous and alien invasive species occur in the proposed footprint.

8.2. Site specific vegetation:

Rare plant species are classified either as protected species in the National Forests Act (Act 84 of 1998 as amended in 2005) and Nature and Environmental Conservation Ordinance (No.19 of 1974) or as Red Data species according to the Red Data List of Southern African Plants (2017). The Red Data species are classified in several categories such as Endangered, Vulnerable, Rare and Not Threatened. Species that are endemic to a certain area are important in terms of conservation status as their distribution may be very localized and as such may be threatened by new developments, be it housing, industrial or mining. However, endemic species may, or may not be listed as Red Data or protected species.

Grasses dominate the vegetation in the area with various shrubs and trees present. The disturbance on the property include vehicle tracks and clearance of vegetation. Ongoing disturbance has made this area vulnerable to invasion by weeds and other alien invasive species. Various trees were found on mostly the edges of the proposed development site as the area was used for agricultural purposes in the past (see Figure 7). The area is heavily degraded by cattle, vehicle tracks, illegal waste dumping and clearing of vegetation. Some of the residents of the existing township from across the road are already allocating and demarking areas for houses to be built on site.

The list below contains the plant species observed on the proposed development during the site visit but are not limited to the following:

Table 5 Species list of plants that were encountered during the survey.

Species	Common Name	Family	Origin	Conservation Status (Redlist)
Agave americana variegata	Spreading century plant	Agavaceae	Category 3 in Western Cape and Not listed elsewhere in South Africa.	Least concern

Argemone ochroleuca	White flowered Mexican poppy	Papaveraceae	Not Endemic – invasive – NEMBA Category 1b	N/A
Aristida canescens	Pale Three Awn Grass	Poaceae	Not Endemic - indigenous	Least concern
Aristida congesta subsp. congesta	Buffalo Grass	Poaceae	Not Endemic to South Africa	Least concern
Asparagus laricinus	Cluster-leaf asparagus	Asparagaceae	Not Endemic to South Africa	Least concern
Carthamus lanatus	Woolly distaff thistle	Asteraceae	Not Endemic – invasive – NEMBA Category 1b	N/A
Casuarina cunninghamiana	River Oak	Casuarinaceae	Not Endemic – invasive – NEMBA Category 2	N/A
Chloris virgata	Blougras	Poaceae	Not Endemic to South Africa	Least concern
Datura stramonium	Jimsonweed	Solanaceae	Not Endemic – invasive - NEMBA Category 1b	N/A
Digitaria eriantha	Bloukruisgras	Poaceae	Not Endemic to South Africa	Least concern
Digitaria sanguinalis	Summer grass	Poaceae	Not Endemic to South Africa	Least concern
Eragrostis curvula	Weeping lovegrass	Poaceae	Not Endemic to South Africa	Least concern
Eucalyptus camaldulensis	River red gum	Myrtaceae	Not listed within cultivated land that is at least 50 metres away from untransformed land. Otherwise category 1B	N/A
Eucalyptus cladocalyx	Sugar gum	Myrtaceae	Category 1B	N/A
Euphorbia polygona	Bobbejannoors	Euphorbiaceae	Endemic to South Africa	Least concern
Felicia spp.	-	Asteraceae	-	-
Flacourtia indica	ramontchi	Salicaceae	Not Endemic to South Africa	Least concern
Juncus effusus	Common rush	Juncaceae	Not Endemic to South Africa – freshwater systems	Least concern
Leptochloa fusca	Kuilgras	Poaceae	Not Endemic to South Africa – freshwater systems	Least concern
Moraea pallida	Cape Tulip	Iridaceae	Not Endemic to South Africa	Least concern
Nenax microphylla	Daggabossie	Rubaceae	Not Endemic to South Africa	Least concern
Opuntia ficus indica	Mission prickly pear	Cactaceae	Not Endemic – invasive – NEMBA Category 1b	N/A
Panicum spp.	-	Poaceae	-	-
Pennisetum clandestinum	Kikuyu Grass	Poaceae	Not Endemic to South Africa	Least concern

Phoenix canariensis chabaud	Canary Island date palm	Arecaceae	Not Endemic to South Africa	Least concern
Pollichia campestris	Waxberry	Caryophyllaceae	Not Endemic to South Africa	Least concern
Senecio consanguineus	Springkaanbossie	Asteraceae	Not Endemic - indigenous	Least concern
Solanum elaeagnifolium	Silver leaf bitter apple	Solanaceae	Not Endemic – invasive – NEMBA Category 1b	N/A
Stenocerus thuberi	Organ pipe cactus	Cactaceae	Not Endemic to South Africa	Least concern
Themeda Triandra	Red grass	Poaceae	Not Endemic - indigenous	Least concern
Tragus racemosa	Burr grass	Poaceae	Not Endemic to South Africa	Least concern
Vachellia robusta	Cape thorn tree	Fabaceae	Not Endemic to South Africa	Least concern
Ziziphus mucronata	Blinkblaar	Rhamnaceae	Not Endemic to South Africa	Least concern

8.3. Evaluation:

The area of the proposed township development is situated on a degraded piece of land. The sites' original vegetation was damaged due to previous vegetation clearing for agricultural purposes, housing plot marking, and gravel roads, cattle grazing, a soccer field and illegal dumping of waste. Access roads leading to the site are existing as the surrounding areas towards the western, northern and eastern sides are already heavily developed. There are three areas on site where the vegetation indicate areas of wetness (*Juncus effuses* and *Leptochloa fusca*). One of the sites is situated towards the western side of the property and the other two areas, towards the northern side (artificial watercourse 1) and towards the south-western side (artificial watercourse 2) (Figure 8 and 9). The identified wetland areas will likely be affected directly by the proposed project as it is situated inside area of planned construction of the proposed township development (Figure 8 and 9). The layout plan makes provision for the wetlands by including them into the public open spaces and mitigations must be implemented in order to mitigate impacts on these watercourses during construction and operation. A recommendation is to conduct a thorough wetland delineation and Risk Matrix in order to determine the extent and importance, ecologically, of these wetland areas on site.

The proposed area for the township development is already modified by the disruption in natural vegetation composition, structure and ecosystem functioning due to previous activities that took place on the specific site. At a local scale the site is degraded. No species of conservation concern were found present or are likely expected to be present. The property is surrounded by transformed and degraded habitat making recovery to a functional and representative ecosystem highly unlikely and very slow.

The proposed construction area falls inside an area classified as 'Degraded' and 'Other' by the Sensitivity map (Figure 2). Previous transformation and destruction of portions of the site results in it not fulfilling the physical and functional role in order to be deemed a representative sample of the vegetation type, which forms part of the Bloemfontein Dry Grassland vegetation type - classified as Endangered. This property is not of high conservation significance for habitat preservation or ecological functionality persistence in support of the surrounding ecosystem or broader vegetation type. All alien invasive plants must be located, removed and destroyed by burning in controlled conditions. No alien invasive plants must be left in a condition to bear fruit, to spread by seed dispersal or propagate through vegetative means.

It is anticipated that the development will have a low level of impact on the conservation status of the vegetation type and the ecological functioning of the ecosystem. The reason for the latter is because of the low significance of the current state of the vegetation found on the site. It is further recommended that the excavation and construction be restricted to the footprint in order to preserve the surrounding natural areas that might still be intact.

Due to land availability and service connections, the proposed site is the only site that has been identified for establishing a township during the consultation process with the Local Municipality. Therefore, no alternative site has been identified or considered during this study.

The proposed construction of the proposed township development will transform the existing surface vegetation inside the development footprint as most to all vegetation within the project footprint will be cleared during the construction phase. The surface hardness and roughness of the footprint will also be changed due to vegetation removal, possible compaction, paving of surfaces and excavation on the premises.

The area is modified and degraded by the disruption in natural vegetation composition, structure and ecosystem functioning due to previous activities, soil compaction and clearance of vegetation. A loss of natural habitat, biota and basic ecosystem functions has occurred. The latter because of the fact that the area is degraded as well as partly invaded by invasive species. However, the development will add to the cumulative disturbance to the ecosystem structure and function, caused by the previous disturbance on the proposed site. The latter because of the fact that most vegetation will be cleared and construction of a human settlement will take place.

The area is not ecologically important and sensitive at any scale. Biodiversity is usually ubiquitous and not sensitive to flow and habitat modifications. It is classified as a Degraded Area although the vegetation type (when in pristine condition) is classified as Endangered. At a local scale the site is

degraded and poses very little significance ecologically. No species of conservation concern were found present or are likely expected to be present. The property is surrounded by transformed land cover, mainly housing and previous agricultural activities, making recovery to a functional and representative ecosystem unlikely and very slow.

This section is not of high conservational significance for habitat preservation or ecological functionality persistence in support of the surrounding ecosystem or broader vegetation type.

8.4. Wetlands on site:

The sensitivity map indicated two (2) NFEPA wetland areas to be present on site (Figure 4). The National Wetland map5 (NWM5) and Free State Wetland Probability map data were used in determining the wetland areas during the desktop study. However, an additional artificial watercourse (Artificial watercourse 2) was identified during the site visit. The latter falls outside the scope area of the project (Figure 1).

8.5. Fauna evaluation and found on site:

No fauna other than *Suricata suricatta* (meerkat) was found at the site. Evaluating the area showed signs of animals present (manure and footprints). The latter mainly refer to introduced animals grazing on the premises.

Table 6 Bird of conservation concern known from the QDS 2926AB, records from 1980 to present from ADU (2019a; 2019b).

Family	Scientific name	Common name	No. of Records	Last recorded	SA Endemic	Redlist category
Alcedinidae	*Alcedo cristata*	Malachite Kingfisher	1	2016-04-24	No	Least Concern
Anatidae	*Anas capensis*	Cape Teal	1	2018-07-10	No	Least Concern
Anatidae	*Anas undulata*	Yellow-billed Duck	1	2015-12-12	No	Least Concern
Ardeidae	*Bubulcus ibis*	Cattle egret	1	2019-01-01	No	Least Concern
Charadriidae	*Charadrius tricollaris*	Three-banded Plover	1	2016-04-24	No	Least Concern
Cisticolidae	*Cisticola tinniens*	Levaillant's (Tinkling) Cisticola	1	2016-04-23	No	Least Concern
Cuculidae	*Chrysococcyx caprius*	Dideric (Diederik) Cuckoo	1	2015-12-12	No	Least Concern
Estrildidae	*Amandava subflava*	Orange-breasted (Zebra) Waxbill	1	2007-02-24	No	Least Concern
Estrildidae	*Estrilda astrild*	Common Waxbill	1	2016-04-24	No	Least Concern

Hirundinidae	*Hirundo albigularis*	White-throated Swallow	1	2009-03-21	No	Least Concern
Hirundinidae	*Ptyonoprogne fuligula*	Rock Martin	1	2014-09-18	No	Least Concern
Hirundinidae	*Riparia paludicola*	Brown-throated (Plain) Martin	2	2010-02-13	No	Least Concern
Jacanidae	*Actophilornis africanus*	African Jacana	1	2018-07-10	No	Least Concern
Motacillidae	*Anthus cinnamomeus*	African (Grassveld/Grassland) Pipit	1	2007-08-01	No	Least Concern
Motacillidae	*Motacilla capensis*	Cape Wagtail	1	2009-03-21	No	Least Concern
Muscicapidae	*Saxicola torquatus*	African (Common) Stonechat	3	2018-07-10	No	Least Concern
Phoenicopteridae	*Phoenicopterus roseus*	Greater Flamingo	1	2016-07-28	No	Least Concern
Ploceidae	*Euplectes orix*	Southern Red (Red) Bishop	1	2016-04-23	No	Least Concern
Ploceidae	*Plocepasser mahali*	White-browed Sparrow-Weaver	6	2016-10-08	No	Least Concern
Ploceidae	*Ploceus velatus*	Southern Masked Weaver	5	2016-04-24	No	Least Concern
Pycnonotidae	*Pycnonotus nigricans*	African Red-eyed Bulbul	1	2016-04-23	No	Least Concern
Rallidae	*Fulica cristata*	Red-knobbed Coot	1	2015-12-14	No	Least Concern
Rallidae	*Gallinula chloropus*	Common Moorhen	2	2015-12-14	No	Least Concern
Rhinopomastidae	*Rhinopomastus cyanomelas*	Common Scimitarbill	1	2009-03-21	No	Least Concern
Scolopacidae	*Phalaropus fulicaria*	Red (Grey) Phalarope	2	2018-03-03	No	Least Concern
Scopidae	*Scopus umbretta*	Hamerkop	1	2016-04-24	No	Least Concern
Sylviidae	*Acrocephalus gracilirostris*	Lesser Swamp-(Cape Reed) Warbler	1	2016-04-24	No	Least Concern

No listed dung beetles are found (DungBeetleMAP, 2019) in the QDS. No Neoroptera, Megaloptera, butterflies nor Odonata of conservation concern are known from the QDS (LacewingMAP, 2019; OdonataMAP, 2019; LepiMAP, 2019). Insects are mobile and can relocate from the development footprint to the adjacent intact vegetation. No listed spiders or scorpions are known to occur in the area and these species are presumed to move away from the construction site due to increased disturbance (ScorpionMAP & SpiderMAP, 2019). No amphibians or reptile of conservation concern are known from the QDS (FrogMAP, 2019; ReptileMAP, 2019).

Several mammals of conservation concern are known from the QDS (MammalMAP, 2019), but due to the agricultural and transformed matrix which surrounds the property there is a lack of suitable

habitat for the species listed in Table 7. It is very unlikely that the property will provide a suitable habitat for these species. The grassland on the property can however by used by domestic animals and smaller roaming mammals, as seen from evidence of their presence, i.e. a small burrow, cow dung and small droppings.

Table 7 Mammals of conservation concern known from the QDS 2926AB, records from 1980 to present from ADU (MammalMAP, 2018).

Family	Scientific name	Common name	Red list category (Child *et al*., 2016)	Number of records	Last recorded
Bovidae	*Damaliscus lunatus lunatus*	(Southern African) Tsessebe	Vulnerable (2016)	2	-
Bovidae	*Damaliscus pygargus pygargus*	Bontebok	Vulnerable (2016)	2	-
Bovidae	*Hippotragus equinus*	Roan Antelope	Endangered (2016)	3	-
Bovidae	*Hippotragus niger niger*	Sable	Vulnerable (2016)	5	-
Equidae	*Equus zebra hartmannae*	Hartmann's Zebra	Vulnerable (2016)	1	-
Felidae	*Leptailurus serval*	Serval	Near Threatened (2016)	1	2012-01-14
Mustelidae	*Aonyx capensis*	African Clawless Otter	Near Threatened (2016)	1	2010-02-13

The property and direct surrounds has a relatively low habitat diversity. The impacts on fauna life is likely to be low because of the already degraded and surrounding areas. Grassland habitat of similar quality is available on the farm adjacent to the proposed development area.

9. Potential Impact Assessment

The following section identifies the potential ecological impacts (both positive and negative) which the proposed project might have on the environment.

Once the potential ecological impacts are identified, they are assessed by rating their Environmental Risk after which the final Environmental Significance is calculated and rated for each identified ecological impact.

The same Environmental Risk rating process is then followed for each ecological impact to determine the Environmental Significance if the recommended mitigation measures were to be implemented.

The objective of this section is therefore firstly to identify the potential ecological impacts of the proposed project and secondly to determine the significance of the impacts and how effective the recommended mitigation measures will be able to reduce their significance.

The following section provides descriptions of the potential ecological impacts which the proposed project will have as well as the recommended mitigation measures to be implemented for each impact as identified. The largest risks of the proposed development are related to the following issues, but are not limited to:

9.1. Spread and establishment of alien invasive species

Soil disturbances from construction will enhance the encroachment of alien invasive vegetation that can outcompete indigenous counterpart species for resources, displace and reduce faunal and floral biodiversity. Clearing current invasive alien species may increase the risk of spreading species if not properly removed and safely transported. Due to the fact that this area is already degraded, with no sensitive vegetation or species of conservation concern on the proposed development site, this will, not be a major point of concern, but may occur because of existing alien invasive species on the site. In instances where this might occur the following mitigation efforts should be implemented:

Mitigation:

- Alien vegetation eradication program should be developed and implemented for the site to remove alien vegetation during all operational phases.
- Follow-up clearing and monitoring should be done to detect any new invasive species establishment and spread during operation and decommissioning.
- Alien plant material removed during construction and eradication efforts should be contained and disposed of properly to limit accidental spread.
- Construction activities must be limited to the smallest possible area.
- Construction vehicles will use existing authorized service roads (where possible).
- Ongoing alien vegetation removal should take place in and around the development footprint.

9.2. Destruction of indigenous vegetation and habitat

The vegetation present on site it is not representative of the Bloemfontein Dry Grassland vegetation type as defined in the vegetation map, Figure 5 and is disturbed. However, some to most of the vegetation occurring on site will be lost/cleared during the construction of the proposed township development. In this case the following mitigation efforts should be implemented:

Mitigation:

- No construction personnel are allowed to collect, harvest or destroy any species of flora on or off the site, unless specifically earmarked for removal.
- The construction activities should be confined within the development footprint and avoid disturbing areas beyond the borders of the development footprint.

- No surrounding intact indigenous vegetation should be disturbed.
- All disturbed and compacted soils need to be ripped, reprofiled and reseeded and/or replanted with indigenous species, in cases of rehabilitation purposes.
- Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the proposed development activities.

9.3. Damage to sensitive habitats

The construction footprint is proposed to take place within the wetland areas as found on site. Except for the three identified areas, no other sensitive watercourse habitats were identified on site. No other impacts on sensitive habitats are anticipated at this point as hydrology in this area has been changed. Possibilities of other impacts may include pollution of water courses downstream as a river is located approximately 700 metres from the proposed area, flowing through the already developed township area. Pollution sources may include hazardous chemicals, waste (litter) and materials entering water runoff. Drainage lines are however present and can be seen in Figure 8. It is therefore recommended that a thorough wetland delineation and Risk Assessment study be conducted on the site to determine the proposed impact on these systems.

Mitigation:

- Water drainage should be properly planned and addressed to drain water from the site and prevent any accumulation on site.
- Stormwater management should maintain the natural flow regime as far as possible.
- Sewage should be handled in the correct manner in order to prevent leakages into any natural watercourse area.
- Proper waste management during all phases of the activity, as well as storm water management, will have to be strictly enforced and monitored. This is to prevent any litter, rubble or possible pollution to enter any watercourses downstream of the site and the surrounding environment in general.

9.4. Disturbance to fauna

The construction of the facility will result in some habitat loss for any resident fauna that may be present. Few signs of animals were observed during the site visit. Fauna observed during the site visit was *Suricata suricatta* and cattle grazing in the area. If any animals, especially burrowing animals are encountered on site, they should be removed by a trained and qualified person. Permits should be applied for should translocation of protected species take place. In addition, increased levels of noise, pollution, disturbance and human presence during construction will be detrimental to resident fauna. Sensitive and shy fauna may move away from the area during the construction phase as a result of the

noise and human activities. During the operational phase (established township), interactions between the infrastructure considered here and fauna are likely to be low. Fauna will most likely avoid the area by moving around the proposed infrastructure. With a large increased human activity as soon as the construction starts it is anticipated that fauna will move away from the proposed footprint area.

Mitigation:

- No construction personnel are allowed to collect, harvest or kill any species of fauna on the site.
- Holes and trenches should not be left open for extended periods of time and should only be dug when immediately needed. Trenches left open for some days, should have escape ramps present at regular intervals to allow any fauna that fall in to escape.
- Keep the facility neat, tidy and clean.
- It is expected that any small mammals that occurred on the property before construction commenced would have moved from the area. Should any animals return to the property once the township is in operation, care should be taken not to disturb any animals.
- It must be ensured that no alien invasive animals or birds are introduced into the area. Should any accidental introductions occur, the species must be controlled in the correct environmentally friendly manner.
- Keep the facility neat, tidy and clean in order not to attract scavenging animals such as rats and mice.

9.5. Soil Erosion:

Areas within and around the project footprint could potentially be prone to surface soil erosion, but the soil has a relatively low erosion potential. In the current degraded state, the proposed area are relatively bare while some patches are bare and therefore the risk is relatively low considering the slope and soil erodibility. No signs of erosion were found on site.

Mitigation:

- Implement suitable erosion prevention measures during the construction, operation and decommissioning phase.
- Make use of surface erosion measures within disturbed areas to avoid erosion in times of high risk (e.g. rain season and time of high wind speeds).
- Stormwater management along any roadways and paths to reduce gulley erosion formation.
- Stormwater management should prevent excessive sediment to be carried into any watercourses.
- Soil disturbance must be kept to a minimum within and around the development footprint.

- Freedom of surface water drainage through placing culvert drains beneath the roadway in a way that disperses the water over the entire width of the area will reduce the impacts of erosion through limiting water velocities and the scouring potential associated to high-velocity water.
- Correct site reinstatement and landscaping following any disturbances will abate channel and gulley formation.
- Removal of debris and other obstructing materials from the site must take place and erosion preventing structures must be constructed. This is done to prevent damming of water and increasing flooding danger.
- Soil erosion must be controlled as an ongoing management strategy throughout the various phases of the proposed development activities.
- Disturbed areas, that will not form part of the operational footprint but which were disturbed as part of the construction activities, should be rehabilitated and re-vegetated using site-appropriate indigenous vegetation and/or seed mixes.
- Sheet runoff from cleared areas, paved surfaces and access roads needs to be curtailed; such as planting grass or capturing water in stormwater channels and slowing it down in retention ponds or increasing surface roughness.
- Point-source discharges (such as road drains) should be dispersed to avoid the formation of gullies.
- Point-source discharges, such as road drains, cause gullies and should be dispersed by using attenuation ponds.

9.6. Dust generation and emissions

The current bare soil of the project area could potentially result in dust emissions. Dust could spread into the surrounding areas. The significance of this potential impact will likely however be medium to high and should be monitored. Emissions from the proposed township development are unlikely to take place, but if present it can have an impact on local wildlife in surrounding areas and the ecosystem if not properly monitored. This impact, if present, will have to be included in the EIA application.

Mitigation:

- Implement suitable dust management and prevention measures during the construction phase.
- Areas around the project footprint must be adequately rehabilitated to prevent significant dust emissions.
- It is recommended that all bare soil, after construction activities, be planted with indigenous grass where possible.
- All regulations should be strictly followed in terms of emission regulations.

9.7. Water quality and quantity

The area is at relatively low risk of groundwater pollution. It is anticipated that municipal water will be used. If borehole water will be used the quality must be sampled quarterly (or as deemed fit by a water specialist) and surface water quality be evaluated annually (or as surface water is available) up and downstream of the property, as pollution from the proposed site may affect the downstream river in the already existing township.

Mitigation:

- Provision of adequate on-site sewerage management.
- Appoint water specialist to monitor groundwater usage and water quality, as well as surface water (if applicable).
- Sewerage and sanitation facilities should be regularly maintained and checked.
- Sufficient waste receptacles should be placed around the development in order to encourage people to use them.
- The principle of reduce, re-use and recycle should be followed.
- Site should be kept clean and tidy during all phases of activity.
- Any waste should be disposed in a registered landfall and not be allowed to be dumped in the surrounding landscape.
- All surfaces used for waste storage and loading areas should have an impermeable surface.
- Avoid the use of concrete lined channels for storm water management as this can increase the speed of water. This in turn increases erosion potential that can cause erosion on site and in channels and increase siltation downstream. If concrete-lined channels are used; they should end in silt traps.
- Structures must be inspected regularly for the accumulation of debris, blockages, instabilities and erosion with concomitant remedial and maintenance actions.
- Regular inspections will be undertaken of any access roads and stormwater management drains for signs of erosion and sedimentation.
- Regularly inspect all vehicles for leaks (during construction). Re-fueling of vehicles (if any) must take place on a sealed surface area surrounded by berms to prevent ingress of hydrocarbons into topsoil.
- No dumping of waste or any other materials is allowed within any stormwater channel or watercourses.
- If any spills occur, they should be immediately cleaned up.
- Stormwater and run-off should be managed and diverted to not be in contact with waste.

- No dirty water runoff from the construction, operational and decommissioning site must be permitted to reach any watercourse.
- Spill kits must be stored on site: In case of accidental spills of oil, petroleum products etc., good oil absorbent materials must be on hand to allow for the quick remediation of the spill. The kits should also be well marked and all personnel should be educated to deal with the spill. Vehicles must be kept in good working order and leaks must be fixed immediately on an oil absorbent mat. The use of a product such as Sunsorb is advised.
- Removed soil and stockpiling of soil must occur outside the extent of watercourses, stormwater channels and water affected areas to prevent siltation and increased runoff.
- Proper toilet facilities must be available during the operational and decommissioning phase. The impact of human waste on the system is immense. Chemical toilets must be provided during construction and should always be well serviced and spaced as per occupational health and safety laws, and placed outside the 1:100 year flood lines.

9.8. Surface- and groundwater contamination

If any organic waste or contaminated waste water enter surface-or ground water it can lead to nutrient build-up in the water with negative impacts on the water quality and the aquatic ecosystem (Gerber et. al, 2007).

Mitigation measures to reduce potential impacts:

- Proposed township and adjacent area should be kept clean and tidy.
- Any waste should be disposed in a registered landfall and not be allowed to be dumped in the surrounding landscape.
- All waste handling or storage surfaces in the facility should have an impermeable surface.
- Storm water and run-off should be managed and diverted to not be in contact with waste.

9.9. Positive impact of rehabilitating development footprint

Once the operation is decommissioned a positive impact on the environment is possible if the site is suitably rehabilitated and restored to host a structure, composition and ecological functioning similar to the applicable vegetation type. It should be noted that the development is not planned to be decommissioned, however, the areas possible for rehabilitation and landscaping should be rehabilitated accordingly.

Mitigation:

- On completion of a section of works, the area must be rehabilitated by suitable landscaping, levelling, topsoil dressing, land preparation, alien plant eradication and where ascribed for by the ECO, vegetation establishment (where needed);
- Clear and completely remove from site all construction structures and temporary infrastructure;
- All permanent infrastructure must be returned to a useable state;
- Remove all inert waste and rubble, such as excess rock, any structural foundations and remaining aggregates. Only once this material has been removed, the site shall be re-instated and rehabilitated;
- The reinstatement of disturbed areas must follow immediately after the removal of structures and temporary infrastructure;
- Topsoil backfilling must be undertaken when the soil is dry, and not following any recent rainfall events;
- The replacement of topsoil should be sought in situ with construction where possible, or as soon as construction in an area has been completed;
- Topsoil must be returned to the same site from where it was stripped;
- When insufficient topsoil remains, soil of a similar quality can be obtained from a nearby area within the construction area which was disturbed;
- Once topsoil has been returned to the ground, stripped vegetation should be randomly spread over the area;
- All re-growth of invasive vegetative material will be monitored by the Developer for one year;
- All areas under rehabilitation are to be treated as no-go areas using danger tape and steel droppers/fencing and cordoned off, to prevent vehicular, pedestrian and livestock access;
- A systematic rehabilitation programme must be undertaken to restore the development footprint to its condition prior to the commencement of the activity;
- All areas of disturbed and compacted soils need to be ripped, reprofiled and reseeded and/or replanted with indigenous species;
- Active alien invasive plant control measures must be implemented to prevent invasion by exotic and alien vegetation within the disturbed area;
- Rehabilitation structures must be inspected regularly for the accumulation of debris, blockages, instabilities and erosion with concomitant remedial and maintenance actions.

9.10. Waste handling and pollution prevention

Proper waste management during construction and operation, as well as storm water management, should be strictly enforced and monitored.

- Provide adequate waste bins on-site equipped with a lid to ensure no pollution;
- General waste must be collected in containers disposed of weekly at the nearest permitted Municipal landfill site;
- Recyclable waste must be recovered for recycling purposes;
- Scrap metals and materials should be stored in a stockpile on an impervious surface where water from rain, sprinklers or surface drainage cannot be in contact with it;
- All domestic waste is to be removed from site and disposed of at a registered solid waste landfill site; as to be mentioned in the EIA Report;
- Hazardous waste quantities my not exceed the thresholds as prescribed in the National Environmental Management: Waste Act, List of Waste Management Activities that have, or are likely to have, a Detrimental Effect on the Environment, GN 921 in Government Gazette 37083 dated 29 November 2013. Commencement date: 29 November 2013 (Repealed GN 718);
- All hazardous substances must be stored on an impermeable surface and away from any stormwater drainage; and,
- Storm water handling must be done in order to prevent erosion.

9.11. Cumulative Impact Assessment

The area is disturbed by previous activities on the proposed site. The proposed project will not fragment habitats, and is located within an urban area adjacent to existing townships. In relation to the existing landscape transformation, the negative impact that the project will cumulatively add to habitat preservation or ecological functionality persistence of the broader area will be low.

10.Risk Ratings of Potential Impact Assessment

The following section provides the Environmental Risk as well as the Environmental Significance Ratings for the potential ecological impacts for the proposed project both before and after implementation of the recommended mitigation measures.

Table 8 – Risk ratings and potential Impact Assessment.

Project alternative	Potential environ-mental impact/ Nature of impact	Environmental significance																	
		Before mitigation									After mitigation								
		Magnitude	Duration	Extent	Irreplaceability	Reversibility	Probability	Total (SP)	Significances	Cumulative	Magnitude	Duration	Extent	Irreplaceability	Reversibility	Probability	Total (SP)	Significance	Cumulative
Project activity	Construction phase																		
Proposed Township development	Spread and establishment of alien invasive species	6	4	1	2	2	4	**60**	Medium	Low	2	3	1	0	1	2	**14**	Low	Low
	Waste handling and pollution prevention	6	3	2	2	2	3	**45**	Medium		4	2	2	2	1	2	**22**	Low	Low
	Destruction of indigenous vegetation and habitat	2	2	1	2	2	3	**27**	Low	Low	2	2	1	1	1	2	**14**	Low	Low
	Disturbance to fauna	4	4	2	2	2	2	**28**	Low	Low	2	3	1	1	2	1	**9**	Low	Low
	Damage to sensitive habitats	4	3	2	3	3	2	**30**	Low	Low	2	2	1	1	2	1	**8**	Low	Low
	Soil erosion	4	3	2	2	2	3	**39**	Low	Low	2	2	1	1	2	2	**16**	Low	Low
	Water quality and quantity	6	3	2	3	2	3	**48**	Medium	Low	2	2	2	2	2	1	**10**	Low	Low
	Surface and groundwater contamination	4	3	3	2	3	2	**30**	Low	Low	2	3	2	2	2	1	**11**	Low	Low
	Dust generation and emissions	6	2	2	2	4	4	**64**	Medium	Low	2	1	1	1	2	3	**21**	Low	Low

Project alternative	Potential environ-mental impact/ Nature of impact	Environmental significance																	
		Before mitigation									After mitigation								
		Magnitude	Duration	Extent	Irreplaceability	Reversibility	Probability	Total (SP)	Significances	Cumulative	Magnitude	Duration	Extent	Irreplaceability	Reversibility	Probability	Total (SP)	Significance	Cumulative
	Operational phase																		
	Soil erosion	4	3	1	1	2	3	**33**	Low	Low	2	2	1	1	2	2	**16**	Low	Low
	Waste handling and pollution prevention	4	3	3	2	2	3	**42**	Medium	Low	2	2	1	1	2	2	**16**	Low	Low
	Spread and establishment of alien invasive species	4	4	1	2	2	3	**39**	Low	Low	0	1	1	0	0	1	**2**	Low	Low
	Destruction of indigenous vegetation and habitat	2	2	1	1	1	3	**21**	Low	Low	2	1	1	1	1	2	**12**	Low	Low
	Damage to sensitive habitats	4	3	2	2	2	9	**39**	Low	Low	2	2	2	2	1	1	**9**	Low	Low
	Disturbance to fauna	4	2	2	2	2	2	**24**	Low	Low	2	2	2	2	1	1	**9**	Low	Low
	Dust generation and emissions	6	2	3	3	3	3	**51**	Medium	Low	4	1	2	2	2	2	**22**	Low	Low
	Water quality and quantity	6	3	3	2	3	2	**34**	Low	Low	2	3	2	2	2	2	**22**	Low	Low
	Surface and groundwater contamination	4	3	3	2	2	2	**28**	Low	Low	2	2	2	1	1	1	**8**	Low	Low

Project alternative	Potential environ-mental impact/ Nature of impact	Environmental significance																	
		Before mitigation									After mitigation								
		Magnitude	Duration	Extent	Irreplaceability	Reversibility	Probability	Total (SP)	Significances	Cumulative	Magnitude	Duration	Extent	Irreplaceability	Reversibility	Probability	Total (SP)	Significance	Cumulative
	Decommission phase																		
	Soil erosion	4	3	2	2	2	3	**39**	Low	Low	2	2	1	1	2	2	**16**	Low	Low
	Spread and establishment of alien invasive species	4	4	1	2	2	3	**39**	Low	Low	0	1	1	0	0	1	**2**	Low	Low
	Disturbance to fauna	4	3	1	1	2	2	**22**	Low	Low	2	2	1	1	2	1	**8**	Low	Low
	Destruction of indigenous vegetation and habitat	2	3	1	1	1	3	**24**	Low	Low	2	2	1	1	1	1	**7**	Low	Low
	Damage to sensitive habitats	4	3	1	2	2	2	**24**	Low	Low	0	1	0	0	1	1	**2**	Low	Low
	Dust generation and emissions	4	1	2	2	3	3	**36**	Low	Low	2	1	1	1	3	2	**16**	Low	Low
	Water quality and quantity	4	3	2	2	2	2	**26**	Low	Low	2	2	2	2	1	1	**9**	Low	Low
	Surface and groundwater contamination	4	3	2	2	2	2	**26**	Low	Low	2	2	2	2	1	1	**9**	Low	Low
	Waste handling and pollution prevention	4	3	3	2	2	3	**42**	Medium	Medium	4	2	2	1	1	2	**20**	Low	Low

Project alternative	Potential environ-mental impact/ Nature of impact	Environmental significance																	
		Before mitigation									After mitigation								
		Magnitude	Duration	Extent	Irreplaceability	Reversibility	Probability	Total (SP)	Significances	Cumulative	Magnitude	Duration	Extent	Irreplaceability	Reversibility	Probability	Total (SP)	Significance	Cumulative
	Positive impact of rehabilitating development footprint	4	4	2	0	2	3	**36 (+)**	Low	Low	-	-	-	-	-	-	NA	NA	NA

11. Monitoring

- The contractor appointed for construction must be contractually bound to the requirements and mitigating measures listed in this document and any other documents relating to the construction (ecological management plan, rehabilitation plan, other specialist studies done etc.). It should be insured that monitoring is done on waste and pollution control.
- An Environmental Control Officer (ECO) must be appointed to ensure compliance with the requirements during the construction- and decommission phase.
- An Ecological Management Plan (EcoMP) for the site should be compiled to address: Alien vegetation control and monitoring and Erosion monitoring and control. As the impact seems to be low, this may however just be a method statement for the constractor during the construction phase.
- Frequent inspection of the site must be done to ensure that no harmful practices occur.
- A photo collection must be taken from fixed demarcated spots to detect changes in the construction area over time. These photographs must be dated and should include the entire site.
- Regular inspection of erosion preventing devices is needed and any new erosion gullies must be remediated immediately.
- Access routes should be demarcated and located properly so that no damage to the system can occur. These roads must be adhered to at all times.
- Storm water leaving the site downstream must be clean and of the same quality as in situ before it enters the construction site (upstream). Preconstruction measures must be in place to ensure sediments are trapped.

- The risk of contamination is however low in this environment provided that chemical spills and oil leaks are closely monitored during construction and decommissioning phases.
- Stormwater management should be closely monitored and any water diversions around construction site and development should be inspected for signs of erosion and sedimentation.
- The flow paths will periodically need to be desilted to ensure that the flow depth is maintained and large vegetation growth removed to prevent the flow paths from becoming blocked.
- Copies of all designs, method statements, risk assessments, rehabilitation plans and any other reports required must be stored and made available to the responsible authorities on request.

12. Recommendations

The proposed area has been subjected to degradation and destruction while alien invasive species establishment took place. There are several pioneer, indigenous, herbaceous, weedy, trees and alien invasive species found in the footprint area. The alien invasive species will spread and re-emerge continually if not controlled and removed in a proper manner.

Although relatively flat, a slight slope is present which may cause water accumulating on site, as found in one natural wetland and two artificial wetland areas. The water accumulates in the artificial wetland areas because of manmade dam walls present at these areas (Appendix 2). Slopes in different directions are present while the netto slope leads to the river situated roughly 700m from artificial watercourse 1. It is advised with construction of the proposed township development that a stormwater management plan and draining should be implemented to properly drain run-off water. A thorough Wetland Delineation study as well as a Risk Matrix must be considered in order to determine if downstream water courses may be effected by any possible pollution that occurs on site and to determine to what extent wetland areas will be influenced. In this study it should be determined what the present ecological status (PES), Ecological Importance and Sensitivity (EIS) and contribution to ecological are. Management measures should be recommended in order to mitigate the effect of construction on these sensitive areas as thorough as possible.

There are various plant species found in the footprint area. Of these species, none was found to be of conservation concern (red data species). It is unlikely that any species of conservation concern will occur on site. Regardless, it is still suggested that a botanical walkthrough be conducted before construction commences, to detect any flowering species that might have been missed before.

13. Conclusion

The site currently contributes relatively low value to the ecological functioning of the area due to the degraded state of the site. The overall footprint of the proposed facility is not likely to generate a significant impact on broad scale ecological processes or landscape connectivity, on condition that all mitigation measures are followed. The latter is due to the surrounding and past activities that resulted in degradation of the site area. If mitigation measures are implemented, the likelihood of significant ecological impacts occurring on the ecosystem will be reduced to low levels. Any risk of pollution due to inappropriate disposal of waste and litter must be mitigated to an acceptable level through the appropriate waste management and ensuring that no runoff or contaminated effluent from the construction site or development enters the environment. No important species (fauna and flora) of conservation concern was found during the site visit. It is also unlikely for any endangered or red list species to occur on the site area. Because of the degradation present on the site and surrounding areas, most of the fauna already moved away.

Overall, the impacts associated with the development are likely to be mainly low to medium and there are no anticipated impacts of high significance. All the impacts can however, be mitigated to low levels. Consequently, it is suggested that the proposed project to continue, if all recommended mitigation measures as per this ecological report and further specialist studies are adequately implemented and managed during the construction phase, operational- and decommission phases of the proposed project. All necessary authorisations and permits must also be obtained prior to any commencement.

Based on this report no significant impacts on the ecology on the proposed construction area was anticipated, and construction can therefore take place from an ecological perspective.

14.References

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15.Appendix 1 – Photos of the proposed site

Figure A1.1 - Northern view of the proposed site

Figure A1.2 – North western view of the proposed site

Figure A1.3 - Western view of the proposed site

Figure A1.4 – South western view of the proposed site

Figure A1.5 - Southern view of the proposed site

Figure A1.6 – South eastern view of the proposed site

Figure A1.7 - Eastern view of the proposed site

Figure A1.8 – North eastern view of the proposed site

16.Appendix 2 – Wetland-and degraded areas as found on site

Figure A2.1 - Wetland area #1 as found on proposed site

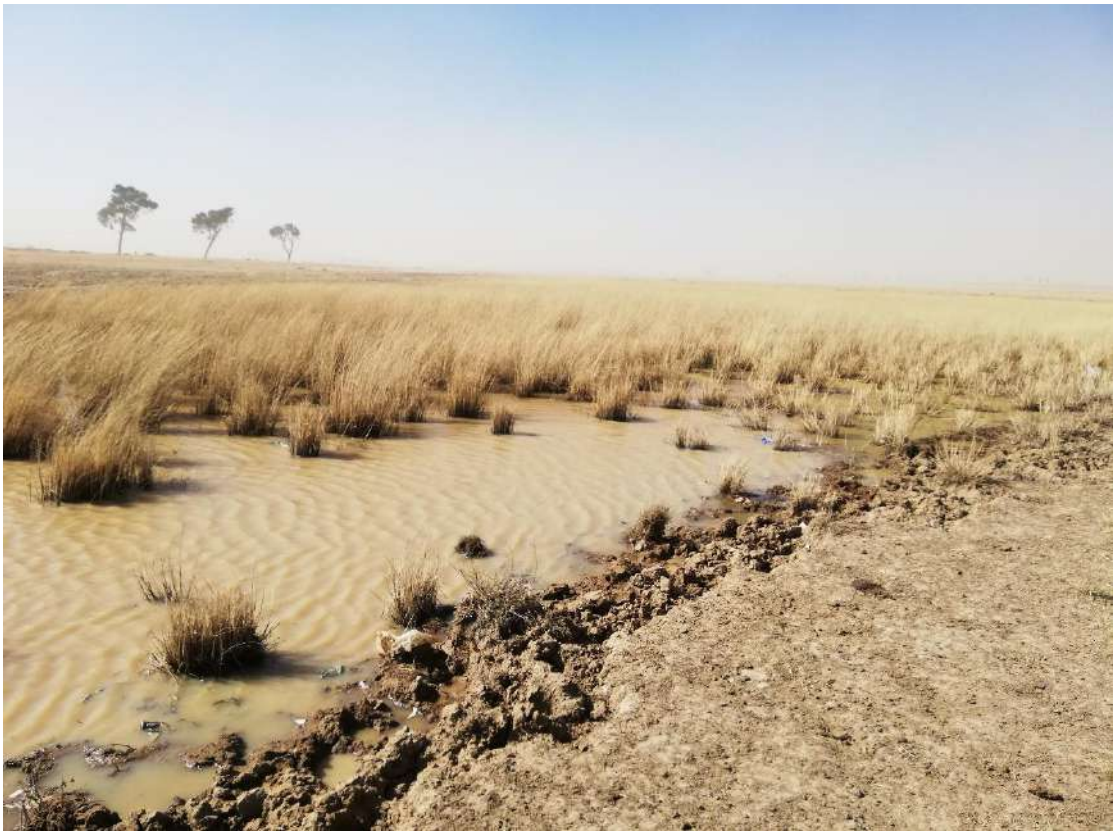

Figure A2.2 - Wetland area #1 as found on proposed site

Figure A2.3 - Wetland area #1 as found on proposed site

Figure A2.4 - Wetland area #1 as found on proposed site

Figure A2.5 - Wetland area #2 (artificial watercourse 1) as found on proposed site

Figure A2.6 - Wetland area #2 (artificial watercourse 1) as found on proposed site

Figure A2.7 - Wetland area #2 (artificial watercourse 1) as found on proposed site

Figure A2.8 - Wetland area #2 (artificial watercourse 1) as found on proposed site

Figure A2.9 - Wetland area #3 (Artificial watercourse 2) as found on proposed site

Figure A2.10 - Wetland area #3 (Artificial watercourse 2) as found on proposed site

Figure A2.11 - Wetland area #3 (Artificial watercourse 2) as found on proposed site

Figure A2.12 – Illegal dumping area as found on the proposed site

Figure A2.13 - Degraded area as found on proposed site

Figure A2.14 - Degraded area as found on proposed site

Figure A2.15 - Degraded area as found on proposed site

APPENDIX D2: FLOODLINE REPORT

CIVILCONSULT
Consulting Engineers

MANGAUNG METROPOLITAN MUNICIPALITY

TOWNSHIP ESTABLISHMENT ON A PORTION OF THE FARM KLIPFONTEIN 716 AND THE FARM CERES 626, BLOEMFONTEIN

FLOOD LINE ANALYSIS AND DETERMINATION REPORT

PROJECT NO. 2698

AUGUST 2019

MANGAUNG METROPOLITAN MUNICIPALITY

TOWNSHIP ESTABLISHMENT ON A PORTION OF THE FARM KLIPFONTEIN 716 AND THE FARM CERES 626, BLOEMFONTEIN

FLOOD LINE ANALYSIS AND DETERMINATION REPORT

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MANGAUNG METROPOLITAN MUNICIPALITY : TOWNSHIP ESTABLISHMENT ON A PORTION OF THE FARM KLIPFONTEIN 716 AND THE FARM CERES 626, BLOEMFONTEIN : FLOOD LINE ANALYSIS AND DETERMINATION REPORT

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MANGAUNG METROPOLITAN MUNICIPALITY : TOWNSHIP ESTABLISHMENT ON A PORTION OF THE FARM KLIPFONTEIN 716 AND THE FARM CERES 626, BLOEMFONTEIN : FLOOD LINE ANALYSIS AND DETERMINATION REPORT

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MANGAUNG METROPOLITAN MUNICIPALITY : TOWNSHIP ESTABLISHMENT ON A PORTION OF THE FARM KLIPFONTEIN 716 AND THE FARM CERES 626, BLOEMFONTEIN : FLOOD LINE ANALYSIS AND DETERMINATION REPORT

1. INTRODUCTION

CIVILCONSULT Projects (Pty) Ltd was appointed by NGOTI Development Consultants to determine the 1:50 and 1:100-year flood lines and to compile a Flood Line Analysis and Determination Report for the Township Establishment on a Portion of the Farm Klipfontein 716 and the Farm Ceres 626, Bloemfontein.

For the purposes of this report we will refer to the Township Establishment on a Portion of the Farm Klipfontein 716 and the Farm Ceres 626, Bloemfontein as the Proposed Development.

2. PROFESSIONAL TEAM

The professional team is as follows :

Professional Discipline	Name of Entity	Contact Person(s)
Client	NGOTI Development Consultants	Fumani Mathebula
Topographical Survey	CIVILCONSULT Projects (Pty) Ltd	Eben Terblanche / Ruan Beukes
Civil Engineers (Flood Lines)	CIVILCONSULT Projects (Pty) Ltd	Eben Terblanche

3. LOCATION OF THE DEVELOPMENT AND WATERCOURSE

The Proposed Development is located on a Portion of the Farm Klipfontein 716 and the Farm Ceres 626 in Bloemfontein, Free State Province.

The Proposed Development is bounded by the Provincial Road R702 to the north-west. Portion 4, 5 and 2 of the Farm Klipfontein 716 forms the north-eastern boundary of the Proposed Development. The southern boundary is formed by the Farm Ravenswood 1611 and the south-western boundary is formed by the Remainder of the Farm Klipfontein 716.

A tributary to the Renosterspruit originates inside the Proposed Development and the flood lines of this watercourse was determined.

Refer to Annexure A, Drawing No. 2698/100/01/00 for a Locality Plan of the Proposed Development.

4. CATCHMENT AREAS

One (1) catchment area was identified for the Proposed Development i.e. Catchment Area 1.

Catchment Area 1 consists of the catchment area of the tributary of the Renosterspruit upstream of the Proposed Development.

The total catchment area is approximately 23.951km^2 and forms part of the Quaternary Drainage Region C52F as indicated by the Department of Water and Sanitation (DWS).

The catchment originates to the south and south-west of the Proposed Development. The catchment area consists of undisturbed natural bush, grasslands and farm and agricultural portions.

There is a low-cost housing development and informal settlements located to the north-west of the Proposed Development.

The undisturbed areas will be developed in future and the development of the existing rural area is expected.

The catchment slopes vary typically from 1% to 5%.

Refer to Annexure B, Drawing No. 2698/101/01/00 and 2698/101/02/00 indicating the catchment area upstream of the Proposed Development.

5. CALCULATION OF FLOOD PEAKS

5.1 General

The impact of the flood lines of the tributary of the Renosterspruit on the Proposed Development was determined and a section of the tributary to the Renosterspruit was analysed for this purpose.

The criteria used to determine the flood peaks, are shown in Table 5.1 below.

Table 5.1 : Data for Catchment Areas

Name of Watercourse	Catchment Area No.	Size (km^2)
Tributary of the Renosterspruit	1	± 23.951km^2

5.2 Hydrological Data and Flood Peaks

The software used to determine the flood peaks are the Utility Programs for Drainage Version 1.0.2 by Sinotech.

The criteria used to determine the flood peaks, are shown in Tables 5.2.1 and 5.2.2 below.

Table 5.2.1 : Hydrological Data of Catchment Area 1

Item No.	Determination Element	Criteria
1.	Methods	Alternative Rational, Unit Hydrograph, SDF and Empirical
2.	Quaternary Drainage Region (DWS)	C52F
3.	Catchment area of the tributary to the Renosterspruit	± 23.951km^2
4.	Length of longest watercourse	± 6.512km
5.	Mean Annual Rainfall	561mm
6.	Flood Return Period	1:50 and 1:100 year
7.	Value of C Factor	0.432
8.	Total Height Difference along longest watercourse	27m
9.	Height Difference along 10 – 85 Slope	22m
10.	SDF Basin Number	9
11.	Rainfall Region	Inland

Table 5.2.2 : Calculated Flood Peaks of the tributary of the Renosterspruit

Method	Flood Peaks (1:50 years)	Flood Peaks (1:100 years)
Alternative Rational	110.32m³/s	130.00m³/s
Unit Hydrograph	85.22m³/s	115.32m³/s
SDF	154.71m³/s	195.92m³/s
Empirical	81.28m³/s	102.67m³/s

The SDF Method was used for the flood line analysis.

Refer to Annexure C for the calculation sheets of the flood peaks.

6. DETERMINATION OF FLOOD LINES

6.1 Software

The software used to determine the flood lines are Autodesk Civil 3D 2019 and HEC-Ras Watercourse Analysis Programs.

6.2 Description of Flood Plain adjacent to the Proposed Development

The flood plain of the tributary of the Renosterspruit consists of the following :

- natural bush
- grassland
- agricultural lands
- low cost housing developments and informal settlements
- an earth embankment dam located in the tributary to the Renosterspruit

An earth embankment dam is located in the north-eastern corner of the Proposed Development in the tributary to the Renosterspruit but has no formal spillway.

The 1:50 and 1:100-year flood lines will overtop this earth embankment dam.

Refer to Annexure D, Drawing No. 2698/120/01/00, 2698/121/01/00, 2698/121/02/00 and 2698/121/03/00 for details and the indication of the 1:50 and 1:100-year flood lines.

6.3 Technical Data Used to Determine the Flood Lines

The criteria used to determine the flood lines, are shown in Table 6.3 below.

Table 6.3 : Technical Data Used to Determine Flood Lines for the tributary to the Renosterspruit

Item No.	Determination Element	Criteria
1.	Cross Section Spacing	20m
2.	Cross Section Width	1000m
3.	Number of Cross Sections for the tributary to the Renosterspruit	186
4.	Flow Regime / Profile Type	Mixed
5.	Manning's 'n Value along River Banks	0.045
6.	Manning's 'n Value along River Centreline	0.035
7.	Type of Analysis	Steady Flow Analysis

7. CONCLUSION

We hereby certify that the positions of the 1:50 and 1:100-year flood lines for the section of the tributary of the Renosterspruit are as indicated on Drawing No. 2698/120/01/00.

The position of the 1:50 and 1:100-year flood lines were determined based on the information discussed in this report.

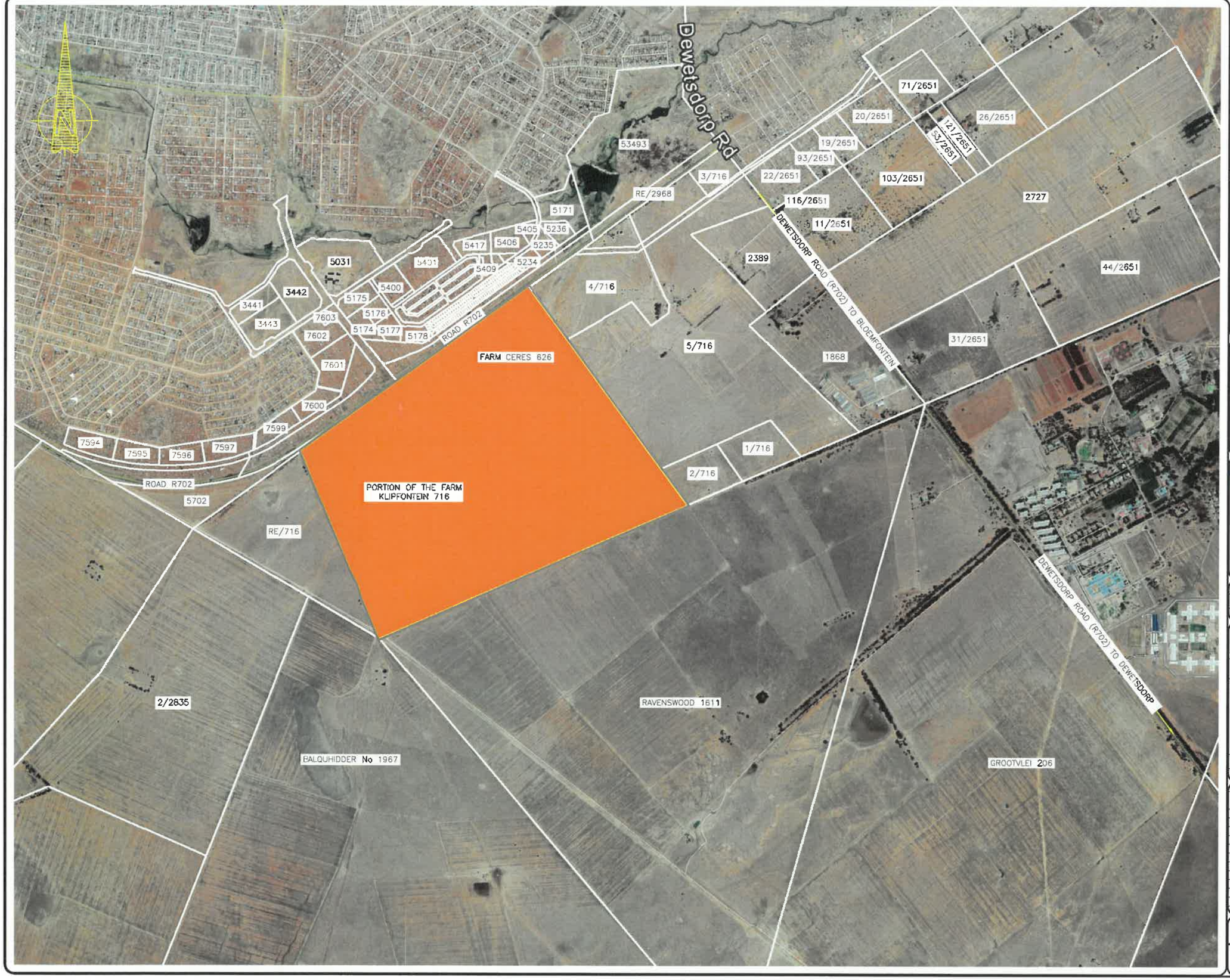
We trust that the above report meets with your requirements. Please contact us should you require any additional information.

.....
Leon Wentzel
for CIVILCONSULT Projects (Pty) Ltd

23/08/2019
.....
Date

ANNEXURE A

LOCALITY PLAN



NOTES / NOTAS

DEVELOPMENT BOUNDARY

PROPOSED DEVELOPMENT

REFERENCE / VERWYSINGS

MANGAUNG
AT THE HEART OF IT ALL

MANGAUNG METROPOLITAN MUNICIPALITY

P O Box 3704
BLOEMFONTEIN
9300

Tel. 051-405 8911
Fax 051-405 8307

CLIENT / KLIËNT

NGOTI

NGOTI DEVELOPMENT CONSULTANTS

BROADWALK OFFICE PARK
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ENGINEER / INGENIEUR	: L. WENTZEL		
DESIGN / ONTWERP	: B. TERBLANCHE	TRACED / NAGETREK	:
DRAWN / GETEKEN	: P.C. PEENS	CHECKED / NAGESIEN	:

PROJECT / PROJEK

TOWNSHIP ESTABLISHMENT ON A PORTION OF THE FARM KLIPFONTEIN 716 AND FARM CERES 626 BLOEMFONTEIN

DRAWING TITLE / TEKENINGTITEL

LOCALITY PLAN

DATE / DATUM: JULY 2019

SCALE / SKAAL: AS SHOWN

REVISION / WYSIGING

No. / Nr.	DATE / DATUM	INITIAL / VOORL.	DESCRIPTION / BESKRYWING

CC DWG. NO./CC TEK. NR.
2698/100/01/00

FILE NO./LÊER NR.

CLIENT DWG. NO./KLIËNT TEK. NR.
--

FILE NO./LÊER NR.
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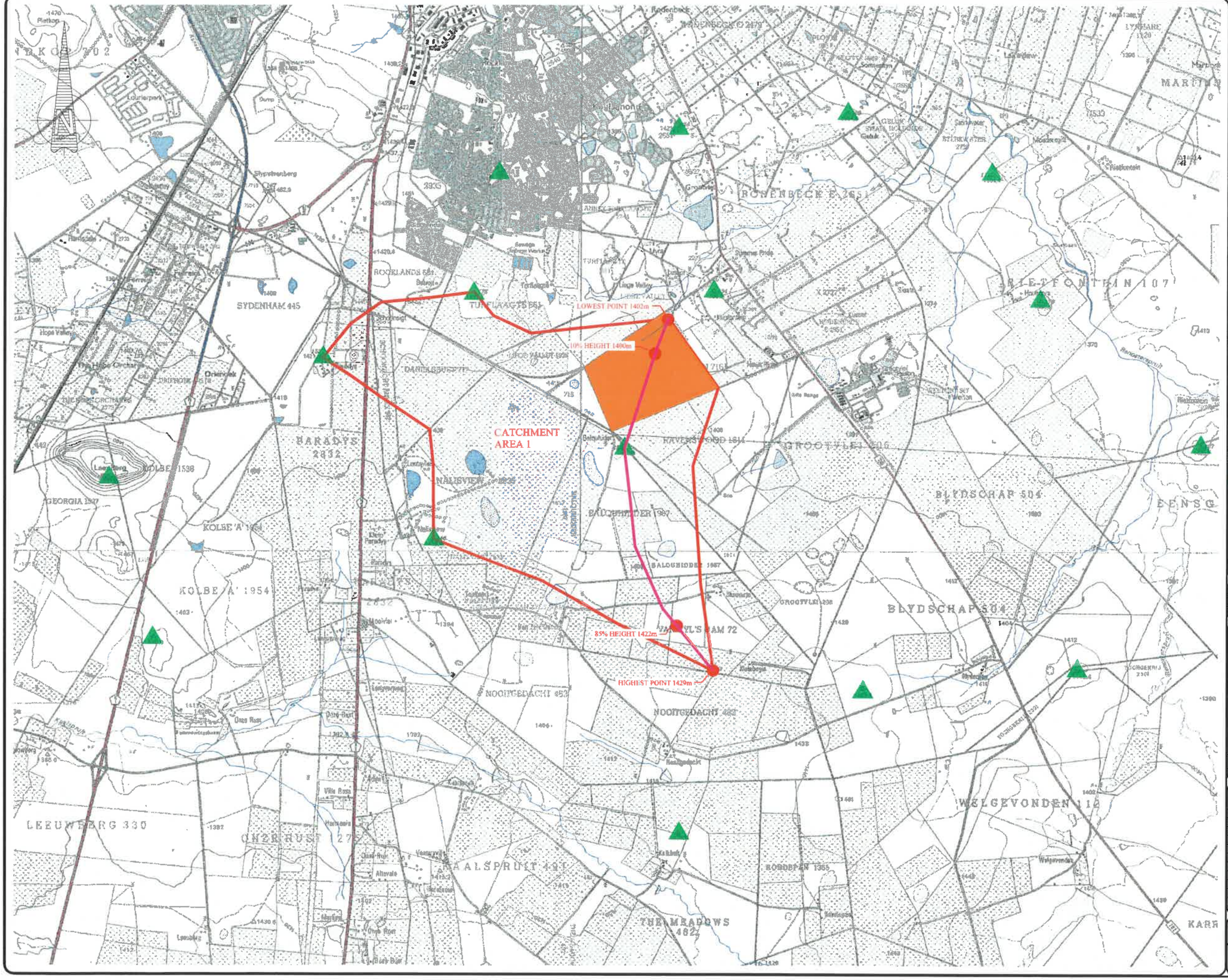
2698/100/01/00

ANNEXURE B

CATCHMENT AREA



NOTES / NOTAS

- DEVELOPMENT BOUNDARY
- EXISTING SEWER / RIOLERS
- CATCHMENT AREA
- LENGTH OF LONGEST WATERCOURSE
- PROPOSED DEVELOPMENT
- HIGH POINTS

REFERENCE / VERWYSINGS

MANGAUNG METROPOLITAN MUNICIPALITY

P O Box 3704
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9300

Tel. 051-405 8911
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ENGINEER / INGENIEUR	: G.F.J. RAS		
DESIGN / ONTWERP	: E. TERBLANCHE	TRACED / NAGETREK	:
DRAWN / TEKEN	: E.TERBLANCHE	CHECKED / NAGESIEN	:

PROJECT / PROJEK

TOWNSHIP ESTABLISHMENT ON A PORTION OF THE FARM KLIPFONTEIN 716 AND THE FARM CERES 626

DRAWING TITLE / TEKENINGTITEL

FLOODLINES:
CATCHMENT AREAS
SHEET 1 OF 2

DATE : / DATUM : AUGUST 2019
SCALE : / SKAAL : 1:30 000

REVISION / WYSIGING

No. / Nr.	DATE / DATUM	INITIAL / VOORL.	DESCRIPTION / BESKRYWING

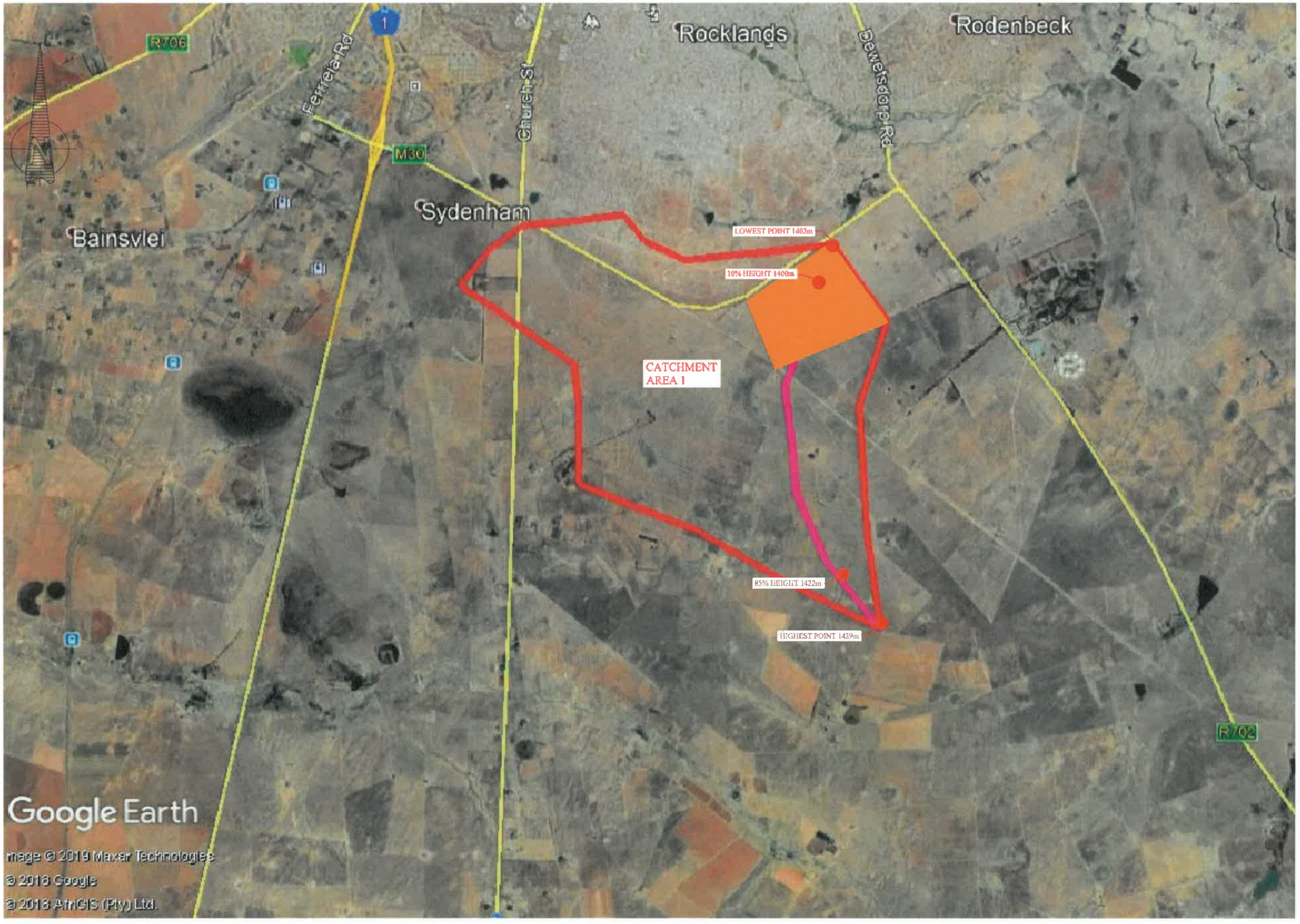
CC DWG. NO./CC TEK. NR. 2698/101/01/00

FILE NO./LêER NR.

CLIENT DWG. NO./KLIËNT TEK. NR. —

FILE NO./LêER NR. -

2698/10/101/8692



NOTES / NOTAS

DEVELOPMENT BOUNDARY
EXISTING STRUT / RIVERS
CATCHMENT AREA
LENGTH OF LONGEST WATERCOURSE
PROPOSED DEVELOPMENT

REFERENCE / VERWYSINGS

MANGAUNG METROPOLITAN MUNICIPALITY

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mail@civilconsult.co.za

ENGINEER / INGENIEUR	: G.F.J. RAS		
DESIGN / ONTWERP	: E. TERBLANCHE	TRACED / NAGETEK	:
DRAWN / GETEKEN	: E.TERBLANCHE	CHECKED / NAGESIEN	:

PROJECT / PROJEK

TOWNSHIP ESTABLISHMENT ON A PORTION OF THE FARM KLIPFONTEIN 716 AND THE FARM CERES 626

DRAWING TITLE / TEKENINGTITEL

FLOODLINES:
CATCHMENT AREAS
SHEET 2 OF 2

DATE / DATUM : AUGUST 2019
SCALE / SKAAL : 1:30 000

REVISION / WYSIGING

No. / Nr.	DATE / DATUM	INITIAL / VOORL.	DESCRIPTION / BESKRYWING

CC DWG. NO./CC TEK. NR.: 2698/101/02/00
FILE NO./LêER NR.:
CLIENT DWG. NO./KLIENT TEK. NR.: -
FILE NO./LêER NR.: -

2698/101/02/00

ANNEXURE C

CALCULATION SHEETS FOR THE FLOOD PEAKS

Utility Programs for Drainage
Flood calculations

Sinotech

Project name:	**PORTION OF THE FARM KLIPFONTEIN 716 AND FARM CERES 626**
Analysed by:	**Eben Terblanche**
Name of river:	**Tributary To The Renosterspruit**
Description of site:	
Filename:	**P:\2698 (Mangaung, Ptn of Klipfontein 716-BD and Ceres 636-BD)\Qsurf\Flood line\Run-Off\Run-Off 30 July 2019.fld**
Date:	**20 August 2019**

Summary of peak flows (m^3/s)

Method	1:2	1:5	1:10	1:20	1:50	1:100	1:200	Design year
Rational	29.90	41.58	53.70	67.59	89.30	111.64		70
Alternative rational	29.38	50.80	68.07	86.11	110.32	130.00	147.18	80
Unit hydrograph	17.82	29.46	42.51	58.33	85.22	115.32		65
Standard design flood	12.45	43.73	72.77	105.65	154.71	195.92	239.66	85
Empirical			50.48	58.18	81.28	102.67		65
Statistical: LN								
Statistical: LEV1								
Statistical: LP3								
Statistical: EV1								

Class of road = Class 1 Primary Distributors

Utility Programs for Drainage
Flood calculations

Project name: PORTION OF THE FARM KLIPFONTEIN 716 AND FARM CERES 626
Analysed by: Eben Terblanche
Name of river: Tributary To The Renosterspruit
Description of site:
Filename: P:\2698 (Mangaung, Ptn of Klipfontein 716-BD and Ceres 636-BD)\Qsurf\Flood line\Run-Off\Run-Off 30 July 2019.fld
Date: 20 August 2019

Flood Frequency Analysis: Alternative Rational Method

Project	= PORTION OF THE FARM KLIPFONTEIN 716 AND FARM CERES 626
Analysed by	= Eben Terblanche
Name of river	= Tributary To The Renosterspruit
Description of site	=
Date	= 20/08/2019
Area of catchment	= 23.951 km²
Dolomitic area	= 0.0 %
Length of longest watercourse	= 6.513 km
Flow of water	= Overland flow
Height difference	= 27.0 m
Value of r for over land flow	= Sparse grass (r=0,3)
Area distribution	= Rural: 70 %, Urban: 30 %, Lakes: 0 %

Catchment description - Urban area (%)					
Lawns		Residential and industry		Business	
Sandy, flat (<2%)	0	Houses	0	City centre	0
Sandy, steep (>7%)	0	Flats	0	Suburban	0
Heavy soil, flat (<2%)	0	Light industry	100	Streets	0
Heavy soil, steep (>7%)	0	Heavy industry	0	Maximum flood	0

Catchment description - Rural area (%)					
Surface slopes		Permeability		Vegetation	
Lakes and pans	0	Very permeable	25	Thick bush & forests	0
Flat area	60	Permeable	60	Light bush & cultivated land	55
Hilly	35	Semi-permeable	10	Grasslands	40
Steep areas	5	Impermeable	5	Bare	5

Days on which thunder was heard = 70 days/year
Weather Services station number = 261367
Weather Services station location = BLOEMFONTEIN (ST MICHAELS)
Mean annual precipitation (MAP) = 536 mm

Duration	2	5	10	20	50	100	200
1 day	50	69	83	99	122	141	162
2 days	64	91	111	134	167	195	226
3 days	68	93	113	134	167	196	227
7 days	88	127	156	188	234	273	316

The modified recalibrated Hershfield relationship was used to determine point rainfall.

Average slope	= 0.00415 m/m
Time of concentration	= 2.97 h
Run-off factor	
Rural - C1	= 0.275
Urban - C2	= 0.800
Lakes - C3	= 0.000
Combined - C	= 0.432

Return period (years)	Time of concentration (hours)	Point rainfall (mm)	ARF (%)	Average intensity (mm)	Factor Ft	Runoff coefficient (%)	Peak flow (m³/s)
1:2	2.97	34.18	100.0	11.50	0.75	38.4	29.38
1:5	2.97	57.66	100.0	19.39	0.80	39.4	50.80
1:10	2.97	75.42	100.0	25.37	0.85	40.3	68.07
1:20	2.97	93.18	100.0	31.34	0.90	41.3	86.11
1:50	2.97	116.66	100.0	39.24	0.95	42.3	110.32
1:100	2.97	134.42	100.0	45.22	1.00	43.2	130.00
1:200	2.97	152.19	100.0	51.19	1.00	43.2	147.18

Run-off coefficient percentage includes adjustment saturation factors (Ft) for steep and impermeable catchments

Calculated using Utility Programs for Drainage 1.0.2

Utility Programs for Drainage
Flood calculations

Project name: PORTION OF THE FARM KLIPFONTEIN 716 AND FARM CERES 626
Analysed by: Eben Terblanche
Name of river: Tributary To The Renosterspruit
Description of site:
Filename: P:\2698 (Mangaung, Ptn of Klipfontein 716-BD and Ceres 636-BD)\Qsurf\Floodline\Run-Off\Run-Off 30 July 2019.fld
Date: 20 August 2019

Flood Frequency Analysis: Unit Hydrograph Method

Project	= PORTION OF THE FARM KLIPFONTEIN 716 AND FARM CERES 626
Analysed by	= Eben Terblanche
Name of river	= Tributary To The Renosterspruit
Description of site	=
Date	= 20/08/2019
Area of catchment	= 23.951 km²
Length of longest watercourse	= 6.513 km
Height difference along equal area slope	= 27.0 m
Distance to catchment centroid	= 3.003 km
Veld type	= Region 4
Duration interval	= 5 minutes

Slope of longest stream	= 0.0041 m/m
Catchment index	= 303.8
Catchment lag	= 2.561
Coefficient (Ku)	= 0.386 m³/s - hours/km²
Peak discharge of unit hydrograph (Qp)	= 3.610 m³/s

Return period = 1:2 year

Storm duration (minutes)	Point rainfall (mm)	Point intensity (mm/h)	ARF (%)	Average rainfall (mm)	Runoff factor (%)	Effective rain (mm)
5	8.6	103.1	90.9	7.8	6.0	0.47
10	12.2	73.4	93.5	11.4	8.5	0.97
15	15.6	62.2	94.5	14.7	10.5	1.55
20	18.1	54.2	95.2	17.2	11.9	2.05
25	20.0	48.1	95.8	19.2	13.0	2.49
30	21.6	43.2	96.2	20.8	13.8	2.87
35	23.0	39.4	96.5	22.2	14.5	3.21
40	24.1	36.1	96.8	23.3	15.0	3.50
45	25.1	33.4	97.1	24.3	15.5	3.77
50	25.9	31.1	97.3	25.2	15.9	4.01
55	26.7	29.2	97.4	26.0	16.2	4.22
60	27.4	27.4	97.6	26.8	16.5	4.42
65	28.0	25.9	97.7	27.4	16.8	4.60
70	28.6	24.5	97.8	28.0	17.0	4.77
75	29.1	23.3	97.9	28.5	17.3	4.93
80	29.6	22.2	98.0	29.0	17.5	5.07
85	30.1	21.2	98.1	29.5	17.7	5.21
90	30.5	20.3	98.2	29.9	17.8	5.34
95	30.9	19.5	98.3	30.3	18.0	5.46
100	31.2	18.7	98.3	30.7	18.1	5.57
105	31.6	18.1	98.4	31.1	18.3	5.68
110	31.9	17.4	98.5	31.4	18.4	5.79
115	32.2	16.8	98.5	31.8	18.5	5.88
120	32.5	16.3	98.6	32.1	18.7	5.98
125	32.8	15.7	98.6	32.3	18.8	6.07
130	33.1	15.3	98.7	32.6	18.9	6.16
135	33.3	14.8	98.7	32.9	19.0	6.24
140	33.6	14.4	98.7	33.1	19.1	6.32
145	33.8	14.0	98.8	33.4	19.2	6.39
150	34.0	13.6	98.8	33.6	19.2	6.47
155	34.2	13.3	98.8	33.8	19.3	6.54
160	34.5	12.9	98.9	34.1	19.4	6.61
165	34.7	12.6	98.9	34.3	19.5	6.67
170	34.8	12.3	98.9	34.5	19.6	6.74
175	35.0	12.0	98.9	34.7	19.6	6.80
180	35.2	11.7	99.0	34.8	19.7	6.86
185	35.4	11.5	99.0	35.0	19.8	6.92
190	35.6	11.2	99.0	35.2	19.8	6.98
195	35.7	11.0	99.0	35.4	19.9	7.03
200	35.9	10.8	99.1	35.5	19.9	7.09
205	36.0	10.5	99.1	35.7	20.0	7.14

2675	0.046	15.113
2680	0.046	15.090
2685	0.046	15.068
2690	0.046	15.045
2695	0.046	15.023
2700	0.046	15.001
2705	0.046	14.979
2710	0.046	14.956
2715	0.046	14.934
2720	0.045	14.912
2725	0.045	14.891
2730	0.045	14.869
2735	0.045	14.847
2740	0.045	14.825
2745	0.045	14.804
2750	0.045	14.782
2755	0.045	14.761
2760	0.045	14.739
2765	0.045	14.718
2770	0.045	14.697
2775	0.045	14.676
2780	0.044	14.655
2785	0.044	14.633
2790	0.044	14.612
2795	0.044	14.592
2800	0.044	14.571
2805	0.044	14.550
2810	0.044	14.529
2815	0.044	14.509
2820	0.044	14.488
2825	0.044	14.467
2830	0.044	14.447
2835	0.044	14.427
2840	0.044	14.406
2845	0.043	14.386
2850	0.043	14.366
2855	0.043	14.346
2860	0.043	14.326
2865	0.043	14.306
2870	0.043	14.286
2875	0.043	14.266
2880	0.043	14.246

Return period	Storm duration (minutes)	Peak discharge (m^3/s)
1:2 year	30	17.82
1:5 year	30	29.46
1:10 year	30	42.51
1:20 year	30	58.33
1:50 year	30	85.22
1:100 year	85	115.32

Calculated using Utility Programs for Drainage 1.0.2

Utility Programs for Drainage
Flood calculations

Project name: PORTION OF THE FARM KLIPFONTEIN 716 AND FARM CERES 626
Analysed by: Eben Terblanche
Name of river: Tributary To The Renosterspruit
Description of site:
Filename: P:\2698 (Mangaung, Ptn of Klipfontein 716-BD and Ceres 636-BD)\Qsurf\Floodline\Run-Off\Run-Off 30 July 2019.fld
Date: 20 August 2019

Flood frequency analysis : Standard Design Flood method

Project name	= PORTION OF THE FARM KLIPFONTEIN 716 AND FARM CERES 626
Analysed by	= Eben Terblanche
Name of river	= Tributary To The Renosterspruit
Description of site	=
Date	= 20/08/2019
Catchment characteristics:	
Area of catchment	= 23.95102 km²
Length of longest watercourse	= 6.513 km
1085 height difference	= 27 m
Average slope	= 0.0055 m/m
Drainage basin characteristics:	
Drainage basin number	= 9
Mean annual daily max rain	= 43 mm
Days on which thunder was heard	= 47 days
Runoff coefficient C2	= 15 %
Runoff coefficient C100	= 60 %
Basin mean annual precipitation	= 380 mm
Basin mean annual evaporation	= 1800 mm
Basin evaporation index MAE/MAP	= 4.74

RAINFALL DATA
The rainfall data in the table below are derived from two sources. The daily rainfall is from the Department of Water Affair's publication TR102 for the representative site. The modified Hershfield equation is used for durations up to four hours. Linear interpolation is used for values between 4 hours and one day.

