Draft Environmental Impact Assessment (EIA) Report the proposed Q4 City Filling Stations

on Portions of Portion 22 & 41 of the farm Schietfontein 437 JQ

Reference No: NWP/EIA/80/2013

December 2015

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LIST OF ABBREVIATIONS

BA: Basic Assessment

DEA: Department of Environmental Affairs

DWS: Department of Water and Sanitation (previously Water Affairs – DWA)

EA: Environmental Authorisation

EAP: Environmental Assessment Practitioner

ECA: Environmental Conservation Act

EIA: Environmental Impact Assessment

EIAR: Environmental Impacts Assessment report

EMP: Environmental Management Plan

EMPr: Environmental Management Plan

GDARD: Gauteng Department of Agriculture and Rural Development

GIS: Geographic Information Systems

I&AP: Interested and affected party

IAIA: International Association of Impact Assessments

IDP: Integrated Development Plan

IEMA: Institute of Environmental Management and Assessment

NEMA : National Environmental Management Act

NEM:AQA: National Environmental Management: Air Quality Act

NEMBA: National Environmental Management Biodiversity Act

NHRA: National Heritage Resources Act

NWA: National Water Act

NWMS: National Waste Management Strategy

NWREAD: Department of Rural, Environmental and Agricultural Development: North West

PoS: Plan of Study

PSDF: Provincial Spatial Development Framework

SACLAP: The South African Council of the Landscape Architects Profession

SAHRA: South African Heritage Resources Agency

SANRAL: South African National Roads Agency Limited

GLOSSARY OF TERMS

Alien species: A plant or animal species introduced from elsewhere: neither endemic nor indigenous.

Applicant: Any person who applies for an authorisation to undertake an activity or to cause such activity to be undertaken as contemplated in the National Environmental Management Act (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2006.

Biodiversity: The variability among living organisms from all sources including, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are apart.

Ecology: The study of the inter relationships between organisms and their environments.

Environment: All physical, chemical and biological factors and conditions that influence an object and/or organism. Also defined as the surroundings within which humans exist and are made up of the land, water, atmosphere, plant and animal life (micro and macro), interrelationship between the factors and the physical or chemical conditions that influence human health and well-being.

Environmental Impact Assessment: Assessment of the effects of a development on the environment.

Environmental Management Programme: A legally binding working document, which stipulates environmental and socio-economic mitigation measures that must be implemented by several responsible parties throughout the duration of the proposed project.

Study Area: Refers to the entire study area compassing the total area of the land parcels as indicated on the study area map.

Sustainable Development: Development that has integrated social, economic and environmental factors into planning, implementation and decision making, so as to ensure that it serves present and future generations.

1. INTRODUCTION

1.1 Background

Bokamoso Landscape Architects & Environmental Consultants CC have been appointed by Q4 Chemicals (Pty) Ltd as independent Environmental Consultants/ Environmental Assessment Practitioner (EAP) to facilitate the application for Environmental Authorisation (EA) for the proposed Q4 City Filling Stations in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) and the 2010 Environmental Impact Assessment (EIA) Regulations. The development areas earmarked for the filling stations will be approximately 16.5 ha in total on **Part of Remainder of Portion 22 and Part of Remainder of Portion 41 of the Farm Schietfontein 437 JQ, North West Province,** in the area of jurisdiction of the Madibeng Local Municipality. *(Please refer to Figure 1, Aerial Map and Figure 2-Locality Map)*

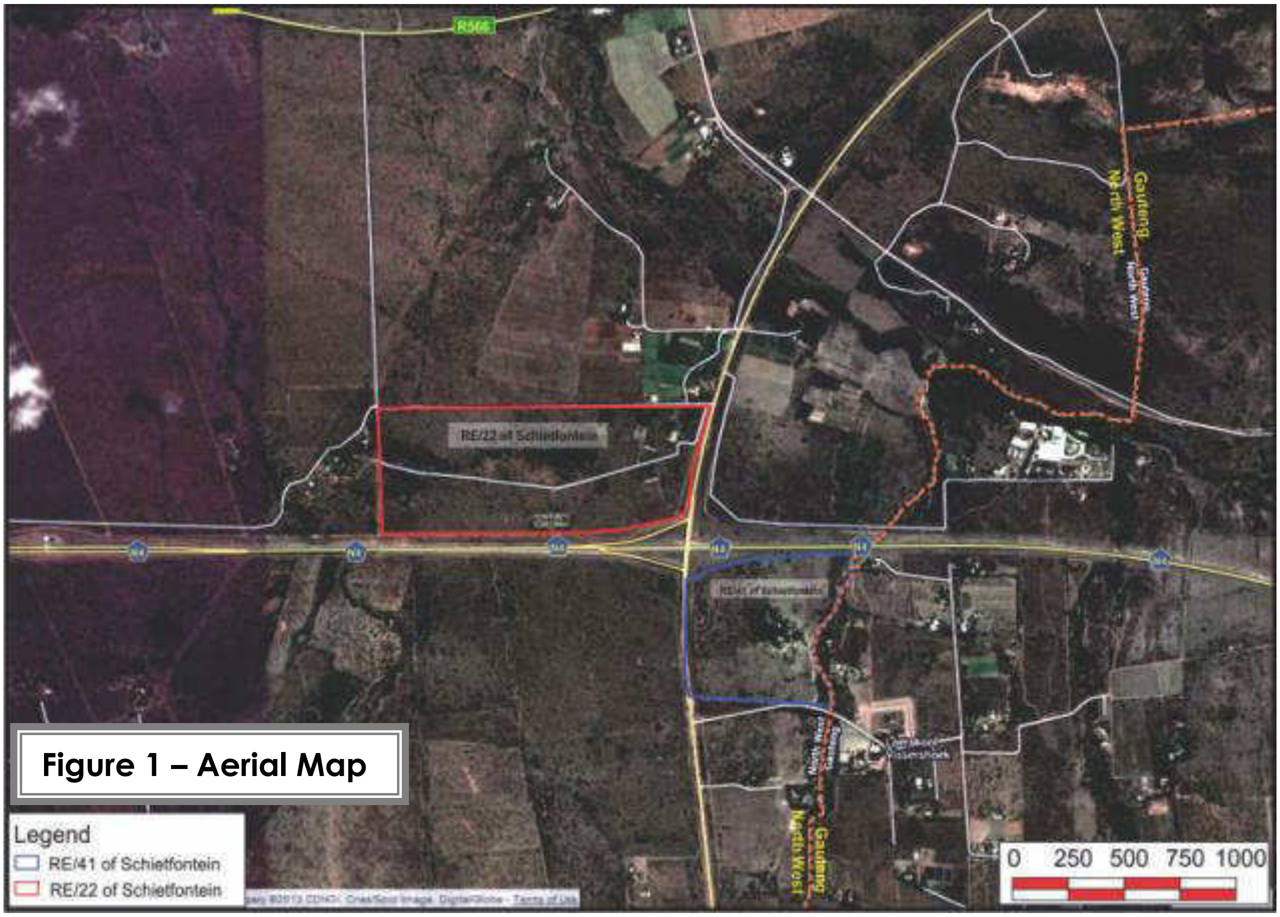

Figure 1 – Aerial Map

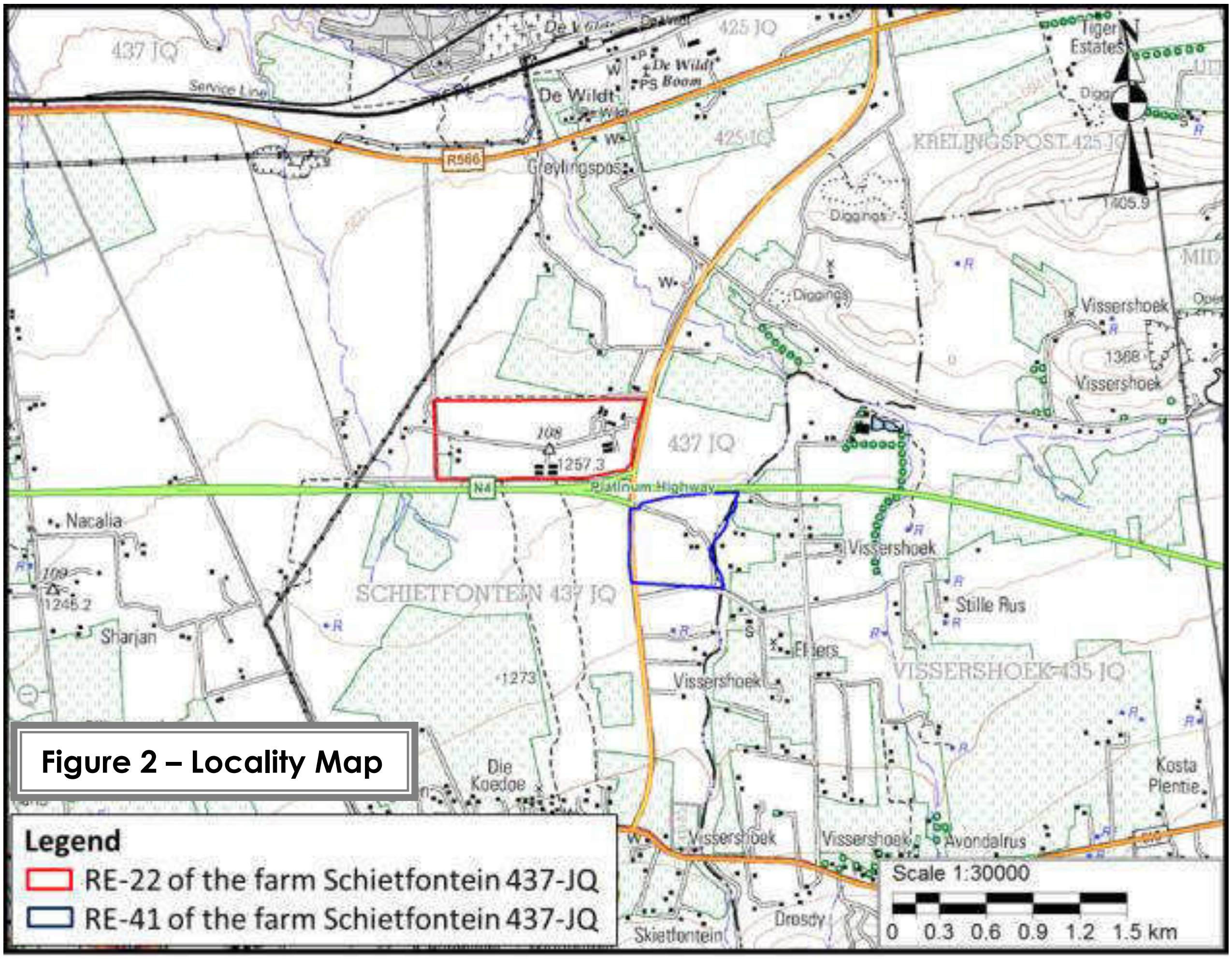

Figure 2 – Locality Map

Please note: enlargements of the Figures are included as Annexure A

The applicant requested (after the applicant purchased the study area) that the Town and Regional Planner apply for the sub-division of the above-mentioned properties. The purpose of the sub-division applications is to create separate development properties for the proposed filling stations. The total size of the Remainder of Portions 22 and 41 is ± 96.3ha (combined) and the proposed filling stations will only cover approximately 16.1 ha (± 7.6ha and ± 8.5ha respectively are required for the filling stations). ***Refer to Figure 3 below for delineation of the filling station study areas, which will be developed on the sub-divided portions 22 and 41.***

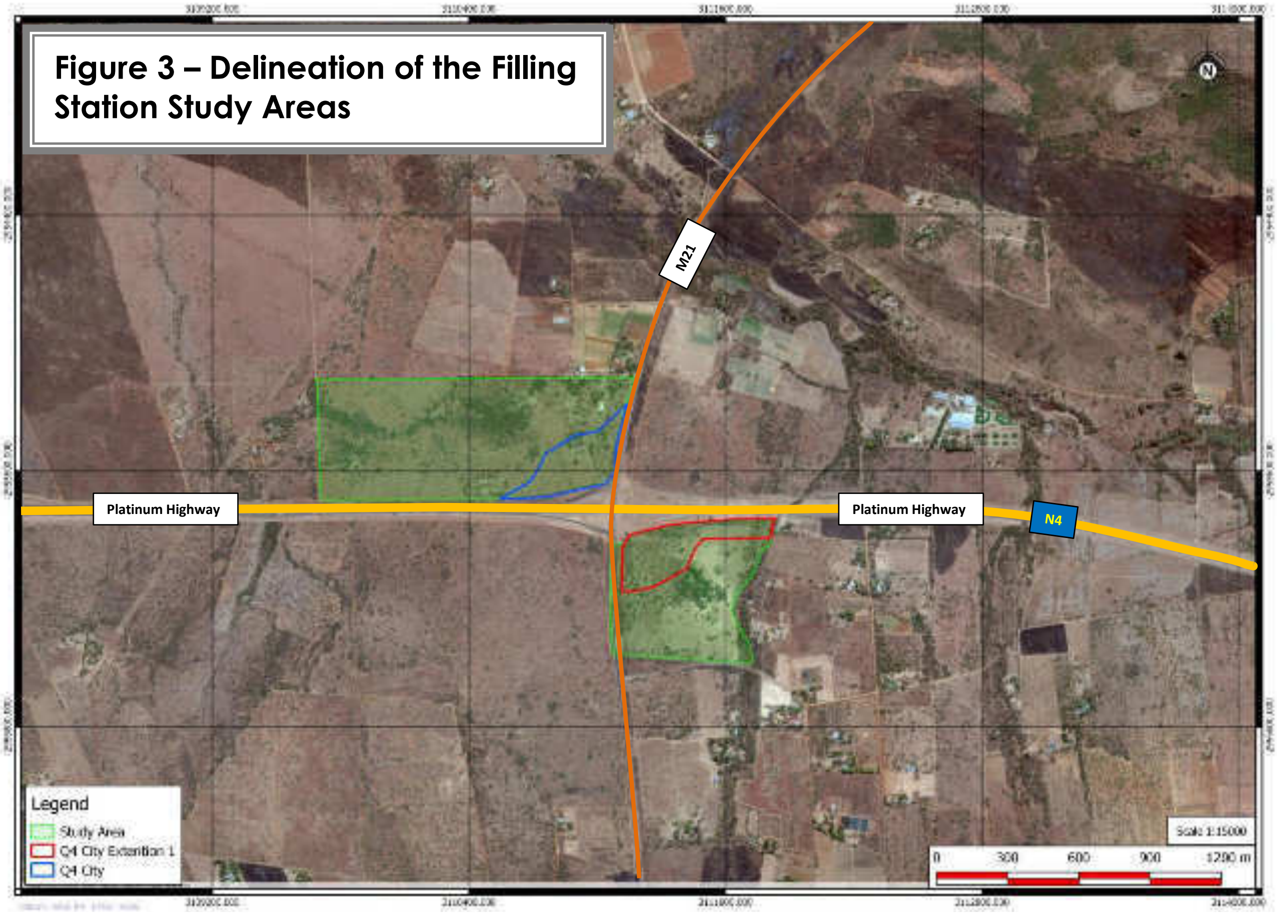

Figure 3 – Delineation of the Filling Station Study Areas

Q4 Chemicals (Pty) Ltd has appointed **Bokamoso Landscape Architects and Environmental Consultants CC**, to compile an Environmental Scoping Report and Environmental Impact Assessment (EIA) for the proposed filling stations development and its associated listed activities.

Take note that Bokamoso originally submitted two separate Basic Assessment (BA) applications for the filling stations (if viewed separately, each filling station qualifies for a Basic Assessment), but the Department of Rural, Environmental and Agricultural Development: North West (NWREAD) requested that Bokamoso rather compile and submit one integrated EIA for both filling stations. Please refer to **Annexure B** for the Application Form, Acknowledgement Letter and correspondence from the NWREAD.

The Scoping Report and the Plan of Study (PoS) for EIA had been approved by the Department of Rural, Environmental and Agricultural Development: North West (NWREAD) and it was requested that the EIAR be compiled and submitted to NWREAD for consideration. ***(Please refer to Annexure C for the approval of Scoping from NWREAD).***

NWREAD required that the following information also be incorporated and addressed as part of the EIA Phase:

a) Geo-hydrological and Geo-Technical Study – It is imperative that for a development of this magnitude, sufficient effort and accompanying information regarding the possibilities of the proposed development to pollute or contaminate groundwater in anyhow, must be investigated including the level of reliance of surrounding properties on groundwater, and the ground water reference in terms of quality **(Refer to Annexures F1 and F2)**;

b) Consultation with the Department of Water and Sanitation – Groundwater is intensely used in the surroundings and therefore the above mentioned Department must be consulted and comments be obtained and incorporated in the EIA **(Refer to Annexure H5 and Section 6.2.9). Due the fact that NWREAD regard it as important to obtain the comments of DWS, it is requested that DWS peruse the application and supply their comments for inclusion as part of the Final EIA to be submitted to NWREAD for consideration**;

c) Final Layout Plan – All engineering and design layout plans for the proposed development must be included in the EIA Report and also be submitted to the identified interested and affected parties. The layout plan must also show all the sensitive environmental features to be affected by the development if any **(Refer to Annexure E)**;

d) Method of sewage disposal – Sewage disposal method for the proposed development must be investigated and quantity in relation to its suitability and compatibility to the site dynamics. Should municipal borne sewer be the best practicable option, the capacity of the sewage treatment plan must be investigated to establish its capacity in handling the additional sewage resulting from the proposed new development **(Refer to Annexure F8)**;

e) Waste Management – Detailed information regarding the management of solid waste during construction and operational phases of the project must be provided. If it is going to be municipal services, a signed agreement by both applicant and the municipality must be included in the final EIA report, and waste management plan for the proposed development must be established in consultation with the Local Municipality and be incorporated in the EIA report **(Refer to Annexure K)**;

f) Services Provisions – Letters as proofs that services will be provided, signed by both applicant and service providers (waste removal / water / electricity), must be submitted to this Department **(Refer to Section 6.2.8 and Annexure F8)**;

g) Consultation with South African National Roads Agency Limited (SANRAL) as the custodian of all national roads in South Africa **(Refer to Annexure F7)**;

h) The proof of newspaper advertisement in ***Annexure D3*** of the report does not reflect the name of the newspaper and date in which it was placed **(Refer to Annexure H3)**;

i) All specialist studies identified during the Scoping Phase must be undertaken and included in the Environmental Impact Assessment Report (EIAR) **(Refer to Annexure F)**;

j) A draft Environmental Impact Assessment Report which includes all specialist studies undertaken must be submitted to all other relevant authorities for comment and their comments including comments from the interested and affected parties must be included in the final Environmental Impact Assessment report to be submitted to this Department for consideration **(to be included in the Final EIA)**;

k) Environmental Management Programme (EMPr) – An EMPr for the construction and operational phases of the project must be developed to identify and mitigate potential environmental and social impacts associated with the proposed activity on the receiving environment. The contents of the EMPr must comply with the guidelines as stipulated in Regulation 33 of Government Notice R.543 **(Refer to Annexure J)**;

l) Specialist studies must be accompanied by fully completed specialist forms, titled “Details of specialists and declaration of interest” **(Refer to Annexure L)**.

This report represents the Final Environmental Impact Assessment (EIA) Report compiled in terms of the 2010 NEMA EIA Regulations for the proposed filling stations development.

1.2 Environmental Assessment Practitioner (EAP)

The new Environmental Regulations require that the relevant details of the Environmental Assessment Practitioner be included as part of the EIAR. In this regard, attached as ***Annexure D***, is a copy of the CV of the EAP for this project, Ms. Lizelle Gregory from Bokamoso Landscape Architects and Environmental Consultants CC. In summary details of the EAP are indicated below:

- **Name:** Lizelle Gregory
- **Company:** Bokamoso Landscape Architects and Environmental Consultants CC
- **Qualifications:** Registered Landscape Architect and Environmental Consultant (degree obtained at the University of Pretoria) with more than 20 years' experience in the following fields:
    - Environmental Planning and Management;
    - Compilation of Environmental Impact Assessments;
    - Landscape Architecture; and
    - Landscape Contracting

Ms. L. Gregory also lectured at the Technicon of South Africa and the University of Pretoria. She is a registered member of the South African Council of the Landscape Architects Profession (SACLAP), the International Association of Impact Assessments (IAIA) and the Institute of Environmental Management and Assessment (IEMA).

1.3 Activities Applied for in Terms of NEMA

The Minister of Environmental Affairs and Tourism passed (in April 2006) Environmental Impact Assessment Regulations[1] (the Regulations) in terms of Chapter 5 of the National

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[1] Environmental Impact Regulations, 2006

Environmental Management Act, 1998[2] (NEMA). The Regulations replaced the environmental impact assessment (EIA) regulations, which were promulgated in terms of the Environmental Conservation Act, 1989[3] in 1997. The new regulations came into place on 3 July 2006. In June 2010 the Minister of Environmental Affairs (DEA) passed the Amended Environmental Impact Assessment Regulations in terms of Chapter 5 of the National Environmental Management Act, 1998 (NEMA). The Amended Regulations came into effect on 2 August 2010. The NEMA EIA Regulations' latest amendment was on 4 December 2014 where the Regulations and associated Listing Notices were amended. These 2014 NEMA EIA Regulations came into effect on 8 December 2014. The application for environmental authorization for the proposed Filling Stations Developments on Part of Remainder of Portion 22 and Part of Remainder of Portion 41 of the Farm Schietfontein 437 JQ was submitted on the 3rd of April 2014 and therefore the application must be made in terms of the New NEMA regulations that came into effect on 2 August 2010.

Notices No. R. 544, R. 545 and R. 546 of the 2010 Regulations list activities which require that the EIA Process be followed. The Activities listed in Notice No. R 544 and R. 546 require that a Basic Assessment Process be followed and the Activities listed in Notice No. R 545 requires that the Scoping and EIA process be followed.

(Please refer to Annexure B for a copy of the application submitted to the approving authority, NWREAD as well as Annexure C for the acceptance/approval letter)

The applicant is applying for the following listed activities:

Table 1: Listed Activities in Terms of Regulation No. R543.

Indicate the number and date of the relevant notice:	Activity No (s) (in terms of the relevant notice):	Describe each listed activity as per project description:
Listing Notice 1, R544, 18 June 2010		
Listing Notice	**9**	The construction of facilities or infrastructure

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[2] Act No. 107 of 1998

[3] Act No. 73 of 1989

<table>
<tr><td>1,
R544,
18 June 2010</td><td></td><td>exceeding 1000 meters in length for the bulk transportation of water, sewage or storm water –
(i) With an internal diameter of 0,36 meters or more; or
(ii) With a peak throughput of 120 liters per second or more;

excluding where:
a. Such facilities or infrastructure are for bulk transportation of water, sewage or storm water drainage inside a road reserve; or
Where such construction will occur within urban areas but further than 32 meters from a watercourse, measured from the edge of the watercourse.</td></tr>
<tr><td colspan="3"><i>Reason for Inclusion:</i>

There are no existing municipal services (water, storm water, sewage, electricity) available for the study area. If the applicant connects with any municipal services networks, it will be necessary to install infrastructure to connect the services of the study area to the nearest services connection points.

If on-site services are provided, it might also be necessary to install infrastructure that exceeds the thresholds as listed above, especially if the services of the 2 proposed filling stations are to be linked.

The applicability of this activity can only be confirmed during the EIA Phase. If confirmed during the EIA phase that this activity will not be triggered. This activity will be excluded and the applications forms submitted will be amended accordingly. Such amended application forms will be submitted with the EIA Report.</td></tr>
<tr><td>R544, (Listing Notice 1), 18 June 2010</td><td>11</td><td>The construction of:
i. Canals;
ii. Channels;
iii. Bridges;
iv. Dams;
v. Weirs;
vi. Bulk storm water outlet structures;
vii. Marinas;
viii. Jetties exceeding 50 square metres in size;
ix. Slipways exceeding 50 square metres in size;
x. Buildings exceeding 50 square metres in size; or
xi. Infrastructure or structures covering 50 square metres or more

Where such construction occurs within a watercourse</td></tr>
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<table>
<tr><td></td><td></td><td>or within 32 metres of a watercourse, excluding where such construction will occur behind the development set back line.</td></tr>
<tr><td colspan="3"><i>Reason for inclusion:</i>

There is a possibility that a non-perennial stream or wetland might be identified during a wetland study and therefore this activity should be included as there is a possibility for it to be triggered. There is also a possibility that some services/ infrastructure will be installed in the watercourse or in the watercourse buffer area. A non-perennial drainage line forms the eastern boundary of Portion 41.

If confirmed during the EIA phase that this activity will not be triggered. This activity will be excluded and the applications forms submitted will be amended accordingly. Such amended application forms will be submitted with the EIA Report.</td></tr>
<tr><td>R544, (Listing Notice 1), 18 June 2010</td><td>18</td><td>The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 5 cubic metres from:
i. A watercourse;
ii. The sea;
iii. The seashore;
iv. The littoral active zone, an estuary or a distance of 100 metres inland of the high-water mark of the sea or an estuary, whichever distance is the greater –

But excluding where such infilling, depositing, dredging, excavation, removal or moving:
a. Is for maintenance purposes undertaken in accordance with a management plan agreed to by the relevant environmental authority; or
b. Occurs behind the development setback line.</td></tr>
<tr><td colspan="3"><i>Reason for inclusion:</i>

There is a possibility that a non-perennial stream or wetland might be identified during a wetland study and therefore this activity should be included as there is a possibility for it to be triggered. There is also a possibility that some services/ infrastructure will be installed in the watercourse or in the watercourse buffer area. A non-perennial drainage line forms the eastern boundary of Portion 41.

If confirmed during the EIA phase that this activity will not be triggered. This activity will be excluded and the applications forms submitted will be amended accordingly. Such</td></tr>
</table>

amended application forms will be submitted with the EIA Report.		
R544, (Listing Notice 1), 18 June 2010	**22**	The construction of a road, outside urban areas: i. With a reserve wider than 13, 5 metres; or ii. Where no reserve exists where the road is wider than 8 metres; or iii. For which an environmental authorization was obtained for the route determination in terms of activity 5 in Government Notice 387 of 2006 or activity 18 in Notice 545 of 2010.
Reason for inclusion: Access roads need to be constructed for the proposed filling stations and the development is located outside the urban area and therefore this activity will be triggered.		
R544, (Listing Notice 1), 18 June 2010	**23**	The transformation of undeveloped, vacant or derelict land to – i. Residential, retail, commercial, recreational, industrial or institutional use, inside an urban area, and where the total area to be transformed is 5 hectares or more, but less than 20 hectares; or ii. Residential, retail, commercial, recreational, industrial or institutional use, outside an urban area and where the total area to be transformed is bigger than 1 hectare but less than 20 hectares; - Except where such transformation takes place – a. For linear activities; or b. For purpose of agriculture or afforestation, in which case Activity 16 of Notice No. R545 applies
Reason for inclusion: The proposed development of two filling stations is outside an urban area and where total area to be transformed for the filling station is more than 1 hectare and therefore this activity is applicable.		
R545, (Listing Notice 2), 18 June 2010		
R545, (Listing Notice 2), 18 June 2010	**3**	The construction of facilities or infrastructure for the storage, or for the storage and handling, of a dangerous good, where such storage occurs in

		containers with a combined capacity of more than 500 cubic metres.
Reason for inclusion: The proposed development of two filling stations will include storage and handling of dangerous goods, namely fuel. The containers for the fuel will have the following specifications: 6 tanks of 46 000ℓ for petrol and 8 tanks of 46 000ℓ for diesel. The total capacity of fuel for the proposed development will be 644 cubic metres.		
GNR 546, (Listing Notice 3), 18 June 2010		
GNR 546, (Listing Notice 3), 18 June 2010	**4**	The construction of a road wider than 4 metres with a reserve less than 13.5 metres. **(c) In North-West:** i. Outside urban areas, in: (aa) … (bb) … (cc) … (dd) … (ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional reserves; (ff) … (gg) … (hh) …
Reason for inclusion: The proposed development of two filling stations is situated in an area that is classified as a threatened ecosystem and an access road will need to be constructed. The Marikana Thornveld is identified as being vulnerable (not critical) according to the list of threatened ecosystems in terms of NEMBA.		
GNR 546, (Listing Notice 3), 18 June 2010	**13**	The clearance of an area of 1 hectare or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation. **(e) In North-West:** i. Outside urban areas in: (aa) … (bb) … (cc) … (dd) … (ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the

<table>
<tr><td></td><td></td><td>competent authority or in bioregional reserves;
(ff) …
(gg) …
(hh) …</td></tr>
<tr><td colspan="3"><i>Reason for inclusion:</i>

The proposed development of two filling stations is situated in an area that is classified as a threatened ecosystem and vegetation will need to be cleared for construction. The Marikana Thornveld is identified as being vulnerable (not critical) according to the list of threatened ecosystems in terms of NEMBA.</td></tr>
<tr><td>GNR 546, (Listing Notice 3), 18 June 2010</td><td>16</td><td>The construction of:
i. …
ii. …
iii. Buildings with a footprint exceeding 10 square metres in size; or
iv. Infrastructure covering 10 square metres or more

Where such construction occurs within a watercourse, measured 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.

(c) In North-West:
i. Outside urban areas, in:
(aa) …
(bb) …
(cc) …
(dd) …
(ee) …
(ff) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional reserves;
(gg) …
(hh) …</td></tr>
<tr><td colspan="3"><i>Reason for inclusion:</i>

The proposed development of two filling stations is situated in an area that is classified as a threatened ecosystem and possibly, construction within close proximity of a water course might occur. The Marikana Thornveld is identified as being vulnerable (not critical) according to the list of threatened ecosystems in terms of NEMBA.</td></tr>
</table>

As mentioned before, since the proposed development includes listed activities from Listing Notices No. R544, R545 and R546, an application for a full EIA process was lodged at the North West Department Economic Development, Environment, Conservation and Tourism. The reference number ***NWP/EIA/80/2013*** had been assigned to the application.

Please take note that the 2010 NEMA EIA Regulations were replaced by the Amended 2014 NEMA EIA Regulations on 4 December 2014, but due to the fact that the application was submitted in terms of the 2010 NEMA EIA Regulations, this application will be dealt with in terms of such Regulations. Once the Decision has been issued in terms of the 2010 NEMA EIA Regulations, such Decision will be regarded as a Decision issued in terms of the New 2014 EIA Regulations and all following procedures i.e. Amendment Applications, Appeals etc. must be made/ submitted in terms of the 2014 NEMA EIA Regulations. Refer to Chapter 8 – Transitional Arrangements and Commencement of the 2014 NEMA EIA Regulations.

Regulation 53 (3) of the 2014 NEMA EIA Regulations furthermore states "Where an application submitted in terms of the previous NEMA EIA Regulations, is pending in relation to the activity of which a component of the same activity was not identified under the previous NEMA Notices, but is now identified in terms of Section 24 (2) of the Act, the competent authority must dispense of such application in terms of the previous NEMA regulations and ***may***[4] *authorise the activity identified in terms of Section 24 (2) as if it was applied for, on condition that all impact of the newly identified activity and requirements of these Regulations have also been considered and adequately assessed."*

Section 24(2) Activities to be considered by NWREAD:

We perused the Amended 2014 NEMA EIA Regulations and decided to list the activities that will most probably be triggered in terms of such Regulations ***(Refer to Table 2 below).*** *The activities identified are very similar to that activities applied for in terms of the 2010 NEMA EIA Regulations and we therefore feel confident that all the activities as listed have been assessed.*

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[4] Take Note: This is not a must

Due to the fact that the 2014 Regulations are still new, we recommend that NWREAD rather dispense this application in terms of the 2010 NEMA EIA Regulations.

Table 2: 2014 Amended NEMA EIA Regulations: Listed Activities that will most probably be triggered

Listing Notice 1:		
R.983	*Activity 9*	*The development of infrastructure exceeding 1000 metres in length for the bulk transportation of water or storm water-* *(i) with an internal diameter of 0,36 metres or more; or* *(ii) with a peak throughput of 120 litres per second or more; excluding where-* *(a) such infrastructure is for bulk transportation of water or storm water or storm water drainage inside a road reserve; or* *(b) where such development will occur within an urban area.*
	Activity 10	*The development and related operation of infrastructure exceeding 1000 metres in length for the bulk transportation of sewage, effluent, process water, waste water, return water, industrial discharge or slimes* *(i) with an internal diameter of 0,36 metres or more; or* *(ii) with a peak throughput of 120 litres per second or more; excluding where-* *(a) such infrastructure is for bulk transportation of sewage, effluent, process water, waste water, return water, industrial discharge or slimes inside a road reserve; or* *(b) where such development will occur within an urban area.*
	Activity 12	*The development of-* *(i) canals exceeding 100 square metres in size;* *(ii) channels exceeding 100 square metres in size;* *(iii) bridges exceeding 100 square metres in size;* *(iv) dams, where the dam, including infrastructure and water surface area, exceeds 100 square metres in size;* *(v) weirs, where the weir, including infrastructure and water surface area, exceeds 100 square metres in size;* *(vi) bulk storm water outlet structures exceeding 100 square metres in size; (vii) marinas exceeding 100 square metres in size;* *(viii) jetties exceeding 100 square metres in size;* *(ix) slipways exceeding 100 square metres in size;* *(x) buildings exceeding 100 square metres in size;*

		(xi) boardwalks exceeding 100 square metres in size; or (xii) infrastructure or structures with a physical footprint of 100 square metres or more; where such development occurs- (a) within a watercourse; (b) in front of a development setback; or (c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse; - excluding- (aa) the development of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour; (bb) where such development activities are related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies; (cc) activities listed in activity 14 in Listing Notice 2 of 2014 or activity 14 in Listing Notice 3 of 2014, in which case that activity applies; (dd) where such development occurs within an urban area; or (ee) where such development occurs within existing roads or road reserves.
	Activity 19	*The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 5 cubic metres from- (i) a watercourse; (ii) the seashore; or (iii) the littoral active zone, an estuary or a distance of 100 metres inland of the high-water mark of the sea or an estuary, whichever distance is the greater- but excluding where such infilling, depositing , dredging, excavation, removal or moving- (a) will occur behind a development setback; (b) is for maintenance purposes undertaken in accordance with a maintenance management plan; or (c) falls within the ambit of activity 21 in this Notice, in which case that activity applies.*
	Activity 24	*The development of- (i) a road for which an environmental authorisation was obtained for the route determination in terms of activity 5 in Government Notice 387 of 2006 or activity 18 in Government Notice 545 of 2010; or (ii) a road with a reserve wider than 13,5 meters, or where no reserve exists where the road is wider than 8 metres;*

		but excluding- (a) roads which are identified and included in activity 27 in Listing Notice 2 of 2014; or (b) roads where the entire road falls within an urban area.	
	Activity 27	*The clearance of an area of 1 hectares or more, but less than 20 hectares of indigenous vegetation, except where such clearance of indigenous vegetation is required for- (i) the undertaking of a linear activity; or (ii) maintenance purposes undertaken in accordance with a maintenance management plan*	
	Activity 28	*Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for agriculture or afforestation on or after 01 April 1998 and where such development: (i) will occur inside an urban area, where the total land to be developed is bigger than 5 hectares; or (ii) will occur outside an urban area, where the total land to be developed is bigger than 1 hectare; excluding where such land has already been developed for residential, mixed, retail, commercial, industrial or institutional purposes.*	
Listing Notice 2:			
R. 984	*Activity 4*	*The development of facilities or infrastructure, for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of more than 500 cubic metres.*	
Listing Notice 3:			
R. 985	*Activity 4*	*The development of a road wider than 4 metres with a reserve less than 13,5 metres.*	*(c) In North-West: i. Outside urban areas, in: (aa) … (bb) … (cc) … (dd) … (ee) Critical biodiversity areas (Terrestrial Type 1 and 2) as identified in systematic biodiversity plans adopted by the competent authority or in bioregional reserves; (ff) …*

			(gg) … *(hh) …*
	Activity 12	*The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of required for maintenance purposes undertaken in accordance with a maintenance management plan.*	*a) In Eastern Cape, Free State, Gauteng, Limpopo, North West and Western Cape provinces:* *i. Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or indigenous vegetation is prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004;* *ii. Within critical biodiversity areas identified in bioregional plans;* *iii. Within the littoral active zone or 100 metres inland from high water mark of the sea or an estuarine functional zone, whichever distance is the greater, excluding where such removal will occur behind the development setback line on erven in urban areas; or* *iv. On land, where, at the time of the coming into effect of this Notice or thereafter such land was zoned open space, conservation or had an equivalent zoning.*
	Activity 14	*The development of-* *(i) canals exceeding 10 square metres in size ;* *(ii) channels exceeding 10 square metres in size;* *(iii) bridges exceeding 10*	*(e) In North West:* *Outside urban areas, in:* *(aa) A protected area identified in terms of NEMPAA;* *(bb) National Protected*

		square metres in size; *(iv) dams, where the dam, including infrastructure and water surface area exceeds 10 square metres in size;* *(v) weirs, where the weir, including infrastructure and water surface area exceeds 10 square metres in size;* *(vi) bulk storm water outlet structures exceeding 10 square metres in size;* *(vii) marinas exceeding 10 square metres in size;* *(viii) jetties exceeding 10 square metres in size;* *(ix) slipways exceeding 10 square metres in size;* *(x) buildings exceeding 10 square metres in size;* *(xi) boardwalks exceeding 10 square metres in size; or* *(xii) infrastructure or structures with a physical footprint of 10 square metres or more; where such development occurs* *(a) within a watercourse* *(b) in front of a development Setback, or* *(c) if no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse* *excluding the development of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or*	*Area Expansion Strategy Focus areas;* *(cc) World Heritage Sites;* *(dd) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority;* *(ee) Sites or areas identified in terms of an International Convention;* *(ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;* *(gg) Core areas in biosphere reserves; or .* *(hh) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core areas of a biosphere reserve.*

		harbour.	

1.4 The Town Planning Process

The Town Planning Application will be lodged with the Madibeng Local Municipality in terms of Section 96 (1) of the Town Planning Ordinance, 1986 (Ordinance 15 of 1986). The purpose of the application is for the addition of land use rights to make provision for a public garage/filling station.

1.5 Scope of Work and Approach to the Study

An application form for environmental authorisation of the relevant activities as well as an Environmental Scoping Report has been submitted to the Department of Rural, Environmental and Agricultural Development: North West **(NWREAD)**. An investigative approach was followed and the relevant physical, social, economic and institutional environmental aspects were assessed.

The scope of work includes the necessary investigations, to assess the suitability of the study area and the surrounding environment for the proposed activities. The scoping exercise identified the anticipated environmental aspects in an issues matrix and it also supplied a preliminary significance rating for the impacts identified. The scoping process also assessed the possible impacts of the proposed development on the surrounding environment (including the interested and affected parties).

This document represents the EIA for the proposed development. The EIA must be in line with Section 32 of the National Environmental Management Act (NEMA), 1998 (Act 107 of 1998) and the Approved Plan of Study for EIA that was submitted as part of the Scoping Report.

The EIA takes into consideration the environment that may be affected by the activity and the manner in which the physical, biological, social, economic and cultural aspects of the environment may be affected by the proposed activity. A description of the property on which the activity is to be undertaken and the location of the activity on the property are described. A description of the proposed activity and any feasible and reasonable alternatives were identified. In addition, a description of the need and desirability of the proposed activity, including advantages and disadvantages that the proposed activity or alternatives may have, on the environment and community that may be affected by the activity are included.

An identification of all legislation and guidelines that we are currently aware of is considered in the preparation of this EIA Report. Furthermore, a description of environmental issues and potential impacts, including cumulative impacts, are identified and discussed. Information on the methodology that will be adopted in assessing the potential impacts is furthermore identified, including any specialist studies or specialised processes that were/ should be undertaken. The EIA Report eventually determines whether a proposed project should receive the “go-ahead” or whether the “no-go” option should be followed. If the EAP recommends that the project receive the “go-ahead”, it will (in most cases) be possible to mitigate the issues identified to more acceptable levels. Reference is also made to the mitigation of identified impacts or for further studies that may be necessary to facilitate the design and construction of an environmentally acceptable facility.

Details of the Public Participation Process are also included. Details of the Public Participation process are included:

(i) the steps that were taken to notify potentially interested and affected parties of the application;
(ii) proof that the notice boards, advertisements and notices, notifying potentially interested and affected parties of the application, have been displayed, placed or given;
(iii) a list of all persons or organizations that were identified and registered;
(iv) a summary of the issues raised by the interested and affected parties; and

(v) correspondence to and from Interested and Affected Parties.

The mitigation measures and guidelines that are listed in the EIA Report are also summarised in a user-friendly document named an Environmental Management Programme (EMPr). An EMPr is also a requirement of the EIA Process. ***(Refer to Annexure J for the EMPr).***

2. REGISTERED OWNERS AND TITLE DEEDS

The property is registered as follows:

Table 3: Registered Land Owner[5]

Ownership	**Property Description**	**Size (ha)**	**Title Deed Nr.**
Q4 Commercial-Properties (Pty) Ltd	Remainder of Portion 22 of the farm Schietfontein 437 JQ	63.0749	T26882/2014
Q4 Commercial-Properties (Pty) Ltd	Remainder of Portion 41 of the farm Schietfontein 437 JQ.	33.2015	T15914/2014

3. LOCALITY OF THE PROPOSED DEVELOPMENT

The proposed Filling Stations development will take place on a part of the Remainder of Portions 22 and 41 of the Farm Schietfontein 437 JQ, North West Province.

The study area lies at the crossing of the N4 Highway and Road M21 (Lucas Mangope Drive) on the farm Schietfontein 437 JQ, with Remainder of Portion 22 located in the north-western quadrant of the crossing and Remainder of Portion 41 located diagonally to the opposite (in the south-eastern quadrant of the crossing). ***(Refer to Figure 2 – Locality Map)***.

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[5] Take note: The applicant is the owner of the study area

4. EXISTING ZONING AND LAND USE AND THE PROPOSED LAND-USE

4.1 Existing Zoning and Land Use

The current zonings on the two properties are agriculture. A conference centre with accommodation facilities is located on a section of the Remainder of Portion 41. This conference centre will continue to operate on the farm and it will not be affected by the proposed new filling stations. **Remainder of Portion 22 accommodates some old structures related to agricultural activities, but such structures are not located within the smaller area (the portion to be subdivided) to be developed for a filling station.** According to the available topographical data maps (Planet GIS), the entire Remainder of Portion 22 and approximately 50% of Remainder of Portion 41 have some grazing potential.

4.2 Proposed Zoning and Land Use

Applications for the establishment of a townships in terms of Section 96 of the town planning and townships Ordinance 15 of 1986 have been submitted for both the properties (separate applications were submitted). The one proposed township on Part of the Remainder of Portion 22 of the farm Schietfontein 437 JQ will be known as Q4 City and the township on Part of the Remainder of Portion 41 of the farm Schietfontein 437 JQ will be known as Q4 City Extension 1.

The proposed zoning for Q4 City will be Special for a filling station and service area and purposes incidental thereto. The following activities will be included:

- Storage and retail selling of vehicle fuels and lubricants;
- Working bay for emergency repairs to vehicles;
- Shop/convenience store;
- Restaurant;
- Confectionary;
- Place of refreshment;
- Take-away facility and drive-thru facility;

- Automatic teller machines;
- Administrative offices;
- Ablution facilities;
- Refuse/service yard;
- Parking site for buses and trucks including a canteen and kitchen;
- Some staff training facilities; and
- Two residential units for management.

The proposed zoning for Q4 City Extension 1 will be similar to the zoning of Q4 City: Special for a filling station and service area. The following activities will be included:

- Storage and retail selling of vehicle fuels and lubricants;
- Working bay for emergency repairs to vehicles;
- Shop/convenience store;
- Restaurant;
- Confectionary;
- Place of refreshment;
- Take-away facility and drive-thru facility;
- Automatic teller machines;
- Administrative offices;
- Ablution facilities;
- Refuse/service yard;
- Parking site for buses and trucks including a canteen and kitchen;
- Some staff training facilities; and
- Two residential units for management.

5. ALTERNATIVES IDENTIFIED

Alternatives should be considered as a norm within the Scoping Process. The alternatives discussed under this section include the "no-go" option, locality alternatives, land use alternatives and layout alternatives.

5.1 The "No-Go" Alternative

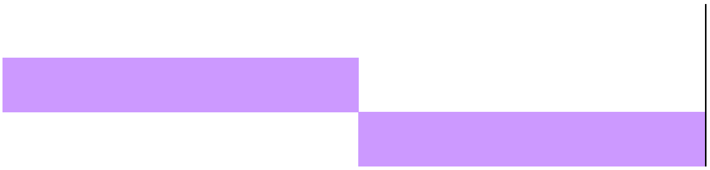
The "No-Go" option entails that the development area stays in its current state.

The sections/corners on the farm portions that are proposed to be developed into filling stations are located at the N4 Platinum highway off-ramp to Ga-Rankuwa via the M21. As mentioned the study area is approximately 2.6 km from the Brits Toll Plaza. Due to the distance between the Doornpoort filling station and the Total Petroport in Rustenburg, many trucks currently overnight at the Brits Toll Plaza. This is dangerous for night traffic at the Brits toll plaza as there is not sufficient space for large transport trucks overnighting. Should they be prohibited from overnighting at the toll plaza it can be a great threat on the highway if the driver is tired. Formalizing a truck stop at the proposed filling station will increase security in the area and prevent the overnighting of trucks at the toll plaza.

At present the study area is unutilised and if the "no-go" option is followed, this will most probably remain the *status quo* of the land. The ecological and conservation potential of the land is regarded as low, because it is affected by the edge effects of the freeway. According to the available provincial data, the study area has low crop production potential, but is has some grazing potential. The usage of land at such a busy intersection for grazing is a risk, because the property will be more exposed to possible livestock-theft exercised from the adjacent freeway and provincial road.

Diagram 1: Environmental issues - "No-Go" Option

Issue	Short term	Medium term	Long Term	Impact	
Geology and soils				Positive	If no development takes place it will not have a significant impact on the geology or hydrology of the study area, especially in the short term. Indirect impacts created by the edge effects of the N4 highway and
	🟥			Neutral	
		🟥	🟥	Negative	

Hydrology		Positive Neutral Negative	surrounding developments could however, in the long term, lead to a decrease in vegetative coverage and even to exposed areas. Erosion, siltation and water pollution problems could then be caused. This will lead to disturbance of the soil and possible loss of topsoil. Changes in the surface drainage patterns could also occur.
Vegetation		Positive Neutral Negative	If no development takes place, the impacts on the fauna and flora and bio-diversity will not be significant in the short term. Indirect impacts created by edge effects of the N4 Platinum highway and surrounding developments and associated activities could, in the long term, have an impact on the ecological potential and bio-diversity of the vegetation of the study area. It will lead to a decrease of vegetative cover due to potential overgrazing by cattle and game. This will lead to the decrease of habitat available for faunal species and therefore their presence will decline.
Fauna		Positive Neutral Negative	
Social		Positive Neutral Negative	If no development takes place the social impact in the short term remains neutral however it could turn negative in the long term due to safety issues that can develop. Livestock theft risks will also increase if the study area is used for grazing.
Economic		Positive Neutral Negative	If no development takes place the economical impact will remain unchanged for the long and short term.

Note: *The "no-go" option is predominantly neutral in the short and medium term, and turns negative in the long term.*

Diagram 2: Environmental issues - Proposed development of filling stations

Issue	**Short term**	**Medium term**	**Long Term**	**Impact**	
Geology and soils				Positive Neutral Negative	In the short term (the construction phase), the proposed development will have a negative impact on the soils and hydrology of the study area. It is, however possible to mitigate the impacts to acceptable levels. The proposed filling stations could result in groundwater pollution and pollution of the storm water drainage system due to the spilling and leaking of petrol, diesel and oil and mitigation measures will have to be implemented during the
Hydrology				Positive Neutral Negative	

			operational phase. Effective temporary and permanent storm water management and guidelines to reduce impacts on drainage lines and channels will have to be implemented during all the development phases.
Vegetation		Positive Neutral Negative	The proposed development will have a negative impact on the vegetation and the fauna of the study area in the short and medium term. The eradication of invasive species will be implemented as part of the development. This programme will ensure a more natural environment and decrease the spreading of alien and invasive plant species. This more natural environment will promote fauna to inhabit the area.
Fauna		Positive Neutral Negative	
Social		Positive Neutral Negative	From a social, institutional and economical point of view, the proposed development will have positive impacts. However, the proposed filling stations could have a negative economical impact on existing filling stations in the surrounding area. The construction and operational phase of the development will create some temporary and permanent job opportunities.
Economic		Positive Neutral Negative	

Note: *From the preliminary investigations that were done, it is anticipated that the proposed development option is predominantly negative in the short term, turns neutral in the medium term and then positive in the long term.*

5.2 Layout Alternatives

There is no actual layout alternative for the proposed filling station as the layout is already compact and structured to be feasible. The orientation and designs of the buildings as well as the designs of the forecourts and associated facilities, mainly depicted the layouts of the two filling stations. Some access and off-ramp alternatives were however considered. ***Refer to Figure 4 for the preferred layout and refer to Figure4a and b for other access alternatives considered.***

During the public participation process as well as the Scoping phase it became evident that the surrounding landowners would like to know how they can gain easy access to their farms as the "shortcut" across the filling station site will now be developed into the filling station on the Remainder of Portion 22 (the study area located in the north-western quadrant). This issue was discussed with the town planner and developer and three alternatives were considered. ***Refer to Annexure H5 for letter from the affected land-owners and refer to Annexure M for the proposed new access solution to the properties that are affected. Take note that the affected I&APs confirmed that they are satisfied with the access alternative for the "short-cut".***

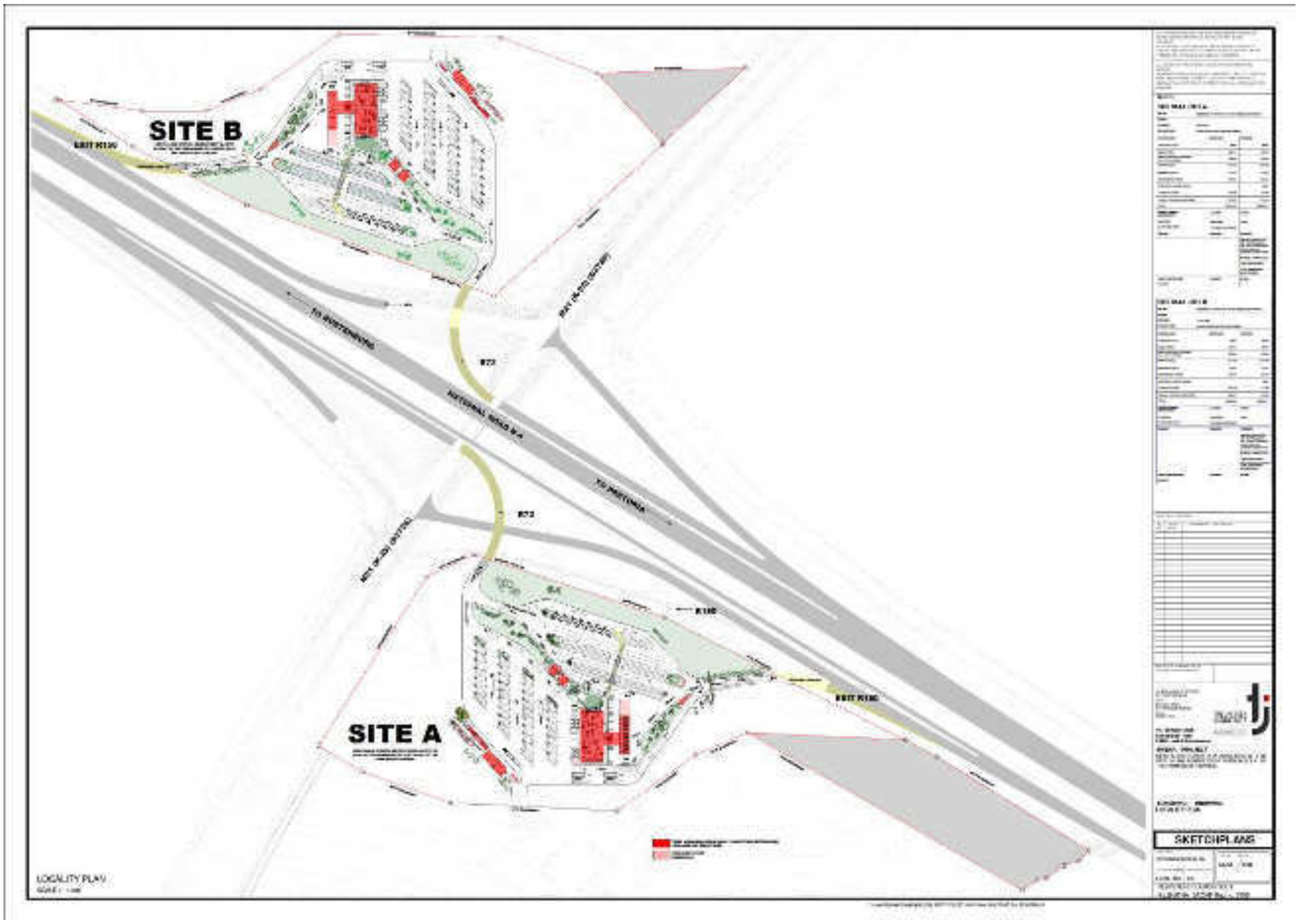


Figure 4 – Layout Map

5.3 Locality Alternatives

The proposed development is located about 32km from the Engen Doornpoort One-Stop at Dr. Swanepoel Avenue in the east and about 80km from the Total Magalies Petroport in the West near Rustenburg, both on the N4 highway. The proposed Q4 City is also located about 2.6km to the east of the Brits Toll Plaza and about 4.5km to the east of the planned PWV6 Route. The location of the proposed facilities complies with the SANRAL minimum requirements of 30km for facilities, which serves traffic in the range 5,000 to 50,000 vehicles per day. Therefore, this site is regarded as the preferred locality in terms of access to the site and serving the needs on the N4 Platinum highway.

5.4 Land-Use Alternatives

5.4.1 Filling Stations with training facility (Alternative 1 - Preferred alternative)

The proposed site for the filling stations is located along the N4 Platinum highway, which is the direct route between Pretoria and Rustenburg, the site is also at the off-ramp. The proposed land use for a "one-stop" filling station will be the most suitable for the area in the sense that there will be a filling station for people commuting between Pretoria and Rustenburg or between Brits and Pretoria. The applicant is of the opinion that the proposed filling station will be a positive social and economical contribution, especially if the proposed training facility is also implemented. A training facility will be developed as part of one/ both of the proposed new filling stations.

5.4.2 Filling Stations (Alternative 2)

The proposed site for the filling stations is located along the N4 Platinum highway, which is the direct route between Pretoria and Rustenburg, the site is also at the off-ramp. The proposed land use for a "one-stop" filling station will be the most suitable for the area in the sense that there will be a filling station for people commuting between Pretoria and Rustenburg or between Brits and Pretoria. The applicant is of the opinion that the proposed filling station will be a positive social and economical contribution, especially if the proposed training facility is also implemented.

5.4.3 Agriculture

The study area is too small for agricultural activities, and according to GIS data the study area is located on an area with high grazing capacity ***(Refer to figure 5 – Provincial Agricultural Potential Map)***. The area to be developed as filling stations is small and no signs of crop production were visible on any of the two application sites. In line with the GIS data base, the study area is not suitable for controlled extensive agriculture. According to the soils scientist who conducted a soil survey as part of the wetland delineation study, both of the sites are small and do not constitute viable agronomic units when viewed in isolation and the presence of the N4 highway and the provincial and local roads leads to disaggregation and fragmentation of the land. The climate of the area is restrictive to regular high yields of agronomic crops. These findings are supported by the lack of recent cultivation activities on the sites. ***Refer to Annexure F10 for Agricultural Potential input***

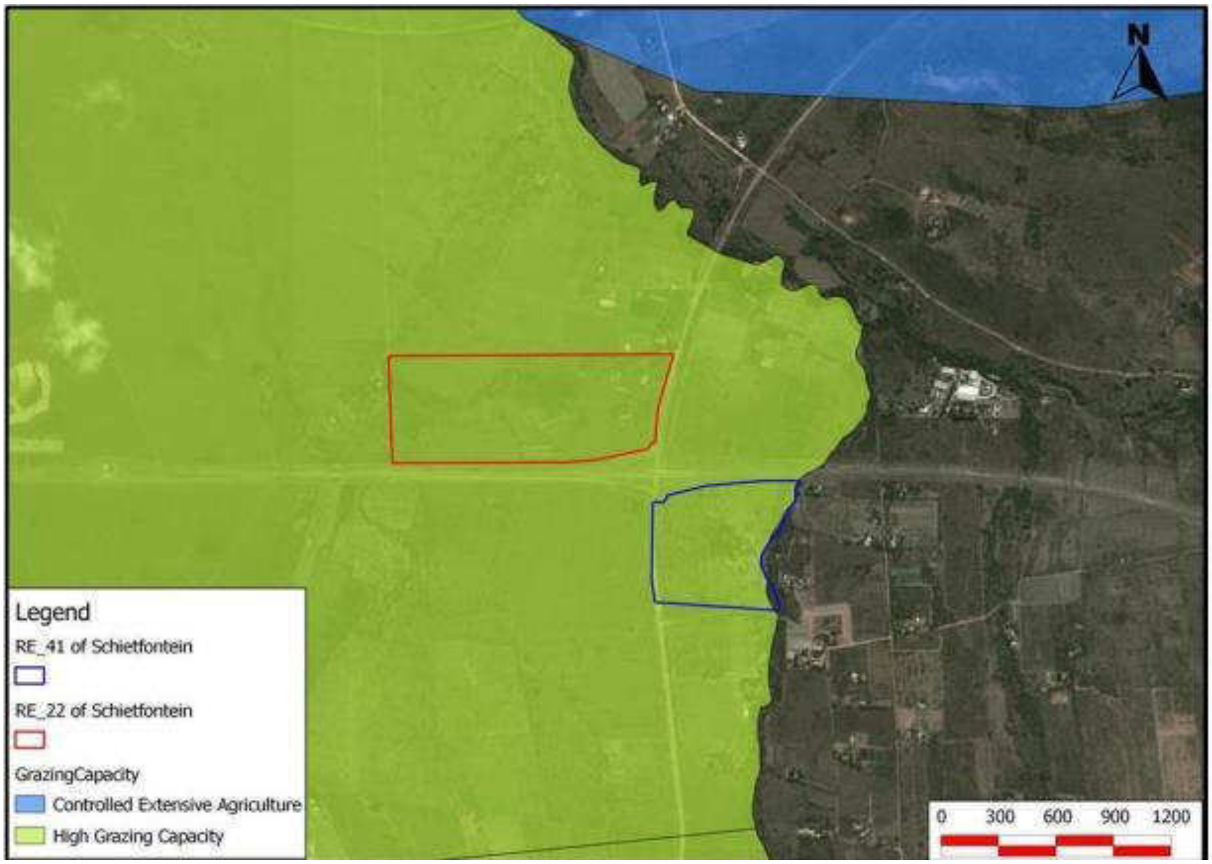


Figure 5 – Agricultural Potential Map

5.4.4 Conservation

The application site is surrounded by agricultural land uses and the land is predominantly disturbed and degraded, especially along the N4 Platinum highway and Road M21, where signs of edge effects are already visible.