Weather Services station ex TR102 = 258458 @ JACOBSDAL
Point mean annual precipitation = 380 mm

Dur:	RP =2	5	10	20	50	100	200
.25 h	14	23	30	37	47	54	61
.50 h	18	30	39	49	61	70	79
1 h	22	37	48	60	75	86	98
2 h	26	44	58	71	89	103	116
4 h	30	51	67	82	103	119	135
1 day	43	61	75	91	114	133	155
2 days	54	78	98	119	151	179	210
3 days	59	87	109	134	171	203	238
7 days	70	104	131	160	203	240	280

Runoff coefficients C2 = 15 % C100 = 60 %

Return period (years)	Time of concentration (hours)	Point precipitation (mm)	ARF (%)	Catchment precipitation (mm)	Runoff coefficient (%)	Peak flow (m³/s)
1:2	2.08	26.2	98.7	25.9	15.0	12.45
1:5	2.08	44.3	98.7	43.7	31.2	43.73
1:10	2.08	57.9	98.7	57.2	39.7	72.77
1:20	2.08	71.5	98.7	70.6	46.7	105.65
1:50	2.08	89.6	98.7	88.4	54.6	154.71
1:100	2.08	103.2	98.7	101.9	60.0	195.92
1:200	2.08	116.8	98.7	115.3	64.8	239.66

Calculated using Utility Programs for Drainage 1.0.2

Utility Programs for Drainage
Flood calculations

Project name: PORTION OF THE FARM KLIPFONTEIN 716 AND FARM CERES 626
Analysed by: Eben Terblanche
Name of river: Tributary To The Renosterspruit
Description of site:
Filename: P:\2698 (Mangaung, Ptn of Klipfontein 716-BD and Ceres 636-BD)\Qsurf\Floodline\Run-Off\Run-Off 30 July 2019.fld
Date: 20 August 2019

Flood Frequency Analysis: Empirical methods

Project	= PORTION OF THE FARM KLIPFONTEIN 716 AND FARM CERES 626
Analysed by	= Eben Terblanche
Name of river	= Tributary To The Renosterspruit
Description of site	=
Date	= 20/08/2019
Area of catchment	= 23.951 km²
Length of longest watercourse	= 6.513 km
Height difference along equal-area slope	= 27.0 m
Distance to catchment centroid	= 3.003 km
Dolomitic area	= 0.0 %
Mean annual rainfall	= 561.0 mm
Veld type	= 4 & 5A
Kovács region	= K1(K = 2.8)
Catchment parameter with regard to reaction time	= 0.079

Peak discharges by means of an empirical method developed by Midgley and Pitman

Return period (years)	KT constant	Peak flow (m³/s)
1:10	0.59	50.48
1:20	0.68	58.18
1:50	0.95	81.28
1:100	1.20	102.67

This RMF calculation includes a transition zone adjustment in the case of small catchments.

Regional maximum flood: 68.9 m³/s

Q50(RMF): 21.86 m³/s (based on QT/QRMF relationship for Kovács regions)
Q100(RMF): 29.51 m³/s (based on QT/QRMF relationship for Kovács regions)
Q200(RMF): 39.30 m³/s (based on QT/QRMF relationship for Kovács regions)

The following equivalent maxima make no transition zone adjustments for small catchments.

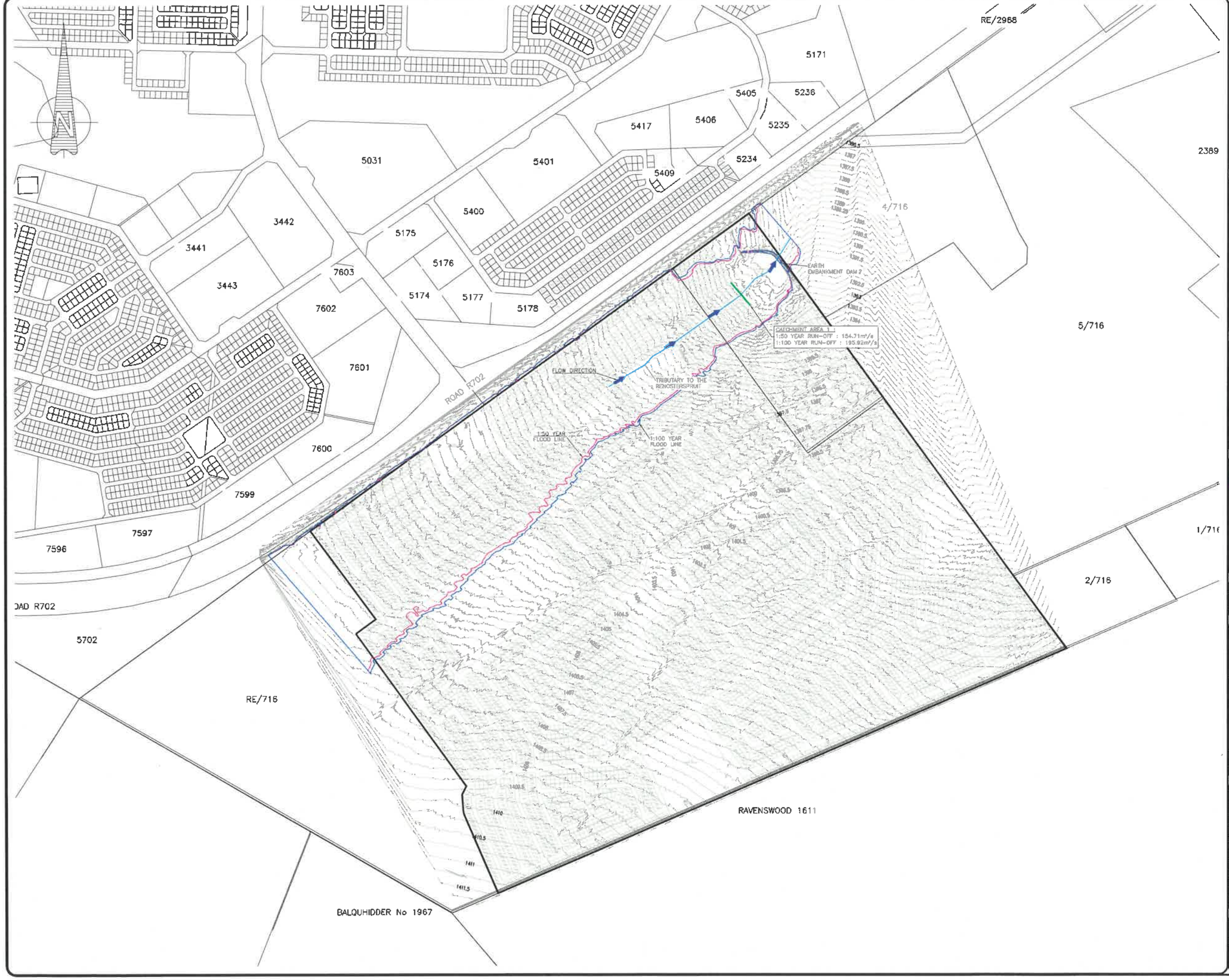
Equivalent southern African maximum
K-factor 5.6: 1222 m³/s

Equivalent world maxima
K-factor 6.0: 2248 m³/s
K-factor 6.3: 3551 m³/s

Calculated using Utility Programs for Drainage 1.0.2

ANNEXURE D

1:50 AND 1:100-YEAR FLOOD LINES



NOTES / NOTAS

DEVELOPMENT BOUNDARY
EXISTING SPRUIT / RIVERS
1:100 YEAR FLOOD LINE (NOT CERTIFIED)
1:50 YEAR FLOOD LINE (NOT CERTIFIED)

FLOOD LINES

IT IS HEREBY CERTIFIED THAT TERMS OF SECTION 144 OF THE NATIONAL WATER ACT (ACT 36 OF 1998) THAT THE POSITION OF THE 1:50 & 1:100 YEAR FLOOD LINES ARE AS INDICATED ON THE DRAWING.

Pr. Eng.

Date:

REFERENCE / VERWYSINGS

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DESIGN / ONTWERP	E. TERBLANCHE	TRACED / NAGETREK	
DRAWN / GETEKEN	E.TERBLANCHE	CHECKED / NAGESIEN	

PROJECT / PROJEK

TOWNSHIP ESTABLISHMENT ON A PORTION OF THE FARM KLIPFONTEIN 716 AND THE FARM CERES 626

DRAWING TITLE / TEKENINGTITEL

FLOODLINES:
1:50 AND 1:100 YEAR FLOOD LINES

DATE / DATUM	AUGUST 2019
SCALE / SKAAL	1:5000

REVISION / WYSIGING

No. Nr.	DATE DATUM	INITIAL VOORL.	DESCRIPTION BESKRYWING

CC DWG. NO./CC TEK. NR.
2698/120/01/00

FILE NO./LêER NR.

CLIENT DWG. NO./KLIËNT TEK. NR.
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FILE NO./LêER NR.
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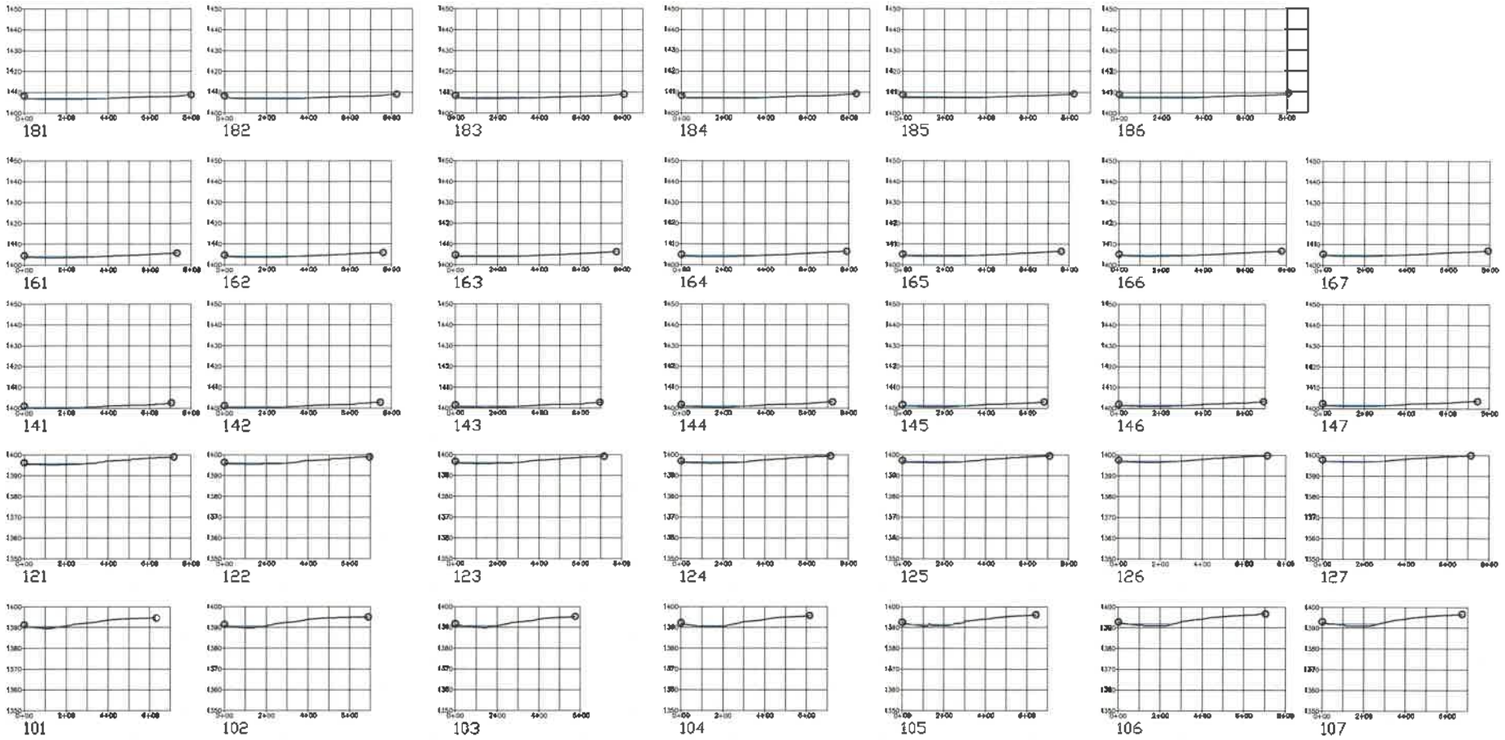
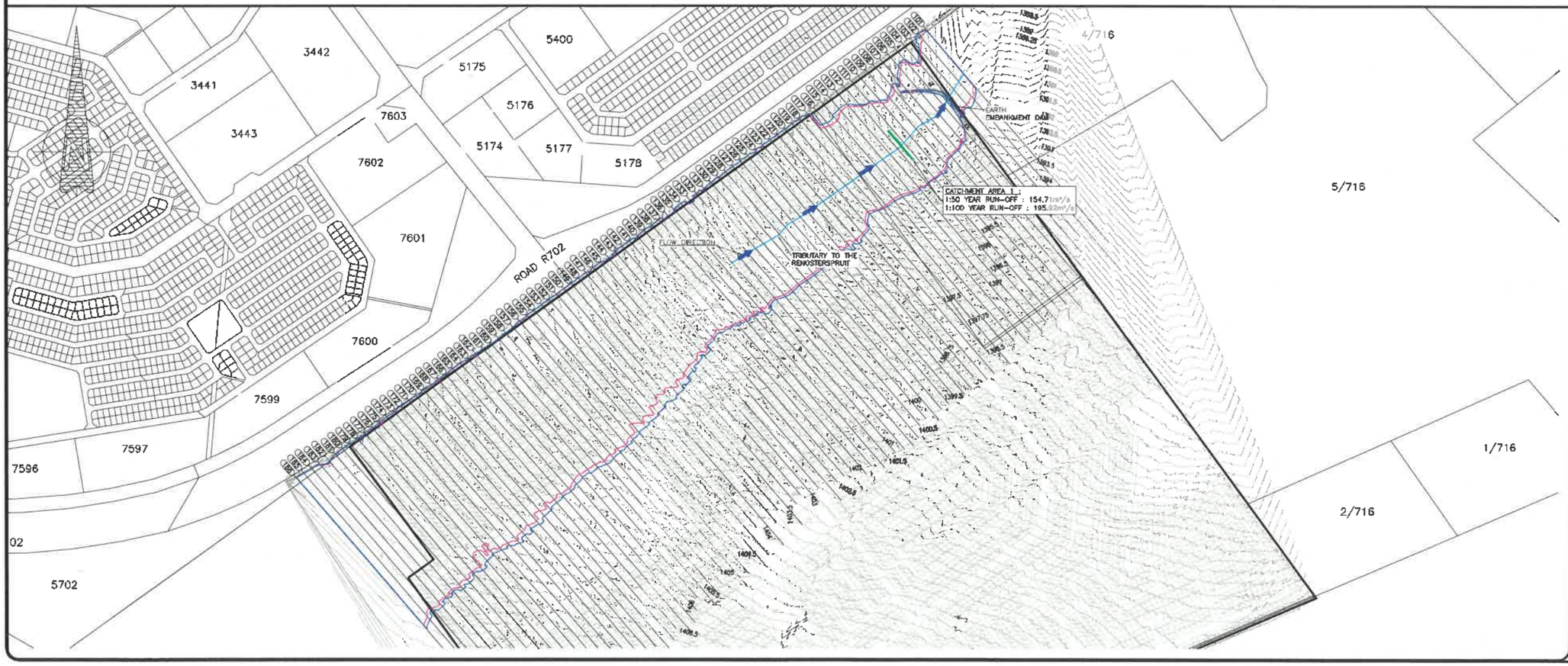
2698/120/01/00





NOTES / NOTAS

DEVELOPMENT BOUNDARY
EXISTING SPRUIT / RIVERS
1:100 YEAR FLOOD LINE
1:50 YEAR FLOOD LINE

REFERENCE / VERWYSINGS

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DRAWN / GETEKEN	: E.TERBLANCHE	CHECKED / NAGESIEN	:

PROJECT / PROJEK

TOWNSHIP ESTABLISHMENT ON A PORTION OF THE FARM KLIPFONTEIN 716 AND THE FARM CERES 626

DRAWING TITLE / TEKENINGTITEL

FLOODLINES:
1:50 AND 1:100 YEAR FLOOD LINES
CROSS-SECTION DETAILS
SHEET 1 OF 3

DATE : AUGUST 2019
DATUM:
SCALE : 1:5000
SKAAL :

REVISION / WYSIGING

No.	DATE / DATUM	INITIAL / VOORL.	DESCRIPTION / BESKRYWING

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2698/121/01/00

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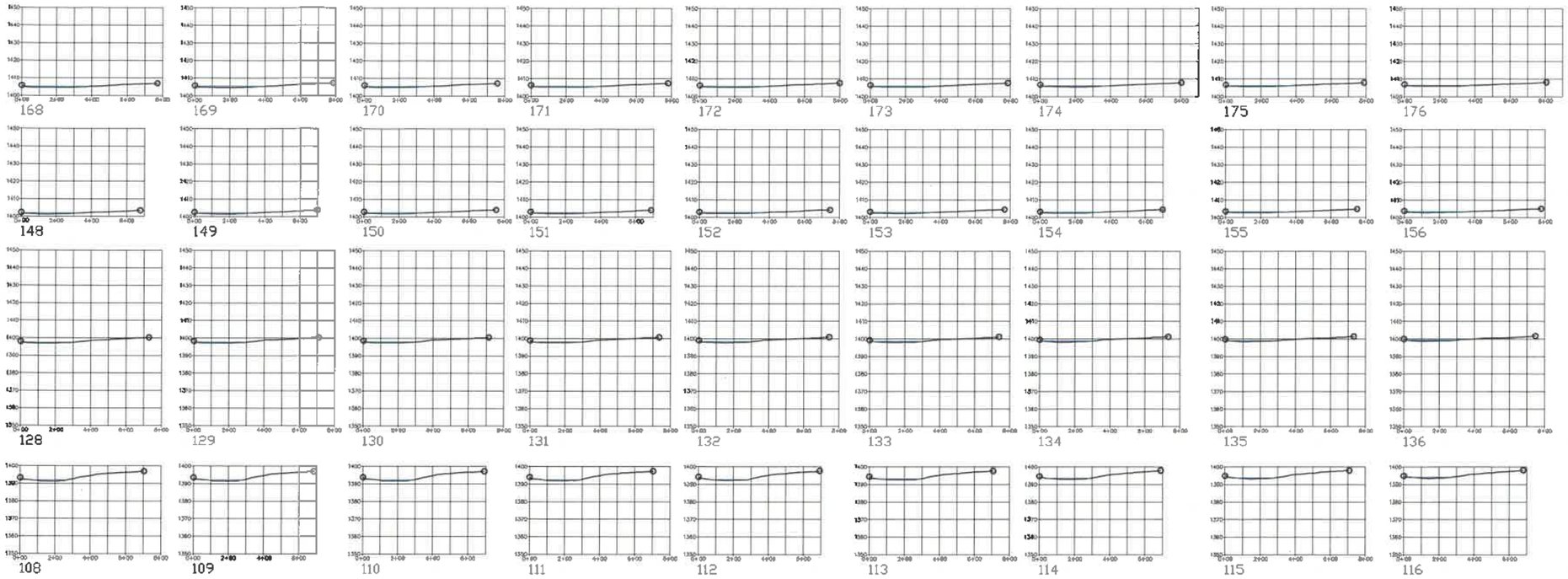

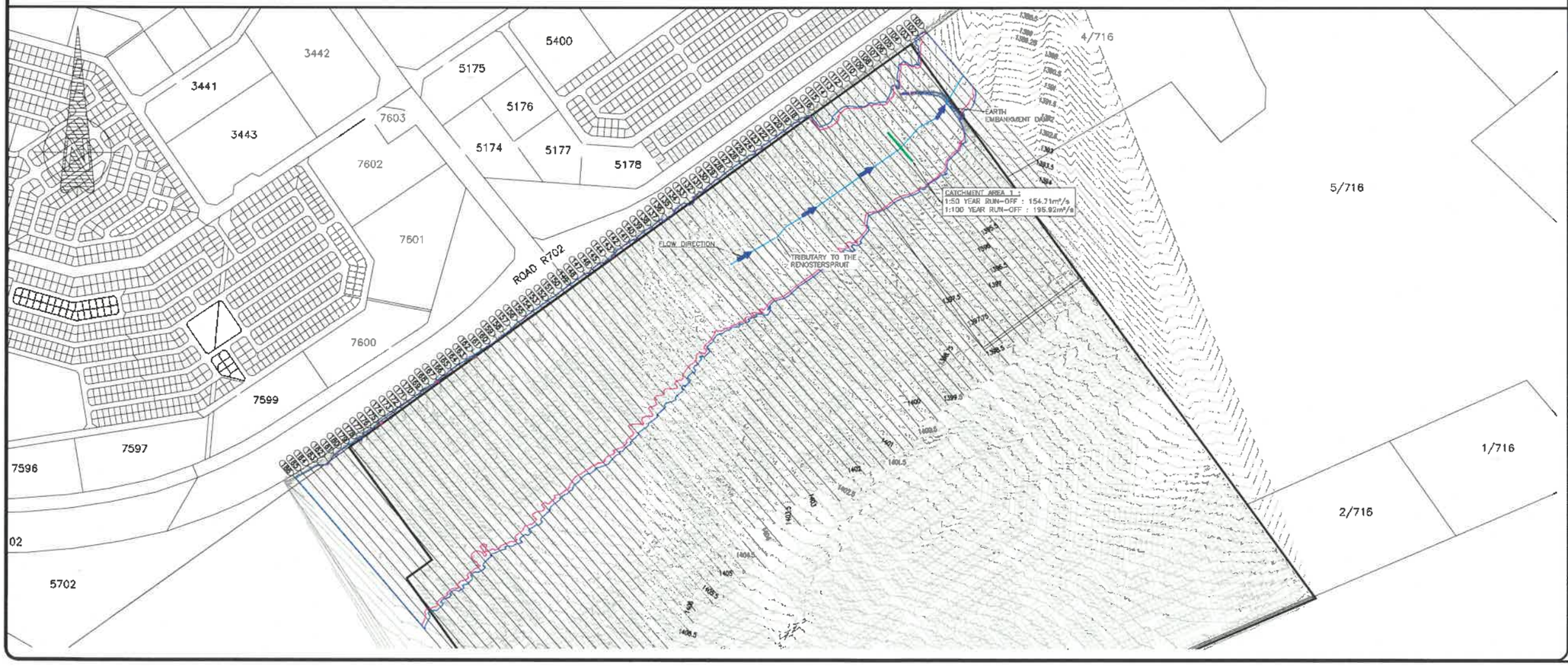

NOTES / NOTAS

- DEVELOPMENT BOUNDARY
- EXISTING SPRUIT / RIVERS
- 1:100 YEAR FLOOD LINE
- 1:50 YEAR FLOOD LINE

REFERENCE / VERWYSINGS

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DRAWN / TEKEN	: E.TERBLANCHE	CHECKED / NAGESIEN	:

PROJECT / PROJEK

TOWNSHIP ESTABLISHMENT ON A PORTION OF THE FARM KLIPFONTEIN 716 AND THE FARM CERES 626

DRAWING TITLE / TEKENINGTITEL

FLOODLINES:
1:50 AND 1:100 YEAR FLOOD LINES
CROSS-SECTION DETAILS
SHEET 2 OF 3

DATE / DATUM: AUGUST 2019
SCALE / SKAAL: 1:5000

REVISION / WYSIGING

No. / Nr.	DATE / DATUM	INITIAL / VOORL.	DESCRIPTION / BESKRYWING

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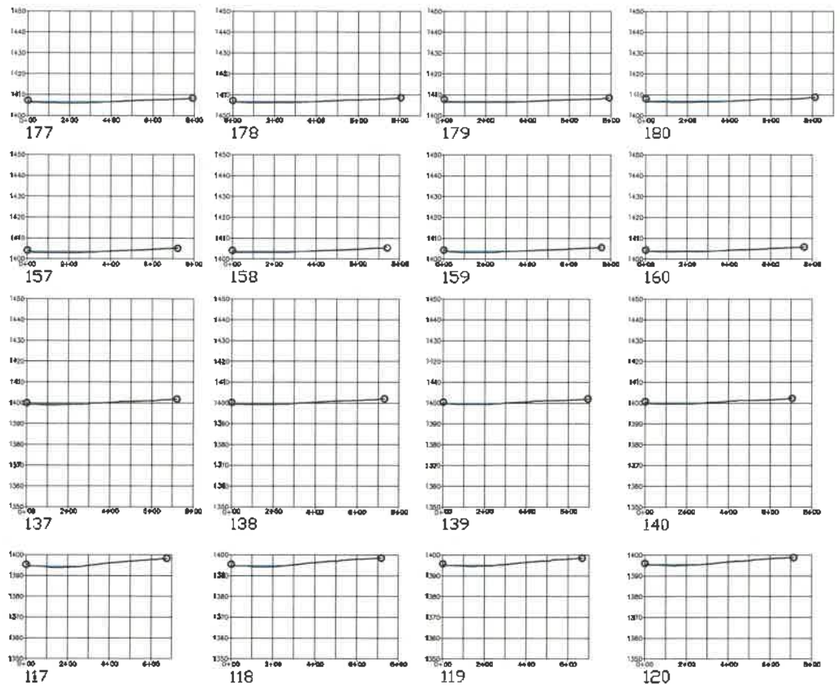

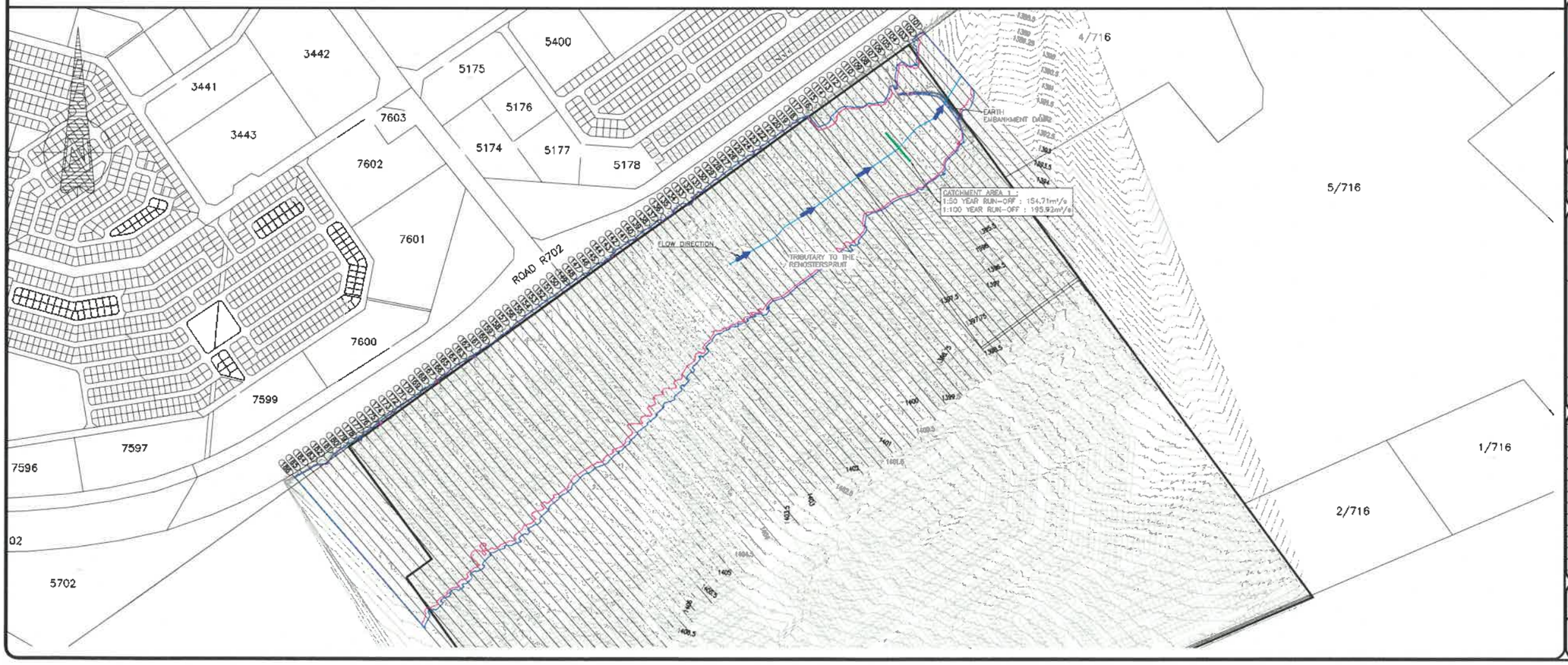

NOTES / NOTAS

- DEVELOPMENT BOUNDARY
- EXISTING SPRUIT / RIVERS
- 1:100 YEAR FLOOD LINE
- 1:50 YEAR FLOOD LINE

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DRAWN / TEKEN	E.TERBLANCHE	CHECKED / NAGESIEN	

PROJECT / PROJEK

TOWNSHIP ESTABLISHMENT ON A PORTION OF THE FARM KLIPFONTEIN 716 AND THE FARM CERES 626

DRAWING TITLE / TEKENINGTITEL

FLOODLINES:
1:50 AND 1:100 YEAR FLOOD LINES
CROSS-SECTION DETAILS
SHEET 3 OF 3

DATE / DATUM: AUGUST 2019
SCALE / SKAAL: 1:5000

REVISION / WYSIGING

No. / Nr.	DATE / DATUM	INITIAL / VOORL.	DESCRIPTION / BESKRYWING

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CLIENT DWG. NO./KLIËNT TEK. NR.: -
FILE NO./LêER NR.: -

2698/121/03/00

APPENDIX D3: HERITAGE IMPACT REPORT

G & A Heritage

Heritage Management Consultants

PROPOSED NEW TOWNSHIP DEVELOPMENT AT MANGAUNG

Heritage Impact Assessment (HIA) Report

July 2019

CREDIT SHEET

Stephan Gaigher (BA Hons, Archaeology, UP)

Principle Investigator for G&A Heritage Properties (Pty) Ltd.

Member of ASAPA (Site Director Status)

Cell: +27 73 752 6583

Email: stephan@gaheritage.co.za

REPORT AUTHOR

Stephan Gaigher

Disclaimer; *Although all possible care is taken to identify all sites of cultural importance during the investigation of study areas, it is always possible that hidden or sub-surface sites could be overlooked during the study. G&A Heritage and its personnel will not be held liable for such oversights or for costs incurred as a result of such oversights.*

Statement of Independence
As the duly appointed representative of G&A Heritage, I Stephan Gaigher, hereby confirm my independence as a specialist and declare that neither I nor G&A Heritage have any interests, be it business or otherwise, in any proposed activity, application or appeal in respect of which the Environmental Consultant was appointed as Environmental Assessment Practitioner, other than fair remuneration for work performed on this project.

SIGNED BY: STEPHAN GAIGHER

MANAGEMENT SUMMARY

Project Name and Location

Proposed New Township Development outside Bloemfontein in the Mangaung Metropolitan Municipality in the Free State Province.
Situated on a Portion of the Farm Klipfontein 716 and the Farm Ceres 626.

Consultant

G&A Heritage Management Properties (Pty) Ltd.
P.O. Box 522, Louis Trichardt, 0920
38 A Vorster Street, Louis Trichardt
Stephan Gaigher
+27 73 752 6583
stephan@gaheritage.co.za

Appointed by

Inaluk Consulting Services

Developer / Proponent

Ngoti Development Consultants

Client

Mangaung Metropolitan Municipality

Date of Report

19 July 2019

MANAGEMENT SUMMARY

The purpose of the management summary is to distil the information contained in the report into a format that can be used to give specific results quickly and facilitate management decisions. It is not the purpose of the management summary to repeat in shortened format all the information contained in the report, but rather to give a statement of results for decision making purposes.

This study focuses on the proposed new township development on a portion of the farm Klipfontein 716 and farm Ceres 626 near Bloemfontein in the Mangaung Metropolitan Municipality in the Free State Province.

This study encompasses the heritage impact investigation. A preliminary layout has been supplied to lead this phase of this study.

Scope of Work

A Heritage Impact Assessment (including Archaeological, Cultural heritage, Built Heritage and Basic Palaeontological Assessment to determine the impacts on heritage resources within the study area.

The following are the required to perform the assessment:

- A desk-top investigation of the area;
- A site visit to the proposed development site;
- Identify possible archaeological, cultural, historic, built and palaeontological sites within the proposed development area;
- Evaluate the potential impacts of construction and operation of the proposed development on archaeological, cultural, historical resources; built and palaeontological resources; and
- Recommend mitigation measures to ameliorate any negative impacts on areas of archaeological, cultural, historical, built and palaeontological importance.

The purpose of this study is to determine the possible occurrence of sites with cultural heritage significance within the study area. The study is based on archival and document combined with fieldwork investigations.

Findings and Recommendations

The area was investigated during a field visit and through archival studies. The site was found to be devoid of any heritage sites with significance.

Some modern ruins were observed within the study area. These hold no heritage value and have been documented photographically.

It is recommended that obscured, subterranean sites be managed, if they are encountered.

The area is indicated as *Very High Importance* on the SAHRIS Paleo Sensitivity Map. A field assessment and protocol for finds is required.

Fatal Flaws

No fatal flaws were identified.

CONTENTS

List of Figures

List of Tables

ABBREVIATIONS

Abbreviation	Meaning
BP	Before Present
c.	circa
BCE	Before the Common Era
Bp	Before Present
CE	Common Era
EIA	Early Iron Age
ESA	Early Stone Age
Fm	Femtometre (10^{-15}m)
GPS	Geographic Positioning System
HIA	Heritage Impact Assessment
LIA	Late Iron Age
LSA	Late Stone Age
MSA	Middle Stone Age
MYA	Million Years Ago
NHRA	National Heritage Resources Agency
OFS	Orange Free State
PIA	Palaeontological Impact Assessment
SAHRA	South African Heritage Resource Agency
SAHRIS	South African Heritage Information System
SANNC	South African Native National Congress
S&EIR	Scoping and Environmental Impact Reporting
Um	Micrometre (10^{-6}m)
WGS 84	World Geodetic System for 1984

GLOSSARY OF TERMS

'**Archaeological**' means:

a) Material remains resulting from human activity which are in a state of disuse and are in or on land and are older than 100 years, including artefacts, human and hominid remains and artificial features and structures;
b) Rock art, being a form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and is older than 100 years including any area within 10 m of such representation; and
c) Wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land or in the maritime cultural zone referred to in section 5 of the Maritime Zones Act 1994 (Act 15 of 1994), and any cargo, debris or artefacts found or associated therewith, which are older than 60 years or which in terms of national legislation are considered to be worthy of conservation;
d) Features, structures and artefacts associated with military history which are older than 75 years and the sites on which they are found.

'**Circa**' is used in front of a particular year to indicate an approximate date.

'Grave' means a place of interment and includes the contents, headstone or other marker of and any other structures on or associated with such place. The South African Heritage Resources Agency (SAHRA) will only issue a permit for the alteration of a grave if it is satisfied that every reasonable effort has been made to contact and obtain permission from the families concerned.

'Paleontological' means any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.

A '**place**' is defined as:

a) A site, area or region;
b) A building or other structure (which may include equipment, furniture, fittings and articles associated with or connected with such building or other structure);
c) A group of buildings or other structures (which may include equipment, furniture, fittings and articles associated with or connected with such group of buildings or other structures); and (d) an open space, including a public square, street or park; and in relation to the management of a place, includes the immediate surroundings of a place.

'**Structures**' means any building, works, device, or other facility made by people and which is fixed to land and any fixtures, fittings and equipment associated therewith older than 60 years.

1. General

1.1 Project Description

G&A Heritage was appointed by Inaluk Consulting Services to undertake a Heritage Impact Assessment (HIA) for the proposed new township development on a portion of the farm Klipfontein 716 and farm Ceres 626 near Bloemfontein in the Mangaung Metropolitan Municipality in the Free State Province.

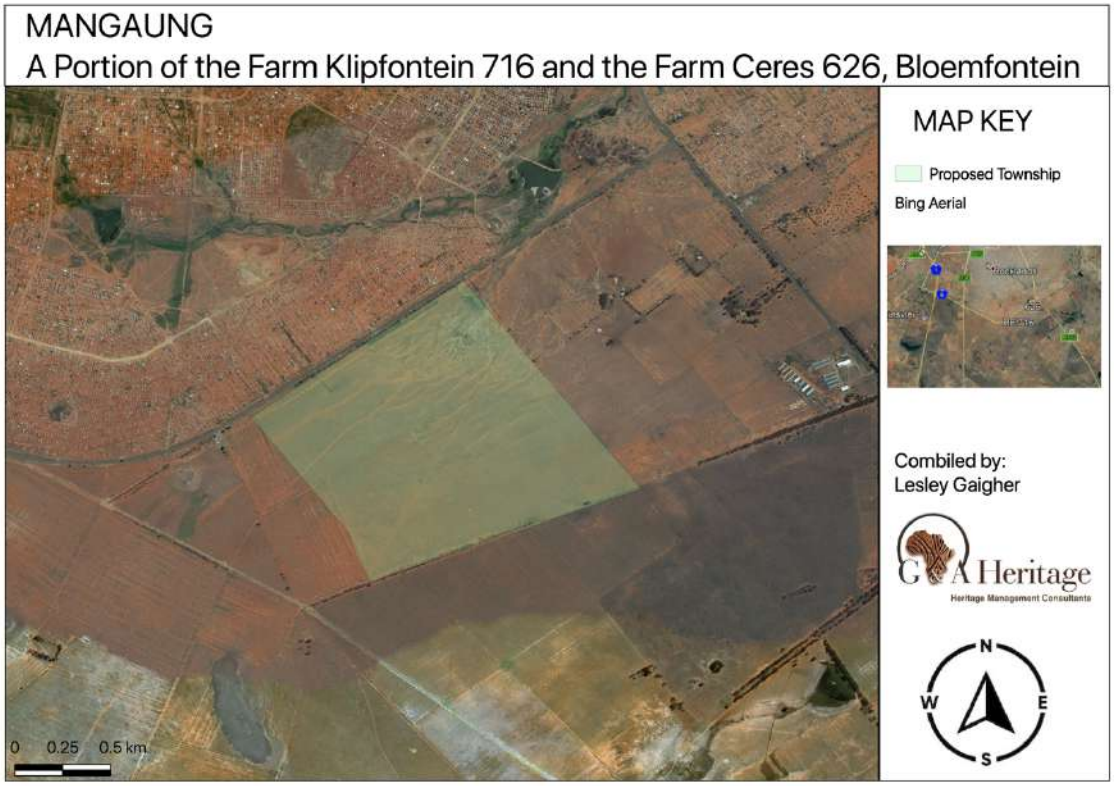

Figure 1. Proposed new township development in Mangaung Metro Municipality

1.2 Technical Scope of HIA

This HIA focused only on the area to be directly affected by the proposed development. The study area is 192.9 Ha in extent.

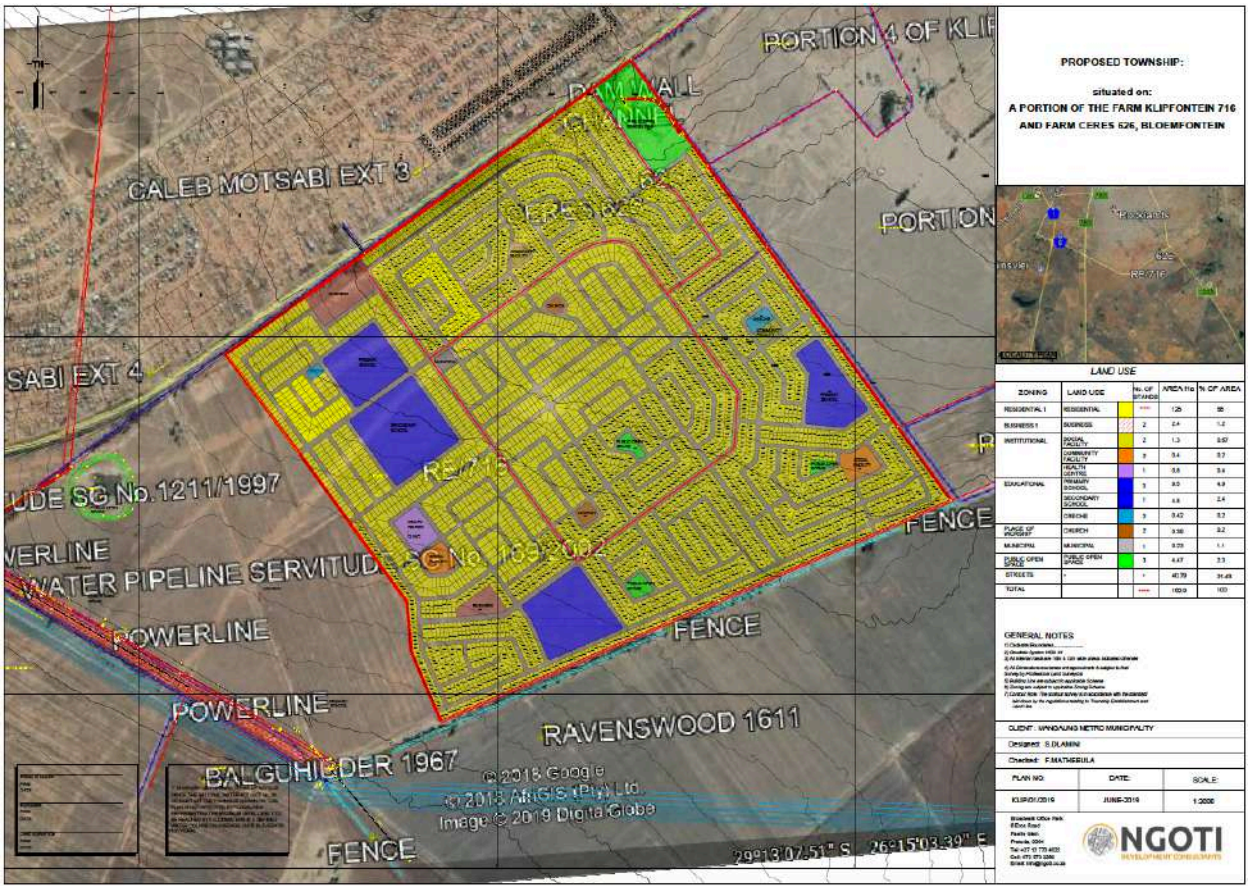

Figure 2. Proposed layout of the new township

The HIA is meant to deliver, evaluate and inform on the following aspects:

(a) The identification and mapping of all heritage resources in the area affected;
(b) An assessment of the significance of such resources in terms of the heritage assessment criteria set out in the relevant legal descriptions, development proponent requirements and as per international best practise approaches and charters;
(c) An assessment of the impact of the development on such heritage resources;
(d) An evaluation of the impact of the development on heritage resources relative to the sustainable social and economic benefits to be derived from the development;
(e) The results of consultation with communities affected by the proposed development and other interested parties regarding the impact of the development on heritage resources;
(f) If heritage resources will be adversely affected by the proposed development, the consideration of alternatives; and
(g) Plans for mitigation of any adverse effects during and after the completion of the proposed development.

The following categories of heritage objects are considered.

Graves: Places of interment including the contents, headstone or other marker of and any other structures on or associated with such place. This may include any of the following:

1) Ancestral graves,
2) Royal graves and graves of traditional leaders
3) Graves of victims of conflict i.e. graves of important individuals
4) Historical graves and cemeteries older than 60 years
5) Other human remains, buried or otherwise.

The removal of graves is subject to the following procedures:

- Notification of the impending removals (using local language media and notices at the grave site);
- Consultation with individuals or communities related or known to the deceased;
- Satisfactory arrangements for the curation of human remains and / or headstones in a museum, where applicable;
- Procurement of a permit from the relevant controlling body;
- Appropriate arrangements for the exhumation (preferably by a suitably trained archaeologist) and re-interment (sometimes by a registered undertaker, in a formally proclaimed cemetery);
- Observation of rituals or ceremonies required by the families.

Movable objects: This includes objects such as historic or rare books and manuscripts, paintings, drawings, sculptures, statuettes and carvings; modern or historic religious items; historic costumes, jewellery and textiles; fragments of monuments or historic buildings; archaeological material; and natural history collections such as shells, flora, or minerals. Discoveries and access resulting from a project may increase the vulnerability of cultural objects to theft, trafficking or abuse. This may include any of the following:

1) Objects recovered from the soil or water including archaeological and paleontological objects and material, meteorites and rare geological specimens;
2) Ethnographic art and objects
3) Military objects
4) Objects of decorative art
5) Objects of fine art
6) Objects of scientific or technological interest
7) Books, records, documents, photographic positives and negatives, graphic, film or video material or sound recordings
8) Any other prescribed categories, but excluding any object made by a living person.

Protection of Historic Battlefields

Heritage "Places": A 'place' is defined as:

a) A site, area or region;
b) A building or other structure (which may include equipment, furniture, fittings and articles associated with or connected with such building or other structure);
c) A group of buildings or other structures (which may include equipment, furniture, fittings and articles associated with or connected with such group of buildings or other structures); and
d) An open space, including a public square, street or park; and in relation to the management of a place, includes the immediate surroundings of a place.
e) Traditional Buildings used in cultural ceremonies.

Heritage Structures: Refers to single or groups of architectural works found in urban or rural settings providing evidence of a particular civilisation, a significant development or a historic event. It includes groups of buildings, structures and open spaces constituting past or contemporary human settlements that are recognised as cohesive and valuable from an architectural, aesthetic, spiritual or socio-cultural perspective.
This may also include any building, works, device, or other facility made by people and which is fixed to land and any fixtures, fittings and equipment associated therewith older than 60 years.

Archaeological Sites
Archaeological sites comprise any combination of structural remains, artefacts, human or ecological elements and may be located entirely beneath, partially above, or entirely above the land or water surface. Archaeological material may be found anywhere on the earth's surface, singly or scattered over large areas. Such material includes burial areas, human remains, artefacts and fossils. Archaeological sites may include:

a) Material remains resulting from human activity which are in a state of disuse and are in or on land and are older than 100 years, including artefacts, human and hominid remains and artificial features and structures;
b) Rock art, being a form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and is older than 100 years including any area within 10 m of such representation; and
c) Wrecks, being any vessel or aircraft, or any part thereof, which was wrecked, whether on land or in the maritime cultural zone, and any cargo, debris or artefacts found or associated therewith, which are older than 60 years or which in terms of national legislation are considered to be worthy of conservation;
d) Features, structures and artefacts associated with military history which are older than 75 years and the sites on which they are found.

Paleontological resources: Refers to any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.

Sacred or Spiritual Sites: Refers to natural features with cultural significance, which may include sacred hills, mountains, landscapes, streams, rivers, waterfalls, caves and rocks; sacred trees or plants, groves and forests; carvings or paintings on exposed rock faces or in caves; and paleontological deposits of early human, animal or fossilised remains. This heritage may have significance to local community groups or minority populations.

1.3 Geographical / Spatial Scope of HIA

The geographic and spatial scope of the HIA centres on the proposed new township development on a portion of the farm Klipfontein 716 and farm Ceres 626, near Bloemfontein in the Mangaung Metropolitan Municipality. Any sites within the directly impacted study area that can be affected by the proposed development and, where known, are included in this report. Mitigation or secondary investigations take this footprint as the spatial parameters of the study area.

1.4 GPS Track Path

The investigation was across the span of the study area. GPX Files are available.

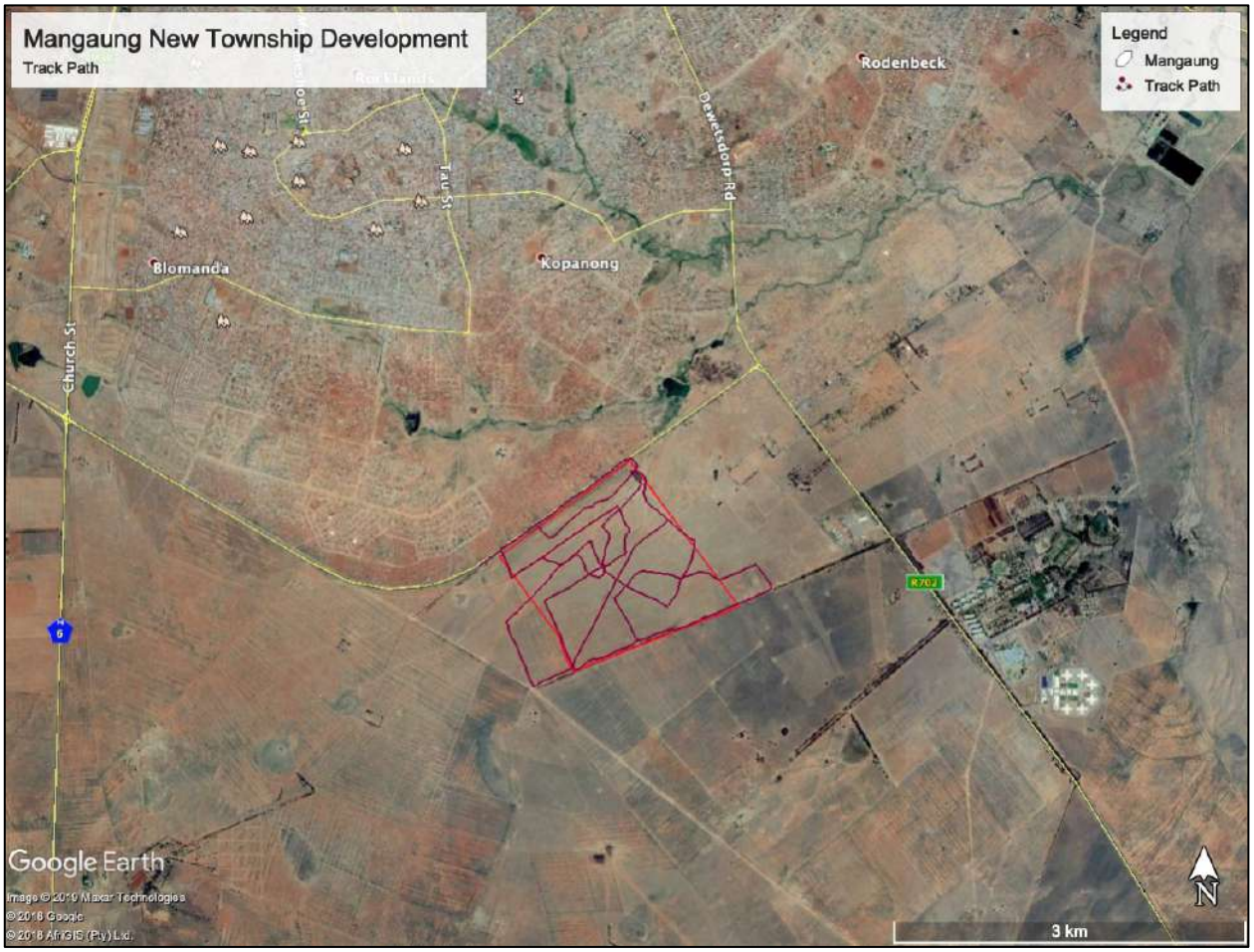

Figure 3. Track Path

1.5 Temporal Scope

The proposed project will consist of three phases;

1) Planning
2) Development
3) Operational

Due to the nature of the proposed development impacts on heritage sites are only anticipated during the development phase of the proposed project. The operational phase will not result in any further alterations to heritage on any significant scale and at present there is still no defined decommissioning phase.

2. Legislative Context

2.1 National Legislation

Section 38(1) of the South African Heritage Resources Act (25 of 1999) requires that a heritage study is undertaken for:

(a) Construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length;
(b) Construction of a bridge or similar structure exceeding 50 m in length; and
(c) Any development, or other activity which will change the character of an area of land, or water –
(1) Exceeding 10 000 m^2 in extent;
(2) Involving three or more existing erven or subdivisions thereof; or
(3) Involving three or more erven, or subdivisions thereof, which have been consolidated within the past five years; or
(d) The costs of which will exceed a sum set in terms of regulations; or
(e) Any other category of development provided for in regulations.

While the above describes the parameters of developments that fall under this Act., Section 38 (8) of the NHRA is applicable to this development. This section states that;

(8) *The provisions of this section do not apply to a development as described in subsection (1) if an evaluation of the impact of such development on heritage resources is required in terms of the Environment Conservation Act, 1989 (Act 73 of 1989), or the integrated environmental management guidelines issued by the Department of Environment Affairs and Tourism, or the Minerals Act, 1991 (Act 50 of 1991), or any other legislation: Provided that the consenting authority must ensure that the evaluation fulfils the requirements of the relevant heritage resources authority in terms of subsection (3), and any comments and recommendations of the relevant heritage resources authority with regard to such development have been taken into account prior to the granting of the consent.*

In regard to a development such as this that falls under Section 38 (8) of the NHRA, the requirements of Section 38 (3) applies to the subsequent reporting, stating that;

(3) The responsible heritage resources authority must specify the information to be provided in a report required in terms of subsection (2) (a): Provided that the following must be included:
(a) The identification and mapping of all heritage resources in the area affected;
(b) An assessment of the significance of such resources in terms of the heritage assessment criteria set out in section 6 (2) or prescribed under section 7;
(c) An assessment of the impact of the development on such heritage resources;
(d) An evaluation of the impact of the development on heritage resources relative to the sustainable social and economic benefits to be derived from the development;
(e) The results of consultation with communities affected by the proposed development and other interested parties regarding the impact of the development on heritage resources;
(f) If heritage resources will be adversely affected by the proposed development, the consideration of alternatives; and
(g) Plans for mitigation of any adverse effects during and after the completion of the proposed development.
(1) Ancestral graves,
(2) Royal graves and graves of traditional leaders,
(3) Graves of victims of conflict (iv) graves of important individuals,
(4) Historical graves and cemeteries older than 60 years, and
(5) Other human remains which are not covered under the Human Tissues Act, 1983 (Act No.65 of 1983 as amended);
(h) Movable objects, including ;

(1) Objects recovered from the soil or waters of South Africa including archaeological and paleontological objects and material, meteorites and rare geological specimens;
(2) Ethnographic art and objects;
(3) Military objects;
(4) Objects of decorative art;
(5) Objects of fine art;
(6) Objects of scientific or technological interest;
(7) Books, records, documents, photographic positives and negatives, graphic, film or video material or sound recordings; and
(8) Any other prescribed categories, but excluding any object made by a living person;

(i) Battlefields;
(j) Traditional building techniques.

A '**place**' is defined as:

a) A site, area or region;
b) A building or other structure (which may include equipment, furniture, fittings and articles associated with or connected with such building or other structure);
c) A group of buildings or other structures (which may include equipment, furniture, fittings and articles associated with or connected with such group of buildings or other structures); and (d) an open space, including a public square, street or park; and in relation to the management of a place, includes the immediate surroundings of a place.

'**Structures**' means any building, works, device, or other facility made by people and which is fixed to land and any fixtures, fittings and equipment associated therewith older than 60 years.

'**Archaeological**' means:

a) Material remains resulting from human activity which are in a state of disuse and are in or on land and are older than 100 years, including artefacts, human and hominid remains and artificial features and structures;
b) Rock art, being a form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and is older than 100 years including any area within 10 m of such representation; and
c) Wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land or in the maritime cultural zone referred to in section 5 of the Maritime Zones Act 1994 (Act 15 of 1994), and any cargo, debris or artefacts found or associated therewith, which are older than 60 years or which in terms of national legislation are considered to be worthy of conservation;
d) Features, structures and artefacts associated with military history which are older than 75 years and the sites on which they are found.

'Paleontological' means any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.

'Grave' means a place of interment and includes the contents, headstone or other marker of and any other structures on or associated with such place. The South African Heritage Resources Agency (SAHRA) will only issue a permit for the alteration of a grave if it is satisfied that every reasonable effort has been made to contact and obtain permission from the families concerned.

The removal of graves is subject to the following procedures as outlined by the SAHRA:

- Notification of the impending removals (using English, Afrikaans and local language media and notices at the grave site);
- Consultation with individuals or communities related or known to the deceased;
- Satisfactory arrangements for the curation of human remains and / or headstones in a museum, where applicable;
- Procurement of a permit from the SAHRA;

- Appropriate arrangements for the exhumation (preferably by a suitably trained archaeologist) and re-interment (sometimes by a registered undertaker, in a formally proclaimed cemetery);
- Observation of rituals or ceremonies required by the families.

The limitations and assumptions associated with this heritage impact assessment are as follows;

- Field investigations were performed on foot and by vehicle where access was readily available.
- Sites were evaluated by means of description of the cultural landscape, direct observations and analysis of written sources and available databases.
- It was assumed that the site layout as provided by *Inaluk Consulting Services* is accurate.
- We assumed that the public participation process performed as part of the Basic Assessment process was sufficiently encompassing not to be repeated in the Heritage Assessment Phase.

Table 1. Impacts on the NHRA Sections

Act	Section	Description	Possible Impact	Action
National Heritage Resources Act (NHRA)	34	Preservation of buildings older than 60 years	No impact	None
	35	Archaeological, paleontological and meteor sites	No impact	None
	36	Graves and burial sites	No impact	None
	37	Protection of public monuments	No impact	None
	38	Does activity trigger a HIA?	Yes	HIA

Table 2. NHRA Triggers

Action Trigger	Yes/No	Description
Construction of a road, wall, power line, pipeline, canal or other linear form of development or barrier exceeding 300m in length.	No	N/A
Construction of a bridge or similar structure exceeding 50m in length.	No	N/A
Development exceeding 5000 m^2	Yes	Proposed new township development
Development involving more than 3 erven or sub divisions	No	N/A
Development involving more than 3 erven or sub divisions that have been consolidated in the past 5 years	No	N/A
Re-zoning of site exceeding 10 000 m^2	Yes	Proposed new township development
Any other development category, public open space, squares, parks or recreational grounds	No	N/A

3. Methodology

3.1 Heritage Management

This study defines the heritage component of the EIA process being undertaken for the proposed new township development on a portion of the farm Klipfontein 716 and the farm Ceres 626 near Bloemfontein in the Mangaung Metropolitan Municipality in the Free State Province.

It is described as a first phase (HIA). This report attempts to evaluate both the accumulated heritage knowledge of the area and information derived from direct physical observations.

3.2 Inventory

Inventory studies involve the in-field survey and recording of archaeological resources within a proposed development area. The nature and scope of this type of study is defined primarily by the results of the overview study. In the case of site-specific developments, direct implementation of an inventory study may preclude the need for an overview.

There are a number of different methodological approaches to conducting inventory studies. Therefore, the proponent, in collaboration with the archaeological consultant, must develop an inventory plan for review and approval by the SAHRA prior to implementation (*Dincause, Dena F., H. Martin Wobst, Robert J. Hasenstab and David M. Lacy 1984)*.

3.3 Evaluating Heritage Impacts

A combination of document research as well as the determination of the geographic suitability of areas and the evaluation of aerial photographs determined which areas could and should be accessed.

After plotting of the site on a GPS the areas were accessed using suitable combinations of vehicle access and access by foot.

Sites were documented by digital photography and geo-located with GPS readings using the WGS 84 datum. An aerial drone was used to evaluate the site from different heights and to improve coverage of the area.

Further techniques (where possible) included interviews with local inhabitants, visiting local museums and information centers and discussions with local experts. All this information was combined with information from an extensive literature study as well as the result of archival studies based on the SAHRA (South African Heritage Resource Agency) provincial databases.

This Heritage Impact Assessment relies on the analysis of written documents, maps, aerial photographs and other archival sources combined with the results of site investigations and interviews with effected people. Site investigations are not exhaustive and often focus on areas such as river confluence areas, elevated sites or occupational ruins.

The following documents were consulted in this study;

- South African National Archive Documents
- SAHRIS (South African Heritage Resources Information System) Database of Heritage Studies
- Internet Search
- Historic Maps
- 1951 and 2007 Surveyor General Topographic Map series
- 1952 1:10 000 aerial photo survey
- Google Earth 2018 imagery
- Published articles and books
- JSTOR Article Archive

3.4 Site Visit / Fieldwork Details

Fieldwork for the HIA was done on the 17th and 18th of July 2019. Most of the areas were found to be accessible by vehicle and on foot. Areas of possible significance were investigated on foot. The survey was tracked using GPS and a track file in GPX format is available on request. An aerial drone was used to increase coverage of the site. It has been found that high resolution aerial photography is much more effective than transect walks (which is usually prohibitively expensive in terms of time and cost). A meshed image of the site is compiled from a mosaic of photos taken from a height of 60m. This gives a resolution of 2cm/pixel. These photographs were compiled on site, analysed and anomalous areas investigated on foot.

Where sites were identified it was documented photographically and plotted using GPS with the WGS 84 datum point as reference. GPX files are available on request from G&A Heritage.

The study area was surveyed using standard archaeological surveying methods. The area was surveyed using directional parameters supplied by the GPS and surveyed by foot and aerial drone. This technique has proven to result in the maximum coverage of an area.

Standard archaeological documentation formats were employed in the description of sites. Using standard site documentation forms as comparable medium, it enabled the surveyors to evaluate the relative importance of sites found. Furthermore, GPS (Global Positioning System) readings of all finds and sites were taken. This information was then plotted using a ***Garmin Colorado*** GPS (WGS 84- datum).

Indicators such as surface finds, plant growth anomalies, local information and topography were used in identifying sites of possible archaeological importance. Test probes were done at intervals to determine sub-surface occurrence of archaeological material. The importance of sites was assessed by comparisons with published information as well as comparative collections.

Test excavation is that form of archaeological excavation where the purpose is to establish the nature and extent of archaeological deposits and features present in a location, which it is proposed to develop (though not normally to fully investigate those deposits or features) and allow an assessment to be made of the archaeological impact of the proposed development. It may also be referred to as archaeological testing' (DAHGI 1999a, 27).

'Test excavation should not be confused with, or referred to as, archaeological assessment which is the overall process of assessing the archaeological impact of development. Test excavation is one of the techniques in carrying out archaeological assessment which may also include, as appropriate, documentary research, field walking, examination of upstanding or visible features or structures, examination of aerial photographs, satellite or other remote sensing imagery, geophysical survey, and topographical assessment' (DAHGI 1999b, 18).

3.5 Findings

A water cistern, troughs and other modern ruins in the centre of the study area were noted. More modern ruins along the southern boundary of the study area was also identified. None of these are considered to be historically significant.

3.6 Consultations

Signage indicating the HIA performed and the planned development actions were placed on site. The heritage component was also included in the larger ESIA advertisements placed by the lead consultant. Since the site is not occupied and bordered by the informal settlements and commercial farming, it is not anticipated that any public participation feedback will be received. It was noted that the site is used by a local farmers as grazing for their sheep. It is not known if this is a formal arrangement.

3.7 Assumptions

It was assumed that the impacted areas will be limited to the proposed layout as received by *Inaluk Consulting Services*. It is furthermore assumed that the Paleo Sensitivity Map provided on the SAHRIS platform is comprehensive enough to inform on actions in this regard. It is assumed that activities will be limited to the development area and that they will not impact any areas outside of the indicated study area.

3.8 Gaps / Limitations / Uncertainty

The area was readily accessible.

3.9 Specialist Specific Methodology

The scope of work includes:

- the identification and assessment of archaeological, cultural, historic, built and paleontological sites within the study area.
- Interrogation of project-specific Drone data and aerial imagery.
- Archival study of existing data and information for the study area.
- This site work includes communicating with local inhabitants to confirm possible locations of heritage and cultural sites.
- Impact assessment has been performed according to the methodology as described in the relevant section.

3.10 Impact Assessment Methodology

Degrees of Significance – Significance Criteria
There are several kinds of significance, including scientific, public, ethnic, historic and economic, that need to be taken into account when evaluating heritage resources. For any site, explicit criteria are used to measure these values. Checklists of criteria for evaluating pre-contact and post-contact archaeological sites are provided. These checklists are not intended to be exhaustive or inflexible. Innovative approaches to site evaluation which emphasize quantitative analysis and objectivity are encouraged. The process used to derive a measure of relative site significance must be rigorously documented, particularly the system for ranking or weighting various evaluated criteria.

Site integrity, or the degree to which a heritage site has been impaired or disturbed as a result of past land alteration, is an important consideration in evaluating site significance. In this regard, it is important to recognize that although an archaeological site has been disturbed, it may still contain important scientific information.

Heritage resources may be of scientific value in two respects. The potential to yield information, which, if properly recovered, will enhance understanding of Southern African human history, is one appropriate measure of scientific significance. In this respect, archaeological sites should be evaluated in terms of their potential to resolve current archaeological research problems. Scientific significance also refers to the potential for relevant contributions to other academic disciplines or to industry.

Public significance refers to the potential a site has for enhancing the public's understanding and appreciation of the past. The interpretive, educational and recreational potential of a site are valid indications of public value. Public significance criteria such as ease of access, land ownership, or scenic setting are often external to the site itself. The relevance of heritage resource data to private industry may also be interpreted as a particular kind of public significance.

Ethnic significance applies to heritage sites which have value to an ethnically distinct community or group of people. Determining the ethnic significance of an archaeological site may require consultation with persons having special knowledge of a particular site. It is essential that ethnic significance be assessed by someone properly trained in obtaining and evaluating such data.

Historic archaeological sites may relate to individuals or events that made an important, lasting contribution to the development of a particular locality or the province. Historically important sites also reflect or

commemorate the historic socioeconomic character of an area. Sites having high historical value will also usually have high public value.

The economic or monetary value of a heritage site, where calculable, is also an important indication of significance. In some cases, it may be possible to project monetary benefits derived from the public's use of a heritage site as an educational or recreational facility. This may be accomplished by employing established economic evaluation methods; most of which have been developed for valuating outdoor recreation. The objective is to determine the willingness of users, including local residents and tourists, to pay for the experiences or services the site provides even though no payment is presently being made. Calculation of user benefits will normally require some study of the visitor population *(Smith, L.D. 1977)*.

- **Rarity**
  - It possesses uncommon, rare or endangered aspects of natural or cultural heritage.
  - Importance for rare, endangered or uncommon structures, landscapes or phenomena.

- **Representivity**
  - It is important in demonstrating the principal characteristics of a particular class of natural or cultural places or objects.
  - Importance in demonstrating the principal characteristics of a range of landscapes or environments, the attributes of which identify it as being characteristic of its class.
  - Importance in demonstrating the principal characteristics of human activities (including way of life, philosophy, custom, process, land-use, function, design or technique) in the environment of the nation, province, region or locality.

The table below illustrates how a site's heritage significance is determined

Table 3. Site's Heritage Significance

Spheres of Significance	High	Medium	Low
International			
National			
Provincial			
Regional			
Local			
Specific Community			

4. Assessment of Heritage Potential

4.1 Assessment Matrix

4.1.1 Determining Archaeological Significance

In addition to guidelines provided by the National Heritage Resources Act (Act No. 25 of 1999), a set of criteria based on Deacon (J) and Whitelaw (1997) for assessing archaeological significance has been developed for Eastern Cape settings (Morris 2007a). These criteria include estimation of landform potential (in terms of its capacity to contain archaeological traces) and assessing the value to any archaeological traces (in terms of their attributes or their capacity to be construed as evidence, given that evidence is not given but constructed by the investigator).

Estimating site potential

Table 4 (below) is a classification of landforms and visible archaeological traces used for estimating the potential of archaeological sites (after J. Deacon and, National Monuments Council). Type 3 sites tend to be those with higher archaeological potential, but there are notable exceptions to this rule, for example the renowned rock engravings site Driekopseiland near Kimberley which is on landform L1 Type 1 – normally a setting of lowest expected potential. It should also be noted that, generally, the older a site the poorer the preservation, so that sometimes any trace, even of only Type 1 quality, could be of exceptional significance. In light of this, estimation of potential will always be a matter for archaeological observation and interpretation.

Table 4. Classification of landforms and visible archaeological traces for estimating the potential for archaeological sites (after J. Deaon, NMC as used in Morris)

Class	Landform	Type 1	Type 2	Type 3
L1	Rocky Surface	Bedrock exposed	Some soil patches	Sandy/grassy patches
L2	Ploughed land	Far from water	In floodplain	On old river terrace
L3	Sandy ground, inland	Far from water	In floodplain or near features such as hill/dune	On old river terrace
L4	Sandy ground, coastal	>1 km from sea	Inland of dune cordon	Near rocky shore
L5	Water-logged deposit	Heavily vegetated	Running water	Sedimentary basin
L6	Developed urban	Heavily built-up with no known record of early settlement	Known early settlement, but buildings have basements	Buildings without extensive basements over known historical sites
L7	Lime/dolomite	>5 myrs	<5000 yrs	Between 5000 yrs and 5 myrs
L8	Rock shelter	Rocky floor	Loping floor or small area	Flat floor, high ceiling
Class	Archaeological traces	Type 1	Type 2	Type 3
A1	Area previously excavated	Little deposit remaining	More than half deposit remaining	High profile site
A2	Shell of bones visible	Dispersed scatter	Deposit <0.5 m thick	Deposit >0.5 m thick; shell and bone dense
A3	Stone artefacts or stone walling or other feature visible	Dispersed scatter	Deposit <0.5m thick	Deposit >0.5 m thick

Table 5. Site attributes and value assessment (adopted from Whitelaw 1997 as used in Morris)

Class	Landforms	Type 1	Type 2	Type 3
1	Length of sequence /context	No sequence Poor context Dispersed distribution	Limited sequence	Long sequence Favourable context High density of arte / ecofacts
2	Presence of exceptional items (incl. regional rarity)	Absent	Present	Major element
3	Organic preservation	Absent	Present	Major element
4	Potential for future archaeological investigation	Low	Medium	High
5	Potential for public display	Low	Medium	High
6	Aesthetic appeal	Low	Medium	High
7	Potential for implementation of a long-term management plan	Low	Medium	High

4.2 Assessing site value by attribute

Table 5 is adapted from Whitelaw (1997), who developed an approach for selecting sites meriting heritage recognition status in KwaZulu-Natal. It is a means of judging a site's archaeological value by ranking the relative strengths of a range of attributes (given in the second column of the table). While aspects of this matrix remain qualitative, attribute assessment is a good indicator of the general archaeological significance of a site, with Type 3 attributes being those of highest significance.

4.3 Impact Statement

4.3.1 Assessment of Impacts

A heritage resource impact may be broadly defined as the net change between the integrity of a heritage site with and without the proposed development. This change may be either beneficial or adverse.

Beneficial impacts occur wherever a proposed development actively protects, preserves or enhances a heritage resource. For example, development may have a beneficial effect by preventing or lessening natural site erosion. Similarly, an action may serve to preserve a site for future investigation by covering it with a protective layer of fill. In other cases, the public or economic significance of an archaeological site may be enhanced by actions, which facilitate non-destructive public use. Although beneficial impacts are unlikely to occur frequently, they should be included in the assessment.

More commonly, the effects of a project on heritage sites are of an adverse nature. Adverse impacts occur under conditions that include:

a) destruction or alteration of all or part of a heritage site;
b) isolation of a site from its natural setting; and
c) introduction of physical, chemical or visual elements that are out-of-character with the heritage resource and its setting.

Adverse effects can be more specifically defined as direct or indirect impacts. Direct impacts are the immediately demonstrable effects of a project which can be attributed to particular land modifying actions. They are directly caused by a project or its ancillary facilities and occur at the same time and place. The immediate consequences of a project action, such as slope failure following reservoir inundation, are also considered direct impacts.

Indirect impacts result from activities other than actual project actions. Nevertheless, they are clearly induced by a project and would not occur without it. For example, project development may induce changes in land use or population density, such as increased urban and recreational development, which may indirectly impact upon heritage sites. Increased vandalism of heritage sites, resulting from improved or

newly introduced access, is also considered an indirect impact. Indirect impacts are much more difficult to assess and quantify than impacts of a direct nature.

Once all project related impacts are identified, it is necessary to determine their individual level-of-effect on heritage resources. This assessment is aimed at determining the extent or degree to which future opportunities for scientific research, preservation, or public appreciation are foreclosed or otherwise adversely affected by a proposed action. Therefore, the assessment provides a reasonable indication of the relative significance or importance of a particular impact. Normally, the assessment should follow site evaluation since it is important to know what heritage values may be adversely affected.

The assessment should include careful consideration of the following level-of-effect indicators, which are defined below:

- magnitude
- severity
- duration
- range
- frequency
- diversity
- cumulative effect
- rate of change

4.4 Indicators of Impact Severity

Magnitude
The amount of physical alteration or destruction, which can be expected. The resultant loss of heritage value is measured either in amount or degree of disturbance.

Severity
The irreversibility of an impact. Adverse impacts, which result in a totally irreversible and irretrievable loss of heritage value, are of the highest severity.

Duration
The length of time an adverse impact persists. Impacts may have short-term or temporary effects, or conversely, more persistent, long-term effects on heritage sites.

Range
The spatial distribution, whether widespread or site-specific, of an adverse impact.

Frequency
The number of times an impact can be expected. For example, an adverse impact of variable magnitude and severity may occur only once. An impact such as that resulting from cultivation may be of recurring or on-going nature.

Diversity
The number of different kinds of project-related actions expected to affect a heritage site.

Cumulative Effect
A progressive alteration or destruction of a site owing to the repetitive nature of one or more impacts.

Rate of Change
The rate at which an impact will effectively alter the integrity or physical condition of a heritage site. Although an important level-of-effect indicator, it is often difficult to estimate. Rate of change is normally assessed during or following project construction.

The level-of-effect assessment should be conducted and reported in a quantitative and objective fashion. The methodological approach, particularly the system of ranking level-of-effect indicators, must be

rigorously documented and recommendations should be made with respect to managing uncertainties in the assessment. *(Zubrow, Ezra B.A., 1984).*

4.4.1 Pre-Contact Sites

No Pre-contact sites were identified.

4.4.2 Post-Contact Sites

No Post-contact sites were identified.

4.4.3 Built Environment

Some modern farming related structures (such as troughs and a cistern) was noted on site. These were not of any heritage significance. The area is used for extensive dumping of building materials, which has no significance.

Table 6. Historic Significance

No	Criteria	Significance Rating
1	***Are any of the identified sites or buildings associated with a historical person or group?*** No	N/A
2	***Are any of the buildings or identified sites associated with a historical event?*** No	N/A
3	***Are any of the identified sites or buildings associated with a religious, economic social or political or educational activity?*** No	N/A
4	***Are any of the identified sites or buildings of archaeological significance?*** No	N/A
5	***Are any of the identified buildings or structures older than 60 years?*** No	N/A

Table 7. Architectural Significance

No	**Criteria**	**Rating**
1	***Are any of the buildings or structures an important example of a building type?*** No	N/A
2	***Are any of the buildings outstanding examples of a particular style or period?*** No	N/A
3	***Do any of the buildings contain fine architectural details and reflect exceptional craftsmanship?*** No	N/A
4	***Are any of the buildings an example of an industrial, engineering or technological development?*** No	N/A
5	***What is the state of the architectural and structural integrity of the building?*** No	N/A
6	***Is the building's current and future use in sympathy with its original use (for which the building was designed)?*** N/A	-
7	***Were the alterations done in sympathy with the original design?*** N/A	-
8	***Were the additions and extensions done in sympathy with the original design?***	

	N/A	-
9	***Are any of the buildings or structures the work of a major architect, engineer or builder?*** No.	N/A

Even though each building needs to be evaluated as a single artefact the site still needs to be evaluated in terms of its significance in its geographic area, city, town, village, neighbourhood or precinct. This set of criteria determines the spatial significance.

Table 8. Spatial Significance

No	Criteria	Rating
1	***Can any of the identified buildings or structures be considered a landmark in the town or city?*** No	-
2	***Do any of the buildings contribute to the character of the neighborhood?*** No	-
3	***Do any of the buildings contribute to the character of the square or streetscape?*** No	-
4	***Do any of the buildings form part of an important group of buildings?*** No	-

5. Impact Evaluation

This HIA Methodology assists in evaluating the overall effect of a proposed activity on the heritage environment. The determination of the effect of a heritage impact on a heritage parameter is determined through a systematic analysis of the various components of the impact. This is undertaken using information that is available to the heritage practitioner through the process of heritage impact assessment. The impact evaluation of predicted impacts was undertaken through an assessment of the significance of the impacts.

5.1 Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics, which include context and intensity of an impact. Context refers to the geographical scale i.e. site, local, national or global whereas intensity is defined by the severity if the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence.
Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

5.2 Impact Rating System

Impact assessment must take account of the nature, scale and duration of effects on the heritage environment whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the project stages:

- planning
- construction
- operation
- decommissioning

Where necessary, the proposal for mitigation or optimisation of an impact will be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

5.2.1 Rating System Used to Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of the impact. Impacts have been consolidated into one rating. In assessing the significance of each issue, the following criteria (including an allocated point system) is used:

Table 9. Impact Ratings

NATURE		
Including a brief description of the impact of the heritage parameter being assessed in the context of the project. This criterion includes a brief written statement of the heritage aspect being impacted upon by a particular action or activity.		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site.
2	Local/district	Will affect the local area or district.
3	Province/region	Will affect the entire province or region.
4	International and National	Will affect the entire country.
PROBABILITY		
This describes the chance of occurrence of an impact		

1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY		
This describes the degree to which an impact on a heritage parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures.
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible, and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which heritage resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION		
This describes the duration of the impacts on the heritage parameter. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
CUMULATIVE EFFECT		

This describes the cumulative effect of the impacts on the heritage parameter. A cumulative effect/impact is an effect, which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible Cumulative Impact	The impact would result in negligible to no cumulative effects.
2	Low Cumulative Impact	The impact would result in insignificant cumulative effects.
3	Medium Cumulative impact	The impact would result in minor cumulative effects.
4	High Cumulative Impact	The impact would result in significant cumulative effects.
INTENSITY / MAGNITUDE		
Describes the severity of an impact.		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
SIGNIFICANCE		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the heritage parameter. The calculation of the significance of an impact uses the following formula: **(Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.** The summation of the different criteria will produce a non weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.		
Points	**Impact Significance Rating**	**Description**
6 to 28	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive Low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive Medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive High impact	The anticipated impact will have significant positive effects.

74 to 96	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive Very high impact	The anticipated impact will have highly significant positive effects.

5.3 Assessing Visual Impact

Visual impacts of developments result when sites that are culturally celebrated are visually affected by a development. The exact parameters for the determination of visual impacts have not yet been rigidly defined and are still mostly open to interpretation. CNdV Architects and The Department of Environmental Affairs and Development Planning (2006) have developed some guidelines for the management of the visual impacts of wind turbines in the Western Cape, although these have not yet been formalised. In these guidelines they recommend a buffer zone of 1km around significant heritage sites to minimise the visual impact.

Due to the fact that the project will mainly involve sub-surface infrastructure it is not anticipated that any visual impacts will be encountered.

5.4 Assumptions and Restrictions

- It is assumed that the South African Heritage Resources Information System (SAHRIS) database locations are correct.
- It is assumed that the paleontological information collected for the project is comprehensive.
- It is assumed that the social impact assessment and public participation process of the environmental assessment will result in the identification of any intangible sites of heritage potential.

6. Assessment of Impacts

6.1 Impact Statement

6.1.1 Built Environment

Some structures associated with rural living were identified;

- Brick outbuildings (modern and historic)
- Barb-wire fences (modern)
- Dirt roads (modern)
- Footpaths
- Farming related structures

Mitigation

None of these structures warrant mitigation.

6.1.2 Cultural Landscape

The following landscape types were identified during the study.

Table 10. Cultural Landscapes

Landscape Type	Description	Occurrence still possible?	Likely occurrence?
1 Paleontological	Mostly fossil remains. Remains include microbial fossils such as found in Baberton Greenstones	Yes, sub-surface	Likely
2 Archaeological	Evidence of human occupation associated with the following phases – Early-, Middle-, Late Stone Age, Early-, Late Iron Age, Pre-Contact Sites, Post-Contact Sites	Yes	Unlikely
3 Historic Built Environment	- Historical townscapes/streetscapes - Historical structures; i.e. older than 60 years - Formal public spaces - Formally declared urban conservation areas - Places associated with social identity/displacement	No	No
4 Historic Farmland	These possess distinctive patterns of settlement and historical features such as: - Historical farm yards - Historical farm workers villages/settlements - Irrigation furrows - Tree alignments and groupings - Historical routes and pathways - Distinctive types of planting - Distinctive architecture of cultivation e.g. planting blocks, trellising, terracing, ornamental planting.	No	No
5 Historic rural town	- Historic mission settlements - Historic townscapes	No	No
6 Pristine natural landscape	- Historical patterns of access to a natural amenity - Formally proclaimed nature reserves - Evidence of pre-colonial occupation	No	No

	- Scenic resources, e.g. view corridors, viewing sites, visual edges, visual linkages - Historical structures/settlements older than 60 years - Pre-colonial or historical burial sites - Geological sites of cultural significance.		
7 Relic Landscape	- Past farming settlements - Past industrial sites - Places of isolation related to attitudes to medical treatment - Battle sites - Sites of displacement,	No	No
8 Burial grounds and grave sites	- Pre-colonial burials (marked or unmarked, known or unknown) - Historical graves (marked or unmarked, known or unknown) - Graves of victims of conflict - Human remains (older than 100 years) - Associated burial goods (older than 100 years) - Burial architecture (older than 60 years)	Yes,	Unlikely
9 Associated Landscapes	- Sites associated with living heritage e.g. initiation sites, harvesting of natural resources for traditional medicinal purposes - Sites associated with displacement & contestation - Sites of political conflict/struggle - Sites associated with an historic event/person - Sites associated with public memory	No	No
10 Historical Farmyard	- Setting of the yard and its context - Composition of structures - Historical/architectural value of individual structures - Tree alignments - Views to and from - Axial relationships - System of enclosure, e.g. defining walls - Systems of water reticulation and irrigation, e.g. furrows - Sites associated with slavery and farm labour - Colonial period archaeology	No	No
11 Historic institutions	- Historical prisons - Hospital sites - Historical school/reformatory sites - Military bases	No	No
12 Scenic visual	- Scenic routes	No	No
13 Amenity landscape	- View sheds - View points - Views to and from - Gateway conditions - Distinctive representative landscape conditions - Scenic corridors	No	No

7. Measuring Impacts

In 2003 the SAHRA (South African Heritage Resources Agency) compiled the following guidelines to evaluate the cultural significance of individual heritage resources:

- **Type of Resource**
  - Place
  - Archaeological Site
  - Structure
  - Grave
  - Palaeontological Feature
  - Geological Feature

- **Type of Significance**

  - Historic Value
    - Important in the community, or pattern of history
    - Important in the evolution of cultural landscapes and settlement patterns
    - Important in exhibiting density, richness or diversity of cultural features illustrating the human occupation and evolution of the nation, province, region or locality.
    - Important for association with events, developments or cultural phases that have had a significant role in the human occupation and evolution of the nation, province, region or community.
    - Important as an example for technical, creative, design or artistic excellence, innovation or achievement in a particular period.
    - It has strong or special association with the life or work of a person, group or organisation of importance in history
    - Importance for close associations with individuals, groups or organisations whose life, works or activities have been significant within the history of the nation, province, region or community.
    - It has significance relating to the history of slavery
    - Importance for a direct link to the history of slavery in South Africa.

  - Aesthetic Value
    - It is important in exhibiting particular aesthetic characteristics valued by a community or cultural group.
    - Important to a community for aesthetic characteristics held in high esteem or otherwise valued by the community.
    - Importance for its creative, design or artistic excellence, innovation or achievement.
    - Importance for its contribution to the aesthetic values of the setting demonstrated by a landmark quality or having impact on important vistas or otherwise contributing to the identified aesthetic qualities of the cultural environs or the natural landscape within which it is located.
    - In the case of an historic precinct, importance for the aesthetic character created by the individual components which collectively form a significant streetscape, townscape or cultural environment.

  - Scientific Value
    - It has potential to yield information that will contribute to an understanding of natural or cultural heritage
    - Importance for information contributing to a wider understanding of natural or cultural history by virtue of its use as a research site, teaching site, type locality, reference or benchmark site.
    - Importance for information contributing to a wider understanding of the origin of the universe or of the development of the earth.

- Importance for information contributing to a wider understanding of the origin of life; the development of plant or animal species, or the biological or cultural development of hominid or human species.
- Importance for its potential to yield information contributing to a wider understanding of the history of human occupation of the nation, Province, region or locality.
- It is important in demonstrating a high degree of creative or technical achievement at a particular period
- Importance for its technical innovation or achievement.

a) Does the site contain evidence, which may substantively enhance understanding of culture history, culture process, and other aspects of local and regional prehistory?

- internal stratification and depth
- chronologically sensitive cultural items
- materials for absolute dating
- association with ancient landforms
- quantity and variety of tool type
- distinct intra-site activity areas
- tool types indicative of specific socio-economic or religious activity
- cultural features such as burials, dwellings, hearths, etc.
- diagnostic faunal and floral remains
- exotic cultural items and materials
- uniqueness or representativeness of the site
- integrity of the site

b) Does the site contain evidence which may be used for experimentation aimed at improving archaeological methods and techniques?

- monitoring impacts from artificial or natural agents
- site preservation or conservation experiments
- data recovery experiments
- sampling experiments
- intra-site spatial analysis

c) Does the site contain evidence which can make important contributions to paleo environmental studies?

- topographical, geomorphological context
- depositional character
- diagnostic faunal, floral data

d) Does the site contain evidence which can contribute to other scientific disciplines such as hydrology, geomorphology, pedology, meteorology, zoology, botany, forensic medicine, and environmental hazards research, or to industry including forestry and commercial fisheries?

- Social Value / Public Significance
  - It has strong or special association with a particular community or cultural group for social, cultural or spiritual reasons
  - Importance as a place highly valued by a community or cultural group for reasons of social, cultural, religious, spiritual, symbolic, aesthetic or educational associations.
  - Importance in contributing to a community's sense of place.

a) Does the site have potential for public use in an interpretive, educational or recreational capacity?

- integrity of the site

- technical and economic feasibility of restoration and development for public use
- visibility of cultural features and their ability to be easily interpreted
- accessibility to the public
- opportunities for protection against vandalism
- representativeness and uniqueness of the site
- aesthetics of the local setting
- proximity to established recreation areas
- present and potential land use
- land ownership and administration
- legal and jurisdictional status
- local community attitude toward development

b) Does the site receive visitation or use by tourists, local residents or school groups?

- Ethnic Significance
  Does the site presently have traditional, social or religious importance to a particular group or community?
  - ethnographic or ethno-historic reference
  - documented local community recognition or, and concern for, the site

- Economic Significance
  What value of user-benefits may be placed on the site?
  - visitors' willingness-to-pay
  - visitors' travel costs

- Scientific Significance
  a) Does the site contain evidence, which may substantively enhance understanding of historic patterns of settlement and land use in a particular locality, regional or larger area?
  b) Does the site contain evidence, which can make important contributions to other scientific disciplines or industry?

- Historic Significance
  a) Is the site associated with the early exploration, settlement, land use, or other aspect of southern Africa's cultural development?
  b) Is the site associated with the life or activities of a particular historic figure, group, organization, or institution that has made a significant contribution to, or impact on, the community, province or nation?
  c) Is the site associated with a particular historic event whether cultural, economic, military, religious, social or political that has made a significant contribution to, or impact on, the community, province or nation?
  d) Is the site associated with a traditional recurring event in the history of the community, province, or nation, such as an annual celebration?

- Public Significance
  a) Does the site have potential for public use in an interpretive, educational or recreational capacity?
  - visibility and accessibility to the public
  - ability of the site to be easily interpreted
  - opportunities for protection against vandalism
  - economic and engineering feasibility of reconstruction, restoration and maintenance
  - representativeness and uniqueness of the site
  - proximity to established recreation areas
  - compatibility with surrounding zoning regulations or land use

- land ownership and administration
- local community attitude toward site preservation, development or destruction
- present use of site

b) Does the site receive visitation or use by tourists, local residents or school groups?

- Other
  - Is the site a commonly acknowledged landmark?
  - Does, or could, the site contribute to a sense of continuity or identity either alone or in conjunction with similar sites in the vicinity?
  - Is the site a good typical example of an early structure or device commonly used for a specific purpose throughout an area or period of time?
  - Is the site representative of a particular architectural style or pattern?

For each predicted impact, criteria are described. These criteria include the **magnitude** (size or degree scale), which also includes the **type** of impact, being either a positive or negative impact; the **duration** (temporal scale); and the **extent** (spatial scale), as well as the **probability** (likelihood). The methodology is quantitative and generated through a spreadsheet but requires professional judgement in the application of the criteria.
When assessing impacts, broader considerations are also considered, these include the **confidence** with which the assessment was undertaken, the **reversibility** of the impact and the resource **irreplaceability**.

Calculations
(as applied in the excel spreadsheet 'Mangaung 2019.xls')

For each predicted impact, certain criteria are applied to establish the likely **significance** of the impact, firstly in the case of no mitigation being applied and then with the most effective mitigation measure(s) in place.

These criteria include the **magnitude** *(*size or degree scale), which also includes the **type** of impact, being either a positive or negative impact; the **duration** (temporal scale); and the **extent** (spatial scale). These numerical ratings are used in an equation whereby the **consequence** of the impact can be calculated. Consequence is calculated as follows:

Consequence = type x (magnitude + duration + extent).

To calculate the significance of an impact, the **probability** (or likelihood) of that impact occurring is applied to the consequence.

Significance = consequence x probability

Depending on the numerical result, the impact would fall into a significance category as negligible, minor, moderate or major, and the type would be either positive or negative.

The following tables show the scales used to classify the above variables and define each of the rating categories.

7.1 Magnitude

The magnitude refers to the degree of alteration of the affected environmental receptor. The relevant descriptor for magnitude is selected by the user (refer to Table).

Table 11. Description of magnitude and assigned numerical values

Numerical Rating	Magnitude	
	Category	**Descriptors**
1	**Negligible**	Natural and/ or social functions and/ or processes are negligibly altered

2	**Very low**	Natural and/ or social functions and/ or processes are slightly altered
3	**Low**	Natural and/ or social functions and/ or processes are somewhat altered
4	**Moderate**	Natural and/ or social functions and/ or processes are moderately altered
5	**High**	Natural and/ or social functions and/ or processes are notably altered
6	**Very high**	Natural and/ or social functions and/ or processes are majorly altered
7	**Extremely high**	Natural and/ or social functions and/ or processes are severely altered

*NOTE: Where applicable, the magnitude of the impact is related to a relevant standard or threshold or is based on specialist knowledge and understanding of that particular field.

7.2 Duration

The duration refers to the length of permanence of the impact on the environmental receptor. The relevant descriptor for duration is selected by the user (refer to Table).

Table 12. Description of duration and assigned numerical values

Numerical Rating	**Duration**	
	Category	**Descriptors**
1	**Immediate**	Impact will self-remedy immediately
2	**Brief**	Impact will not last longer than 1 year
3	**Short term**	Impact will last between 1 and 5 years
4	**Medium term**	Impact will last between 5 and 10 years
5	**Long term**	Impact will last between 10 and 15 years
6	**On-going**	Impact will last between 15 and 20 years
7	**Permanent**	Impact may be permanent, or in excess of 20 years

7.3 Extent

The extent refers to the geographical scale of impact on the environmental receptor. The relevant descriptor for extent is selected by the user (refer to Table).

Table 13. Description of extent and assigned numerical values

Numerical Rating	**Extent**	
	Category	Descriptors
1	**Very limited**	Impacts very limited / felt in isolated areas of the study area
2	**Limited**	Impacts limited to specific parts of the study area
3	**Local**	Impacts felt mostly throughout the study area
4	**Municipal area**	Impacts felt outside the study area, at a municipal level

5	**Regional**	Impacts felt outside the study area, at a regional / provincial level
6	**National**	Impacts felt outside the study area, at a national level
7	**International**	Impacts felt outside the study area, at an international level

7.4 Probability

To calculate the significance of an impact, the probability (or likelihood) of that impact occurring is also taken into account. (Refer to Table).

Table 14. Definition of probability ratings

Numerical Rating	Probability	
	Category	**Descriptors**
1	**Highly unlikely / None**	Expected never to happen
2	**Rare / improbable**	Conceivable, but only in extreme circumstances, and/or might occur for this project although this has rarely been known to result elsewhere
3	**Unlikely**	Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur
4	**Probable**	Has occurred here or elsewhere and could therefore occur
5	**Likely**	The impact may occur
6	**Almost certain / Highly probable**	It is most likely that the impact will occur
7	**Certain / Definite**	There are sound scientific reasons to expect that the impact will definitely occur

7.5 Significance

These are auto-calculated in the spreadsheet as described above and includes the following categories in Table 11. This table is for illustration only.

Table 15. Application of significance ratings

Range		Significance rating
-147	-109	Major (-)
-108	-73	Moderate (-)
-72	-36	Minor (-)
-35	-1	Negligible (-)
0	0	Neutral
1	35	Negligible (+)
36	72	Minor (+)
73	108	Moderate (+)

109	147	Major (+)

The following, broader considerations will also be considered. These include the level of confidence in the assessment rating; the reversibility of the impact; and the irreplaceability of the resource as set out in Tables 12, 13 and 14 respectively.

Table 16. Definition of confidence ratings

Rating	Descriptor
Low	Judgement is based on intuition
Medium	Determination is based on common sense and general knowledge
High	Substantive supportive data exists to verify the assessment

Table 17. Definition of reversibility ratings

Rating	Descriptor
Low	The affected environment will not be able to recover from the impact - permanently modified
Medium	The affected environment will only recover from the impact with significant intervention
High	The affected environmental will be able to recover from the impact

Table 18. Definition of irreplaceability ratings

Rating	Descriptor
Low	The resource is not damaged irreparably or is not scarce
Medium	The resource is damaged irreparably but is represented elsewhere
High	The resource is irreparably damaged and is not represented elsewhere

8. Description of Affected Environment

8.1 Map of Key Features

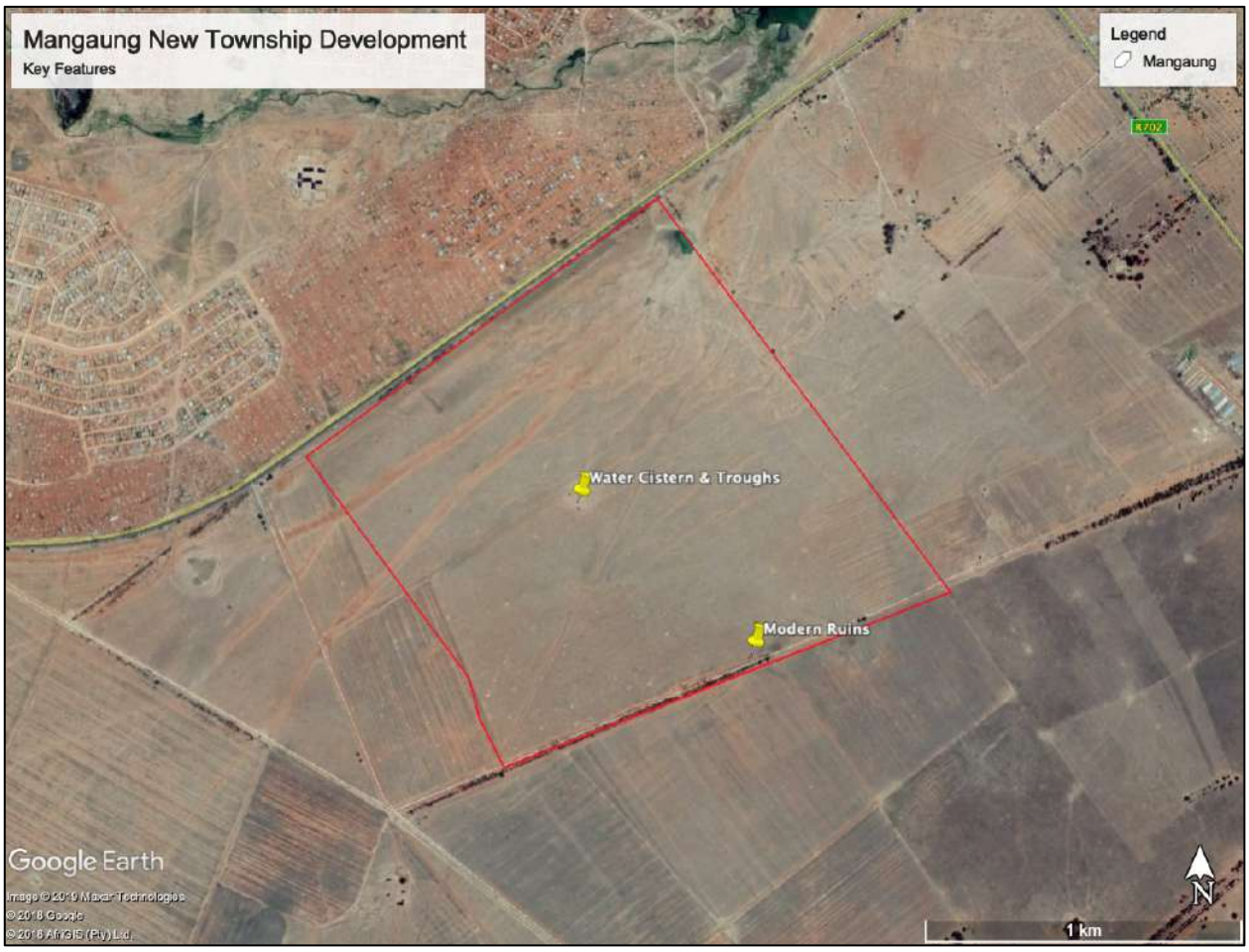

Figure 4. Map of Key Features

8.1.1 Findings

Some modern ruins were found scattered over the property. None of these had any heritage significance and they have been documented photographically during the field survey.

9. Baseline

9.1 Palaeontology

Several paleontological studies have been performed in this general area. The area is indicated as *Very High Importance* on the SAHRIS Paleo Sensitivity Map. A field assessment and protocol for finds is required.

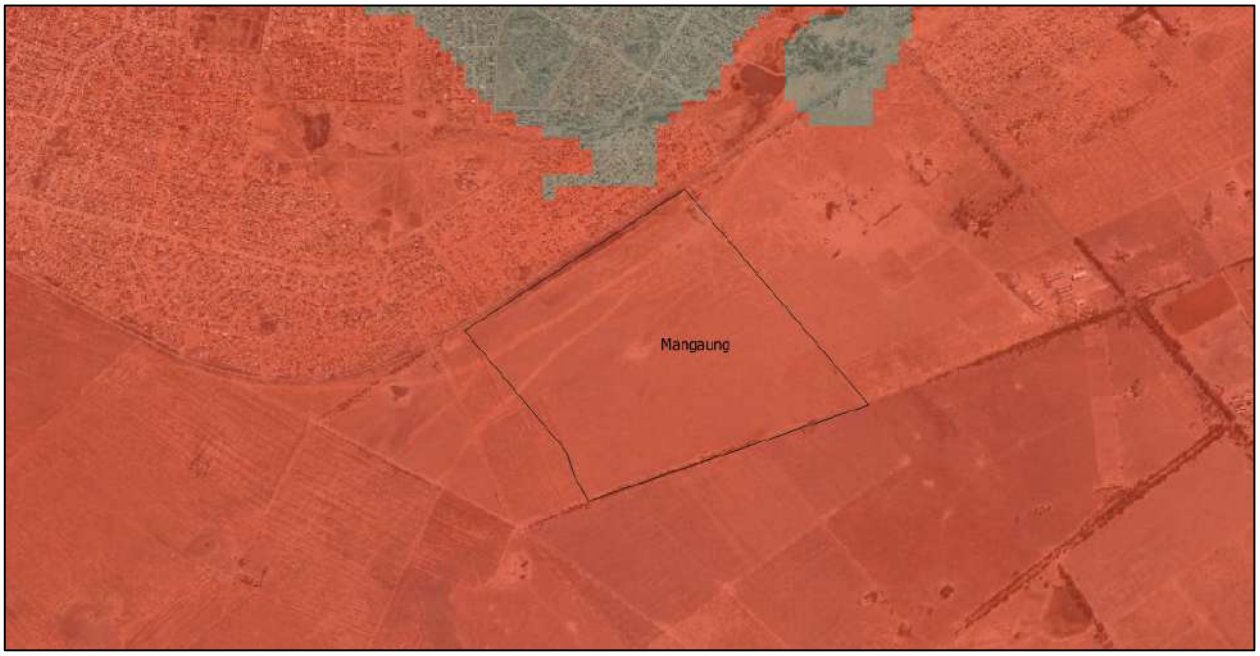

Figure 5. *PalaeoSensitivity* Map

9.2 Stone Age

Extensive research on the Stone Age in this area comes from Goodwin, Van Riet Lowe and Humphreys. Humphreys compiled a map of Fauresmith manufacture sites from 1928, 1929 & 1937 published research of Goodwin and Van Riet Lowe. The map illustrates Fauresmith (circle) and "Stellenbosch" (black dot) manufacturing sites although most of these sites also contain both Smithfield A and B material but in particular Smithfield A with Fauresmith-related sites. It also does not indicate the surface finds of the

Fauresmith tradition that are not manufacturing sites. The most important fact to take from this is that the subject area falls within a known area of the Fauresmith-tradition.

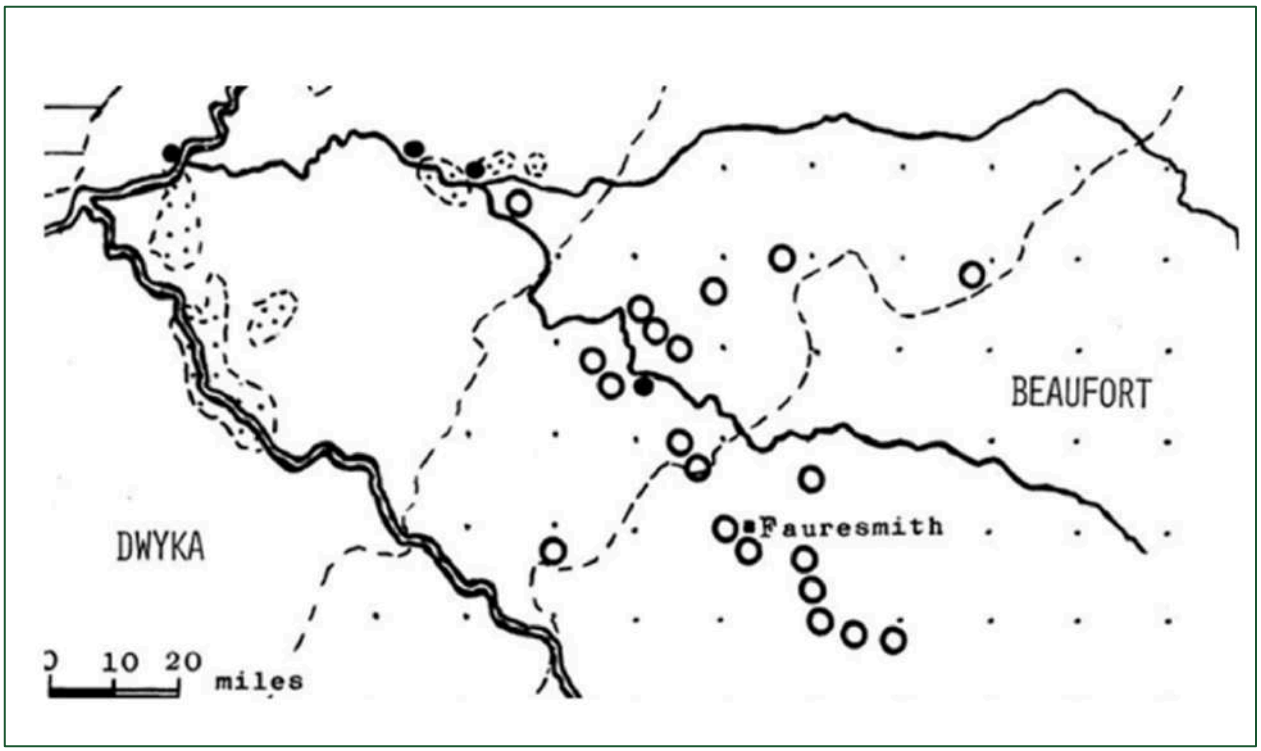

Figure 6. Stellenbosch and Fauresmith sites as per Humphreys (1971)

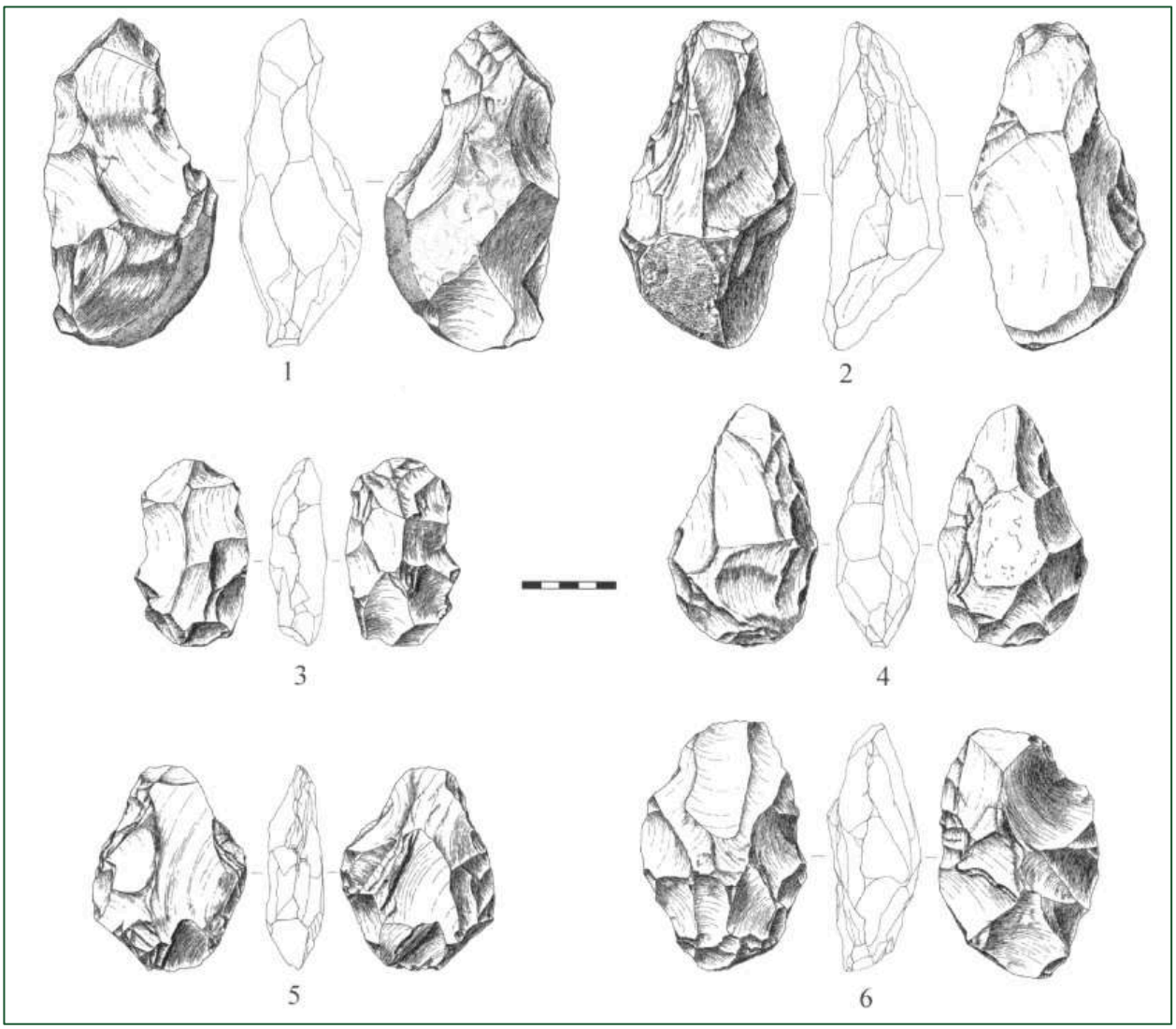

Figure 7. (1,2) Handaxes with large side removal; (3-6) handaxes (Pollarolo, Susino, Kuman, Bruxelles, 2010)

Samson (1974) states that the stratigraphic evidence from three different areas in South Africa demonstrates that the industry following the late Acheulian is not the so-called “Fauresmith”, but a complex without any of the characteristics of the Acheulian samples such as hand-axes, cleavers and picks. He furthermore indicate that secondary working of tools is virtually absent in these areas.

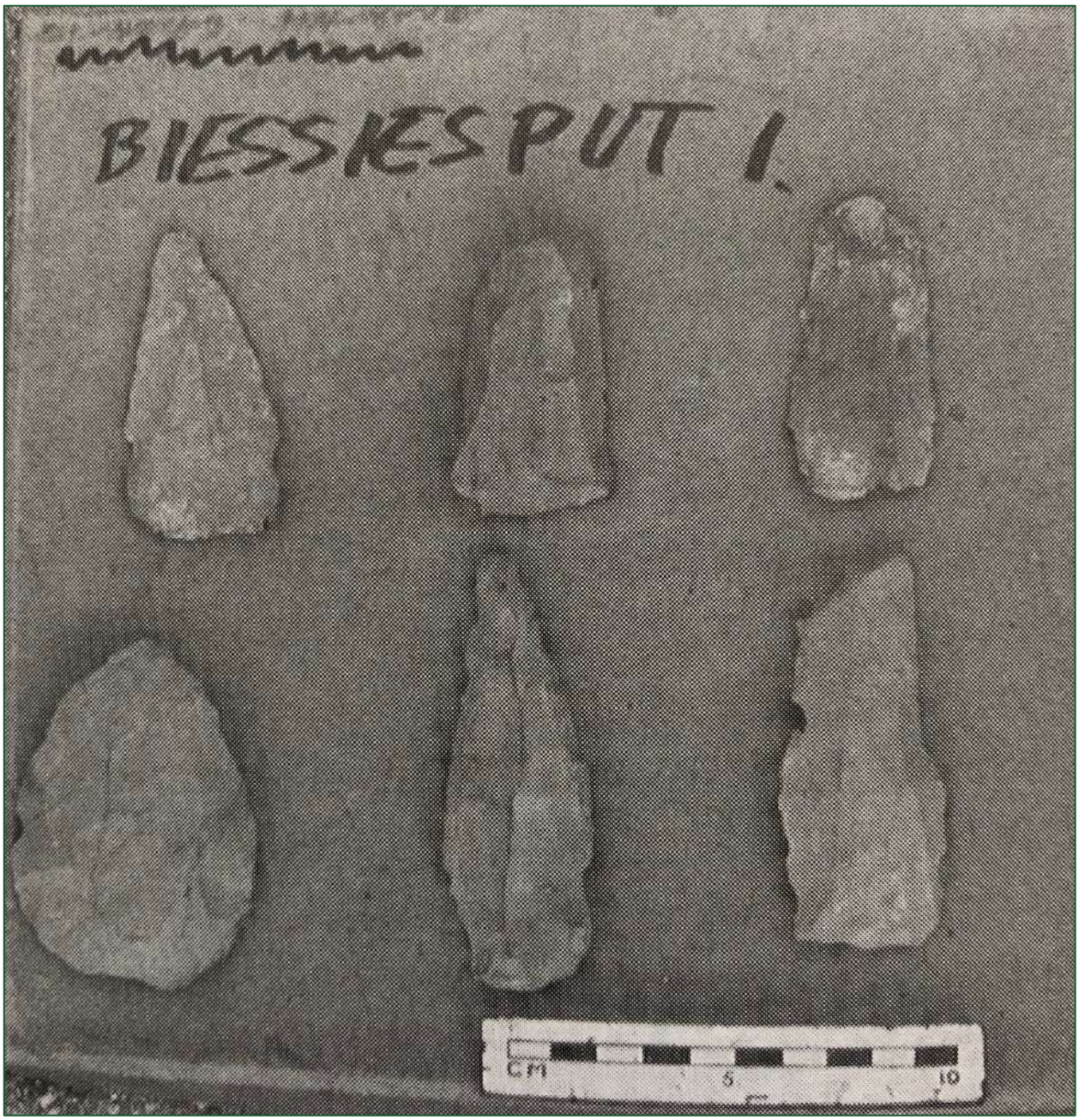

Figure 8. Fauresmith Tools (P. Mitchell, 2002)

Fauresmith Industry manufacturing sites are found on the following farms in the Xhariep District;

- Blaauwheuwel site along the Van Zyl Spruit, a tributary of the Proses Spruit
- Brakfontein (Fauresmith-tradition type site situated 19 km outside Koffiefontein on the road between Koffiefontein and Fauresmith)
- Dwarsvlei-Erfdeel-Fauresmith Townlands
- Koffiefontein
- Leeuwarden
- Petrusberg
- Rorich's Hoop
- Rooidraai
- Spitzkop I and Spitzkop II

- Valschfontein
- Zuurfontein (also along the Van Zyl Spruit)

Material catalogued as Fauresmith-tradition at the National Museum, Bloemfontein, mainly relates to the Orange River area, collected by Sampson during the rescue operation for the new Orange River Scheme (construction of the Gariep Dam).

Goodwin and Van Riet Lowe (1929, pp. 91-92) describe the finding place of the Fauresmith-tradition material at the Fauresmith Town Spruit as *"...in the immediate vicinity of the village, exposed in a bed of water-borne gravel that contains vast quantities of Fauresmith Industry remains." The characteristic artefact of the Fauresmith-tradition are handaxes, described as "a neat almond, sometimes ovate.....generally small [size], and the implements are of a length and weight which make them eminently suitable for use in the hand" and are noted as in general being found in dense concentrations.*

The subject area falls within the boundary of the Smithfield A distribution area as delineated by Goodwin and Van Riet Lowe (1929) in a map of the Orange Free State Smithfield Industry sites.

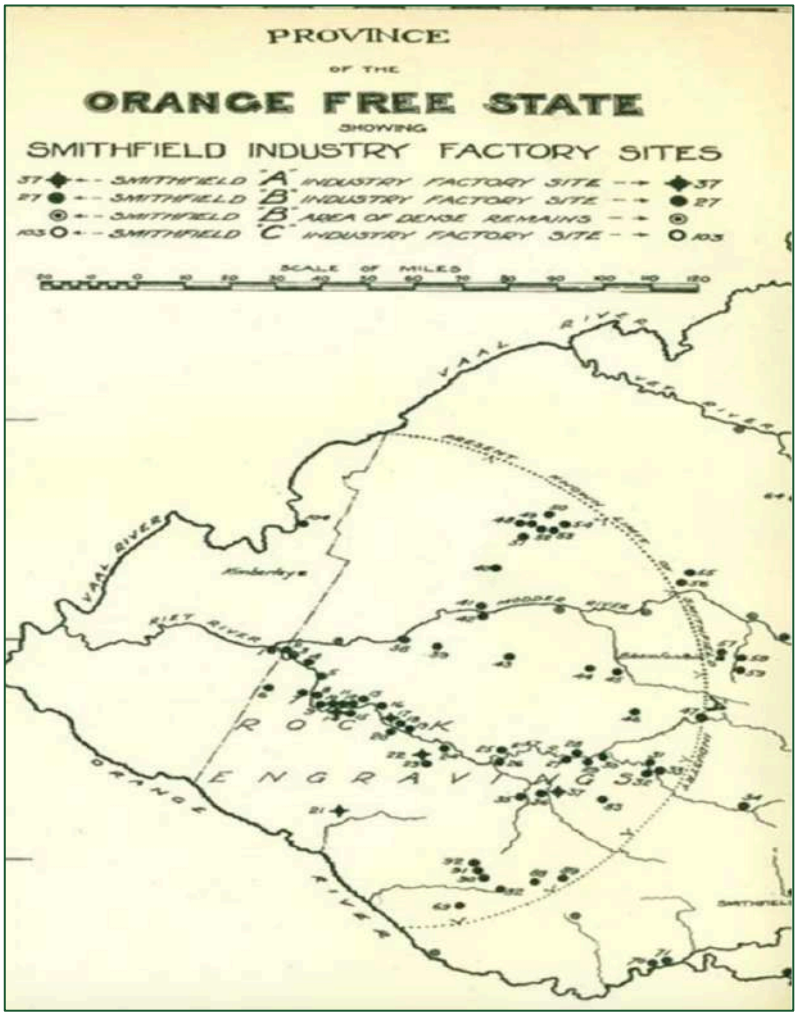

Figure 9. Smithfield A, B & C sites as per van Riet Lowe and Goodwin

A typical factory-site assemblage is described from the Lockshoek site and include:

- Concavo-convex scrapers (restricted to Smithfield A)
- Large circular scrapers (restricted to Smithfield A)
- Duckbill end-scrapers
- Side-scrapers
- Trimmed points
- Stone borers
- Bored Stones
- Grooved Stones
- Grindstones
- Pounders and grinders
- Fabricators: cores; detaching-hammers; trimming-stones; anvils

According to them no notched scrapers are associated with the Smithfield A industry, while re-used Fauresmith hand axes and re-trimmed flakes are found in association with Smithfield industries (Goodwin & Van Riet Lowe, 1929, p. 153).

List of Smithfield sites in vicinity of the study area:

- Smithfield A:
    - Blaauwheuwel 425 (also a Fauresmith industry site)
    - Brakfontein No 231 (typesite for Fauresmith industry – 15 km from Fauresmith on road to Koffiefontein)
    - Lockshoek 191 (also a Fauresmith site) – 27 km north of Jagersfontein

- Smithfield B:
    - Blaauwheuwel
    - Lockshoek

- Smithfield C: None recorded in close proximity of the subject area

9.3 Iron Age

In about 1823, the missionary Rev Burchell hired armed Griqua to protect BaThlaping living at Dithakong, about 300 km northwest of Bloemfontein. These BaThlaping were some of the first Sotho-Tswana people to have been met by Europeans from the Cape (about 1801). The word 'Dithakong' means 'place of walls' and refers to a large concentration of stonewalling on a hill above the 19th century settlement.

Literally, thousands of similar stonewalled settlements lie scattered across the highveld of the Free State. The oldest type of walling stands near the hill known as Ntsuanatsatsi, the legendary place of origin of BaFokeng. Although Tswana-speaking now, new archaeological research indicates that the Fokeng moved up from northern KwaZulu-Natal and were originally Nguni speaking. Type N walling, as it is known, emphasises the centre/side axis expressed through concentric circles: the inner circle encompasses cattle byres and the men's court, while the female residential zone of beehive houses and grain bins constitutes the outer circle. An outer wall sometimes incorporates small stock enclosures because these animals are associated with women. This type of walling first dates to the 15th century.

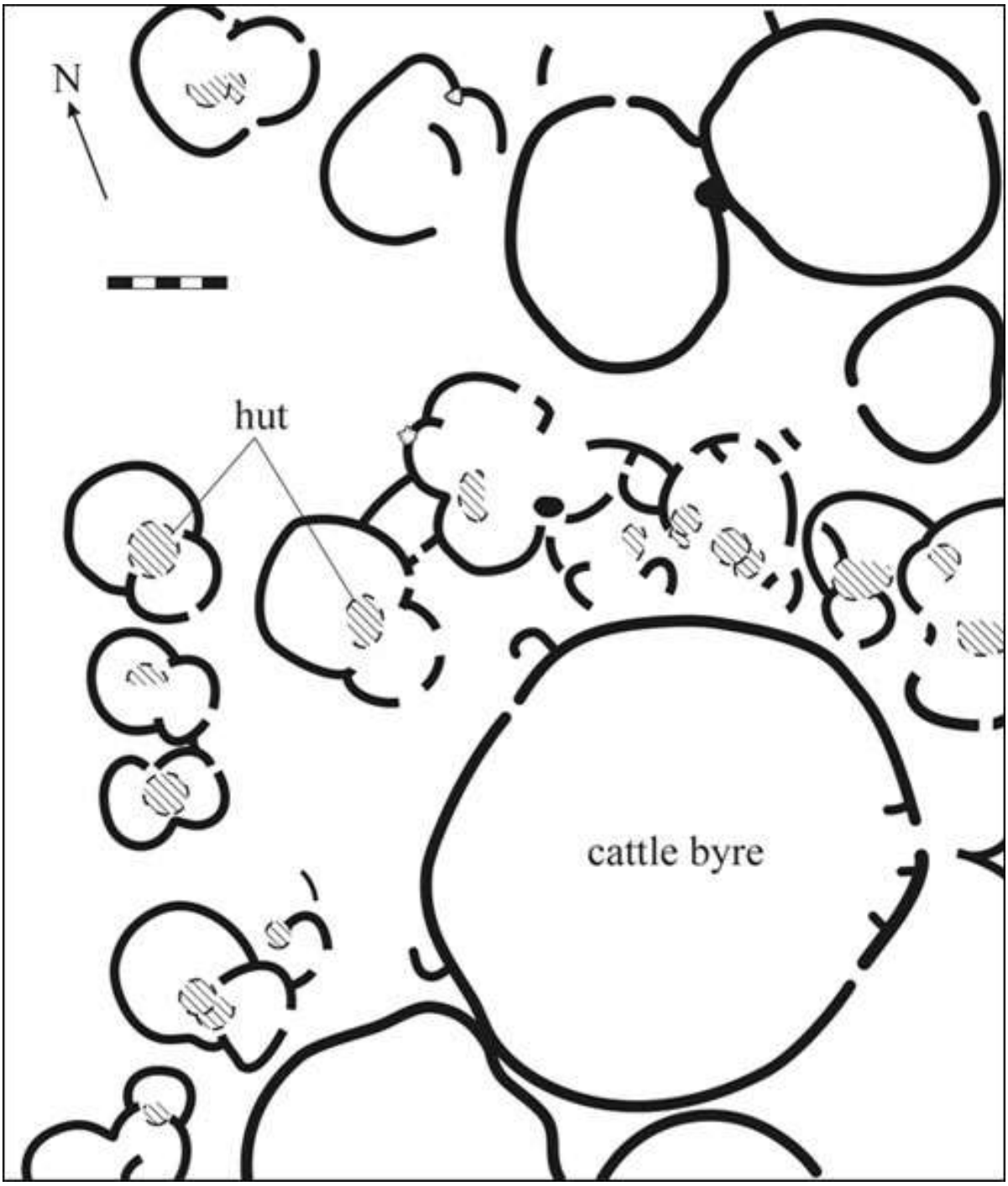

Figure 10. Central Cattle Pattern of the Iron Age

According to oral traditions, Tswana people from the west moved across the Vaal River, found BaFokeng at Ntsuanatsatsi, and assimilated them. Archaeologically, this interaction created another type of walling, called Type V, named after Vegkop near Heilbron. Among other things, this type of settlement includes the famous 'corbelled huts' that captured the imagination of early travellers. Located on the edge of the central cattle area, these low stone huts served mostly as huts for herd boys. In a few places, adults may have lived in larger examples.

The Sand River Nature Reserve contains several stonewalled settlements accessible to the public.

9.4 Historic Era

The area between the Orange and Vaal rivers, originally known as Transoranje, with its abundance of permanent water sources, was the hunting grounds of the San at the beginning of the 19th century. However, other groups began to infiltrate the area in the early 19th century.

The Griquas under Adam Kok came from the west and settled themselves near the area later known as Philippolis. As a result of the Difaqane, many groups came to the Transoranje area in the 1820s from the east, fleeing from Shaka, King of the Zulus, and later Mzilikazi, first King of the Matabele. In 1824, Chief Mzilikazi established himself on ThabaBosiu and began building a strong nation from people previously scattered in the area.

In 1833, the Barolong under the chieftaincy of Moroka II established themselves at what was later known as Thaba Nchu. Around 1821, White stock farmers crossed the Orange River in search of grazing land, after drought and locust infestations ravaged the Cape Colony. Sometime between 1820 and 1826, trek Boer farmer Johan Nicolaas Brits settled in the Transoranje area. The area was convenient as it had a small stream and a fountain provided him with a good water supply.

Johan Nicolaas Brits built a pioneer's home close to the fountain. During the Great Trek many other Voortrekkers also settled in the area. Because these Boers were from the Cape Colony, they were still considered British subjects.

Over a period of time, conflict grew between the different population groups in the Transoranje area, resulting in British intervention. Therefore, in 1846, Major Henry Douglas Warden was appointed to set up a British residency in the area. Warden was tasked with the difficult job of maintaining peace between the different population groups and to set up an administration. His immediate orders were to set up a residency as soon as possible in a centrally situated place, between the areas occupied by Adam Kok and Mosheshwe.

Warden accidentally came across the fountain area between the Riet and Modder rivers. From a military point of view, Warden found the area suitable because it was situated in a small valley surrounded by hills on all sides and was free of horse sickness. The centrality of the site would also make it easy for transport riders to bring necessary commodities to the settlement.

Warden's troops, known as the Cape Riflemen, arrived in Bloemfontein on 26 March 1846 and Warden followed shortly after. He was charmed by the position of the new residency and took over the farm 'Bloemfontein' from Brits and paid him 500 *rijksdaalders* for the layout and improvements that he made. At the time the farm consisted of a small mud house with a garden in the front and an orchard which was watered through a furrow.

One division of Warden's soldiers began building a fort to the north of the fountain which was named Fort Drury, after Sergeant Drury who served the dual function of garrison's doctor and teacher to the children of the soldiers. The second division began building the official residency at the top end of the present St George Street. While this was being done, Warden moved temporarily into the Brits' house. The third division of the regiment concentrated on building clay huts for the soldiers and stables for the horses, which was the beginning of the settlement.

However, relations between the different groups in the area were still strained, with the biggest problem being land. To put an end to this problem, Sir Henry Smith, Governor of the Cape Colony, annexed the area and renamed it the Orange River Sovereignty. This led to the Battle of Boomplaats between the British and Boers who were unhappy with the annexation, which resulted in the British increasing their garrison to 400 men to defend the Bloemfontein area. In addition, a more strategically situated fort called Queen's Fort, was built to replace Fort Drury. Fort Queen was situated at the top end of what was later known as Monument Road. At the foot of the fort were the officers' houses, barracks for the soldiers, the horses' stables and the Commissioner's depot.

Bloemfontein was officially founded in 1846 as a fort by British army major Henry Douglas Warden as a British outpost in the Transoranje region, at that stage occupied by various groups of peoples including Cape Colony Trek Boers, Griqua, and Barolong.

Warden originally chose the site largely because of its proximity to the main route to Winburg, the spacious open country, and the absence of horse sickness. Bloemfontein was the original farm of Johannes Nicolaas Brits born 21 February 1790, owner and first inhabitant of Bloemfontein.

The town was surveyed and pegged out by Andrew Hudson Bain, whose layout took the form of long streets that were parallel to the stream running in a north and south direction. The shorter streets were at right angles to the long ones and the town continued to expand northwards of the stream. Bain's plans went only as far north as St Andrews Street.

The Orange River Colony was made a British sovereignty and in 1848 Sir Harry Smith issued a proclamation establishing a form of government, with Bloemfontein as its seat. On 23 February 1854 the Bloemfontein Convention was signed, which gave the Orange River Sovereignty self-governing status, the first President being Mr. Josias Philip Hoffman. On 11 March 1854, Clark, together with staff and troops, left the Orange River Sovereignty and the area became an independent Republic. The name was changed to the Orange Free State (OFS) and Bloemfontein became the official capital.

In August 1855, JN Boshoff succeeded Hoffman as Hoffman as President of the OFS. During President Boshoff's period in office, Bloemfontein grew slowly but steadily. By 1858, the need for a municipality or town council became stronger and in April 1859 five municipal commissioners were chosen, with James Cameroon becoming the first Town Clerk, tax collector and market-master. With the establishment of a municipality, plans were now made for a regular market and in April 1859 the market began, which quickly became a profitable venture and served as an important source of income.

MW Pretorius succeeded Boshoff in 1860, chosen mainly because Free State residents hoped it would strengthen their bond with the South African Republic. JH Brand succeeded Pretorius in 1864 and was re-elected to office for five consecutive periods until his death in 1888.

The discovery of diamonds between 1867 and 1871, and the discovery of gold on the Witwatersrand in 1886 led to a general boom in trade and gave stimulus to Bloemfontein's growth. The discovery of diamonds near Hopetown in 1867, in Jagersfontein and next to the banks of the Vaal River around the Du Toit's Pan area in 1869, led to an immense number of fortune seekers rushing to the area between the Vaal and Orange Rivers. In 1871, diamonds were also discovered in Kimberly.

After the discovery of diamonds in the OFS the Griqua Chief Nicolas Waterboer claimed that the area between the Vaal and Orange Rivers rightfully belonged to the Griquas. After some deliberation between Sir Henry Barkly and President Brand, Sir Henry Barkly issued a proclamation that the area known as Griqualand West was now declared a British territory. In March 1876, President Brand undertook a deputation to Britain to discuss compensation for Bloemfontein's loss of the diamond fields. It was decided that Britain would pay a sum of 90 000 pounds as damages to the OFS. During President Brand's long period of office, Bloemfontein became the leading town in the Republic, mainly because the diamond fields created new markets and brought in new trade.

In 1875, the Basotho monument, on the hill near the Fort, was unveiled in memory of the Burghers that lost their lives during the Basotho war of 1865-1866.

During the 1880s, trade in Bloemfontein declined due to the long drought and depression that devastated the OFS. However, trade improved drastically when gold was discovered on the Witwatersrand in 1886. In 1880, Bloemfontein received municipal status with a population of about 2567, and Robert Innes was chosen as the first Town Mayor.

Francis Willem Reitz, who was appointed in 1874 as the OFS Chief Justice, was appointed as candidate in the next election. Reitz accepted the nomination and in December 1888 he was elected as the fifth President of the Orange Free State.

From 1902–10 it served as the capital of the Orange River Colony and since that time as the provincial capital of the Free State. In 1910 it became the Judicial capital of the Union of South Africa.

On 31 May 1910, exactly eight years after the Boers signed the Peace Treaty of Vereeniging that ended the Anglo-Boer War between the British Empire and two Boer states, the South African Republic (Republic of Transvaal) and the Orange Free State, South Africa became a Union.
Due to disagreements over where the Union's capital should be, a compromise was reached that allowed Bloemfontein to host Appellate Division and become the Union's judicial capital. Bloemfontein was also given financial compensation.

On 8 January 1912, the South African Native National Congress (SANNC) was founded in Bloemfontein. The Union of South Africa had not granted rights to black South Africans, causing the organisation's creation. Its primary aim was to fight for the rights of black South Africans.

From 1 to 9 January 1914, James Barry Munnik Hertzog and his supporters met in Bloemfontein to form the National Party of the Orange Free State, and to lay down its principles, following Hertzog's exit from the South African Party in 1913. The National Party grew to govern South Africa in 1948 and implement the policy of racial segregation known as apartheid. When the South African apartheid government passed the Group Areas Act of 1950, the Bloemfontein municipality put into effect changes in the racial set-up of the city.

In 1952 the Bloemfontein municipality began building new residential areas for the city's black population. New residential areas to separate ethnic groups such as Sotho, Xhosa and Tswana were formed. The residential areas were jointly known as Mangaung. Phahameng, a Sotho township, was the first formal housing projects to be approved by the municipality in 1956. In 1968, Mangaung faced serious housing shortages when as much as 3000 to 6000 housing units were needed. To counter this problem, a 55 km east ward expansion called Botshabelo was added in 1979. The Bloemfontein municipality channelled of all black urbanisation to Thaba Nchu and Botshabelo.

In 1994, after the disestablishment of the apartheid government, Bloemfontein, Botshabelo, and Thaba Nchu became part of Motheo District Municipality. The Motheo District Municipality was disestablished on 18 May 2011 and Mangaung was upgraded to become an autonomous metropolitan municipality with Bloemfontein as the main seat.

Free State Provincial Government building Bloemfontein forms part of the Mangaung Metropolitan Municipality, which was upgraded from a Local Municipality in 2011.

Sources:
www.nasmus.co.za
www.theheritageportal.co.za
www.sahistory.org.za/article/colonial-history-bloemfontein

9.5 Archival Research

The main sources of information regarding the heritage sensitivity of this area could be identified. These were;

- Previous heritage studies in the area as per the SAHRIS database
- Historic maps and figures as available in the National Archive

9.6 SAHRIS Database Studies

An extensive research into the SAHRIS database resulted in the identification of the following heritage related studies that have been performed over the last decade in the study area. Only studies within a radius of 50km from the study area were considered.

- Rossouw, L. 2017. Phase 1 Archaeological Impact Assessment of a new township development on Farm Rodenbeck 2972, Bloemfontein, FS Province.
- Rossouw, L. 2018. Heritage Impact Assessment for a portion of the Remaining Extent of the farm Content 1167, Magisterial District of Bloemfontein, Free State Province.
- Rssouw, L. 2017. Phase 1 Heritage Impact Assessment: Plot 4, Spitskop Smallholdings, Bloemfontein, Free State Province.
- Rossouw, L. 2013. Phase 1 Palaeontological & Archaeological Impact Assessment of portion of remainder of the farm Bloemfontein 654, Bloemfontein, Free State Province.
- Rossouw, L. 2016. Heritage Impact Assessment of Portion 1, Plot 13 Lilyvale, Bloemfontein, Free State Province.
- Dreyer, C. 2014. First Phase Archaeological & Heritage Assessment of the Proposed Bypass Water Pipeline Development at Bloemfontein.
- Du Plooy, J. 2018. Heritage Impact Assessment Suzuki Bloemfontein ERVEN 977/2; 977/3; 978/3; 980 & 3937 Bloemfontein.
- Rossouw, L. 2016. Phase 1 Archaeological Impact Assessment of the proposed new Lourierpark township development on Portion 1 of the farm Brandkop 702, Bloemfontein, FS Province.
- Rossouw, L. 2013. Phase 1 Heritage Impact Assessment of a new borrow pit on the farm Sydenham 445/RE, near Bloemfontein, FS Province.
- Bothma, J. 2013. Heritage Impact Assessment for the Proposed Upgrade of National Road N8, Bloemfontein to Thaba Nchu, Free State Province.
- Rossouw, L. 2013. Phase 1 Palaeontological & Archaeological Impact Assessment of a portion of the farm The Retreat 804, Bloemfontein, FS.
- Samie, Q. 2014. Heritage Impact Assessment for Subdivision 3 of the Farm Sunnyside No. 2620 Bram Fischer Airport, Bloemfontein.
- Rossouw, L. 2019. Phase 1 Archaeological Impact Assessment of Portions of Lilyvale 2313 and Bayswater 2865, Bloemfontein.
- Philip, L. 2017. Phase 1 Heritage Impact Assessment Erf 22011 Hospital and Heritage Lifestyle Centre Bloemfontein.
- Botes, J. 2015. Phase 1 Heritage Impact Assessment of the Remainder of the farm Cecilia 2352, Remainder of the farm Bloemfontein 654 and a portion of the farm Kwaggafontein 9300, Bloemfontein, FS Province.
- Rossouw, L. 2017. Heritage Impact Assessment for Gravel Mining on Portion 4 of the farm Kaalspruit, Bloemfontein.
- Rossouw, L. 2017. Phase 1 Heritage Assessment for the proposed mining of sand on the Remaining Extent of the farm Glen Throne 2163, Magisterial District Bloemfontein.
- Rossouw, L. 2017. Heritage Impact Assessment for the proposed construction of a service toad on a portion of Erf 30476 (Public Open Space), Bloemfontein, Free State Province.
- Groenewald, H. 2018. The proposed upgrade of an existing diesel depot on Portion 1 of the farm Rooidam 2354, Bloemfontein, Free State Province.
- Dreyer, C. 2013. First Phase Archaeological & Heritage Assessment of the proposed Solar Farm Developments at Portion 1 & portion 10 of the farm Spes Bona 2355, Bloemfontein.
- Dreyer, L. 2018. The proposed township development on the farm Kloof 2921, Bloemfontein, Free State Province.
- Tomose, N.G. 2012. Phase 1 HIA study for the proposed PV solar energy facilities in Sannaspos, near Bloemfontein, Free State Province.

9.7 Historical Typographical Maps

Especially during the evaluation of historic structures, the use of archived historic maps is very handy. They give a direct chronological reference for such sites and also lead the investigation on the ground.

The following historic map sets are relevant for this study (in chronological order);

- 2926 AB 1951
- 2926 AB 2007

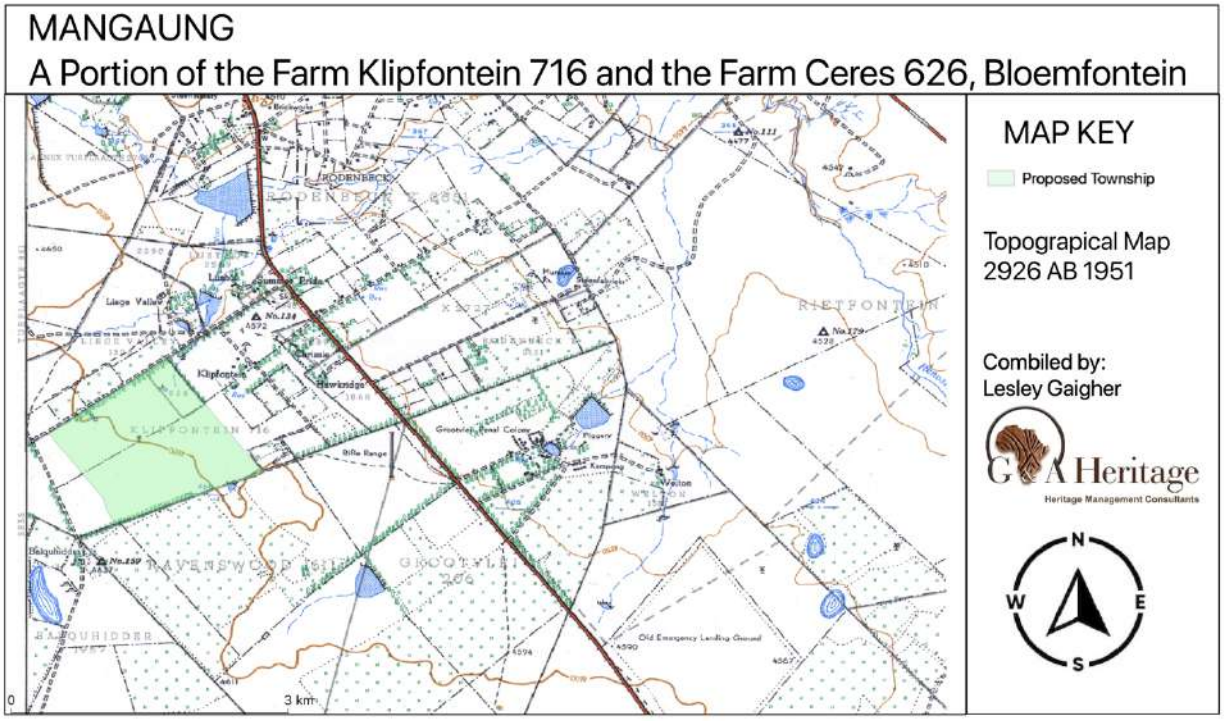

Figure 11. Typographical Map 2926 AB 1951

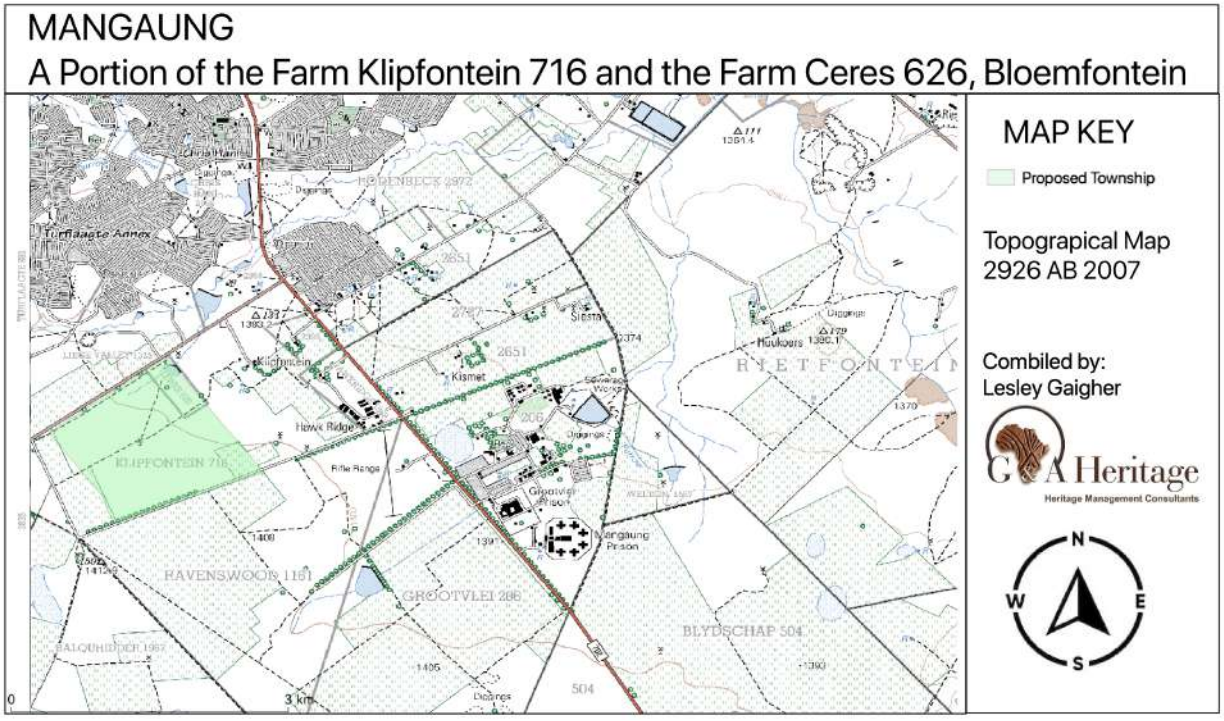

Figure 12. Typographical Map 2926 AB 2007

9.8 Natural / Cultural Landscape

The study area is characterised by open fields and grazing areas with patches of eucalyptus trees and some dumping of building materials.

10. Photos

Figure 13. Northern section of the study area near the tar road

Figure 14. Informal soccer field on the northern side of the study area

Figure 15. Illegal dumping and dangerous grazing occurring in the study area

Figure 16. Northern section of the study area, view towards the south

Figure 17. Northern section of the study area, view towards the east

Figure 18. Dam located in the study area near the northern boundary

Figure 19. Water cistern and troughs

Figure 20. Troughs close up

Figure 21. Water cistern close up

Figure 22. A feature near the water cistern

Figure 23. Modern ruins near the water cistern

Figure 24. The study area is currently being used for grazing

Figure 25. Centre of the study area, view towards the south

Figure 26. Centre of the study area, view towards the north

Figure 27. Western section of the study area, view towards the east

Figure 28. Western section of the study area, view towards the north

Figure 29. Site notice placed on the fence of the western boundary of the study area

Figure 30. Site notice

Figure 31. Site notice placed on the fence of the southern boundary of the study area

Figure 32. Site notice

Figure 33. Modern ruins along the southern boundary of the study area

Figure 34. Modern ruins along the southern boundary of the study area

Figure 35. Bricks scattered along the southern boundary of the study area

Figure 36. Investigating the possibility of this features being a grave, found to be negative

Figure 37. Modern ruins along the southern boundary of the study area

Figure 38. Modern ruins along the southern boundary of the study area

Figure 39. Modern ruins outside the boundaries on the north-eastern side of the study area

Figure 40. Sacred Ibises feeding outside the study area on the north-eastern side

Figure 41. Southern section of the study area, view towards the north

11. Potential Heritage Impacts and Proposed Mitigation

11.1 Introduction and scope

This component will evaluate the potential impact that the proposed development could have on heritage sites and objects of community, cultural or scientific value. This includes archaeological, cultural heritage, built heritage and basic paleontological assessments to determine the impacts on heritage resources within the study area.
The scope of work includes:

- Identification and assessment of archaeological, cultural, historic, built and paleontological sites within the study area
- Interrogation of project specific Drone data and aerial imagery
- Archival study of existing data and information for the study area
- Site inspection and fieldwork: 17 and 18 July 2019. This site work includes communicating with local inhabitants to confirm possible locations of heritage and cultural sites.
- Compilation of a Heritage Impact Assessment (HIA) Report.

11.2 Impact Assessment and Proposed Mitigation

The site was readily accessible, and the confidence level of the provided impact evaluation is as a result high.

Damage to Graves and Burial Sites
None

Table 19. Damage to Graves and Burial Sites

Ref:	1			
Project phase	**Construction**			
Impact	**Damage to Unmarked Grave and Burial Sites**			
Description of impact	**Construction on the site could physically damage unmarked burial and grave sites.**			
Mitigatability	High	Mitigation exists and will considerably reduce the significance of impacts		
Potential mitigation	**Chance Finds Protocol to be included in the EMPR**			
Assessment	**Without mitigation**		**With mitigation**	
Nature	Negative		gative	
Duration	Permanent	Impact may be permanent, or in excess of 20 years	Brief	Impact will not last longer than 1 year
Extent	Limited	Impacts limited to specific parts of the study area	Limited	Impacts limited to specific parts of the study area
Magnitude	High	Natural and/ or social functions and/ or processes are notably altered	Low	Natural and/ or social functions and/ or processes are somewhat altered
Probability	Probable	The impact has occurred here or elsewhere and could therefore occur	Unlikely	Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur
Confidence	High	Substantive supportive data exists to verify the assessment	High	Substantive supportive data exists to verify the assessment
Reversibility	Low	The affected environment will not be able to recover from the impact - permanently modified	High	The affected environmental will be able to recover from the impact
Resource irreplaceability	High	The resource is irreparably damaged and is not represented elsewhere	Low	The resource is not damaged irreparably or is not scarce
Significance	**Minor - negative**		**Negligible - negative**	
Comment on significance	Chance finds protocol to be applied to any burial sites encountered during the construction phase.			
Cumulative impacts	Extensive agricultural activities in the area could compound this effect.			

Excavation of Palaeontological Materials
Unlikely

Table 20. Excavation of Palaeontological Materials

Ref:	3			
Project phase	**Construction**			
Impact	**Excavation of Fossils**			
Description of impact	**If foundation excavations are to intrude deeper than 10m (the upper ceiling of these deposits) it could unearth fossiliferous materials.**			
Mitigatability	High	Mitigation exists and will considerably reduce the significance of impacts		
Potential mitigation	**A chance finds protocol for fossils should be included in the ESMP.**			
Assessment	**Without mitigation**		**With mitigation**	
Nature	Negative		Positive	
Duration	Long term	Impact will last between 10 and 15 years	Short term	impact will last between 1 and 5 years
Extent	Limited	Impacts limited to specific parts of the study area	Limited	Impacts limited to specific parts of the study area
Magnitude	High	Natural and/ or social functions and/ or processes are notably altered	Low	Natural and/ or social functions and/ or processes are somewhat altered
Probability	Unlikely	Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur	Unlikely	Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur
Confidence	Medium	Determination is based on common sense and general knowledge	Medium	Determination is based on common sense and general knowledge
Reversibility	Low	The affected environment will not be able to recover from the impact - permanently modified	High	The affected environmental will be able to recover from the impact
Resource irreplaceability	Medium	The resource is damaged irreparably but is represented elsewhere	Medium	The resource is damaged irreparably but is represented elsewhere
Significance	**Minor - negative**		**Negligible - positive**	
Comment on significance	Due to the limited research on palaeontology in this area, the recovery of fossils will actually be beneficial to science if the			
Cumulative impacts	Mining activities (prospecting) in the area can result in a cumulative increased impact, but also an expansion of knowledge.			

Damage to Unidentified or Buried Archaeological Sites
Unlikely

Table 21. Damage to Unidentified or Buried Archaeological Sites

Ref:	4			
Project phase	**Construction**			
Impact	**Unidentified/Sub-surface Archaeological Remains**			
Description of impact	**Archaeological deposits not identified during the fieldwork or which are buried under the predominant and shifting alluvial substrates could be uncovered during the construction activities.**			
Mitigatability	High	Mitigation exists and will considerably reduce the significance of impacts		
Potential mitigation	**A walkdown survey of the final alignment Chanve finds protocol to be included in the EMPR**			
Assessment	**Without mitigation**		**With mitigation**	
Nature	Negative		Positive	
Duration	Short term	impact will last between 1 and 5 years	Long term	Impact will last between 10 and 15 years
Extent	Local	Impacts felt mostly throughout the study area	Regional	Impacts felt outside the study area, at a regional / provincial level
Magnitude	High	Natural and/ or social functions and/ or processes are notably altered	Moderate	Natural and/ or social functions and/ or processes are moderately altered
Probability	Unlikely	Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur	Likely	The impact may occur
Confidence	Medium	Determination is based on common sense and general knowledge	High	Substantive supportive data exists to verify the assessment
Reversibility	Low	The affected environment will not be able to recover from the impact - permanently modified	High	The affected environmental will be able to recover from the impact
Resource irreplaceability	Medium	The resource is damaged irreparably but is represented elsewhere	Medium	The resource is damaged irreparably but is represented elsewhere
Significance	**Negligible - negative**		**Minor - positive**	
Comment on significance	Although information on archaeological sites are scant, there is a possibility of encountering Stone Age and Iron Age sites.			
Cumulative impacts	No cumulative impacts are expected.			

11.3 No-Go Alternative

The no-go option will have the least impact on the heritage components discussed in this report. It is not expected that there will be any significant change in the impact (or lack thereof) in regards to Palaeontological resources.

11.4 Conclusions and Recommendations

The study area was found to be basically devoid of any significant heritage sites. Some modern ruins were observed but for the most part these were out of context and none of the identified structures comprised an occupational or production site.

The palaeontological significance of the site is very high and it is recommended that a field based paleontological study be conducted on site.

It is not anticipated that any sites of heritage significance (with the exclusion of possible paleontological sites) will be impacted upon by the proposed development.

11.5 Chance Finds Protocol

It is important to note that, although unlikely, sub-surface remains of heritage sites could still be encountered during construction of the project. Such sites would offer no surface indication of their presence due to the

high state of alterations in some areas as well as heavy vegetation cover in other areas. The following indicators of unmarked sub-surface sites could be encountered:

- Ash deposits (unnaturally grey appearance of soil compared to the surrounding substrate);
- Bone concentrations, either animal or human;
- Ceramic fragments such as pottery shards either historic or pre-contact;
- Stone concentrations of any formal nature.