6. THE DESCRIPTION OF THE BIOPHYSICAL AND SOCIO-ECONOMICAL ENVIRONMENTS

This section briefly describes the biophysical and socio-economical environments, which are associated with the study area and its surroundings. This section is in addition concerned with the potential environmental impacts to be associated with the filling stations development, and indicate the anticipated adverse and beneficial environmental impacts. All potential impacts identified, whether beneficial or adverse will be investigated, assessed and addressed through the application of an impact significance assessment methodology.

The following incorporates a description of the physical and biological environment and the potential environmental impact of the proposed activity on the aforementioned environment(s) through the application of data obtained by means of a Geographic Information Systems (GIS) desktop study and inputs from various specialists.

6.1 THE BIO-PHYSICAL ENVIRONMENT

6.1.1 The Physical Environment

Les Holland Muter and Associates conducted an Engineering Geological Investigation **(Annexure F1)** for the proposed development of Q4 City filling stations and GCS Water and Environmental Consultants was appointed to conduct a Hydrogeological Investigation **(Annexure F2).** A wetland delineation **(Annexure F3)** was done by Terrasoil Science ***(Refer to Annexure F for these specialist reports).***

6.1.1.1 Geology and Soils

The site is situated in the area that is underlined between sedimentary rocks of the Pretoria group of the Transvaal sequence which are located on the south of the terrain and the igneous rocks of the Bushveld complex located to the north of terrain. The rocks were mainly norite and quartzite. The norites are very hard, greenish grey to black interbedded rocks when fresh and these rocks weather to a brownish-red to olive silty clay or a black highly plastic clay. The quartzite is hard, yellowish brown to light grey, thickly bedded rock when fresh and it weathers to reddish-brown silty sands and ravels.

The sites' terrain mainly consists of transported material containing thick horizons of colluvium and residual soils comprising of decomposed highly weathered sandstone. The general soil profile is mainly of thick horizons of transported soils have been derived from the nearby Magaliesburg mountain ridge and they vary between sand clay and clayey sand. The alluvial deposits occur on the eastern side on part of Remainder of Portion 41. The site's terrain has a fairly good internal drainage. On both the sites (Parts of Remainder of Portion 22 and Remainder of Portion 41) no rock outcrop or water conditions were perceived.

The Soil Mapping Unit comprises of Soil Zone I, II, III, and IV (Please refer to Figure 6 and 7 for an extraction of the soil zone map as attached to the Specialist Report):

- Soil Zone I(a) is generally a top layer of transported clayey sand colluvium to an average of 0.5m which is underlain by soft colluvial sandy silty clay to depths of 2m and becoming more firm at depth. These zones can be found both in parts of Remainder of Portion 22 and the Remainder of Portion 41.
- Soil Zone I(b) has a sandy clay top horizon to an average depth of 0.5m which is underlain by soft sandy clay materials to an average depth of 1.8m. These zones can be found only in part of Remainder of Portion 22.
- Soil Zone I(c) is composed of fissured and soft clayey sand horizon which is underlain by firm sandy clay material from 0.4m to the bottom of the trial pit.
- Soil Zone II has a thin cover of transported; soft, clayey sand overlies a pebble marker horizon at 0.3m below surface.
- Soil Zone III consists of a top layer of soft alluvial clayey sand underlain by firm clayey sand from an average depth of 0.6m.
- Soil Zone IV consists of a softly clayey sand top horizon to an average depth of 0.4m below ground surface which is underlain by firm clayey sand to depth in excess of 2.2m

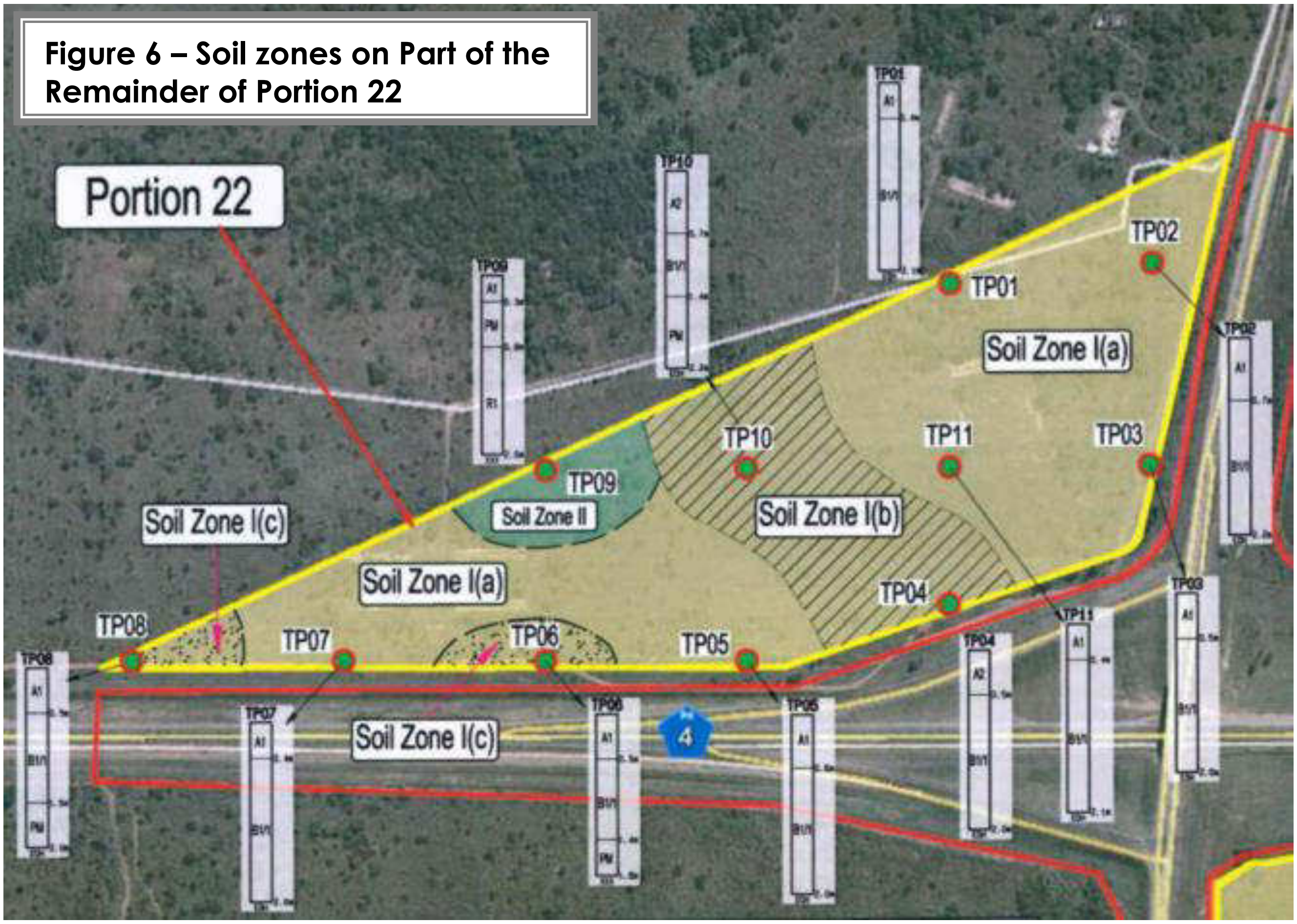


Figure 6 – Soil zones on Part of the Remainder of Portion 22

No seepage water was encountered during the site investigation. In some areas shallow water tables might occur in trial pits during the summer season (higher rainfall season). ***Refer to Annexure F1 for the Engineering Geological Investigation.***

Conclusions and Recommendations made in the Engineering Geological Investigation:

- Materials from soil zone II can be used as a fill material, still, it is recommended that construction materials be imported in order to optimise the development potential of the sites.
- There is adequate bearing capacity for the proposed structures but precautionary measures should be taken during the design and construction phase for the expected differential settlements associated with potential collapse and compression of the transported soils which may between the founding depth and bedrock.

- Proper site drainage must be provided to reduce the risk of subsurface materials from becoming saturated. The risk of differential settlement as well as to prevent scouring and erosion of the surface materials.
- No excavatability problems are foreseen for services throughout the sites except in soil zone II where slight difficulty might be experienced as there is a shallow bedrock head present,

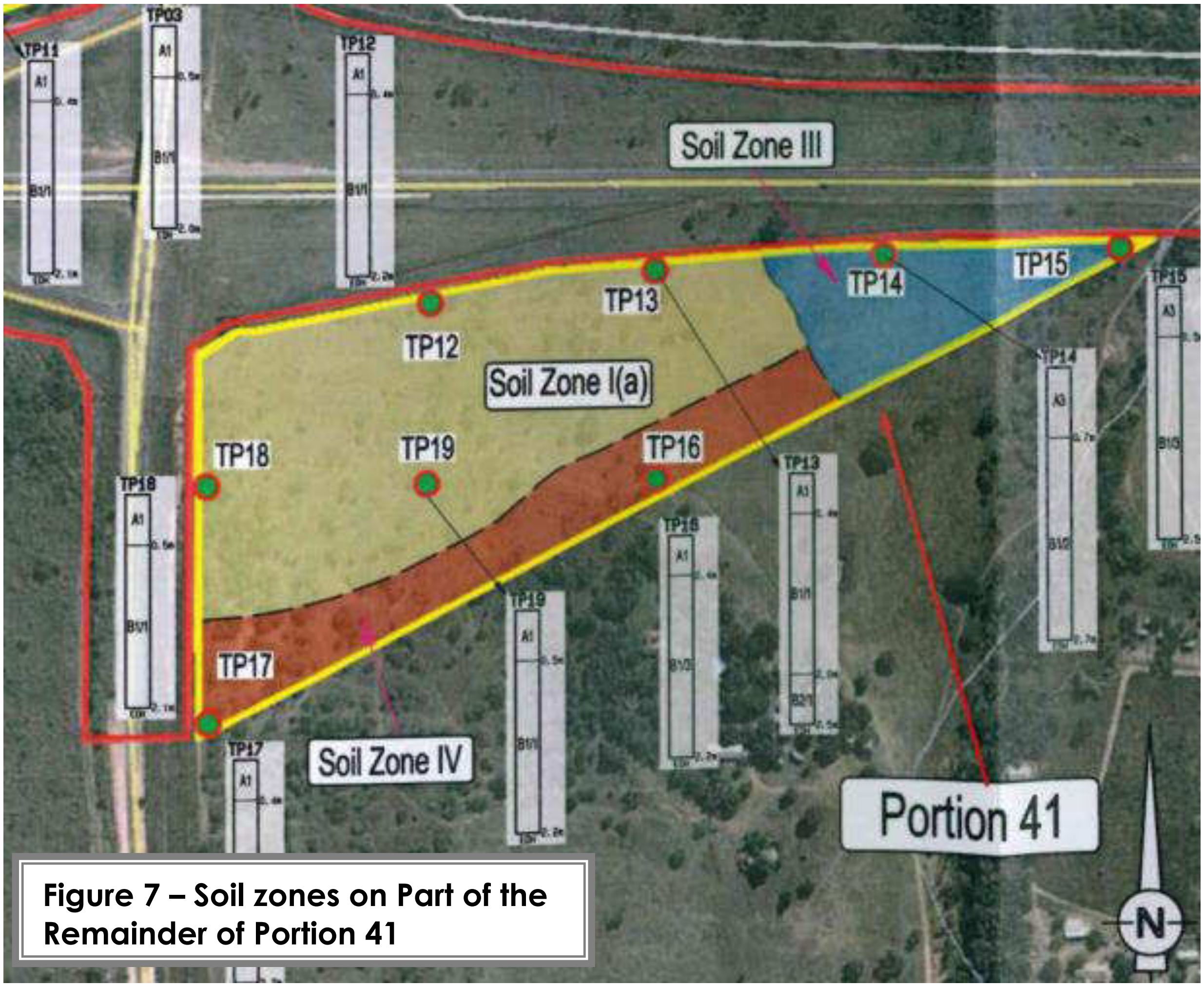


Figure 7 – Soil zones on Part of the Remainder of Portion 41

Issues and Impacts – Geology and Soils

Table 4: Issues and Impacts – Geology and Soils

	Issue/ Impact	Positive/ Negative/	Mitigation Possibilities

		Neutral ±	**High ☻ Medium ☺** **Low ◙** **Positive Impact - Not Necessary To Mitigate** ☼
1)	Expansive soils and possible collapsible soils	-	☻
2)	Hard excavations and blasting may be required in localized areas	-	☺
3)	Groundwater seepage	-	☺
4)	Erodibility	-	☻
5)	Stockpile areas for construction materials and topsoil	-	☺
6)	Low pH	-	☻

Discussion of issues identified, possible mitigation measures and significance of issue after mitigation

1) Stability of structures due to expansive and collapsible soils

All the soil horizons on the sites indicate low activities of expansiveness, however due to the thickness of the horizons that show potential expansiveness, greater amounts of heave can be expected at the surface in these areas. The sandy material in soil zone II may potentially collapse when subject to loads if the material is wet and pressed into a denser state.

Table 5: Significance of Issue 1 (Stability of structures due to expansive and collapsible soils) After Mitigation

Mitigation Possibilities **High ☻ Medium ☺ Low ◙** **Positive Impact/ Neutral - Not Necessary To Mitigate ☼**	Mitigation Already achieved √ Must be implemented during **P**lanning phase, **C**onstruction and/ or **O**perational phase **P/ C / O** Mitigation	Significance of Issue after mitigation Low/ eliminated **L / E** Medium **M** High **H** Not possible to mitigate, but not regarded as a fatal flaw **NP**
High ☻	**P & C -** The foundation recommendations supplied by the involved geotechnical engineers and the Engineering Geological Investigation must be implemented. The submerged fuel tanks to be embedded in a sandy soil layer in order to accommodate the potential expansive and collapsible conditions.	**L -** To be included in EMPr

Result:

Although the issue can be mitigated, the significance of the impact should still be determined / confirmed assessed in the Significance Rating Table

2) Hard excavations and blasting may be required in localized areas

Very hard excavation and possibly jackhammer work and blasting may be required in the areas of soil zone II. No problems are foreseen with excavatability except for some difficulty in the areas of soil zone II due to the presence of a possible shallow rock head.

Table 6: Significance of Issue 2 (Hard excavations and blasting may be required in localized areas) After Mitigation

Mitigation Possibilities **High** ☻ **Medium** ☺ **Low** ◙ **Positive Impact/ Neutral - Not Necessary To Mitigate** ☼	Mitigation Already achieved √ Must be implemented during **P**lanning phase, **C**onstruction and/ or **O**perational phase **P/ C / O** Mitigation	Significance of Issue after mitigation Low/ eliminated **L / E** Medium **M** High **H** Not possible to mitigate, but not regarded as a fatal flaw **NP**
Medium ☺	**P / C –** Blasting may only be done by specialists in the field and should be limited to localised areas. **P/ C** - Surrounding land-owners of properties in close proximity of blasting exercises must be informed/ warned (at least one week in advance) of blasting exercises that will take place on the study area. **C** - Warning signs to warn site workers and members of the public of blasting exercises must be erected at strategic points on the study area and the area where the blasting exercises will take place must be fenced off with barrier tape.	**L** - To be included in EMPr **L** - To be included in EMPr **L** - To be included in EMPr

Result:

Although the issue can be mitigated, the significance of the impact should still be determined / confirmed assessed in the Significance Rating Table

3) Groundwater seepage

No groundwater seepage was observed in any of the trial pits during the investigation but perched water conditions are possible in areas where a shallow rock head occurs during periods of high rainfall.

Table 7: Significance of Issue 3 (Groundwater seepage) After Mitigation

Mitigation Possibilities **High ☻ Medium ☺ Low ◙** **Positive Impact/ Neutral - Not Necessary To Mitigate ☼**	Mitigation Already achieved √ Must be implemented during **P**lanning phase, **C**onstruction and/ or **O**perational phase **P/ C / O** Mitigation	Significance of Issue after mitigation Low/ eliminated **L / E** Medium **M** High **H** Not possible to mitigate, but not regarded as a fatal flaw **NP**
Medium ☺	**P/ C -** Sub-surface drainage measures should be installed prior to any construction work in wet areas.	**L** - To be included in EMPr
	P/C - Groundwater should be removed from excavations.	**L -** To be included in EMPr
	C - Adequate drainage and services precautions should be implemented to reduce the risk associated with the expected shallow seasonal water table.	**L -** To be included in EMPr
	P/C - Proper damp proofing precautions should be taken and cognizance should be taken of the presence of shallow water in the design of underground containers. Subsurface containers will have to be anchored or weighted down to prevent uplift when emptied during the wet season.	**L -** To be included in EMPr

Result:

Although the issue can be mitigated, the significance of the impact should still be determined / confirmed assessed in the Significance Rating Table

4) Erodibility

The transported materials over the site vary between sandy clay and clayey sand. These materials are of low to medium plasticity and consequently they are susceptible to water erosion. Therefore, storm water might possibly cause serious erosion constraints to the proposed filling stations development should the vegetative cover be removed during construction.

Table 8: Significance of Issue 4 (Erodibility) After Mitigation

Mitigation Possibilities **High** ☻ **Medium** ☺ **Low** ◙ **Positive Impact/ Neutral - Not Necessary To Mitigate** ☼	Mitigation Already achieved √ Must be implemented during **P**lanning phase, **C**onstruction and/ or **O**perational phase **P/ C / O** Mitigation	Significance of Issue after mitigation Low/ eliminated **L / E** Medium **M** High **H** Not possible to mitigate, but not regarded as a fatal flaw **NP**
High ☻	**C –** Vegetation should only be removed in the section where construction will take place. **C –** Temporary storm water management measures need to be implemented during the construction phase.	**L -** To be included in EMPr **L -** To be included in EMPr

Result:

Although the issue can be mitigated, the significance of the impact should still be determined / confirmed assessed in the Significance Rating Table

5) Stockpile areas for construction materials and topsoil

Designated areas for stockpiling of construction materials must be specified by the Environmental Control Officer in an area that is already disturbed. Topsoil should be stockpiled as specified in the EMPr to ensure that the soil quality does not deplete and that the grass seed remain in the soil for later rehabilitation of any possible disturbed areas.

In addition to the impact discussed in the paragraph above, rainwater falling onto stockpiles may become polluted with dust originating from aggregate and other construction material, such as bitumen from pre-mix stockpiles. Therefore, stockpiles of topsoil should be correctly covered to prevent this as well as loss of topsoil by wind erosion.

The footprint of stockpile areas will be contaminated with the stored material and will require cleaning before rehabilitation.

Table 9: Significance of Issue 5 (Stockpile areas for construction materials and topsoil) After Mitigation

Mitigation Possibilities **High ☻ Medium ☺ Low ◙** **Positive Impact/ Neutral - Not Necessary To Mitigate ☼**	Mitigation Already achieved √ Must be implemented during **P**lanning phase, **C**onstruction and/ or **O**perational phase **P/ C / O** Mitigation	Significance of Issue after mitigation Low/ eliminated **L / E** Medium **M** High **H** Not possible to mitigate, but not regarded as a fatal flaw **NP**
Medium ☺	**C** - Remove vegetation only in designated areas for construction.	**M** - To be included in EMPr
	C - Rehabilitation works must be done immediately after the involved works are completed	**M** - To be included in EMPr

	C -All compacted areas should be ripped prior to them being rehabilitated/landscaped;	**M - To be included in EMPr**
	P/C - The top layer of all areas to be excavated must be stripped and stockpiled in areas where this material will not be damaged, removed or compacted. This stockpiled material should be used for the rehabilitation of the site and for landscaping purposes	**M - To be included in EMPr**
	C - Strip topsoil at beginning of works and store in stockpiles no more than 1,5 m high in designated materials storage area.	**M - To be included in EMPr**
	C – Stockpiles should be covered correctly	**M - To be included in EMPr**

Result:

Although the issue can be mitigated, the significance of the impact should still be determined / confirmed assessed in the Significance Rating Table

6) Low pH

The pH values of the soils are on average 5.3, which is low (<7). This may be slightly aggressive to concrete or iron pipes.

Table 10: Significance of Issue 6 (Low pH) After Mitigation

Mitigation Possibilities **High ☻ Medium ☺ Low ◙** **Positive Impact/ Neutral - Not Necessary To Mitigate ☼**	Mitigation Already achieved √ Must be implemented during **P**lanning phase, **C**onstruction and/ or **O**perational phase	Significance of Issue after mitigation Low/ eliminated **L / E** Medium **M** High **H**

	P/ C / O Mitigation	Not possible to mitigate, but not regarded as a fatal flaw **NP**
High ☺	**P / C –** The use of non-ferrous metal pipes or plastic pipes is recommended for wet services.	**M -** To be included in EMPr

Result:

Although the issue can be mitigated, the significance of the impact should still be determined / confirmed and assessed in the Significance Rating Table

6.1.1.2 Hydrology:

Refer to Figure 10 for the Surface Hydrology Map, Annexure F2, Hydrogeological Investigation, and Annexure F3, Wetland Delineation.

6.1.1.2.a Surface Hydrology:

In general, the southern site (Remainder of Portion 22) and the northern site (Remainder of Portion 41) drain gently towards the north-west. Both sites are rather flat with slight slopes. The entire delineated sub-catchment, which accommodates both sites, falls within the A21J quaternary drainage area. **Refer to Figure 8, Surface Hydrology Map.**

A wetland feature was identified along the eastern boundary of the Remainder of Portion 41. No sign of lateral feeding mechanisms through the soils could be observed and it is therefore concluded that the main driver of the wetland/watercourse feature is surface runoff water from the site as well as upslope in the feature's catchment.

It is expected that the slope will be sufficient to allow for natural storm water drainage as well as for the installation of essential services. The topographical characteristics will have no detrimental effect on the development potential of the site.

- **Floodlines:**

The development area on the Remainder of Portion 22 is not subject to floods with an expected frequency of 1:50 years or 1:100 years. The proposed development area on the Remainder of Portion 41 is affected by the 1:100-year flood line. This has been certified on the Plan ***(attached to the Memorandum in Annexure F6***) by the relevant consulting engineer.

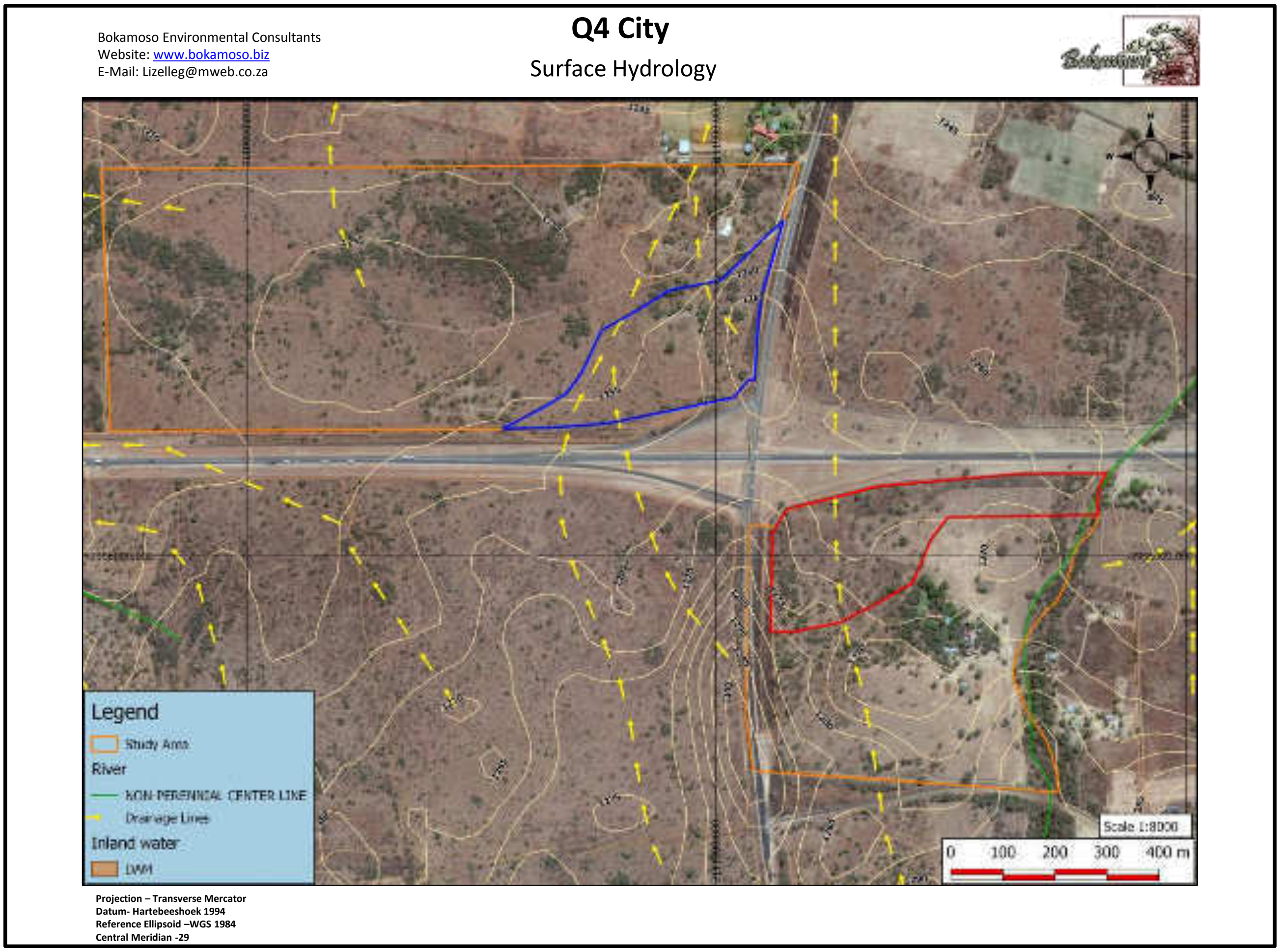


Figure 8 – Surface Hydrology Map

6.1.1.2. b Sub-Surface Hydrology:

GCS Water and Environmental Consultants were appointed to conduct a Hydrogeological Investigation on Part of Remainder of Portion 22 and Part of Remainder of Portion 41 of the Farm Schietfontein 437 JQ. ***Refer to Annexure F2 for the attached report***

- **Boreholes and yield on site**

Six boreholes (BH) were identified on the site. BH3 and BH4 are located on the east of Remainder of Portion 41 and used for irrigational and potable purposes. BH1, BH2 and BH5 are not in use and BH6 was found to be used to supply drinking water for cattle. The static water level ranged from 28.14 to 35.1 m below ground level. From interviews with owners and the depth of installed pumps, it was determined that all the boreholes are more than 90 m deep. Three monitoring wells (QB1, QB2 and QB3) and two production wells (QP1 and QP2) were drilled and constructed on the sites. QB1 and QB2 were dry with no shallow perched water level encountered. ***Please refer to Figure 9 for the location of the boreholes***

After conducting aquifer testing it could be concluded that Borehole 3 (BH 3) can be pumped at 0.5 ℓ/s over a 24-hour period, this is the borehole's recommended yield. Borehole 4 (BH4) has a recommended yield of 1 ℓ/s over a 24-hour period. Recommended borehole yield for Production Borehole 2 (QP2) is 1.5 ℓ/s over a 24-hour period. BH3, BH4 and QP2 can supply the site with 111.6m^3/day.

The average ground water level measured on the site was between 28 and 29.84 meters. This in turn is an indicator of no shallow/perched water tables (aquifers).

- **Groundwater Analysis**

BH3, BH4, QB3, QP1 and QP2 were subject to a groundwater analysis and groundwater samples were taken from all five these boreholes or wells. The hardness parameter for all five the boreholes is high and this may lead to scale on heat exchange surfaces or may result in an increase in soap required to produce lather when bathing and in household cleaning. No volatile petroleum hydrocarbons were detected in any of these five boreholes has been detected.

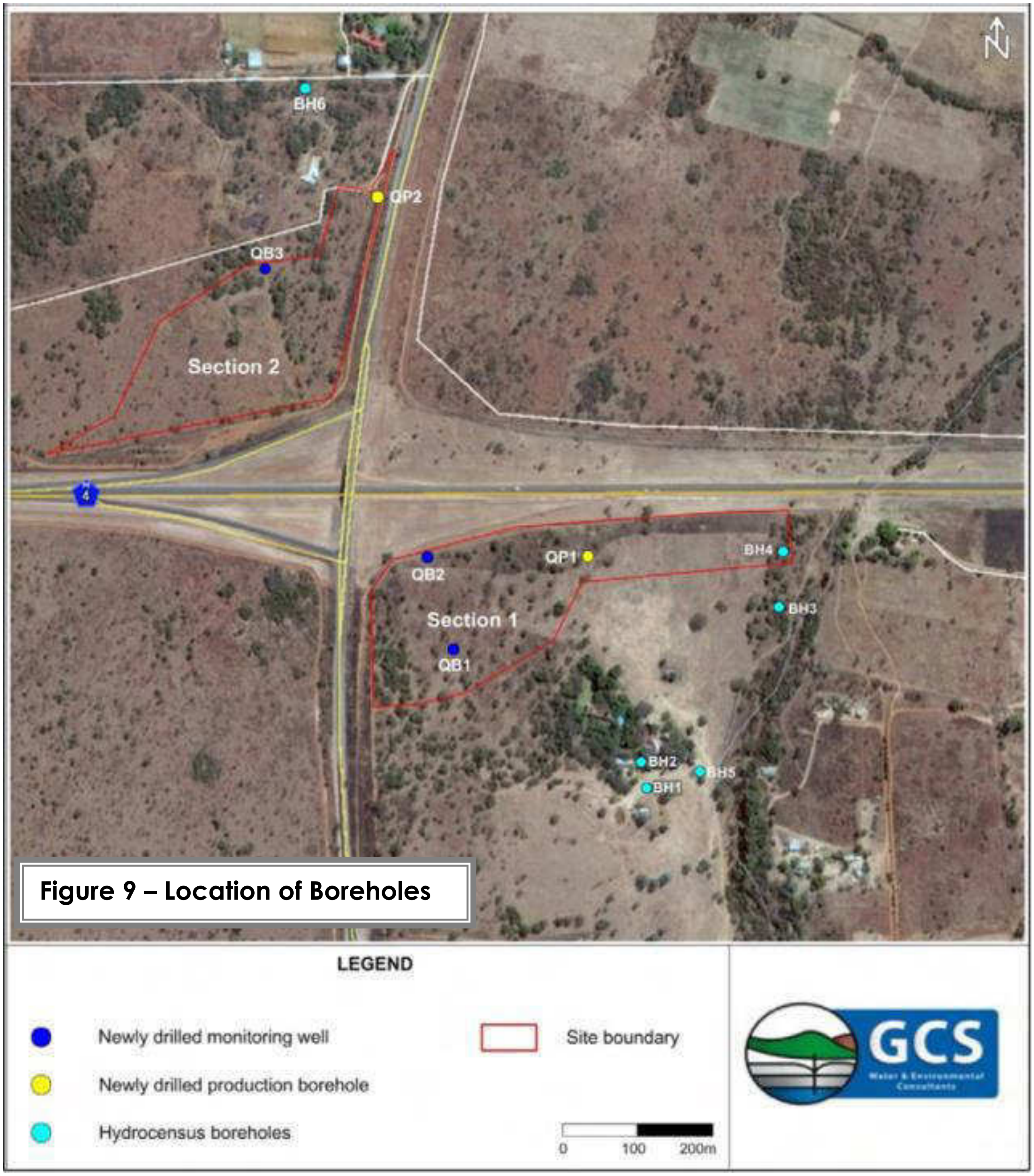


Figure 9 – Location of Boreholes

- ❖ **Existing and Proposed Abstraction**

Within the sub-catchment there is low scale abstraction present. On the northern site there is small scale stock watering and for 50 cattle only 1 m^3/day has to be abstracted. On the southern site 15 m^3/ day is abstracted for water supply on the conference and lodge facility.

After all tests were conducted, it was determined that the water demand for the proposed filling stations would be 0.44 ℓ/s (38.4kℓ/day) while the recommended sustainable abstraction according to the aquifer tests is 111.6m^3/day for the sites. The water balance calculations showed that groundwater can be abstracted as a viable source of water supply for the proposed filling stations.

Recommendations by the Hydrogeological Engineer:

- Adherence to the sustainable yield quantities for each borehole.
- Weekly monitoring of groundwater levels of each borehole is recommended and any fluctuation must be reported.
- Once the operational phase begins, quarterly groundwater monitoring must be done.

6.1.1.2.c Wetlands:

Terrasoil Science was appointed to conduct a wetland delineation for the proposed filling stations development. ***(Please refer to Annexure F3 for the attached report).*** The soils encountered on the southern site, the Remainder of Portion 41, ranged from red apedal profiles in the north-west to soils with yellow-brown apedal profiles with quartzite rocks in the south. The only wetland feature that could be identified is the drainage depression on the eastern boundary of the site on the Remainder of Portion 41. This identified feature fits the description of a "watercourse" with a riparian zone as wetland signs in the form of mottles and wetland vegetation are sporadic in the more recently transported alluvial soils in channel. No sign of lateral feeding mechanisms through the soils could be observed and it is therefore concluded that the main driver of the wetland/ watercourse feature is surface runoff water from the site as well as upslope in the feature's catchment. A buffer was not included as the best buffer concept on the site is adequate storm water management measures for any development to take place on the site. **Please refer to Figure 10 for the Wetland Delineation.**

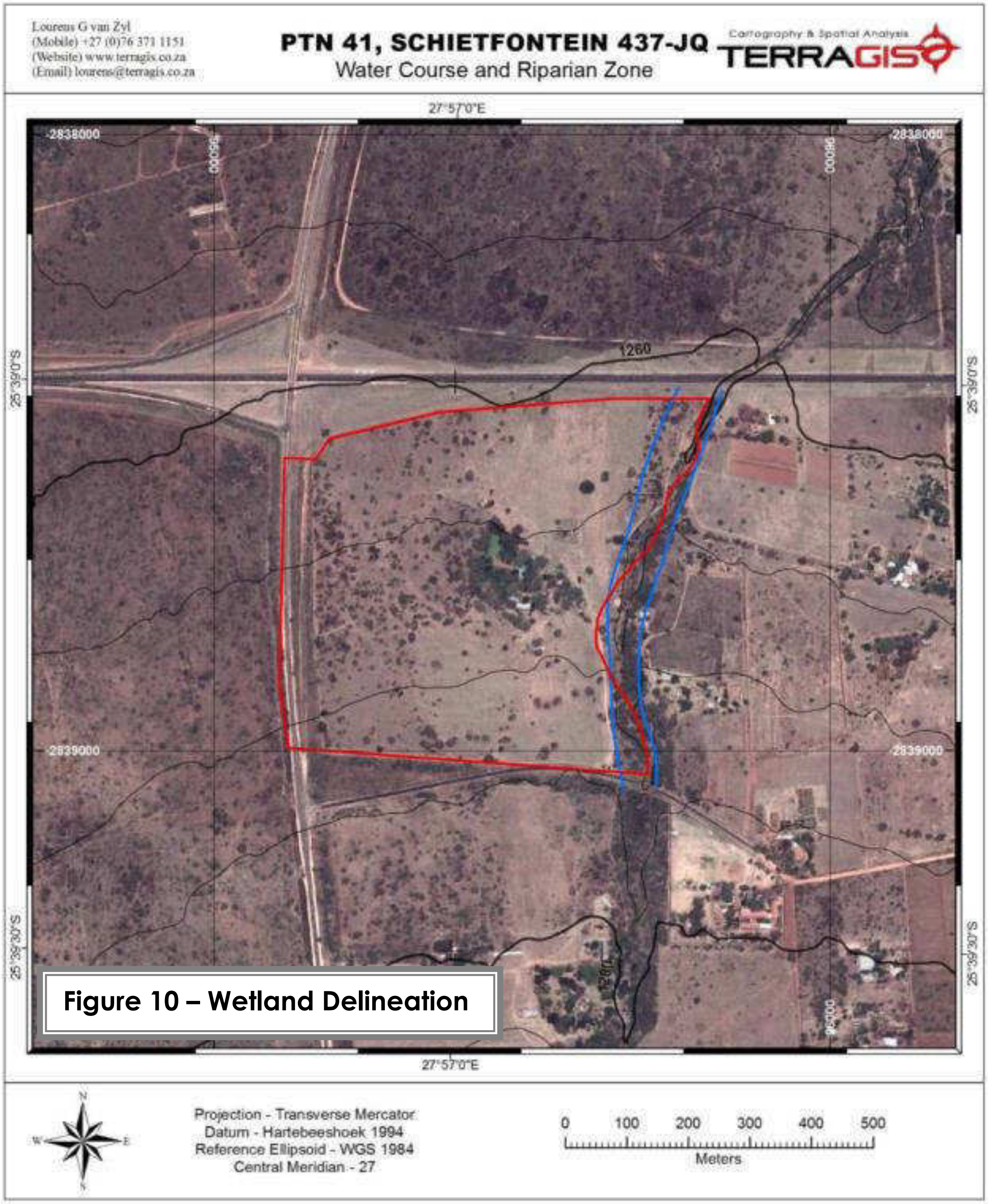


Figure 10 – Wetland Delineation

The soils encountered on the northern site, the Remainder of Portion 22, were of the Hutton, Shortlands and Arcadia forms. None of the soils exhibited any morphological signs of wetness (hydromorphism). No distinct drainage features were observed on the site. The surrounding area outside the site is characterised by two drainage depressions that qualify as water courses with associated riparian zones. However, due to the geology and specific soils these features also do not exhibit distinct signs of wetness (hydromorphism). It was concluded that there is no wetland on the site.

Recommendations from the Wetland Specialist:

- It is recommended that adequate storm water management structure be included for developments on the site in order to protect the drainage feature against erosion.

Issues and Impacts – Hydrology

Table 11: Issues and Impacts – Hydrology

	Issue/ Impact	**Positive/ Negative/ Neutral ±**	**Mitigation Possibilities High ☻ Medium ☺ Low ◘ Positive Impact/ Neutral - Not Necessary To Mitigate ☼**
7)	Siltation, erosion and water pollution could occur in the systems lower down in the catchment area if a storm water management plan is not implemented.	-	☺
8)	Surface and ground water pollution due to leaking equipment and spillages associated with the proposed filling stations.	-	☺

9)	Removal of vegetation coverage, increased hard surfaces and increased erosion, surface water pollution and siltation problems	-	☻

Discussion of issues identified, possible mitigation measures and significance of issue after mitigation

7) Siltation, erosion and water pollution could occur in the drainage line and systems lower down in the catchment area if a storm water management plan is not implemented.

Due to the presence of a wetland feature on Remainder of Portion 41 erosion, siltation and water pollution needs to be mitigated through a storm water management plan and temporary storm water management measures to prevent the pollution of the wetland and any downstream areas.

Table 12: Significance of Issue 7 (Siltation, erosion and water pollution) After Mitigation/ Addressing of the Issue

Mitigation Possibilities **High ☻ Medium ☺ Low ◙** **Positive Impact/ Neutral - Not Necessary To Mitigate ☼**	Mitigation Already achieved √ Must be implemented during **P**lanning phase, **C**onstruction and/ or **O**perational phase **P/ C / O** Mitigation	Significance of Issue after mitigation Low/ eliminated **L / E** Medium **M** High **H** Not possible to mitigate, but not regarded as a fatal flaw **NP**
Medium ☺	**P/ C / O –** The storm water design for the proposed filling stations development must be	**M** - To be included in EMPr

	designed to: - Reduce and/ or prevent siltation, erosion and water pollution. If erosion, siltation and water pollution is not addressed, the sustainability of the drainage and the open space systems lower down in the catchment area can be negatively impacted by the development. - Storm water runoff should not be concentrated as far as possible and sheet flow should be implemented. - The vegetation must be retained as far as possible, and rehabilitated if disturbed by construction activities to ensure that erosion and siltation do not take place. - No trees should be planted within five meters of the line of the water bearing services. - Temporary storm water management measures such as hay bales or sand bags need to be put into place during the construction phase.	

Result:

Although the issue can be mitigated, the significance of the impact should still be determined / confirmed and assessed in the Significance Rating Table

8) Spillages/leakages could cause ground water pollution

Surface and ground water pollution could occur due to leaking equipment and spillages associated with the proposed filling stations.

Table 13: Significance of Issue 8 (spillages/leakages could cause ground water pollution) After Mitigation/ Addressing of the Issue

Mitigation Possibilities **High** ☻ **Medium** ☺ **Low** ◙ **Positive Impact/ Neutral - Not Necessary To Mitigate** ☼	Mitigation Already achieved √ Must be implemented during planning phase, construction and/ or operational phase **P/ C / O**	Significance of Issue after mitigation Low/ eliminated **L / E** Medium **M** High **H** Not possible to mitigate, but not regarded as a fatal flaw **NP**
Medium ☺	**P/C/O -** Leak detection facilities must be installed around the storage tanks and vapour samples must be taken according to a six monthly monitoring programme.	**M - T**o be included in EMPr
	P/C/O - On-site monitoring boreholes should be installed, during the construction phase of the filling station and should be monitored closely. This should be done to protect the perched aquifer, which is vulnerable to pollution. -The surface water head and runoff should be monitored with the groundwater levels. For this purpose a continuous water level recorded should be installed in at least one of the monitoring boreholes. -The surface and groundwater	**M - T**o be included in EMPr

	quality should be monitored, especially surface water releases from industrial and other activities upstream. Industrial activities such as fuel stations, industries with potential for chemical spills should have.	
	P/C/O – To limit groundwater pollution areas around the perimeter of all structures should be appropriately paved, this also applies to areas used for the proposed storage tanks and peripheral infrastructure as it would limit/prevent groundwater contamination after spillage. A flexible sealant should be applied to joints between paved areas and the walls of buildings to prevent moisture reaching foundations.	**M - T**o be included in EMPr
	P/C – The construction camps as well as sanitation facilities should be correctly positioned to ensure that no wastewater runs freely into naturally vegetated areas or surrounding streets.	**M - T**o be included in EMPr
	C/O – In case of any spillages or leakages, the associated authorities should be notified.	**M - T**o be included in EMPr
	O – Weekly monitoring of groundwater levels of each of the boreholes to ensure sustainable water use.	**L - T**o be included in EMPr
	O – Quarterly groundwater monitoring must be conducted to ensure that there is no contamination of groundwater	**L - T**o be included in EMPr

	resources.	

Result:

Although the issue can be mitigated, the significance of the impact should still be determined / confirmed and assessed in the Significance Rating Table

9) Removal of vegetation coverage, increased hard surfaces and increased erosion, surface water pollution and siltation problems

The development will add hard surfaces such as paving and structures with roofs to the study area. The proposed development will also lead to the compaction of soils. The soil layers will thus become less permeable; storm water will be canalised rather than evenly spread. The quantity and speed of the storm water will increase significantly and the quality of the surface water will deteriorate, because of the lack of vegetative coverage. Erosion and siltation will also become a problem.

In order to address this issue, it will be necessary to compile a storm water management plan/ system for the proposed development. The storm water management plan must be designed to:

- Removal of vegetation need to be planned in such a way that all cover is not removed at once.
- Reduce and/ or prevent siltation, erosion and water pollution. If erosion, siltation and water pollution is not addressed, the long-term sustainability of the water bodies and open space systems lower down in the catchment area cannot be guaranteed; and
- Improve the surface and ground water quality of the study area as well as the lower lying areas within the catchment area.

Table 14: Significance of Issue 9 (Removal of vegetation coverage, increased hard surfaces and increased erosion, surface water pollution and siltation problems) After Mitigation/ Addressing of the Issue

Mitigation Possibilities **High ☻ Medium ☺ Low ◙** **Positive Impact/ Neutral - Not Necessary To Mitigate ☼**	Mitigation Already achieved √ Must be implemented during planning phase, construction and/ or operational phase **P/ C / O**	Significance of Issue after mitigation Low/ eliminated **L / E** Medium **M** High **H** Not possible to mitigate, but not regarded as a fatal flaw **NP**
High ☻	**P** - Compilation of a storm water management plan that will address storm water management during the construction and operational phases of the project	**M** - **T**o be included in EMPr and conditions of approval

Result:

Although the issue can be mitigated, the significance of the impact should still be determined / confirmed and assessed in the Significance Rating Table

6.1.1.3 Topography

The area slopes slightly to the north-east of the property and allows for adequate draining of storm water and the effective functioning of water borne sewerage systems. The area will be visible from the surrounding properties and roads that are on the same elevation and topography ***(Please refer to Figure 11- Dimensional Illustrations of the study area, and Figure 12-Visibility Map)***.

Potential Environmental Impacts- Topography:

- The prevailing topography provide for increased visibility from surrounding view sheds, and thus increased awareness among motorists and pedestrians;

- The infrastructure installed and parking areas could result into light glare which could affect and impair the visibility of surrounding sensitive receptors, including motorists and pedestrians; and
- The filling stations will be illuminated during evenings, and thus could result into visual pollution. Vehicles which access the property may furthermore illuminate surrounding properties which in addition could cause adverse effects and subsequently visual pollution.

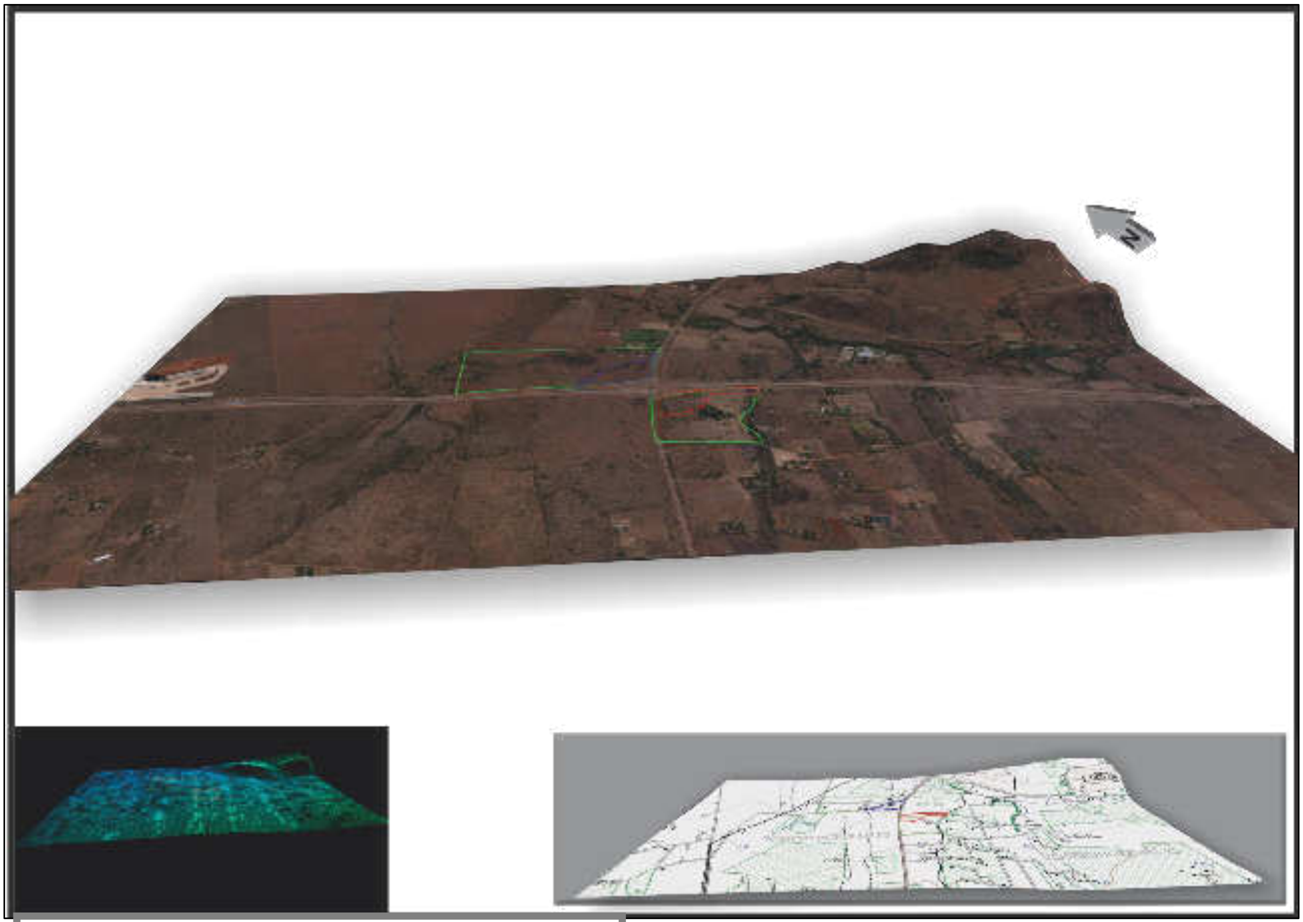


Figure 11 – Dimensional Illustrations

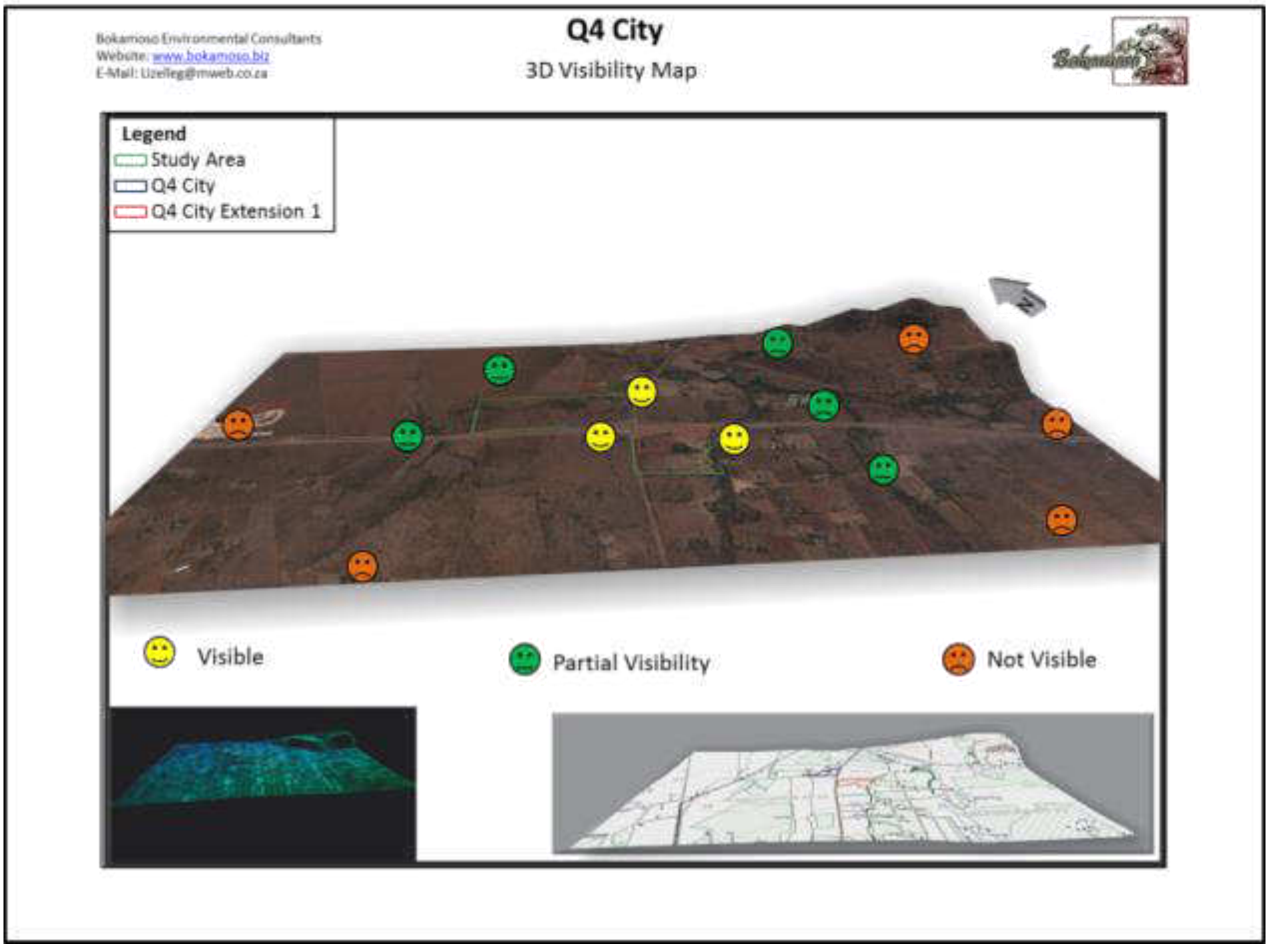


Figure 12 – Visibility Map

Issues & Impact Identification – Topography

Table 15: Issues and Impacts – Topography

	Issue/ Impact	Positive/ Negative/ Neutral ±	Mitigation Possibilities High ☻ Medium ☺ Low ◘ Positive Impact - Not Necessary To Mitigate ☼

10)	Due to the topography the filling stations development will be visible from view sheds in the flatter areas around the study area.	-/+ Depending on the architectural style and finishes	☺
11)	If not planned correctly, roofs and parking areas could reflect the sun into the eyes of oncoming traffic.	-	☺
12)	If not planned and managed correctly the lights (interior and exterior) and the signage of the development could cause visual pollution.	-	☻

Discussion of issues identified, possible mitigation measures and significance of issue after mitigation

- Due to the topography the filling station development will be visible from view sheds in the flatter areas around the study area. Visibility could however be advantageous for a filling station development.

Table 16: Significance of Issue 10 (Parts of the Development Will Be Visible from View Sheds in the Flatter Areas around the Study Area) After Mitigation/ Addressing of the Issue

Mitigation Possibilities	Mitigation	Significance of Issue after mitigation
High ☻ **Medium** ☺ **Low** ◘ **Positive Impact/ Neutral - Not Necessary To Mitigate** ☼	Already achieved √ Must be implemented during planning phase, construction and/ or operational phase **P/ C / O**	Low/ eliminated **L / E** Medium **M** High **H** Not possible to mitigate, but not regarded as a fatal flaw **NP**

Medium ☺	**P** – Architectural and landscaping guidelines must be supplied in the EMPr and the proposed Architectural theme must blend in with the surrounding area. **P/C/O** – Advertisements and/or sign boards shall not be erected or displayed on the property without the approval of the municipality and SANRAL first being obtained in terms of municipal by-laws for outdoor advertising.	**M –** To be incorporated as part of the EMPr **L –** To be incorporated as part of the EMPr

Result:

Although the issue can be mitigated, the significance of the impact should still be determined / confirmed assessed in the Significance Rating Table

11) If not planned correctly, roofs and parking areas could reflect the sun into the eyes of oncoming traffic.

Table 17: Significance of Issue 11 (Roofs and Parking Areas Could Reflect the Sun into the Eyes of Oncoming Traffic and Surrounding Landowners) After Mitigation/ Addressing of the Issue

Mitigation Possibilities **High ☻ Medium ☺ Low ◘** **Positive Impact/ Neutral - Not Necessary To Mitigate ☼**	Mitigation Already achieved √ Must be implemented during planning phase, construction and/ or operational phase **P/ C / O**	Significance of Issue after mitigation Low/ eliminated **L / E** Medium **M** High **H** Not possible to mitigate, but not regarded as a fatal flaw **NP**
Medium ☺	**P/C –** Roof materials used for buildings and structures must	**L - T**o be included in EMPr

	be non-reflective materials and not bright. **P** – Suitable plant materials should be used at strategic points to screen off impacts caused by roofs and cars in the parking areas.	**L** – To be incorporated as part of the EMPr

Result:

Although the issue can be mitigated, the significance of the impact should still be determined / confirmed assessed in the Significance Rating Table

12) If not planned and managed correctly, the lights of the development (exterior and interior) and the lights of signage could cause visual pollution during the night.

Table 18: Significance of Issue 12 (The lights of the development (exterior and interior) and the lights of signage could cause visual pollution during the night) After Mitigation/ Addressing of the Issue

Mitigation Possibilities **High** ☻ **Medium** ☺ **Low** ◘ **Positive Impact/ Neutral - Not Necessary To Mitigate** ☼	Mitigation Already achieved √ Must be implemented during planning phase, construction and/ or operational phase **P/ C / O**	Significance of Issue after mitigation Low/ eliminated **L / E** Medium **M** High **H** Not possible to mitigate, but not regarded as a fatal flaw **NP**
Medium ☺	**P/C** – The generation of light by night events, security lighting and other lighting shall be effectively designed so as not to spill unnecessary outward into the oncoming traffic or into the yards of the neighbouring properties or open spaces.	**L** - **T**o be included in EMPr

	P/C – Flood lights or spot lights used to illuminate buildings or signs, should be positioned as such that none of the light spills onto adjacent properties or shines into the eyes of motorists or pedestrians.	**L** - **T**o be included in EMPr

Result:

Although the issue can be mitigated, the significance of the impact should still be determined / confirmed assessed in the Significance Rating Table

6.1.1.4 Climate:

Climatological data for the site was taken from the Brits area. No drastic extremes in average temperatures have been recorded for the area.

- **Wind:**

The prevailing wind direction on the site is in a south-western direction with an average speed of 16km/h.

- **Temperature °C:**

In summer the average maximum temperature is 29.3°C and the average minimum 17.0°C in January. During the winter average maximum temperature is 19.8°C in June and minimum 2.1°C in July.

- **Rain:**

The average annual rainfall of the area is 540mm, with a maximum of 105mm in January and no rainfall in June and July.