The following recommendations are given should any sub-surface remains of heritage sites be identified as indicated above:

- All operators of excavation equipment should be made aware of the possibility of the occurrence of sub-surface heritage features and the following procedures should they be encountered.
- All construction in the immediate vicinity (50m radius of the site) should cease.
- The heritage practitioner should be informed as soon as possible.
- Mitigation measures (such as refilling etc.) should not be attempted.
- The area in a 50m radius of the find should be cordoned off with hazard tape.
- Public access should be limited.
- The area should be placed under guard.
- No media statements should be released until such time as the heritage practitioner has had enough time to analyze the finds.

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Appendix 1: Public Participation

G&A Heritage
Heritage Management Consultants

NOTICE OF PHASE 1 HERITAGE IMPACT ASSESSMENT (HIA)

Notice is hereby given that an application for a Phase 1 Heritage Impact Assessment (HIA) in terms of Section 38 of the National Heritage Resources Act (Act 25 of 1999) will be lodged with the Free State Provincial Heritage resources Authority (FSPHRA).

PROJECT NAME: Proposed Township on a Portion of the Farm Klipfontein 716 and Ceres 626, Bloemfontein.

NAME OF PROPONENT: Mangaung Metropolitan Municipality

ANY ENQUIRIES SHOULD BE REFERED TO:

G&A Heritage Properties (Pty) Ltd
Public Participation Registration and Enquiries
Lesley Gaigher
lesley@gaheritage.co.za
0825515082
PO Box 522
Louis Trichardt
0920

Voster Street 38 A, Louis Trichardt, 0920, South Africa
PO Box 522, Louis Trichardt, 0920
Tel +27 15 516 1561 Cell +27 73 752 6585

Figure 42. Site Notice

BACKGROUND INFORMATION DOCUMENT

Proposed New Township Development on a Portion of the Farm Klipfontein 716 and the Farm Ceres 626 near Bloemfontein in the Mangaung Metropolitan Municipality, Free State Province.

38A Vorster street
Louis Trichardt, 0920

Phone: +27 (015) 516 1561
Cell: +27 (0) 82 551 5082
Email: lesley@gaheritage.co.za
www.gaheritage.co.za

2

Background Information Document

Purpose of this Document

This Background Information Document (BID) provides Interested and Affected Parties (I&APs) with information on the Heritage Impact Assessment (HIA) being done by G&A Heritage Properties (Pty) LTD for the Heritage Impact Assessment for the proposed new township development located on a portion of the farm Klipfontein 716 and the farm Ceres 626 near Bloemfontein in the Mangaung Metropolitan Municipality in the Free State Province.

This BID provides I&APs with the opportunity to register as stakeholders in this process; and comment on the proposed projects. The purpose of a HIA is to identify and evaluate potential impacts, to recommend measures to avoid or reduce negative impacts and to enhance positive impacts. The decision-making authority for this HIA is the South African Heritage Resources Agency (SAHRA) and the Free State Provincial Heritage Resource Authority (FSPHRA).

You will be included in the stakeholder database and receive further documents for review and comment/s. Your comments will ensure that all issues of concern are addressed. To raise your concerns, complete the enclosed registration sheet, write a letter, call or email the public participation office.

Contact Information
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Email: lesley@gaheritage.co.za
Postal Address: 38A Vorster Street, Louis Trichardt, 0920, South Africa

3

HERITAGE IMPACT ASSESSMENT FOR THE PROPOSED NEW TOWNSHIP DEVELOPMENT IN THE MANGAUNG METROPOLITAN MUNICIPALITY

THE DEADLINE FOR RECEIPT OF COMMENTS AND REGISTRATION AS AN IAP IS 2019/08/19.

Participation should be free, and you may submit any comments or information you feel may be useful to the HIA. Registered interested and affected parties are entitled to comment, in writing, on all written submissions to the competent authority (SAHRA & FSPHRA) as well as any issues which the party believes may be of significance to the consideration of the application.
Please find attached to this BID a comment sheet to complete, should you wish to comment on the above.

www.gaheritage.co.za

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Heritage Impact Assessment (HIA)

A Heritage Impact Assessment is a study to determine the impact of a proposed development on the cultural heritage value of a property and to recommend an overall approach to the conservation of the heritage resources. This information is then used by the competent authorities to compile a Record of Decision (RoD) regarding the impact of the development on the area's cultural heritage. At the very least the HIA should;

- Identify the potential impacts of the proposed development;
- Record the issues, concerns and suggestions raised by I&APs; and
- Outline mitigation measures to be taken to avoid or reduce negative impacts and enhance positive impacts.

HIA Stakeholder Engagement Phase

As an important part of the HIA for the proposed project, G&A Heritage Properties (Pty) Ltd. will also conduct the stakeholder engagement and public participation component. This will enable stakeholders to influence the course of the investigations and to review the findings of the independent study that is to be undertaken. The steps of the public participation component are outlined below. The following steps will be taken in this regard:

- Advertising - public notices in regional and local newspapers;
- Placement of these site notices around the sites being investigated;
- Supplying adjacent landowners with this Background Information Document (BID);
- Contacting stakeholders and notifying them of the process;
- Documenting stakeholder correspondence within the Draft HIA that will be made available for public review; and
- Notifying stakeholders when the Record of Decision (RoD) is issued by SAHRA & FSPHRA as well as the appeals process open to them.

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HIA Reports

- ✓ The Draft Heritage Impact Assessment Report (DHIAR) will be made available for a period of four weeks. Registered IAP's will then have the opportunity to comment on the findings of the report.
- ✓ The Final Heritage Impact Assessment Report (FHIAR) will be compiled to incorporate and address any comments received during the stakeholder engagement phase.

Final Notification by Authorities

Once the relevant authorities SAHRA & FSPHRA, has issued the RoD, I&APs will be notified of the decision and what procedure to follow should they wish to appeal the RoD. There will be a 14-day appeal period available for this.

HIA QUESTIONNAIRE

PROPOSED NEW TOWNSHIP DEVELOPMENT IN THE MANGAUNG METROPOLITAN MUNICIPALITY

Your comments on this questionnaire will contribute towards ensuring that the process which is applied to direct the Heritage Impact Assessment (HIA) is sound and will permit an informed project decision to be taken.

Correspondent to complete the following:

Title & Name:	
Address:	
Phone/email:	

By completing this questionnair you indicate that the information provided was done so at your own will and not under duress.

THE DEADLINE FOR THE RECEIPT OF COMMENTS IS 19th OF AUGUST 2019.

1. Are there any concerns that you feel the heritage team should be aware about in terms of heritage preservation of significance within the study area?

2. Would you like to nominate further IAP's that you feel should be involved in this process? (Please provide adequate contact details in order for us to contact I&AP).

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3. Do you feel that the HIA performed upholds the requirements of the NHRA no 25 of 1999 and the minimum standards as set out by SAHRA for HIA reports?

Yes ☐

No ☐ *(if no, please give a short explanation below)*

Thank you for taking the time to complete this questionnaire. Your views and opinions are important to us and ensures the protection of our cultural heritage. Please feel free to attach further pages to this questionnaire if needed.

YOUR COMMENTS SHOULD BE SENT TO:

G&A HERITAGE PROPERTIES (PTY) LTD

Lesley Gaigher
Tel. +27 (015) 516 1561 / +27 (0) 82 551 5082
Email: lesley@gaheritage.co.za
Postal Address: 38A Vorster street, Louis Trichardt, 0920, South Africa

www.gaheritage.co.za

Figure 43. BID

APPENDIX D4: GEOTECHNICAL REPORT

Ngoti Development Consultants - Phase 1 Geotechnical Housing Investigation – Portion 626 Ceres and 716 Klipfontein Farms– Bloemfontein

Reference: 19-719

Dated: October 2019

DELTA
GEOTECH

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Report to Ngoti Development Consultants - Phase 1 Geotechnical Housing Investigation – Portion 626 Ceres and 716 Klipfontein Farms – Bloemfontein

Reference : 19-719	**Dated : October 2019**

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Report to Ngoti Development Consultants - Phase 1 Geotechnical Housing Investigation – Portion 626 Ceres and 716 Klipfontein Farms – Bloemfontein

Reference 19-719	**Dated : October 2019**

EXECUTIVE SUMMARY

At the request of Mr. Fumani Mathebula of Ngoti Development Consultants, Delta Geotech (Pty) Ltd provided a proposal, on the 24th July 2019. The proposal indicated the methodology and cost to undertake a geotechnical investigation. Delta Geotech's quote was successful and a letter of appointment was received on 8th August 2019 to proceed with the investigation.

The site is located approximately 17km south of Bloemfontein. Access is gained via regional and district roads. The site currently undeveloped and, topographically, the site is flat with a slight fall towards south-west.

As the site is approximately 214Ha, according to GSFH-2 specifications, a total of sixty (60) test pits were required. These were excavated using a CAT 428F digger loader and have been designated TP1 to TP60. Test pits were advanced to depths of between 0.90m to 2.70mbegl and were profiled. Representative disturbed samples of material were taken from selected horizons for testing in a SANAS accredited commercial soils laboratory. A total of 60 DPL tests were conducted alongside each test pit. These have been numbered in conjunction with the test pit positions DPL1 – DPL60. The DPL tests extended to a depth of 2.1mbegl or earlier refusal.

The general geology of the area comprises sandstone shale and mudstone of the lower stage of the Beaufort Series, Karoo Sequence, which is intruded by Jurassic Age igneous dolerite. Colluvium and residual soils overlie rock horizons as intersected in the test pits. Perched groundwater was not intersected during the investigations. The main water table is expected to occur at depth within the fractured rock aquifer.

Twenty Foundation Indicator and five chemical tests samples, collected and sent for laboratory testing, were required to ascertain the likelihood or otherwise of active clays and potential corrosiveness at selected positions within the study area.

The site is classified as **S2/H2/R.** Foundation recommendations are tabulated in the report according to the varying soil and rock conditions. Foundation types such as cellular rafts, piers and ground beams, as well as, strip footings have been recommended.

Report to Ngoti Development Consultants - Phase 1 Geotechnical Housing Investigation – Portion 626 Ceres and 716 Klipfontein Farms – Bloemfontein

Reference : 19-719	**Dated : October 2019**

1. INTRODUCTION AND TERMS OF REFERENCE

At the request of Mr. Fumani Mathebula of Ngoti Development Consultants, Delta Geotech (Pty) Ltd provided a proposal, on the 24th July 2019. The proposal indicated the methodology and cost to undertake a geotechnical investigation. Delta Geotech's quote was successful and a letter of appointment was received on 8th August 2019 to proceed with the investigation.

2. SCOPE OF REPORT

The geotechnical report sets out the findings of the geotechnical investigation. The objectives of the investigation were as follows:

a) Undertake a desktop study using topographical and geological maps, as well as, a review of available geotechnical literature;

b) Identify any potential hazards;

c) Provide an assessment of the bearing capacity of the various founding horizons in terms of single story buildings;

d) Prediction of total heave, collapse etc. under buildings and floors;

e) Determine excavat-ability for earthworks and foundation sidewall stability;

f) Prediction of groundwater table for the protection of fills, floors and pavements;

g) Recommendations and design parameters regarding foundation solutions and approximate bearing capacities; and

h) Site class designations for EF003 form.

3. INFORMATION SUPPLIED

The following information was utilized during the investigation:

- Site development plan (SDP) provided by Ngoti Development Consultants: Proposed Township – A portion of the farm Klipfontein 716 and Farm Ceres 626, Bloemfontein.

- Remote Colour Imagery – Google (2018).
- The 1:250 000 geological map – 2926 – Bloemfontein (Council for Geoscience).
- Brink A.B.A (1985). Engineering Geology of South Africa - Post Gondwana Deposits. Volume 4. Building Publications. South Africa. 332pp.

4. SITE DESCRIPTION

The site is located approximately 17km south of Bloemfontein. Access is gained via regional and district roads. The site currently undeveloped (see Site Plan - Figure 3). The site co-ordinates are as follows:

29°13'23.83"S
26°15'28.13"E

Topographically the site is flat with a slight fall towards a wetland on the south-western portion

Plates 1 and 2 below provide an indication of the topography and conditions encountered on site.

Plate 1: Flat topography across the site.

Plate 2: Wetland on south-western portion.

5. NATURE OF INVESTIGATION

Fieldwork for the site investigation was carried out on the 21st August 2019.

The fieldwork comprised the following:

- Test Pit Excavations, Profiling & Sampling
- Dynamic Penetration Light (DPL) tests

5.1 Test Pitting

As the site is approximately 214Ha, according to GSFH-2 specifications, a total of sixty (60) test pits were required. These were excavated using a CAT 428F digger loader and have been designated TP1 to TP60. Test pits are positioned by the engineering geologist on site to cover a representative area. The detailed logs and photographs of all the profiles are provided in Appendix A with test pit locations indicated in Figure 3.

Test pits were advanced to depths of between 0.90m to 2.70mbegl (meters below existing ground level) and were profiled[1]. Representative disturbed samples of material were taken from selected horizons for testing in a SANAS accredited commercial soils laboratory.

5.2 DPL Tests

A total of 60 DPL tests were conducted alongside each test pit. These have been numbered in conjunction with the test pit positions DPL1 – DPL60. The DPL tests extended to a depth of 2.1mbegl or earlier refusal.

The results of the DPL tests are provided in Appendix B.

6. GEOLOGY AND GROUNDWATER CONDITIONS

6.1 General Geology of the Area

The general geology of the area comprises sandstone shale and mudstone of the lower stage of the Beaufort Series, Karoo Sequence which is intruded by Jurassic Age igneous dolerite.

Colluvium and residual soils overlie rock horizons as intersected in the test pits.

6.2 Site Geology

The site is overlain by colluvial and residual soils whilst underlain by rock.

[1] Geoterminology Workshop (2002) – Guidelines for Soil and Rock Logging - SAIEG-AEG-SAICE (Geotech Div) pp47

6.2.1 Colluvium

Colluvial soils were intersected in all test pits and comprise sandy silt, clayey sand, sandy clay, clayey sandy silt, silty clayey sand and silty fine sands. These occur from surface and extend to a depth of between 0.05m to 1.40m begl.

6.2.2 Residual

Intersected in all test pits except for TP1 and TP30. The residual soils comprise clayey silt, sandy clay, silty clay and clayey silty sands. These occur from below the colluvium and extend to depths of 0.40m to 1.90m begl.

6.2.3 Rock

Mudstone siltstone and sandstone were intersected in all test pits with igneous dolerite intersected in TP27. The rock occurs below the soils and extends to depths in excess of 2.70m begl. The rock varies from completely weathered very soft rock to un-weathered hard rock.

6.3 Groundwater

Perched groundwater was not intersected during the investigations. Groundwater generally relies mainly on recharge from direct infiltration of rainfall, as well as, from upslope recharge of the groundwater via horizontal flow. As such, this water table will be best developed during the wet and rainy seasons. Groundwater was however, noted in the wetland and small dam that occur on site.

The main water table is expected to occur at depth within the fractured rock aquifer.

7. LABORATORY TESTING

Twenty Foundation Indicator and five chemical tests samples, collected and sent for laboratory testing, were required to ascertain the likelihood or otherwise of active clays and potential corrosiveness at selected positions within the study area.

The points below provide a summary of the laboratory tests undertaken:

- Foundation Indicator testing comprising Atterberg Limits, Particle Size Distribution and Hydrometer analysis
- Chemical tests – pH and conductivity of soil paste

The laboratory results are provided in Table 1 and interpreted in Table 2. The full laboratory results are included in Appendix C.

Table 1:

Summary of Results of Particle Size Distribution Analysis, Atterberg Limit Determination Tests.

TP No.	Depth (m)	Description	Particle Size Distribution %				Atterberg Limits %			GM			
			Clay	Silt	Sand	Gravel	LL	PI	LS		Classification	pH	Conductivity (Sm^{-1})
3	0.10	Silty clayey sand: Colluvium	34	13	53	0	38	17	8.5	0.43	A-6; CL; Medium heave potential	-	-
8	0.40	Clayey sand: Residual	32	4	64	0	32	12	6.0	0.49	A-6; CL; Low heave potential	5.2	17.8
9	0.50	Silty clayey sand: Colluvium	27	19	54	0	24	8	4.0	0.52	A-4; SC; Low heave potential	-	-
12	0.20	Silty clayey sand: Colluvium	22	14	64	0	33	19	8.0	0.46	A-6; CL; Medium heave potential	5.3	26.5
16	1.90	Weathered mudstone	17	5	33	45	34	17	8.0	1.78	A-2-6; SC; Medium heave potential	6.9	14.6
21	0.10	Silty clayey sand: Colluvium	21	14	64	1	43	19	9.5	0.34	A-7-6; CL; Medium heave potential	8.3	31.5
26	0.40	Silty clayey sand: Residual	22	15	61	2	42	19	9.5	0.49	A-7-6; CL; Medium heave potential	-	-
30	0.10	Sandy clay: Colluvium	-	-	-	-	-	-	-	-	-	7.1	18.4
32	0.20	Silty clayey sand: Residual	34	14	49	3	43	19	9.5	0.40	A-7-6; CL; Medium heave potential	7.0	23.2

34	0.20	Silty clayey sand: Colluvium	23	18	59	0	47	23	11.5	0.22	A-7-6; CL; High heave potential	7.2	43.2
37	0.70	Clayey sand: Residual	33	5	42	20	48	20	10.0	1.19	A-7-6; CL; Medium heave potential	6.4	16.1
39	0.50	Clayey sand: Residual	27	8	63	2	29	14	7.0	0.52	A-6; CL; Medium heave potential	-	-
42	0.50	Silty clayey sand: Residual	21	17	61	1	34	19	9.5	0.42	A-6; CL; Medium heave potential	6.4	18.2
44	0.40	Silty clay sand: Residual	35	29	35	1	38	13	6.5	0.36	A-7-6; CL; Low heave potential	-	-
46	1.40	Weathered mudstone	23	23	50	4	42	18	9.0	0.26	A-7-6; CL; Medium heave potential	-	-
48	0.20	Silty clayey sand: Colluvium	33	14	53	0	30	15	7.5	0.33	A-6; CL; Low heave potential	8.3	20.2
50	1.20	Weathered mudstone	20	6	73	1	27	10	5.0	0.52	A-4; CL; Low heave potential	-	-
52	0.20	Clayey sand: Colluvium	29	7	61	3	30	14	7.0	0.57	A-6; CL; Medium heave potential	-	-
55	0.70	Clayey sand: Residual	19	5	75	1	29	13	6.5	0.42	A-6; CL; Medium heave potential	-	-
56	1.70	Weathered mudstone	24	14	62	0	39	12	6.0	0.28	A-6; CL; Medium heave potential	-	-
57	0.50	Silty clayey sand: Residual	23	18	58	1	38	17	8.5	0.42	A-6; CL; Medium heave potential	-	-

LL	-	Liquid Limit	GM	-	Grading Modulus	Classification in Terms of:	
PI	-	Plasticity Index	OMC	-	Optimum Moisture Content		Unified Soil Classification System[2]
LS	-	Linear Shrinkage					Van der Merwe[3]

[2] ASTM D 2487-06 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System). June 2006

[3] D.H. Van Der Merwe (1964) The Prediction of Heave from the Plasticity Index and Percentage Clay Fraction of Soils. The Civil Engineer, pp 103-107

To aid in the clarity of interpreting the laboratory results the interpretation of the materials has been summarized in Table 2.

Table 2: Materials Classification and Usage for Construction

Material Type	Classification Details	Laboratory result evaluation
Colluvium	Silt & Clay = 22 to 47% Sand = 53 to 61% Gravel = 0 to 3% PI = 8 to 23 LL = 24 to 47 GM = 0.22 to 0.57 LS = 4.0 to 11.5 pH = 5.3 to 8.3 Conductivity = 18.4 to 43.2 A-6, A-7-6; CL to SC; Low to high heave potential.	Moderate fines content, with moderate to high PI, LL and LS, confirm potential expansiveness of material. With a moderate sand component of between 53 to 61% this indicates that the fines are potentially highly expansive. pH and conductivity values indicate slightly acidic to slightly basic soil conditions. Precautions may be required. Soils should have a fair workability due to the mixed grading, and could possibly be considered for use as general fill where required.
Residual	Silt & Clay =24 to 64 % Sand = 35 to 75% Gravel = 0 to 20% PI = 12 to 20 LL = 29 to 48 GM = 0.36 to 1.19 LS = 6.0 to 10.0 pH = 5.2 to 7.0 Conductivity = 16.1 to 23.2 A-6, A-7-6; CL; Low to medium heave potential.	Generally higher fines with a minor gravel component in reworked horizons. Hence high grading moduli in certain samples. High PI, LL and LS values indicate moderate potential expansiveness. pH and conductivity values indicate slightly acidic soil conditions. Precautions may be required. Soils are likely to have poor workability and should not be considered for use during construction unless for landscaping.
Weathered mudstone	Silt & Clay = 22 to 46% Sand = 33 to 60% Gravel = 0 to 45% PI = 12 to 18 LL = 34 to 42 GM = 0.26 to 1.78 LS = 6.0 to 8.0 pH = 6.9 Conductivity = 14.6 A2-6, A-6, A7-6; CL to SC; Medium heave potential	Low gravel component and grading moduli would indicate deeply weathered and decomposed horizon whilst higher values would indicate better quality less weathered material. PI and LS values are higher than expected, and possibly due to the degree of weathering and presence of fines in some of the sample. Neutral in terms of corrosion potential of the rock. Generally, highly weathered mudstone would be classified as G7 to G9 quality and could possibly be considered for use as selected subgrade or subbase materials during construction.

8. GEOTECHNICAL EVALUATION

8.1 Engineering and Materials Characteristic's

On the basis of the desk study and the available geotechnical investigation information, the following points relating to the site geotechnical conditions and constraints, may be made:

a) Colluvial soils occur consistently throughout the site. Very loose to loose and highly compressible horizons occur from surface to 1.20m begl. Below the soils are medium dense to dense in consistency slightly compressible. The colluvium is potentially moderately to highly expansive according to laboratory test results. Pockets of more fine-grained material may also be encountered due to the nature of deposition of the colluvium. Provided the structures are designed to accommodate heave movements, and allowable bearing pressures are appropriate, the medium dense to dense colluvial soils could be considered as a competent founding horizon.

b) Residual soils are generally medium dense to dense in consistency and potentially moderately to highly expansive. Provided the structures are designed to accommodate heave movements, and allowable bearing pressures are appropriate, the medium dense colluvial soils could be considered as a competent founding horizon.

c) The weathered rock is generally soft to medium hard with a low potential compressibility. The completely weathered or less weathered rock would form a competent founding horizon for the single storey structures envisaged with no additional precautions.

d) In terms of construction materials:
   - The colluvium has not been tested for moisture-density and CBR but would likely form G9/G10 quality material and could be considered as general fill if required. Compaction and strength testing is however recommended to confirm.
   - The residual soils are generally fine grained, and would have poor workability, these soils could be used for landscaping if required.
   - Experience indicates that highly weathered mudstone and dolerite would form G7-G9 quality material, and could be considered for use as selected subgrade or subbase materials. The highly weathered sandstone would likely form G8/G9, according to COLTO specifications, and could be considered as selected subgrade quality material if required.

e) Perched groundwater was not intersected in any of the test pit excavations but would likely occur at the contact between the colluvial and residual/weathered rock after periods of intense rainfall. Minor drainage precautions will likely be required.

9. IMPACT ON THE GEOTECHNICAL CHARACTER OF THE SITE ON SUBSIDY HOUSING DEVELOPMENTS

The following geotechnical characteristics of the site are expected to have an impact on subsidy housing development and subsidy variations:

Table 3: Factors to consider in subsidy variations

Category of Subsidy Variation	Verification Criteria	Factors Affecting Amount of Subsidy Variation
Site Conditions: Difficulty of servicing of land due to slopes – Type 1	Average slope measured along a line in any direction form any of the boundaries of the erf is flatter 1:100.	Difficulties associated with the provision of waterborne sanitation and the drainage of sites/provision of pumps stations.
Difficulty of excavation – Type 3	Average slope measures across any erf in any direction is steeper than 1:10 and material to a depth of 1.50m below pre-development level is classified as Boulder Class B or Hard rock excavation.	Additional cost of trench excavation.

10. RESIDENTIAL SITE CLASS DESIGNATION AND SUBSIDY VARIATIONS

The site class designations is **S2/H2/R**. The designation summarized in Table 4:

Table 4: Residential site class designations

Site Class Designation	Character of Founding Materials	Expected Range of Total Soil Movements (mm)	Assumed Differential Movement (% of Total)	Maximum Allowable Bearing Capacity (kPa) and consistency
S2	Colluvium	>20	50	80 – Medium dense
H2	Residual	15-30	50	80 – Medium dense/Firm
R	Weathered mudstone, sandstone or dolerite	Negligible	-	150 – completely weathered 300 – Highly weathered

All erven are classified as **S2/H2/R.**

11. RECOMMENDATIONS

With reference to items discussed in the geotechnical evaluation this section provides recommendations for foundations and surface beds, as well as recommendations for excavatability and drainage.

11.1 Foundation Recommendations

The following options listed in Table 5 should be considered:

Table 5: Foundation Solutions

Site Class Designation	Foundation Solutions
S2/H2/R	Found structures on colluvial and residual soils or underling rock. **Colluvial and Residual soils:** • Found on at least medium dense/firm soil using a stiffened or cellular raft with articulation joints or lightly reinforced masonry. An approximate allowable bearing pressure of 80kPa would be achievable. **Completely weathered soft rock:** • Strip or pad footings with normal construction techniques. Approximate allowable bearing pressure of 150kPa. **At least highly weathered medium hard rock:** • Strip or pad footings with normal construction techniques. Approximate allowable bearing pressure of 300kPa. In areas where rock occurs deeper than 1.10m begl consider pad footings, piers and ground beams or excavating to moderately weathered rock and backfilling with cement stabilized geotechnically inert material.

Due to slight soil acidity and alkalinity precautions to safeguard against concrete degradation should be considered. Increasing the thickness of the concrete to provide a "buffer" or, if reinforcing degradation is of concern, then consider using glass fibre reinforcing instead of steel. Glass fibre also has the benefit of being lighter which can reduce associated haulage costs.

11.2 Pavements and Surface Beds

In areas where the structures are founded over rock the following options should be considered:

1) Soils underlying the surface beds should be excavated and spoiled. This followed by introduction of geotechnically inert material from borrow, compacted in layers, to form the surface bed subgrade.
2) Alternatively, consider suspended or "floating" floor slabs.

11.3 Excavatability

Excavation in the colluvial and residual soils, as well as completely weathered rock, classifies as "Soft" excavation in terms of the SANS 1200DM Earthworks Specification. Soils can be excavated using hand picks and spades or backhoes.

Excavation in highly weathered medium hard rock would be classified as "Intermediate" excavation and could be excavated by back-acting excavator having a fly wheel power >0.10kW for each mm of tined-bucket width or with the use of pneumatic tools before removal by a machine capable of removing soft material.

Deeper excavations for services into "Hard" rock will likely require the use of pneumatic tools and blasting in the less weathered hard rock.

11.4 Slope Stability and Erosion

Due to the granular nature of the colluvium erosion could occur. Erosion would be minor due to fairly flat site gradient where vegetating the soils at surface and adequate surface water management should help in this regard.

The natural slopes in the area are relatively stable under present conditions. Excavations in unconsolidated soils deeper than 1.5m for service trenches will require shoring or battered slopes for safety reasons.

11.5 Drainage

In general attention to drainage and the effective collection and disposal of storm water run-off is required throughout the site as part of general surface water management.

Measures to prevent water ingress into soils below and against foundations will be required. These would include, grading of slopes to promote run-off and to prevent ponding close to the buildings, effective collection and removal of stormwater, and water from downpipes, as well as regular checking of wet services for leaks.

12. CONCLUSIONS

In summary, the site is suitable for the developments envisaged provided that all structures are designed accordingly.

The ground conditions described in this report refer specifically to point sources encountered in test pits and DPL's. It is therefore possible, or probable, that conditions at variance with those discussed may be encountered. Important then is that Delta Geotech (Pty) Ltd carry out periodic inspections during construction, before *in situ* subgrade treatment is carried out. Any change from the anticipated ground conditions could then be taken into account to avoid unnecessary expense. In this regard, it is important that the construction phase of the project be treated as an augmentation of the geotechnical investigation. This additional work can be conducted on a time and cost basis.

We trust that the information provided meets with your requirements. Should you have any queries do not hesitate to contact us.

Yours faithfully,

DELTA GEOTECH (PTY) LTD

Matthew Jones
MEng (Geotechnical), Pr.Sci.Nat, MSAIEG

APPENDIX - A

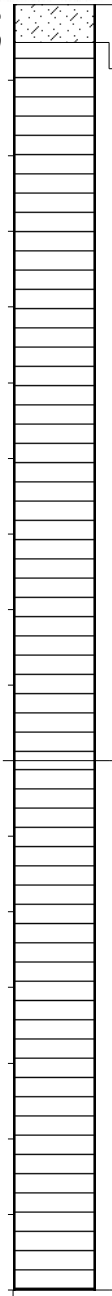
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP1**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry grey brown dense shattered CLAYEY SAND: Colluvium.

0.05 Light grey completely weathered soft rock SILTSTONE.

1.00 Light grey moderately weathered widely jointed hard roc SILTSTONE.

1.70

NOTES

1) End of hole at 1.70m.
2) TLB refused @ 1.70m.
3) No water table
4) No Sample.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29ł12’55.50"S
Y-COORD : 26ł15’46.38"E

HOLE No: **TP1**

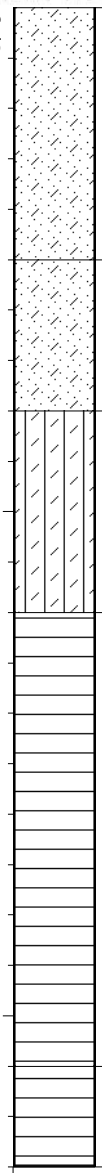
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP2**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:15



0.00 Dry grey brown dense intact CLAYEY SAND: Colluvium.

0.50 Slightly moist red brown dense intact CLAYEY SAND: Colluvium.

0.80 Moist light grey firm intact: CLAYEY SILT: Residual.

1.20 Grey completely weathered soft rock MUDSTONE.

2.10 Grey highly weathered closely jointed medium hard rock MUDSTONE.

2.30

NOTES

1) End of hole at 2.30m.
2) TLB near refusal @ 2.30m.
3) No water table.
4) No sample.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29ł12’59.69"S
Y-COORD : 26ł15’39.16"E

HOLE No: **TP2**

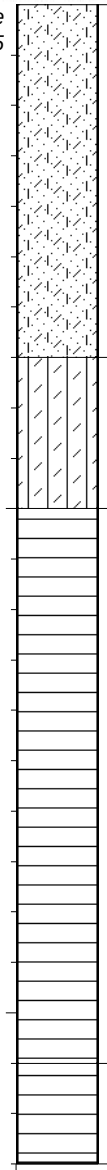
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP3**
Sheet 1 of 1

JOB NUMBER: 000

Scale
B3 1:15



0.00

Dry becoming moist red brown dense becoming loose intact SILTY CLAYEY SAND: Colluvium.

0.70

Moist grey stiff intact CLAYEY SILT: Residual.

1.00

Grey completely weathered soft rock MUDSTONE.

2.10

Grey highly weathered closely jointed medium hard rock MUDSTONE.

2.30

NOTES

1) End of hole at 2.30m.
2) TLB refusal @ 2.30m.
3) No groundwater.
4) Sample B3 @ 0.10m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29ł13’4.75"S
Y-COORD : 26ł15’30.50"E

HOLE No: **TP3**

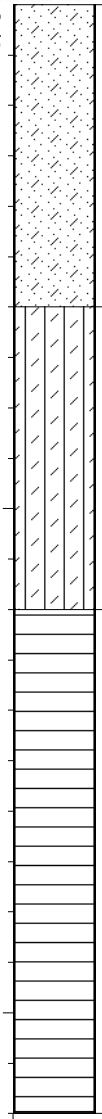
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP4**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:15



0.00

Dry becoming slightly moist grey brown dense to medium dense intact CLAYEY SAND: Colluvium.

0.60

Moist grey stiff intact CLAYEY SILT: Residual.

1.20

Grey completely weathered soft rock MUDSTONE.

2.20

NOTES

1) End of hole at 2.20m.
2) TLB stopped @ 2.20m.
3) No water table.
4) No sample.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: **TP4**

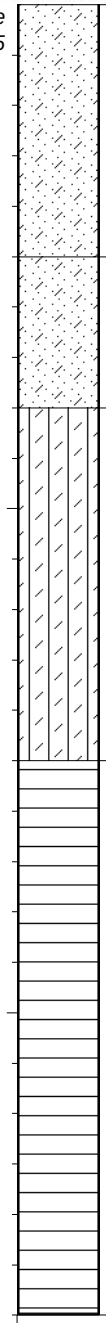
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP5**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:15



0.00 Dry light grey dense intact CLAYEY SAND: Colluvium.

0.50 Slightly moist red brown loose intact CLAYEY SAND: Colluvium.

0.80 Dry grey speckled orange brown firm intact CLAYEY SILT: Residual.

1.50 Light grey completely weathered soft rock MUDSTONE.

2.60

NOTES

1) End of hole at 2.60m.
2) TLB stopped @ 2.60m.
3) No groundwater.
4) No Sample.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29ł13’8.14"S
Y-COORD : 26ł15’25.47"E

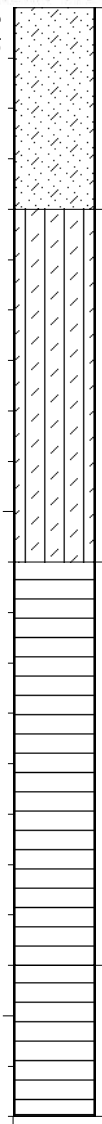
HOLE No: **TP5**

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP6**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:15



0.00 Dry heavy moist red brown medium dense intact CLAYEY SAND: Colluvium.

0.40 Moist red brown soft intact CLAYEY SILT: Residual.

1.10 Grey completely weathered soft rock MUDSTONE.

1.90 Grey highly weathered closely jointed soft rock MUDSTONE.

2.20

NOTES

1) End of hole at 2.20m.
2) TLB stopped @ 2.20m.
3) No groundwater.
4) No Sample

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29ł13’15.88"S
Y-COORD : 26ł15’12.20"E

HOLE No: **TP6**

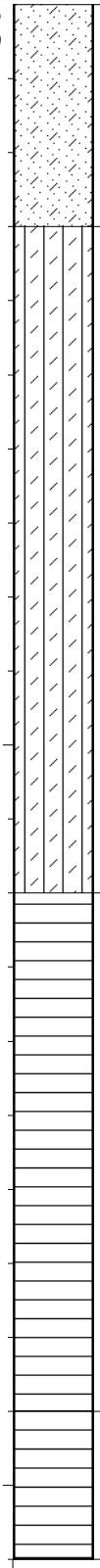
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP7**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist red brown medium dense intact CLAYEY SAND: Colluvium.

0.30 Moist grey firm intact CLAYEY SILT: Residual

1.20 Grey completely weathered very soft rock MUDSTONE.

1.90 Grey highly weathered medium jointed medium hard rock MUDSTONE.

2.10

NOTES

1) End of hole at 2.10m.
2) TLB stopped @ 2.10m.
3) No perched groundwater
4) No sample.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD :
Y-COORD :

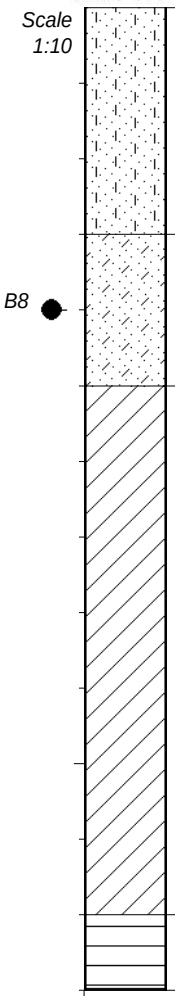
HOLE No: **TP7**

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP8**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry red brown dense intact SILTY FINE SAND: Colluvium.

0.30 Moist red brown speckled olive firm intact CLAYEY SAND: Reworked residual.

0.50 Moist brown grey specked olive soft intact CLAY: Residual.

1.20 Light grey completely weathered soft rock SILTSTONE.

1.30

NOTES

1) End of hole at 1.30m.
2) TLB stopped @ 1.30m.
3) No groundwater
4) Sample B8 @ 0.4m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 26
Y-COORD : 26 14 55

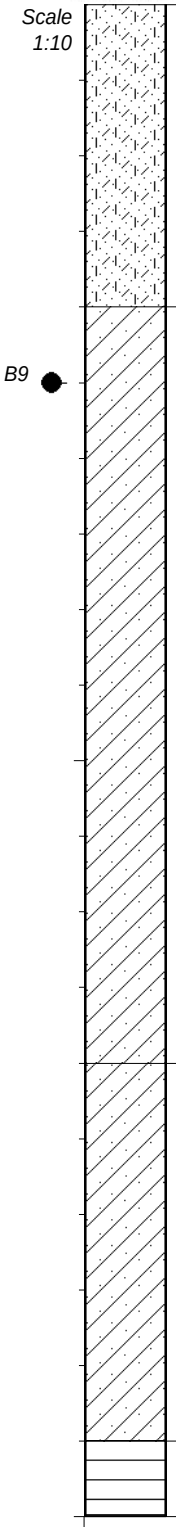
HOLE No: **TP8**

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP9**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry light grey brown dense intact SILTY CLAYEY SAND: Colluvium.

0.40 Moist light grey brown soft intact SANDY CLAY: Colluvium.

1.40 Moist light olive speckled orange stiff intact SANDY CLAY: Residual.

1.90 Grey olive highly weathered very closely jointed medium hard MUDSTONE.

2.00

NOTES

1) End of hole at 2.00m.
2) TLB stopped at 2.00m.
3) No perched groundwater
4) Sample B9 @ 0.5m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 29
Y-COORD : 26 14 53

HOLE No: **TP9**

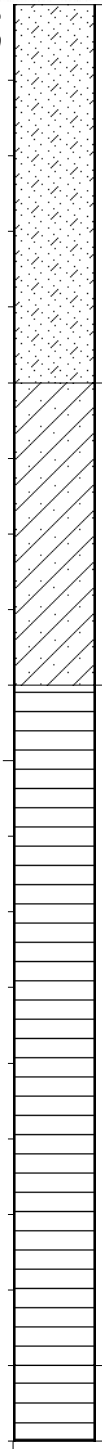
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP10**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist red brown loose intact CLAYEY SAND: Colluvium.

0.50 Moist light grey speckled orange firm intact SANDY CLAY: Residual.

0.90 Olive completely weathered soft rock MUDSTONE.

1.80 Olive highly very closely jointed weathered medium hard MUDSTONE.

1.90

NOTES

1) End of hole at 1.90m.
2) TLB stopped @ 1.90m.
3) No perched groundwater.
4) No sample.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29ł13’20.54"S
Y-COORD : 26ł15’5.01"E

HOLE No: **TP10**

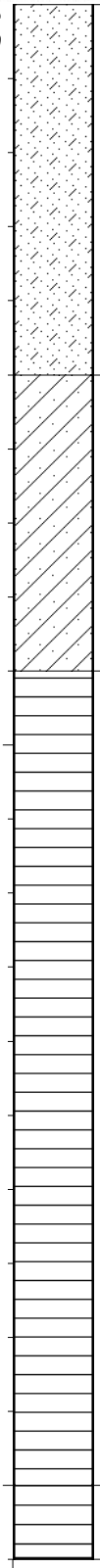
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP11**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist red brown dense becoming loose intact CLAYEY SAND: Colluvium.

0.50 Moist olive streaked red brown soft intact SANDY CLAY: Residual.

0.90 Light olive completely weathered soft rock MUDSTONE.

2.00 Light olive highly weathered very closely jointed medium hard rock MUDSTONE.

2.10

NOTES

1) End of hole at 2.10m.
2) TLB stopped @ 2.10m.
3) No perched groundwater.
4) No sample.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 37.4
Y-COORD : 26 14 52.6

HOLE No: **TP11**

DELTA GEOTECH (PTY) LTD

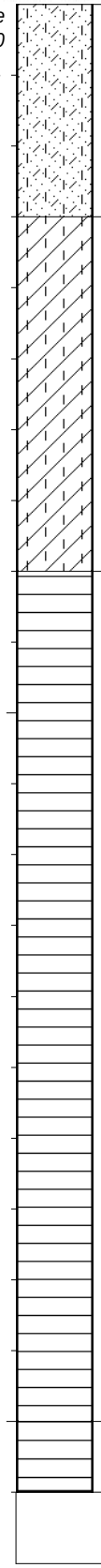
NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP12**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10

B12



0.00 Dry grey brown dense shattered SILTY CLAYEY SAND: Colluvium.

0.30 Dry light olive very stiff intact SILTY CLAY: Residual.

0.80 Light olive completely weathered soft rock MUDSTONE.

2.00 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

2.10

NOTES

1) End of hole at 2.10m.
2) TLB near refusal @ 2.10m.
3) No groundwater.
4) No water table.
5) Sample B12 @ 0.10m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 32.8
Y-COORD : 26 15 01.8

HOLE No: **TP12**

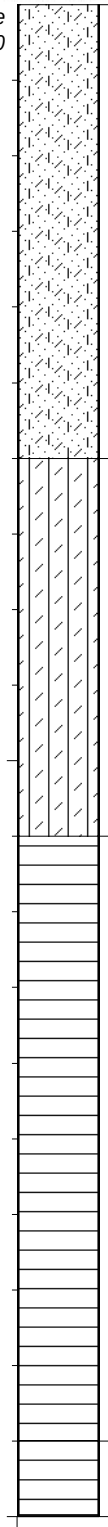
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP13**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry red brown very dense intact SILTY CLAYEY SAND: Colluvium.

0.60 Moist light olive intact CLAYEY SILT: Residual.

1.10 Light olive completely weathered soft rock MUDSTONE.

1.90 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

2.00

NOTES

1) End of hole at 2.00m.
2) TLB near refusal @ 2.00m.
3) No groundwater.
4) No sample.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 30.00
Y-COORD : 23 15 07.90

HOLE No: **TP13**

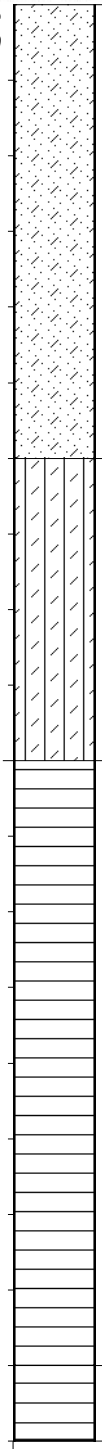
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP14**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist red brown dense becoming loose intact CLAYEY SAND: Colluvium.

0.60 Moist light olive frim intact CLAYEY SILT: Residual.

1.00 Light olive completely weathered soft rock MUDSTONE.

1.80 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

1.90

NOTES

1) End of hole at 1.90m.
2) TLB stopped @ 1.90m.
3) No groundwater.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 25.6
Y-COORD : 26 15 16.6

HOLE No: **TP14**

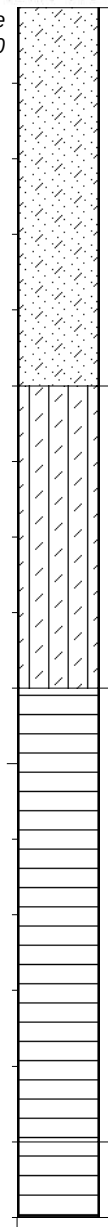
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP15**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.50 Moist light olive firm intact CLAYEY SILT: Residual.

0.90 Light olive completely weathered soft rock MUDSTONE.

1.50 Dark olive highly weathered closely jointed medium hard rock MUDSTONE.

1.60

NOTES

1) End of hole at 2.00m.
2) TLB stopped @ 1.60m
3) No groundwater.
4) No sample.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 22.8
Y-COORD : 26 15 14.3

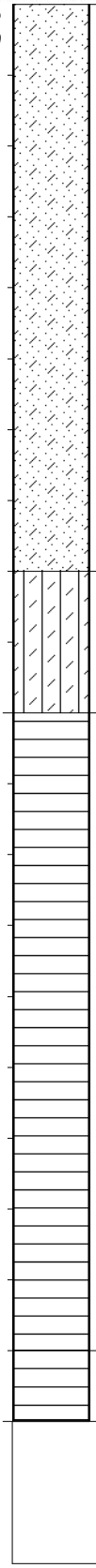
HOLE No: **TP15**

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP16**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.80 Moist light olive firm intact CLAYEY SILT: Residual.

1.00 Light olive completely weathered soft rock MUDSTONE.

1.90 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

2.00

NOTES

1) End of hole at 2.00m.
2) TLB stopped @ 2.00m.
3) No groundwater.
4) Sample B16 @ 1.90m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 18.8
Y-COORD : 26 15 24.8

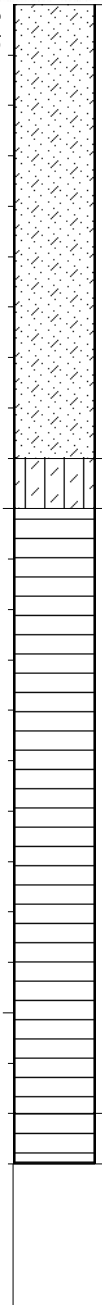
HOLE No: **TP16**

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP17**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:15



0.00 Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.90 Moist light olive firm intact CLAYEY SILT: Residual.

1.00 Light olive completely weathered soft rock MUDSTONE.

2.20 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

2.30

NOTES

1) End of hole at 2.30m.
2) TLB stopped @ 2.30m.
3) No perched groundwater.
4) No sample.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 15.5
Y-COORD : 26 15 31.5

HOLE No: **TP17**

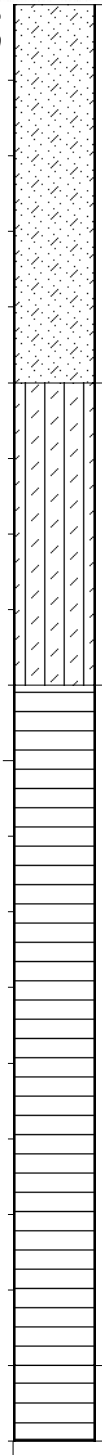
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP18**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.50 Moist light olive firm intact CLAYEY SILT: Residual.

0.90 Light olive completely weathered soft rock MUDSTONE.

1.80 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

1.90

NOTES

1) End of hole at 1.90m.
2) TLB refusal @ 1.90m.
3) No perched groundwater.
4) No sample.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 11.9
Y-COORD : 26 15 37.4

HOLE No: **TP18**

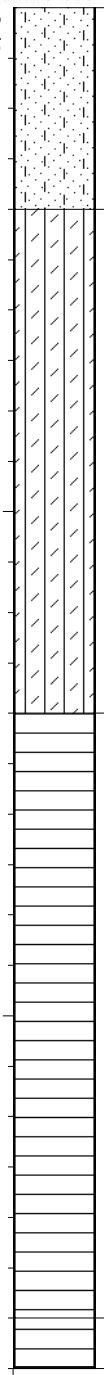
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP19**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:15



0.00 Dry grey brown dense intact SILTY FINE SAND: Colluvium.

0.40 Moist grey speckled orange brown firm intact CLAYEY SILT: Residual.

1.40 Light olive completely weathered soft rock MUDSTONE.

2.60 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

2.70

NOTES

1) End of hole at 2.70m.
2) TLB near refusal @ 2.70
3) No perched groundwater.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 08.4
Y-COORD : 26 15 44.3

HOLE No: **TP19**

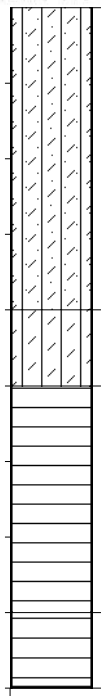
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP20**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00	Dry grey brown dense intact CLAYEY SANDY SILT: Colluvium.
0.40	Moist light olive firm intact CLAYEY SILT: Residual.
0.50	Light olive completely weathered soft rock MUDSTONE.
0.80	Light olive highly weathered closely jointed medium hard rock MUDSTONE.
0.90	

NOTES

1) End of hole at 0.90m.
2) TLB refused @ 0.90m.
3) No perched groundwater.
4) No sample.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 01.0
Y-COORD :

HOLE No: **TP20**

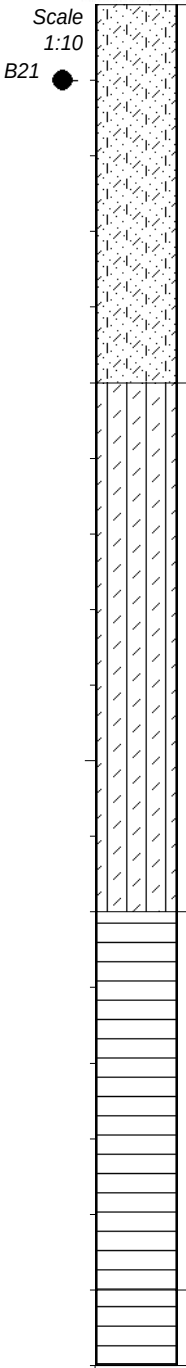
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP21**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist red brown dense to loose intact SILTY CLAYEY SAND: Colluvium.

0.50 Moist light olive firm intact CLAYEY SILT: Residual.

1.20 Light olive completely weathered soft rock MUDSTONE.

1.70 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

1.80

NOTES

1) End of hole at 1.80m.
2) TLB stopped @ 1.80m.
3) No perched groundwater.
4) Sample B21 @ 0.10m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 42.0
Y-COORD : 26 14 59.0

HOLE No: **TP21**

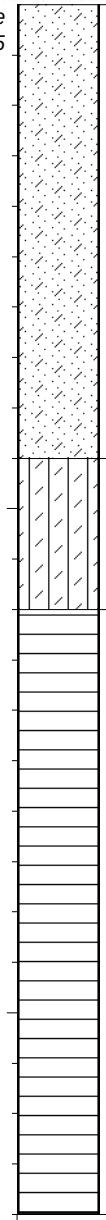
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP22**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:15



0.00

Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.90

Moist light olive firm intact CLAYEY SILT: Residual.

1.20

Light olive completely weathered soft rock MUDSTONE.

2.40

NOTES

1) End of hole at 2.40m.
2) TLB stopped @ 2.40m.
3) No perched groundwater.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29ł13’38.40
Y-COORD : 26ł15’05.10

HOLE No: **TP22**

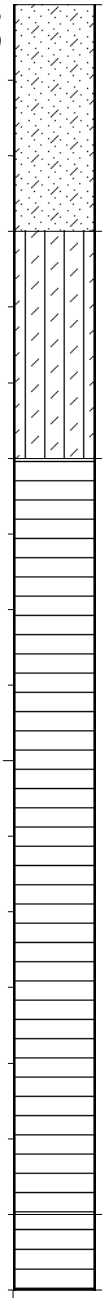
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP23**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.30 Moist light olive firm intact CLAYEY SILT: Residual.

0.60 Light olive completely weathered soft rock MUDSTONE.

1.60 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

1.70

NOTES

1) End of hole at 1.70m.
2) TLB stopped @ 1.70m.
3) No perched groundwater.
4) No sample.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 35.2
Y-COORD : 26 15 11.8

HOLE No: **TP23**

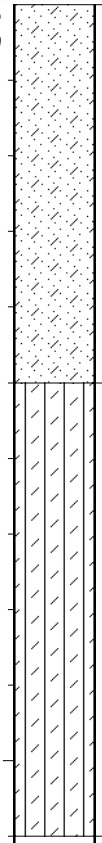
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP24**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.50 Moist light olive firm intact CLAYEY SILT: Residual.

1.10 Light olive completely weathered soft rock MUDSTONE.

1.70 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

1.80

NOTES

1) End of hole at 1.80m.
2) TLB stopped @ 1.80m.
3) No perched groundwater.
4) No sample.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 31.6
Y-COORD : 26 15 18.3

HOLE No: **TP24**

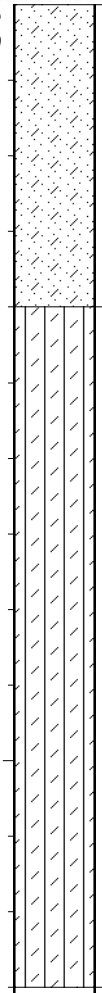
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP25**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.40 Moist light olive firm intact CLAYEY SILT: Residual.

1.30 Light olive completely weathered soft rock MUDSTONE.

2.00 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

2.10

NOTES

1) End of hole at 2.10m.
2) TLB stopped @ 2.10m.
3) No perched groundwater.
4) No sample.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29ł13’27.90"S
Y-COORD : 26ł15’22.20"E

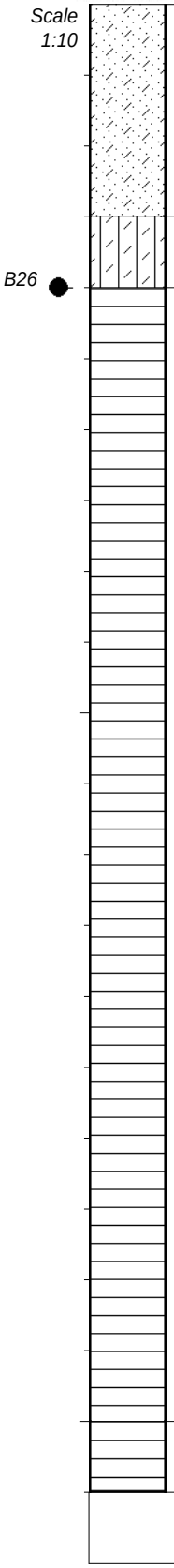
HOLE No: **TP25**

DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP26**
Sheet 1 of 1

JOB NUMBER: 000



0.00 Dry becoming moist red grey brown dense intact CLAYEY SAND: Colluvium.

0.30 Moist light olive soft intact SILTY CLAYEY SILT: Residual.

0.40 Light olive completely weathered soft rock MUDSTONE.

2.00 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

2.10

NOTES

1) End of hole at 2.10.
2) TLB stopped @ 2.10.
3) No perched groundwater.
4) Sample B26 @ 0.40m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 23.8
Y-COORD : 26 15 27.7

HOLE No: **TP26**

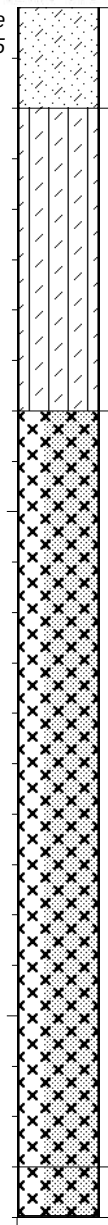
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP27**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:15



0.00 Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.20 Moist red brown firm intact CLAYEY SILT: Residual.

0.80 Olive completely weathered soft rock DOLERITE.

2.30 Olive highly weathered closely jointed medium hard rock DOLERITE.

2.40

NOTES

1) End of hole at 2.40m.
2) TLB stopped @ 2.40m.
3) No perched groundwater.
4) No sample.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 20.9
Y-COORD : 26 15 36.7

HOLE No: **TP27**

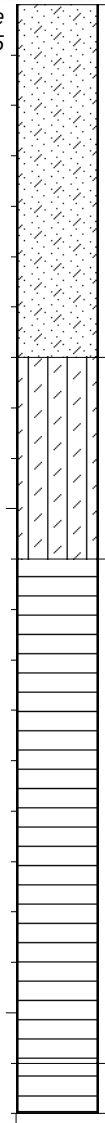
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP28**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:15



0.00

Dry becoming moist light grey brown dense to loose intact CLAYEY SAND: Colluvium.

0.70

Moist light olive firm intact CLAYEY SILT: Residual.

1.10

Light olive completely weathered soft rock MUDSTONE.

2.10

Light olive highly weathered closely jointed medium hard rock MUDSTONE.

2.20

NOTES

1) End of hole at 2.20m.
2) TLB stopped @ 2.20m.
3) No perched groundwater.
4) No sample.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 17.10
Y-COORD : 26 15 43.3

HOLE No: **TP28**

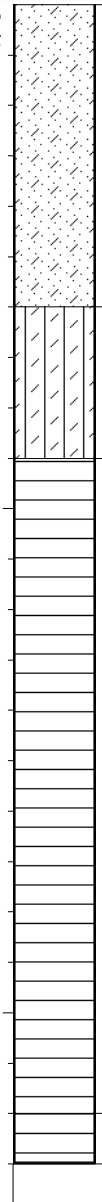
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP29**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:15



0.00 Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.60 Moist light olive firm intact CLAYEY SILT: Residual.

0.90 Light olive completely weathered soft rock MUDSTONE.

2.20 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

2.30

NOTES

1) End of hole at 2.30m.
2) TLB stopped @ 2.30m.
3) No perched groundwater.
4) No sample.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 13.40
Y-COORD :

HOLE No: **TP29**

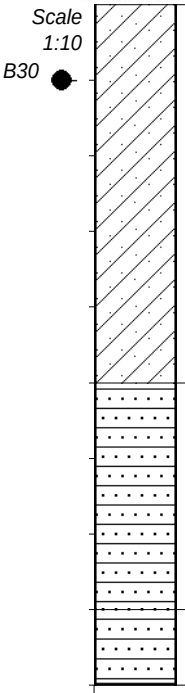
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP30**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming slightly moist very stiff shattered SANDY CLAY: Colluvium.

0.50 Olive completely weathered soft rock SANDSTONE.

0.80 Olive highly weathered closely jointed medium hard rock SANDSTONE.

0.90

NOTES

1) End of hole at 0.90m.
2) TLB stopped @ 0.90m.
3) No perched groundwater.
4) Sample B30 @ 0.10m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 07.0
Y-COORD : 26 15 59.6

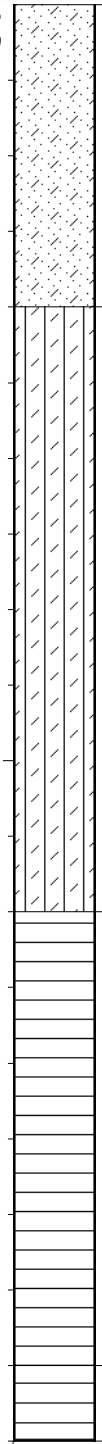
HOLE No: **TP30**

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP31**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.40 Moist light olive firm intact CLAYEY SILT: Residual.

1.20 Light olive completely weathered soft rock MUDSTONE.

1.80 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

1.90

NOTES

1) End of hole at 1.90m.
2) TLB stopped @ 1.90m.
3) No perched groundwater.
4) No sample.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 45.10
Y-COORD : 26 15 04.70

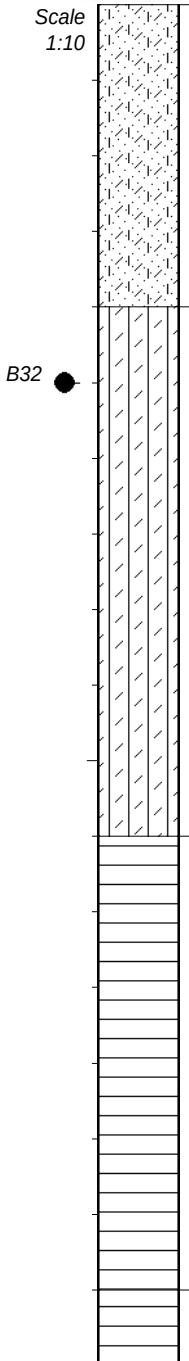
HOLE No: **TP31**

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP32**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist red brown dense to loose intact SILTY CLAYEY SAND: Colluvium.

0.40 Moist light olive firm intact CLAYEY SILT: Residual.

1.10 Light olive completely weathered soft rock MUDSTONE.

1.70 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

1.80

NOTES

1) End of hole at 1.80m.
2) TLB stopped @ 1.80m.
3) No perched groundwater.
4) Sample B32 @ 0.50m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 15 09.30
Y-COORD : 26ł15'9.28

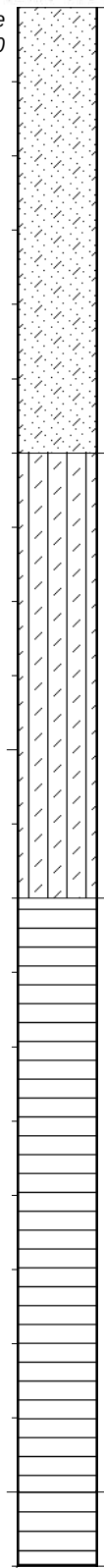
HOLE No: **TP32**

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP33**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.60 Moist light olive firm intact CLAYEY SILT: Residual.

1.20 Light olive completely weathered soft rock MUDSTONE.

2.00 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

2.10

NOTES

1) End of hole at 2.10m.
2) TLB stopped @ 2.10m.
3) No perched groundwater.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 39.4
Y-COORD : 26 15 15.9

HOLE No: **TP33**

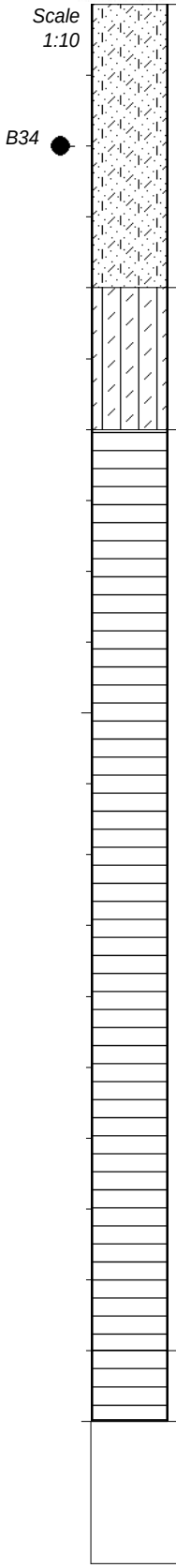
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP34**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist red brown dense to loose intact SILTY CLAYEY SAND: Colluvium.

0.40 Moist light olive firm intact CLAYEY SILT: Residual.

0.60 Light olive completely weathered soft rock MUDSTONE.

1.90 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

2.00

NOTES

1) End of hole at 2.00m.
2) TLB stopped @ 2.00m.
3) No perched groundwater.
4) Sample B34 @ 0.20m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 35.7
Y-COORD : 26 15 21.0

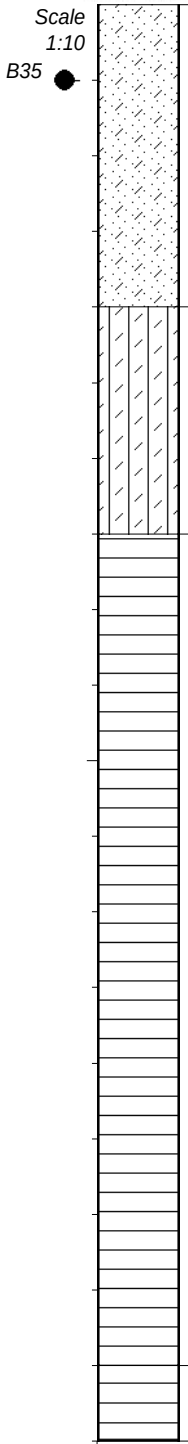
HOLE No: **TP34**

DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP35**
Sheet 1 of 1

JOB NUMBER: 000



0.00 Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.40 Moist light olive firm intact CLAYEY SILT: Residual.

0.70 Light olive completely weathered soft rock MUDSTONE.

1.80 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

1.90

NOTES

1) End of hole at 1.90m.
2) TLB stopped @ 1.90m.
3) No perched groundwater.
4) Sample B35 @ 0.10m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 33.4
Y-COORD : 26 15 27.1

HOLE No: **TP35**

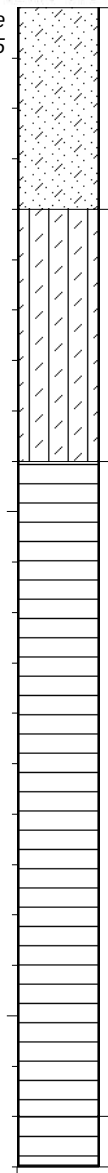
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP36**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:15



0.00 Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.40 Moist light olive firm intact CLAYEY SILT: Residual.

0.90 Light olive completely weathered soft rock MUDSTONE.

2.20 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

2.30

NOTES

1) End of hole at 2.30m.
2) TLB stopped @ 2.30m.
3) No perched groundwater.
4) No sample.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 29.2
Y-COORD : 26 15 33.4

HOLE No: **TP36**

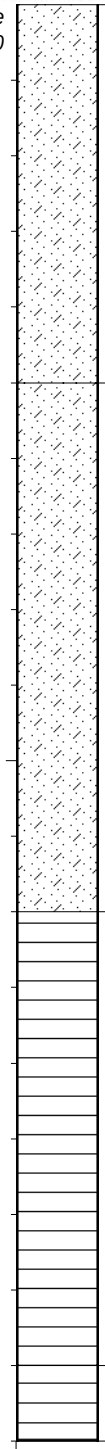
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP37**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.50 Moist light olive speckled white firm intact CLAYEY SAND: Residual.

1.20 Light olive completely weathered soft rock MUDSTONE.

1.80 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

1.90

NOTES

1) End of hole at 1.90m.
2) TLB stopped @ 1.90m.
3) No perched groundwater.
4) B37 @ 0.70m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 24.7
Y-COORD : 26 15 40.6

HOLE No: **TP37**

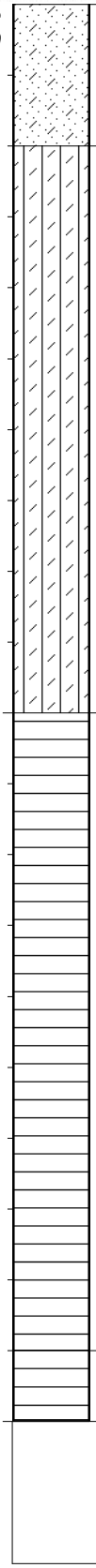
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP38**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist grey brown dense to loose intact CLAYEY SAND: Colluvium.

0.20 Moist light olive firm intact CLAYEY SILT: Residual.

1.00 Light olive completely weathered soft rock MUDSTONE.

1.90 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

2.00

NOTES

1) End of hole at 2.00m.
2) TLB stopped @ 2.00m.
3) No sample.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 20.30
Y-COORD : 26 15 47.20

HOLE No: **TP38**

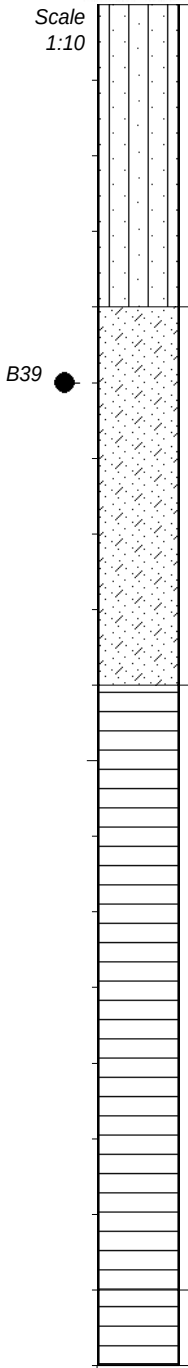
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP39**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist light grey dense to loose intact SANDY SILT: Colluvium.

0.40 Moist light brown speckled orange brown firm intact CLAYEY SAND: Residual.

0.90 Light olive completely weathered soft rock MUDSTONE.

1.70 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

1.80

NOTES

1) End of hole at 1.80m.
2) TLB stopped @ 1.80m.
3) No perched groundwater.
4) Sample B39 @ 0.50m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29ł13’17.57
Y-COORD : 26ł15’55.57

HOLE No: **TP39**

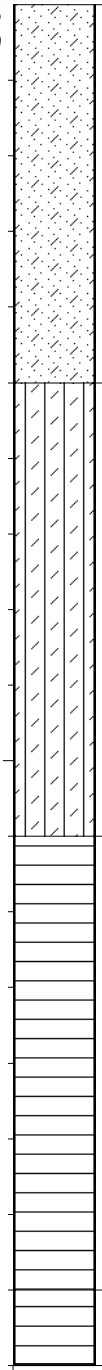
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP40**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist grey brown dense to loose intact CLAYEY SAND: Colluvium.

0.50 Moist light olive firm intact CLAYEY SILT: Residual.

1.10 Light olive completely weathered soft rock MUDSTONE.

1.70 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

1.80

NOTES

1) End of hole at 1.80m.
2) TLB stopped @ 1.80m.
3) No perched groundwater.
4) No samples.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 12.80
Y-COORD : 26 16 05.50

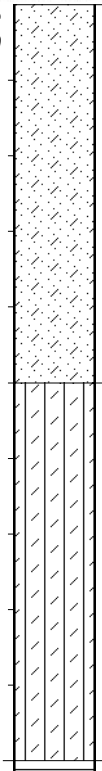
HOLE No: **TP40**

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP41**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.50 Moist light olive firm intact CLAYEY SILT: Residual.

1.00 Light olive completely weathered soft rock MUDSTONE.

1.80 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

1.90

NOTES

1) End of hole at 1.90m.
2) TLB stopped @ 1.90m.
3) No perched groundwater.
4) No sample.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 48.80
Y-COORD : 26 15 12.30

HOLE No: **TP41**

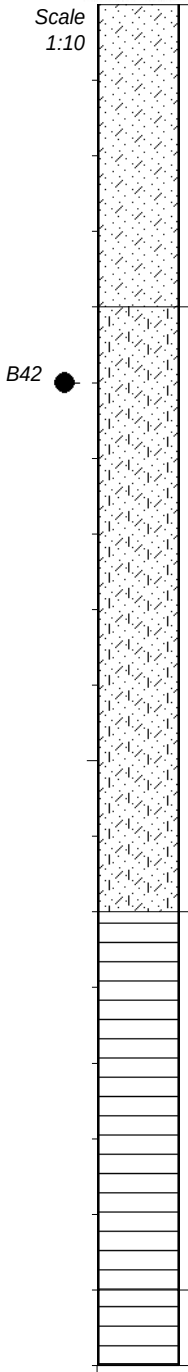
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP42**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.40 Moist light olive firm intact SILTY CLAYEY SAND: Residual.

1.20 Light olive completely weathered soft rock MUDSTONE.

1.70 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

1.80

NOTES

1) End of hole at 1.80m.
2) TLB stopped @ 1.80m.
3) No perched groundwater.
4) Sample B42 @ 0.50m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 46.20
Y-COORD : 26 15 15.70

HOLE No: **TP42**

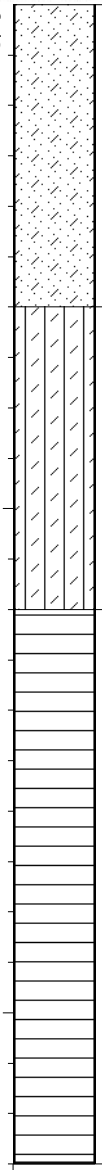
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP43**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:15



0.00

Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.60

Moist light olive firm intact CLAYEY SILT: Residual.

1.20

Light olive completely weathered soft rock MUDSTONE.

2.30

NOTES

1) End of hole at 2.30m.
2) TLB stopped @ 2.30m.
3) No perched groundwater.
4) No sample.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 43.70
Y-COORD : 26 15 20.20

HOLE No: **TP43**

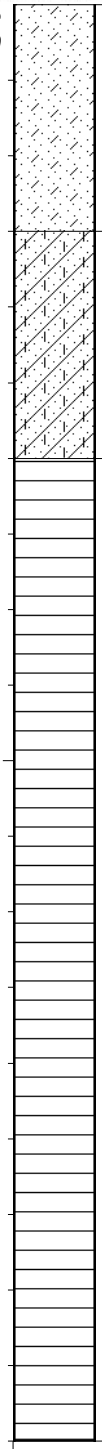
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP44**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.30 Moist light olive firm intact SILTY CLAY SAND: Residual.

0.60 Light olive completely weathered soft rock MUDSTONE.

1.90

NOTES

1) End of hole at 1.90m.
2) TLB stopped @ 1.90m.
3) No perched groundwater.
4) Sample B44 @ 0.40m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 40.2
Y-COORD : 26 15 25.2

HOLE No: **TP44**

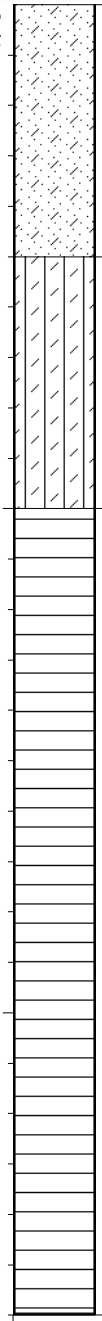
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP45**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:15



0.00 Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.50 Moist light olive firm intact CLAYEY SILT: Residual.

1.00 Light olive completely weathered soft rock MUDSTONE.

2.60

NOTES

1) End of hole at 2.60m.
2) TLB stopped @ 2.60m.
3) No perched groundwater.
4) No sample.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 37.0
Y-COORD : 26 15 29.8

HOLE No: **TP45**

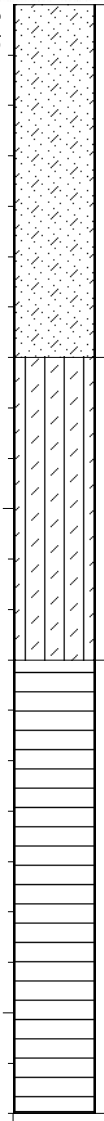
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP46**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:15



0.00 Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.70 Moist light olive firm intact CLAYEY SILT: Residual.

1.30 Light olive completely weathered soft rock MUDSTONE.

2.20

NOTES

1) End of hole at 2.20m.
2) TLB stopped @ 2.20m.
3) No perched groundwater.
4) Sample B46 @ 1.40m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 33.40
Y-COORD : 26 15 35.70

HOLE No: **TP46**

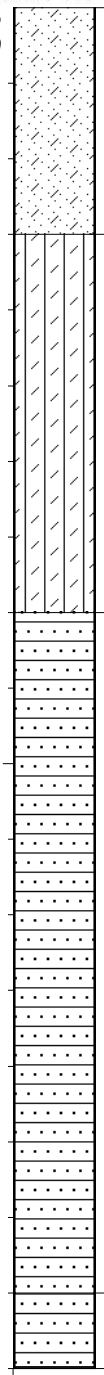
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP47**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.30 Moist red brown firm intact CLAYEY SILT: Residual.

0.80 Light olive completely weathered soft rock SANDSTONE.

1.70 Light olive highly weathered closely jointed medium hard rock SANDSTONE.

1.80

NOTES

1) End of hole at 1.80m.
2) TLB stopped @ 1.80m.
3) No perched groundwater.
4) No sample.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 30.20
Y-COORD : 26 15 43.70

HOLE No: **TP47**

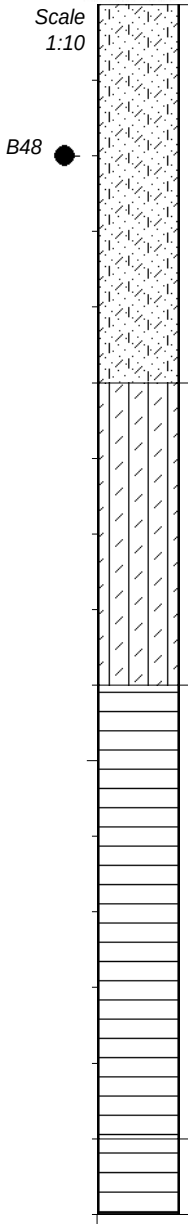
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP48**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist red brown dense to loose intact SILTY CLAYEY SAND: Colluvium.

0.50 Moist light olive firm intact CLAYEY SILT: Residual.

0.90 Light olive completely weathered soft rock MUDSTONE.

1.50 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

1.60

NOTES

1) End of hole at 1.60m.
2) TLB stopped @ 1.60m.
3) No perched groundwater.
4) Sample B48 @ 0.20m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 25.50
Y-COORD : 26 15 50.10

HOLE No: **TP48**

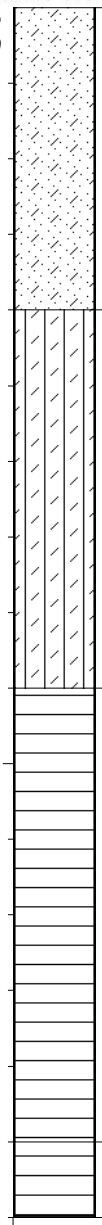
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP49**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.40 Moist light olive firm intact CLAYEY SILT: Residual.