Potential Environmental Impacts- Climate:

- Should the construction phase be scheduled for the summer months, frequent rain could cause very wet conditions, which makes it extremely difficult to build in and to do rehabilitation works of disturbed areas. These wet conditions often cause delays to building projects and the draining of water away from the construction works into the water bodies of the adjacent properties, could (if not planned and managed correctly) have an impact on the water quality of these water bodies; and

- If dry and windy conditions occur during the construction phase, dust pollution could become a problem.

Issues & Impact Identification – Climate

Table 19: Issues and Impacts – Climate

	Issue/ Impact	**Positive/ Negative/ Neutral ±**	**Mitigation Possibilities** **High** ☻ **Medium** ☺ **Low** ◙ **Positive Impact - Not Necessary To Mitigate** ☼
13)	Should the construction phase be scheduled for the summer months, frequent rain could cause very wet conditions, which makes it extremely difficult to build in and to do rehabilitation works of disturbed areas.	-	☻
14)	If dry and windy conditions occur during the construction phase, dust pollution could become a problem	-	☻

Discussion of issues identified, possible mitigation measures and significance of issue after mitigation

13) Should the construction phase be scheduled for the summer months, frequent rain could cause very wet conditions, which makes it extremely difficult to build in and to do rehabilitation works of disturbed areas.

These wet conditions often cause delays to building projects and the draining of water away from the construction works (in the case of high water tables) into the water bodies of the adjacent properties, could (if not planned and managed correctly) have an impact on the water quality of these water bodies.

Table 20: Significance of Issue 13 (Should the construction phase be scheduled for the summer months, frequent rain could cause very wet conditions, which makes it extremely difficult to build in and to do rehabilitation works of disturbed areas) After Mitigation/ Addressing of the Issue

Mitigation Possibilities **High** ☻ **Medium** ☺ **Low** ◙ **Positive Impact/ Neutral - Not Necessary To Mitigate** ☼	Mitigation Already achieved √ Must be implemented during planning phase, construction and/ or operational phase **P/ C / O**	Significance of Issue after mitigation Low/ eliminated **L / E** Medium **M** High **H** Not possible to mitigate, but not regarded as a fatal flaw **NP**
High ☻	**P/C –** Construction workers and construction vehicles and machinery must stay out of the soggy areas during the wet periods. Barrier tape should be used to demarcate the areas that are drenched with water and it should only be removed when the appointed Environmental Control Officer (ECO)/ site supervisor/ project manager/ main contractor regard the conditions in the affected areas as favourable.	**L -** To be included in EMPr

Result:

Although the issue can be mitigated, the significance of the impact should still be determined / confirmed assessed in the Significance Rating Table.

14) If dry and windy conditions occur during the construction phase, dust pollution could become a problem.

This can particularly become a problem on the N4 highway. Sweeping of the construction site, clearing of builders' rubble and debris as well as the regular watering of the construction site (storage areas, roads etc.) must take place at least once a day.

Table 21: Significance of Issue 14 (Dust Pollution) After Mitigation/ Addressing of the Issue

Mitigation Possibilities **High ☻ Medium ☺ Low ◙** **Positive Impact/ Neutral - Not Necessary To Mitigate ☼**	Mitigation Already achieved √ Must be implemented during planning phase, construction and/ or operational phase **P/ C / O**	Significance of Issue after mitigation Low/ eliminated **L / E** Medium **M** High **H** Not possible to mitigate, but not regarded as a fatal flaw **NP**
High ☻	**C** – Sweeping of the construction site, clearing of builders' rubble and debris as well as the regular watering of the construction site (storage areas, roads etc.) must take place at least once a day.	**L** - To be included in EMPr

Result:

Although the issue can be mitigated, the significance of the impact should still be determined / confirmed assessed in the Significance Rating Table

6.1.2 THE BIOLOGICAL ENVIRONMENT

Galago Environmental was appointed to facilitate a floral and faunal assessment for the proposed Q4 City filling stations development on the Remainder of Portion 22 and Remainder of Portion 41 of the Farm Schietfontein 437 JQ. Please refer to **Annexure F4** for the Fauna and Flora assessments.

6.1.2.1 Flora

Mucina and Rutherford (2006) classified the area as Marikana Thornveld, with open *Acacia karroo* woodland occurring in valleys and slightly undulating plains and lowland hills. Shrubs are denser along drainage lines, on termitaria and rocky outcrops or in other fire-protected habitat. This unit falls within a summer-rainfall region with very dry winters and frequent winter frosts. The Marikana Thornveld vegetation unit is considered vulnerable according to the list of threatened ecosystems in terms of NEMBA.

There are five vegetation study units which were identified on site by the specialists, namely:

- *Peltophorum – Dichrostachys* thicket;
- *Acacia robusta – Clerodendrum* savanna;
- Mixed alien and indigenous vegetation;
- *Eragrostis – Digitaria* fields; and
- Drainage line vegetation.

The specialist report for fauna and flora has been conducted for the larger portion and it is important to note that the proposed filling stations development will be situated on a much smaller area. For this reason, the *Peltophorum - Dichrostachys* Thicket will not form part of the proposed filling station areas. This vegetation unit is the only unit considered sensitive of the five identified vegetation units. Please refer to Figure 13 for the map indicating the identified vegetation units.

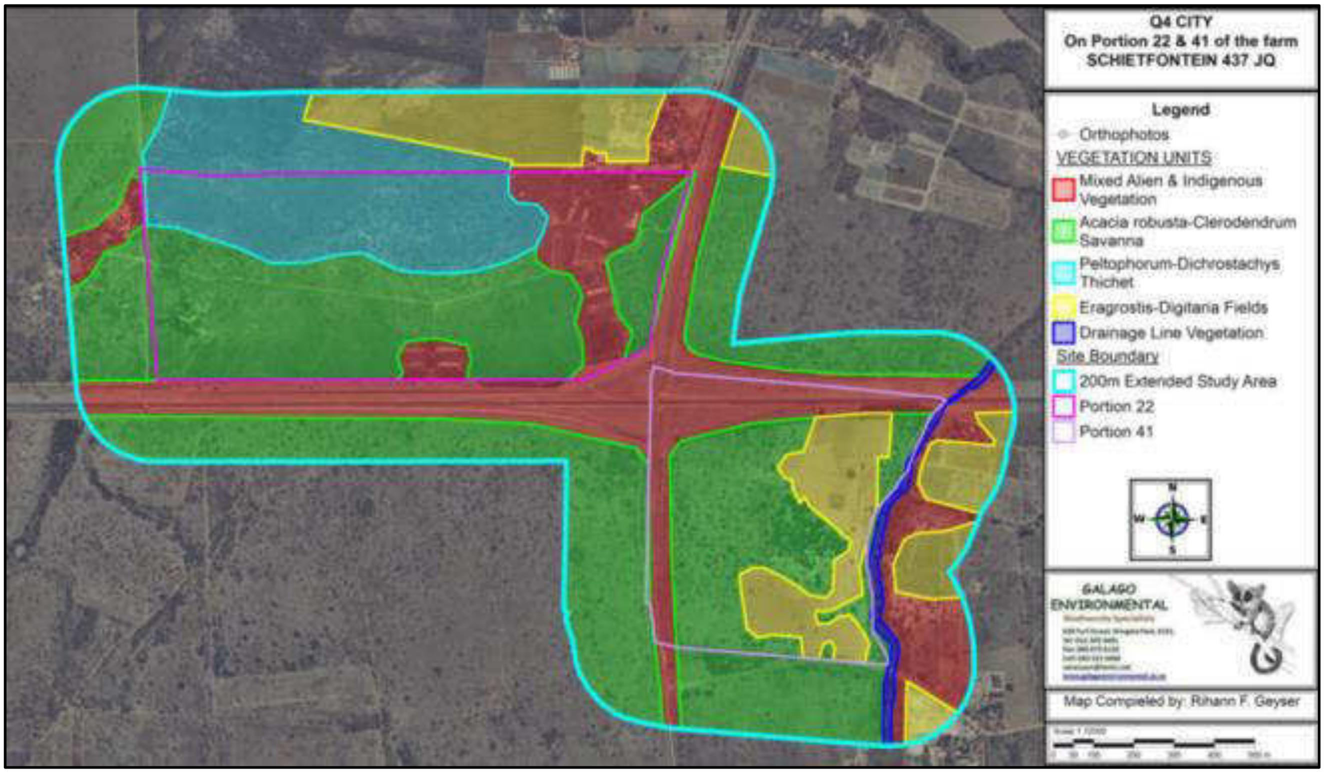


Figure 13 – Identified Vegetation Units

No threatened plant species or plant species of conservation concern were found on the study area. A single protected tree species have been identified on both sites with a number of specimens found. Within the *Acacia robusta – Clerodendrum* savanna vegetation unit some *Sclerocarya birrea* subsp. *caffra* (Marula) trees were identified, which is considered a protected tree species. Another protected plant species was identified in the *Peltophorum – Dichrostachys* thicket vegetation unit that is situated outside the proposed filling stations development area. *Acacia robusta – Clerodendrum* savanna, Mixed alien and indigenous vegetation and *Eragrostis – Digitaria* fields are considered not sensitive by the specialist. The drainage line, situated on the eastern boundary of Portion of Portion 41, is regarded as sensitive because drainage lines form corridors for the movement of species.

Potential Environmental Impacts- Flora:

- Loss of Protected tree species;

- Disturbance and loss to vegetation species on site; and
- Spreading of alien and invasive plant species.

6.1.2.2 Fauna

Figure 14 – Mammal Sensitivity Map

The mammal study found that the proposed development will spatially be modest, with the major portion of the two Portions to be excluded from development. The developments will entirely displace terrestrial mammals, but relatively speaking this will be modest, apart from consisting mostly of common species. The conservation status of no endangered species will be jeopardized. From a mammal perspective, the site has a low sensitivity. Five mammal species have been confirmed during the assessment, namely *Lepus saxatilis* (Scrub hare), *Cryptomys hottentotus* (African mole rat), *Equus quagga* (Plains zebra), *Tragelaphus angasii* (Nyala) and *Damaliscus pygargus* (Blesbok). It is important to note that the three larger mammals have been identified on the Remainder of Portion 41 as part of the conference centre. These species will remain on the conference centre section. Please refer to Figure 14 for the Mammal Sensitivity Map.

Figure 15 – Avifaunal Sensitivity Map

The avifaunal study found that the proposed development will not have a negative effect on any Red Data avifaunal species. None of these Red Data avifaunal species are likely to occur within the study area due to lack of suitable habitat. The Woodland areas can be regarded as medium sensitive in terms of habitat for general avifaunal biodiversity and the disturbed and transformed areas as low sensitive. The woodland areas are assigned a medium sensitivity by the specialist mainly due to the endangered status of the Marikana Thornveld vegetation unit. It is very important to note that the proposed filling stations development will take place on a small section of the areas that were surveyed for this fauna assessment. Therefore, avifauna species on the site will still have habitat remaining to forage and for cover. When the filling stations development is operational avifaunal species will be able to return to the landscaped areas of the filling stations. Please refer to Figure 15 for the Avifaunal Sensitivity Map.

Figure 16 – Herpetofaunal Sensitivity Map

The herpetological study found that the drainage line and its 32m buffer zone should be considered as ecologically sensitive. There is a possibility that one or two Southern African pythons may occur on the study site from time to time however, the specialist regarded the site as too small to support a viable population. The site does not contain suitable habitat for Giant Bullfrogs. The Red Toad (*Schismaderma carens*) and the Common River Frog (*Amietia angolensis*) were observed on the study area. The specialist said that these species should be abundant on the site and elsewhere in its range. If the development should go ahead, a very important indirect effect would be the likely impact that the proposed development might have on the surface water runoff and water quality of the drainage line. This could have a negative impact on the herpetofaunal species on site. Please refer to Figure 16 for the Herpetofaunal Sensitivity Map.

The results of the Fauna and Flora assessments have shown that the site mostly constitutes of low sensitivity areas. However, there are some sensitive areas that the specialists recommend be conserved. It is proposed by the specialists that the development be located as near to the N4 as possible. Please refer to Figure 17 for the Combined Environmental Sensitivity of the site.

Figure 17 – Combined Environmental Sensitivity Map

Potential Environmental Impacts- Fauna:

- Disturbance, trapping and hunting of faunal species on site; and
- Loss of habitat for faunal species.

Issues & Impact Identification – Flora and Fauna

Table 22: Issues and Impacts – Flora and Fauna

	Issue/ Impact	**Positive/ Negative / Neutral ±**	**Mitigation Possibilities** **High** ☻ **Medium** ☺ **Low** ◘ **Positive Impact - Not Necessary To Mitigate** ☼
15)	Loss of Protected tree species.	-	☺
16)	Disturbance and loss to vegetation species on site.	-	☺
17)	Spreading of alien and invasive plant species.	-	☻
18)	Disturbance, trapping and hunting of faunal species on site.	-	☻
19)	Loss of habitat for faunal species.	-	☺

15) Loss of Protected tree species

Some specimens of the protected tree species, the Marula tree, have been identified on the site and the specialist recommended that they be retained as far as possible.

Table 23: Significance of Issue 15 (Loss of Protected tree species) After Mitigation/ Addressing of the Issue

Mitigation Possibilities **High** ☻ **Medium** ☺ **Low** ◘ **Positive Impact/ Neutral - Not Necessary To Mitigate** ☼	Mitigation Already achieved √ Must be implemented during planning phase,	Significance of Issue after mitigation Low/ eliminated **L / E** Medium **M**

	construction and/ or operational phase **P/ C / O**	High **H** Not possible to mitigate, but not regarded as a fatal flaw **NP**
Medium ☺	**P/ C** - Where possible, trees naturally growing on the site should be retained as part of the landscaping; **P/ C** - Measures to ensure that the Protected trees on site (Marula tree) survive the physical disturbance from the development should be implemented. A tree surgeon should be consulted in this regard. **C** – Vegetation should only be removed in areas designated for construction.	**M** -To be included in EMPr **M** -To be included in EMPr **L** -To be included in EMPr

Result:

Although this issue can be mitigated, the significance of the impact should still be determined / confirmed assessed in the Significance Rating Table

16) Disturbance and loss to vegetation species on site.

Even though the majority of the vegetation units are not considered sensitive the vegetation will be removed in the areas where the filling stations will be developed. Large trees will be retained as far as possible to be included in the landscaping.

Table 24: Significance of Issue 16 (Disturbance and loss to vegetation species on site) After Mitigation/ Addressing of the Issue

Mitigation Possibilities	Mitigation Already achieved √	Significance of Issue after mitigation

High ☻ **Medium** ☺ **Low** ◙ **Positive Impact/ Neutral - Not Necessary To Mitigate** ☼	Must be implemented during planning phase, construction and/ or operational phase **P/ C / O**	Low/ eliminated **L / E** Medium **M** High **H** Not possible to mitigate, but not regarded as a fatal flaw **NP**
Medium ☺	**C** – Vegetation should only be removed in areas designated for construction. **C** - Rehabilitation works, especially in terms of landscaping, must be done immediately after construction works are completed to ensure that the biodiversity is maintained. Vegetation used for rehabilitation should be indigenous. **P/C** - The top layer of all areas to be excavated must be stripped and stockpiled in areas where this material will not be damaged, removed or compacted. This stockpiled material should be used for the rehabilitation of the site and for landscaping purposes. **P/C/O** – Weeds and exotic invaders should be eradicated on a continuous basis	**L** -To be included in EMPr **L** -To be included in EMPr **L** -To be included in EMPr **L** -To be included in EMPr

Result:

Although this issue can be mitigated, the significance of the impact should still be determined / confirmed assessed in the Significance Rating Table

17) Spreading of alien and invasive plant species.

Construction activities disturb the environment and introduce seeds through construction vehicles and deliveries. Disturbed areas are more prone to the establishment of alien and invasive plant species. This should be managed and mitigated in the correct manner.

Table 25: Significance of Issue 17 (Spreading of alien and invasive plant species) After Mitigation/ Addressing of the Issue

Mitigation Possibilities **High** ☻ **Medium** ☺ **Low** ◘ **Positive Impact/ Neutral - Not Necessary To Mitigate** ☼	Mitigation Already achieved √ Must be implemented during planning phase, construction and/ or operational phase **P/ C / O**	Significance of Issue after mitigation Low/ eliminated **L / E** Medium **M** High **H** Not possible to mitigate, but not regarded as a fatal flaw **NP**
High ☻	**P/C/O** – Weeds and exotic invaders should be eradicated on a continuous basis	**L** -To be included in EMPr
	P/C/O - The removal of Category 1 Declared invaders from the property is mandatory and Category 2 Declared invaders must be controlled in terms of the Conservation of Agricultural Resources Act, 1983 and Section 28 of NEMA, 1998. An invasive control plan should be implemented every 3 months after construction.	**L** -To be included in EMPr
	P/C - Ensure that materials used for mulching and topsoil/ fertilisers are certified weed free. Collect certifications where available. Control weed	**L** -To be included in EMPr

	growth that appears during construction.	

Result:

Although this issue can be mitigated, the significance of the impact should still be determined / confirmed assessed in the Significance Rating Table

18) Disturbance, trapping and hunting of faunal species on site.

The construction and associated activities on the proposed areas will disrupt the faunal species on the site. These impacts can be minimised through proper management of the construction activities.

Table 26: Significance of Issue 18 (Disturbance, trapping and hunting of faunal species on site) After Mitigation/ Addressing of the Issue

Mitigation Possibilities **High ☻ Medium ☺ Low ◘** **Positive Impact/ Neutral - Not Necessary To Mitigate ☼**	Mitigation Already achieved √ Must be implemented during planning phase, construction and/ or operational phase **P/ C / O**	Significance of Issue after mitigation Low/ eliminated **L / E** Medium **M** High **H** Not possible to mitigate, but not regarded as a fatal flaw **NP**
High ☻	**C** - The integrity of the remaining wildlife should be upheld, and no trapping or hunting by construction personnel should be allowed; **C** - During the construction phase, noise should be kept to a minimum to reduce the impact of the development on the fauna.	**M** **-T**o be included in EMPr **M** **-T**o be included in EMPr

Result:

Although this issue can be mitigated, the significance of the impact should still be determined / confirmed assessed in the Significance Rating Table

19) Loss of habitat for faunal species.

The proposed construction of the filling stations will result in vegetation being removed as well as faunal habitat. Due to the filling stations only being developed on a section of the study area, there will be habitat remaining on the study area for feeding and shelter. Certain management measures can be implemented to ensure that fauna species are protected in the best manner.

Table 27: Significance of Issue 19 (Loss of habitat for faunal species) After Mitigation/ Addressing of the Issue

Mitigation Possibilities **High ☻ Medium ☺ Low ◙** **Positive Impact/ Neutral - Not Necessary To Mitigate ☼**	Mitigation Already achieved √ Must be implemented during planning phase, construction and/ or operational phase **P/ C / O**	Significance of Issue after mitigation Low/ eliminated **L / E** Medium **M** High **H** Not possible to mitigate, but not regarded as a fatal flaw **NP**
Medium ☺	**C** - The integrity of the remaining wildlife should be upheld, and no trapping or hunting by construction personnel should be allowed; **C** - During the construction phase, noise should be kept to a minimum to reduce the impact of the development on the fauna. **P/C** – Vegetation should only be removed in areas designated for construction.	**M** -To be included in EMPr **M** -To be included in EMPr **L** -To be included in EMPr

	P/C - Where possible, work should be restricted to one area at a time.	**L** -To be included in EMPr

Result:

Although this issue can be mitigated, the significance of the impact should still be determined / confirmed assessed in the Significance Rating Table

6.2 DESCRIPTION OF THE EXISTING SOCIO-ECONOMIC ENVIRONMENT

6.2.1 Archaeology/Cultural History

A study was conducted by Leonie Marais-Botes Heritage Practitioner and Archaetnos Archaeologists and Heritage Consultants on Remainder of Portion 22 and Remainder of Portion 41 of the Farm Schietfontein 437 JQ (which is the larger study area) for the proposed filling station development. On the Remainder of Portion 22 an old Kraal had been identified. This site is in poor condition and was determined to be of low heritage significance and therefore the report is seen as ample mitigation. It is however important to note that the old kraal is not within the proposed development area of the filling stations (referring to Figure 18 for the Surrounding Land Use Map which indicates the position of the old kraal). On the Remainder of Portion 41 no sites of heritage significance were found. The proposed development may continue on both the portions according to the specialist.

Recommendations:

It should be noted however that the subterranean presence of archaeological and/or historical sites, features or artefacts is always a possibility. As such, care should be taken during any work in the entire area, that if any historical sites, features or artefacts are discovered, a qualified archaeologist should be commissioned to investigate. ***Refer to Annexure F5 - Heritage Impact Assessment Report.***

Potential Environmental Impacts- Archaeology/Cultural History:

- Features, artefacts and objects of a cultural and historical significance may be exposed/ uncovered during construction, especially during bulk earthworks, which may be damaged and/or destroyed in the process.

Issues & Impact Identification – Cultural and Historical

Table 28: Issues and Impacts - Cultural

	Issue/ Impact	**Positive/ Negative/ Neutral ±**	**Mitigation Possibilities** **High ☻ Medium ☺ Low ◘** **Positive Impact - Not Necessary To Mitigate ☼**
20)	If any cultural or historical artefacts are found during construction it may be destroyed by construction activities.	-	☻

Discussion of issues identified, possible mitigation measures and significance of issue after mitigation

20) If any cultural or historical artefacts are found during construction it may be destroyed by construction activities.

Table 29: Significance of Issue 20 (If any cultural or historical artefacts are found during construction it may be destroyed by construction activities) After Mitigation/ Addressing of the Issue

Mitigation Possibilities **High ☻ Medium ☺ Low ◘**	Mitigation Already achieved √ Must be implemented during	Significance of Issue after mitigation Positive ☼

Positive Impact/ Neutral - Not Necessary To Mitigate ☼	planning phase, construction and/ or operational phase **P/ C / O**	Low/ eliminated **L / E** Medium **M** High **H** Not possible to mitigate, but not regarded as a fatal flaw **NP**
High ☻	**P/ C/ O** - It should be noted that in terms of the South African Resources Act (Act 25 of 1999) Section 35(4) no person may, without a permit issued by the responsible heritage resources authority destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or material. **P/ C/ O** - Also important is that Section 34(1) of this act states that no person may alter or demolish any structure or part of a structure, which is older than 60 years without a permit, issued by the relevant provincial heritage resources authority.	**L** – To be included in the EMPr **L** – To be included in the EMPr

Result:

Although the issue can be mitigated, the significance of the impact should still be determined / confirmed assessed in the Significance Rating Table

6.2.2 Existing Land-Use

6.2.2.1 The Surrounding Environment

Most of the surrounding properties are also zoned as agriculture and some former/ existing agricultural activities were identified on the farm portions to the north of the filling stations as well as some to the south. The N4/ Bakwena Platinum Freeway[6], which stretches in a west-east direction, runs to the south of Remainder of Portion 41 and to the north of Remainder of Portion 22. Road M21, which stretches in a south-north direction (towards Ga-Rankuwa), runs to the east of Remainder of Portion 41 and to the west of Remainder of Portion 22. There is not currently any on or off-ramp from the freeway to Road M21 from the eastern side, only to the west ***(Refer to Figure 18 –Surrounding Land Use Map).***

6.2.2.2 The Study Area

The current zoning on the two properties is agriculture. A conference centre with accommodation facilities is located on a section of the Remainder of Portion 41. This conference centre will continue to operate on the farm and it will not be affected by the proposed new filling stations. **Remainder of Portion 22 has some old structures related to agricultural activities but not on the smaller area to be developed for a filling station.** According to the available topographical data maps (Planet GIS), the entire Remainder of Portion 22 and approximately 50% of Remainder of Portion 41 have some grazing potential. A drainage feature forms the eastern boundary of Remainder of Portion 41. This drainage feature also forms the boundary between North-West Province and Gauteng. ***Figure 19*** illustrates the current issues and/or land uses on the site.

Due to the fact that the Remainder of Portion 41 lies on the western boundary of Gauteng, we were of the opinion that we also had to submit the Scoping and EIA Reports to GDARD for inputs. Mr. Steven Mukhola (during 2014 he was working at NWDEDECT – now known as NWREAD) however confirmed that it will not be necessary, because the application is not regarded as a cross-border application (the entire study area falls within the boundaries of North-West Province).

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[6] The Platinum Freeway falls under the jurisdiction of SANRAL and the M21 falls under the jurisdiction of North-West Province (Department Public Works and Roads North West Provincial Government).

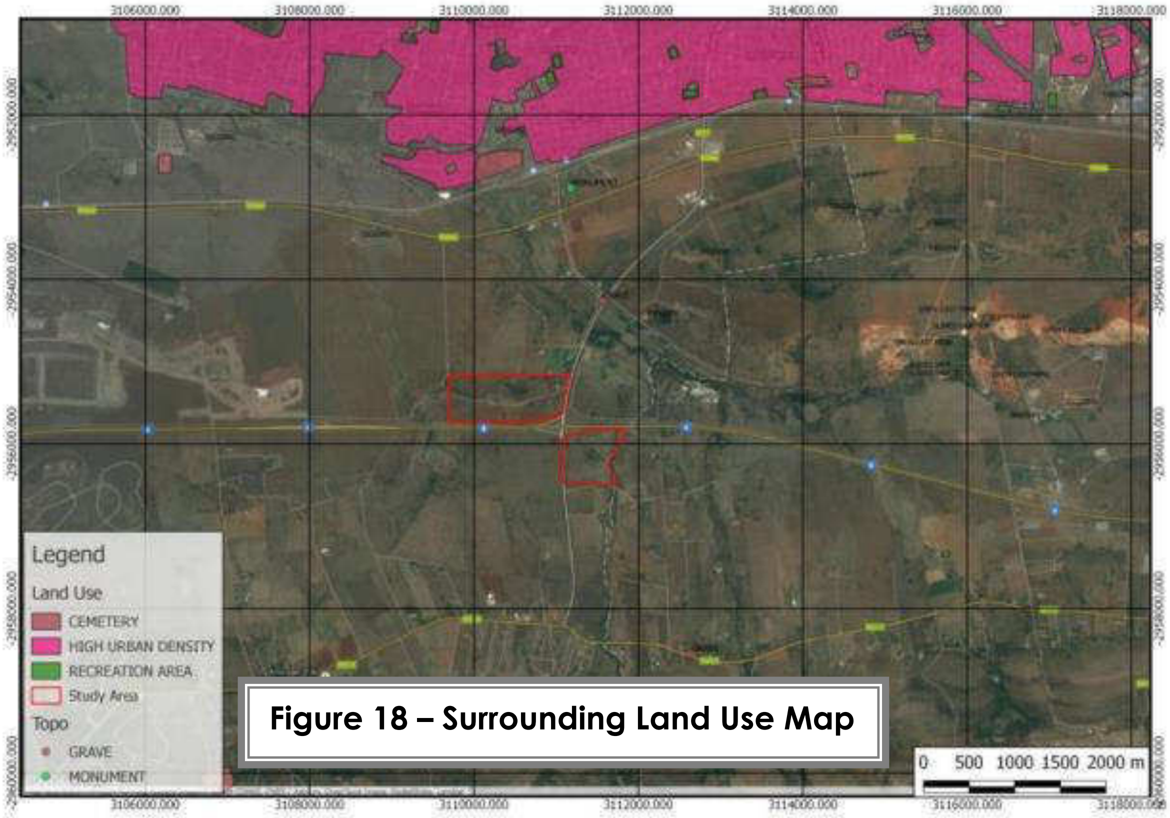

Figure 18 – Surrounding Land Use Map

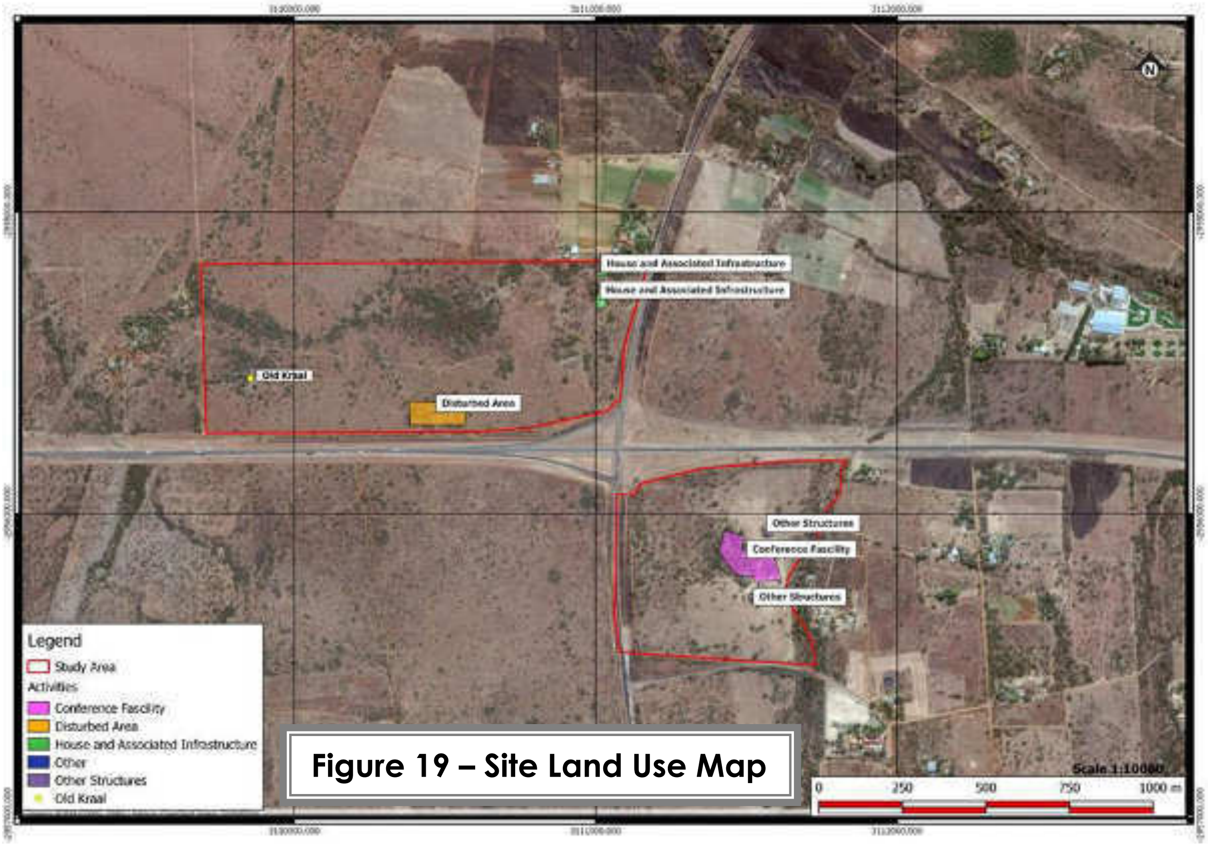

Figure 19 – Site Land Use Map

6.2.3 Proposed Land Use

As mentioned earlier in this report, the application for the establishment of a township in terms of Section 96 of the town planning and townships Ordinance 15 of 1986 has been for both the properties separately. The one township on Part of the Remainder of Portion 22 of the farm Schietfontein 437 JQ will be known as Q4 City and the township on Part of the Remainder of Portion 41 of the farm Schietfontein 437 JQ will be known as Q4 City Extension 1. Please refer to **Annexure F6** for the Town Planning Memorandums.

The proposed zoning for Q4 City will be Special for a filling station and service area and purposes incidental thereto. The following will be included:

- Storage and retail selling of vehicle fuels and lubricants;
- Working bay for emergency repairs to vehicles;
- Shop/convenience store;
- Restaurant;
- Confectionary;
- Place of refreshment;
- Take-away facility and drive-thru facility;
- Automatic teller machines;
- Administrative offices;
- Ablution facilities;
- Refuse/service yard;
- Parking site for buses and trucks including a canteen and kitchen;
- Two residential units for management.

The proposed zoning for Q4 City Extension 1 will be similar to the zoning of Q4 City: Special for a filling station and service area. The following will be included:

- Storage and retail selling of vehicle fuels and lubricants;
- Working bay for emergency repairs to vehicles;
- Shop/convenience store;
- Restaurant;
- Confectionary;

- Place of refreshment;
- Take-away facility and drive-thru facility;
- Automatic teller machines;
- Administrative offices;
- Ablution facilities;
- Refuse/service yard;
- Parking site for buses and trucks including a canteen and kitchen;
- Two residential units for management.

6.2.4 Feasibility and Sustainability

Information supplied by Techworld CC (Refer to Annexure F7 – Traffic Report & Viability Investigation).

The proposed sites along the N4 highway will serve two potential markets, namely the Urban/Inter-urban market and the Transient market. The Urban/Inter-urban market, which is commuting traffic, will serve traffic in metropolitan areas or between metro poles as well as transient traffic in rural areas between towns. Filling stations rarely only serve a single market; normally they serve a combination of markets such as it is the case for this project.

The interception rates of filling station sites along highways includes a large component which is not fuel related, these will include food and comfort purposes. The interception rates in the Viability investigation only refers to fuel related interception rates. The proposed filling stations development will provide fuel, food, rest areas and ablution facilities and services for light and heavy vehicles. There will also be overnight parking facilities for trucks as a large number of trucks currently overnight along the N4 at the Brits Toll Plaza. Consequently the filling stations will be important for convenience as well as for safety.

According to the Viability investigation the proposed filling stations development will not have a significant impact on the viability of the competing filling station because of the following:

- Any given traffic stream is generally served by several filling stations. The addition of another filling station can at most have a modest impact on the fuel sales of the other filling stations;
- Numerous other filling stations are located in the larger area/corridor but these filling stations are serving different markets and different traffic streams;
- The existing highway sites along the N4 Platinum Highway are located more than 30km from the proposed filling stations development; and
- Existing traffic growth of about 4.6% p.a. for light vehicles and about 5.9% p.a. for heavy vehicles in the corridor continuously increases the traffic demand and thus demand for fuel sales that allows new entries into the market without significantly affecting the fuel sales of existing filling stations.

On the local market, the nearby filling stations is located along different routes that serves different markets and different traffic streams and therefore the unlikely maximum impact will therefore be insignificant. These local filling stations do not provide the same range of facilities and services to the road user compared to what the proposed filling stations will provide. Two of the closest local filling stations (Caltex at Skietfontein – R513 and Sasol at Schoemansville – R511/R560 intersection) are expected to have a very small percentage shared traffic as the proposed filling stations development will not be able to serve traffic on the crossroad (D2726/M21) or any turning movements from the N4 highway to the M21 and the other way around.

In terms of the long-distance market, there are two highway sites that are approximately 30km east and west of the proposed filling stations namely the ENGEN One-Stop at Doornpoort and the TOTAL Petroport at Magalies.

The Viability Investigation found that the ENGEN One-Stop at Doornpoort has very high interception rates and only approximately 14% of the current traffic volumes that bypasses the ENGEN One-Stop at Doornpoort will be shared with the proposed filling stations. This however does not mean that they will lose 14% of their current fuel sales as the 14% shared traffic is served by a number of filling stations. Should there not be any other filling stations serving this shared traffic, the shared volume will most probably be divided between the two filling station sites. Thus, according to the Viability Investigation, the proposed filling stations will not threaten the sustainability of the ENGEN One-Stop at Doornpoort as the expected potential loss will be single digit figures. Please refer to Table 19 and 20 of the Traffic Report and Viability Investigation compiled by Techworld.

The TOTAL Petroport at Magalies, to the west of the proposed filling stations, showed very high interception rates (little less than ENGEN One-Stop at Doornpoort) and according to the Viability Investigation only 23% of the current traffic volume that bypasses the TOTAL Petroport at Magalies will be shared with the proposed filling stations. Similar to the ENGEN One-Stop at Doornpoort, the shared traffic with TOTAL Petroport at Magalies does not mean a fuel sale loss of 23%. This shared traffic volume will be served by several filling stations and should there not be any other filling stations serving this shared traffic, the shared volume will most probably be divided between the two filling station sites. The expected potential loss for the TOTAL Petroport at Magalies will be single digit figures (except for heavy vehicles) which will not threaten the sustainability of the TOTAL Petroport according to the Viability Investigation. Please refer to Table 21 and 22 of the Traffic Report and Viability Investigation compiled by Techworld.

The traffic and viability investigations have shown that the proposed filling stations are both technically and financially viable. It is also unlikely that the proposed filling stations will impact detrimentally on the sustainability of existing facilities in the area and corridor.

Issues & Impact Identification – Proposed Land-Use

Table 30: Issues and Impacts – Proposed Land-Use

	Issue/ Impact	**Positive/ Negative/ Neutral ±**	**Mitigation Possibilities** **High ☻ Medium ☺ Low ◘** **Positive Impact - Not Necessary To Mitigate ☼**

21)	The proposed land use is in line with land uses in the area (the existing highway and on- and off-ramps)	+	☼
22)	Creation of temporary and permanent jobs.	+	☼
23)	Supply in the need for a filling station facility/ies along the N4 in the Brits area, especially the need for an overnight truck stop.	+	☼
24)	Economic impact on existing filling stations in the area.	-	◘

Discussion of issues identified, possible mitigation measures and significance of issue after mitigation

24) Economic impact on existing filling stations in the area

The proposed filling stations could have an economic impact on existing filling stations in the area. However, the Viability Investigation showed that the other highway sites will not be detrimentally impacted upon.

Table 31: Significance of Issue 24 (Economic impact on existing filling stations in the area) After Mitigation/ Addressing of the Issue

Mitigation Possibilities **High** ☻ **Medium** ☺ **Low** ◘ **Positive Impact/ Neutral - Not Necessary To Mitigate** ☼	Mitigation Already achieved √ Must be implemented during planning phase, construction and/ or operational phase **P/ C / O**	Significance of Issue after mitigation Low/ eliminated **L / E** Medium **M** High **H** Not possible to mitigate, but not regarded as a fatal flaw **NP**
Low ◘	**O** - Economic impact on existing filling stations in the	**NP**

	area	

Result: *The issue cannot be mitigated; the significance of the impact should be determined / confirmed assessed in the Significance Rating Table.*

6.2.5 Institutional Environment

This section contains a documented motivation of the sustainability of the proposed development in terms the relevant design rationale, proposed zoning and development controls and guidelines of several policy documents.

This development is in line with the legislation, planning frameworks and strategies of both the local, provincial and national authorities:

6.2.5.1 On a National Level:

- **The Constitution of the Republic of South Africa (Act No. 108 of 1996):**

The "environment" in South Africa, is regulated by statutes, of which the Constitution of the Republic of South Africa, considered as the most prominent. The Constitution of the Republic of South Africa, provide for an environmental right contained Chapter 2, Bill of Rights, with specific reference to Section 24. As per Section 24 of the Constitution, "*everyone has a right:*

- *To an environment which is not harmful to their health or well-being; and*
- *To have the environment protected for the benefit of present and future generations, through reasonable legislative and other measures that:*
    - *Prevent pollution and ecological degradation;*
    - *Promote conservation;*
    - *Secure ecologically sustainable development while promoting justifiable economic and social development.*

The "environment" has been assigned a meaning and definition in terms of the Section 1[7] of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA).

Implications for proposed development:

Significant- An environmental right has been designated for each citizen within the Republic of South Africa, and as such the said citizen has the right to an environment that is not harmful to their health and well-being and to have the environment protected for present and future generations. The development and operation of the proposed Q4 City filling stations, should governed by our environmental right, and all actions and activities performed will have to take cognisance of the environmental right contained in Chapter 2, Section 24. The entity responsible for developing and operating the filling stations are legally obligated to ensure that their respective activities, through their actions will not have a significant effect on the environment.

- **National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and Amended Regulations:**

NEMA provide for co-operative, environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote co-operative governance and procedures for coordinating environmental functions exercised by organs of state and to provide for matters connected therewith. This Act formulates a set of general principles to serve as guidelines for land development and it is desirable that:

- The law develops a framework for integrating good environmental management into all development activities;
- The law should promote certainty with regard to decision-making by organs of state on matters affecting the environment;

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[7] As per the above mentioned Section the "Environment" means- *"the surroundings within which humans exist and that are made up of:*

(i) The land, water and atmosphere of the earth;
(ii) Microorganisms, plant and animal life;
(iii) Any part or combination of (i) and (ii) and the interrelationships among and between them; and
(iv) The physical, chemical aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being.

- The law should establish principles guiding the exercise of functions affecting the environment;
- The law should ensure that organs of state maintain the principles guiding the exercise of functions affecting the environment;
- The law should establish procedures and institutions to facilitate and promote co-operative government and inter-governmental relations;
- The law should establish procedures and institutions to facilitate and promote public participation in environmental governance; and
- The law should be enforced by the State and that the law should facilitate the enforcement of environmental laws by civil society.

Integrated Environmental Management

Integrated Environmental Management (IEM) is a philosophy, which prescribes a code of practice for ensuring that environmental considerations are fully integrated into all stages of the development process. This philosophy aims to achieve a desirable balance between conservation and development (Department of Environmental Affairs, 1992). The IEM guidelines intend endearing a pro-active approach to sourcing, collating and presenting information at a level that can be interpreted at all levels.

The Environmental Impact Assessment Regulations (EIA)

The Minister of Environmental Affairs, promulgated and passed in (April 2006) Environmental Impact Assessment Regulations (the new regulations) in terms of Chapter 5 of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). When these regulations came into effect on 3 July 2006 they replaced the Environmental Impact Assessment Regulations that were promulgated in terms of the Environmental Conservation Act, 1989 (Act No. 73 of 1989) (ECA) in 1997, and introduced new provisions for EIAs.

The National Environmental Management Amendment Act, 2008 (Act 62 of 2008) (NEMAA), that was promulgated on 9 January 2009 (came into effect on 1 May 2009), made a number of significant amendments to the general provisions applicable to EIA's. On 2 August 2010 the Amended EIA Regulations came into effect and replaced the previous EIA Regulations that were promulgated on 21 April 2006. Please note that amendments were made to the NEMA EIA Regulations on 4 December 2014 which came into effect on 8 December 2014. Earlier in this report in Section 1 this has been discussed in more detail.

Notice No. **R 544**, **R 545** and **R 546** of the Amended Regulations list the activities that indicate the process to be followed. The activities listed in Notice No. R 544 requires that a Basic Assessment process be followed and the Activities listed in terms of Notice No. R 545 requires that the Scoping and EIA process be followed. Notice No. 546 has been introduced to make provision for Activities in certain geographical and sensitive areas.

Subsequently, listing 2 (R 545) requires that a Scoping/EIA process be followed. It should however be noted that the Draft Guideline Document of DEA [Department of Environmental Affairs, previously known as the Department of Environmental Affairs and Tourism] states that if an activity being applied for is made up of more than one listed activity, and the Scoping and EIA process is required for one or more of these activities, the Scoping and EIA process must be followed for the whole application.

Implications for proposed development:

Significant- The proposed filling stations development is a listed activity in terms of the 2010 NEMA EIA Regulations, and thus should subsequently be considered, assessed and reported to the competent authority prior to commencement.

- **The National Water Act, 1998 (Act No 36 of 1998):**

The purpose of this Act is to ensure that the nation’s water resources are protected, used, developed, conserved, managed and controlled in ways that take into account, amongst other factors, the following:

- Meeting the basic human needs of present and future generations;
- Promoting equitable access to water;
- Promoting the efficient, sustainable and beneficial use of water in the public interest;

- Reducing and preventing pollution and degradation of water resources;
- Facilitating social and economic development; and
- Providing for the growing demand for water use.

In terms of the Section 21 of the National Water Act, the developer must obtain water use licenses if the following activities are taking place:

a) Taking water from a water resource;
b) Storing water;
c) Impeding or diverting the flow of water in a watercourse;
d) Engaging in a stream flow reduction activity contemplated in section 36;
e) Engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1);
f) Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;
g) Disposing of waste in a manner which may detrimentally impact on a water resource;
h) Disposing in any manner of water which contains waste from or which has been heated in any industrial or power generation process;
i) Altering the bed, banks, course or characteristics of a water course;
j) Removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and
k) Using water for recreational purposes.

The National Water Act also required that (where applicable) the 1:50 and 1:100 year flood line be indicated on all the development drawings (even the drawings for the external services) that are being submitted for approval.

Implications for proposed development:

Significant- Section 21 Water Use Licenses will be required for the proposed filling stations as water will be abstracted for domestic use.

- **National Environmental Management: Air Quality Act (Act No. 39 of 2004) (NEM:AQA):**

The NEMA: Air Quality Act, 2004 (here after referred to as NEM:AQA) repealed the Atmospheric Pollution Prevention Act, 1965 (Act 45 of 1965) ('APPA'), and came into effect on 11 September 2005. However, Part 2 of this act is still applicable. Part 2 of the act is however still applicable and deals with the control of noxious or offensive gases. The proposed development will not release any of the listed gases into the atmosphere and this act is therefore not applicable to the proposed development. The list of activities which may result in atmospheric emissions which have a detrimental effect on the environment was amended and published on 22 November 2013 under Government Notice No. 893 in Gazette No. 37054.

The Air Quality Act regulates air quality in order to protect the environment. It provides reasonable measures for the prevention of pollution and ecological degradation and for securing ecological sustainable development while promoting justification economic and social development.

The purpose of the Act is "To reform the law regulating air quality in order to protect the environment by providing reasonable measures for the prevention of pollution and ecological degradation and for securing ecologically sustainable development while promoting justifiable economic and social development; to provide for national norms and standards regulating air quality monitoring, management and control by all spheres of government; for specific air quality measures; and for matters incidental thereto."

Amongst other things, it is intended that the setting of norms and standards will achieve the following:

- The protection, restoration and enhancement of air quality in South Africa;
- Increased public participation in the protection of air quality and improved public access to relevant and meaningful information about air quality;
- The reduction of risks to human health and the prevention of the degradation of air quality.

The Act describes various regulatory tools that should be developed to ensure the implementation and enforcement or air quality management plans. These include:

- Priority Areas, which are air pollution “hot spots”;
- Listed activities, which are ‘problem’ processes that require an Atmospheric Emission License;
- Controlled emitters, which includes the setting of emission standards for ‘classes’ of emitters, such as motor vehicles, incinerators, etc.;
- Control of noise;
- Control of odours.

Implications for proposed development:

Not Significant- Dust pollution could be a concern primarily during the construction phase of the proposed project. Dust control would be adequately minimized during this phase by way of water spraying and possible dust-nets, when working close to the N4 Platinum highway.

- **The National Heritage Resources Act, 1999 (Act 25 of 1999) (NHRA)**

The NHRA requires heritage resources impact assessments for various categories of development stipulated in section 38 of the Act. It also provides for the grading of heritage resources and the implementation of a three-tier level of responsibilities and functions for heritage resources to be undertaken by the State, Provincial authorities, depending on the grade of the heritage resource. The Act defines cultural significance, archaeological and paleontological sites and materials (section 35), historical sites and structures (section 34), and graves and burial sites (section 36) that fall under its jurisdiction. Archaeological sites and material are generally those resources older than a hundred years, including gravestones and grave dressing. Procedures for managing graves and burial grounds are set out in section 36 of the NHRA. Graves older than 100 years are legislated as archaeological sites and must be dealt with accordingly. Section 38 of the NHRA makes provision for application by developers for permits before any heritage resource may be damaged or destroyed.

Implications for proposed development:

Not Significant- No graves or structures of cultural importance have been identified on the areas proposed for the filling stations development. A Heritage Impact Assessment was done for the farm portions of this proposed development. If any remains/cultural resources are exposed or uncovered during the construction phase, it should immediately be reported to the South African Heritage Resources Agency (SAHRA) and construction should be ceased until a specialist was on site. Burial remains should not be disturbed or removed until inspected by an archaeologist.

- **National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008):**

The Waste Management Act which was finally Gazetted on 10 March 2009, is to give effect to the White Paper on Integrated Pollution and Waste Management and the National Waste Management Strategy (NWMS). The list of triggered activities was amended and published on 29 November 2013.

Purpose:

To reform the law regulating waste management in order to protect the health and the environment by providing reasonable measures for the prevention of pollution and ecological degradation and for securing ecologically sustainable development; to provide for institutional arrangements and planning matters; national norms and standards for regulating the management of waste by all spheres of government; to provide for specific waste management measures; to provide for the licensing and control of waste management activities; to provide for the remediation of contaminated land; to provide for the national waste information system; to provide for compliance and enforcement; and to provide for matters connected therewith.

Objectives:

- To provide for utilisation of environmentally-sound methods that maximise the utilisation of valuable resources and encourage resource conservation and recovery;
- To ensure sound environmental management of waste;

- To reduce risk to human health and prevent the degradation of the environment through usage of mechanisms that promote the following:
- Pollution prevention and cleaner production
- Volume reduction at source
- Recycling, recovery and re-use
- Set guidelines and targets for waste avoidance and volume reduction through source reduction and waste minimisation measures, including composting, recycling, re-use, recovery, green charcoal process, and others, before collection, treatment and disposal in appropriate and environmentally sound waste management facilities in accordance with this act;
- To ensure the proper segregation, collection, transportation, storage, treatment and disposal of waste through the formulation and adoption of the best environmental practice in ecological waste management;
- To promote national research and development programs for improved waste management and resource conservation techniques, more effective institutional arrangement and indigenous and improved methods of cleaner production, waste reduction, re-use, collection, treatment, separation and recovery;
- To encourage greater private sector participation in waste management;
- To encourage cooperation and self-regulation among waste generators through the application of market-based instruments;
- To institutionalize public participation in the development and implementation of national, provincial and local integrated, comprehensive, and ecological waste management programs;
- To strengthen the integration of ecological waste management and resource conservation and recovery topics into the academic curricula of formal and non-formal education in order to promote environmental awareness and action among the citizenry; and
- To control the export, import, transit, re-use, recovery, treatment and disposal of waste to ensure that all operations relating to export, import, transit, re-use, recovery, treatment and disposal will be undertaken in an environmentally sound manner.

Implications for proposed development:

Not significant- Should the development trigger any of the listed activities in the Act, relevant authorizations will be required.

- **The National Environmental Management: Protected Areas Act, 2003 (Act No 57 of 2003)**

The purpose of this Act is to provide for the protection, conservation and management of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes, for the management of those areas in accordance to national norms and standards, as well as for the intergovernmental co-operation and public consultation in matters concerning protected areas. Protected areas are to be conserved for their biodiversity and ecological integrity.

Implications for proposed development:

Not significant- The proposed filling stations do not fall within any protected areas.

- **National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004)**

The Biodiversity Act, provides for the management and protection of the country's biodiversity within the framework established by NEMA. It provides for the protection of species and ecosystems in need of protection, sustainable use of indigenous biological resources, equity and bioprospecting, and the establishment of a regulatory body on biodiversity- South African National Biodiversity Institute.

Objectives of the Act:

a) With the framework of the National Environmental Management Act, to provide for:
   (i) The management and conservation of biological diversity within the Republic and of the components of such biological diversity:
   (ii) The use of indigenous biological resources in a sustainable manner; and
   (iii) The fair and equitable sharing among stakeholders of benefits arising from bio-prospecting involving indigenous biological resources;

b) To give effect to ratified international agreements relating to biodiversity which are binding on the republic;
c) To provide for co-operative governance in biodiversity management and conservation; and
d) To provide for a South African National Biodiversity Institute to assist in achieving the objectives of this Act.

Under this Act notices are published in terms of alien and invasive species or threatened ecosystems in order to promote the biodiversity of natural resources and protect species endemic to South Africa. Specialist studies need to be conducted for the study area.

Implications for proposed development:

Significant- The sites are not characterised as sensitive areas. However, the vegetation type they fall in, Marikana Thornveld, is considered vulnerable.

- **The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983)**

The Act provides for the control over the utilisation of Natural Agricultural resources of South Africa, in order to promote the conservation of soil, water sources and vegetation, as well as combating of weeds and invader plants and for matters connecting therewith.

Implications for proposed development:

Not significant- According to a GIS desktop study, the study area has high grazing potential. Bokamoso are however of the opinion that as the development site is considered small and located adjacent to the N4 highway, it would not be viable to utilise the site altenratively for the purpose of agricluture.

6.2.5.2 On a Provincial Level

- **North West Provincial Spatial Development Framework (PSDF)**

The purpose of the PSDF is to facilitate appropriate development in the area and to achieve economic, social and environmental sustainability in both the development process and the quality of life.

The objectives of the PSDF are to:

- Provide relevant information to be utilized in the participatory development of the provincial spatial development and environmental management.
- Address the existing spatial planning and land use management situation in the province to enhance co-ordinated, integrated and faster decision-making.
- Sensitively address the existing imbalances and unsustainable development in the province with special emphasis on rural development.
- Enhance spatial integration between provinces and within regions (functional areas) in North West.
- Enhance growth and development of areas through a multi-sectoral approach in accordance with their potential (location, comparative advantages, availability of natural and human resources).
- Contribute to co-operative governance by ensuring better alignment between economic and social infrastructure provision by providing guidelines for setting of priorities.
- Conserve, protect and rehabilitate the natural resource base in such a way that natural resources remain available for use by present and future generations.

Implications for proposed development:

Significant- This plan/framework will be considered during the execution of the EIA phase.

6.2.5.3 On a Local Level

- **Local Municipality of Madibeng Integrated Development Plan (2011-2016)**

The priorities of the local municipality have been identified in the Integrated Development Plan (IDP) for 2011 to 2016. Water and sanitation is first on the priority list followed by roads and storm water.

Implications for proposed development:

Significant- The Madibeng Local Municipality IDP was consulted to inform whether the need and desirability of the proposed development is in line with the socio-economic characteristics as well as the objectives and strategies of their planning objectives of the local municipality.

Issues & Impact Identification – Institutional

Table 32: Issues and Impacts – Institutional

	Issue/ Impact	**Positive/ Negative/ Neutral ±**	**Mitigation Possibilities** **High** ☻ **Medium** ☺ **Low** ◘ **Positive Impact - Not Necessary To Mitigate** ☼
25)	The proposed development will be in line with the international, national, provincial and local legislation, planning frameworks, guidelines, policies etc.	+	☼

6.2.6 Qualitative Environment

6.2.6.1 Visual Analysis

Table 33: Visual Impact Analysis

		IMPACT	
CRITERIA	**HIGH**	**MEDIUM**	**LOW**
Visibility	A prominent place with an almost	A place with a loosely defined theme or	A place having little or no ambience with

	tangible theme or ambience	ambience	which it can be associated
Visual quality	A very attractive setting with great variation and interest – no clutter	A setting with some visual and aesthetic merit	A setting with no or little aesthetic value
Compatibility with the surrounding landscape	Cannot accommodate proposed development without the development appearing totally out of place – not compatible with the existing theme	Can accommodate the proposed development without it looking completely out of place	The surrounding environment will ideally suit the proposed development
Character	The site or surrounding area has a definite character/ sense of place	The site or surrounding environment has some character	The site or surrounding environment exhibits little or no character/ sense of place
Visual Absorption Capacity	The ability of the landscape not to accept a proposed development because of a uniform texture, flat slope and limited vegetation cover	The ability of the landscape to less easily accept visually a particular type of development because of less diverse landform, vegetation and texture	The ability of the landscape to easily accept visually a particular type of development because of its diverse landform, vegetation and texture
View distance	If uninterrupted view distances to the site are > 5Km	If uninterrupted view distances to the site are < 5Km but > 1Km	If uninterrupted view distances to the site are > 500m and < 1000m
Critical Views	Views of the site seen by people from sensitive view sheds i.e. farms, nature areas, hiking trails etc.	Some views of the site from sensitive view sheds	Limited or partial views of the site from sensitive view sheds
Scale	A landscape with horizontal and vertical elements in high contrast to human scale	A landscape with some horizontal and vertical elements in some contrast to human scale	Where vertical variation is limited and most elements are related to the human and horizontal scale

The study area is visible from the surrounding view sheds as indicated on ***Figure 12*** (earlier in the report and below), especially from the N4 highway. The filling stations seem to be more visible from the north than from the south. Good visibility is desirable for a filling station development.

Although the anticipated short term visual impact of the proposed development is regarded as moderate, longer term visual impacts of the proposed development will be **low**.

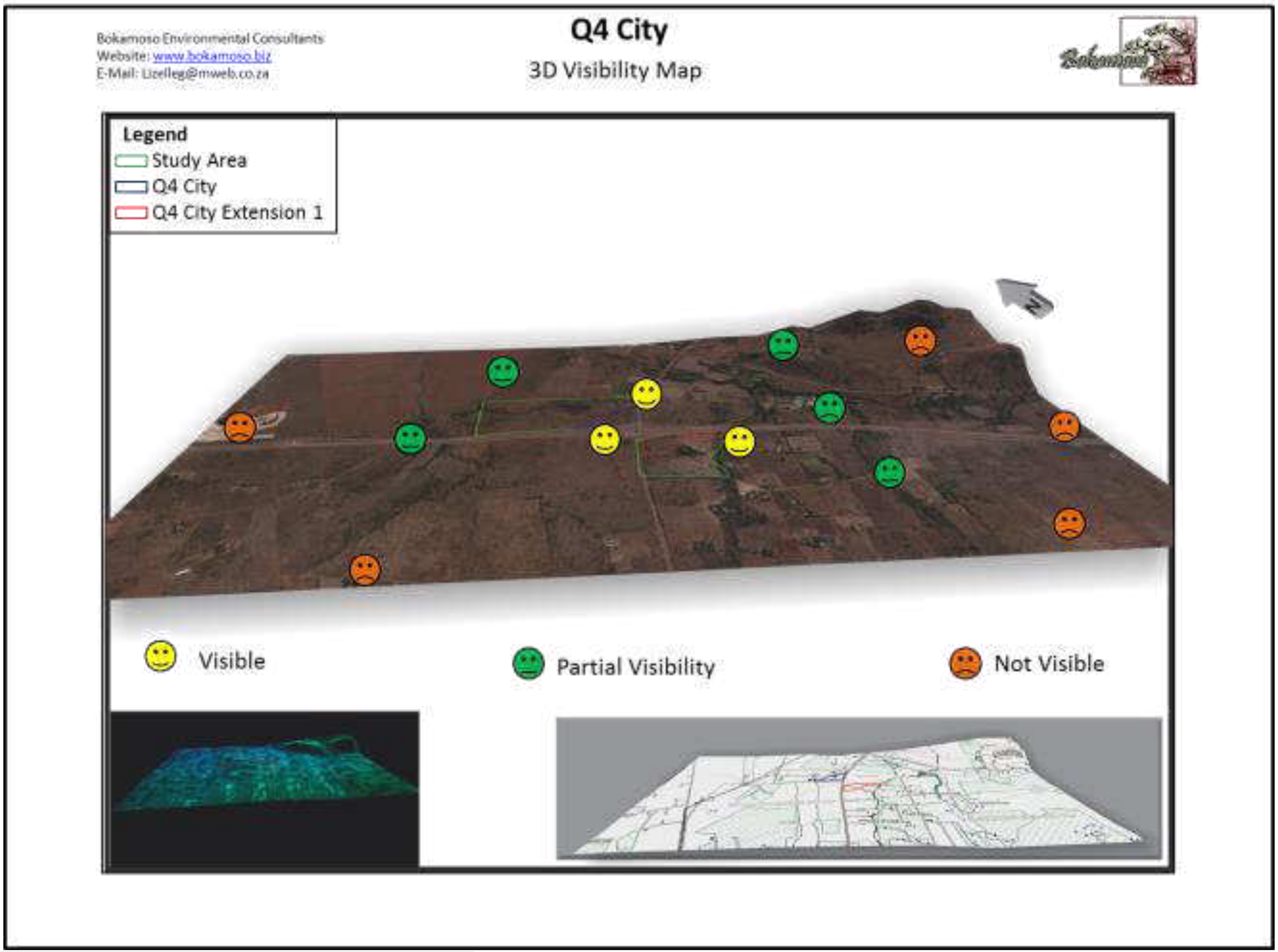


Figure 12 – Visibility Map

6.2.6.2 "Sense of Place" and "Place Structure"

The concept of "a Sense of Place" does not equate simply to the creation of picturesque landscapes or pretty buildings, but to recognise the importance of a sense of belonging.