0.90 Light olive completely weathered soft rock MUDSTONE.

1.50 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

1.60

NOTES

1) End of hole at 1.60m.
2) TLB stopped @ 1.60m.
3) No perched groundwater.
4) No sample.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 22.70
Y-COORD : 26 15 59.60

HOLE No: **TP49**

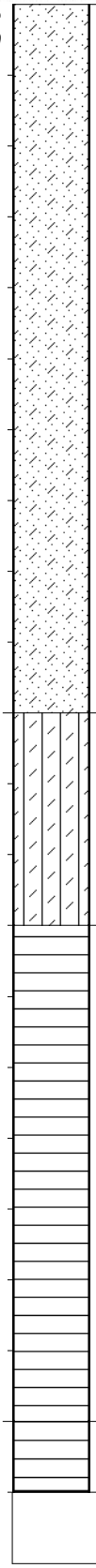
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP50**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

1.00 Moist grey speckled orange brown firm intact CLAYEY SILT: Residual.

1.30 Light olive completely weathered soft rock MUDSTONE.

2.00 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

2.10

NOTES

1) End of hole at 2.10m.
2) TLB stopped @ 2.10m.
3) No perched groundwater.
4) Sample B50 @ 1.40m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 17.90
Y-COORD : 26 16 08.80

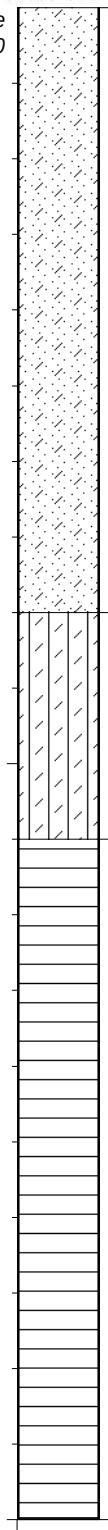
HOLE No: **TP50**

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP51**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.80 Moist light olive firm intact CLAYEY SILT: Residual.

1.10 Light olive completely weathered soft rock MUDSTONE.

2.00

NOTES

1) End of hole at 2.00m.
2) TLB stopped @ 2.00m.
3) No perched groundwater.
4) No sample.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 53.00
Y-COORD : 26 15 19.50

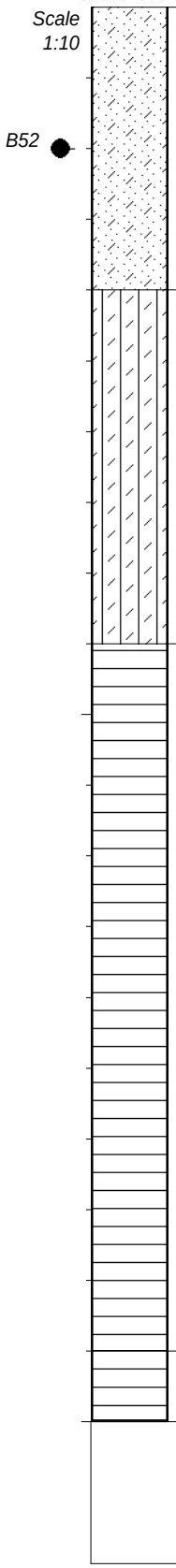
HOLE No: **TP51**

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP52**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.40 Moist light olive firm intact CLAYEY SILT: Residual.

0.90 Light olive completely weathered soft rock MUDSTONE.

1.90 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

2.00

NOTES

1) End of hole at 2.00m.
2) TLB stopped @ 2.00m.
3) No perched groundwater.
4) Sample B52 @ 0.20m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 49.50
Y-COORD : 26 15 22.20

HOLE No: **TP52**

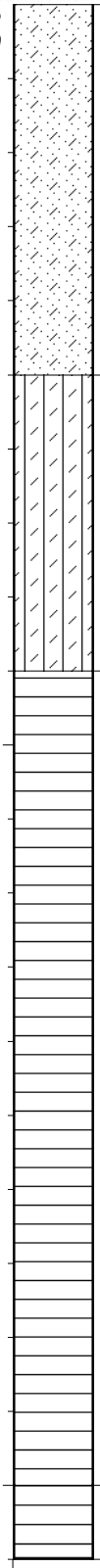
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP53**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.50 Moist light olive firm intact CLAYEY SILT: Residual.

0.90 Light olive completely weathered soft rock MUDSTONE.

2.00 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

2.10

NOTES

1) End of hole at 2.10m.
2) TLB stopped @ 2.10m
3) No perched groundwater.
4) No sample.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 47.10
Y-COORD : 26 15 26.30

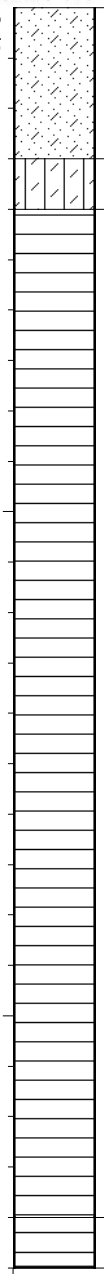
HOLE No: **TP53**

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP54**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:15



0.00 Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.30 Moist light olive firm intact CLAYEY SILT: Residual.

0.40 Light olive completely weathered soft rock MUDSTONE.

2.40 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

2.50

NOTES

1) End of hole at 2.50m.
2) TLB stopped @ 2.50m.
3) No perched groundwater.
4) No sample.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29ł13'44.23"S
Y-COORD : 26ł15'31.14"E

HOLE No: **TP54**

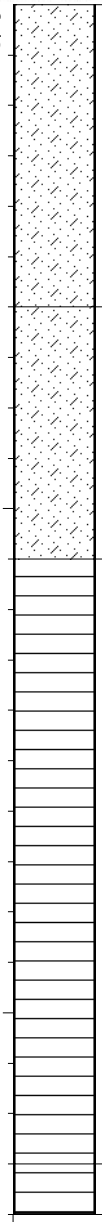
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP55**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:15



0.00 Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.60 Moist light olive firm intact CLAYEY SAND: Residual.

1.10 Light olive completely weathered soft rock MUDSTONE.

2.30 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

2.40

NOTES

1) End of hole at 2.40m.
2) TLB stopped @ 2.40m
3) No perched groundwater.
4) B55 @ 0.70m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 24 13 41.60
Y-COORD : 26 15 38.60

HOLE No: **TP55**

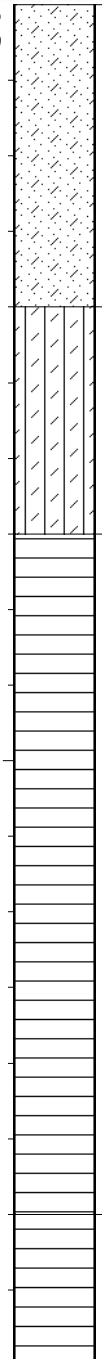
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP56**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.40 Moist light olive firm intact CLAYEY SILT: Residual.

0.70 Light olive completely weathered soft rock MUDSTONE.

1.60 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

B56

1.80

NOTES

1) End of hole at 1.80m.
2) TLB stopped @ 1.80m.
3) No perched groundwater.
4) Sample B56 @ 1.70m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29á13 37.80
Y-COORD : 26 15 44.50

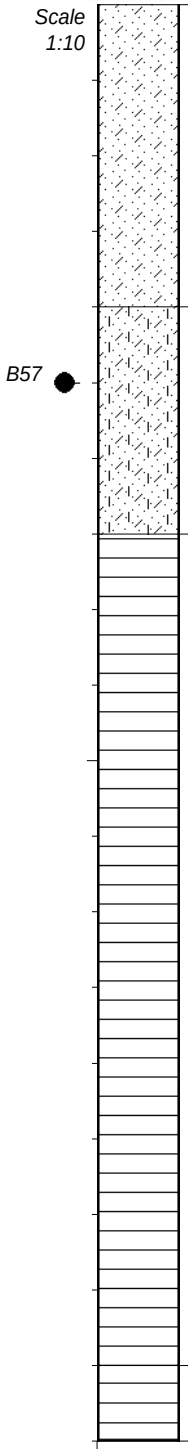
HOLE No: **TP56**

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP57**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.40 Moist light olive firm intact SILTY CLAYEY SAND: Residual.

0.70 Light olive completely weathered soft rock MUDSTONE.

1.80 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

1.90

NOTES

1) End of hole at 1.90m.
2) TLB stopped @ 1.90m.
3) No perched groundwater.
4) Sample B57 @ 0.50m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 35.70
Y-COORD : 26 15 50.70

HOLE No: **TP57**

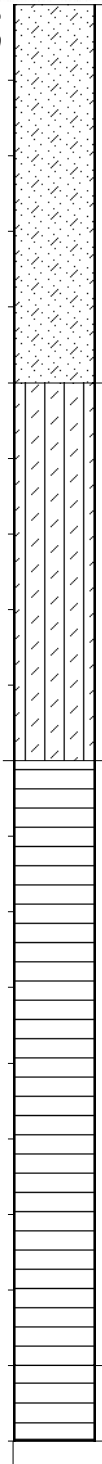
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP58**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.50 Moist light olive firm intact CLAYEY SILT: Residual.

1.00 Light olive completely weathered soft rock MUDSTONE.

1.80 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

1.90

NOTES

1) End of hole at 1.90m.
2) TLB stopped @ 1.90m.
3) No perched groundwater.
4) No sample.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29 13 32.40
Y-COORD : 26 15 59.10

HOLE No: **TP58**

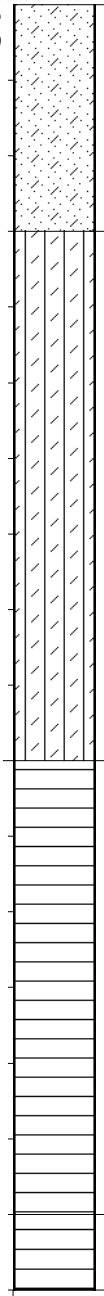
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP59**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.30 Moist light grey speckled olive firm intact CLAYEY SILT: Residual.

1.00 Light olive completely weathered soft rock MUDSTONE.

1.60 Light olive highly weathered closely jointed medium hard rock MUDSTONE.

1.70

NOTES

1) End of hole at 1.70m.
2) TLB stopped @ 1.70m.
3) No perched groundwater.
4) No sample.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ
TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019
DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 29ł13’28.60"S
Y-COORD : 26ł16’5.89"E

HOLE No: **TP59**

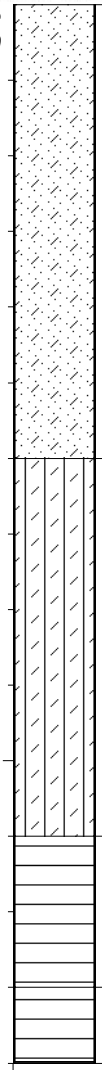
DELTA GEOTECH (PTY) LTD

NGOTI DEVELOPMENT CONSULTANTS
KLIPFONTEIN & CERES HOUSING DEVELOPMENT

HOLE No: **TP60**
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00

Dry becoming moist red brown dense to loose intact CLAYEY SAND: Colluvium.

0.60

Moist light olive firm intact CLAYEY SILT: Residual.

1.10

Light olive completely weathered soft rock MUDSTONE.

1.30

Light olive highly weathered closely jointed medium hard rock MUDSTONE.

1.40

NOTES

1) End of hole at 1.40m.
2) TLB refusal @ 1.40m.
3) No perched groundwater.
4) No sample.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : MJ

TYPE SET BY : RDC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 21 August 2019

DATE : 02/10/2019 09:32
TEXT : ..emKlipfonteinAug2019.doc

ELEVATION :
X-COORD : 32 39 48.00
Y-COORD : 27 17 40.30

HOLE No: **TP60**

APPENDIX - B

Delta Geotech (Pty) Ltd

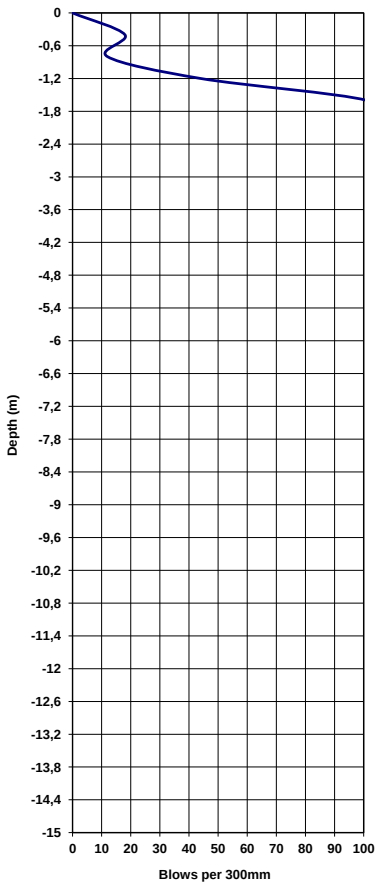
Client:	**Ngoti Development Consultants**	**Ref.No.**	**19-719**
Project:	**Ceres and Klipfontein Development - Bloemfontein**	**Date:**	**2019/08/21**
Section:		**Operator:**	**MJ**

Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 1***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	18	Med.Dense
0,6	12	Loose
0,9	44	Dense
1,2	Ref	

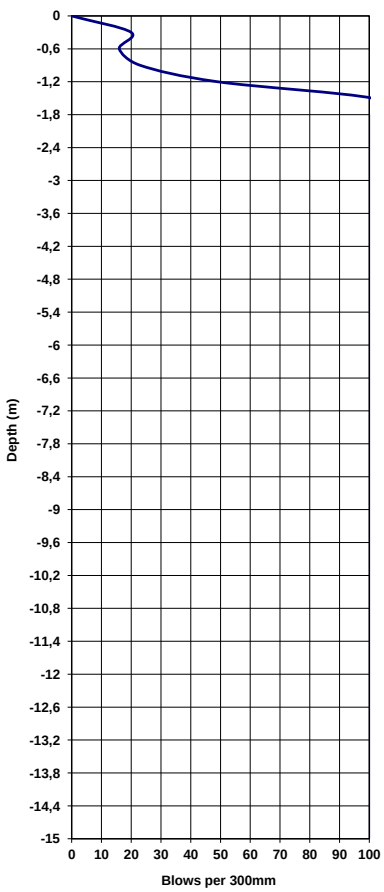


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 2***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	20	Med.Dense
0,6	16	Med.Dense
0,9	23	Med.Dense
1,2	49	Dense
1,5	Ref	

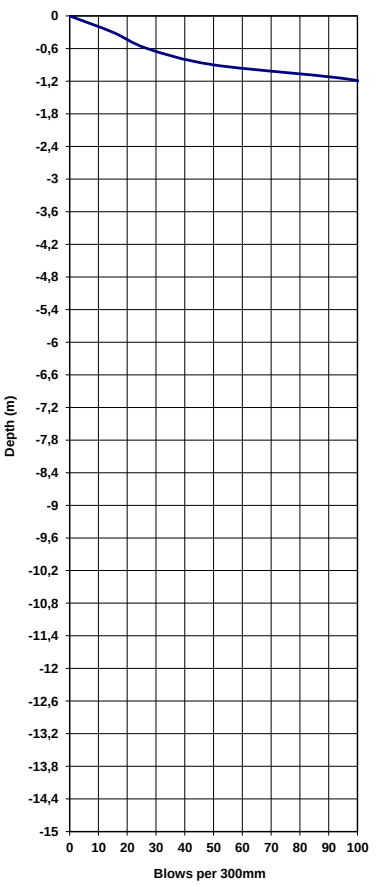


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0	27	
0,3	15	Loose
0,6	27	Med.Dense
1,2	50	Med.Dense
1,5	Ref	



THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Delta Geotech (Pty) Ltd

Client:	**Ngoti Development Consultants**	**Ref.No.**	**19-719**
Project:	**Ceres and Klipfontein Development - Bloemfontein**	**Date:**	**2019/08/21**
Section:		**Operator:**	**MJ**

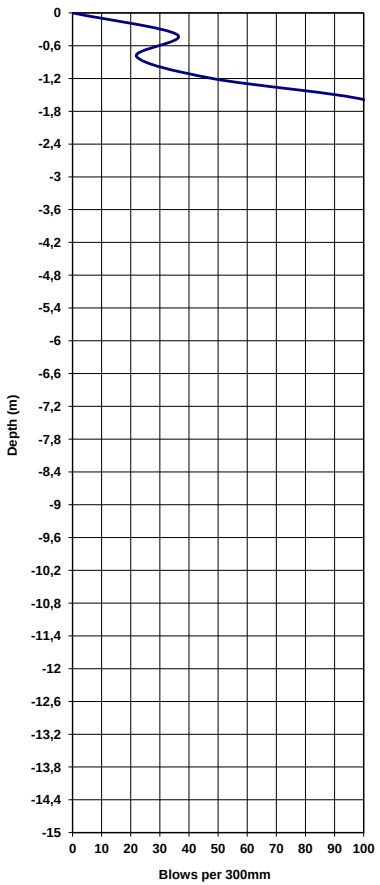
Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 4***

THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	36	Med.Dense
0,6	22	Med.Dense
0,9	48	Dense
1,2	Ref	

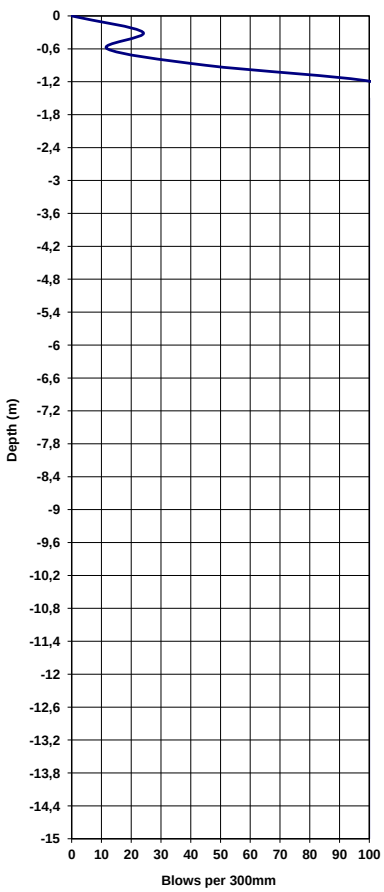


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 5***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	24	Med.Dense
0,6	12	Loose
0,9	45	Dense
1,2	Ref	

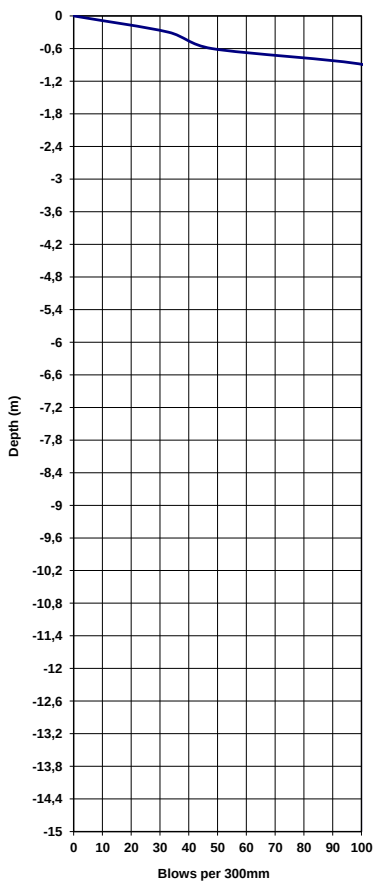


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 6***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	33	Med.Dense
0,6	48	Dense
1,2	Ref	



Delta Geotech (Pty) Ltd

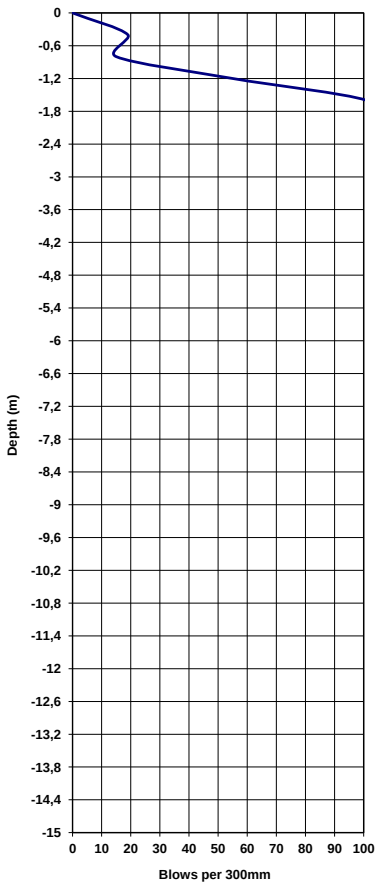
Client:	**Ngoti Development Consultants**	**Ref.No.**	**19-719**
Project:	**Ceres and Klipfontein Development - Bloemfontein**	**Date:**	**2019/08/21**
Section:		**Operator:**	**MJ**

Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 7***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	19	Med.Dense
0,6	15	Loose
0,9	55	Dense
1,2	Ref	

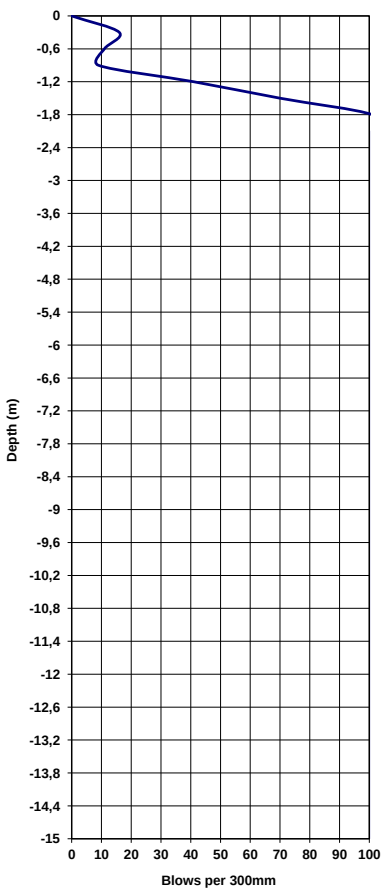


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 8***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	16	Med.Dense
0,6	11	Loose
0,9	9	Loose
1,2	41	Dense
1,5	70	Dense
1,8	Ref	

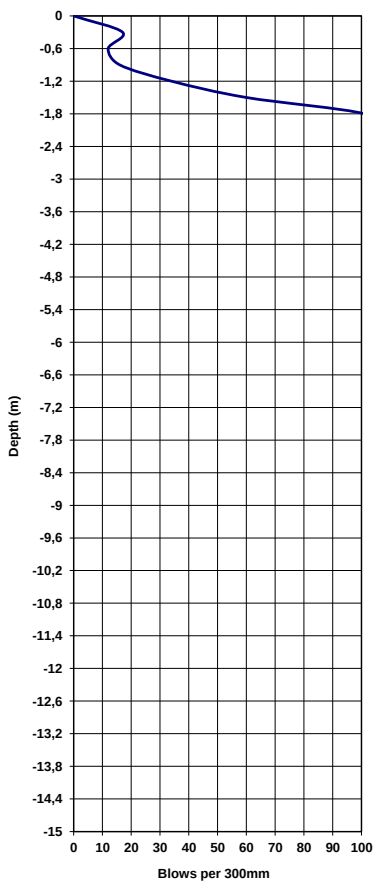


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 9***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	17	Med.Dense
0,6	12	Loose
1,2	16	Loose
1,5	34	Med.Dense
1,8	60	Dense
2,1	Ref	



THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Delta Geotech (Pty) Ltd

Client:	**Ngoti Development Consultants**	**Ref.No.**	**19-719**
Project:	**Ceres and Klipfontein Development - Bloemfontein**	**Date:**	**2019/08/21**
Section:		**Operator:**	**MJ**

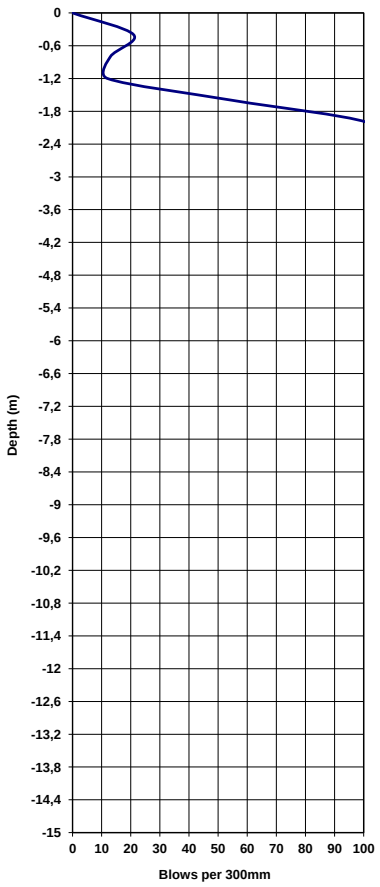
Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 10***

THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	21	Med.Dense
0,6	13	Loose
0,9	12	Loose
1,2	55	Dense
	Ref	

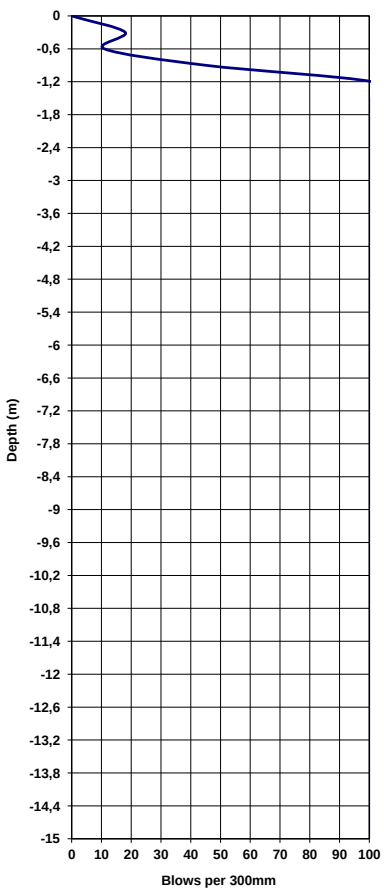


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 11***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	18	Med.Dense
0,6	11	Loose
0,9	45	Dense
1,2	Ref	

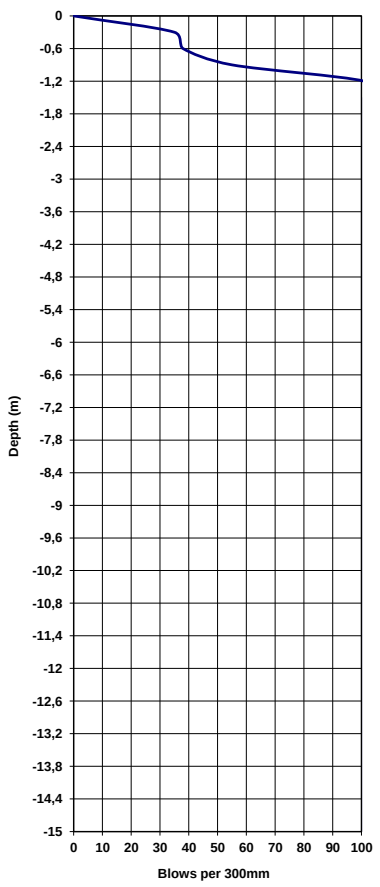


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 12***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	35	Med.Dense
0,6	38	Med.Dense
1,2	55	Med.Dense
1,5	Ref	



Delta Geotech (Pty) Ltd

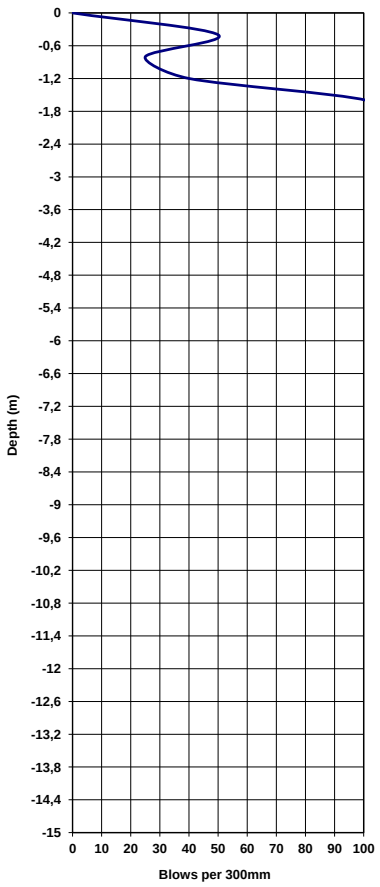
Client:	**Ngoti Development Consultants**	**Ref.No.**	**19-719**
Project:	**Ceres and Klipfontein Development - Bloemfontein**	**Date:**	**2019/08/21**
Section:		**Operator:**	**MJ**

Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 13***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	50	Dense
0,6	25	Med.Dense
0,9	40	Med.Dense
1,2	Ref	

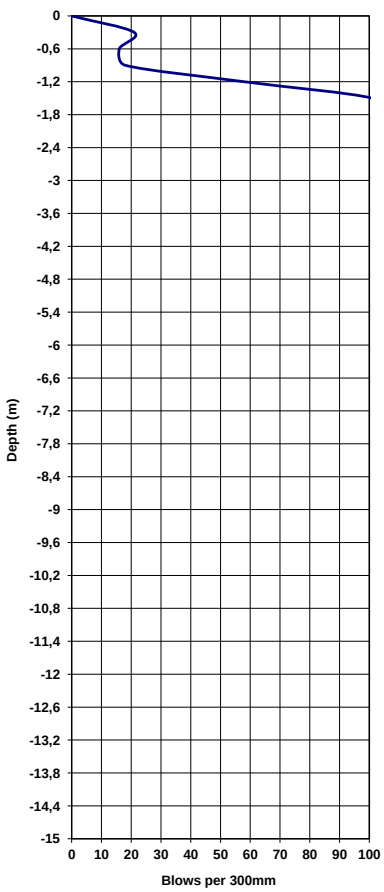


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 14***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	21	Med.Dense
0,6	16	Med.Dense
0,9	18	Med.Dense
1,2	58	Dense
	Ref	



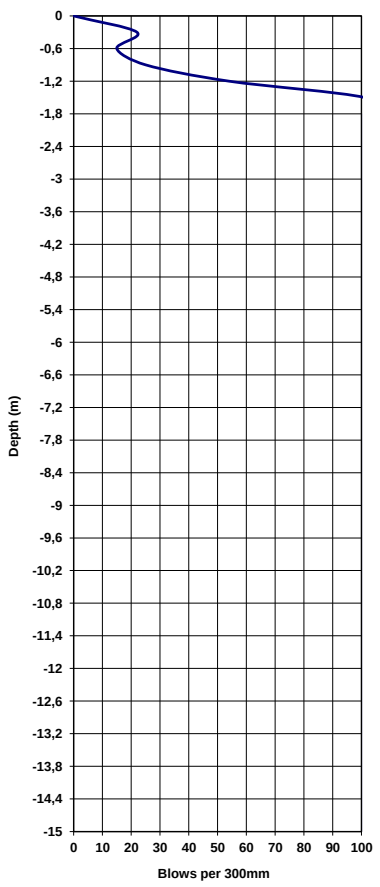
Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 15***

THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	22	Med.Dense
0,6	15	Loose
1,2	25	Loose
1,5	54	Dense
	Ref	



Delta Geotech (Pty) Ltd

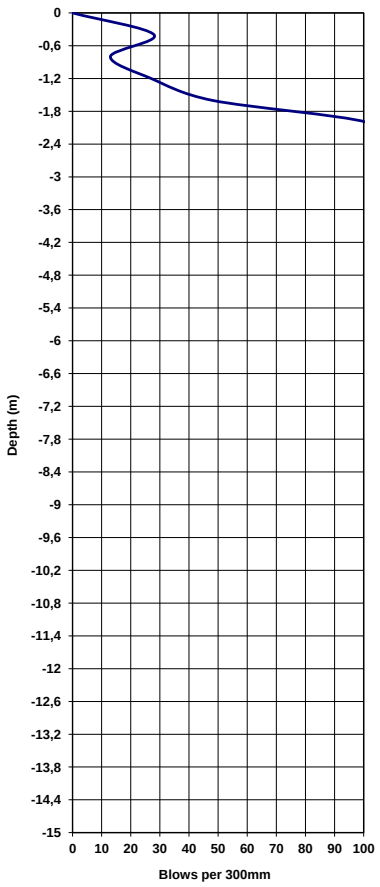
Client:	**Ngoti Development Consultants**	**Ref.No.**	**19-719**
Project:	**Ceres and Klipfontein Development - Bloemfontein**	**Date:**	**2019/08/21**
Section:		**Operator:**	**MJ**

Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 16***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	28	Med.Dense
0,6	13	Loose
0,9	27	Med.Dense
1,2	48	Dense
1,5	Ref	

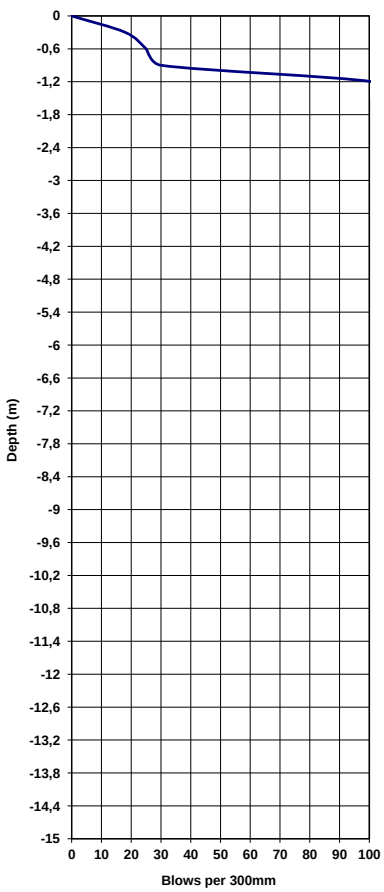


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 17***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	18	Med.Dense
0,6	25	Med.Dense
0,9	30	Med.Dense
1,2	Ref	

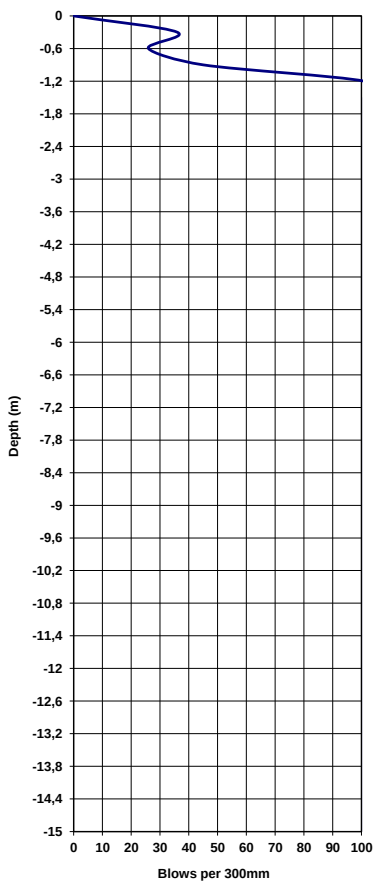


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 18***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	36	Med.Dense
0,6	26	Med.Dense
1,2	45	Med.Dense
1,5	Ref	



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Delta Geotech (Pty) Ltd

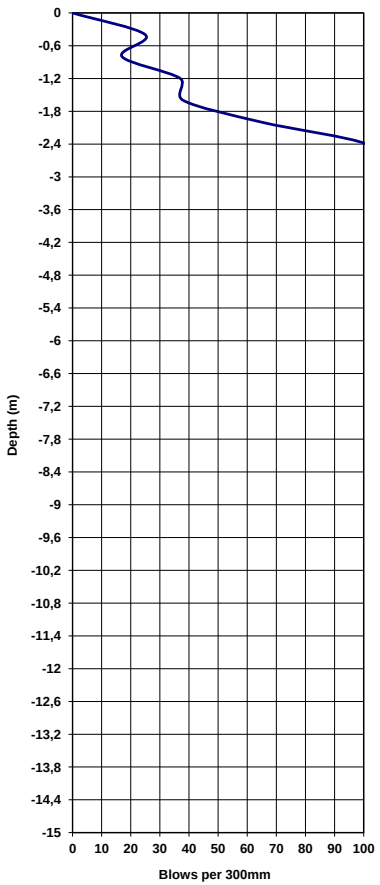
Client:	**Ngoti Development Consultants**	**Ref.No.**	**19-719**
Project:	**Ceres and Klipfontein Development - Bloemfontein**	**Date:**	**2019/08/21**
Section:		**Operator:**	**MJ**

Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 19***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	25	Med.Dense
0,6	17	Med.Dense
0,9	37	Med.Dense
1,2	38	Med.Dense
1,5	65	Dense
	Ref	

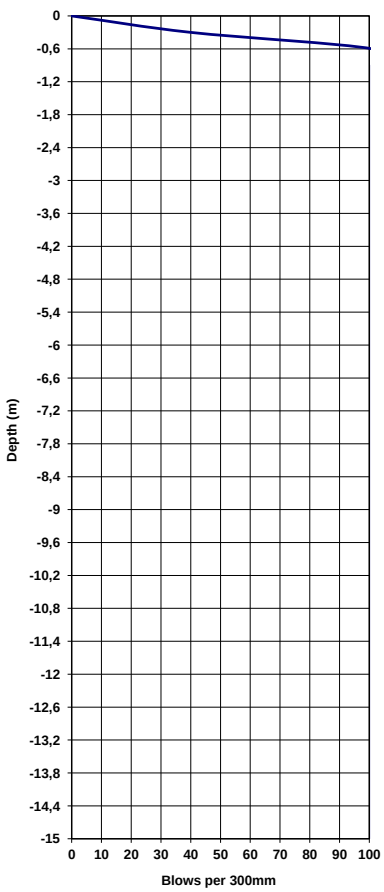


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 20***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	40	Med.Dense
0,6	Ref	

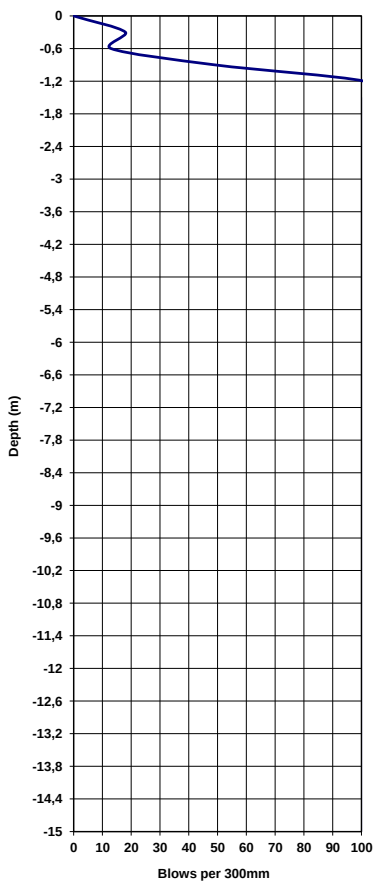


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 21***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	18	Med.Dense
0,6	13	Loose
1,2	49	Med.Dense
1,5	Ref	



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Delta Geotech (Pty) Ltd

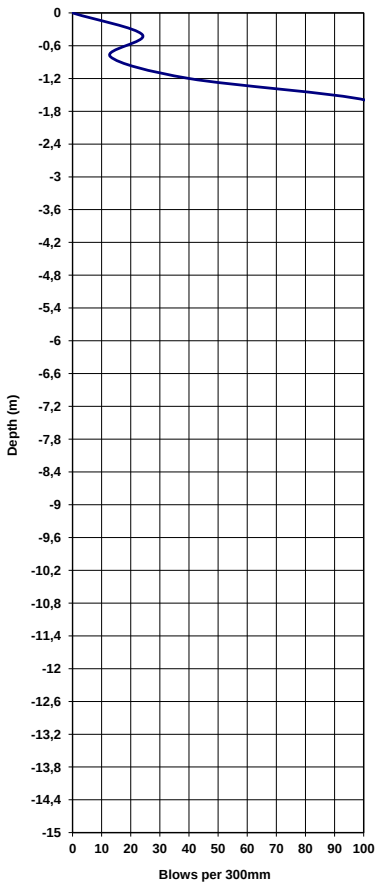
Client:	**Ngoti Development Consultants**	**Ref.No.**	**19-719**
Project:	**Ceres and Klipfontein Development - Bloemfontein**	**Date:**	**2019/08/21**
Section:		**Operator:**	**MJ**

Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 22***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	24	Med.Dense
0,6	13	Loose
0,9	40	Med.Dense
1,2	Ref	

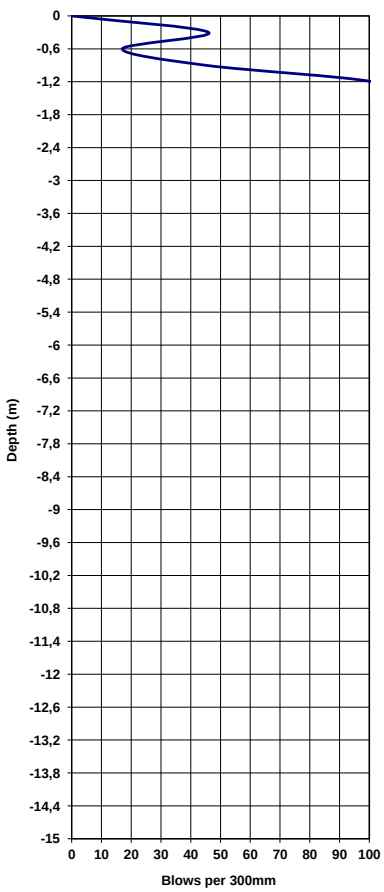


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 23***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	46	Dense
0,6	17	Med.Dense
0,9	45	Dense
1,2	Ref	

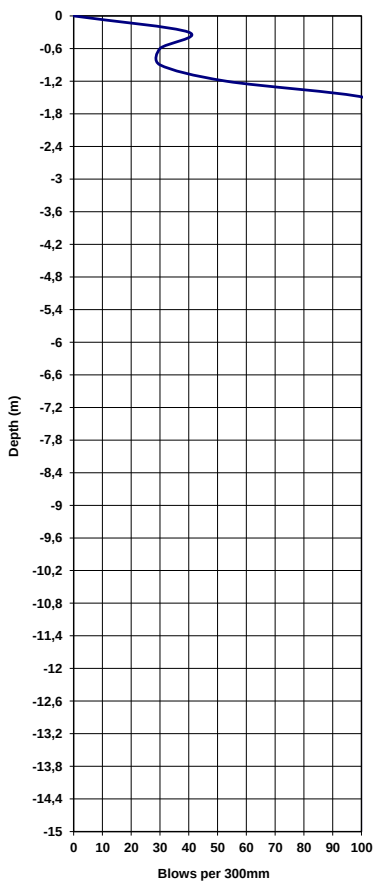


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 24***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	40	Med.Dense
0,6	30	Med.Dense
1,2	30	Loose
1,5	53	Dense
1,8	Ref	



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Delta Geotech (Pty) Ltd

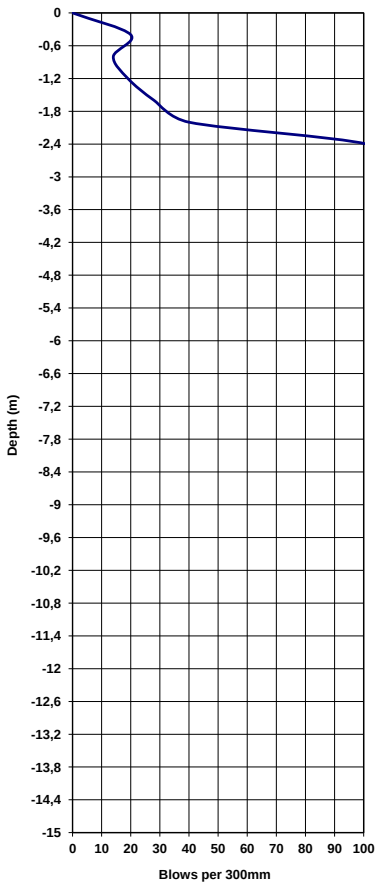
Client:	**Ngoti Development Consultants**	**Ref.No.**	**19-719**
Project:	**Ceres and Klipfontein Development - Bloemfontein**	**Date:**	**2019/08/21**
Section:		**Operator:**	**MJ**

Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 25***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	20	Med.Dense
0,6	14	Loose
0,9	19	Med.Dense
1,2	28	Med.Dense
1,5	40	Med.Dense
1,8	Ref	

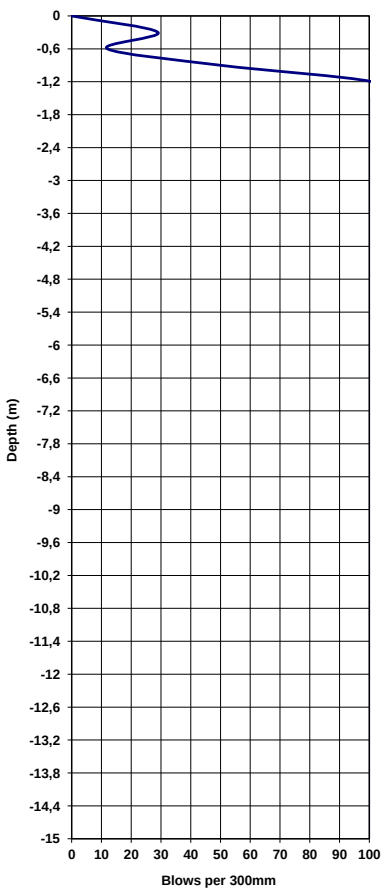


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 26***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	29	Med.Dense
0,6	12	Loose
0,9	50	Dense
1,2	Ref	

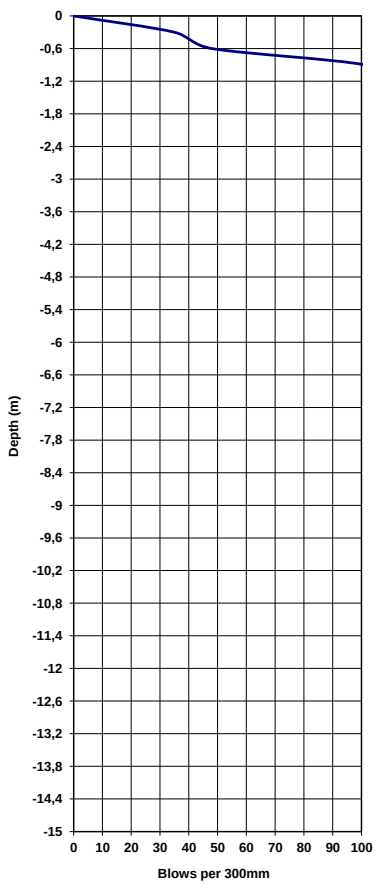


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 27***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	35	Med.Dense
0,6	48	Dense
1,2	Ref	



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Delta Geotech (Pty) Ltd

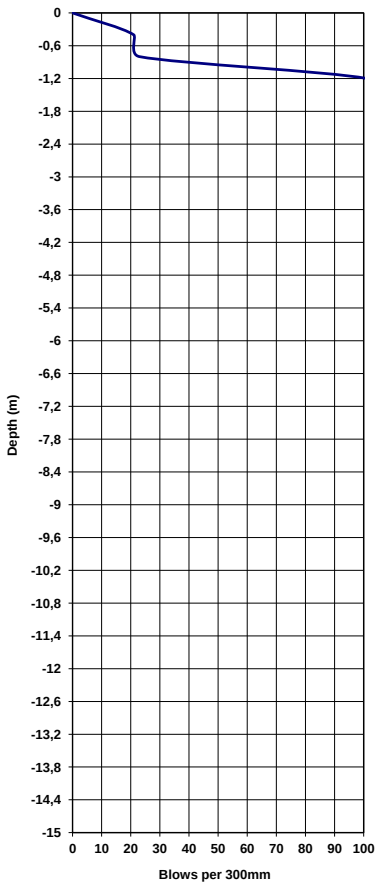
Client:	**Ngoti Development Consultants**	**Ref.No.**	**19-719**
Project:	**Ceres and Klipfontein Development - Bloemfontein**	**Date:**	**2019/08/21**
Section:		**Operator:**	**MJ**

Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 28***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	21	Med.Dense
0,6	23	Med.Dense
0,9	Ref	

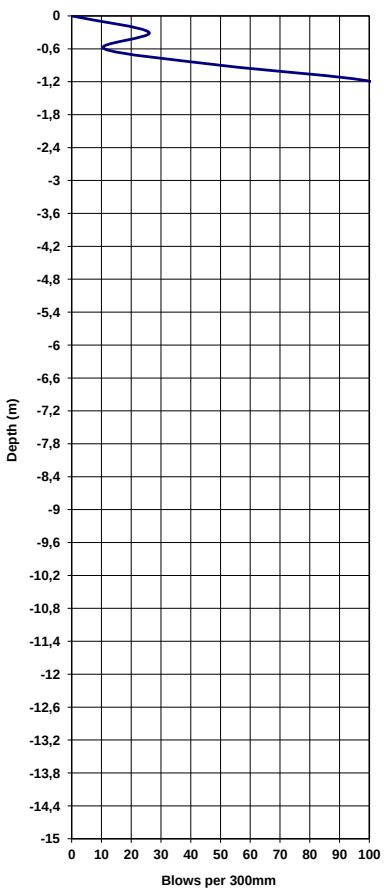


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 29***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	26	Med.Dense
0,6	11	Loose
0,9	50	Dense
1,2	Ref	

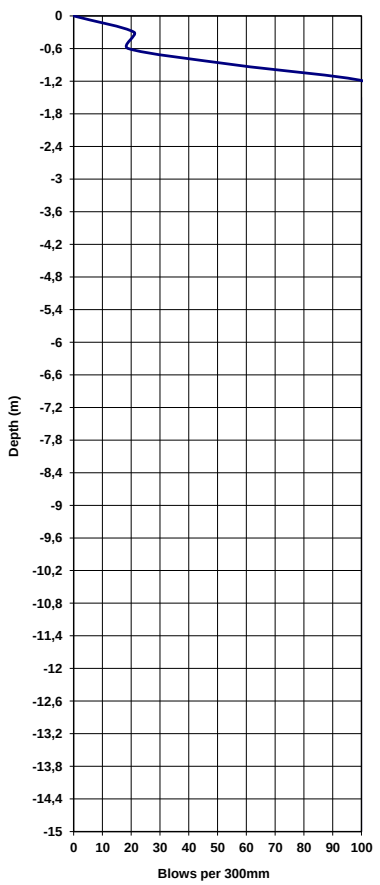


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 30***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	21	Med.Dense
0,6	19	Med.Dense
1,2	56	Med.Dense
1,5	Ref	



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Delta Geotech (Pty) Ltd

Client:	**Ngoti Development Consultants**	**Ref.No.**	**19-719**
Project:	**Ceres and Klipfontein Development - Bloemfontein**	**Date:**	**2019/08/21**
Section:		**Operator:**	**MJ**

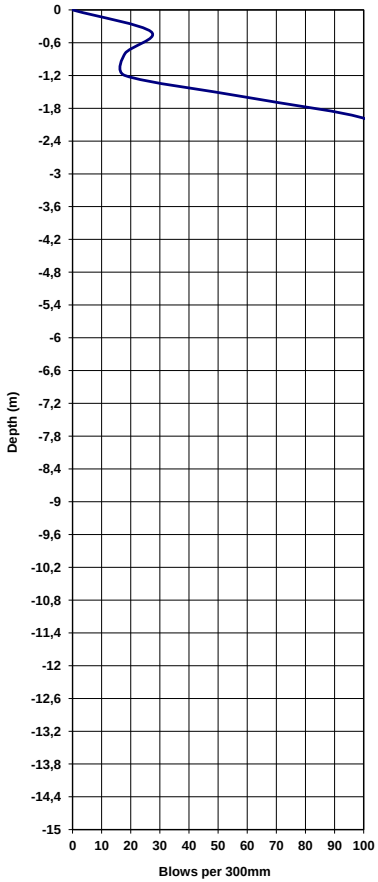
Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 31***

THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	27	Med.Dense
0,6	18	Med.Dense
0,9	18	Med.Dense
1,2	60	Dense
1,5	Ref	

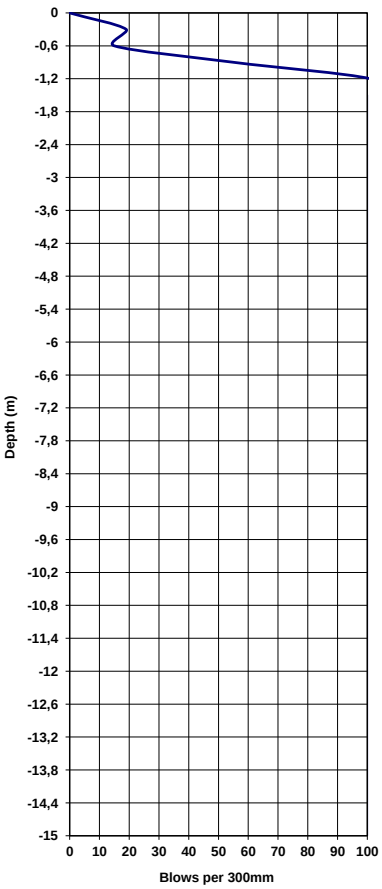


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 32***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	19	Med.Dense
0,6	15	Loose
0,9	55	Dense
1,2	Ref	

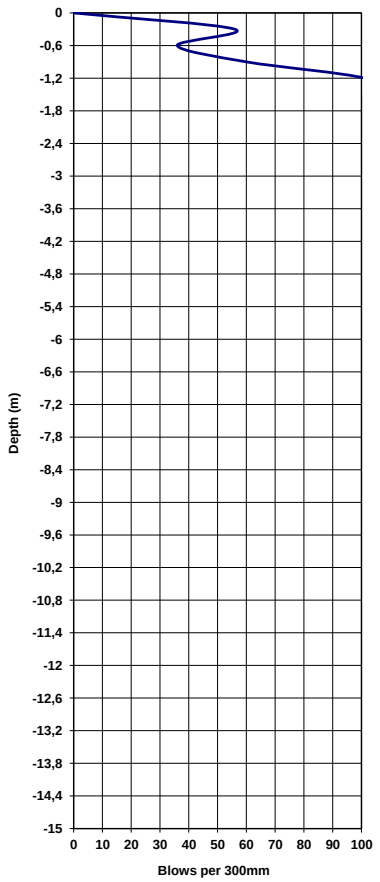


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 33***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	56	Dense
0,6	36	Med.Dense
1,2	60	Med.Dense
1,5	Ref	



Delta Geotech (Pty) Ltd

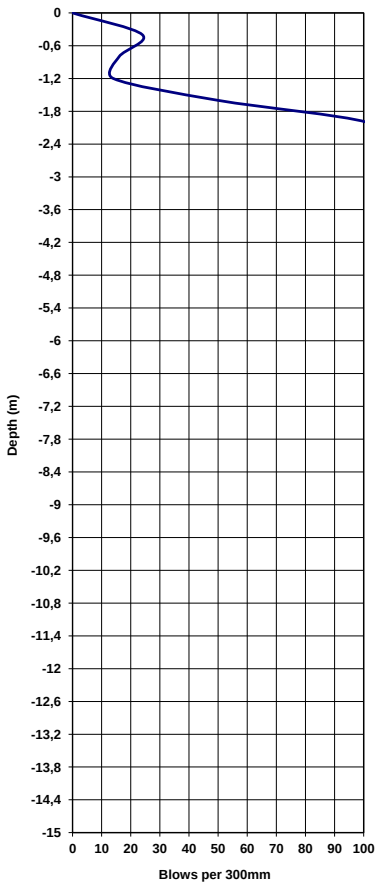
Client:	**Ngoti Development Consultants**	**Ref.No.**	**19-719**
Project:	**Ceres and Klipfontein Development - Bloemfontein**	**Date:**	**2019/08/21**
Section:		**Operator:**	**MJ**

Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 35***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	24	Med.Dense
0,6	16	Med.Dense
0,9	14	Loose
1,2	50	Dense
1,5	Ref	

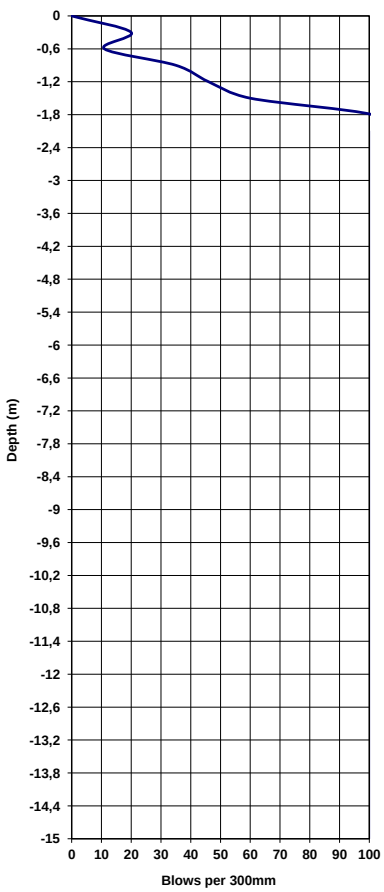


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 36***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	20	Med.Dense
0,6	11	Loose
0,9	35	Med.Dense
1,2	46	Dense
1,5	60	Dense
1,8	Ref	

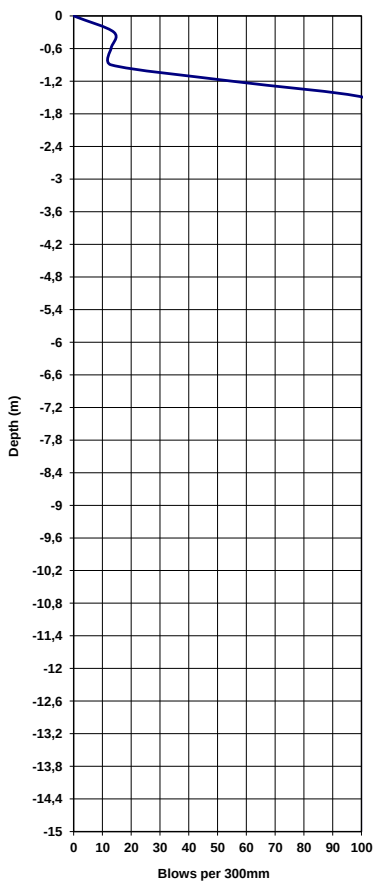


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 37***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	14	Loose
0,6	13	Loose
1,2	13	Very Loose
1,5	55	Dense
1,8	Ref	



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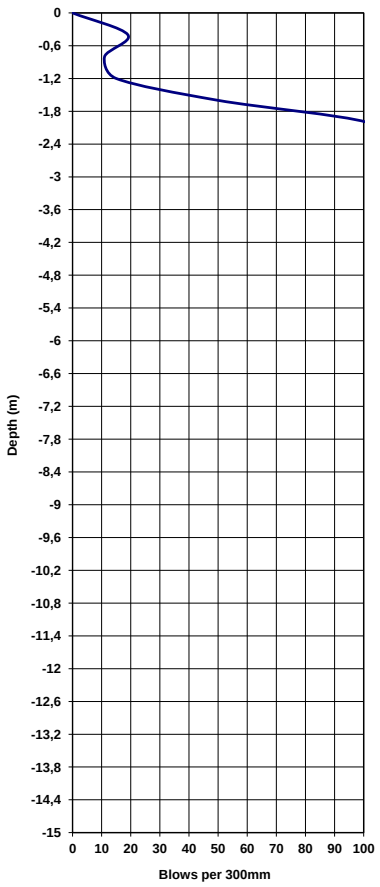
Delta Geotech (Pty) Ltd

Client:	**Ngoti Development Consultants**	**Ref.No.**	**19-719**
Project:	**Ceres and Klipfontein Development - Bloemfontein**	**Date:**	**2019/08/21**
Section:		**Operator:**	**MJ**

Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 38***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings
C=1
Phi=0

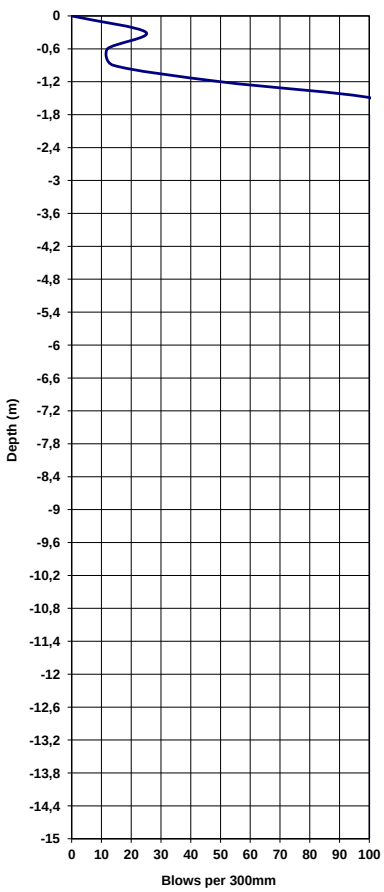
Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	19	Med.Dense
0,6	11	Loose
0,9	15	Loose
1,2	50	Dense
1,5	Ref	



Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 39***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings
C=1
Phi=0

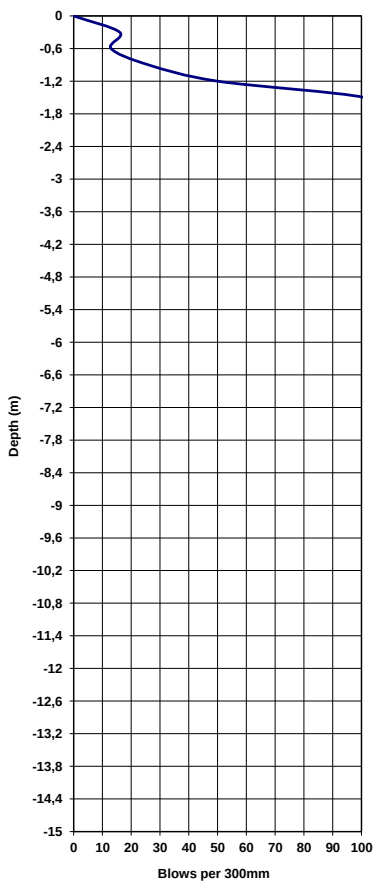
Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	25	Med.Dense
0,6	12	Loose
0,9	14	Loose
1,2	50	Dense
1,5	Ref	



Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 40***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings
C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	16	Med.Dense
0,6	13	Loose
1,2	26	Loose
1,5	50	Dense
1,8	Ref	



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Delta Geotech (Pty) Ltd

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Section:		**Operator:**	**MJ**

Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 41***

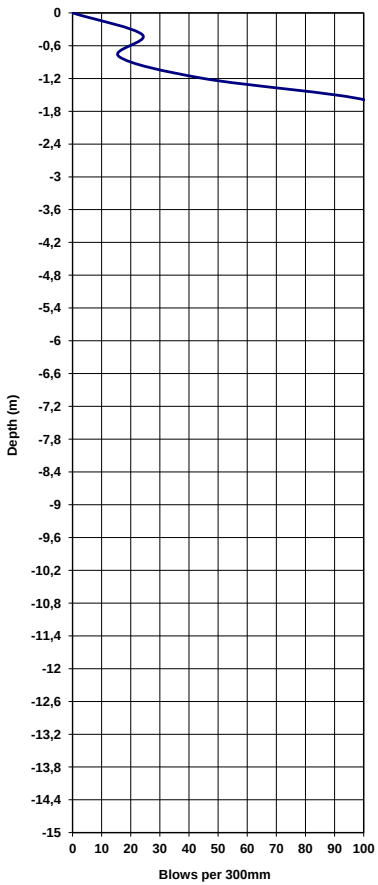
Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 42***

Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 43***

THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

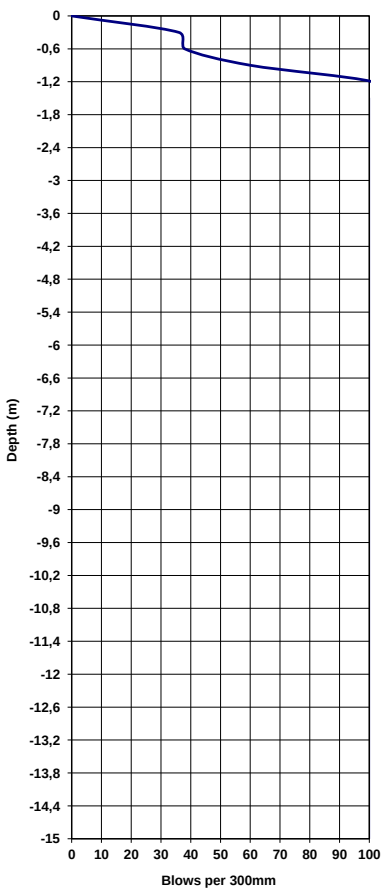
Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings
C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	24	Med.Dense
0,6	16	Med.Dense
0,9	45	Dense
1,2	Ref	



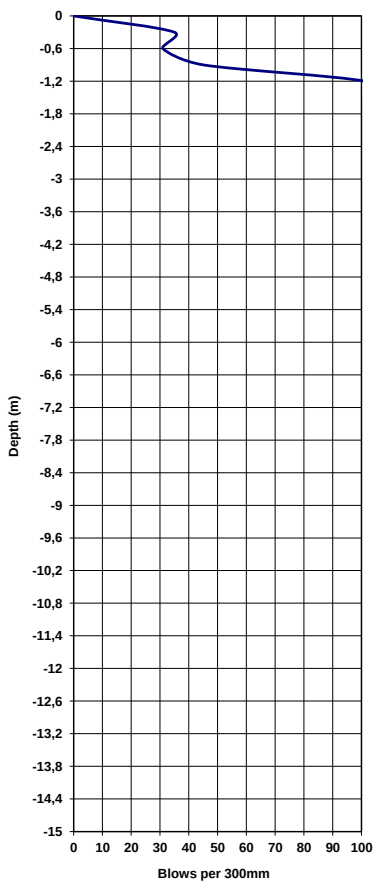
Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings
C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	36	Med.Dense
0,6	38	Med.Dense
0,9	60	Dense
1,2	Ref	



Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings
C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	35	Med.Dense
0,6	31	Med.Dense
1,2	45	Med.Dense
1,5	Ref	



Delta Geotech (Pty) Ltd

Client:	**Ngoti Development Consultants**	**Ref.No.**	**19-719**
Project:	**Ceres and Klipfontein Development - Bloemfontein**	**Date:**	**2019/08/21**
Section:		**Operator:**	**MJ**

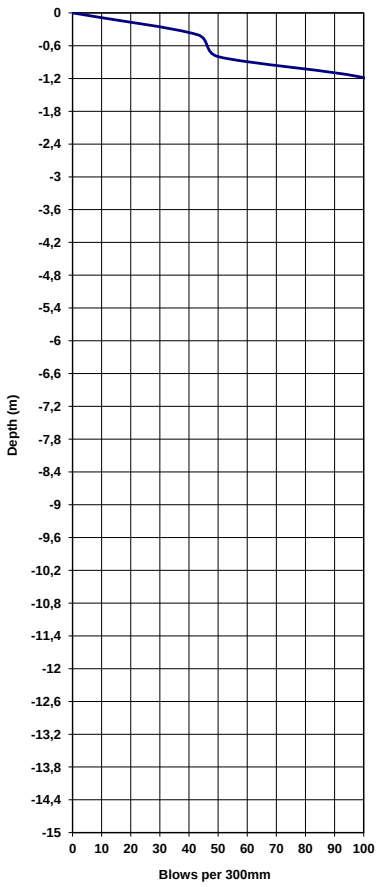
Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 44***

THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	43	Dense
0,6	50	Dense
0,9	Ref	

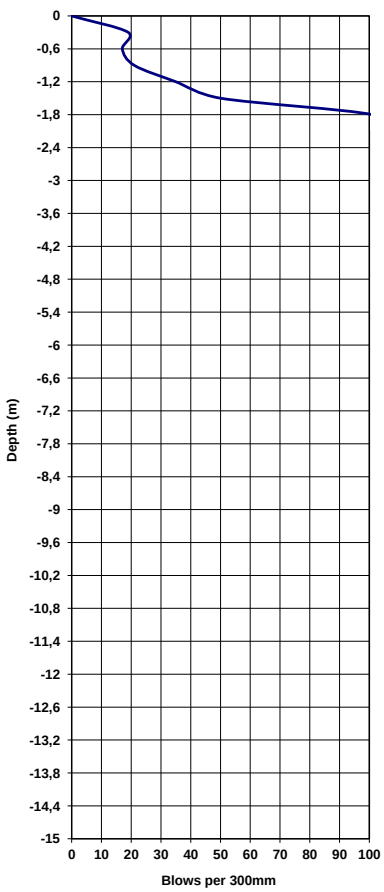


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 45***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	19	Med.Dense
0,6	17	Med.Dense
0,9	21	Med.Dense
1,2	35	Med.Dense
1,5	50	Dense
1,9	Ref	

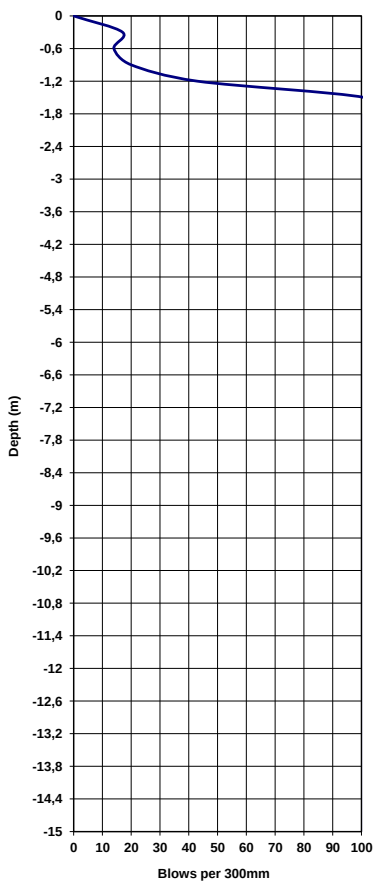


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 46***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	17	Med.Dense
0,6	14	Loose
1,2	20	Loose
1,5	43	Dense
1,9	Ref	



Delta Geotech (Pty) Ltd

Client:	**Ngoti Development Consultants**	**Ref.No.**	**19-719**
Project:	**Ceres and Klipfontein Development - Bloemfontein**	**Date:**	**2019/08/21**
Section:		**Operator:**	**MJ**

Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 47***

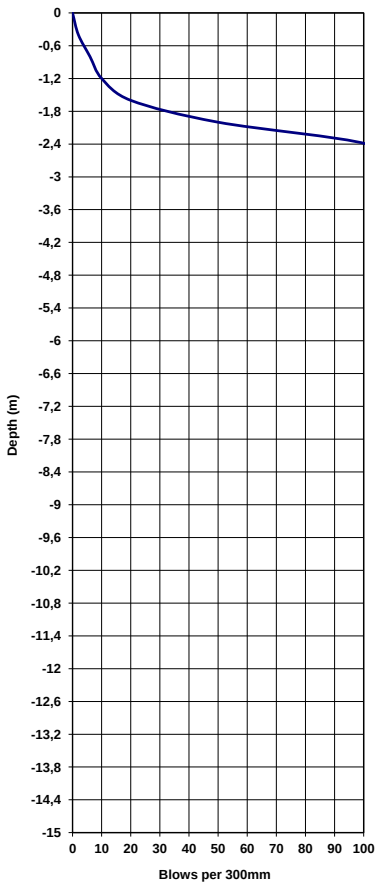
THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	2	Very Loose
0,6	6	Very Loose
0,9	10	Loose
1,2	20	Med.Dense
1,5	50	Dense
1,9	Ref	

200mm above ground on ant hill

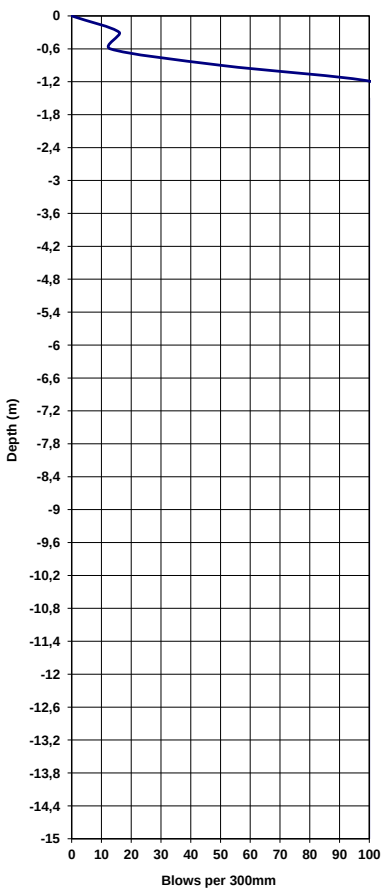


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 48***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	16	Med.Dense
0,6	13	Loose
0,9	50	Dense
1,2	Ref	

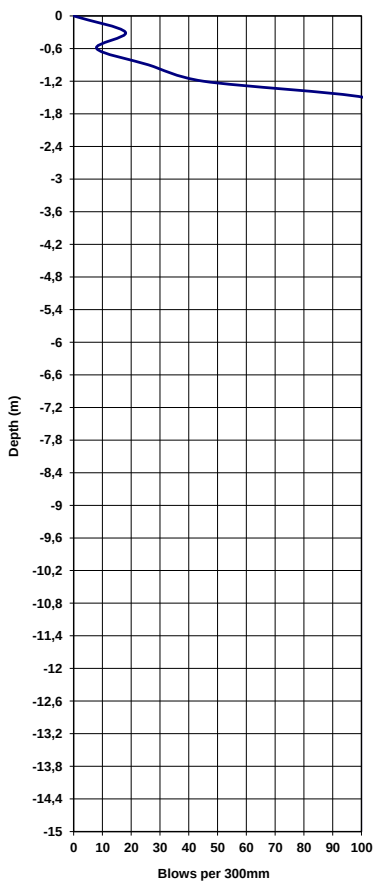


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 49***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	18	Med.Dense
0,6	8	Loose
1,2	26	Loose
1,5	45	Dense
1,9	Ref	



Delta Geotech (Pty) Ltd

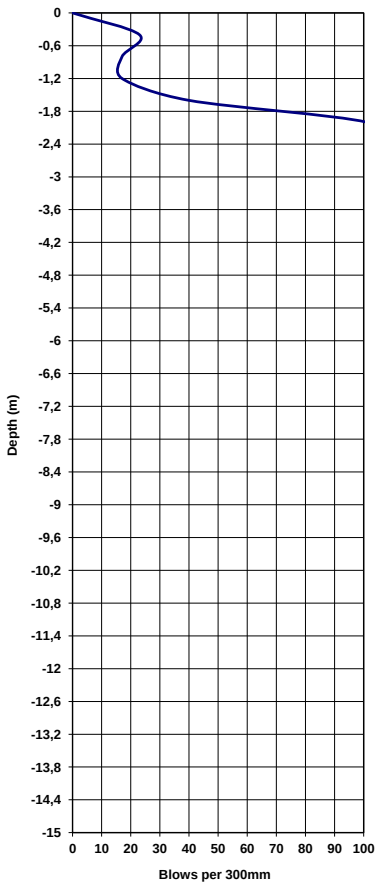
Client:	**Ngoti Development Consultants**	**Ref.No.**	**19-719**
Project:	**Ceres and Klipfontein Development - Bloemfontein**	**Date:**	**2019/08/21**
Section:		**Operator:**	**MJ**

Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 50***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	23	Med.Dense
0,6	17	Med.Dense
0,9	17	Med.Dense
1,2	40	Med.Dense
1,5	Ref	

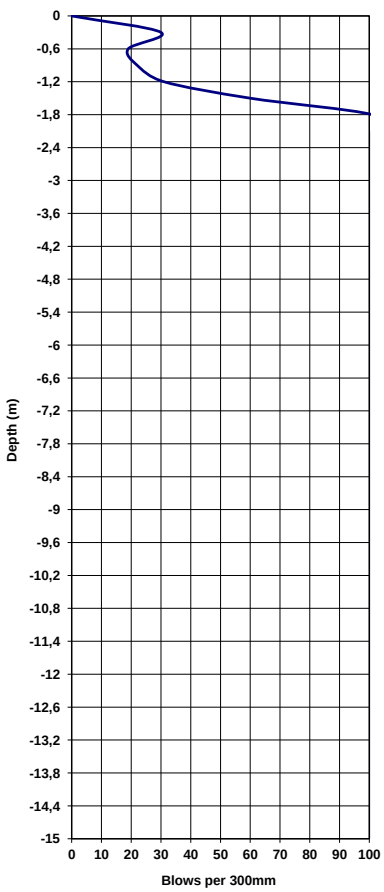


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 51***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	30	Med.Dense
0,6	19	Med.Dense
0,9	22	Med.Dense
1,2	31	Med.Dense
1,5	60	Dense
1,9	Ref	