Embracing uniqueness as opposed to standardisation attains quality of place. In terms of the natural environment it requires the identification, a response to and the emphasis of the distinguishing features and characteristics of landscapes. Different natural landscapes suggest different responses. Accordingly, settlement design should respond to nature.

In terms of the man-made environment, quality of place recognises that there are points where elements of settlement structure, particularly the movement system, come together to create places of high accessibility and these places are recognised in that they become the focus of public investment, aimed at making them attractive, user-friendly and comfortable to experience.

The landscape is usually experienced in a sensory, psychological and sequential sense, in order to provide a feel and image of place ("genius loci").

A landscape is an integrated set of expressions, which responds to different influences. Each has its unique spirit of place, or "genius loci". Each landscape has a distinct character, which makes an impression in the mind, an image that endures long after the eye has moved to other settings.

"Sense of Place" is the subjective feeling a person gets about a place, by experiencing the place, visually, physically, socially and emotionally. The "Sense of Place" of a property/ area within the boundaries of a city, is one of the major contributors to the "Image of a City/ City Image".

City Image consists of two main components, namely "***place structure"*** and "***Sense of place"***. Place structure refers to the arrangement of physical place making elements within a space, whereas sense of place refers to the spirit of a place. It could be defined as follows:

- ***"Place Structure"*** refers to the arrangement of physical place making elements within a unique structure that can be easily legible and remembered.

- The "***Sense of place"*** is the subjective meanings attached to a certain area by individuals or groups and is closely linked to its history, culture, activities, ambience and the emotions the place creates.

Due to the locality of the sites along the N4 National Highway and on- and off-ramps, the "Sense of Place" has already been impacted upon. The small size of the proposed development compared to the surrounding environment the impact of the proposed filling stations on the "Sense of Place" is almost negligible. The proposed development would be architecturally designed in such a way to include as much as possible of the large tree species on the site. The structures that will be built also create a sense of comfort and security to passing motorists. Filling stations provide food, restrooms, security, mechanical workshops and a general sense of comfort to tired travellers.

Issues & Impact Identification – Qualitative Environment

Table 34: Issues and Impacts – Qualitative Environment

	Issue/ Impact	**Positive/ Negative/ Neutral ±**	**Mitigation Possibilities** **High ☻ Medium ☺ Low ◙** **Positive Impact - Not Necessary To Mitigate ☼**
12)	**Visual** If not planned and managed correctly the lights (interior and exterior) and the signage of the development could cause visual pollution - ***Please refer to Section- 6.1.1.3***	-	☻
11)	If not planned correctly, roofs and parking areas could reflect the sun into the eyes of oncoming traffic and surrounding landowners - ***Please refer***	-	☻

	to Section 6.1.1.3		
26)	Construction works could have a visual impact during the construction phase and the new buildings during the operational phase if not planned and managed correctly.	-	☺
27)	The location of the study area is desirable for filling stations in terms of visibility around the proposed site.	+	☼
28)	**Noise Pollution** The construction activities could disturb surrounding residents. However, the operational phase of the proposed filling stations will not have a significant noise impact on the surrounding residents.	-	☺
14)	**Air Pollution** If dry and windy conditions occur during the construction phase, dust pollution could become a problem.	-	☻
29)	**Sense of Place** If planned and managed correctly, the proposed filling stations development could have a positive impact on the "Sense of Place" of the study area and its surroundings.	+	☼

Discussion of issues identified, possible mitigation measures and significance of issue after mitigation

26) Visual pollution during the construction and operational phases if not planned and managed correctly.

Table 35: Significance of Issue 26 (Visual Pollution during construction and operational phases) After Mitigation/ Addressing of the Issue

Mitigation Possibilities **High** ☻ **Medium** ☺ **Low** ◙ **Positive Impact/ Neutral - Not Necessary To Mitigate** ☼	Mitigation Already achieved √ Must be implemented during planning phase, construction and/ or operational phase **P/ C / O**	Significance of Issue after mitigation Low/ eliminated **L / E** Medium **M** High **H** Not possible to mitigate, but not regarded as a fatal flaw **NP**
Medium ☺	**P/C** – All equipment and materials should be stored in a designated area indicated by the ECO.	**M** – To be included in the EMPr
	C – All areas must be kept neat and tidy and waste should be stored in the designated areas and removed on a weekly basis.	**M** – To be included in the EMPr
	P/C - The proposed development will be seen from a distance and therefore the roofs should not reflect the sun or be covered with roofing materials that have bright colours.	**M** – To be included in the EMPr
	P/C - Landscaping should be done in concurrence with the building construction in order to create an instant visual enhancement of the development.	**M** – To be included in the EMPr
	P/C - The landscaping of the proposed development should blend in with the natural vegetation of the area. Trees, shrubs and groundcovers that	**L** – To be included in the EMPr

	are endemic to the area and/or indigenous should preferably be used – landscaping that is in line with the natural vegetation of the area will not only help to reduce the visual impact of the development, but it will also create habitats for fauna and flora species.	
	P/C /O – The landscaping shall be completed by completion of the development. The continued maintenance of the landscaped development shall be to the satisfaction of the Municipality.	**L** – To be included in the EMPr

Result:

Although the issue can be mitigated, the significance of the impact should still be determined / confirmed assessed in the Significance Rating Table

28) Noise Pollution

Construction works during the construction phase will be a source of disturbance in terms of noise to the residential areas around the site.

Table 36: Significance of Issue 28 (Noise Pollution) After Mitigation/ Addressing of the Issue

Mitigation Possibilities **High ☻ Medium ☺ Low ◙** **Positive Impact/ Neutral - Not Necessary To Mitigate ☼**	Mitigation Already achieved √ Must be implemented during planning phase, construction and/ or operational phase **P/ C / O**	Significance of Issue after mitigation Low/ eliminated **L / E** Medium **M** High **H** Not possible to mitigate, but not regarded as a fatal flaw **NP**
Medium ☺	**P/C** – Noise levels should be	**M** – To be included in the EMPr

	kept below "disturbing" as defined in the National Noise Regulations. **P/C** - Noise activities shall only take place during working hours. **P/C** –The surrounding residents must be notified of blasting activities in advance. The necessary safety measures must also be implemented.	**M** – To be included in the EMPr **M** – To be included in the EMPr

Result:

Although the issue can be mitigated, the significance of the impact should still be determined / confirmed assessed in the Significance Rating Table

6.2.7 Demography

Demographics, population composition, income profiles and other population statistics always play a very important role in evaluating the need for additional land uses. The proposed filling stations development will be situated along the N4 National Highway with access only from this National Highway. The proposed Q4 City filling stations aim to serve the traffic volumes travelling between Pretoria and Rustenburg. The traffic volume is split between light and heavy vehicles. The filling stations will provide fuel and facilities to travellers as well as overnight facilities for truck drivers.

Implications for the Development

The proposed filling stations development is compatible with the surrounding area as it is along the N4 National Highway where it will serve the traffic volumes. There is no access to the sites from any other road than the N4 National Highway.

6.2.8 Services

6.2.8.1 Storm water Management

Both sites are drained through surface drainage towards the north. The site that is situated south of the N4 highway has a slight slope towards the east as well, where it drains into the river which crosses the highway by means of a culvert.

The storm water systems that would be designed for each of the two filling station sites will consist of standard grid inlets and underground storm water pipes and the parking areas of each site will intercept majority of the surface water during rainfall events. This collected water will run through the underground storm water pipes and will be discharged into a retention pond. A retention pond would be located on the lowest point of each site. Storm water from the northern site (Portion 22) would discharge into a channel next to the M21 and then drain to the stream that are found north of the site. The southern site (Portion 41) run-off will drain into the existing culvert at the N4 highway via the existing open channel next to the N4. Storm water must be tested regularly before allowing it to enter the existing streams found on each site to ensure the quality of storm water outflow complies to General Limit Values of the National Water Act (No.36 of 1998) (NWA).

The refuelling procedure will take place on a dished refuelling station where fuel will be decanted into underground tanks. This station will consist of a reinforced concrete apron and centrally located catch-pits. The catch-pits will drain into a storm water pollution containment chamber (underground) with an isolation valve (downstream of the chamber) to prevent contaminated storm water from flowing out. During refuelling this operator is closed and under normal operations the valve remains open and the storm water flows to a Calcamite sand, oil and grease trap. The fuel is separated from the storm water in this trap. The clean water then flows to the waste water treatment facility located on each site. Regular inspections and maintenance must be done of these areas.

For the forecourt a catch pit system will be used to collect wash water from the site. The wash water would flow into a pollution containment chamber such as a suitable oil/ water separator system. The separated effluent water would flow to the wastewater treatment plant on each of the sites. The oil collected must be removed from the site by a qualified and approved waste contractor for disposal. Please refer to **Annexure F8** for the Outline Scheme Report.

6.2.8.2 Sewer

There is no Waste Water Treatment Works in the area and therefore the only option for sanitation services will be to install a purification plant on each of the filling station sites. Such a plant would consist of a 16 m^3/day package plant and be constructed on the lowest level of each site. This purification plant will consist of a primary combined settlement tank and anaerobic digester, a secondary aerobic process comprising of the Becon Bio-Filter RBC fixed film reactor units, followed by a humus settlement and a disinfection tank. Water from the purification plant can be used as irrigation water for the gardens. The operations and maintenance of the plant can be done by the supplier on appointment. As mentioned earlier the total annual average demand (AADD) for each filling station site will be 16 kℓ/day. Please refer to **Annexure F8** for the Outline Scheme Report and to Figure 20 for layout of services.

6.2.8.3 Water Supply

The site has no connection to the municipal water system as there is a lack of municipal supply sources in this area. Due to absence of municipal water supply the use of borehole water (each site with its own borehole and elevated storage tank) is the preferred option. A new borehole (QP2) had been drilled on the Remainder of Portion 22 and its yield was deemed satisfactory for the use on that site. This borehole has a safe yield of 64.8 kℓ/day. On Remainder of Portion 41, one of the existing boreholes (BH4) will supply a safe yield of 43.2 kℓ/day. The combined safe yield for both the boreholes will be 108 kℓ/day. The water demand (annual average daily demand) for the proposed filling stations development, including both facilities, will be 38.4 kℓ/day. Water samples taken and tested have also determined that the groundwater found is fresh, clean and young with no contamination present. Please refer to **Annexure F8** for the Outline Scheme Report and to Figure 20 for layout of services.

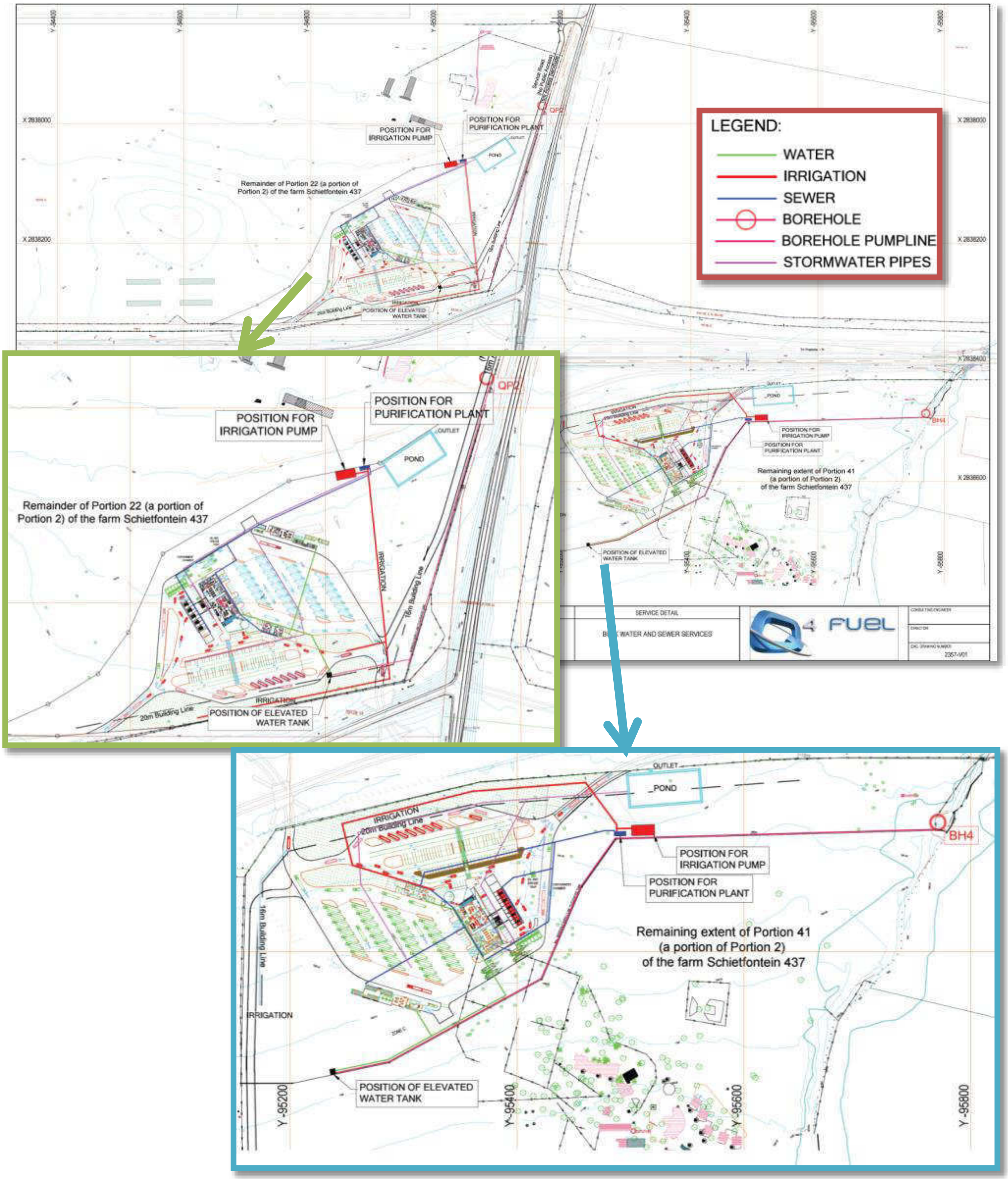


Figure 20 – Services Layout

6.2.8.4 Electricity

An electrical connection can be supplied, for the proposed filling stations development, from the local 11 kV overhead network. The Tshwane Municipality is responsible for this distribution. The total demand for the two filling stations is estimated at 346 kVA. Tshwane Municipality has confirmed that there is sufficient capacity from the local 11 kV overhead network. Please refer to **Annexure F9** for the Electrical Services Report and confirmation from the Municipality.

6.2.8.5 Solid Waste

The solid waste generated from the convenience store and other on-site services will be accumulated and stored on site in the prescribed bins provided by a Contracted Private Waste Removal Company. These bins will be collected at regular intervals and or on request and disposed of at registered landfill facility with the required capacity. Chemicals and hazardous waste will be catered for according to the prescribed requirements in legislation. Please refer to **Annexure F8** for the Outline Scheme Report.

6.2.8.6 Access and Traffic

The purpose of the Traffic Report and Financial Viability Investigation, prepared by **Techworld Consulting Engineers** ***(refer to Annexure F7)*** during January 2015, was to determine the impact on the existing road users and infrastructure as well as surrounding filling stations.

The purpose of the study was to determine when and if the proposed site is feasible and what impact the site will have on existing sites should it be constructed.

Access

Access to the proposed filling stations will be gained directly from the N4 highway. Both the off- and on-ramps of the proposed filling stations will be combined with those of the interchange by using typical SANRAL design standards. A single off-ramp taper/ nose will diverge into a second off-ramp taper / nose after 300m to serve the service areas. The on-ramps from the service area will cross under the off-ramps of the interchange and the D2726 (K25) M21 bridge to merge with the on-ramps of the interchange before a single on-ramp taper/ nose connects to the N4 highway. According to the traffic report, the crossing of the off-ramps of the interchange will be by means of new culvert type structures (8.0m wide) while the crossing of the D2726 (K25) M21 bridge will be behind the piers of the two-portal bridge by replacing the land abutments with retaining walls.

The two existing western ramps must be partially reconstructed to accommodate the ramps that will serve the proposed filling station facilities. Although the construction of the eastern ramps is not planned by either Bakwena or SANRAL at this stage, the design of the new configuration will make provision for the construction of these ramps in future. The traffic demand for these ramps is low and their construction may have significant toll implications (opportunity to avoid the Brits Toll Plaza). The design of the service areas and ramp configurations will furthermore also make provision for the construction of the second carriageway of the N4 highway in the near future.

Each of the filling stations will be provided with a service road from existing access roads/ intersections along Road D2726 to provide access to the facilities for service and delivery vehicles and to link the two facilities via Road D2726. Public vehicles will not have access from any other road than the n4 highway. Pedestrian movements between the facilities can be accommodated via the existing bridge crossing of Road D2726.

Traffic

The proposed filling stations are located 4.5km from the planned PWV6 Route and 2.6km from the Brits Toll Plaza. In terms of other filling stations, the Engen Doornpoort One-Stop is located 33km east from the site and the Total Magalies Petroport is 30km west from the site. This location of the proposed filling stations developed is in line with SANRAL's minimum requirements of 30km for facilities that serve traffic in the range of 5 000 to 50 000 vehicles per day.

Data for the traffic volumes were obtained from the permanent traffic counting stations at the Brits mainline Toll Plaza (CTO 2560) and at the M17 (K67) Ga-Rankuwa Interchange (CTO 1618). The total traffic count for 2014 is 12 380 vehicles per day which includes heavy vehicles as well. Heavy vehicles or trucks account for 14.2% of the total traffic which is 1 760 vehicles per day. These heavy vehicles are longer trucks, in the majority, as the estimated average is 5.2 axles per truck. Twelve percent of the traffic occurs during the night (20:00-6:00), while 88% is during day time (6:00-20:00). The proposed filling stations will be located outside the national road reserve of the N4 highway. The forecasted traffic growth rates for the proposed filling stations development for the period 2014 to 2036 are 4.60% for light vehicles and 5.90% for heavy vehicles.

Fuel sales

The proposed highway facilities will serve long distance traffic along the N4 Highway between destinations in the east (along the N1 National Highway and the City of Tshwane) and in the west (in the North-West Province up to the Border with Botswana). Although the proposed filling stations facilities will primarily serve a transient market (long distance traffic that travels less frequently), the location between the Tshwane Metropolitan Area in the east and Brits (Madibeng Local Municipality) in the west and Rustenburg in the far west will also result in commuting traffic patronizing the facilities. The fuel demand characteristics of the proposed facilities are expected to be indicative of a transient market (i.e. relatively higher average fills and attraction rates).

The expected total fuel sales after the opening of the filling stations will be approximately 0.90 million litres per month. The ramp-up period is the initial period before the full potential of a filling station is realized. For the first three years' ramp-up percentages of 85%, 90% and 95% were assumed. The expected average monthly fuel sales will increase in future based on the expected growth in traffic as follows: 1.28 million litres in year 5, 1.64 million litres in year 10, and 2.11 million litres in year 15.

Issues & Impact Identification – Services

Table 37: Issues and Impacts – Services

	Issue/ Impact	**Positive/ Negative/ Neutral ±**	**Mitigation Possibilities** **High ☻ Medium ☺** **Low ◘** **Positive Impact - Not Necessary To Mitigate ☼**
30)	**Storm water** The proposed development will lead to increased hard surfaces and the quantity and the speed of the storm water above the study area and into the water bodies and adjacent areas will increase.	-	☻
31)	Surface water flows will be altered during the construction phase	-	☻
32)	The use of insufficient drainage systems during the construction phase (i.e. sub-surface drainage systems & no mechanisms to break the speed of the surface water)	-	☻
33)	Temporary disruption of services due to relocation and installation of services	-	☻
34)	**Waste Management** The construction phase of the proposed development will create large quantities of builder's waste to be accommodated by local	-	☺

	legal landfill sites. The operational phase will create domestic waste and waste associated with the filling stations.		
35)	Spillage of an on-site sewerage system	-	☻

Discussion of issues identified, possible mitigation measures and significance of issue after mitigation

30) The proposed development will lead to increased hard surfaces and the quantity and the speed of the storm water across the study area and into the water bodies and adjacent areas will increase.

Should contaminated storm water run-off from roads not be managed, it could lead to surface water and ground water pollution. This will also raise flood levels of water bodies in the area, if storm water is not managed correctly.

Table 38: Significance of Issue 30 (The proposed development will lead to increased hard surfaces and the quantity and the speed of the storm water across the study area and into the water bodies and adjacent areas will increase.) After Mitigation/ Addressing of the Issue

Mitigation Possibilities **High** ☻ **Medium** ☺ **Low** ◙ **Positive Impact/ Neutral - Not Necessary To Mitigate** ☼	Mitigation Already achieved √ Must be implemented during planning phase, construction and/ or operational phase **P/ C / O**	Significance of Issue after mitigation Low/ eliminated **L / E** Medium **M** High **H** Not possible to mitigate, but not regarded as a fatal flaw **NP**
High ☻	**P** - A comprehensive storm water management plan	**L** – To be included in the EMPr

	indicating the management of all surface runoff generated as a result of the development (during both the construction and operational phases) prior to entering any natural drainage system, must be submitted and approved by the local authority prior to construction activities commencing.	
	P - The storm water management plan should be designed in a way that aims to ensure that post development runoff does not exceed predevelopment values in: •Peak discharge for any given storm; •Total volume of runoff for any given storm; •Frequency of runoff; and •Pollutant and debris concentrations reaching water courses.	**M –** To be included in the EMPr

Result: *Although the issue can be mitigated, the significance of the impact should still be determined / confirmed assessed in the Significance Rating Table*

31) Surface water flows will be altered during the construction phase

Due to the excavations that will take place (there will be trenches and topsoil as well as subsoil mounds in and around the study area) the topography of the study area will temporarily be altered. This will however only be a short-term impact and if the levels are restored to normal (the surface drainage patterns from the new levels should not differ too much from the surface water drainage of the original levels) once the construction phase is completed.

Table 39: Significance of Issue 31 (Surface water flows will be altered during the construction phase) After Mitigation/ Addressing of the Issue

Mitigation Possibilities **High** ☻ **Medium** ☺ **Low** ◙ **Positive Impact/ Neutral - Not Necessary To Mitigate** ☼	Mitigation Already achieved √ Must be implemented during planning phase, construction and/ or operational phase **P/ C / O**	Significance of Issue after mitigation Low/ eliminated **L / E** Medium **M** High **H** Not possible to mitigate, but not regarded as a fatal flaw **NP**
High ☻	**P/C** – Construction activities should preferably take place during the winter months	**M** – To be included in the EMPr
	P/C - If it is not possible for construction activities to take place during the winter months, construction activities should take place in phases in order to prevent large exposed areas that will cause an increase in the speed of surface water.	**M** – To be included in the EMPr
	P - When storm water planning is done, every attempt possible should be made to keep the post construction and pre-construction flows similar.	**M** – To be included in the EMPr

Result: *Although the issue can be mitigated, the significance of the impact should still be determined / confirmed assessed in the Significance Rating Table*

32) The use of insufficient drainage systems including sub-surface drainage systems and no mechanisms to break the speed of surface water during the construction phase.

Table 40: Significance of Issue 32 (The use of insufficient drainage systems during the construction phase (i.e. sub-surface drainage systems & no mechanisms to break the speed of the surface water) After Mitigation/ Addressing of the Issue

Mitigation Possibilities **High** ☻ **Medium** ☺ **Low** ◙ **Positive Impact/ Neutral - Not Necessary To Mitigate** ☼	Mitigation Already achieved √ Must be implemented during planning phase, construction and/ or operational phase **P/ C / O**	Significance of Issue after mitigation Low/ eliminated **L / E** Medium **M** High **H** Not possible to mitigate, but not regarded as a fatal flaw **NP**
High ☻	**C** – Implement temporary storm water management measures that will help to reduce the speed of surface water. These measures will also assist with the prevention of water pollution, erosion and siltation. **C** - No excavated materials should be dumped in or near drainage channels. **C** – Sandbags and hay bales can be used as temporary measures to assist with storm water management and erosion control.	**L – **To be included in the EMPr **L – **To be included in the EMPr **L – **To be included in the EMPr

Result: *Although the issue can be mitigated, the significance of the impact should still be determined / confirmed assessed in the Significance Rating Table*

33) Temporary disruption of services due to relocation and installation of services

This issue has a small possibility of occurring as the local municipality has not confirmed services for sewer and water at this stage and therefore on site services will be installed and utilised. This means that services interruptions, causing a nuisance for neighbouring residents, are unlikely but the issue has been identified and mitigated below should it occur at some stage during the construction of the filling stations.

Table 41: Significance of Issue 33 (Temporary disruption of services due to relocation and installation of services) After Mitigation/ Addressing of the Issue

Mitigation Possibilities **High ☻ Medium ☺ Low ◙** **Positive Impact/ Neutral - Not Necessary To Mitigate ☼**	Mitigation Already achieved √ Must be implemented during planning phase, construction and/ or operational phase **P/ C / O**	Significance of Issue after mitigation Low/ eliminated **L / E** Medium **M** High **H** Not possible to mitigate, but not regarded as a fatal flaw **NP**
High ☻	**P/C** – Neighbouring land owners should be notified of the commencement of construction of the filling stations. It should also be brought under their attention that there might be a possibility of services interruptions during the construction phase.	**L** – To be included in the EMPr
	P/C – Neighbouring land owners should be notified of services interruptions at least 24 hours before the potential interruption.	**L** – To be included in the EMPr

Result: *Although the issue can be mitigated, the significance of the impact should still be determined / confirmed assessed in the Significance Rating Table*

34) During the construction and operational phases waste would be generated on site. The waste may consist of the following waste streams, namely:

- Liquid waste from vehicles and the filling stations;
- Solid domestic waste; and
- Solid construction waste.

Disposal of some of the above waste streams may lead to soil, water and aesthetic pollution of the site. The soil and water pollution should be localised with little impact on the surrounding environment. Waste disposal on site may stimulate the surrounding population to also dispose domestic waste on the site. This may lead to an uncontrolled situation that would be aesthetically unacceptable to future occupants and costly to rehabilitate.

The disposal of large quantities of waste during both the construction and operational phases would place a burden on landfill sites in the area to accommodate the additional volumes. Although this waste is inert in most cases, it may be of significant proportions and will contribute to the saturation of the formal landfill sites in the area.

Table 42: Significance of Issue 34 (The construction and operational phases of the proposed development will create large quantities of builder's and domestic waste and liquids) After Mitigation/ Addressing of the Issue

Mitigation Possibilities **High ☻ Medium ☺ Low ◘** **Positive Impact/ Neutral - Not Necessary To Mitigate ☼**	Mitigation Already achieved √ Must be implemented during planning phase, construction and/ or operational phase **P/ C / O**	Significance of Issue after mitigation Low/ eliminated **L / E** Medium **M** High **H** Not possible to mitigate, but not regarded as a fatal flaw **NP**
Medium ☺	**C** – Prevent unhygienic usage on site and pollution of the natural assets. Develop a central waste temporary holding site to be used during construction (Near the access entrance). This site should comply with the following: - Skips for the containment and disposal of waste that could cause soil and water pollution, i.e. paint,	**L** – To be included in the EMPr

	lubricants, etc.; - Small lightweight waste items should be contained in skips with lids to prevent wind littering; - Bunded areas for containment and holding of dry building waste. - THESE AREAS SHALL BE PREDETERMINED AND LOCATED IN AREAS THAT IS ALREADY DISTURBED. THESE AREAS SHALL NOT BE IN CLOSE PROXIMITY OF DRAINAGE CHANNELS.	
	C - Workers will only be allowed to use temporary chemical toilets on the site. CHEMICAL TOILETS SHALL NOT BE IN CLOSE PROXIMITY OF DRAINAGE CHANNELS.	L – To be included in the EMPr
	C - No French drain systems may be installed.	L – To be included in the EMPr
	C - No bins containing organic solvents such as paints and thinners shall be cleaned on site, unless containers for liquid waste disposal are placed for this purpose on site. All waste must be removed to a recognized waste disposal site on a weekly basis. No waste materials may be disposed of on or adjacent to the site. The storage of solid waste on site, until such time that it may be disposed of, must be in the manner acceptable to the Local Authority	L – To be included in the EMPr
	C - Keep records of waste reuse, recycling and disposal	L – To be included in the EMPr

	for future reference. Provide information to ECO. (Environmental Control Officer)	

Result: *Although the issue can be mitigated, the significance of the impact should still be determined / confirmed assessed in the Significance Rating Table*

35) Spillage of an on-site sewerage system

On-site sewerage systems are planned for the proposed filling stations development and potential spill emergency has been identified and mitigation measures are in place. It should be noted that the proposed sewer systems are designed with the best suited technology.