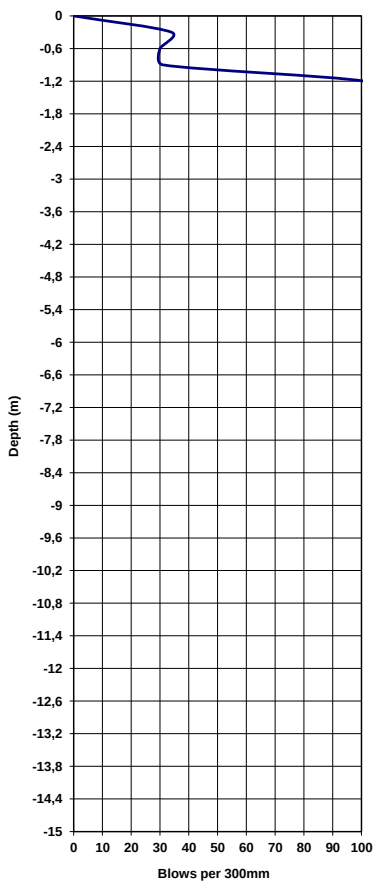


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 52***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	34	Med.Dense
0,6	30	Med.Dense
1,2	31	Loose
1,5	Ref	



THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Delta Geotech (Pty) Ltd

Client:	**Ngoti Development Consultants**	**Ref.No.**	**19-719**
Project:	**Ceres and Klipfontein Development - Bloemfontein**	**Date:**	**2019/08/21**
Section:		**Operator:**	**MJ**

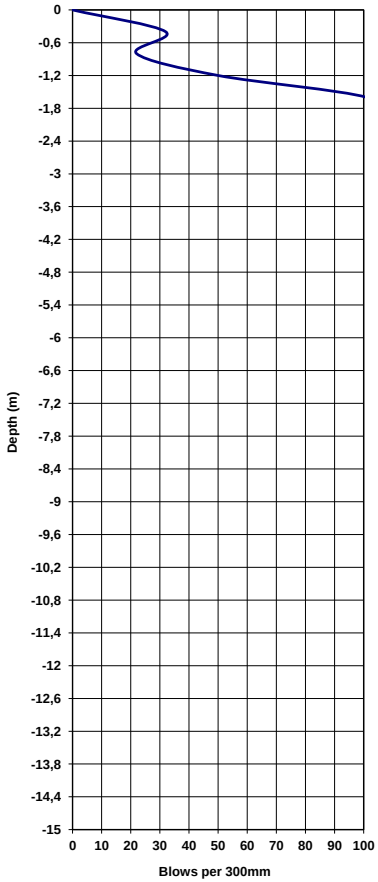
Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 53***

THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	32	Med.Dense
0,6	22	Med.Dense
0,9	50	Dense
1,2	Ref	
1,5		

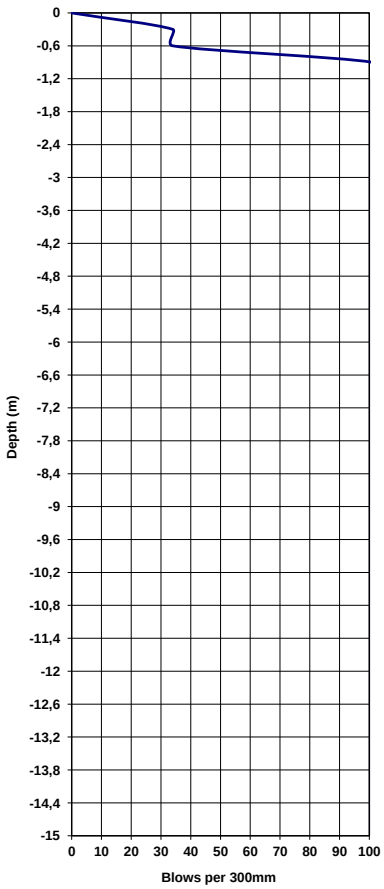


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 54***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	34	Med.Dense
0,6	34	Med.Dense
0,9	Ref	

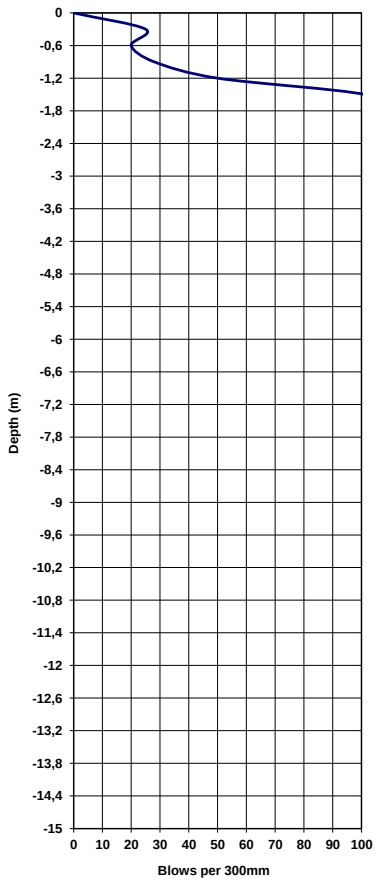


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 55***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	25	Med.Dense
0,6	20	Med.Dense
1,2	28	Loose
1,5	50	Dense
	Ref	



Delta Geotech (Pty) Ltd

Client:	**Ngoti Development Consultants**	**Ref.No.**	**19-719**
Project:	**Ceres and Klipfontein Development - Bloemfontein**	**Date:**	**2019/08/21**
Section:		**Operator:**	**MJ**

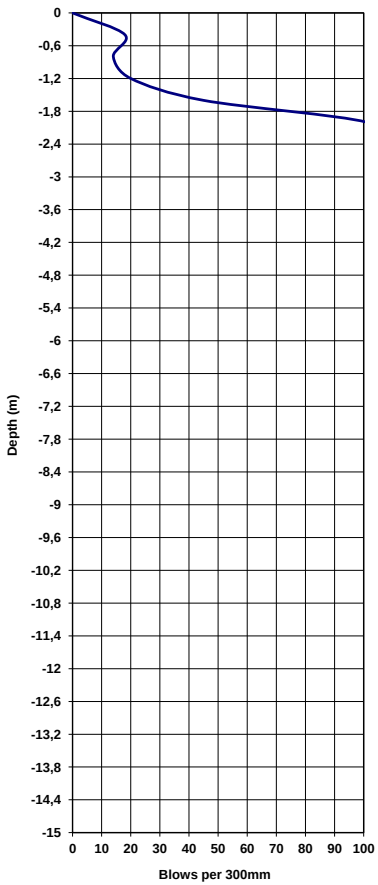
Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 56***

THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	18	Med.Dense
0,6	14	Loose
0,9	20	Med.Dense
1,2	45	Dense
1,5	Ref	

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

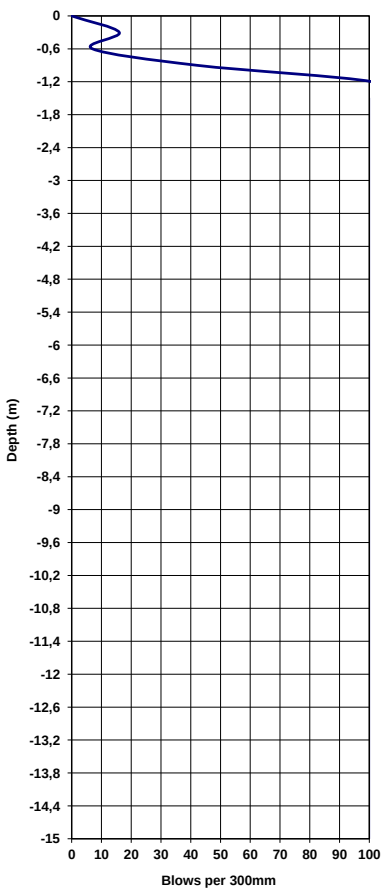


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 57***

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	16	Med.Dense
0,6	7	Loose
0,9	42	Dense
	Ref	

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

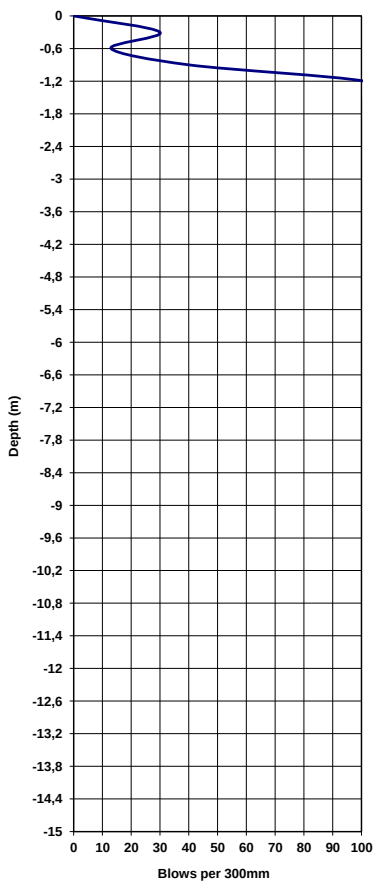


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 58***

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	30	Med.Dense
0,6	13	Loose
1,2	40	Med.Dense
1,5	Ref	

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0



Delta Geotech (Pty) Ltd

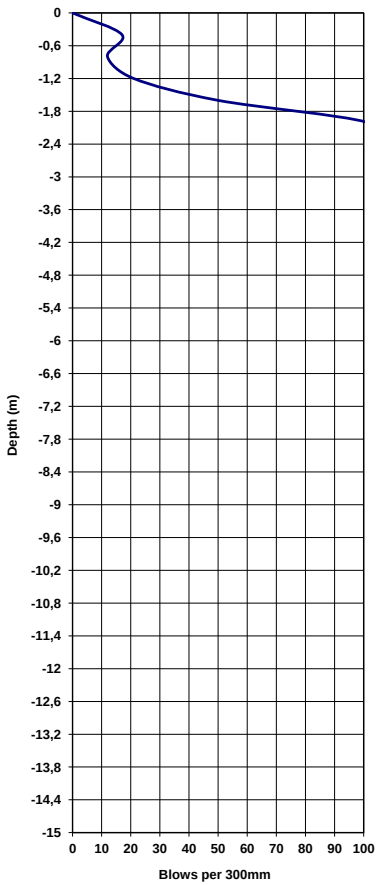
Client:	**Ngoti Development Consultants**	**Ref.No.**	**19-719**
Project:	**Ceres and Klipfontein Development - Bloemfontein**	**Date:**	**2019/08/21**
Section:		**Operator:**	**MJ**

Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 59***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	17	Med.Dense
0,6	12	Loose
0,9	21	Med.Dense
1,2	50	Dense
1,5	Ref	

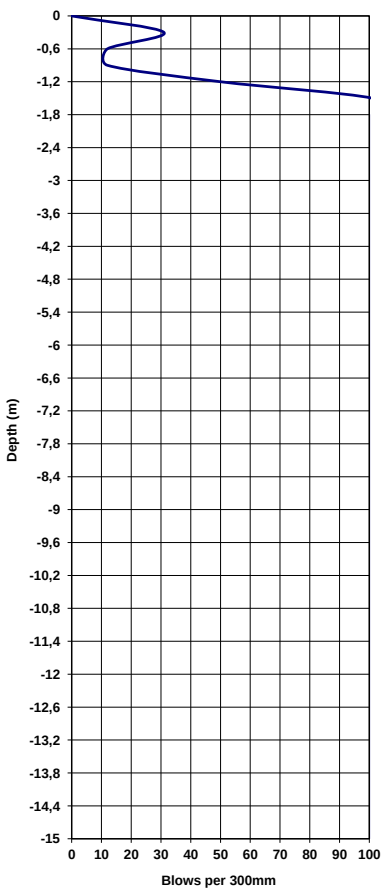


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 60***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0,3	31	Med.Dense
0,6	12	Loose
0,9	12	Loose
1,2	50	Dense
1,5	Ref	

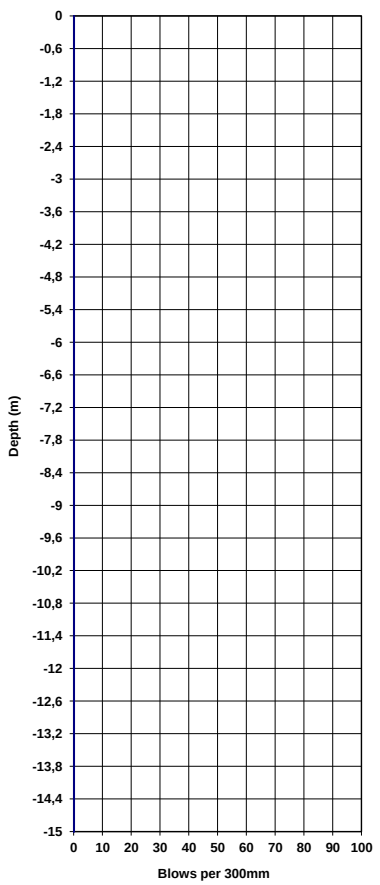


Light Dynamic Penetrometer Probe ---------- ***Test No. DPL***

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency



THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

APPENDIX - C

Labco
sanas T0727
Email: infosl@labco.co.za ■ www.labco.co.za
Email: andy@labco.co.za ■ Phone: +27 (0)43 050 0903
East London Branch – Unit 5 Evergreen Park, C/o B Road & Main Road, Beacon Bay ■ PO Box 10114 Linton Grange 6015

Client	:	Delta Geotech (Pty) Ltd			
Address	:	17 Clearview Place	**Client Reference**	:	
	:	Beacon Bay	**Order No.**	:	
	:	East London			
Attention	:	Mr. M. Jones	**Date Received**	:	23/08/2019
Facsimile	:		**Date Tested**	:	25/09/2019
E-mail	:	matthew@deltageotech.co.za	**Date Reported**	:	25/09/2019
Project	:	Bloemfontein			
Project No.	:	2019-E-891	**Report Status**	:	Final
			Page	:	1 of 11

Herewith please find the test report(s) pertaining to the above project. All tests were conducted in accordance with prescribed test method(s). Information herein consists of the following:

Test(s) conducted / Item(s) measured	Qty.	Test Method(s)	Authorized By**	Page(s)
Atterberg Limits <0.425mm	20	SANS 3001-GR10	N VaN Rooi	2-11
Sieve Analysis 0.075mm	20	SANS 3001-GR1	N VaN Rooi	2-11
Hydrometer Analysis	20	SANS 3001-GR3*	N VaN Rooi	2-11

Any test results contained in this report and marked with * in the table above are "not SANAS accredited" and are not included in the schedule of accreditation for this laboratory.

Any information contained in this test report pertain only to the areas and/or samples tested. Documents may only be reproduced or published in their full context. • Any information gained by the laboratory prior, during or after test process will be treated as confidential and will not be reproduced or disclosed to any person or organization, unless required by law.

All interpretations, Interpolations, Opinions and/or Classifications contained in this report falls outside our scope of accreditation.

The following parameters, where applicable, were excluded from the classification procedure: Chemical modifications, Additional fines, Fractured Faces, Soluble Salts, pH, Conductivity, Coarse Sand Ratio, Durability (COLTO: G4-G9).

The following parameters, where applicable, were assumed: Rock types were assumed to be of an Arenaceous nature with Siliceous cementing material.

Unless otherwise requested or stated, all samples will be discarded after a period of 3 months.

Deviations in Test Methods:

**All results are authorized by technical signatories.

30/09/2019.
Technical Signatory.

Email: infoct@labco.co.za ▪ www.labco.co.za
Email: andy@labco.co.za ▪ Phone: +27 (0)43 050 0803
East London Branch – Unit 5 Evergreen Park, C/o S Road & Main Road, Beacon Bay ▪ PO Box 10114 Linton Grange 6015

sanas T0787

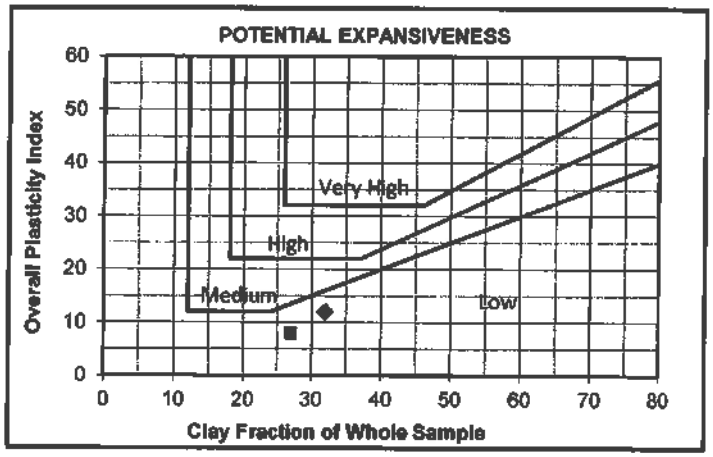
Client	:	Delta Geotech (Pty) Ltd	Date Received:	23/08/2019
Project	:	Bloemfontein	Date Reported:	25/09/2019
Project No	:	2019-E-891	Page No. :	2 of 11

Sampling Method: Samples delivered by client.

Any test results in this report, marked with *, are not included in the schedule of accreditation for this laboratory.

FOUNDATION INDICATOR

Laboratory Number		1 ◆	2 ■
Field Number		E891/1	E891/2
Client Reference			
Depth (m)		0.4	0.5
Position		TP:08	TP:09
Coordinates	X		
	Y		
Description		Red brown Sandy Clay	Brown Clayey Sand
Aditional Information			
Calcrete / Crushed			
Stabilizing Agent			

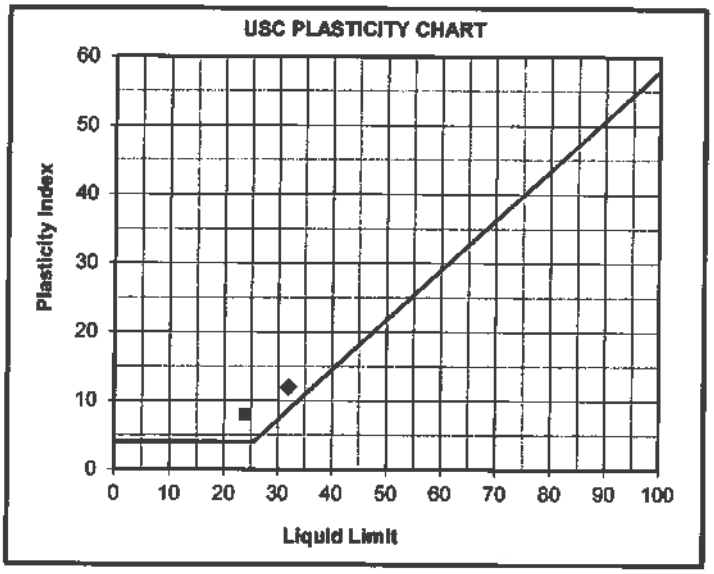


Moisture Content & Relative Density

Moisture Content (%)		
Relative Density (S.G.)		

Sieve Analysis (Wet Prep) — SANS 3001-GR1

		1 ◆	2 ■
Percentage Passing	100 mm	100	100
	75 mm	100	100
	63 mm	100	100
	50 mm	100	100
	37.5 mm	100	100
	28 mm	100	100
	20 mm	100	100
	14 mm	100	100
	5 mm	100	100
	2 mm	100	100
	1 mm	100	100
	0.425 mm	100	99
	0.250 mm	97	97
	0.150 mm	84	82
	0.075 mm	51	49
Grading Modulus		0.49	0.52

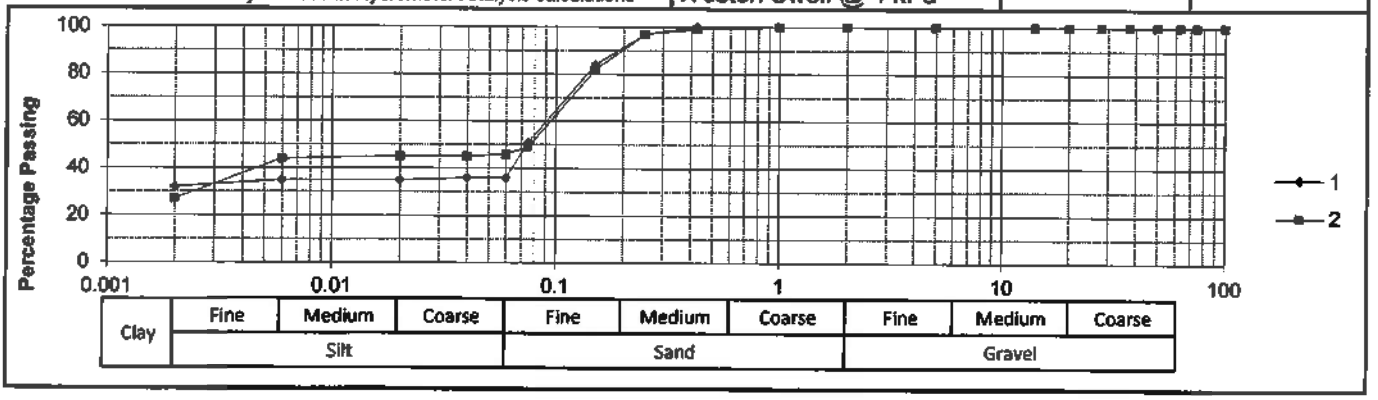


Hydrometer Analysis* — SANS 3001-GR3*

		1 ◆	2 ■
Percentage Passing	0.060 mm	36	46
	0.040 mm	36	45
	0.020 mm	35	45
	0.006 mm	35	44
	0.002 mm	32	27
Gravel	%	0	0
Sand	%	64	54
Silt	%	4	19
Clay	%	32	27

Note: An assumed S.G. may be used in Hydrometer Analysis calculations

Laboratory Number		1 ◆	2 ■
Atterberg Limits -425µ		SANS 3001-GR10	
Liquid Limit	%	32	24
Plasticity Index	%	12	8
Linear Shrinkage	%	6.0	4.0
Overall PI	%		
Classifications			
HRB (AASHTO)		A-6	A-4
Unified (ASTM D2487)		CL	SC
Weston Swell @ 1 kPa			



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sanas T0787

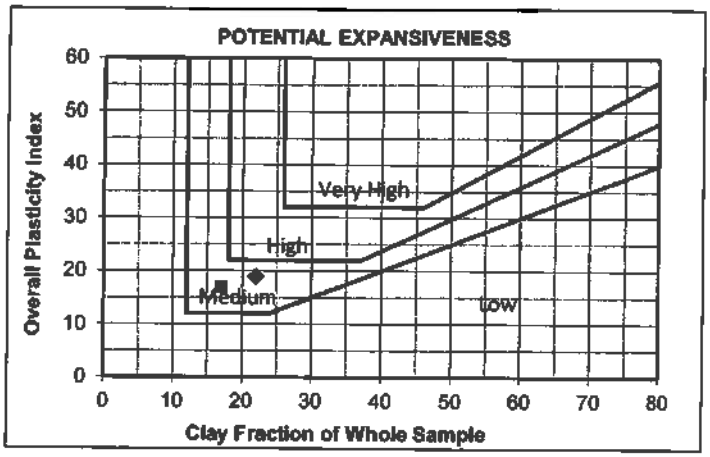
Client	:	Delta Geotech (Pty) Ltd	Date Received:	23/08/2019
Project	:	Bloemfontein	Date Reported:	25/09/2019
Project No	:	2019-E-891	Page No. :	3 of 11

Sampling Method: Samples delivered by client.

Any test results in this report, marked with *, are not included in the schedule of accreditation for this laboratory.

FOUNDATION INDICATOR

Laboratory Number		3 ◆	4 ■
Field Number		E891/3	E891/4
Client Reference			
Depth (m)		0.2	1.9
Position		TP:12	TP:16
Coordinates	X		
	Y		
Description		Black Sandy Clay	Brown Mudstone
Aditional Information			
Calcrete / Crushed Stabilizing Agent			

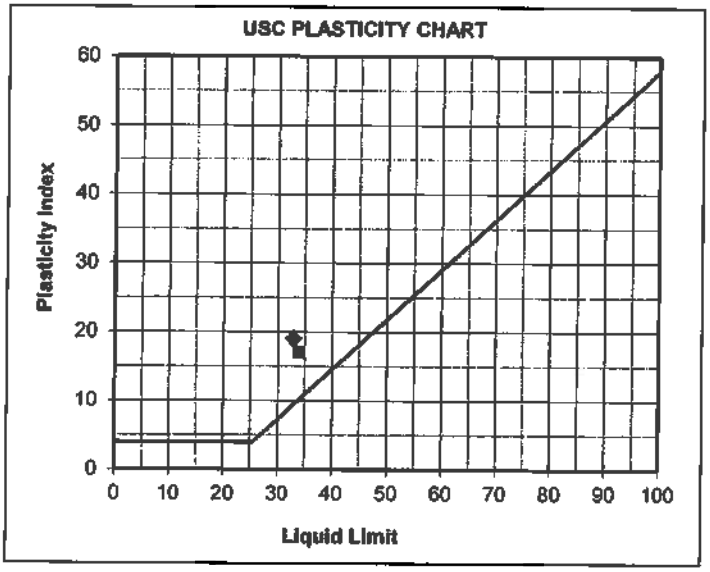


Moisture Content & Relative Density

Moisture Content (%)		
Relative Density (S.G.)		

Sieve Analysis (Wet Prep) — SANS 3001-GR1

Percentage Passing	100 mm	100	100
	75 mm	100	100
	63 mm	100	100
	50 mm	100	100
	37.5 mm	100	100
	28 mm	100	100
	20 mm	100	100
	14 mm	100	99
	5 mm	100	88
	2 mm	100	55
	1 mm	100	55
	0.425 mm	99	40
	0.250 mm	96	37
	0.150 mm	84	33
	0.075 mm	55	27
Grading Modulus		0.46	1.78



Hydrometer Analysis* — SANS 3001-GR3*

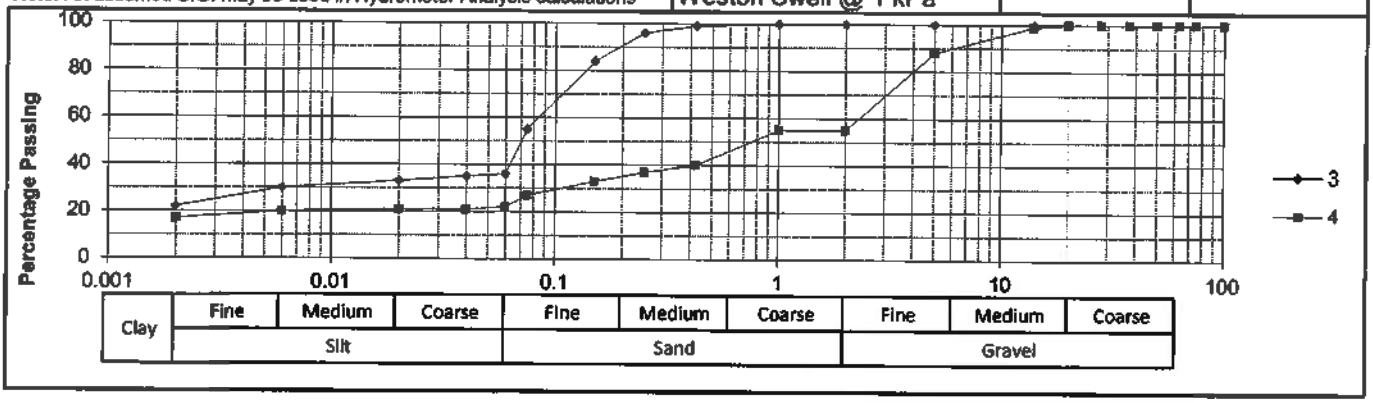
Percentage Passing	0.060 mm	36	22
	0.040 mm	35	21
	0.020 mm	33	21
	0.006 mm	30	20
	0.002 mm	22	17
Gravel	%	0	45
Sand	%	64	33
Silt	%	14	5
Clay	%	22	17

Note: An assumed S.G. may be used in Hydrometer Analysis calculations

Laboratory Number		3 ◆	4 ■
Atterberg Limits -425µ		SANS 3001-GR10	
Liquid Limit	%	33	34
Plasticity Index	%	19	17
Linear Shrinkage	%	8.0	8.0
Overall PI	%		

Classifications

HRB (AASHTO)	A-6	A-2-6
Unified (ASTM D2487)	CL	SC
Weston Swell @ 1 kPa		



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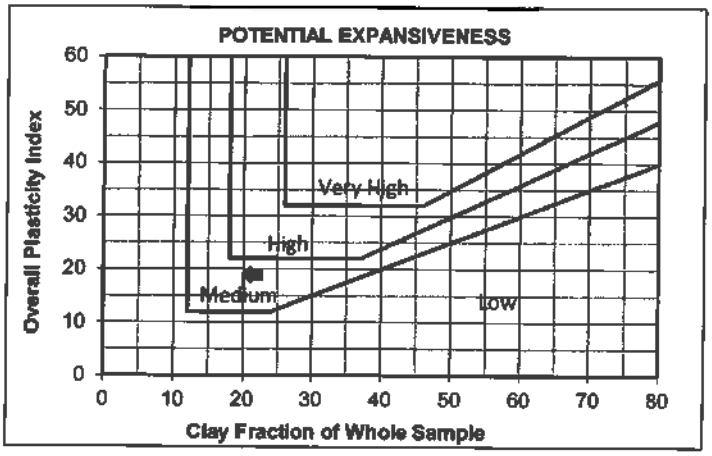
Client	:	Delta Geotech (Pty) Ltd	Date Received:	23/08/2019
Project	:	Bloemfontein	Date Reported:	25/09/2019
Project No	:	2019-E-891	Page No. :	4 of 11

Sampling Method: Samples delivered by client.

Any test results in this report, marked with *, are not included in the schedule of accreditation for this laboratory.

FOUNDATION INDICATOR

Laboratory Number	5 ◆	6 ■
Field Number	E891/5	E891/6
Client Reference		
Depth (m)	0.1	0.4
Position	TP:21	TP:26
Coordinates X		
Coordinates Y		
Description	Red brown Sandy Clay	Olive Sandy Clay
Aditional Information		
Calcrete / Crushed Stabilizing Agent		

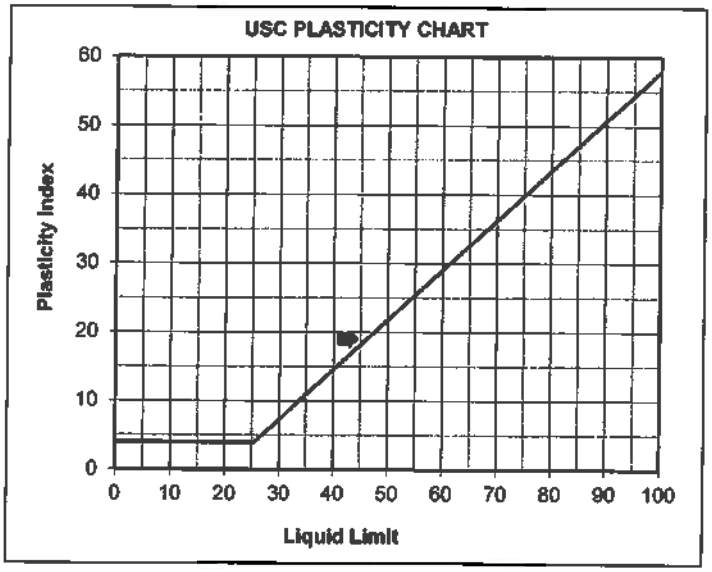


Moisture Content & Relative Density

Moisture Content (%)		
Relative Density (S.G.)		

Sieve Analysis (Wet Prep) — SANS 3001-GR1

		5 ◆	6 ■
Percentage Passing	100 mm	100	100
	75 mm	100	100
	63 mm	100	100
	50 mm	100	100
	37.5 mm	100	100
	28 mm	100	100
	20 mm	100	100
	14 mm	100	100
	5 mm	100	100
	2 mm	99	98
	1 mm	99	98
	0.425 mm	98	94
	0.250 mm	97	90
	0.150 mm	88	81
	0.075 mm	69	59
Grading Modulus		0.34	0.49



Hydrometer Analysis* — SANS 3001-GR3*

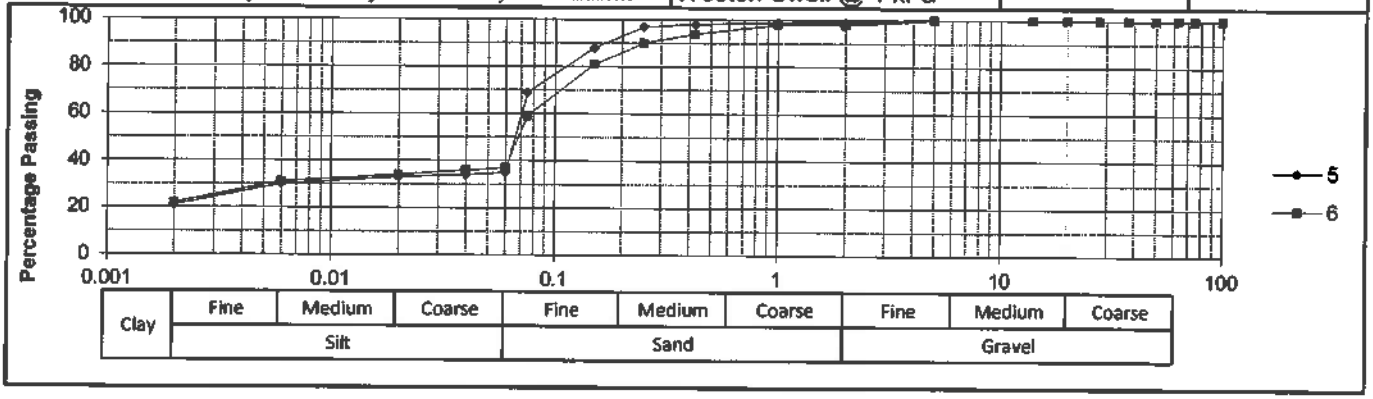
		5 ◆	6 ■
Percentage Passing	0.060 mm	35	37
	0.040 mm	34	36
	0.020 mm	33	34
	0.006 mm	30	31
	0.002 mm	21	22
Gravel	%	1	2
Sand	%	64	61
Silt	%	14	15
Clay	%	21	22

Note: An assumed S.G. may be used in Hydrometer Analysis calculations

Laboratory Number		5 ◆	6 ■
Atterberg Limits -425µ		SANS 3001-GR10	
Liquid Limit	%	43	42
Plasticity Index	%	19	19
Linear Shrinkage	%	9.5	9.5
Overall PI	%		

Classifications

HRB (AASHTO)	A-7-6	A-7-6
Unified (ASTM D2487)	CL	CL
Weston Swell @ 1 kPa		



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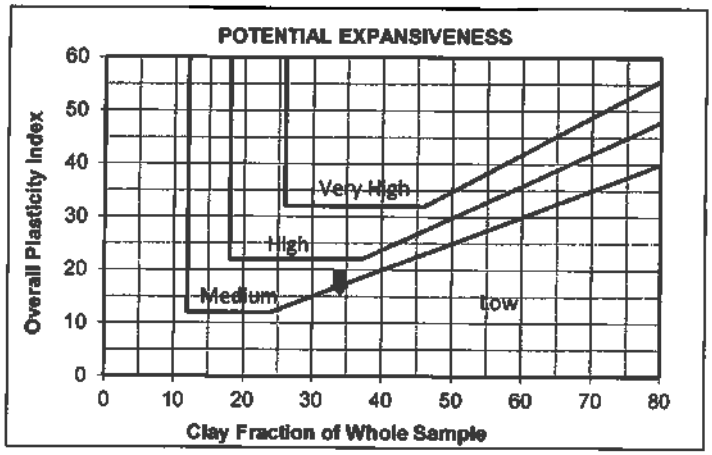
Client	:	Delta Geotech (Pty) Ltd	Date Received:	23/08/2019
Project	:	Bloemfontein	Date Reported:	25/09/2019
Project No	:	2019-E-891	Page No. :	5 of 11

Sampling Method: Samples delivered by client.

Any test results in this report, marked with *, are not included in the schedule of accreditation for this laboratory.

FOUNDATION INDICATOR

Laboratory Number	7 ◆	8 ■
Field Number	E891/7	E891/8
Client Reference		
Depth (m)	0.1	0.2
Position	TP:03	TP:32
Coordinates X		
Coordinates Y		
Description	Brown Sandy Clay	Olive Sandy Clay
Additional Information		
Calcrete / Crushed Stabilizing Agent		

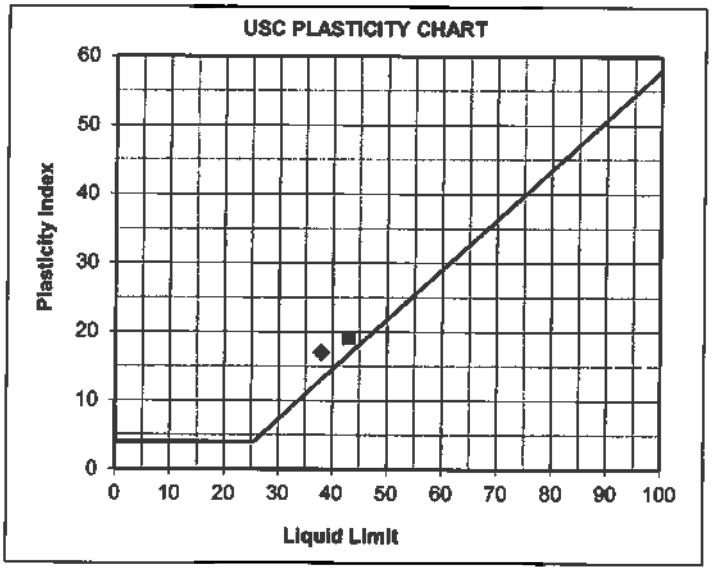


Moisture Content & Relative Density

Moisture Content (%)		
Relative Density (S.G.)		

Sieve Analysis (Wet Prep) — SANS 3001-GR1

Percentage Passing	100 mm	100	100
	75 mm	100	100
	63 mm	100	100
	50 mm	100	100
	37.5 mm	100	100
	28 mm	100	100
	20 mm	100	100
	14 mm	100	100
	5 mm	100	99
	2 mm	100	97
	1 mm	100	97
	0.425 mm	99	96
	0.250 mm	97	94
	0.150 mm	86	87
	0.075 mm	58	67
Grading Modulus		0.43	0.40



Hydrometer Analysis* — SANS 3001-GR3*

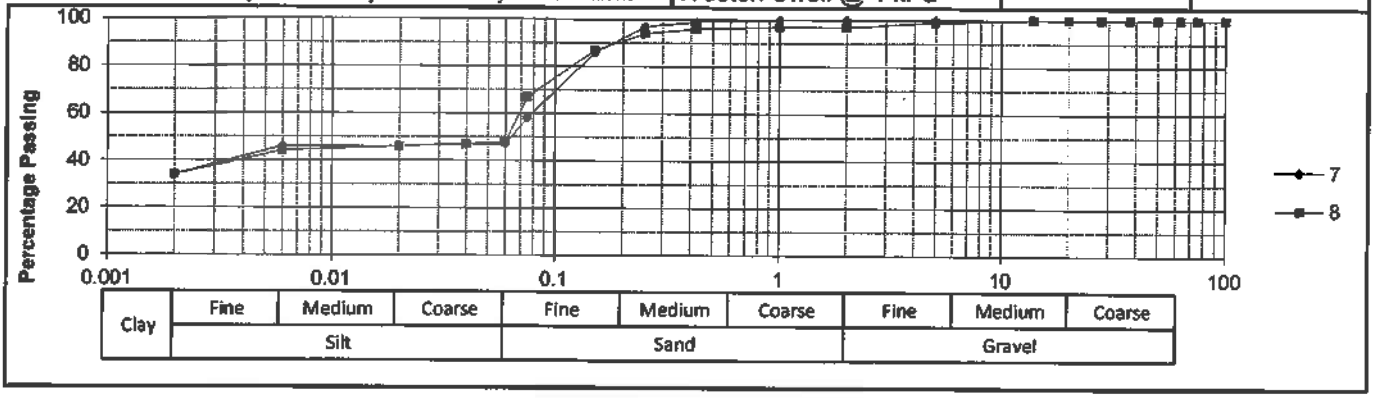
Percentage Passing	0.060 mm	47	48
	0.040 mm	47	47
	0.020 mm	46	46
	0.006 mm	46	44
	0.002 mm	34	34
Gravel	%	0	3
Sand	%	53	49
Silt	%	13	14
Clay	%	34	34

Note: An assumed S.G. may be used in Hydrometer Analysis calculations

Laboratory Number		7 ◆	8 ■
Atterberg Limits -425µ		SANS 3001-GR10	
Liquid Limit	%	38	43
Plasticity Index	%	17	19
Linear Shrinkage	%	8.5	9.5
Overall PI	%		

Classifications

HRB (AASHTO)	A-6	A-7-6
Unified (ASTM D2487)	CL	CL
Weston Swell @ 1 kPa		



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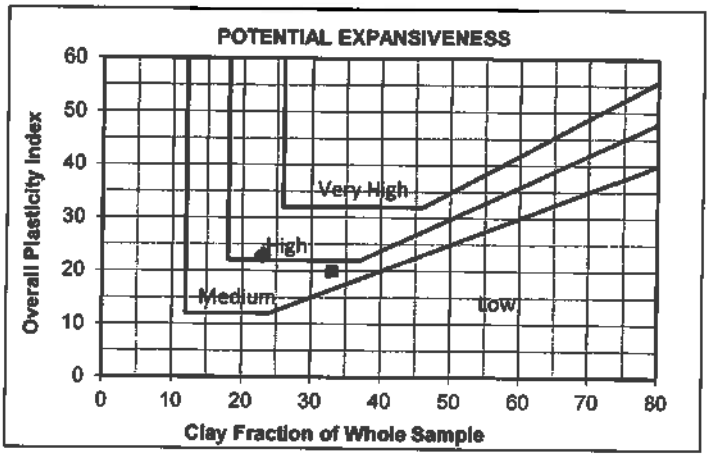
Client	:	Delta Geotech (Pty) Ltd	Date Received:	23/08/2019
Project	:	Bloemfontein	Date Reported:	25/09/2019
Project No	:	2019-E-891	Page No. :	6 of 11

Sampling Method: Samples delivered by client.

Any test results in this report, marked with *, are not included in the schedule of accreditation for this laboratory.

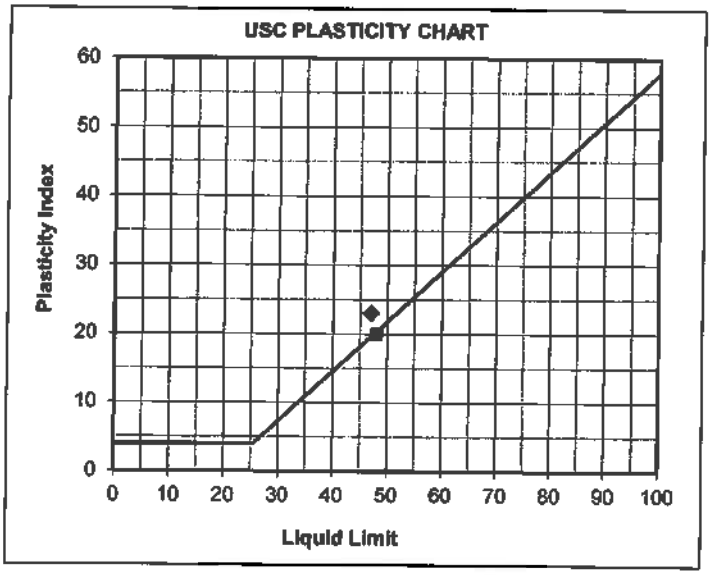
FOUNDATION INDICATOR

Laboratory Number	9 ◆	10 ■
Field Number	E891/9	E981/10
Client Reference		
Depth (m)	0.2	0.7
Position	TP:34	TP:37
Coordinates X		
Coordinates Y		
Description	Red brown Sandy Clay	Olive Clay
Aditional Information		
Calcrete / Crushed Stabilizing Agent		



Moisture Content & Relative Density

Moisture Content (%)		
Relative Density (S.G.)		



Sieve Analysis (Wet Prep) — SANS 3001-GR1

Percentage Passing	100 mm	100	100
	75 mm	100	100
	63 mm	100	100
	50 mm	100	100
	37.5 mm	100	100
	28 mm	100	100
	20 mm	100	100
	14 mm	100	100
	5 mm	100	99
	2 mm	100	80
	1 mm	100	80
	0.425 mm	99	62
	0.250 mm	98	59
	0.150 mm	94	52
	0.075 mm	79	39
Grading Modulus		0.22	1.19

Hydrometer Analysis* — SANS 3001-GR3*

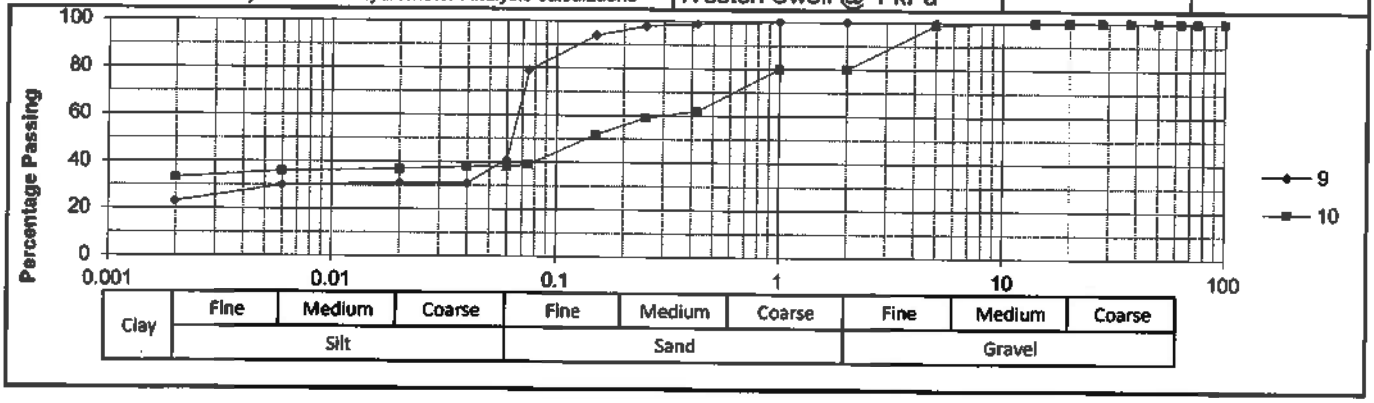
Percentage Passing	0.060 mm	41	38
	0.040 mm	31	38
	0.020 mm	31	37
	0.006 mm	30	36
	0.002 mm	23	33
Gravel	%	0	20
Sand	%	59	42
Silt	%	18	5
Clay	%	23	33

Note: An assumed S.G. may be used in Hydrometer Analysis calculations

Laboratory Number		9 ◆	10 ■
Atterberg Limits -425µ		SANS 3001-GR10	
Liquid Limit	%	47	48
Plasticity Index	%	23	20
Linear Shrinkage	%	11.5	10.0
Overall PI	%		

Classifications

HRB (AASHTO)	A-7-6	A-7-6
Unified (ASTM D2487)	CL	CL
Weston Swell @ 1 kPa		



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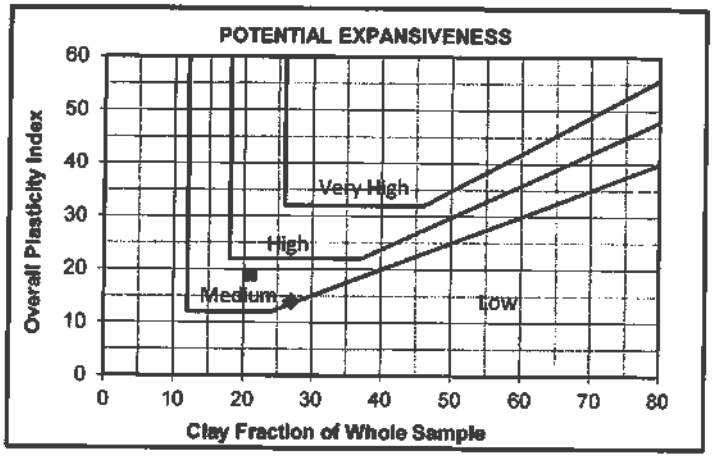
Client	:	Delta Geotech (Pty) Ltd	Date Received:	23/08/2019
Project	:	Bloemfontein	Date Reported:	25/09/2019
Project No	:	2019-E-891	Page No. :	7 of 11

Sampling Method: Samples delivered by client.

Any test results in this report, marked with *, are not included in the schedule of accreditation for this laboratory.

FOUNDATION INDICATOR

Laboratory Number	11 ◆	12 ■
Field Number	E891/11	E891/12
Client Reference		
Depth (m)	0.5	0.5
Position	TP:39	TP:42
Coordinates X		
Coordinates Y		
Description	Light grey Sandy Clay	Red brown Sandy Clay
Aditional Information		
Calcrete / Crushed Stabilizing Agent		

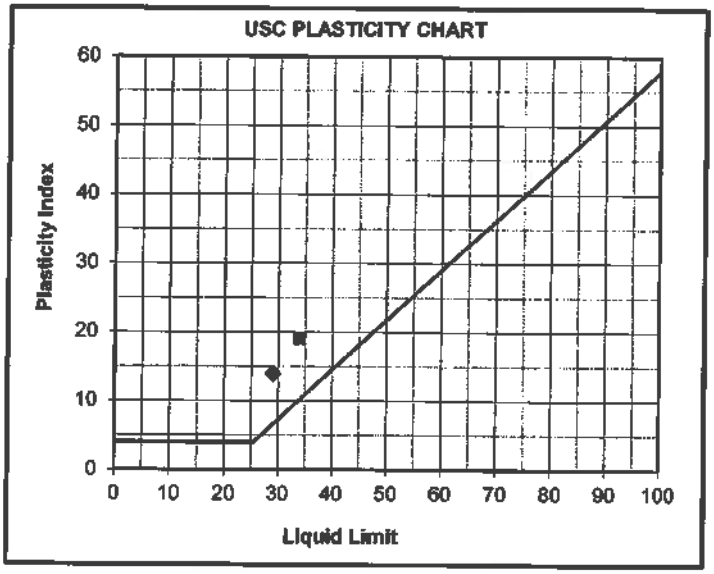


Moisture Content & Relative Density

Moisture Content (%)		
Relative Density (S.G.)		

Sieve Analysis (Wet Prep) SANS 3001-GR1

Percentage Passing	100 mm	100	100
	75 mm	100	100
	63 mm	100	100
	50 mm	100	100
	37.5 mm	100	100
	28 mm	100	100
	20 mm	100	100
	14 mm	100	100
	5 mm	100	100
	2 mm	98	99
	1 mm	98	99
	0.425 mm	94	98
	0.250 mm	91	96
	0.150 mm	80	84
	0.075 mm	56	61
Grading Modulus		0.52	0.42

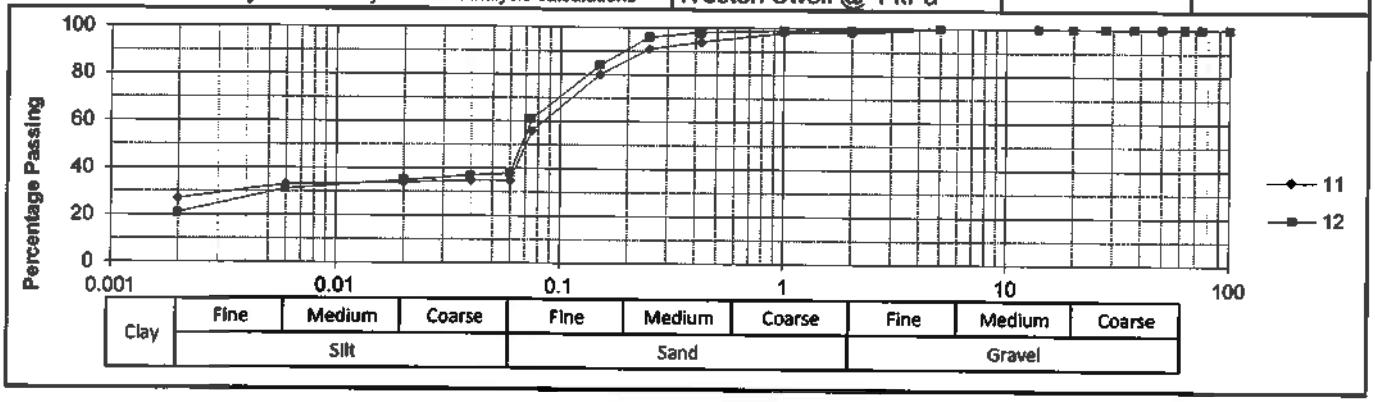


Hydrometer Analysis* SANS 3001-GR3*

Percentage Passing	0.060 mm	35	38
	0.040 mm	35	37
	0.020 mm	34	35
	0.006 mm	33	31
	0.002 mm	27	21
Gravel	%	2	1
Sand	%	63	61
Silt	%	8	17
Clay	%	27	21

Note: An assumed S.G. may be used in Hydrometer Analysis calculations

Laboratory Number		11 ◆	12 ■
Atterberg Limits -425µ		SANS 3001-GR10	
Liquid Limit	%	29	34
Plasticity Index	%	14	19
Linear Shrinkage	%	7.0	9.5
Overall PI	%		
Classifications			
HRB (AASHTO)		A-6	A-6
Unified (ASTM D2487)		CL	CL
Weston Swell @ 1 kPa			



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Client	:	Delta Geotech (Pty) Ltd	Date Received:	23/08/2019
Project	:	Bloemfontein	Date Reported:	25/09/2019
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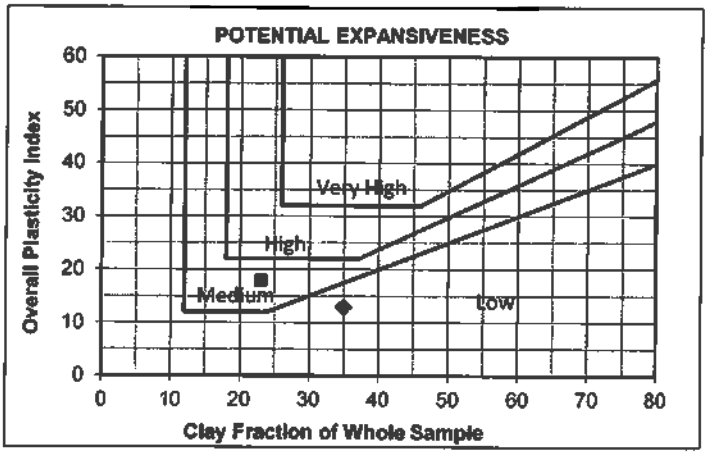
Sampling Method: Samples delivered by client.

Any test results in this report, marked with *, are not included in the schedule of accreditation for this laboratory.

FOUNDATION INDICATOR

Laboratory Number	13 ◆	14 ■
Field Number	E891/13	E891/14
Client Reference		
Depth (m)	0.4	1.4
Position	TP:44	TP:46
Coordinates X		
Coordinates Y		
Description	Grey Clay	Weathered Dolerite
Aditional Information		
Calcrete / Crushed Stabilizing Agent		

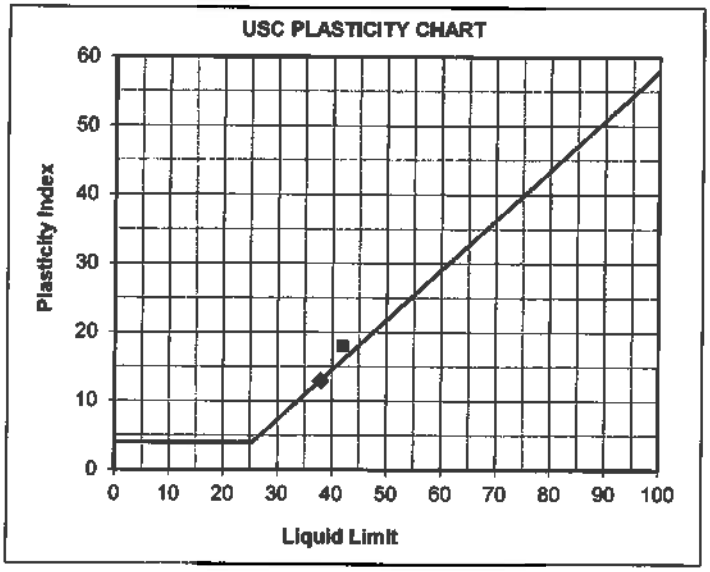


Moisture Content & Relative Density

Moisture Content (%)		
Relative Density (S.G.)		

Sieve Analysis (Wet Prep) — SANS 3001-GR1

Percentage Passing	100 mm	100	100
	75 mm	100	100
	63 mm	100	100
	50 mm	100	100
	37.5 mm	100	100
	28 mm	100	100
	20 mm	100	100
	14 mm	100	100
	5 mm	100	98
	2 mm	99	96
	1 mm	99	96
	0.425 mm	98	93
	0.250 mm	97	92
	0.150 mm	88	91
	0.075 mm	67	85
Grading Modulus		0.36	0.26

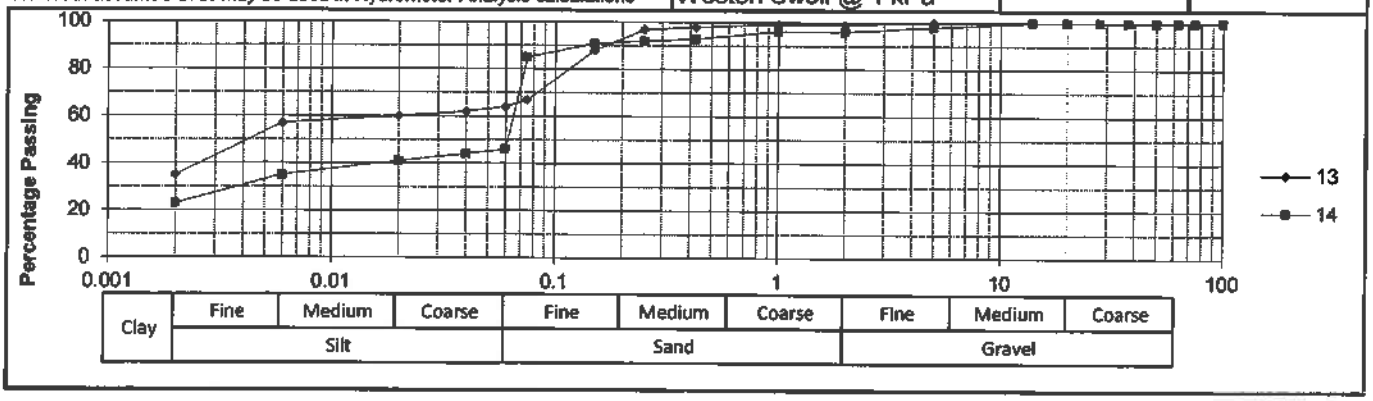


Hydrometer Analysis* — SANS 3001-GR3*

Percentage Passing	0.060 mm	64	46
	0.040 mm	62	44
	0.020 mm	60	41
	0.006 mm	57	35
	0.002 mm	35	23
Gravel	%	1	4
Sand	%	35	50
Silt	%	29	23
Clay	%	35	23

Note: An assumed S.G. may be used in Hydrometer Analysis calculations

Laboratory Number		13 ◆	14 ■
Atterberg Limits -425µ		SANS 3001-GR10	
Liquid Limit	%	38	42
Plasticity Index	%	13	18
Linear Shrinkage	%	6.5	9.0
Overall PI	%		
Classifications			
HRB (AASHTO)		A-7-6	A-7-6
Unified (ASTM D2487)		CL	CL
Weston Swell @ 1 kPa			



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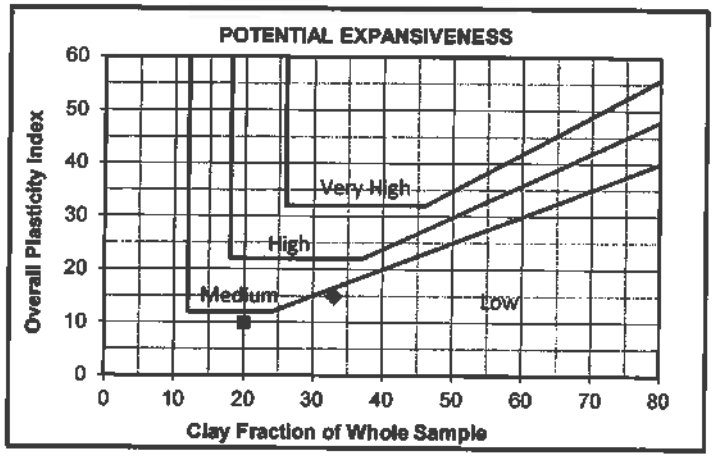
Client	:	Delta Geotech (Pty) Ltd	Date Received:	23/08/2019
Project	:	Bloemfontein	Date Reported:	25/09/2019
Project No	:	2019-E-891	Page No. :	9 of 11

Sampling Method: Samples delivered by client.

Any test results in this report, marked with *, are not included in the schedule of accreditation for this laboratory.

FOUNDATION INDICATOR

Laboratory Number	15 ◆	16 ■
Field Number	E981/15	E891/16
Client Reference		
Depth (m)	-	1.2
Position	TP:48	TP:50
Coordinates X		
Coordinates Y		
Description	Red brown Sandy Clay	Grey brown Clayey Snd
Aditional Information		
Calcrete / Crushed Stabilizing Agent		

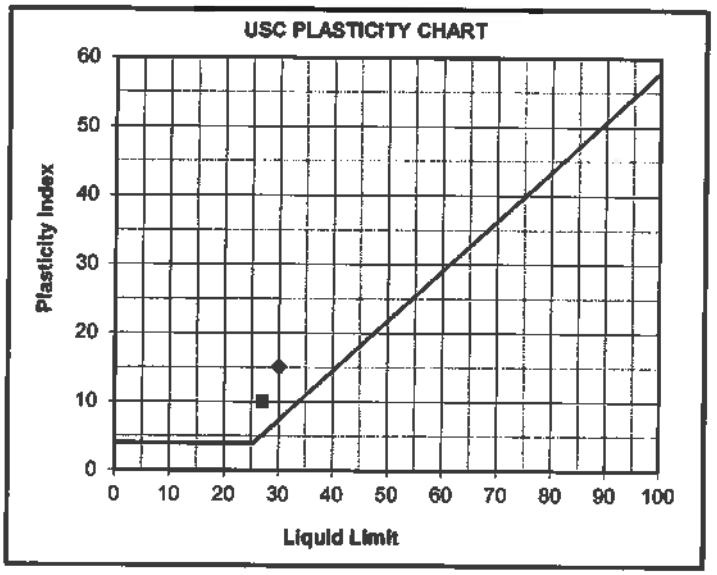


Moisture Content & Relative Density

Moisture Content (%)		
Relative Density (S.G.)		

Sieve Analysis (Wet Prep) — SANS 3001-GR1

Percentage Passing	100 mm	100	100
	75 mm	100	100
	63 mm	100	100
	50 mm	100	100
	37.5 mm	100	100
	28 mm	100	100
	20 mm	100	100
	14 mm	100	100
	5 mm	100	100
	2 mm	100	99
	1 mm	100	99
	0.425 mm	99	97
	0.250 mm	98	95
	0.150 mm	88	83
	0.075 mm	68	52
Grading Modulus		0.33	0.52



Hydrometer Analysis* — SANS 3001-GR3*

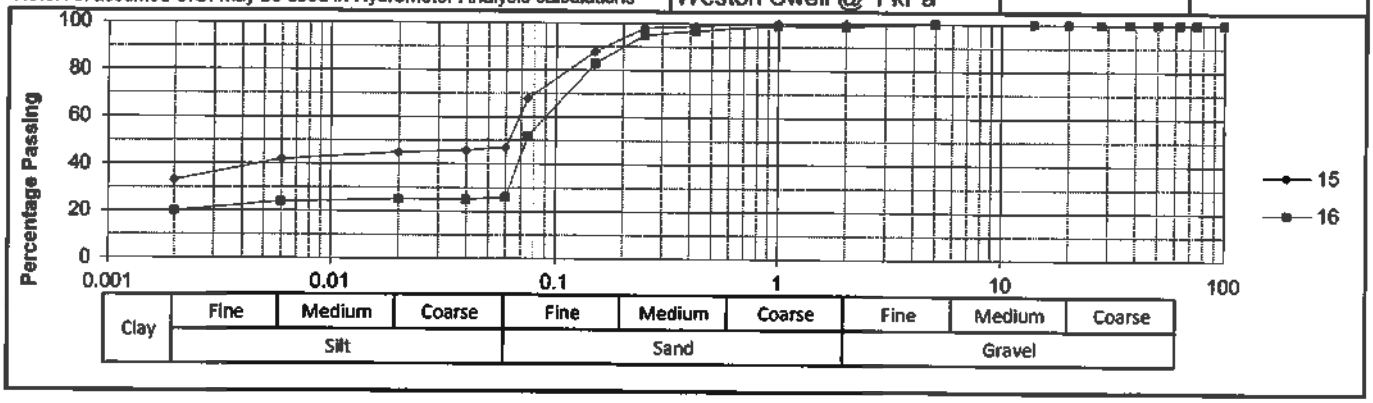
Percentage Passing	0.060 mm	47	26
	0.040 mm	46	25
	0.020 mm	45	25
	0.006 mm	42	24
	0.002 mm	33	20
Gravel	%	0	1
Sand	%	53	73
Silt	%	14	6
Clay	%	33	20

Note: An assumed S.G. may be used in Hydrometer Analysis calculations

Laboratory Number		15 ◆	16 ■
Atterberg Limits -425µ		SANS 3001-GR10	
Liquid Limit	%	30	27
Plasticity Index	%	15	10
Linear Shrinkage	%	7.5	5.0
Overall PI	%		

Classifications

HRB (AASHTO)	A-6	A-4
Unified (ASTM D2487)	CL	CL
Weston Swell @ 1 kPa		



Email: infoel@labco.co.za ■ www.labco.co.za
Email: andy@labco.co.za ■ Phone: +27 (0)43 050 0903
East London Branch – Unit 5 Evergreen Park, C/o 8 Road & Main Road, Beacon Bay ■ PO Box 16114 Linton Grange 6015

sanas T0787

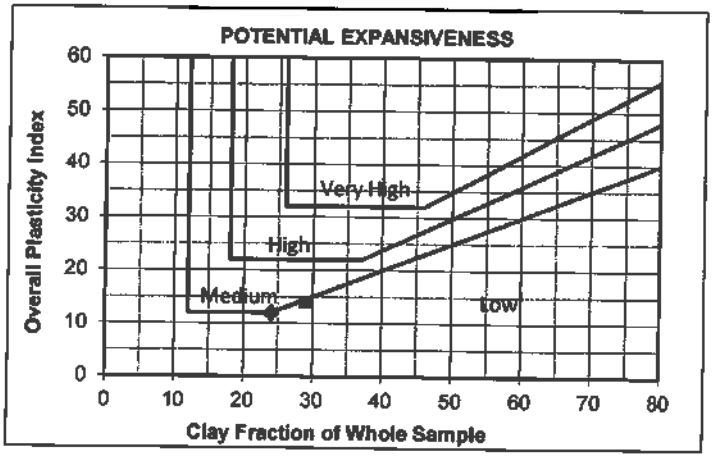
Client	:	Delta Geotech (Pty) Ltd	Date Received:	23/08/2019
Project	:	Bloemfontein	Date Reported:	25/09/2019
Project No	:	2019-E-891	Page No. :	10 of 11

Sampling Method: Samples delivered by client.

Any test results in this report, marked with *, are not included in the schedule of accreditation for this laboratory.

FOUNDATION INDICATOR

Laboratory Number		17 ◆	18 ■
Field Number		E891/17	E891/18
Client Reference			
Depth (m)		1.7	0.2
Position		TP:56	TP:52
Coordinates	X		
	Y		
Description		Olive Sandy Clay	Red brown Sandy Clay
Aditional Information			
Calcrete / Crushed Stabilizing Agent			

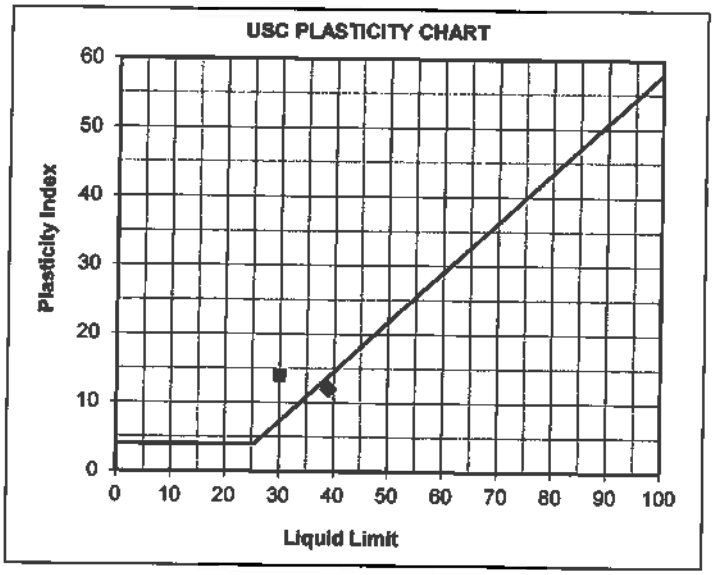


Moisture Content & Relative Density

Moisture Content (%)		
Relative Density (S.G.)		

Sieve Analysis (Wet Prep) — SANS 3001-GR1

Percentage Passing	100 mm	100	100
	75 mm	100	100
	63 mm	100	100
	50 mm	100	100
	37.5 mm	100	100
	28 mm	100	100
	20 mm	100	100
	14 mm	100	100
	5 mm	100	99
	2 mm	100	97
	1 mm	100	97
	0.425 mm	99	95
	0.250 mm	96	92
	0.150 mm	88	81
	0.075 mm	73	51
Grading Modulus		0.28	0.57



Hydrometer Analysis* — SANS 3001-GR3*

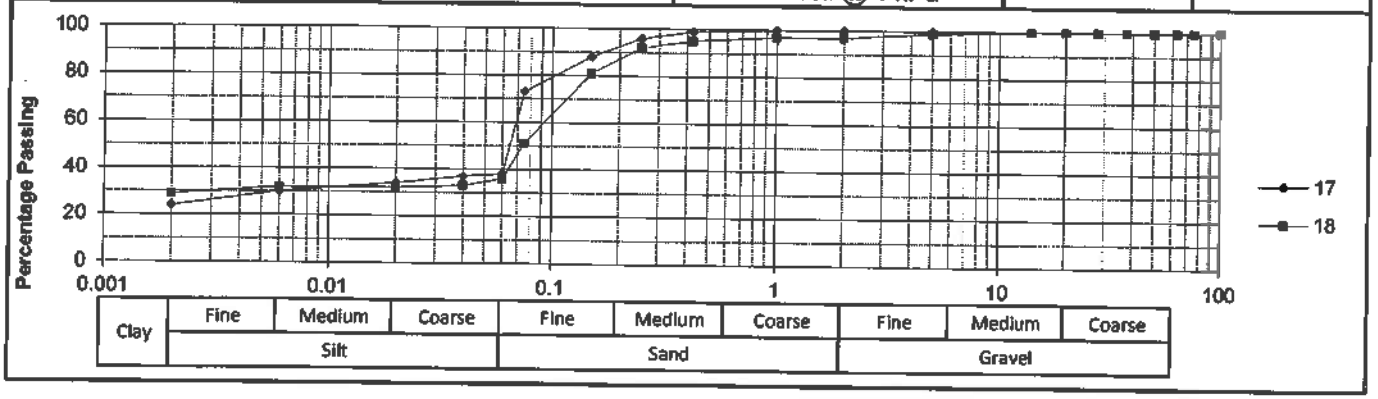
Percentage Passing	0.060 mm	38	36
	0.040 mm	37	33
	0.020 mm	34	32
	0.006 mm	30	32
	0.002 mm	24	29
Gravel	%	0	3
Sand	%	62	61
Silt	%	14	7
Clay	%	24	29

Note: An assumed S.G. may be used in Hydrometer Analysis calculations

Laboratory Number		17 ◆	18 ■
Atterberg Limits -425µ		SANS 3001-GR10	
Liquid Limit	%	39	30
Plasticity Index	%	12	14
Linear Shrinkage	%	6.0	7.0
Overall PI	%		

Classifications

HRB (AASHTO)	A-6	A-6
Unified (ASTM D2487)	CL	CL
Weston Swell @ 1 kPa		



Email: infosl@laboo.co.za ≡ www.laboo.co.za
Email: andy@laboo.co.za ≡ Phone: +27 (0)43 050 0803
East London Branch – Unit 5 Evergreen Park, C/o B Road & Main Road, Beacon Bay ≡ P.O Box 10114 Linton Grange 5015

sanas T0737

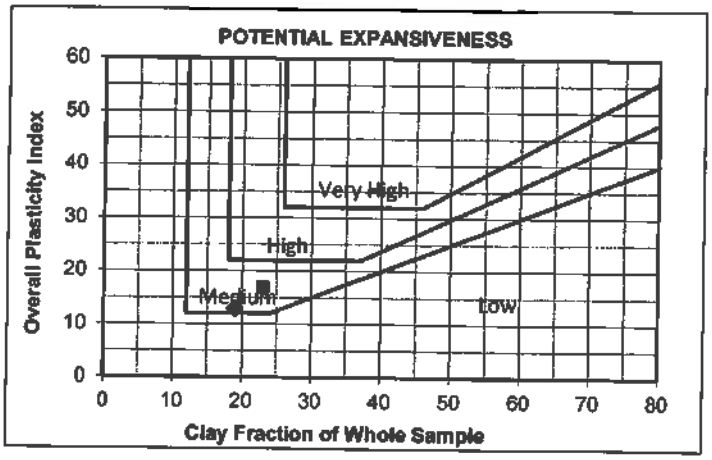
Client	:	Delta Geotech (Pty) Ltd	Date Received:	23/08/2019
Project	:	Bloemfontein	Date Reported:	25/09/2019
Project No	:	2019-E-891	Page No. :	11 of 11

Sampling Method: Samples delivered by client.

Any test results in this report, marked with *, are not included in the schedule of accreditation for this laboratory.

FOUNDATION INDICATOR

Laboratory Number		19 ◆	20 ■
Field Number		E891/19	E891/15
Client Reference			
Depth (m)		0.7	0.5
Position		TP:55	TP:57
Coordinates	X		
	Y		
Description		Olive Sandy Clay	Grey Sandy Clay
Aditional Information			
Calcrete / Crushed Stabilizing Agent			

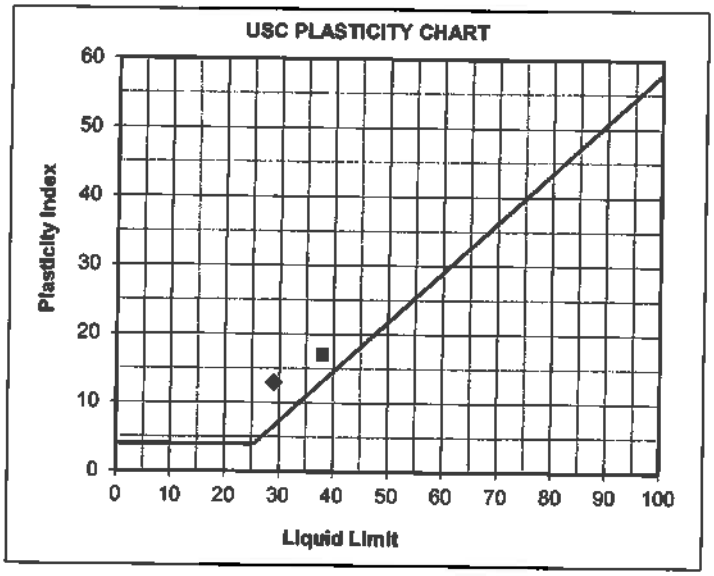


Moisture Content & Relative Density

Moisture Content (%)		
Relative Density (S.G.)		

Sieve Analysis (Wet Prep) — SANS 3001-GR1

		19 ◆	20 ■
Percentage Passing	100 mm	100	100
	75 mm	100	100
	63 mm	100	100
	50 mm	100	100
	37.5 mm	100	100
	28 mm	100	100
	20 mm	100	100
	14 mm	100	100
	5 mm	100	100
	2 mm	99	99
	1 mm	99	99
	0.425 mm	98	98
	0.250 mm	96	96
	0.150 mm	85	85
	0.075 mm	61	61
Grading Modulus		0.42	0.42



Hydrometer Analysis* — SANS 3001-GR3*

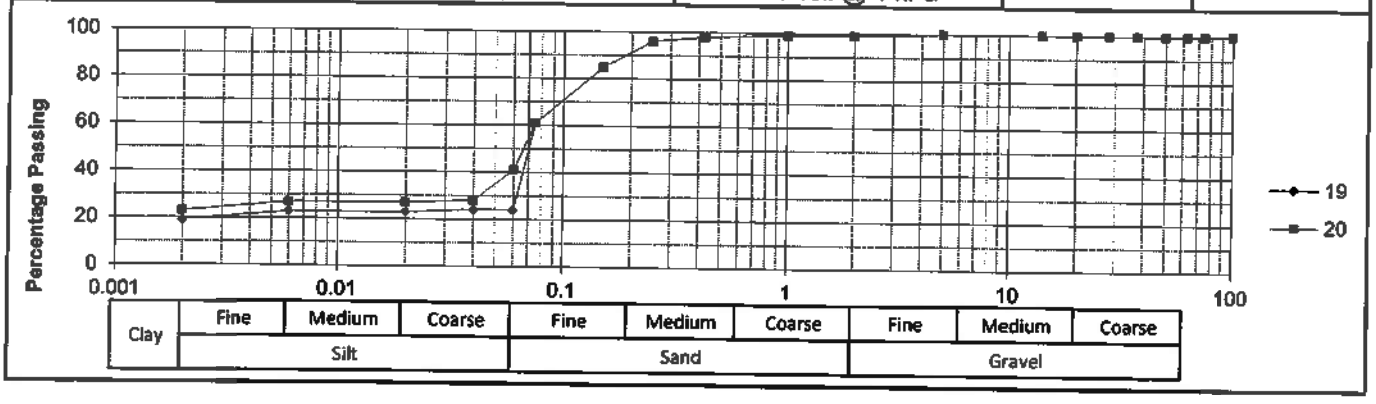
		19 ◆	20 ■
Percentage Passing	0.060 mm	24	41
	0.040 mm	24	28
	0.020 mm	23	27
	0.006 mm	23	27
	0.002 mm	19	23
Gravel	%	1	1
Sand	%	75	58
Silt	%	5	18
Clay	%	19	23

Note: An assumed S.G. may be used in Hydrometer Analysis calculations

Laboratory Number		19 ◆	20 ■
Atterberg Limits -425µ		SANS 3001-GR10	
Liquid Limit	%	29	38
Plasticity Index	%	13	17
Linear Shrinkage	%	6.5	8.5
Overall PI	%		

Classifications

HRB (AASHTO)	A-6	A-6
Unified (ASTM D2487)	CL	CL
Weston Swell @ 1 kPa		



WATERLAB (PTY) LTD

23B De Havilland Crescent
Persequor Techno Park,
Meiring Naudé Road, Pretoria
P.O. Box 283, 0020

Telephone: +2712 – 349 – 1066
Facsimile: +2712 – 349 – 2064
Email: accounts@waterlab.co.za

CERTIFICATE OF ANALYSES
TCLP / ACID RAIN / DISTILLED WATER EXTRACTIONS

Date received: 2018-09-04 **Date completed: 2019-09-10**
Project number: 1000 **Report number: 86063** **Order number: 16426**

Client name: Labco Southern Africa (Pty) Ltd **Contact person: Natasya van Rooi**
Address: PO Box 10114, Linton Grange, Port Elizabeth, 6015 **Email: natasya@labco.co.za**
Telephone: +27 (0)43 050 0903 **Facsimile: +27 (0)41 364 0494** **Cell: 043 050 0903**

Analyses	Sample Identification	
	TP:08 @04m	TP:16 @1.9m
Sample number	73820	73821
TCLP / Borax / Distilled Water	Distilled Water	Distilled Water
Mass Used (g)	500	500
Volume Used (mℓ)	1000	1000
Paste pH 1:2	5.2	6.9
Paste Electrical Conductivity in mS/m at 25˚C	17.8	14.6

Analyses	Sample Identification	
	TP:21 @0.1m	TP:30 @0.1m
Sample number	73822	73823
TCLP / Borax / Distilled Water	Distilled Water	Distilled Water
Mass Used (g)	500	500
Volume Used (mℓ)	1000	1000
Paste pH 1:2	8.3	7.1
Paste Electrical Conductivity in mS/m at 25˚C	31.5	18.4

Analyses	Sample Identification	
	TP:34 @0.2m	TP:37 @0.7m
Sample number	73824	73825
TCLP / Borax / Distilled Water	Distilled Water	Distilled Water
Mass Used (g)	500	500
Volume Used (mℓ)	1000	1000
Paste pH 1:2	7.2	6.4
Paste Electrical Conductivity in mS/m at 25˚C	43.2	16.1

S. Laubscher
Assistant Geochemistry Project Manager

WATERLAB (PTY) LTD

23B De Havilland Crescent
Persequor Techno Park,
Meiring Naudé Road, Pretoria
P.O. Box 283, 0020

Telephone: +2712 – 349 – 1066
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Address: PO Box 10114, Linton Grange, Port Elizabeth, 6015 **Email: natasya@labco.co.za**
Telephone: +27 (0)43 050 0903 **Facsimile: +27 (0)41 364 0494** **Cell: 043 050 0903**

Analyses	Sample Identification	
	TP:42 @0.5m	TP:48 @0.2m
Sample number	73826	73827
TCLP / Borax / Distilled Water	Distilled Water	Distilled Water
Mass Used (g)	500	500
Volume Used (mℓ)	1000	1000
Paste pH 1:2	6.4	8.3
Paste Electrical Conductivity in mS/m at 25˚C	18.2	20.2

Analyses	Sample Identification	
	TP 12 @ 0.2m (E891/12 TP 42 @0.5)	TP 32@ 0.5m (E891/15 0.2 Brown Red Silty Clay)
Sample number	73828	73829
TCLP / Borax / Distilled Water	Distilled Water	Distilled Water
Mass Used (g)	500	500
Volume Used (mℓ)	1000	1000
Paste pH 1:2	5.3	7.0
Paste Electrical Conductivity in mS/m at 25˚C	26.5	23.2

Please note:
- The blank is subtracted from all leach results, except pH and Electrical Conductivity.

S. Laubscher
Assistant Geochemistry Project Manager

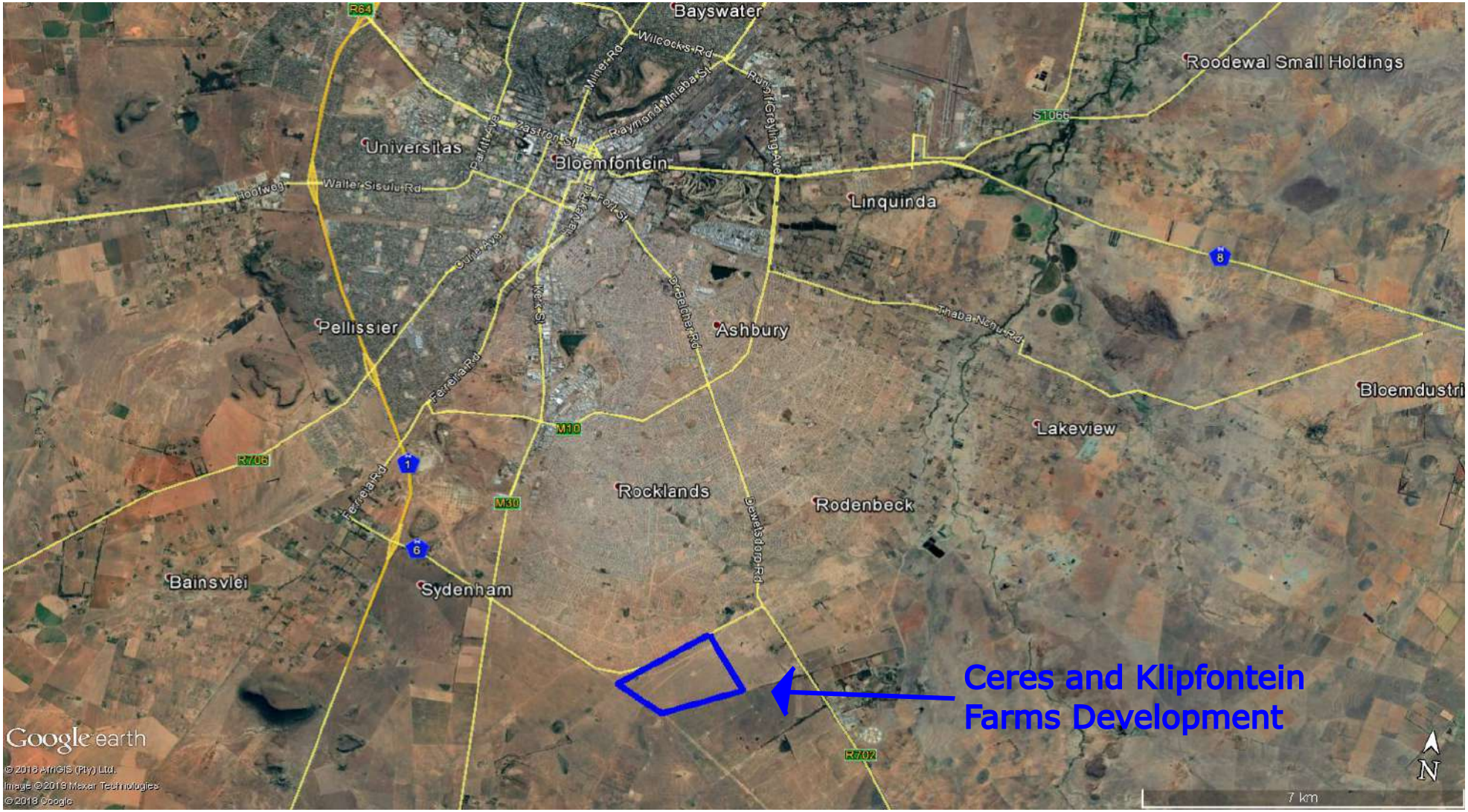
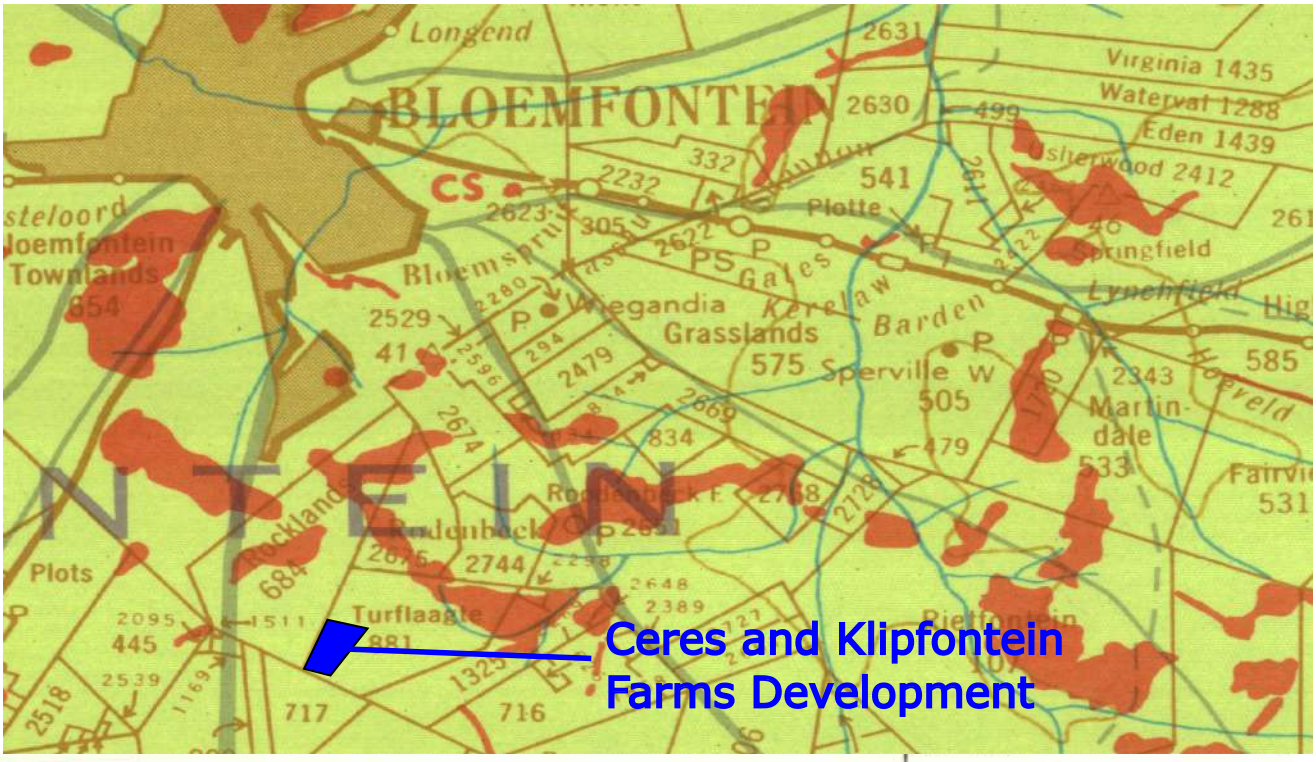


Figure 1 : Locality Plan

DELTA GEOTECH (PTY) LTD



	Dolerite, overprinted on geological formations Doleriet, oorgedruk op geologiese formasies		
K4d	Basaltic lava Basaltiese lawa	Drakensberg Stage Etage Drakensberg	Stormberg Series Serie Stormberg
K4c	Massive sandstone, thin shale Massiewe sandsteen, dun skalie	Cave Sandstone Stage Etage Holkranssandsteen	
K4r	Purple shale and mudstone; thin sandstone Pers skalie en moddersteen; dun sandsteen	Red Beds Stage Etage Rooilae	
K4m	Feldspathic sandstone and grit, green shale Veldspatiese sand- en grintsteen, groen skalie	Molteno Stage Etage Molteno	
K3u	Purple and green shale, thick sandstone beds Pers en groen skalie, dik sandsteenlae	Upper Stage Boonste Etage	Beaufort Series Serie Beaufort
K3m	Sandstone, shale and mudstone Sandsteen, skalie en moddersteen	Middle Stage Middelste Etage	
K3l	Sandstone, shale and mudstone Sandsteen, skalie en moddersteen	Lower Stage Onderste Etage	
K2u	Mudstone, shale Moddersteen, skalie	Upper Stage Boonste Etage	Ecca Series Serie Ecca

KARROO SYSTEM
SISTEEM KAROO

Figure 2 : Geological Plan

Not to scale

DELTA GEOTECH (PTY) LTD

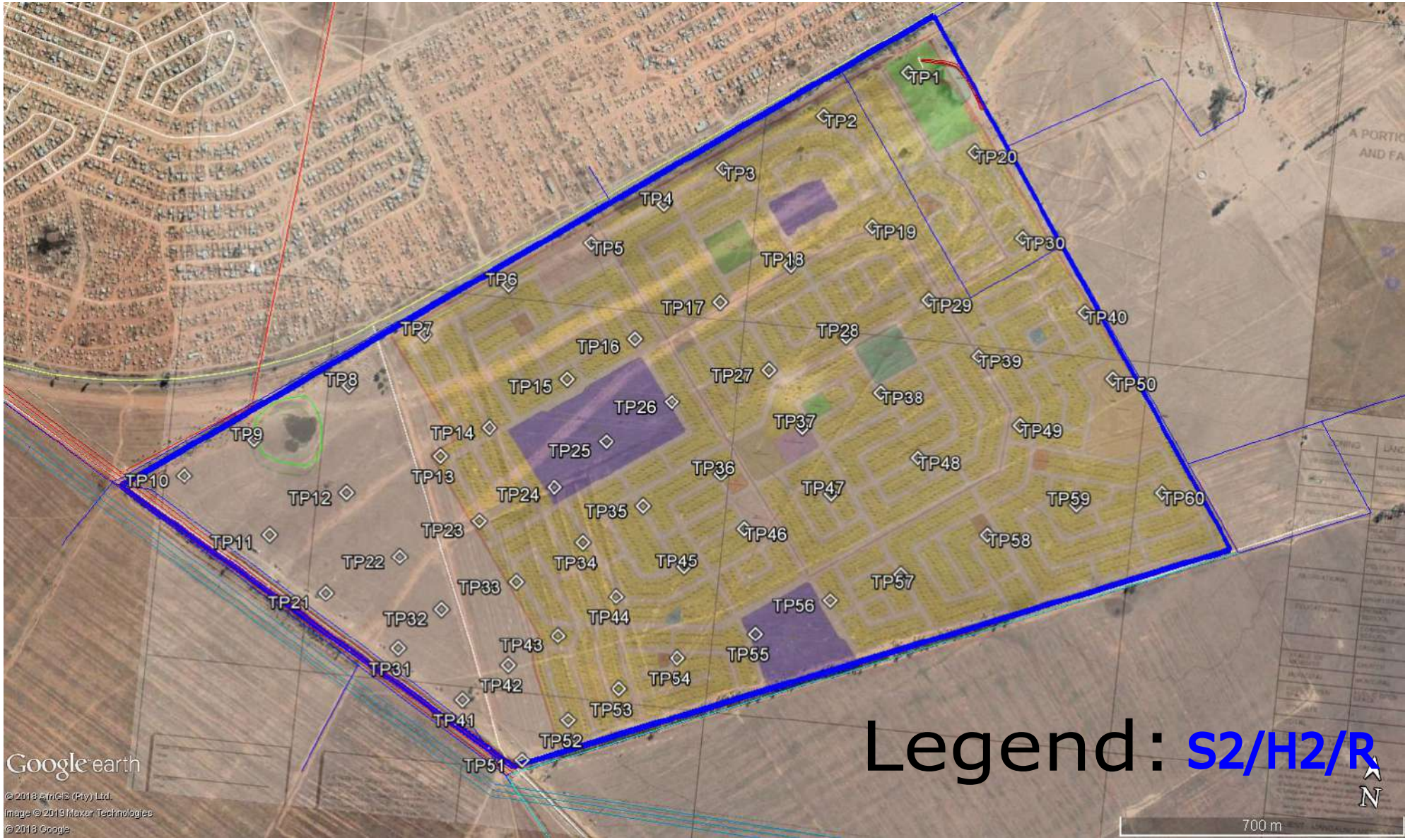


Figure 3 : Site Plan - Ceres and Klipfontein Farms Development

DELTA GEOTECH (PTY) LTD

APPENDIX D5: ENGINEERING SERVICES REPORT

APPENDIX D6: TRAFFIC IMPACT REPORT

APPENDIX E: PUBLIC PARTICIPATION

Volksblad Veilings

Veilingnuus: Maricelle Botha ☎ 051-404-7610
e-pos: maricelle.botha@volksblad.com
Advertensies: Maggie Koortzen ☎ 051-404 7833
e-pos: mkoortze@volksblad.com

Legendariese wiele onder hamer

Veteraanmotors nou te kry

Die veilingshuis Stephan Welz & Co, wat bekend is om sy kundigheid in kuns, juweliersware en meubels, bring dié naweek 'n opwindende versameling van klassieke en veteraanmotors na die veilingsvloer.

Dié veiling, wat as een van die hoogtepunte op die jaar se klassiekemotorkalender bestempel word, sluit in motors wat jare lank in private versamelings was.

Meer as 40 lotte met motors en motorgedenkwaardighede, onder meer emaljetekens wat van die 1920's dateer, asook 'n kinderpedaalmotor van die 1950's, word môre by die Killarney Country Club onder die hamer verkoop. Die veiling met sy skatkis van skaarshede wat 'n verskeidenheid van smake en begrotings sal pas, beloof om die belangstelling van 'n wye spektrum entoesiaste, versamelaars en beleggers te lok.

"Die klassiekemotorveilingsbedryf is wêreldwyd 'n multimiljoendollar-bedryf en word met valkoë uit 'n magdom bedrywe gemonitor, en dus is veilings geneig om die markwaarde van die motors op te stoot," sê Steffan Liebenberg, spesialismotorkonsultant by Stephan Welz & Co.

Hy sê klassieke motors is een van die snelgroeiendste beleggingsklasse ter wêreld. "Dit is 'n belegging wat geniet kan word en die voordeel is dat die tipe motors nie meer gemaak word nie, wat daarop neerkom dat beleggers behoorlik skarrel vir die bates."

Hy sê vanuit 'n Suid-Afrikaanse perspektief is eiendom tans 'n moeilike beleggingskategorie en min mense kan 'n bate wat nie presteer nie, bekostig. " 'n Klassieke motor het internasionale waarde en kan saam verhuis."

Van die hoogtepunte is 'n 1936 Derby Bentley met vier deure wat skaarser as hoendertande is.

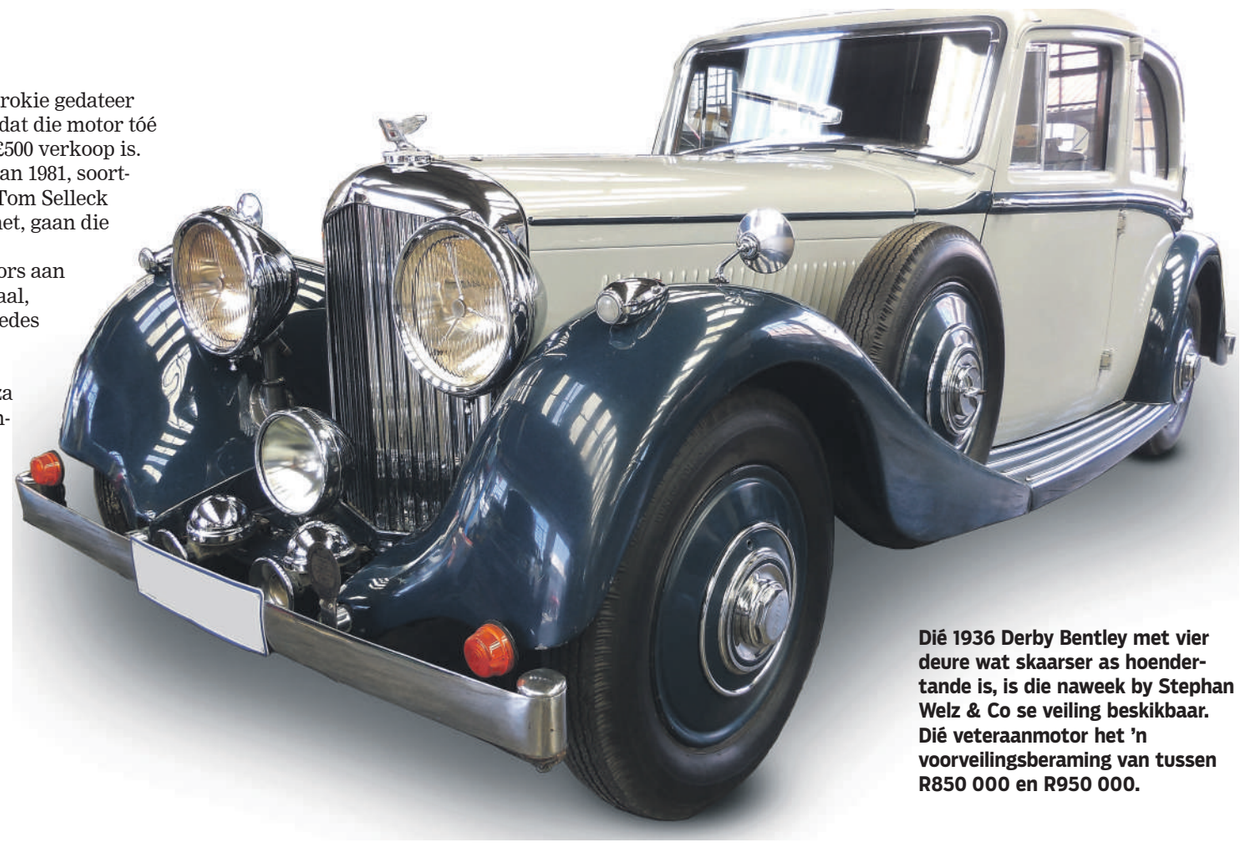
'n Fiat 15 pk. Torpedo van 1911, die oudste Fiat in die land wat nog kan ry, is ook te kry. Die motor kom saam met 'n argief van dokumente wat sy herkoms bevestig. Dit sluit in die oorspronklike verkoopstrokie gedateer 9 Augustus 1911 wat aandui dat die motor tóé vir die koninklike som van £500 verkoop is.

'n Rooi Ferrari 308 GTSi van 1981, soortgelyk aan die een waarmee Tom Selleck in *Magnum P.I.* rondgerits het, gaan die koppe laat draai.

Daar is ook klassieke motors aan die laer kant van die prysskaal, soos 'n gerestoureerde Mercedes 2205 Ponton.

Inligting is te kry by www.stephanwelzandco.co.za of volg die veilingshuis op Instagram en Facebook.

'n Fiat 15 pk. Torpedo (1911), die oudste Fiat in die land wat nog kan ry.



Dié 1936 Derby Bentley met vier deure wat skaarser as hoendertande is, is die naweek by Stephan Welz & Co se veiling beskikbaar. Dié veteraanmotor het 'n voorveilingsberaming van tussen R850 000 en R950 000.

Wenke vir nuwelingbeleggers

■ Doen jou huiswerk voor jy koop. Dit is belangrik om te weet of die onderdele beskikbaar is en waar om die voertuig te laat diens.

■ Begin deur iets "veiligs" te koop, verkieslik 'n klassieke motor wat nie 'n nisbelegging is nie en een wat almal graag wil besit. Só kan jy die motor verkoop en jou geld terugkry as jy agterkom dat dit nie die regte wiele vir jou is nie.

■ Die bateklas is soortgelyk aan die kunsmark en nie almal hou van dieselfde items nie. Vanweë sentiment is daar kopers wat bereid is om meer as die markprys te betaal. 'n Praktiese reël is dat dit beter is om vir beleggingsdoeleindes eerder in 'n skaars voertuig, waarvan daar minder gemaak is, te belê. Dié tipe motors is gewoonlik op almal se wenslysies.

■ Wees geduldig omdat dit 'n bateklas is wat oor tyd in waarde toeneem.

■ Verstaan die geskiedenis van die motor en dit wat dit spesiaal maak.

Bo: Dié bloedrooi Ferrari 308 GTSi van 1981, soortgelyk aan die een waarmee Tom Selleck in *Magnum P.I.* rondgerits het, gaan die koppe laat draai.

KENNISGEWINGS

NOTICE OF ENVIRONMENTAL IMPACT ASSESSMENT (SCOPING PROCESS) FOR THE PROPOSED TOWNSHIP ESTABLISHMENT DEVELOPMENT, WITHIN MANGAUNG METROPOLITAN MUNICIPALITY, BLOEMFONTEIN, FREE STATE PROVINCE

Notice is hereby given in terms of Regulation published in Government notice GNR 327, 324, and 325 Amended on the 7th of April 2017 published in terms of Chapter 5 of the National Environmental Management Act (Act no. 107 of 1998) and the EIA Regulations of the intent to conduct an Environmental Impact Assessment study for the project outlined in this advert.

NATURE OF ACTIVITY
The proposed project is the development of a mixed-use township establishment covering an area of 214.1 Hectares, within the jurisdiction of Mangaung Metropolitan Municipality. The mixed used township establishment will entail of the following: Residential; Institutional Facilities (police station, health centre, library, community centres); Recreational facilities; Educational facilities; Place of worship; Business sites; Public open spaces; and Municipal facilities.

The proposed project constitutes of activities listed under National Environmental Management Act 107 of 1998 as amended on 07 April 2017 which are: Activity 9, Activity 10, Activity 11, Activity 15, and Activity 24 of Notice 1 GNR 327.The activity listed require an Environmental Impact Assessment to be undertaken by an Independent Environmental Assessment Practitioner for the Environmental Authorisation.

PROPERTY DESCRIPTION
The proposed development is located at Mangaung situated at a land described as portion of farm Klipfontein 716 farm Ceres 626 within Mangaung Metropolitan Municipality, Bloemfontein, Free State Province.

GPS: **26o15'48.176"E 29o12'51.064"S**

NAME OF APPLICANT
Mangaung Metropolitan Municipality

NAME OF ENVIRONMENTAL ASSESSMENT PRACTITIONER
Inaluk Consulting Services

REGISTRATION OF INTERESTED AND AFFECTED PARTIES
This Notice serves to invite all Interested and or Affected Parties on the project to kindly register as stakeholders to the proposed project so as to have an opportunity to correspond with the project team on project activities. In order to register as Interested and Affected Parties you can contact us by telephone or e-mail within 30 days of this notice. Or alternatively attend the meeting that will be held on the 30th of November 2019 at 10h00 am on site.

REGISTRATION, QUERIES OR WRITTEN COMMENTS SHOULD BE SUBMITTED TO:
Contact Person:
Kulani Nkuna
Tel: 072 783 4002,
Email: kulani@inaluk.co.za
Address: 29 Tulana; Jozini Street;
Moreleta Park; Pretoria, Gauteng, 0181

X1VW6YNR-VB221119

VEILINGS

APPENDIX E1 SITE NOTICE

NOTICE OF ENVIRONMENTAL IMPACT ASSESSMENT (SCOPING PROCESS) FOR THE PROPOSED TOWNSHIP ESTABLISHMENT DEVELOPMENT, WITHIN MANGAUNG METROPOLITAN MUNICIPALITY, BLOEMFONTEIN, FREE STATE PROVINCE

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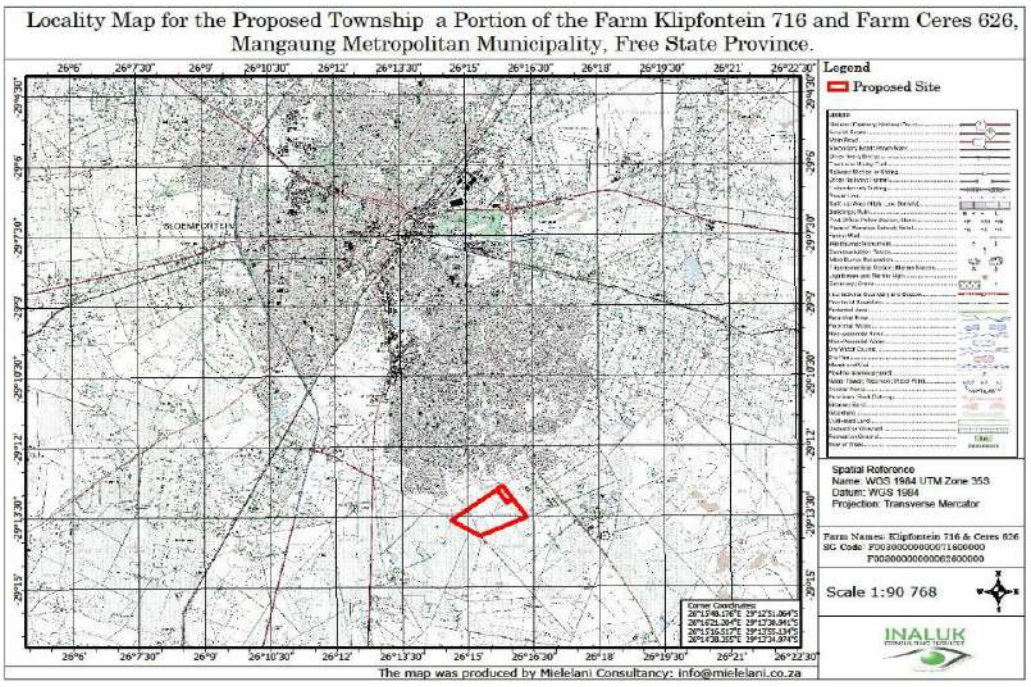

NATURE OF ACTIVITY

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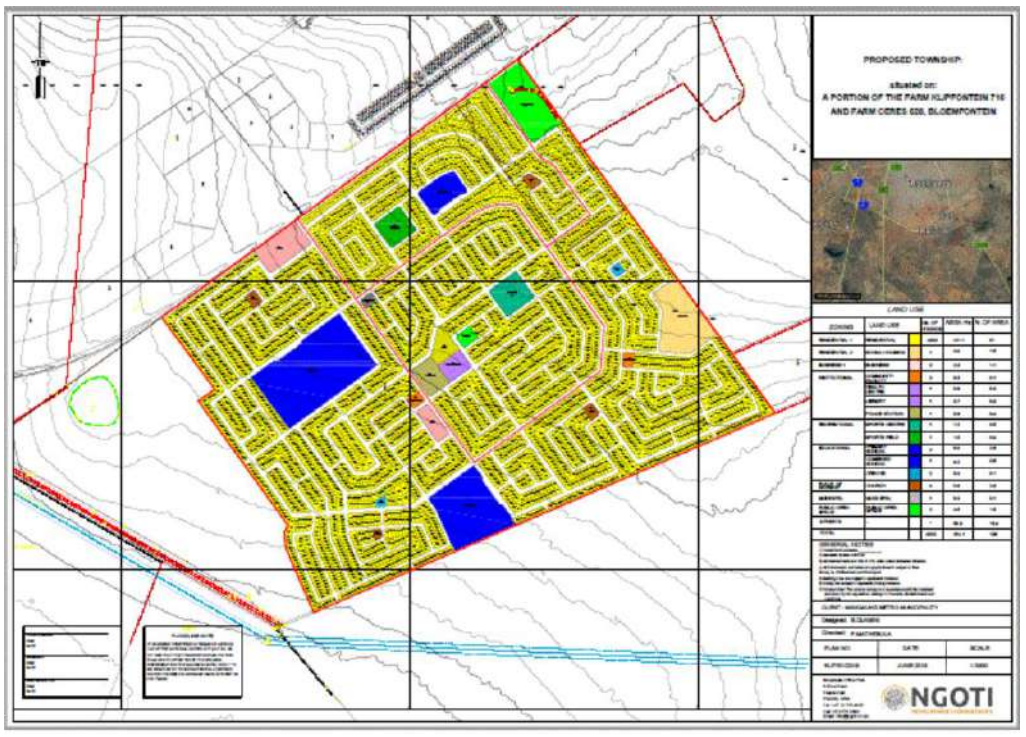
- Residential;
- Institutional Facilities (police station, health centre, library, community centres);
- Recreational facilities;
- Educational facilities;
- Place of worship;
- Business sites;
- Public open spaces; and
- Municipal facilities.



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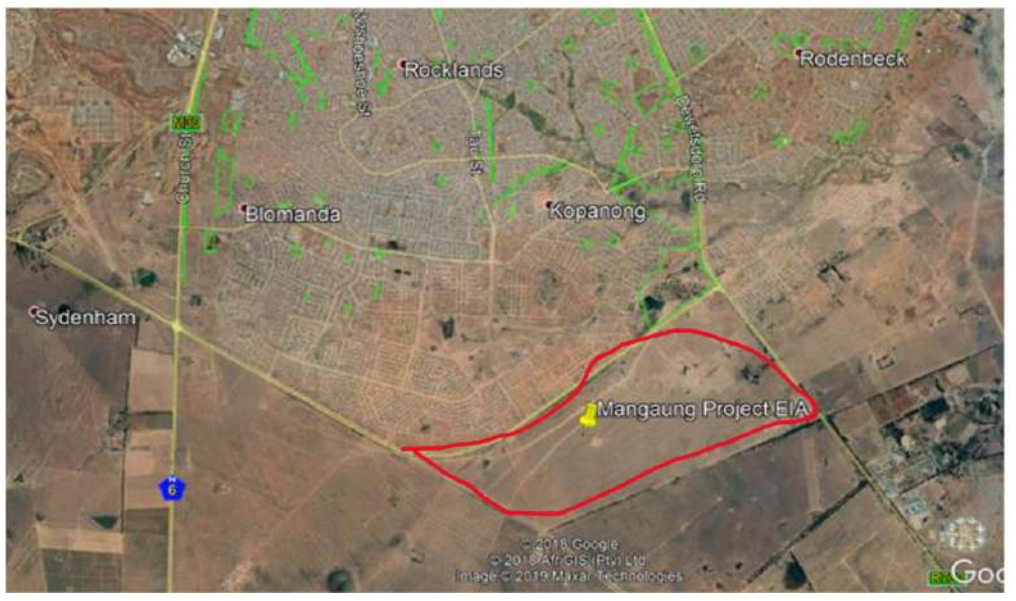

NAME OF APPLICANT

Mangaung Metropolitan Municipality

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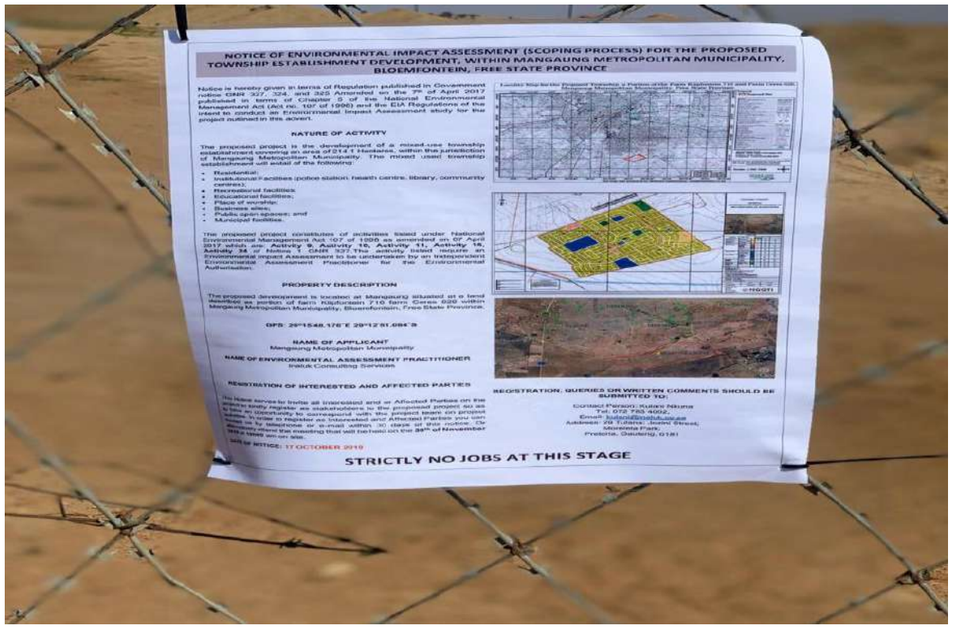
DATE OF NOTICE: 08 NOVEMBER 2019

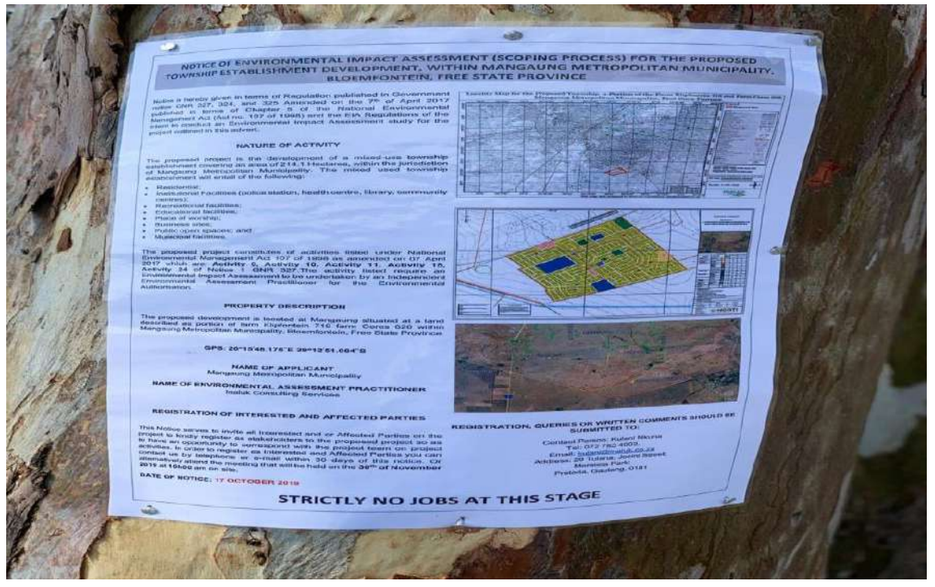
REGISTRATION, QUERIES OR WRITTEN COMMENTS SHOULD BE SUBMITTED TO:

Contact Person: Kulani Nkuna
Tel: 072 783 4002,
Email: kulani@inaluk.co.za
Address: 29 Tulana; Jozini Street;
Moreleta Park;
Pretoria, Gauteng, 0181

STRICTLY NO JOBS AT THIS STAGE

SITE NOTICE PHOTOGRAPHS





APPENDIX E2 KEY STAKEHOLDERS

PUBLIC PARTICIPATION DATABASE REGISTRATIONS

Project Name: Application for environmental authorisation for the proposed township establishment on a portion of the farm Klipfontein 716 and farm Ceres 626, Bloemfontein

Reference Number:

Province: free State

Name and Surname	Organisation	Postal Address	Physical Address	Contact
Client				
Attie Vanheerde	Mangaung Metropolitan Municipality	P O Box 3704 Bloemfontein 9300	Room 915, Bram Fischer Building , Nelson Mandela Drive & Markgraaf Street, Bloemfontein,9301	Tel: 051 405 8911 Email:attie.vanheerden@mangaung.co.za
Local Authority				
Mrs M. Ramongalo	Mangaung Metropolitan Municipality	P O Box 3704 Bloemfontein 9300	Room 1017, 10th floor, Bram Fischer Building , Nelson Mandela Drive & Markgraaf Street, Bloemfontein,9301	Tel: 015 405 8429/ 051 405 8577 Email: Mpolokeng.Ramangalo@mangaung.co.za
Crl Rampai (Chabeli Frank)	Mangaung Metropolitan Municipality – Ward 7 Councillor			Tel: 083 5910 512 /063 6993 527 Email: frankrampaifr6@gmail.com
State Department				

Name and Surname	Organisation	Postal Address	Physical Address	Contact
	Department of economic, small business development, tourism and environmental affairs		Room 19, 3rd Floor, 113 ST Andrews Street, Bloemfontein 9300	
Mr Jack Morton	Department of Agriculture Forestry and Fisheries	Private Bag X01 Glen 9360		Tel:051 861 8369 Cell: 083 302 0703 Fax: 086 234 6758 Email: jack@fs.agric.za
Dr Redelstorf	SAHRA		111 Harrington Street, Cape Town, 8001	Tel: 021 462 4502 Email: rredelstorff@sahra.org.za

APPENDIX E3 COMMENTS AND RESPONSES

INALUK CONSULTING SERVICES

REGISTRATION AND COMMENT SHEET

THE PROPOSED TOWNSHIP ESTABLISHMENT ON A PORTION OF THE FARM KLIPFONTEIN 716 AND FARM CERES 626, BLOOMFOTEIN, FREE STATE PROVINCE.

REPLY SLIP: PLEASE FILL-IN AND RETURN

ATTENTION: KULANI NKUNA

CELL: 072 783 4002 **Email: kulani@inaluk.co.za**

Name and Surname:	CHRIS SMITH		
Tittle:	MR		
Organisation / Company:	DEPT AGRICULTURE RURAL DEV (DARD)		
Address:	GLEN		
Tel:	Fax:	Email:	Cell:
073 156 2740		CSMITH@DARD.GOV.ZA	

Record your comments below:

According our information these two farms are still agricultural land and cannot be develop without rezoning

Signature: Date: 28/11/2019

APPENDIX E6. CORRESPONDENCE AND MINUTES OF ANY MEETINGS

PUBLIC PARTICIPATION REPORT (PPR)

FOR THE PROPOSED TOWNSHIP ESTABLISHMENT ON PORTION OF FARM KLIPFONTEIN 716 AND FARM CERES 626 WITHIN THE MANGAUNG METROPOLITAN MUNICIPALITY

NOVEMBER 2019

PREPARED BY:	APPLICANT:
Inaluk Consulting Service: **29 Tulana Jozini street Moreleta Park,** **Pretoria, Gauteng, 0181** **Contact Person: Kulani Nkuna** **TEL: 072 783 4002** **E-mail: kulani@inaluk.ac.za**	**Mangaung Metropolitan Municipality** **PO Box 3704, Bloemfontein, 9300** **Contact Person: Attie Vanheerde** **TEL: 051 405 8911** **Email:** **attie.vanheerden@mangaung.co.za**

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1. Project Information

The applicant intends to establish a mixed-use township. The proposed development footprint is located across the road from an already established township area (near Kopanong) and approximately 193 ha in surface size, situated within the Mangaung Metropolitan Municipality, Free State Province. The site is situated partly adjacent to Dewetsdorp Road and the M30, approximately 17 km outside Bloemfontein central with the following coordinates: 29° 12' 55.95" S and 26° 15' 51.58" E. The proposed footprint is situated on a Portion of the Farm Klipfontein 716 and Farm Ceres 626.

Inaluk Consulting Service has been appointed as independent consultant to undertake the Basic Assessment process.

2. Public Participation Process

Public participation is the involvement of all parties who potentially have an interest in a development or project, or may be affected by it. The objective of the public participation process (PPP) is to meet all legal requirements, to ensure that where possible all interested and affected parties (I&APs) are informed of the proposed project, comments and issues are captured and responded to, a database is compiled containing information of the I&APs and that registered I&APs are communicated with on an on-going basis in an open an honest manner

Public participation process is conducted along the guidelines given in terms of chapter 6 of National Environmental Management Act, 107 of 1998 (amended) and the Environmental Impact Assessment Regulations of 2010. It forms an integral part of the EIA process and influenced by:

- Placing notifications on site and in the local media (**Appendix E-1**)
- Distribution background Information (BID) to adjacent property owners and/or tenants and other I&APs (**Appendix E-4**)
- Conduction public meeting with I&APs
- Providing registered I&APs with sufficient and transparent information on an on-going basis.

Anyone who is interested or affected by the proposed project has the right to participate and is encouraged to do so. A detailed account of the process followed is elaborated in the following section and issues and/or concerns raised are documented and addressed where possible.

2.1. The participation process

- Submit an application and obtain an acknowledgement and reference number
- Inform I&APs, including but not limited to:

- Local Municipalities
- Relevant Government Departments
- Non-government Organisation (If applicable)
- Community Based Organisation (If applicable)
- Adjacent Landowners and tenants

➢ Organise public meeting/s focus group meeting / Open Day(s) (operational)
➢ Make Draft Scoping Report (DSR) available for Public Review and comments
➢ Submit Final Scoping Report to authority including comments received during review period and public participation.
➢ Inform I&APs of decision and allow 10 days for Notice of intent to appeal and 30 days for appeals

3. Process followed to Date

The following processes were undertaken to facilitate the public participation for the proposed establishment project, which commenced on Friday, 08th November 2019

3.1. Newspaper advertisement

A newspaper advertisement was published in the Volksblad Newspaper on Friday 22nd November 2019 notifying the public of the Scoping process and requesting Interested and Affected Parties (I&APs) to register with, and submit their comments at Inaluk Consulting services. A content of the newspaper advertisement is attached in **Appendix E-1**

3.2 Site notice

Five (4) site notices will be fixed in conspicuous places around the proposed site on Friday, 08th November 2019. The site notices will give a brief description of the project and Interested and/ or Affected Parties will be invited to register on the database of the proposed project and to raise any issues concerns about the project within 30 days. Copies of the site notices and photographic evidence of the site notices are attached as **Appendix E-2**

3.3 Identified I&APs

(Please refer to the **Appendix E-3** for a register of all identified and/or contacted I&APs).

3.4. Hand-delivered notifications

Background Information Documents (BIDs) were prepared and will be distributed to adjacent landowners/tenants within 100 meters of the proposed site to notify and inform them of the proposed project. The BID gave a full description of the proposed project and invited the I&APs to register on the database and raise concerns or comments. The BID also included the registration and comments sheet as well as a locality map. Identified landowners and stakeholder representatives were sent the BID, invited to participate in the project and to attend a public meeting. A copy of the BID will be attached as **Appendix E-4.**

4 Comments and Response Report

Issues, comments and /or suggestions that will be submitted by I&APs by e-mail, fax, post or telephonically will be captured in the Comments and Response Report, attached as **Appendix E-6.**

5 Public Meetings

A public meeting will be held on 30th of November 2019, at Mangaung, at 10h00 .The purpose of the meeting is to inform I&APs of the proposed development, discuss any issues or concerns they may have, obtain their inputs and comments and allow them an opportunity to register to participate in the process. Minutes of the public meeting will be attached in **Appendix E-5.**

6 Correspondence with I&APs

Correspondence with I&APs has been maintained on an ongoing basis throughout the process and any comments, concerns or issues captured are attached in the comments and Response Report, and forms part of all the reports that will be submitted to DESTEA.

7 Way Forward

Once the Scoping Report (SR) for the Environmental Impact Assessment has been accepted and a decision made by DESTEA, registered I&APs will be informed of this decision. and given an opportunity to appeal the decision

All registered I&APs will be informed about a way forward and the public participation report will be incorporated on the final EIA report.

Appendix E-1: Wording of the Newspaper Advertisement

Appendix E-2: Copy of Site Notice Text and Photos

Appendix E-3: List of Identified and Contacted I&APs

Appendix E-4: Copy of BID

Appendix E-5: Minutes of Public Meeting

Appendix E-6: Comments and Response Report

APPENDIX F: IMPACT ASSESSMENT

IMPACT ASSESSMENT

FOR THE PROPOSED TOWNSHIP ESTABLISHMENT ON PORTION OF FARM KLIPFONTEIN 716 AND FARM CERES 626 WITHIN THE MANGAUNG METROPOLITAN MUNICIPALITY

Prepared For:

Department of Economic Small Business Development, Tourism and Environment Affairs (DESTEA).

Prepared By:

Inaluk Consulting Services

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Environmental Mitigation and Management Measures

These guidelines will form the basis for environmental mitigation and management on site. The appointed Environmental Control Officer (ECO) will ensure that any modifications are communicated, explained to and discussed with all the Interested and Affected Parties (i.e. the authorities, contractor, the proponent and any directly affected party who requests this information):

- Mitigation of the potential impact in regard to the:
  - Potential to mitigate any negative impacts;
  - Potential to optimize any positive impacts; and
  - The likelihood of successful mitigation.

Overall assessment and general comments as to the predicted impacts of the development after mitigation in terms of such criteria as may be relevant to a particular impact, and which may include the following aspects:

- The severity and permanence of the impact on either local biota or surrounding human communities;
- The size of the affected communities and their relative significance;
- The general ecological and socio – economic context within which a particular impact would occur; and
- The final balance of between positive and negative impacts, and related costs and benefits to society.

Pre-construction and construction phases

Establishment of environmental governing bodies

- **Establishment of Environmental Monitoring Committee (EMC)**

An Environmental Monitoring Committee needs to be established with representatives of I&APs, relevant authorities and the holder of an Environmental Authorization. The role of this EMC is to monitor the environmental compliance during all phases of the

project and satisfy as far as possible the issues and concerns of all parties involved in or affected by the project.

- Appointment of Environmental Control Officer (ECO)

An Environmental Control Officer will fulfil the responsibility of assuring that environmental performance is achieved by the developer and its contractors during all phases of the project. It is the responsibility of the ECO to audit compliance with the commitments set out in this EMP, and assist with the implementation of mitigation measures. The contractor and / the clients representative (ECO) will inspect all the construction activities on a monthly basis. All issues highlighted in this Environmental Management Plan will be investigated and compliance with the mitigation measures audited. Preceding complaints, concerns or incidents reported in the logbook will also be monitored.

Feedback of the findings, changes to this document as well as all reported incidents will be reported at the monthly progress meetings between the Consulting Engineer, Contractor and Client Representative. A summary of these reports will also be forwarded to the Free State Department of Economic Small Business Development, Tourism and Environment Affairs (DESTEA), and the measures to rectify the issue stated. Any previous findings must be audited to confirm the successful implementation thereof. At the end of the project a summary document will be prepared and presented to the Department of Economic Small Business Development, Tourism and Environment Affairs (DESTEA).

Establishment of complaints register

A complaints register is to be established and kept onsite to address complaints in a timorous fashion, which will be reported to the EMC.

Responsibilities and timeframes for the pre-construction phase

Number	Establishment of Environmental Governing Bodies	Responsibility	Timeframe
1.	**Establishment of Environmental Monitoring Committee (EMC):** Establish an Environmental Monitoring Committee with I&APs' representatives. Formal agreement regarding the frequency of meetings and agenda must be reached.	Environmental consultant(s)/specialist(s)	During the lifetime of the project (from pre-construction through operation and maintenance phases).
2.	**Appointment of Environmental Control Officer (ECO):** Developer to appoint the ECO for the project.	Developer	Pre-construction, construction and operation and maintenance phases.
3.	**Establishment of a complaints register:** Environmental complaint register to be maintained: ✓ All complaints with regards to environmental non-compliance on the construction site need to be recorded and addressed accordingly. ✓ Establish an Environmental complaints register. ✓ Address complaints timorously and report back to EMC meetings. ✓ Open liaison channels should be identified and developed to ensure that all queries, complaints from affected individuals/ parties may be addressed with the shortest possible delay.	Site engineer and contracts managers will be responsible for maintaining the register and report any complaints received to the ECO	During construction, operation and maintenance phases

Assessment Approach to environmental issues during the construction phase

The assessment and description of identified environmental issues were conducted according to the structure and approach detailed below. The following is a brief description of how these impacts were identified and rated. The approach may be tailored and altered where required to deal adequately with the description and assessment of a specific impact.

A description of the nature of the potential issues as to its:

- General background and context within this application
- Causes and effect
- Who or what will be affected
- How it will be affected

Assessment of the impact as to:

- Probability
- Duration
- Extent
- Reversibility
- Magnitude

The table below shows how each impact was assessed and is an elaboration of the approach used in identifying rate these impacts.

Potential issue	Criteria	Description of elements that are central to each issue
Description	Nature	What causes the effect?
		Who will be affected?

Potential issue	Criteria	Description of elements that are central to each issue
		What will be affected?
		How will it be affected?
	Probability	Certain / may not occur with mitigation.
	Status	Positive (beneficial impact); negative (deleterious or adverse impact); or neutral (impacts is either beneficial or diverse).
Assessment	Extent	Is the impact site specific?
		Does the impact extend locally, i.e. to the site and its nearby surroundings?
		Does the impact extend regionally, i.e. have an impact on the region.
		Does the impact extend nationally, i.e. have an impact on a national scale.
	Duration	Short term, i.e. 0-5 years.
		Medium term i.e. 5-11 years.
		Long term, i.e. impact ceases after the construction or operational life cycle.
		Permanent, i.e. mitigation either by natural process or by human intervention will not occur in such a way or in such a time span that the impact can be considered transient.
	Magnitude	Low, i.e. natural and social functions and processes are not affected or minimally affected.

Potential issue	Criteria	Description of elements that are central to each issue
		Medium, i.e. affected environment is notably altered. Natural and social functions and processes continue albeit in a modified way.
		High, i.e. natural or social functions or processes could be substantially affected or altered to the extent that they could temporarily or permanently cease.
	Reversibility	Impact is reversible or irreversible.
	Cumulative or non-cumulative	Potential of two or more impacts to combine to form cumulative or synergistic impacts.

Identified Impacts for the construction of the township development

No	Impact	Description		Assessment					
		Nature	*Probability*	*Status*	*Extent*	*Duration*	*Magnitude*	*Reversibility*	*Cumulative/ Non-cumulative*
1	**Noise**: It is expected that the construction activities will cause noise pollution in the area during working hours.	The current site is a vegetation land surrounded by residential area and the noise is expected to be not higher than the allowable ambient noise limit.	The probability of change is certain with regard to the potential sources of noise pollution during construction phase.	An increase in noise pollution would be a negative impact to the surrounding environment.	The impact would be site specific and in the local environment.	During construction phase due to construction vehicles and machinery.	Medium.	Reversible, after completion of the construction the noise level will return to the initial state.	Cumulative, an increase in noise due to construction activity or vehicles.

No	Impact	Description		Assessment					
		Nature	*Probability*	*Status*	*Extent*	*Duration*	*Magnitude*	*Reversibility*	*Cumulative/ Non-cumulative*
2	**Dust:** The creation of dust would be evident in the area during construction	The current site is vacant and open space. Dust pollution at site is at moderate level. Increase of dust level during construction phase could have an impact to the air quality.	During construction period the dust level could rise as a result of heavy construction vehicles movement and the construction itself.	An increase in dust would be a negative impact to the surrounding environment.	The impact would be site specific and in the local environment.	The impact would only result during the construction phase	Medium.	Reversible, after completion of the construction the dust level will be lower than the initial state.	Non-cumulative

No	Impact	Description		Assessment					
		Nature	*Probability*	*Status*	*Extent*	*Duration*	*Magnitude*	*Reversibility*	*Cumulative/ Non-cumulative*
3	**Soil erosion**: The construction activities for the development of the township have the potential to create soil erosion.	The current environmental site is an open space evidenced with grazing of cattle and donkeys.	The probability of change is uncertain during construction phase.	The current site infrastructure designs does cater for the Storm Water Management. If it is not addressed in the proposed development it could increase the impact.	The impact would be site specific.	Might occur only during construction phase. Short term.	Medium. The surrounding might be negatively affected.	Reversible, when the construction is completed, the storm water management in the area is improved, intern soil erosion issue	Non-cumulative. If the proposed development design addresses the storm water management issue.

No	Impact	Description		Assessment					
		Nature	*Probability*	*Status*	*Extent*	*Duration*	*Magnitude*	*Reversibility*	*Cumulative/ Non-cumulative*
								could be addressed.	
4	**Waste disposal:** Uncontrolled and random disposal of waste has a negative effect on the health status of the local environment.	The existing current site is affected by poor waste disposal on some parts of the proposed site.	The probability of change is uncertain.	An increase in waste and improper disposal might result in an encouragement of illegal dumping site establishment that could later pose serious	Impact would be site specific and in the local environment.	Only during construction phase. Short term.	Medium.	If well managed, it can be reversed or even avoided.	Non-cumulative.

No	Impact	Description		Assessment					
		Nature	*Probability*	*Status*	*Extent*	*Duration*	*Magnitude*	*Reversibility*	*Cumulative/ Non-cumulative*
				environmental health hazard to the environment.					
5	**Mixing of concrete:** Concrete residue when left to harden can create areas which can be difficult to remove or rehabilitate.	The current site is free from concrete slabs, proper measures need to be implemented to avoid adverse impacts.	The probability of change is uncertain which may rise as a result of dry concrete mixture left during construction.	If concrete mixing is not well managed and left to dry it may result into concrete slab formation or negatively impact to the surrounding.	Impact would be site specific and in the local environment.	This might permanently affect the soil.	Medium. The soil character might be changed.	Reversible.	Non-cumulative.

No	Impact	Description		Assessment					
		Nature	*Probability*	*Status*	*Extent*	*Duration*	*Magnitude*	*Reversibility*	*Cumulative/ Non-cumulative*
6	**Waste generation and disposal:** Waste generation and inappropriate disposal could lead to wide array of environmental problems i.e.	The current state of the site is affected by illegal waste disposal.	The probability of change is uncertain.	Generated waste and disposal method could be sources of pollution.	Impacts could be site specific and in the local environment.	If waste management plans are not in place this could be a long term effect.	High.	If well managed, it can be reversible.	Cumulative.

No	Impact	Description		Assessment					
		Nature	*Probability*	*Status*	*Extent*	*Duration*	*Magnitude*	*Reversibility*	*Cumulative/ Non-cumulative*
	soil, surface contamination								
7	**Hazardous waste:** Various hazardous materials, construction waste and by-products as thinners and oils used during construction	The current state of the site is free from toxic chemicals.	The probability of change is uncertain depending on the management.	Hazardous substances if not managed or used in an appropriate manner can be sources of pollution.	Impacts would be site specific and could extend to regional environment.	Short term if early managed .	High.	If well managed can be reversible.	Cumulative

No	Impact	Description		Assessment					
		Nature	*Probability*	*Status*	*Extent*	*Duration*	*Magnitude*	*Reversibility*	*Cumulative/ Non-cumulative*
	could become sources of pollution if not disposed of in an appropriate manner.								
9	**Endemic flora and fauna:** Endemic flora and fauna in and around the construction	The site is an undisturbed land, disturbance to the vegetation is expected	The probability of change is certain.	The current state of the site pose impact to flora and fauna during vegetation clearance (this can be minimal)	The impact could be site specific and in the local	Permanent.	Low.	It could be reversible or rehabilitated.	Cumulative.

No	Impact	Description		Assessment					
		Nature	*Probability*	*Status*	*Extent*	*Duration*	*Magnitude*	*Reversibility*	*Cumulative/ Non-cumulative*
	site should be protected as much as possible.	during the construction.			environment.				
10	**Storm water runoff:** Uncontrolled storm water runoff could create various problems such as soil erosion.	A wetland exist on the targeted site, poor storm water management could lead to the wetland accumulating	The probability of change is certain.	If storm water is not properly managed, during rainy season water could be stagnant or erode soil and that could also lead to	The impacts would be site specific and in the local environment.	Short term.	Low.	Not applicable.	Non-cumulative.

No	Impact	Description		Assessment					
		Nature	*Probability*	*Status*	*Extent*	*Duration*	*Magnitude*	*Reversibility*	*Cumulative/ Non-cumulative*
		the waste water.		the environment being unhygienic.					
11	**Storage of equipment and materials:** Equipment and materials if not stored in an appropriate	Materials and equipment storage should be done properly to eliminate	The probability of change is uncertain.	Equipment and materials if not stored in an appropriate manner could be	Impacts would be site specific and in the local	Short term.	Low.	If well managed it can be reversible	Non-cumulative.

No	Impact	Description		Assessment					
		Nature	*Probability*	*Status*	*Extent*	*Duration*	*Magnitude*	*Reversibility*	*Cumulative/ Non-cumulative*
	manner could be a source of pollution.	injuries and accidents.		sources of pollution.	environment.				
12	**Vehicle maintenance and refueling:** Spillages of hazardous liquids such as fuel, engine oil and other liquids used during vehicle	Looking at the magnitude of the project, a lot of mobile equipment are expected.	The probability of change is uncertain.	Oil/Hydrocarbons spillages would be a negative impact to the current environment.	Impacts would be site specific and in the regional environment. As a results of the highly	Short term.	Medium.	Could be reversible when construction is completed.	Could be cumulative. Soil characteristic could change and species and plant could be destroyed in the area.

No	Impact	Description		Assessment					
		Nature	*Probability*	*Status*	*Extent*	*Duration*	*Magnitude*	*Reversibility*	*Cumulative/ Non-cumulative*
	maintenance and equipment handling on the ground surface could result into contamination of soil, surface water and ground water.				soluble rock type of the area.				

No	Impact	Description		Assessment					
		Nature	*Probability*	*Status*	*Extent*	*Duration*	*Magnitude*	*Reversibility*	*Cumulative/ Non-cumulative*
13	**Vehicle and Equipment washing:** Spillages of washing detergents and wash water containing detergents and oils could impact the environment negatively.	The site is not contaminated by any spillage of washing detergents or oil.	The probability of change is uncertain.	An increase in washing detergents would have a negative impact. This has to be avoided.	Impacts would be site specific	Short term if well managed	High.	If appropriately managed it could be reversed.	Non-cumulative.

No	Impact	Description		Assessment					
		Nature	*Probability*	*Status*	*Extent*	*Duration*	*Magnitude*	*Reversibility*	*Cumulative/ Non-cumulative*
14	**Labour force:** Environmentally unfriendly actions and lack of good social behavior of the Labour force can create various problems (i.e. as crime, pollution.)	The targeted site is situated amongst residential, agricultural areas and accessed by near-by locals.	The probability of change is uncertain.	The current local communities is faced with high unemployment rate, the proposed project will create several jobs within community.	Impacts would be site specific and in the local community.	Permanent.	Not applicable.	Permanent.	Not applicable.

No	Impact	Description		Assessment					
		Nature	*Probability*	*Status*	*Extent*	*Duration*	*Magnitude*	*Reversibility*	*Cumulative/ Non-cumulative*
15	**Temporary Jobs:** It is important to use local labour where possible and comply with the public requirement for the proposed development.	A place/site where development is to be located, job seekers are always around the area for an employment.	The probability of change is uncertain	Unemployment is a negative effect in and around the local community. Not employing the local labours could impact the project negatively.	Impacts could be site specific and in the local community however could extend to national.	Permanent.	Not applicable.	Not applicable.	Not applicable.

No	Impact	Description		Assessment					
		Nature	*Probability*	*Status*	*Extent*	*Duration*	*Magnitude*	*Reversibility*	*Cumulative/ Non-cumulative*
16	**Security and Crime:** Security on the construction site needs to be maintained. Construction work and related activities are usually associated with an increase in	Vacant land at this stage of reporting	The probability of change is uncertain.	Vacant land at this stage of reporting	The impacts could be site specific and in the local community. However it could extend	Permanent.	Medium.	Low.	Non-cumulative

No	Impact	Description		Assessment					
		Nature	*Probability*	*Status*	*Extent*	*Duration*	*Magnitude*	*Reversibility*	*Cumulative/ Non-cumulative*
	criminal incidents in the area where development occurs.								
17	**Fire prevention and control:** The activities that take place in the contractor's	The site currently does not have any activities that may pose fire threats except	The probability of change is uncertain.	The presence of construction operation could pose fire hazards.	Impacts could be site specific and in the local	Short term.	Medium.	Low.	Cumulative.

No	Impact	Description		Assessment					
		Nature	*Probability*	*Status*	*Extent*	*Duration*	*Magnitude*	*Reversibility*	*Cumulative/ Non-cumulative*
	camp may pose a threat of the creation of fires. Therefore appropriate measures are to be taken.	out of natural course.			environment				
18	**Safety and access control:** Sufficient safety measures	Safety in areas of high unemployment rate is always a concern.	The probability of change is certain.	Safety is currently a big concern to the community members as they are affected by	Impacts would be site specific and in the local	Short term.	Medium.	Non reversible.	Non-cumulative But could cumulate if not managed.

No	Impact	Description		Assessment					
		Nature	*Probability*	*Status*	*Extent*	*Duration*	*Magnitude*	*Reversibility*	*Cumulative/ Non-cumulative*
	should be taken to avoid unnecessary accidents and/or injuries.			crime. The construction could be affected by criminal elements which would in turn increase crime statistics in the area.	environment.				
19	**Material handling:** Handling of materials such as fuels,	The site is currently without material such as fuels,	The probability of change is certain during construction period.	The hydrocarbon materials if not stored in an appropriate manner can be	Impacts would be site specific and also	Short term if not managed well.	Low, if well managed.	Reversible if well managed.	Non-cumulative.

No	Impact	Description		Assessment					
		Nature	*Probability*	*Status*	*Extent*	*Duration*	*Magnitude*	*Reversibility*	*Cumulative/ Non-cumulative*
	grease and oils must be supervised daily on a continuous basis.	grease storages.		sources of pollution.	extend to regional environment.				
20	**Survey points:** The surrounding environment must be taken into consideration	The site boundaries are given and need to be clearly pegged.	The probability of change is certain.	If boundaries are not clearly demarcated, construction activity can have impact on neighboring site.	Impacts would be site specific and in the local	Short term.	Low.	Reversible.	Non-cumulative.

No	Impact	Description		Assessment					
		Nature	*Probability*	*Status*	*Extent*	*Duration*	*Magnitude*	*Reversibility*	*Cumulative/ Non-cumulative*
	when survey operations are to be performed.				environment.				
21	**Construction camp**: The choice of site for the contractors' camp requires the Environmental Control Officer	Location of site camps is significant, To avoid unnecessary negative impacts	The probability of change is uncertain.	Construction camps are associated with environmental impacts, if not properly selected and managed.	Impacts would be site specific and in the local environment.	Medium term.	Medium.	Irreversible.	Non-cumulative.

No	Impact	Description		Assessment					
		Nature	*Probability*	*Status*	*Extent*	*Duration*	*Magnitude*	*Reversibility*	*Cumulative/ Non-cumulative*
	and Engineers permission, and must take into account location of local villagers and or ecological sensitive areas.								
22	**Workers conduct on site:** A general	The site is currently not used.	The probability of change is uncertain	Workers conduct could have a negative impact	Impacts would be site	The duration of the	Low.	Reversible.	Non-cumulative

No	Impact	Description		Assessment					
		Nature	*Probability*	*Status*	*Extent*	*Duration*	*Magnitude*	*Reversibility*	*Cumulative/ Non-cumulative*
	regard for the social and ecological well-being of the site and adjacent areas is expected of the site staff. The presence of construction employees in the area could impact negatively to the social life		depending on the workers behavior.	on the surrounding neighbors.	specific and in the local environment.	impact is project term related.			

No	Impact	Description		Assessment					
		Nature	*Probability*	*Status*	*Extent*	*Duration*	*Magnitude*	*Reversibility*	*Cumulative/ Non-cumulative*
	of the local community.								

Proposed mitigation and management

<table>
<tr><th>Mitigation</th><th>Impact and proposed mitigation

and management actions</th><th>Responsibility</th><th>Timeframe</th></tr>
<tr><td>Potential to mitigation negative impact</td><td rowspan="2">Description of mitigation measures. Extent to which mitigation measures could influence the significance and status of impact.

Where ever possible a description of the optimization measures. Extent to which they could influence the significance of impact.</td><td rowspan="2">The responsible person to ensure that the mitigation measures are taken</td><td rowspan="2">Implementation period for the mitigation</td></tr>
<tr><td>Potential to enhance positive impacts</td></tr>
<tr><td>Significant rating of impact after mitigation</td><td colspan="3">Low, i.e. natural and social functions and processes are not affected or minimally affected.</td></tr>
<tr><td></td><td colspan="3">Medium, i.e. affected environment is notably altered. Natural and social functions and processes continue albeit in a modified way.</td></tr>
<tr><td></td><td colspan="3">High, i.e. natural or social functions or processes could be substantially affected or altered to the extent that they could temporarily or permanently cease.</td></tr>
</table>

Comment on the overall assessment and conclusion.	Overall Assessment and concluding comments as to the predicted impacts after mitigation and their: ✓ Severity and permanence ✓ Size and relative significance ✓ Ecological and socio – economic context ✓ Balance between positive and negative aspect ✓ Cost and benefits ✓ Acceptability / Unacceptability

Proposed mitigation and management

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
1.	Noise	✓ Construction and other noise generating activities should be restricted to between 06h00 and 18h00 Monday to Friday, unless otherwise approved by the appropriate competent person in	Not applicable	Contractor	During construction	Low	If construction vehicles are serviced and properly maintained the level of noise should be less.

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		consultation with adjacent landowners/affected persons and ECO. ✓ During the operational phase all activities must take place in a manner that will allow as little noise as possible.					

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		✓ Activities, which are deemed to generate high levels of noise, will be restricted to normal working hours.					
2.	Dust	✓ The liberation of dust into the surrounding environment shall be effectively controlled	Not applicable	Contractor	During construction	Low	The level of dust should be reduced to minimal as the result of water spraying during working hours and pilling of soil should be avoided where ever possible.

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		by the use of, water spraying. ✓ The speed of haul trucks and other vehicles must be strictly being controlled to avoid dangerous conditions, excessive dust or deterioration of the road being used.					

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		✓ Site clearance to be done only as needed in phases.					
3.	Soil erosion	✓ Submission of an operational plan for the construction phase indicating technical and management measures to prevent soil erosion.	Not application	Contractor	During construction phase	Low	The design lay out plan should address all issues relating to storm water management and soil erosion. This could be a complete mitigation of this soil erosion.

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		✓ Stock piled topsoil should not be compacted and should be replaced as final soil layer. ✓ Soil should be exposed for the minimum time possible once cleared of vegetation, i.e. the timing of clearing and					

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		grubbing should be co-ordinate as much as possible to avoid prolonged exposure of soils to wind and water erosion. ✓ The A-horizon will be removed and used for rehabilitation purposes. The lower soil horizons will be					

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		used for construction activities. The A-horizon will be stockpiled in a responsible manner and replaced during rehabilitation.					
4.	Waste generation and disposal	✓ A waste management plan to be developed for the construction site.	Not application	Contractor	During construction	Low	Waste removal should be done regularly and that could make the environment free from any hazards.

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		✓ Plan to ensure that all waste is contained in suitable containers to prevent waste being washed into water bodies. ✓ Containers for waste to ensure that any fluids generated by waste are trapped					This could completely mitigate this impact.

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		and can be disposed of in a suitable.					
5.	Mixing of concrete	✓ Where concrete has been mixed, especially in the natural environment, all residues must be removed and disposed of in an environmentally	Not applicable	Contractor	During construction	Low	Unused cement should not be left to dry on the ground. If proper housekeeping rules are complied with, most impacts should not affect the environment.

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		responsible manner approved by the ECO.					
6.	Sewage disposal	✓ The contractor to install adequate portable chemical toilets to meet the sanitation needs on the construction site (14 people per toilet).	Not applicable	contractor	During construction and maintenance	Low or completely mitigated	Ablution facility should be made available during construction phase for the employee to able to use this facility. All type of waste should be classified and disposed in an appropriate registered waste disposal site.

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
7.	Hazardous substances	✓ Hazardous materials to be stored correctly, marked, labelled, without the risk of contamination and hazardous waste to be disposed of correctly with the	Non-applicable	Contractor in co-operation with the ECO	During construction	Low	Employees dealing with hazardous substances should be trained and be competent to do so. This could completely mitigate reduce the risk posed by this impact.

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		necessary certificates issued. ✓ All oils, hydraulic fluids and other hazardous materials will be stored in suitable containers in a structure or facility designated for this purpose.					

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		✓ Material Safety Data Sheets (MSDSs) shall be readily available on site for all chemicals and hazardous substances to be used on site. ✓ Storage areas containing hazardous substances must be					

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		clearly signed and the designated person contact and names should be displayed. ✓ Residents living adjacent to the construction site must be notified of the existence of the hazardous storage area.					

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		✓ Staff dealing with these materials/substances must be aware of their potential impacts and follow the appropriate safety measures.					
8.	Endemic flora and fauna	✓ No endemic flora and fauna species will be deliberately destroyed or permanent	Not applicable	Contractor and ECO	During construction	Low	Identified indigenous plants and species existing in the area will be protected by all means.

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		alienated from their natural habitat during construction. ✓ Excavations left open during construction should be checked periodically such that animals falling in can be safely removed and released away from construction					

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		activities. All excavations should be filled as soon as possible. ✓ Construction staff should be advised not to chase, kill or catch animals found or encountered during construction.					

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		✓ Only vegetation falling in directly in demarcated in operational area should be removed where necessary. ✓ No exotic/invasive plants are to be planted on common ground of the site.					

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		✓ No vegetation will be removed without prior permission from ECO.					
9.	Storm water runoff	✓ To prevent storm water damage, the increase in storm water run-off resulting from construction activities must be estimated and the drainage systems	Not applicable	contractor	During construction	Low	This should be able to address soil erosion as well as the design of the site should have appropriate storm water management as well as drainage system that should have oil trap/ filters if necessary.

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		assessed accordingly. ✓ A drainage plan must be submitted to the Engineer for approval and must include the location and design criteria of any temporary stream crossing.					

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		✓ All storm water runoff from compacted materials must be monitored if signs of erosion become apparent.					
10.	Storage of equipment and	✓ Choice of location for storage areas must take into account prevailing winds, exposure	Not applicable	Contractor	Throughout the lifecycle of a project	Low	If employees on site shall practice good housekeeping behavior, the work condition will be free of injuries and everything would be in its place

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
	materials	sun, distance to water bodies and general onsite topology. ✓ All equipment and materials must be stored in a designated area in an appropriate manner as to prevent pollution.					and there will be space for everything.

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		✓ Storage areas must be designated, demarcated and fenced as effective as possible. ✓ Fire prevention facilities must be present and accessible at all times.					

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
11.	Vehicle maintenance and refueling	✓ Vehicle maintenance and equipment handling to be carried out in areas especially equipped for this purpose in order to prevent spillage and contamination. ✓ All oil changes, lubrication and maintenance will take	Not applicable	Contractor	During construction	Low	The impact should be completely mitigated or reduced form posing danger to the environment.

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		place only at the designated areas. ✓ Refueling of vehicles will and must take place at the designated refueling area. This area will have a sufficiently impermeable surface to prevent seepage into ground water.					

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		The refueling area will be bounded to prevent any surface water from running over this area.					
12.	Vehicle and equipment washing	✓ Washing of vehicles and equipment should be done in one place and if ever spillages of detergents occur then cleaning up	Not applicable	Site workers	During construction	Low or completely mitigated	If the washing of vehicles and equipment is done in an appropriate manner and detergents are always sealed then the negative impact would be low or no more.

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		should be considered immediately					
13.	Labour force	✓ Laborers to be restricted to construction area. ✓ Access to the site should be restricted to employees of the contractor. ✓ Temporary ablution facilities to be	If local labour is used, the local community will benefit.	Contractor to identify suitable areas for the said facilities. Contractor to maintain the above facilities.	During construction	Not applicable	Skills and knowledge should be gained by these employees who assist in building local communities.

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		provided at appropriate sites (one toilet for 14 laborers). ✓ Such ablution facilities to be kept away from natural water bodies. ✓ Cooking facilities to be provided in demarcated areas.					

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		✓ All informal traders to be discouraged. ✓ All labor will undergo basic induction, where safety, health and environmentally issues will be discussed. ✓ Construction staff should be educated, prior to					

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		commencement of construction, as to the need to refrain from destruction or killing of animals and plants, as well as from indiscriminate defecation, waste disposal and / or pollution of local soil and water sources.					

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		✓ The contractor should ensure proper supervision of employees at all times.					
14.	Temporary jobs	✓ Local labor and contractors must be used wherever possible. Basic skills development and	Not applicable	Contractor	During construction	Low	Local laborers should be given priorities.

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		capacity development must be incorporated with this. It will be a specific condition in the contractors' agreements that local labor be used wherever possible. All reasonable attempts will be made to appoint people from the local communities					

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		as temporary laborers for non- specialize tasks and they will be subject to the necessary basic skills training.					
15.	Security and crime	✓ Members of the community should be hired to patrol the premises during	Safety on site will be enhanced	Contractor	During construction and maintenance	Low	Crime could be reduced or completely eradicated by the improvement of security system.

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		construction and maintenance. ✓ The access of unauthorized individuals must be minimized.					
16.	Fire prevention and control	✓ Contractor must make sure that there is supervision for all fires that are used in	Not applicable	Contractor	During construction	Low	Every public structure has to have fire prevention measures in place the presence of this facility is a necessity.

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		the construction camp. ✓ Smoking should be prohibited in the vicinity of flammable substances. ✓ The contractor should ensure that fire-fighting equipment is available on site, in particular where					

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		flammable substances are stored. ✓ Fires started for comfort(warmth) should be discouraged by the contractor, due to the risk of vegetation fires and risk to adjacent property					

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		✓ Fire-fighting equipment and emergency plans must be in place prior to the construction phase. ✓ The contractor will plan and implement a fire prevention programs and develop a					

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		contingency plan in the event of any fire. ✓ No refuse or waste may be burn. ✓ The contractor will be responsible for all damages caused by the outbreak of a fire originating from a site where work is undertaken. Damage					

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		to adjacent properties will be to his account. ✓ The contractor is to provide cooking areas where fire risks will be minimized and controllable.					
17.	Safety and access control	✓ Safety equipment must be provided to all employees to prevent personal	Safety on site will be enhanced	Contractor	During construction	Low	Safety and Access control will be management according to the requirement.

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		injury during construction activities. This includes equipment such as protective eye and ear wear and protective clothing where necessary. ✓ Staff should be appropriately trained					

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		in all assigned activities. ✓ Access to dangerous excavations and materials, must be controlled by the site manager. ✓ All personnel and vehicles used for transportation and/or construction purposes					

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		should remain within these demarcated areas. ✓ Excavations should only remain open of a minimum period of time and during this time the must be clearly demarcated so as to prevent					

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		accidental ingress of people and animals.					
18.	Material handling	✓ Re-fueling and maintenance of vehicles must take place off site. ✓ No oils, chemicals or other hazardous materials used during construction are to be stored on site.	Not applicable	Contractor and site workers	During construction	Not applicable	If employees will be properly trained to handle material this could avoid any incidents from occurring.

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
19.	Survey points	✓ Roads or trails that are cut to provide temporary access for survey work must be minimized. ✓ Vegetation clearing must be kept to a minimum during survey operations.	Not applicable	Contractor	During construction	Low	Construction will only take place on the proposed or demarcated area.

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
20.	Construction camp	✓ The choice of the site for the contractors' camp requires the Engineers permission and must take into account location of villagers and or ecological sensitive areas, including flood zones and unstable zones.	Not applicable	Contractor and engineers	During construction	Low	The site will be accessible and pose less impact on the environment if chosen in a correct place. The engineers should be responsible to ensure that the chosen place has less or no environmental impact.

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		✓ The size of the construction camp should be kept to a minimum. ✓ The contractor must attend to the drainage of the camp to avoid standing water and or sheet erosion.					

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
21.	Workers conduct on site	✓ A general regard for the social and ecological well-being of the site and adjacent areas is expected of the site staff. ✓ Workers need to be aware of the following general rules:	Not applicable	Contractor	During construction	Not applicable	Workers will be provided sufficient SHERQ awareness training.

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		✓ No alcohol / drugs to be present on site. ✓ No firearms are allowed on site or in vehicles transporting staff to or from the site (Unless used by the security personnel). ✓ Prevent excessive noise.					

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
		✓ No harvesting of firewood from the site or from the areas adjacent to it. ✓ Other than per-approved security staff, no workers shall be permitted to live on site.					

Operation and maintenance phase

The table below indicates the identified impacts and mitigation measures that could occur during operational and maintenance phases.

No.	Impact	Responsible person	Timeframe
1.	Storm water management: ✓ It is recommended that proper storm water drainage system be ensured during operation and maintenance phase. ✓ Storm water should not be allowed to discharge onto bare soil but must be diverted to the surrounding grasslands or to the landscaped gardens during the operational phase.	Operator	During operation and maintenance
2.	Clean-up action: ✓ In the event of incident or leakage of hazardous waste from storage site, a professional company to be appointed to remove and cleanup the waste as quickly as possible.	Operator and contractor	During both construction, operation and maintenance phases
3.	Waste generation and disposal: ✓ Solid waste generated during operation and maintenance phase must be removed in a continuous and efficient manner to the satisfaction of the local municipality.	Operator and contractor	During construction, operation and maintenance

No.	Impact	Responsible person	Timeframe
	✓ A waste management plan to be developed and maintained for the construction site. ✓ No solid waste should be dumped on the site. ✓ All domestic waste generated on the site should be disposed of in a proper manner off site i.e. no burial on site.		
4.	Maintaining environmental complaint register: ✓ The environmental complaint register must be maintained during the operation and maintenance phase.	Operator	Operation and maintenance
5.	Maintenance of access roads: ✓ Access/ alternate roads to be maintained with an acceptable free of erosion, and no surface water ponding.	Operator	Operation and maintenance
6.	Traffic: ✓ Any traffic disruptions due to the movement of heavy machinery should be undertaken with the approval of all relevant authorities and in accordance with all relevant legislation.	Local municipality	

APPENDIX G: ENVIRONMENTAL MANAGEMENT PROGRAMME (EMPR)

ENVIRONMENTAL MANAGEMENT PROGRAMME (EMPR)

FOR THE PROPOSED TOWNSHIP ESTABLISHMENT ON PORTION OF FARM KLIPFONTEIN 716 AND FARM CERES 626 WITHIN THE MANGAUNG METROPOLITAN MUNICIPALITY

NOVEMBER 2019

Prepared For:

Department of Economic Small Business Development, Tourism and Environment Affairs (DESTEA).

Prepared By:

Inaluk Consulting Services

Report Tittle : Draft Environmental Management Programme for the Proposed Mangaung Township

Place and Date : Pretoria November 2019

PROPONENT

Proponent:	Mangaung Metropolitan Municipality
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ENVIRONMENTAL ASSESSMENT PRACTITIONER

Consultant:	Inaluk Consulting Services
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DECLARATION OF INDEPENDENCE
I, Kulani Nkuna as authorised representative of Inaluk Consulting Services hereby confirm my independence as an Environmental Assessment Practitioner and declare that neither I nor Inaluk Consulting Services have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which Inaluk Consulting Services was appointed as Environmental Assessment Practitioner in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), other than fair remuneration for worked performed, specifically in connection with the Environmental Authorisation process for the Ladysmith Township extension 61.

Signature……. Date…….

Contents

List of Tables

1. EXECUTIVE SUMMARY

Mangaung Metropolitan Municipality appointed Ngoti Development Consultants for town planning services for the proposed township establishment. Inaluk Consulting Service was appointed by Mangaung Metropolitan Municipality as an Independent Environmental Assessment Practitioner (EAP), to compile an Environmental Management Programme Report (EMPr) for the proposed Township (mixed-use) development within the Mangaung Metropolitan Municipality in the Free State Province.

Based on chapter 2, section 24 of the Constitution of the Republic of South Africa "everyone a right to an environment which is not harmful to their health or wellbeing and to have their environment protected for the benefit of present and the future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation, promote conservation and the sustainable use of natural resources while promoting justifiable economic and social development". The purpose of this EMPr is to serve as a framework that can be used in order to ensure that negative environmental impacts are dealt with in a safe and professional manner throughout the lifecycle of the project's construction phase. This could only be done by applying relevant environmental Acts and Regulations. This EMPr must be considered throughout the lifecycle of the proposed development's construction activities and mitigation and management measures outlined in this document must be applied accordingly.

2. INTRODUCTION

This EMPr describes the methodology for the management, monitoring and rehabilitation of potential negative impacts and maximization of positive impacts of the township development. The Contractor/developer, Environmental Control Officer (ECO), the site Manager and any person who will be taking part in the activities of the proposed development must use the EMPr as a guideline in order to avoid, minimise and manage adverse environmental impacts and effects associated with the development.

The EMPr provides specifications and regulations that must in all instances be adhered to. It is the responsibility of everyone who is involved in this project to have a commitment at all costs with the implementation of the EMPr. The main contractor shall receive a copy of the EMPr from the proponent and the engineer on which he will be given the opportunity to clear any misconceptions and uncertainties. The EMPr should form part of the contract and will therefore be a legally binding document for the development of the township. In the event of any discrepancies with regard to environmental matters or environmental specifications this document shall take precedence.

The primary objectives of the EMPr are as follows:

•To indicate responsibilities, schedules and staff resources regarding the implementation of this document

•To describe action plans for achieving the mitigation measures

•To describe a monitoring programme, this enables the review of the EMPr success and the provision of such information to the relevant decision-makers.

3. OBJECTIVES OF EMPR

A set of environmental management measures for implementation during the construction phase of the project has been prepared to meet the following overall environmental management objectives:

•Minimize disturbance to indigenous plant species;

•Prevent and or reduce possible soil erosion;

•Minimizing disturbances to the local community (social impacts);

•Reducing negative visual aspects during the construction phase; and to

•Prevent and or minimize air and noise pollution; and to

•To avoid loss or damage to archaeological resources (should they be uncovered during construction).

4. LEGAL REQUIREMENT

This EMPr has been developed to serve as an environmental guiding tool during construction activities. The contractor must take note that conditions as stated in this EMPr are legally binding in terms of the environmental statutory legislation. A hard copy of the EMPr must be kept on site during construction. Two hard copies will be kept at the Local Community Councils when the development is occupied, operational and in the maintenance phase.

National Fire Protection Association (NFPA) standards
International Standards Organization (ISO) 9000/2000 Quality Systems
South African standards, codes and regulations, which include:
Occupational Health and Safety Act (OHASA) Act 85 of 1993

South African National Standard (SANS) 10089 (pertaining to the building industry)
National Environmental Management Act, Act 107 of 1998
Environmental Conservation Act, 1989 (Act No 73 of 1989) (ECA)
National Water Act, 1998 (Act No.36 of 1998)
Constitution of South Africa 1996 (Act No. 108 of 1996)
National Heritage Resources Act 1999 (Act No 25 of 1999)
Protected species – provincial ordinances
Conservation of Agricultural Resources Act (Act No 103 of 1997)
National Environmental Management: Biodiversity Act (Act No. 10 of 2004)
National Environmental Management: Air Quality Act (Act No. 39 of 2004)
Atmospheric Pollution Prevention Act (Act No. 45 of 1965)
Hazardous Substances Act, 1973 (Act No. 15 of 1973).

The most important legislative Act is the National Environmental Management Act (Act No. 107 of 1998). NEMA is an overarching environmental legislation and it provides a framework for environmental law reform and covers the following:

•Land, planning and development

•Natural and cultural resources, use and conservation

•Pollution control and waste management.

Based on section 28 (1) of the National Environmental Management Act (Act No. 107 of 1998):

“Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorized by law or cannot reasonably be avoided

or stopped, to minimize and rectify such pollution or degradation of the environment''

5. SITE DESCRIPRTION AND LOCATION

The proposed mixed-use development falls under the Mangaung Metropolitan Municipality, Free State Province.

The proposed development footprint is located across the road from an already established township area (near Kopanong) and approximately 193 ha in surface size, situated within the Mangaung Metropolitan Municipality, Free State Province. The site is situated partly adjacent to Dewetsdorp Road and the M30, approximately 17 km outside Bloemfontein central with the following coordinates: 29° 12' 55.95" S and 26° 15' 51.58" E. The proposed footprint is situated on a Portion of the Farm Klipfontein 716 and Farm Ceres 626.

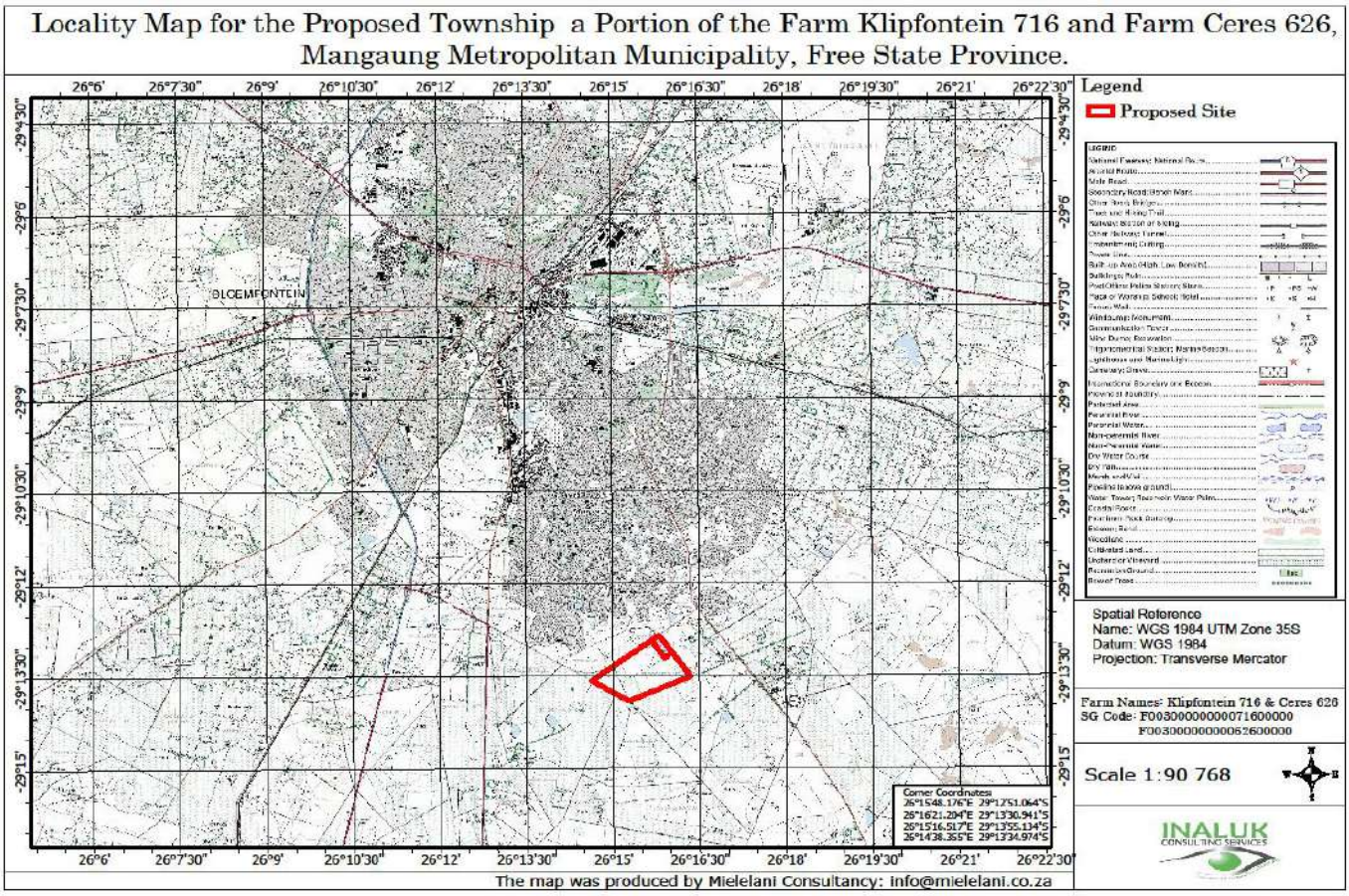

Figure 1: Locality Map

6. DESCRIPTION OF RECEIVING ENVIRONMENT

6.1. Vegetation:

The study area and project site is situated within the Grassland Biome and Dry Highveld Grassland bioregion. The proposed project area forms part of the (Gh5) Bloemfontein Dry Grassland vegetation type (Mucina & Rutherford, 2006).

The proposed footprint forms part of an area classified by the Critical Biodiversity Area map of the Free State Province as partly 'Degraded' and partly 'Other natural areas'. The vegetation present on site is not typically representative of the Bloemfontein Dry Grassland vegetation type, although some areas (small parts) appears to show signs of the natural vegetation type representation. The vegetation as found on site are dominated by grasses while indigenous, non-indigenous and alien invasive species occur in the proposed footprint.

Table 1: Conservation status of the vegetation type occurring in and around the study area

Vegetation Type	Target (%)	Conserved (%)	Transformed (%)	Conservation Status
				Driver et al., 2005; Mucina & Rutherford, 2006
Bloemfontein Dry Grassland	24%	Small portion	40%	Endangered

6.2. Climate:

The project area normally receives about 450mm of rain per year, with most rainfall occurring mainly during summer. It receives the lowest rainfall in July and the highest in March. The mean annual temperature (MAT) of the region is approximately 15.7° C. The region is the coldest during July with high incidence of frost in the winter.

6.3. Topography and Drainage:

The proposed site for the township is located in quaternary catchment C52F. The general flow of water on site will be in a north eastern direction, when evaluating the positions of the dam walls and site topography. The topography found at the proposed construction area is relatively flat. As this is a large area, slopes occur towards various directions, however, the overall slope tends towards the north eastern direction.

7. ENVIRONMENTAL MITIGATION AND MANAGEMENT MEASURES

These guidelines will form the basis for environmental mitigation and management on site. The appointed Environmental Control Officer (ECO) will ensure that any modifications are communicated, explained to and discussed with all the

Interested and Affected Parties (i.e. the authorities, contractor, the proponent and any directly affected party who requests this information).

- Mitigation of the potential impact in regard to the
  - Potential to mitigate any negative impacts
  - Potential to optimize any positive impacts
  - The likelihood of successful mitigation

- Overall assessment and general comments as to the predicted impacts of the development after mitigation in terms of such criteria as may be relevant to a particular impact, and which may include the following aspects :

  - The severity and permanence of the impact on either local biota or surrounding human communities
  - The size of the affected communities and their relative significance
  - The general ecological and socio – economic context within which a particular impact would occur
  - The final balance of between positive and negative impacts, and related costs and benefits to society.

Pre-construction and construction phases

Establishment of environmental governing bodies

- **Establishment of Environmental Monitoring Committee (EMC)**

An Environmental Monitoring Committee needs to be established with representatives of I&APs, relevant authorities and the holder of an Environmental Authorization. The role of this EMC is to monitor the environmental compliance during all phases of the project and satisfy as far as possible the issues and concerns of all parties involved in or affected by the project.

- **Appointment of Environmental Control Officer (ECO)**

An Environmental Control Officer will fulfil the responsibility of assuring that environmental performance is achieved by the developer and its contractors during all phases of the project. It is the responsibility of the ECO to audit compliance with the commitments set out in this EMP, and assist with the implementation of mitigation measures. The contractor and / the clients representative (ECO) will inspect all the construction activities on a monthly basis. All issues highlighted in this Environmental Management Plan will be investigated and compliance with the mitigation measures audited. Preceding complaints, concerns or incidents reported in the logbook will also be monitored.

Feedback of the findings, changes to this document as well as all reported incidents will be reported at the monthly progress meetings between the Consulting Engineer, Contractor and Client Representative. A summary of these reports will also be forwarded to the Free State Department of Economic Small Business Development, Tourism and Environment Affairs (DESTEA), and the measures to rectify the issue stated. Any previous findings must be audited to confirm the successful implementation thereof. At the end of the project a summary document will be prepared and presented to the Department of Economic Small Business Development, Tourism and Environment Affairs (DESTEA).

Establishment of complaints register

A complaints register is to be established and kept onsite to address complaints in a timorous fashion, which will be reported to the EMC.

Responsibilities and timeframes for the pre-construction phase

Number	Establishment of Environmental Governing Bodies	Responsibility	Timeframe
1.	**Establishment of Environmental Monitoring Committee (EMC):**	Environmental consultant(s)/specialist(s)	During the lifetime of the project (from pre-construction through

	Establish an Environmental Monitoring Committee with I&APs' representatives. Formal agreement regarding the frequency of meetings and agenda must be reached.		operation and maintenance phases).
2.	**Appointment of Environmental Control Officer (ECO):** Developer to appoint the ECO for the project.	Developer	Pre-construction, construction and operation and maintenance phases.
3.	**Establishment of a complaints register:** Environmental complaint register to be maintained: ✓ All complaints with regards to environmental non-compliance on the construction site need to be recorded and addressed accordingly. ✓ Establish an Environmental complaints register. ✓ Address complaints timorously and report back to EMC meetings. ✓ Open liaison channels should be identified and developed to ensure that all queries, complaints from affected individuals/ parties may be addressed with the shortest possible delay.	Site engineer and contracts managers will be responsible for maintaining the register and report any complaints received to the ECO	During construction, operation and maintenance phases

Assessment Approach to environmental issues during the construction phase

The assessment and description of identified environmental issues were conducted according to the structure and approach detailed below. The following is a brief description of how these impacts were identified and rated. The approach

may be tailored and altered where required to deal adequately with the description and assessment of a specific impact.

A description of the nature of the potential issues as to its:

- General background and context within this application
- Causes and effect
- Who or what will be affected
- How it will be affected

Assessment of the impact as to:

- Probability
- Duration
- Extent
- Reversibility
- Magnitude

The table below shows how each impact was assessed and is an elaboration of the approach used in identifying rate these impacts.

Potential issue	**Criteria**	**Description of elements that are central to each issue**
Description	Nature	What causes the effect?
		Who will be affected?
		What will be affected?
		How will it be affected?
	Probability	Certain / may not occur with mitigation.
	Status	Positive (beneficial impact); negative (deleterious or adverse impact); or neutral (impacts is either beneficial or diverse).
Assessment	Extent	Is the impact site specific?

		Does the impact extend locally, i.e. to the site and its nearby surroundings?
		Does the impact extend regionally, i.e. have an impact on the region.
		Does the impact extend nationally, i.e. have an impact on a national scale.
	Duration	Short term, i.e. 0-5 years.
		Medium term i.e. 5-11 years.
		Long term, i.e. impact ceases after the construction or operational life cycle.
		Permanent, i.e. mitigation either by natural process or by human intervention will not occur in such a way or in such a time span that the impact can be considered transient.
	Magnitude	Low, i.e. natural and social functions and processes are not affected or minimally affected.
		Medium, i.e. affected environment is notably altered. Natural and social functions and processes continue albeit in a modified way.
		High, i.e. natural or social functions or processes could be substantially affected or altered to the extent that they could temporarily or permanently cease.
	Reversibility	Impact is reversible or irreversible.
	Cumulative or non-cumulative	Potential of two or more impacts to combine to form cumulative or synergistic impacts.

Identified Impacts for the construction of the township development

No.	Impact	Description		Assessment					
		Nature	***Probability***	***Status***	***Extent***	***Duration***	***Magnitude***	***Reversibility***	***Cumulative/ Non-cumulative***
1	**Noise**: It is expected that the construction activities will cause noise pollution in the area during working hours.	The current site is a vegetation land surrounded by residential area and the noise is expected to be not higher than the allowable ambient noise limit.	The probability of change is certain with regard to the potential sources of noise pollution during construction phase.	An increase in noise pollution would be a negative impact to the surrounding environment.	The impact would be site specific and in the local environment.	During construction phase due to construction vehicles and machinery.	Medium.	Reversible, after completion of the construction the noise level will return to the initial state.	Cumulative, an increase in noise due to construction activity or vehicles.
2	**Dust:** The creation of dust would be evident in the	The current site is vacant and open space. Dust pollution at site is at	During construction period the dust level could rise as a result of heavy construction	An increase in dust would be a negative impact to the surrounding environment.	The impact would be site specific and in the local	The impact would only result during the	Medium.	Reversible, after completion of the construction the dust level will be	Non-cumulative

	area during construction	moderate level. Increase of dust level during construction phase could have an impact to the air quality.	vehicles movement and the construction itself.		environment.	construction phase		lower than the initial state.	
3	**Soil erosion**: The construction activities for the development of the township have the potential to create soil erosion.	The current environmental site is an open space evidenced with grazing of cattle and donkeys.	The probability of change is uncertain during construction phase.	The current site infrastructure designs does cater for the Storm Water Management. If it is not addressed in the proposed development it could increase the impact.	The impact would be site specific.	Might occur only during construction phase. Short term.	Medium. The surrounding might be negatively affected.	Reversible, when the construction is completed, the storm water management in the area is improved, intern soil erosion issue could be addressed.	Non-cumulative. If the proposed development design addresses the storm water management issue.

4	**Waste disposal:** Uncontrolled and random disposal of waste has a negative effect on the health status of the local environment.	The existing current site is affected by poor waste disposal on some parts of the proposed site.	The probability of change is uncertain.	An increase in waste and improper disposal might result in an encouragement of illegal dumping site establishment that could later pose serious environmental health hazard to the environment.	Impact would be site specific and in the local environment.	Only during construction phase. Short term.	Medium.	If well managed, it can be reversed or even avoided.	Non-cumulative.
5	**Mixing of concrete:** Concrete residue when left to harden can create areas which can be difficult to remove or rehabilitate.	The current site is free from concrete slabs, proper measures need to be implemented to avoid adverse impacts.	The probability of change is uncertain which may rise as a result of dry concrete mixture left during construction.	If concrete mixing is not well managed and left to dry it may result into concrete slab formation or negatively impact to the surrounding.	Impact would be site specific and in the local environment.	This might permanently affect the soil.	Medium. The soil character might be changed.	Reversible.	Non-cumulative.

6	**Waste generation and disposal:** Waste generation and inappropriate disposal could lead to wide array of environmental problems i.e. soil, surface contamination…	The current state of the site is affected by illegal waste disposal.	The probability of change is uncertain.	Generated waste and disposal method could be sources of pollution.	Impacts could be site specific and in the local environment.	If waste management plans are not in place this could be a long term effect.	High.	If well managed, it can be reversible.	Cumulative.
7	**Hazardous waste:** Various hazardous materials, construction waste and by-products as thinners and oils used during	The current state of the site is free from toxic chemicals.	The probability of change is uncertain depending on the management.	Hazardous substances if not managed or used in an appropriate manner can be sources of pollution.	Impacts would be site specific and could extend to regional environment.	Short term if early managed.	High.	If well managed can be reversible.	Cumulative

	construction could become sources of pollution if not disposed of in an appropriate manner.								
9	**Endemic flora and fauna:** Endemic flora and fauna in and around the construction site should be protected as much as possible.	The site is an undisturbed land, disturbance to the vegetation is expected during the construction.	The probability of change is certain.	The current state of the site pose impact to flora and fauna during vegetation clearance (this can be minimal)	The impact could be site specific and in the local environment.	Permanent.	Low.	It could be reversible or rehabilitated.	Cumulative.

10	**Storm water runoff:** Uncontrolled storm water runoff could create various problems such as soil erosion.	A wetland exist on the targeted site, poor storm water management could lead to the wetland accumulating the waste water.	The probability of change is certain.	If storm water is not properly managed, during rainy season water could be stagnant or erode soil and that could also lead to the environment being unhygienic.	The impacts would be site specific and in the local environment.	Short term.	Low.	Not applicable.	Non-cumulative.
11	**Storage of equipment and materials:** Equipment and materials if not stored in an appropriate manner could be a source of pollution.	Materials and equipment storage should be done properly to eliminate injuries and accidents.	The probability of change is uncertain.	Equipment and materials if not stored in an appropriate manner could be sources of pollution.	Impacts would be site specific and in the local environment.	Short term.	Low.	If well managed it can be reversible	Non-cumulative.

12	**Vehicle maintenance and refueling:** Spillages of hazardous liquids such as fuel, engine oil and other liquids used during vehicle maintenance and equipment handling on the ground surface could result into contamination of soil, surface water and ground water.	Looking at the magnitude of the project, a lot of mobile equipment are expected.	The probability of change is uncertain.	Oil/Hydrocarbons spillages would be a negative impact to the current environment.	Impacts would be site specific and in the regional environment. As a results of the highly soluble rock type of the area.	Short term.	Medium.	Could be reversible when construction is completed.	Could be cumulative. Soil characteristic could change and species and plant could be destroyed in the area.
13	**Vehicle and Equipment washing:** Spillages of	The site is not contaminated by any spillage of	The probability of change is uncertain.	An increase in washing detergents would have a negative impact.	Impacts would be site specific	Short term if well managed	High.	If appropriately managed it could be reversed.	Non-cumulative.

	washing detergents and wash water containing detergents and oils could impact the environment negatively.	washing detergents or oil.		This has to be avoided.					
14	**Labour force:** Environmentally unfriendly actions and lack of good social behavior of the Labour force can create various problems (i.e. as crime, pollution.)	The targeted site is situated amongst residential, agricultural areas and accessed by near-by locals.	The probability of change is uncertain.	The current local communities is faced with high unemployment rate, the proposed project will create several jobs within community.	Impacts would be site specific and in the local community.	Permanent.	Not applicable.	Permanent.	Not applicable.

15	**Temporary Jobs:** It is important to use local labour where possible and comply with the public requirement for the proposed development.	A place/site where development is to be located, job seekers are always around the area for an employment.	The probability of change is uncertain	Unemployment is a negative effect in and around the local community. Not employing the local labours could impact the project negatively.	Impacts could be site specific and in the local community however could extend to national.	Permanent.	Not applicable.	Not applicable.	Not applicable.
16	**Security and Crime:** Security on the construction site needs to be maintained. Construction work and related activities are usually associated with an increase in criminal incidents in the	Vacant land at this stage of reporting	The probability of change is uncertain.	Vacant land at this stage of reporting	The impacts could be site specific and in the local community. However it could extend	Permanent.	Medium.	Low.	Non-cumulative

	area where development occurs.								
17	**Fire prevention and control:** The activities that take place in the contractor's camp may pose a threat of the creation of fires. Therefore appropriate measures are to be taken.	The site currently does not have any activities that may pose fire threats except out of natural course.	The probability of change is uncertain.	The presence of construction operation could pose fire hazards.	Impacts could be site specific and in the local environmen t	Short term.	Medium.	Low.	Cumulative.
18	**Safety and access control:** Sufficient safety measures should be taken to avoid	Safety in areas of high unemployment rate is always a concern.	The probability of change is certain.	Safety is currently a big concern to the community members as they are affected by crime. The	Impacts would be site specific and in the local	Short term.	Medium.	Non reversible.	Non-cumulative But could cumulate if not managed.

	unnecessary accidents and/or injuries.			construction could be affected by criminal elements which would in turn increase crime statistics in the area.	environment.				
19	**Material handling:** Handling of materials such as fuels, grease and oils must be supervised daily on a continuous basis.	The site is currently without material such as fuels, grease storages.	The probability of change is certain during construction period.	The hydrocarbon materials if not stored in an appropriate manner can be sources of pollution.	Impacts would be site specific and also extend to regional environment.	Short term if not managed well.	Low, if well managed.	Reversible if well managed.	Non-cumulative.
20	**Survey points:** The surrounding environment must be taken into consideration	The site boundaries are given and need to be clearly pegged.	The probability of change is certain.	If boundaries are not clearly demarcated, construction activity can have	Impacts would be site specific and in the local	Short term.	Low.	Reversible.	Non-cumulative.

	when survey operations are to be performed.			impact on neighboring site.	environment.				
21	**Construction camp**: The choice of site for the contractors' camp requires the Environmental Control Officer and Engineers permission, and must take into account location of local villagers and or ecological sensitive areas.	Location of site camps is significant, To avoid unnecessary negative impacts	The probability of change is uncertain.	Construction camps are associated with environmental impacts, if not properly selected and managed.	Impacts would be site specific and in the local environment.	Medium term.	Medium.	Irreversible.	Non-cumulative.

22	**Workers conduct on site:** A general regard for the social and ecological well-being of the site and adjacent areas is expected of the site staff. The presence of construction employees in the area could impact negatively to the social life of the local community.	The site is currently not used.	The probability of change is uncertain depending on the workers behavior.	Workers conduct could have a negative impact on the surrounding neighbors.	Impacts would be site specific and in the local environment.	The duration of the impact is project term related.	Low.	Reversible.	Non-cumulative

Proposed mitigation and management

<table>
<tr><th>Mitigation</th><th>Impact and proposed mitigation and management actions</th><th>Responsibility</th><th>Timeframe</th></tr>
<tr><td>Potential to mitigation negative impact</td><td rowspan="2">Description of mitigation measures. Extent to which mitigation measures could influence the significance and status of impact.

Where ever possible a description of the optimization measures. Extent to which they could influence the significance of impact.</td><td rowspan="2">The responsible person to ensure that the mitigation measures are taken</td><td rowspan="2">Implementation period for the mitigation</td></tr>
<tr><td>Potential to enhance positive impacts</td></tr>
<tr><td rowspan="3">Significant rating of impact after mitigation</td><td colspan="3">Low, i.e. natural and social functions and processes are not affected or minimally affected.</td></tr>
<tr><td colspan="3">Medium, i.e. affected environment is notably altered. Natural and social functions and processes continue albeit in a modified way.</td></tr>
<tr><td colspan="3">High, i.e. natural or social functions or processes could be substantially affected or altered to the extent that they could temporarily or permanently cease.</td></tr>
<tr><td>Comment on the overall assessment and conclusion.</td><td colspan="3">Overall Assessment and concluding comments as to the predicted impacts after mitigation and their:
✓ Severity and permanence
✓ Size and relative significance
✓ Ecological and socio – economic context
✓ Balance between positive and negative aspect
✓ Cost and benefits
✓ Acceptability / Unacceptability</td></tr>
</table>

No.	Impact	Mitigation		Responsibility	Timeframe	Significant rating of impact after mitigation	Comment on the overall assessment and conclusion
		Potential to mitigate negative impacts	Potential to mitigate positive impacts				
1.	Noise	✓ Construction and other noise generating activities should be restricted to between 06h00 and 18h00 Monday to Friday, unless otherwise approved by the appropriate competent person in consultation with adjacent landowners/affected persons and ECO. ✓ During the operational phase all activities must take place in a manner	Not applicable	Contractor	During construction	Low	If construction vehicles are serviced and properly maintained the level of noise should be less.

		that will allow as little noise as possible. ✓ Activities, which are deemed to generate high levels of noise, will be restricted to normal working hours.					
2.	Dust	✓ The liberation of dust into the surrounding environment shall be effectively controlled by the use of, water spraying. ✓ The speed of haul trucks and other vehicles must be strictly being controlled to avoid dangerous conditions, excessive dust or deterioration of the road being used. ✓ Site clearance to be done only as needed in phases.	Not applicable	Contractor	During construction	Low	The level of dust should be reduced to minimal as the result of water spraying during working hours and pilling of soil should be avoided where ever possible.

3.	Soil erosion	✓ Submission of an operational plan for the construction phase indicating technical and management measures to prevent soil erosion. ✓ Stock piled topsoil should not be compacted and should be replaced as final soil layer. ✓ Soil should be exposed for the minimum time possible once cleared of vegetation, i.e. the timing of clearing and grubbing should be co-ordinate as much as possible to avoid prolonged exposure of soils to wind and water erosion. ✓ The A-horizon will be removed and used for rehabilitation purposes.	Not application	Contractor	During construction phase	Low	The design lay out plan should address all issues relating to storm water management and soil erosion. This could be a complete mitigation of this soil erosion.

		The lower soil horizons will be used for construction activities. The A-horizon will be stockpiled in a responsible manner and replaced during rehabilitation.					
4.	Waste generation and disposal	✓ A waste management plan to be developed for the construction site. ✓ Plan to ensure that all waste is contained in suitable containers to prevent waste being washed into water bodies. ✓ Containers for waste to ensure that any fluids generated by waste are trapped and can be disposed of in a suitable.	Not application	Contractor	During construction	Low	Waste removal should be done regularly and that could make the environment free from any hazards. This could completely mitigate this impact.

5.	Mixing of concrete	✓ Where concrete has been mixed, especially in the natural environment, all residues must be removed and disposed of in an environmentally responsible manner approved by the ECO.	Not applicable	Contractor	During construction	Low	Unused cement should not be left to dry on the ground. If proper housekeeping rules are complied with, most impacts should not affect the environment.
6.	Sewage disposal	✓ The contractor to install adequate portable chemical toilets to meet the sanitation needs on the construction site (14 people per toilet).	Not applicable	contractor	During construction and maintenance	Low or completely mitigated	Ablution facility should be made available during construction phase for the employee to able to use this facility. All type of waste should be classified and disposed in an appropriate registered waste disposal site.
7.	Hazardous substances	✓ Hazardous materials to be stored correctly, marked, labelled, without the risk of contamination and hazardous waste to be disposed of correctly with	Non-applicable	Contractor in co-operation with the ECO	During construction	Low	Employees dealing with hazardous substances should be trained and be competent to do so. This could completely mitigate reduce the risk posed by this impact.

		the necessary certificates issued. ✓ All oils, hydraulic fluids and other hazardous materials will be stored in suitable containers in a structure or facility designated for this purpose. ✓ Material Safety Data Sheets (MSDSs) shall be readily available on site for all chemicals and hazardous substances to be used on site. ✓ Storage areas containing hazardous substances must be clearly signed and the designated person contact and names should be displayed. ✓ Residents living adjacent to the construction site					

		must be notified of the existence of the hazardous storage area. ✓ Staff dealing with these materials/substances must be aware of their potential impacts and follow the appropriate safety measures.					
8.	Endemic flora and fauna	✓ No endemic flora and fauna species will be deliberately destroyed or permanent alienated from their natural habitat during construction. ✓ Excavations left open during construction should be checked periodically such that animals falling in can be safely removed and released away from construction activities. All	Not applicable	Contractor and ECO	During construction	Low	Identified indigenous plants and species existing in the area will be protected by all means.

		excavations should be filled as soon as possible. ✓ Construction staff should be advised not to chase, kill or catch animals found or encountered during construction. ✓ Only vegetation falling in directly in demarcated in operational area should be removed where necessary. ✓ No exotic/invasive plants are to be planted on common ground of the site. ✓ No vegetation will be removed without prior permission from ECO.					
9.	Storm water runoff	✓ To prevent storm water damage, the increase in storm water run-off resulting from	Not applicable	contractor	During construction	Low	This should be able to address soil erosion as well as the design of the site should have appropriate storm water management as well

		construction activities must be estimated and the drainage systems assessed accordingly. ✓ A drainage plan must be submitted to the Engineer for approval and must include the location and design criteria of any temporary stream crossing. ✓ All storm water runoff from compacted materials must be monitored if signs of erosion become apparent.					as drainage system that should have oil trap/ filters if necessary.
10.	Storage of equipment and materials	✓ Choice of location for storage areas must take into account prevailing winds, exposure sun, distance to water bodies and	Not applicable	Contractor	Throughout the lifecycle of a project	Low	If employees on site shall practice good housekeeping behavior, the work condition will be free of injuries and everything would be in its place and there will be space for everything.

		general onsite topology. ✓ All equipment and materials must be stored in a designated area in an appropriate manner as to prevent pollution. ✓ Storage areas must be designated, demarcated and fenced as effective as possible. ✓ Fire prevention facilities must be present and accessible at all times.					
11.	Vehicle maintenance and refueling	✓ Vehicle maintenance and equipment handling to be carried out in areas especially equipped for this purpose in order to	Not applicable	Contractor	During construction	Low	The impact should be completely mitigated or reduced form posing danger to the environment.

		prevent spillage and contamination. ✓ All oil changes, lubrication and maintenance will take place only at the designated areas. ✓ Refueling of vehicles will and must take place at the designated refueling area. This area will have a sufficiently impermeable surface to prevent seepage into ground water. The refueling area will be bounded to prevent any surface water from running over this area.					
12.	Vehicle and equipment washing	✓ Washing of vehicles and equipment should be done in one place and if ever spillages of detergents occur then cleaning up	Not applicable	Site workers	During construction	Low or completely mitigated	If the washing of vehicles and equipment is done in an appropriate manner and detergents are always sealed then the negative impact would be low or no more.

		should be considered immediately					
13.	Labour force	✓ Laborers to be restricted to construction area. ✓ Access to the site should be restricted to employees of the contractor. ✓ Temporary ablution facilities to be provided at appropriate sites (one toilet for 14 laborers). ✓ Such ablution facilities to be kept away from natural water bodies. ✓ Cooking facilities to be provided in demarcated areas. ✓ All informal traders to be discouraged. ✓ All labor will undergo basic induction, where safety, health and	If local labour is used, the local community will benefit.	Contractor to identify suitable areas for the said facilities. Contractor to maintain the above facilities.	During construction	Not applicable	Skills and knowledge should be gained by these employees who assist in building local communities.

		environmentally issues will be discussed. ✓ Construction staff should be educated, prior to commencement of construction, as to the need to refrain from destruction or killing of animals and plants, as well as from indiscriminate defecation, waste disposal and / or pollution of local soil and water sources. ✓ The contractor should ensure proper supervision of employees at all times. ✓					
14.	Temporary jobs	✓ Local labor and contractors must be used wherever possible. Basic skills development and	Not applicable	Contractor	During construction	Low	Local laborers should be given priorities.

		capacity development must be incorporated with this. It will be a specific condition in the contractors' agreements that local labor be used wherever possible. All reasonable attempts will be made to appoint people from the local communities as temporary laborers for non- specialize tasks and they will be subject to the necessary basic skills training.					
15.	Security and crime	✓ Members of the community should be hired to patrol the premises during construction and maintenance.	Safety on site will be enhanced	Contractor	During construction and maintenance	Low	Crime could be reduced or completely eradicated by the improvement of security system.

		✓ The access of unauthorized individuals must be minimized.					
16.	Fire prevention and control	✓ Contractor must make sure that there is supervision for all fires that are used in the construction camp. ✓ Smoking should be prohibited in the vicinity of flammable substances. ✓ The contractor should ensure that fire-fighting equipment is available on site, in particular where flammable substances are stored. ✓ Fires started for comfort(warmth) should be discouraged by the contractor, due to the risk of vegetation fires and risk to adjacent property	Not applicable	Contractor	During construction	Low	Every public structure has to have fire prevention measures in place the presence of this facility is a necessity.

		✓ Fire-fighting equipment and emergency plans must be in place prior to the construction phase. ✓ The contractor will plan and implement a fire prevention programs and develop a contingency plan in the event of any fire. ✓ No refuse or waste may be burn. ✓ The contractor will be responsible for all damages caused by the outbreak of a fire originating from a site where work is undertaken. Damage to adjacent properties will be to his account. ✓ The contractor is to provide cooking areas					

		where fire risks will be minimized and controllable.					
17.	Safety and access control	✓ Safety equipment must be provided to all employees to prevent personal injury during construction activities. This includes equipment such as protective eye and ear wear and protective clothing where necessary. ✓ Staff should be appropriately trained in all assigned activities. ✓ Access to dangerous excavations and materials, must be controlled by the site manager. ✓ All personnel and vehicles used for transportation and/or construction	Safety on site will be enhanced	Contractor	During construction	Low	Safety and Access control will be management according to the requirement.

		purposes should remain within these demarcated areas. ✓ Excavations should only remain open of a minimum period of time and during this time the must be clearly demarcated so as to prevent accidental ingress of people and animals.					
18.	Material handling	✓ Re-fueling and maintenance of vehicles must take place off site. ✓ No oils, chemicals or other hazardous materials used during construction are to be stored on site.	Not applicable	Contractor and site workers	During construction	Not applicable	If employees will be properly trained to handle material this could avoid any incidents from occurring.
19.	Survey points	✓ Roads or trails that are cut to provide temporary access for survey work must be minimized.	Not applicable	Contractor	During construction	Low	Construction will only take place on the proposed or demarcated area.

		✓ Vegetation clearing must be kept to a minimum during survey operations.					
20.	Construction camp	✓ The choice of the site for the contractors' camp requires the Engineers permission and must take into account location of villagers and or ecological sensitive areas, including flood zones and unstable zones. ✓ The size of the construction camp should be kept to a minimum. ✓ The contractor must attend to the drainage of the camp to avoid standing water and or sheet erosion.	Not applicable	Contractor and engineers	During construction	Low	The site will be accessible and pose less impact on the environment if chosen in a correct place. The engineers should be responsible to ensure that the chosen place has less or no environmental impact.

21.	Workers conduct on site	✓ A general regard for the social and ecological well-being of the site and adjacent areas is expected of the site staff. ✓ Workers need to be aware of the following general rules: ✓ No alcohol / drugs to be present on site. ✓ No firearms are allowed on site or in vehicles transporting staff to or from the site (Unless used by the security personnel). ✓ Prevent excessive noise. ✓ No harvesting of firewood from the site or from the areas adjacent to it. ✓ Other than per-approved security staff, no workers shall be permitted to live on site.	Not applicable	Contractor	During construction	Not applicable	Workers will be provided sufficient SHERQ awareness training.

Operation and maintenance phase

The table below indicates the identified impacts and mitigation measures that could occur during operational and maintenance phases.

No.	Impact	Responsible person	Timeframe
1.	Storm water management: ✓ It is recommended that proper storm water drainage system be ensured during operation and maintenance phase. ✓ Storm water should not be allowed to discharge onto bare soil but must be diverted to the surrounding grasslands or to the landscaped gardens during the operational phase.	Operator	During operation and maintenance
2.	Clean-up action: ✓ In the event of incident or leakage of hazardous waste from storage site, a professional company to be appointed to remove and cleanup the waste as quickly as possible.	Operator and contractor	During both construction, operation and maintenance phases
3.	Waste generation and disposal: ✓ Solid waste generated during operation and maintenance phase must be removed in a continuous and efficient manner to the satisfaction of the local municipality. ✓ A waste management plan to be developed and maintained for the construction site. ✓ No solid waste should be dumped on the site. ✓ All domestic waste generated on the site should be disposed of in a proper manner off site i.e. no burial on site.	Operator and contractor	During construction, operation and maintenance

4.	Maintaining environmental complaint register: ✓ The environmental complaint register must be maintained during the operation and maintenance phase.	Operator	Operation and maintenance
5.	Maintenance of access roads: ✓ Access/ alternate roads to be maintained with an acceptable free of erosion, and no surface water ponding.	Operator	Operation and maintenance
6.	Traffic: ✓ Any traffic disruptions due to the movement of heavy machinery should be undertaken with the approval of all relevant authorities and in accordance with all relevant legislation.	Local municipality	

8. MANAGEMENT AND MONITORING

This section focuses on the systems and procedures required to ensure that the environmental specifications contained in the EMPr are effectively implemented, monitored and recorded.

General Monitoring and Reporting

The appointed ECO as well as the contractors on site are responsible for ensuring compliance with the EMPr. Monthly EMPr compliance reports (audits) will be compiled by the ECO and submitted to the contractor for his/her review and correction of non-compliance issues. It is the responsibility of the ECO to report any non-compliance, which is not correctly rectified to the contractor. Interested and Affected Parties (I&APs) have the right to monitor specific aspects of the EMPr (e.g. noise regulations, working hours stipulated) and must be allowed access to the EMPr document in conjunction with the contractor in a reasonable and informal manner, without unreasonably disrupting construction activities.

The contractor shall keep a record of all complaints received from the community and communicate them to the ECO. These complaints must be addressed and mitigated within reason. Records relating to the compliance/non-compliance with the conditions of the EMPr as well as audits reports shall be kept in good order. It is suggested that all records be kept for at least two years following construction activities for reference purposes.

Specific Roles and Responsibilities

The roles of the responsible people on site are included below:

Applicant

•The applicant shall ensure that the EMPr forms part of all contract documents;

•The applicant must ensure that the contractor and his/her subcontractors comply with all the environmental specifications outlined in this document;

•Assume overall responsibility for the effective implementation and administration of the EMPr;

•Ensure construction personnel are trained in accordance of the requirements of the EMPr.

The Contractor

Is responsible for complying with the EMPr during the construction phase of the development. The contractor is responsible for ensuring that his/her sub-contractors and their employees appointed by him/her are familiar with the EMPr and that they abide to conditions as set out in the EMPr. The contactor will be responsible for any non-compliance with the EMPr and will pay for any remedial work that may result from non-compliance resulting directly from his/her negligence.

Project Manager

The project Manager is responsible for overall management of project and EMPr implementation and has the following tasks:

•Be familiar with the recommendations and mitigation measures of this EMPr, and implement them;

•Monitor site activities on a daily basis for compliance;

•Conduct internal audits of the construction site against the EMPr;

•Confine the construction sites to the demarcated areas.

The Environmental Control Officer (ECO)

ECO is responsible for communicating environmental issues associated with the site to the contractor and his subcontractors. The ECO is responsible for the explanation of environmental issues contained in this EMP to anyone working on the site. Should any non-compliance with the EMPr take place, the ECO must communicate this with the party responsible for the non-compliance as well as the contractor. If the non-compliance continues after written request by the ECO to rectify the situation, the ECO must inform the local / provincial environmental authority in writing. Should any issues arise on the site of an environmental nature or concern, the ECO will be responsible for taking the appropriate action.

The Local/Provincial Environmental Authority

The local/provincial Environmental Authority responsible for taking action against any non-compliance with the EMPr by the Applicant, the Contractor or any of his/her subcontractors. The Local/Provincial Authority can request a compliance audit to be undertaken on the site at any time during the development phase of the project.

Emergency Procedures

The contractor must ensure that all emergency procedures are in place prior to commencing work. Emergency procedures must include, but are not limited to, fire, spills, contamination of the ground, accidents to employees, use of hazardous substances and materials, etc. The contractor must ensure that lists of all emergency telephone numbers/contact persons (including fire control) are kept up to date and that all numbers and names are posted at relevant locations throughout the duration of the construction period.

- **Fires**

The contractor must take all reasonable measures to ensure that fires are not started as a result of construction activities on site, and shall also ensure that their operations comply with the Occupational Health and Safety Act (Act No. 85 of 1993). The contractor shall ensure that there is basic firefighting equipment available on site at all times. The contractor shall appoint a member of his staff to be responsible for the installation and inspection of this equipment. The contractor is to ensure that he/she has the contact details of the nearest fire station in case of an emergency. No large open fires are permitted on site. Sparks generated during welding, cutting of metal or gas cutting can result in fires. Every possible precaution shall therefore be taken when working with this equipment near potential sources of combustion. Such precautions include having an approved fire extinguisher immediately available at the site of any such activities.

- **Safety**

The contractor must ensure that his employees comply with the Occupational Health and Safety Act (OHSA) (Act No. 85 of 1993). All reasonable measures must be taken to ensure the safety of all personnel on site. The contractor must ensure:

•Compliance with the Occupational Health and Safety Act (Act No. 85 of 1993);

•That all reasonable measures are taken to ensure the safety of all site staff;

•That all construction vehicles using public roads are in a roadworthy condition, that drivers adhere to the speed limits and that their loads are secured and that all local, provincial and national regulations are adhered to.

•That all accidents and incidents are recorded and reported to the ECO.

•Provision of first aid facilities at all times and in line with the requirements of Construction Regulations.

•Relevant Personal Protective Equipment (PPE)/clothing is provided to all personnel on site at all times.

•All accidents and incidents shall be recorded and reported to the Safety officer on site.

The contractor is to ensure that he/she has the contact details of the nearest emergency rooms (hospitals) to the site, of both private and public hospitals.

Construction Site

Restriction to Working Areas

Working areas are defined as those areas required by the contractor to undertake the works. It is important that activities are conducted within a limited area so as to facilitate control and to minimise the impact on the existing natural environment.

Access Roads

No any other access routes must be constructed. Only by-pass where necessary shall be constructed during the development phase of the project. Construction vehicles must be limited to approved access routes and areas on the site so as to minimise excessive environmental disturbance to the soil and vegetation on or close to the site.

Contractor's Camp

Prior commencement of construction activities, an area to be approved by the ECO should be fenced off for the use as a construction camp and for temporary staff

accommodation facilities during the construction period. The mesh size of the fence should be small enough to act as a filter net for litter as well as a demarcation of the site.

- No camp or office site shall be located closer than 200m from a stream or any drainage line;
- No trees or shrubs will be felled or damaged for the purpose of obtaining firewood;
- Permit to remove any protected tree shall be obtained from the relevant competent authority
- There has to be proper signage to indicate the particular area as camp site/office site;
- The contractor must ensure that the construction camp is enclosed with a fence for the duration of the construction period. The fence will serve to prevent public access to the camp, for public safety and security reasons. The contractor must maintain the fence for the duration of the construction period. All temporary fences must be removed on completion of the project;
- All temporary structures erected for construction purposes will be restricted to the construction campsite;
- All construction vehicles and machinery be stored in a location where an oil trap will be installed to prevent soil pollution. The ECO will advise the contractor on a suitable area on the site.

Security personnel and skeleton staff shall be supplied (by the contractor) with adequate protective clothing, ablution facilities, water and refuse facilities (with regular collection) and facilities for cooking and heating. These measures will ensure that open fires are not necessary.

Refuse and Waste Management

The contractor shall be responsible for the establishment of a waste management methods and removal system that prevents the spread of waste/refuse within and beyond the construction camp. The contractor shall make provision of waste collection facilities to collect for waste prior disposal and shall make arrangements for disposal thereof. Refuse refers to all solid waste, including construction debris (cement bags, wrapping material, timber, cans, wire, nails, etc.), waste and surplus food, food packaging, organic waste etc. The contractor shall be responsible for the establishment of a refuse control and removal system that prevents the spread of refuse within and beyond the construction site.

The contractor shall ensure that all refuse is disposed of by him and his sub-contractors' employees in refuse bins which he shall supply and arrange to be emptied as and when required. These bins must be adequate in number and accessibility.

Waste shall be separated into recyclable and non-recyclable waste, and shall be further separated as follows:

•Hazardous waste, consisting of substances that may be harmful to the receiving environment, and therefore require precautionary measures when handled. Examples include (but not limited to) oil, paint, diesel etc;

•General waste, consisting of non-hazardous substances and substances that cannot be recycled. Examples include (but not limited to) construction rubble, excess construction materials that cannot be reused, and food waste.

•Reusable construction material, which can be used at other construction sites.

•Recyclable waste shall preferably be deposited in separate bins. Recyclable material includes paper, tins and glass. The contractor is advised that "Collect-a-Can" collect tins, including paint tins, chemical tins, etc. for recycling.

Refuse bins shall be watertight, wind-proof and scavenger proof and shall be appropriately placed throughout the site and shall also be conspicuous (e.g. painted bright yellow). Refuse must also be protected from rain, which may cause

pollutants to leach out. Particular caution is to be exercised with regards to handling of hazardous waste, to ensure that it does not spill or leak from the waste collection containers. The utmost care must be taken to ensure that no waste is able to enter wetlands and/or dams on or near to the site. The contractor or the appointed Waste Removal Company shall truck refuse collected out of the construction site. Refuse must be disposed of at a Municipal registered landfill site, which is also approved of by the local authority. Refuse may not be burned or buried on or near the site.

The contractor shall provide cleaning services to clean up the contractors camp and construction site on a daily basis. These areas shall then be inspected by the contractor to ensure compliance with this requirement. A litter patrol around the construction area is to take place twice weekly to ensure that all litter is cleared up. The contractor shall be warned, in writing by the ECO, of any infringement and will be expected to clear the litter within 24 hours of the notification. The contractor will be responsible for removal of litter, which may wash into watercourse.

Ablution Facilities

The contractor will be responsible for the provision of sanitation for the sub-contractors and their staff. A minimum of one chemical toilet shall be provided per 15 individuals. Toilets provided by the contractor must be easily accessible. All toilets must be located within the construction site. Should toilets be needed elsewhere, their location must first be approved by the ECO. The ECO is responsible for ensuring that all toilet structures are suitably located and comply with requirements stated below.

•The toilets shall be neat construction and shall be provided with doors and locks and shall be secured to prevent them from falling over.

•Toilets shall be placed outside areas susceptible to potential flooding or within drainage channels. Toilets may not be placed in close proximity to the watercourse or drainage line. The contractor shall supply toilet paper at all toilets at all times.

•Toilet paper dispensers shall be provided in all toilets. The contractor shall ensure that the labourers make use of the toilets provided.

•The contractor (or reputable toilet-servicing company) shall be responsible for the cleaning, maintenance and servicing of the toilets. The contractor shall ensure that the toilets are emptied on a weekly basis or as required.

•The contractor shall ensure that no spillage occurs when chemical toilets are cleaned and emptied. Any accidental spillage must be reported to the ECO and the client, and cleaned up immediately. The contractor shall ensure that the toilets are protected from vandals.

If the contractor (or reputable toilet-servicing company) fails to provide and/or maintain all site sanitation facilities in a clean and hygienic condition, the ECO may request the contractor to suspend work until the requirements have been met. Washing areas must be situated away from the watercourse, and the use of biodegradable soaps is recommended.

Eating Areas

The contractor shall designate restricted areas for eating within the construction site. If fires are required for cooking purposes, they must be restricted to the construction camp and the location shall agreed upon by the ECO. The feeding, or leaving of food, for stray or other animals in the area is strictly prohibited.

Construction Vehicles and Machinery

Site vehicles are only permitted within the demarcated construction camp, as required, to complete their specific task. All construction vehicles should be in a good working order to reduce possible noise pollution. On-site vehicles must be limited to approved access routes and areas (including turning circles and parking) on the site so as to minimise excessive environmental disturbance to the soil and vegetation on site. Servicing and maintenance of vehicles on-site shall be done at areas specifically restricted for such use.

Material Storage and Stacking

Construction material and other building material may only be placed within the demarcated area, which must fall within the demarcated site. The contractor must, where possible, avoid stockpiling materials in vegetated areas that will not be cleared. Stockpiles of construction materials must be clearly separated from topsoil stockpiles in order to limit any contamination of the topsoil. Stockpiles must be located away from sensitive hydrological features (including but not limited to, watercourses, drainage channels, areas susceptible to erosion etc.).

Fuel and Chemical Management

The following shall apply when storing fuel and chemicals on site:

•The contractor shall ensure that fuels and chemicals (e.g. drums of fuel, grease, oil, brake fluid etc) are stored and handled carefully so as to prevent spillage. These liquids shall be confined to specific and secured areas within the contractor's camp and shall be clearly marked. Should the contractor intend to store such goods with a capacity of more than 80m^3, an application for Environmental Authorisation must be submitted to the DESTEA.

•The liquids will be stored in a bunded area with adequate containment (at least 1.5 times the volume of the fuel) with an impermeable floor beneath them for potential spills or leaks, in such a way that does not pose any danger of pollution even during times of high rainfall.

•In addition, the contractor must ensure that workers do not smoke or take part in any activity that may result in sparks in the vicinity of fuels and other flammable substances to prevent ignition. Relevant signage should be displayed at this points e.g. No smoking, flammable etc.

•Refuelling of vehicles shall only take place at a predetermined area, where adequate measures are in place to prevent spillage or pollution.

•The contractor will be responsible for ensuring that any party delivering potentially dangerous chemicals and oil to site is aware of the appropriate storage and drop-off locations and procedures. Transfer of hazardous chemicals and other potentially hazardous substances must be carried out so as to minimise the potential leakage and prevent spillage onto the soil.

Equipment

Drip trays must be put in relevant locations (inlets, outlets, points of leakage, etc) so as to prevent such spillage or leakage during transfer. The contractor shall stand any equipment that may leak, and does not have to be transported regularly, on watertight drip trays to catch any pollutants. The drip trays shall be of a size that provides at least 1, 5 times the total potential spillage. Drip trays shall be cleaned regularly and shall not be allowed to overflow. Substances, which cannot be reused, must be disposed of according to the relevant waste disposal procedure.

Handling of spillages

The contractor shall keep the necessary materials and equipment on site to deal with spillage of the relevant hazardous substances present on site. The contractor shall set up a procedure for dealing with spills, which will include notifying the ECO and the relevant authorities immediately following the spillage event. In the event

of a spill, appropriate steps must be undertaken to prevent pollution. The clean-up of spills caused as a result of the construction activities, and any damage to the environment, shall be for the contractor's own account. A record must be kept of all spills and the corrective action taken.

Working Hours

Working hours for all operations shall be limited to between 08h00 and 17h00 during weekdays (Monday to Friday) and between 08h00 and 13h00 on Saturdays. No work may take place on a Sunday or Public Holidays. Any deviations to these work hours must be cleared with the ECO and the Oversight committee prior to implementation.

Site Preparation and Clearing

Site preparation for the proposed construction works and site camp might involve the tree felling, clearing of brushwood, temporary removal of utilities, topsoil stripping and diversion/rechanneling of waterways. Vegetation loss result in loss of some valuable/protected species and it pose risks of erosion to exposed ground or stored topsoil, and increased runoff of water and siltation of water bodies. Natural vegetation does exist on the site. Vegetation on the site may be removed but care must be taken to confine removal of vegetation during construction activities to within the boundaries of the development area.

Heritage Sites and Features

A water cistern, troughs and other modern ruins in the centre of the study area were noted. More modern ruins along the southern boundary of the study area was also identified. None of these are considered to be historically significant. No archaeological or heritage sites have been uncovered on this site. Should such features be uncovered during construction, work must be halted immediately. Old burial grounds (if found) will be reported to the ECO who will advise the contractor as to the mode of action, which will include informing either the South African

Police Service (SAPS) and/or a representative from the South African Heritage Resources Agency (SAHRA).

Natural Features

Trees and natural vegetation, or any other natural features outside the work area, which will not be cleared for construction purposes, shall not be defaced, painted for benchmarks or otherwise damaged, even for survey purposes. The latter can only be done if agreed to by the ECO. Any feature defaced by the contractor shall be reinstated by the contractor to the satisfaction of the ECO.

Soil Management

Top soil shall not be removed from areas where physical disturbance of the surface will take place. The soil shall be stored and adequately protected from any pollution and erosion either by wind or water. The contractor shall temporarily stockpile excavated materials (e.g. soils and rocks) and construction materials in such a way that the spread of materials is minimised. The following measures must be applied when stock piling:

•The stockpiles must not be higher than 2m to avoid compaction.

•All stockpiled material must be easily accessible without any environmental damage.

•The stockpiles may only be placed within the demarcated areas the location of which must be approved by the site Environmental Officer (EO) or ECO (As applicable).

•It is suggested that the stockpiles be placed on the already disturbed areas of the building site. The contractor must, where possible, avoid stockpiling materials in vegetated areas that will not be cleared.

•Stockpiles are to be stabilised if signs of erosion are visible.

•Soils from different horizons must not be stockpiled such that topsoil stockpiles do not get contaminated by sub-soil material.

•Topsoil stockpiles must be monitored for invasive exotic vegetation growth. Contractors must remediate as and when required in consultation with the EO, RE and ECO (As applicable).

•Stockpiles of construction materials must be clearly separated from topsoil stockpiles in order to limit any contamination of the topsoil.

Pollution Control

Pollution could result from the release, accidental or otherwise, of chemicals, oils, fuels, sewage, wastewater containing organic kitchen waste, detergents, solid waste, litter and other such substances. The following measures must be implemented to prevent possible pollution"

•The contractor shall ensure that rainwater does not run into areas containing cement, oil, diesel and other such substances as this could result in a pollution threat to sensitive environmental areas.

•Fuel tanks must be placed in designated areas with concrete bunded walls, collection trays and fire extinguishers. Any spillage of fuel, oils, sewage resulting in soil contamination shall be cleaned up at the expense of the contractor.

•Used fuels/oils hydraulic fluids, paints solvents and grease must be stored in drums or suitable containers and must be disposed off at an appropriate site or sent to a local recycling plant.

•Never allow any hazardous substances to soak into soil.

Runoff from the site itself must be free from oil, waste and litter before joining the stormwater system. This must be ensured by securing any containers containing hazardous substances, in order that it cannot enter runoff, and by cleaning up any refuse and construction material from the site on a regular basis.

Waste and Refuse Management

During construction phase, waste will be generated. These include solid wastes such as papers, food and beverage tins and containers. Wastes lead to unsightly landscape/environment. Substantial impacts on the environment can occur due to litter, fuel, accidental release of hazardous materials and chemical spillage during construction phase of the proposed development. Excessive accumulation of waste around construction site may create untidy conditions.

•The contractor shall ensure enough waste collection facilities are available on site for collection of waste prior to disposal. He/she must ensure that all refuse is disposed of by him/her and his sub-contractors' employees in refuse bins supplied and arrange to be emptied on a weekly basis.

•Bins must be adequate in number and accessibility. Refuse bins shall be watertight, wind-proof and scavenger proof and shall be appropriately placed throughout the site. Refuse must also be protected from rain, which may cause pollutants to leach out.

•All solid and chemical wastes that are generated during construction must be removed and disposed of at a licensed waste disposal site. Chemical containers and packaging brought onto the site must be removed.

•Waste shall be separated into recyclable and non-recyclable waste, and shall be further separated as follows:

•Hazardous waste, consisting of substances that may be harmful to the receiving environment, and therefore require precautionary measures when handled. Examples include (but not limited to) oil, paint, diesel etc;

•General waste, consisting of non-hazardous substances and substances that cannot be recycled. Examples include (but not limited to) construction rubble, excess construction materials that cannot be reused, and food waste;

•Reusable construction material, which can be used at other construction sites;

•Recyclable waste shall preferably be deposited in separate bins painted in different colours. Recyclable material includes paper, tins and glass.

The contractor or the appointed Waste Removal Company shall truck refuse collected out of the construction site. Refuse must be disposed of at a registered Landfill site, which is also approved of by the contractor and the local authority. Refuse may not be burned or buried on or near the site.

Noise Nuisance

Due to the locality of the development, construction activities are likely to cause noise nuisance to the students and university personnel. Probably the two most important concepts in the regulation of noise are those of disturbing noise and noise nuisance.

•A disturbing noise is one that exceeds the zone sound level set by the local authority.

•A noise nuisance means any sound, which disturbs or impairs or may disturb or impair the convenience or peace of persons.

Some of the activities that could constitute a noise nuisance are power tools, driving, loading and hooters. All of these elements could be connected with construction activities. The contractor must obtain and familiarise him/herself with any regulations and municipal by-laws regarding noise and must ensure that he/she abides by these regulations at all times. It is recommended that the following measures be implemented to keep noise levels down:

•The contractor may not use sound amplifying devices on site, unless in emergency cases;

•No work is to be done after hours, working hours must be strictly adhered to (The operational schedule must be strictly adhered to. Work hours during the

construction phase shall be strictly enforced unless permission is given. Permission shall not be granted without consultation with the I&APs;

•Construction activities should be limited to normal working hours. Should normal working hours extend into evenings and weekends, students and campus dwellers should be timorously informed of the dates and the times of such activities. Noisy activities shall take place only during working hours.

•Construction vehicles and machinery must be kept in good order so not to cause excessive noise, Were possible the contractor must use equipment designed to limit noise levels;

•Employees exposed to high level of noise must be provided with ear protection gear.

•During construction, all reasonable precautions must be taken to minimise noise generated on site, especially when carrying out activities that may impact on neighbouring landowners and users. Every effort must be made to limit exceedingly noisy activities.

Noise reduction is essential and the contractor shall endeavour to limit unnecessary noise. The use of silent compressors is a specific requirement. The ECO must inform I&APs in writing 24 hours prior to any planned activities that will be unusually noisy or any other activities that could reasonably have an impact on the adjacent sites. These activities could include, but are not limited to, blasting (if required), piling, use of pneumatic jack-hammers and compressors, bulk demolitions, etc.

Air Quality

The contractor must take appropriate and reasonable measures to minimise the generation of dust as a result of his works, operations and activities. Additionally fumes from construction vehicles and machinery could contribute to air pollution if not addressed properly. Particular attention must be given to prevent dust generation during excavation and stockpiling and transportation activities. The

contractor is responsible for informing his/her sub-contractors and their employees to report any excessively dusty conditions to the contractor, the EO or the responsible representative. Corrective and preventative measures shall include but not be limited to:

•Regular (at least daily during dry and windy seasons) and effective treatment of working areas using water sprays and appropriate scheduling of dust-generating activities (potable water cannot be used as a means of dust suppression, alternative measures must be sourced);

•Covering for all load beds when transporting;

•The construction camp shall be watered during dry and windy conditions to control dust fallout.

•Concrete bags must not be allowed to blow around the site and spread cement dust.

•All construction vehicles and machinery shall be in good order and serviced regularly to avoid releasing excessive emissions to the atmosphere.

Erosion Control

The disturbance of steep slopes, for example by the removal of vegetation, may result in slope instability and erosion by rain and surface runoff. All slopes that are disturbed during construction shall immediately be stabilised to prevent erosion. Where re-vegetation of slopes is undertaken, this shall be done in accordance with the landscape architect (or appointed landscaper). The contractor must take reasonable measures to prevent erosion caused by their works. Erosion control measures must be in place in areas where runoff concentrates, in order to detain the sediment load and slow down the runoff. Erosion controls must be put in place on all drainage channels that drain into hydrological features. These measures may include, but not be limited to:

- silt fences;
- brushwood; and

- Rows of sawdust-filled onion bags.

Runoff containing high sediment loads shall not be released directly into natural or storm water drainage systems or nearby hydrological features. Any erosion that occurs during a heavy rainfall event must be remediated at the expense of the contractor. This will include clean-up of the silt deposited and filling up of erosion channels that may form. The contractor shall be responsible for rehabilitating all eroded areas in such a way that the erosion potential is minimised after construction has been completed.Storm water shall be delivered away from all construction or site areas in cut-off drains. The contractor shall ensure protection of areas susceptible to erosion by installing temporary or permanent structures such as meter drains, drainage pipes, sandbags, gabion mattresses etc.

Excavations, Trenching and Backfilling

All excavations for any purpose must be preceded by selective striping and stockpiling of topsoil for rehabilitation purposes of affected areas. Temporary stockpiles shall be done in a manner which will avoid erosion.

•Excavated areas must be barricaded to warn personnel of associated dangers.

•Rehabilitation should be progressive with construction and not left until the end of the project.

•The contractor shall temporarily stockpile excavated materials (e.g. soils and rocks) and construction materials in such a way that the spread of materials is minimised. The stockpiles must not be higher than 2m to avoid compaction.

•The contractor must avoid vegetated areas that will not be cleared. It is suggested that the stockpiles be placed on the already disturbed areas of the building site. Stockpiles are to be stabilised if signs of erosion are visible.

•Soils from different horizons must not be stockpiled such that topsoil stockpiles do not get contaminated by sub-soil material.

Public Safety

Appropriate measures shall be in place to warn I&AP's (including university personnel and students as well as any person(s) visiting the premises) interested and affected parties of the dangers during construction. Flagmen and women shall be deployed at any intersection to regulate passage and movement of traffic vehicles. Appropriate signage and information shall be displayed where necessary to warn the public of associated dangers. Speed limit shall be adhered to at all times to avoid accidents at by construction personnel and other road users during construction.

9. REHABILITATION

After construction, any area cleared or disturbed (as a result of the construction activities) within and outside the boundaries of the construction site shall be rehabilitated. The contractor shall be responsible for cleaning the contractor's camp and construction site of all structures, equipment, residual litter and building materials at the end of the contract and where necessary and appropriate, the ground scarified, topsoil restored and indigenous vegetation re-established. All construction equipment and excess aggregate, gravel, stone, concrete, bricks, temporary fencing and the like shall be removed from the site upon completion of the work. No discarding of burying of materials of whatsoever nature shall be allowed on the site, or on any vacant or open land in the area. Such materials may only be disposed of at the appropriate registered waste disposal site.

10. GENERAL CONDUCT

Each member of the work force shall be subjected to a project orientation period prior to commencing work on the site. The orientation shall include a discussion

on environmental matters of concern on this project. The ECO, with the assistance of the contractor, shall communicate all aspects of the EMP to the site staff (i.e. site agents to labourers) prior to commencement of excavation or any other environmentally disturbing activity. Basic environmental awareness training must be carried out for all employees (it is suggested that this be conducted in a language best understood by all employees) and should be included in safety training.

A copy of the EMPr must always be made available on site. General waste such as food wrapping and sanitary waste shall be confined to the work site and collected daily for appropriate disposal at an approved municipal landfill. Construction waste such as rubble shall be gathered up for disposal at an approved location. No waste is to be burned or disposed of on-site and construction personnel are required to confine their activities within the approved work site. It should be emphasized that the Environmental Practitioner shall be given the responsibility to inventory all the environmental aspects of the operation. Such responsibilities are to include the following:

•Documentation of specific environment-related activities, such as lists of fuel spill incidents.

•Ensuring that project related activities comply with contingency plans, regulatory permits and approval conditions, as well as contract provision or specifications.

•Providing environmental information for staff, and ensuring that all personnel and contractors understand the terms and conditions outlined in all regulatory permits and in the Management Plan.

•Maintaining the required records for environmental monitoring programs.

•Maintaining a photographic record of prior to, and during construction activities that have the potential to affect environmental resources in an adverse manner.

11. CONCLUSION

This EMPr is to be implemented in a cooperative spirit between all parties involved in this development. This EMPr must be used as a tool to support the development in being sustainable in environmental terms while still promoting economic and social development. It contributes to the environmental awareness of the workforce and can also facilitate the prevention of environmental degradation, and minimise impacts when they are unavoidable. It also describes the methods and procedures for mitigating potential impacts and monitoring thereof.

12. REFERENCES

1. Environmental Conservation Act of 1989 (Act No; 73 of 1989) Republic of South Africa, Pretoria Department of Environmental Affairs and Tourism (1998).

2. EIA Regulations-Implementation of Section 21, 22 and 26 of the Environment Conservation Act, Government Printer, Pretoria.

3. National Environmental Management Act of 1998 (Act No; 107 of 1998).

4. Regulation in terms of Chapter 5 of the National Environmental Management Act, 1998 (21 April 2005) Department of Environmental affairs and Tourism.

5. Occupational Health and Safety Act (OHSA) (Act No. 85 of 1993)

APPENDIX H: DETAILS OF EAP AND EXPERTISE

APPENDIX I: SPECIALIST'S DECLARATION OF INTEREST

APPENDIX J: ADDITIONAL INFORMATION