Table 43: Significance of Issue 35 (Spillage of an on-site sewerage system) After Mitigation/ Addressing of the Issue

Mitigation Possibilities **High ☻ Medium ☺ Low ◘** **Positive Impact/ Neutral - Not Necessary To Mitigate ☼**	Mitigation Already achieved √ Must be implemented during planning phase, construction and/ or operational phase **P/ C / O**	Significance of Issue after mitigation Low/ eliminated **L / E** Medium **M** High **H** Not possible to mitigate, but not regarded as a fatal flaw **NP**
High ☻	**P/C** – It is the recommended that the on-site sewerage systems be bunded or in an enclosed area. **O** – The on-site sewerage systems should be monitored on a daily basis and should any spills be noticed on site the supplier should be contacted for maintenance and rectification of this issue. Contaminated soil should be properly disposed of.	**L** – To be included in the EMPr **L** – To be included in the EMPr

Result: *Although the issue can be mitigated, the significance of the impact should still be determined / confirmed assessed in the Significance Rating Table*

6.2.8.7 Filling Stations Details

Tank Details/Safety Features and Mitigation measures

Seven 45m^3 Double Skin Underground Storage Tanks will be installed on each of the filling station sites. The developer will use tanks manufactured by Petrotank South Africa. The tanks will be UST double wall steel tank in accordance with EN12285-1 specification. The tanks will have a surface treatment of 2.5 SA grit blasted and a Polyurethane (Endoprene) layer, minimum 800μm thick, to 14KV resistance. Polyurethane – Endoprene, for external corrosion protection, is Solvents-free and Non-toxic with no aggressive odor (environmental friendly). Petrotank South Africa is currently part of a working group at the SABS and have requested that the SANS 1535 specification is revised to allow for Polyurethane coated tanks as well. ***Refer to Annexure G1 for typical details on tanks.***

As mentioned in the storm water section of this report, the refuelling procedure will take place on a dished refuelling station where fuel will be decanted into underground tanks. This station will consist of a reinforced concrete apron and centrally located catch-pits. The catch-pits will drain into a storm water pollution containment chamber (underground) with an isolation valve (downstream of the chamber) to prevent contaminated storm water from flowing out. During refuelling this operator is closed and under normal operations the valve remains open and the storm water flows to a Calcamite sand, oil and grease trap. The fuel is separated from the storm water in this trap. The clean water then flows to the waste water treatment facility located on each site. Regular inspections and maintenance must be done of these areas. ***Refer to Annexure G3 for Details on an Oil Separator.***

Emergency Plan

Refer to Annexure G2

An emergency plan for actions and remedial measures to be activated in case of a fuel spillage, fire and gas leaks are drawn up and posted at the filling station. Filling station staff is trained in measures to be taken in case of accidents, fighting different types of fire, use of emergency stop and fireman's switches and emergency numbers are displayed prominently in accessible locations at the service station.

The Emergency Plan includes the following (the full emergency plan can be perused in **Annexure G2):**

VAPOUR RECOVERY PLAN

Organic vapour is released into the atmosphere by petrol and diesel. These hydrocarbons released into the atmosphere/environment are called Volatile Organic Compounds (VOC's). The release of fuel vapour into the atmosphere could create an explosion and therefore it is vital to capture the petrol vapour. The following measures should be adhered to with the aim of limiting the release of vapour into the atmosphere:

- During the unloading of fuel by the tanker trucks, vents should be closed on the tanker as well as the underground storage tank.
- Rubber seals should be used on the dispensing pipe (from the tanker) that runs to the underground storage tanks.
- A modified petrol filling nozzle should be used for refuelling. The nozzle could also be modified with a rubber seal.
- An automatic switch valve should be used to cut the flow of fuel when full.
- Install leak detection on the gauge system of the tank.
- Spillages should be cleaned immediately.
- No open containers containing fuel will be allowed.

FUEL SPILLAGES

The Regulations of Hazardous Chemical Substances regulates the storage of hazardous substances on various premises.

1. Depending on the quantity of the product spilled, all pumps should be stopped either through an emergency button that switches off all pumps or the electrical distribution board.
2. Fuel should be shut off by the road tanker. Most tanker vehicles have an emergency button that should be hit. The individual compartments valves can also be shut.
3. Customers and bystanders should be kept away from the area and evacuated. An explosion could occur if a vapour cloud is ignited in any manner.
4. Ensure that customer vehicles in the vicinity of the spill will not be started as this may ignite the vapour and cause a fire/explosion.
5. No vehicle may enter the filling station.
6. Any source of ignition in the immediate area should be eliminated.
7. Sand buckets should be placed in the forecourt area and be easily accessible. The sand should be used to soak up the spilt fuel and prevent it from spreading.
8. Fire extinguishers should be removed from the forecourt and area of spillage.
9. Should any neighbours be vulnerable to an explosion at the filling station, they should be warned.
10. Fuel may not be flushed down drains.
11. If anyone had been contaminated with fuel, they should be sprayed with water and their clothing should be removed.
12. Any soil contaminated by the spill should be placed in an empty container such as a drum and removed by a hazardous waste removal company.
13. The Petroleum Company's emergency centre / team should be contacted. They may assist or give advice on the procedure to be followed.
14. With major spills it is important to notify the relevant Departments as well for example the Department of Water and Sanitation.
15. Should a spill catch fire the emergency plan for a fire should be followed.

<u>FIRE</u>

Fire at a filling station is very dangerous and can lead to major injuries and destruction. Fire can be caused by a variety of factors and/or actions. It is important to erect signs at the filling station area to notify the public that no smoking and no cell phones will be allowed around the pump areas and tanks. Fires can also be ignited through petroleum spillages and the release of fuel vapour into the atmosphere. The fire could be in the forecourt area or in any of the buildings. The following procedure can be followed in case of an emergency:

1. Refuelling should be stopped immediately at the filling station.
2. The emergency shut-off switch should be activated.
3. If not done simultaneously with the emergency shut-off switch, the electrical supply to all equipment in the immediate area should be isolated at the distribution board.
4. The emergency fire alarm should be activated. There should be a clear indication of where the fire alarm is located.
5. Immediate notification of the manager or owner.
6. The forecourt and/or building should be evacuated of customers and employees, away from the danger area, to a safe assembly area(s).
7. Customers should move their vehicles away from the fire/danger area.
8. Injured people should be guided away from the fire/danger area.
9. The manager or owner to notify the fire brigade and emergency response.
10. If safe to do so an attempt should be made to extinguish the fire by using fire extinguishers.
11. Close the driveways in order to prevent access to the forecourt.
12. Adjacent property owners should be notified of the fire if it is possible that it can spread towards them.
13. The fire emergency services should be assisted when they arrive.
14. The Petroleum Company should be notified immediately by the manager or owner.
15. It is very important that a first aid kit should always be readily accessible on site in case of any emergency.

Issues & Impact Identification – Filling Stations

Table 44: Issues and Impacts – Filling Stations

	Issue/ Impact	**Positive/ Negative/ Neutral ±**	**Mitigation Possibilities** **High** ☻ **Medium** ☺ **Low** ◘ **Positive Impact - Not Necessary To Mitigate** ☼
36)	Possible surface water pollution due to unaddressed spillages associated with the proposed filling stations.	-	☺
37)	Possible ground water pollution due to leaking equipment and spillages associated with the proposed filling stations.	-	☺
38)	Risk for fires or explosion associated with the proposed filling stations.	-	☺

36) Possible hydrocarbon contamination due to un-addressed spillages could occur.

Table 45: Significance of Issue 36 (surface water pollution due to unaddressed spillages) After Mitigation/ Addressing of the Issue

Mitigation Possibilities **High** ☻ **Medium** ☺ **Low** ◘ **Positive Impact/ Neutral - Not Necessary To Mitigate** ☼	Mitigation Already achieved √ Must be implemented during planning phase, construction and/ or operational phase	Significance of Issue after mitigation Low/ eliminated **L / E** Medium **M** High **H** Not possible to mitigate,

	P/ C / O	but not regarded as a fatal flaw **NP**
Medium ☺	**O** – The Emergency Plan attached as ***Annexure G2*** must be implemented. The Emergency Plan is incorporated in the EMPr ***(refer to Annexure J).*** **O** – A Spill response kit comprising of absorbent fibers and associated waste containers should be available on site. All materials for clearing of surface spillages should be stored in a container and moved on a regular basis by an approved contractor to a hazardous waste disposal site.	**M** – To be included in the EMPr **M** – To be included in the EMPr

Result: *Although the issue can be mitigated, the significance of the impact should still be determined / confirmed assessed in the Significance Rating Table*

37) Possible ground water pollution due to leaking equipment and spillages associated with the proposed filling stations.

Table 46: Significance of Issue 37 (ground water pollution due to leaking equipment and spillages) After Mitigation/ Addressing of the Issue

Mitigation Possibilities **High** ☻ **Medium** ☺ **Low** ◙ **Positive Impact/ Neutral - Not Necessary To Mitigate** ☼	Mitigation Already achieved √ Must be implemented during planning phase, construction and/ or operational phase **P/ C / O**	Significance of Issue after mitigation Low/ eliminated **L / E** Medium **M** High **H** Not possible to mitigate, but not regarded as a fatal flaw **NP**
Medium ☺	**C/O** – The Emergency Plan attached as ***Annexure G2*** must be implemented. The	**M** – To be included in the EMPr

	Emergency Plan is incorporated in the EMPr ***(refer to Annexure J).***	
	C – Appropriate damp proofing and drainage precautions must be implemented beneath all fuel storage areas to prevent groundwater pollution during periods of sustained rainfall.	**M** – To be included in the EMPr
	C/O – All surface areas utilized for the proposed storage tanks and peripheral infrastructure must be appropriately paved to prevent ingress of contaminated water into the ground.	**M** – To be included in the EMPr
	C/O – All pipes and connections to the proposed tanks must be provided with flexible coupling to prevent spillages.	**M** – To be included in the EMPr
	C/ – To mitigate any expanding or shifting soils, the tank excavation should be backfilled with coarse grained river sand. The river sand will act as a stabilizer which will allow for expansion and contraction in the surrounding soils without affecting the tank.	**M** – To be included in the EMPr
	C/O – Storm water management on site and around all fuel/ oil bearing infrastructure should aim the fast and efficient disposal of water into the surrounding and existing drainage systems.	**M** – To be included in the EMPr
	C – Paving must be provided around the perimeter of all	**M** – To be included in the EMPr

	structures. Joints between paved areas and the walls of the buildings should be sealed with a flexible sealant to prevent moisture reaching the foundations.	
	O – A complete waste handling and separation procedure for the operational phase should be implemented due to the handling, storing and disposal of hazardous chemicals. An oil/water separator should be installed on site, which will allow for the processing and separation of insoluble fuel hydrocarbons and the storm and wash down water of the current dispensing area. Only processed water will be allowed and directed to the local sewage system. Under no circumstances may processed water be directed to the storm water system or the surrounding wetland areas.	**M** – To be included in the EMPr
	O – All fuel dispensers must include a shut-off valve.	**M** – To be included in the EMPr
	O –All materials and installations shall comply with the relevant standards and regulations as imposed by the South African Bureau of Standards (SABS) and the Occupational Health and Safety Act (Act 85 of 1993).	**M** – To be included in the EMPr

Result: *Although the issue can be mitigated, the significance of the impact should still be determined / confirmed assessed in the Significance Rating Table*

38) Risk for fires or explosion associated with the proposed filling stations.

Due to the proposed facilities for storage and handling of a dangerous and flammable goods, an Emergency / Fire Response Plan approved by a risk consultant must be implemented and adhered to.

Table 47: Significance of Issue 38 (Risk for fires or explosion associated with the proposed filling stations) After Mitigation/ Addressing of the Issue

Mitigation Possibilities **High** ☻ **Medium** ☺ **Low** ◙ **Positive Impact/ Neutral - Not Necessary To Mitigate** ☼	Mitigation Already achieved √ Must be implemented during planning phase, construction and/ or operational phase **P/ C / O**	Significance of Issue after mitigation Low/ eliminated **L / E** Medium **M** High **H** Not possible to mitigate, but not regarded as a fatal flaw **NP**
Medium ☺	**C/O** – The Emergency Plan attached as ***Annexure G2*** must be implemented. The Emergency Plan is incorporated in the EMPr ***(refer to Annexure J).***	**M** – To be included in the EMPr
	O – All general emergency fire system should be in place, including hose reels, fire main rings etc.	**M** – To be included in the EMPr

Result: *Although the issue can be mitigated, the significance of the impact should still be determined / confirmed assessed in the Significance Rating Table*

6.2.9 Public Participation

Refer to Annexure H

Public participation is an important aspect of the EIA Process. The principles of the National Environmental Management Act govern many aspects of environmental impact assessments, including public participation. These include provision of sufficient and transparent information on an ongoing basis to stakeholders to allow them to comment and ensuring the participation of previously disadvantaged people, women and youth.

Effective public involvement is an essential component of many decision-making structures, and effective community involvement is the only way in which the power given to communities can be used efficiently. The public participation process is designed to provide sufficient and accessible information to interested and affected parties (I&AP's) in an objective manner to assist them to:

- ☐ Raise issues of concern and suggestions for enhanced benefits.
- ☐ Verify that their issues have been captured.
- ☐ Verify that their issues have been considered by the technical investigations.
- ☐ Comment on the findings of the EIA.

Stakeholders (and I&APs) were notified of the **EIA Process** through:

1) A site notice that was erected (at a prominent point on the study area) on 6 August 2015 ***(refer to Annexure H1);***
2) Notices were distributed to the stakeholders and interested and affected parties by means of faxes and e-mail ***(refer to Annexure H2 and H5);*** and
3) An advertisement was placed in the local newspaper, Kormorant, and the provincial newspaper, Beeld, on 6 August 2015 ***(refer to Annexure H3)***.

Table 48. Registered Interested and Affected Parties (does not include stakeholders)

Nr	Registered Parties	Contact details
1	Johan van Rensburg	johan@calcuplan.com Cell: 083 491 2793
2	Lynette Strauss	strausslynette@gmail.com Cell: 082 697 8090
3	Johan Strauss	Cell: 073 655 0585
4	Ria Mclellan	riamclellan11@gmail.com Cell: 083 953 1800

5	Andre du Toit	andre@adtrp.co.za Cell: 083 659 4037
6	Beverley Oosthuizen	tph@tph.co.za Tel: 012 809 2229
7	Pine Pienaar	netpet@lantic.net Cell: 082 789 5131
8	Frans Lombard	frans@fuelarama.co.za Tel: 011 781 8312/4/7
9	Kallie Erasmus	kallie@erasmuslaw.com
10	Gwen Theron	gwen.theron@telkomsa.net Cell: 083 302 2116
11	Jitske Botes	jitske@telkomsa.net Cell: 061 220 2414
12	Danie Neumann	praxis@mweb.co.za Cell: 074 092 3602
13	Nokukhanya Khumalo	nkhumalo@sahra.org.za
14	DWHM De Wildt Help Mekaar	dewildthelpmekaar@gmail.com

6.2.9.1 Issues raised by I & APs

Comments were received on this project during the Scoping Phase. The issues mainly dealt with parties that wanted to register and be kept informed on the project as well as objectors that feel the proposed filling stations will impact upon already existing filling stations. Some of the comments received which highlighted different issues are discussed below. For all the issues/comments received for the proposed filling stations, consult the Comments and Issues register ***(Refer to Annexure H7)***.

SOUTH AFRICAN HERITAGE RESOURCE AGENCY (SAHRA)

Comment from Nokukhanya Khumalo:

Thank you for notifying SAHRA on the proposed Q4 City Filling Station in Schietfontein, north of the Magaliesburg mountain range, located on a Part of Portion 22 and a part of Portion 41 of the Farm Schietfontein 437 JQ. Madibeng Local Municipality, North-West Province. The development consists of rezoning of 7 hectares of agricultural land for both portions of land for the filling stations on both sides of the N4 Freeway and the M21 Lucas Mangope Drive.

In terms of the National Heritage Resources Act, no 25 of 1999, heritage resources, including archaeological or palaeontological sites over 100 years old, graves older than 60 years, structures older than 60 years are protected. They may not be disturbed without a permit from the relevant heritage resources authority. This means that before such sites are disturbed by development and, where deemed necessary by the heritage authority, a Heritage Impact Assessment is done. This may include the archaeological component (Phase 1) any other applicable heritage components. Appropriate (Phase 2) mitigation, which involves recording, sampling and dating sites that are to be destroyed, must be done as required.

This development lies in the wider surrounding area where there is known archaeological resources, so there is a likelihood of there being archaeological resources on the site proposed for development. Thus a Heritage Impact Assessment is requested by SAHRA to assess and find any potential heritage resources on the development site and to determine the impacts the development might have on those resources.

SAHRA exempts this project from a Palaeontological Impact Assessment, because the location of the filling station development lies on land that has a negligible palaeontological sensitivity.

SAHRA APM Unit will make further comment on this case, once the following documents are submitted to this case:

However, this report and assessment must be done by a professional archaeologist, who is already familiar with the minimum standards. If you are not sure of where to find an archaeologist, we suggest searching in (http://www.asapa.org.za/uploads/files/crm-list-october.pdf)

Response from EAP:

The Heritage Impact studies of the proposed two filling station sites are attached to this report in **Annexure F5**.

MADIBENG LOCAL MUNICIPALITY

Comment from Mpho Magasa:

The Draft Scoping received from Bokamoso Landscaping Architects & Environmental Consultants refers:

<u>Description of the Project:</u>

The proposed activity involves the construction of two filling stations adjacent to the Bakwena Platinum Freeway. The construction will take place concurrently on portion 22 and 41 of the Farm Schietfontein 437 JQ, North West Province.

The distance mentioned in the report of Petroport being 80km from the site is incorrect. Petroport is approximately 40km from the site.

Response from EAP:

This has been noted and corrected in this Report.

<u>Description of Alternatives:</u>

Four alternatives, namely: locality alternatives, land use alternative, layout alternative and the no-go alternative have been compared and discussed in the report. However, it is not clear form the Report which alternative is preferred one.

Response from EAP:

The preferred alternative have been described and labelled in the Scoping as well as this EIA Report.

Description and assessment of the identified environmental issues:

The review of the report confirms that the methods followed in the identification and assessment of the impacts is considered to be adequate. In addition, the impacts associated with the proposed development are assessed in terms of the different phases of the proposed development. However, the report states that more detailed assessment will be done during the EIA phases.

Evaluation and presentation of the mitigation measures:

The proposed mitigation measures suggested in the report are inadequate since they are discussed in passing. In addition, no specialist studies are included in the report. However, the report states the Specialist studies will be undertaken and included in the EIA Report which the municipal will be awaiting.

Response from EAP:

Specialist studies have been included in this Report as **Annexure F**.

Public Participation Process:

The Public Participation Process was not undertaken in accordance with the EIA regulations. No site photographs are attached in the report showing the 8 cardinal directions.

Response from EAP:

Site photographs are attached as **Annexure I** of this Report.

NB: Please note that in addition to providing information as required by EIA Regulation the following must also be included in the Environmental Impact Assessment Report (EIAR):

a. Design drawing of the proposed development clearly detailing the following aspects:
    i. Storm water management;
    ii. Plans to separate clean and dirty storm water;
    iii. Spill management measures;

   - iv. Information on whether that tanks will be single or double walled; and
   - v. Safety features and mitigation measures.

b. Discussion on the operation and efficiency of the separator and the type of effluent streams to be treated in the separator and the disposal thereof;

c. The proposed project must comply with all applicable Sections and Regulations of the National Water Act, 1998 (Act 36 of 1998) and Water Services Act, 1997 (Act 108 of 1997);

d. Commitment that all storm water to be discharged directly into sewer system will comply with the requirements of Madibeng Local Municipality and the Department of Water Affairs (DWA);

e. Streams nearby should not be disturbed, should there be a major need to do anything on them, the Department of Water Affairs should be informed.

f. Written confirmation from the oil company/supplier that the tanks are manufactured in accordance with SANS standards, and that the installation will conform to such standards;

g. Commitment to comply with the requirements of the Occupational Health and Safety Act 1993 (Act No 83 of 1993);

h. A detailed discussion on the waste disposal methods (both General waste and hazardous waste) during construction, operation and decommissioning phases of the proposed activity;

i. Incident Management Plan, including Emergency/Fire Response and Spill response plans approved by the qualified risk consultant and/or local Authority;

j. Vapor recovery plan, including reporting thereof;

k. The location of wells and boreholes on site and neighboring properties with an indication of the level of reliance of the neighboring properties on groundwater resources;

l. The groundwater monitoring boreholes should be drilled and groundwater samples taken for analysis and recorded for reference quality, prior to the operation of the filling station;

m. Proof that Local Authority confirming waste removal during all stages of the project must be attached in the final EIA report for review;

n. For all hazardous (and non-hazardous) materials/waste taken off the site for disposal (or incineration or other treatment or reuse) by the proponent or a contractor, the proponent must keep record of details including the type of material, quality, name and other important details tracking the contractor, dates and time of collection of the material and details of use/reuse and "safe disposal certificates";
o. A description of the compatibility of the soil type to this type of development, as well as the depth of ground water on site. Attention must be given to expansion and stability properties;
p. A detailed discussion on the proximity of the proposed area to the perennial and non-perennial rivers and likely impacts that the proposed development might have on these streams; and
q. A Comprehensive Environmental Management Plan (EMP) for various phases of the proposed activity (i.e. construction, operational and decommissioning phases). The EMP must include a discussion on mitigation measures for all potential impacts as well as the persons responsible for implementing such measures.

Response from EAP:

Various drawings and specialist reports have been attached to this report as annexures in reference to these comments. Detailed information has been included in Sections of this report and additional information can be found in the relevant specialist reports.

THE TOWN PLANNING HUB CC

Comment from Beverley Oosthuizen:

Kindly be advised that our office has worked through your final Scoping Report, however cannot give informed comments as vital information is still not available on the project.

Please keep our office (on behalf of Total South Africa) listed as Interested and Affected Party to the application for Environmental Authorization. We would require a copy of the following documentation:

- Feasibility Study
- Geotechnical Study

- Wetland Study
- Fauna and Flora Study
- Services Report

The following points of concern are raised.

- The application site(s) are earmarked for high grazing potential.
- The application site(s) will negatively affect from the existing filling stations along the N4 highway. The Feasibility is required to be informed on what the estimate fuel losses will be.

Response from EAP:

Please find the requested specialist reports attached to **Annexure F** of this report. The Traffic and Viability Assessment **(Annexure F7)** have considered the existing filling stations and according to the assessment, there will be no detrimental impact on those filling stations. The Agricultural Potential has been discussed in Section 5.4 of this EIA report and a letter from the soils scientist on the site's agricultural potential can be found under **Annexure F10**.

DEPARTMENT OF WATER AND SANITATION

Comment from Thabakgolo Bopape:

In order to make an informed decision, the following details must be provided in the final Environmental Impact Assessment Report:

1. The impact of the proposed development on the receiving environment as well as the proposed mitigation.
2. Detailed information with regard to the source of water for the above mentioned development.
3. Detailed information of sewage treatment and disposal method during construction and operational phases of the project.
4. Detailed information of the storm water management plan/system and erosion control measures.
5. A detailed site layout plan indicating ecologically sensitive areas must be submitted to this Department.

6. Identification of any environmental sensitive area and water resources such as wetlands, streams, rivers, etc. as well as possible pollution impacts and mitigation measures of such water resources.
7. Management of solid waste and hazardous waste materials generated during construction, operational and post construction phase.
8. Environmental Management Plan.
9. Spillage contingency plans.
10. Geotechnical investigation report.
11. Detailed information regarding the 1:100-year flood line.

Response from EAP:

The above information requested by the Department of Water and Sanitation have been included in this EIA Report and/or attached as an annexure.

7. SIGNIFICANCE ASSESSMENT

7.1 Description of Significance Assessment Methodology

The significance of Environmental Impacts was assessed in accordance with the following method:

Significance is the product of probability and severity. Probability describes the likelihood of the impact actually occurring, and is rated as follows:

☐ Improbable - Low possibility of impact to occur either because of design or historic experience.
Rating = 2

☐ Probable - Distinct possibility that impact will occur.
Rating = 3

☐ Highly probable - Most likely that impact will occur.
Rating = 4

☐ Definite - Impact will occur, in the case of adverse impacts regardless of any prevention measures.
Rating = 5

The ***severity factor*** is calculated from the factors given to "intensity" and "duration". Intensity and duration factors are awarded to each impact, as described below.

The ***Intensity factor*** is awarded to each impact according to the following method:

☐ Low intensity - natural and man-made functions not affected – Factor 1

☐ Medium intensity - environment affected but natural and man-made functions and processes continue - Factor 2

☐ High intensity - environment affected to the extent that natural or man-made functions are altered to the extent that it will temporarily or permanently cease or become dysfunctional - Factor 4

Duration is assessed and a factor awarded in accordance with the following:

☐ Short term - <1 to 5 years - Factor 2

☐ Medium term - 5 to 15 years - Factor 3

☐ Long term - impact will only cease after the operational life of the activity, either because of natural process or by human intervention - factor 4.

☐ Permanent - 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 - Factor 4.

The ***severity rating*** is obtained from calculating a severity factor, and comparing the severity factor to the rating in the table below. For example:

The Severity factor = Intensity factor X Duration factor
= 2 x 3
= 6

A ***Severity factor*** of six (6) equals a Severity Rating of Medium severity (Rating 3) as per table below:

Table 49: Severity Ratings

RATING	FACTOR
Low Severity (Rating 2)	Calculated values 2 to 4
Medium Severity (Rating 3)	Calculated values 5 to 8
High Severity (Rating 4)	Calculated values 9 to 12
Very High severity (Rating 5)	Calculated values 13 to 16
Severity factors below 3 indicate no impact	

A Significance Rating is calculated by multiplying the Severity Rating with the Probability Rating.

The ***significance rating*** should influence the development project as described below:

❑ Low significance (calculated Significance Rating 4 to 6)
  - Positive impact and negative impacts of low significance should have no influence on the proposed development project.

❑ Medium significance (calculated Significance Rating >6 to 15)
  - Positive impact:
    Should weigh towards a decision to continue
  - Negative impact:
    Should be mitigated to a level where the impact would be of medium significance before project can be approved.

❑ High significance (calculated Significance Rating 16 and more)

- Positive impact:
  Should weigh towards a decision to continue, should be enhanced in final design.

- Negative impact:
  Should weigh towards a decision to terminate proposal, or mitigation should be performed to reduce significance to at least medium significance rating.

7.2 *Significance Assessment of Anticipated Impacts*

Impacts indicated under each section of the environment were each assessed according to the above methodology. ***Table 50*** below contains the results of the significance assessment.

Table 50: Result of Significance Assessment of impacts identified to be associated with the proposed Q4 City Filling Stations (After Mitigation)

Impact	Probability Rating	Severity Rating		Severity Factor	Severity Rating	Significance Rating
		Intensity	Duration			
CONSTRUCTION PHASE						
Beneficial Impacts						
22. Creation of temporary job opportunities.	5	4	2	8	3	15 Medium
Adverse Impacts						
1. Expansive soils and possible collapsible soils	4	2	4	8	3	12 Medium
2. Hard excavations and blasting may be required	3	4	2	8	3	9 Medium
3. Groundwater seepage	3	2	2	4	2	6 Low
4.	3	2	2	4	2	6 Low

Impact	Probability Rating	Severity Rating		Severity Factor	Severity Rating	Significance Rating
		Intensity	Duration			
Erodibility						
5. Stockpile areas for construction materials and topsoil.	4	2	4	8	3	12 Medium
6. Low pH	3	4	3	12	4	12 Medium
7. Siltation, erosion and ground water pollution could occur if a storm water management plan is not implemented.	3	2	4	8	3	9 Medium
9. Removal of vegetation coverage, increased hard surfaces and increased erosion, surface water pollution and siltation problems	4	2	4	8	3	12 Medium
10. Due to the topography the filling stations development will be visible from view sheds in the flatter areas around the study area	4	2	4	8	3	12 Medium
11. If not planned correctly, roofs and parking areas could reflect the sun into the eyes of oncoming traffic	4	2	4	8	3	12 Medium
12. If not planned and managed correctly the lights (interior and exterior) and the signage of the filling station development could cause visual pollution.	4	2	4	8	3	12 Medium
13. Construction during the wet season may cause erosion and	3	2	2	4	2	6 Low

Impact	Probability Rating	Severity Rating		Severity Factor	Severity Rating	Significance Rating
		Intensity	Duration			
delays to the construction phase.						
14. Construction during the dry and windy season may cause dust pollution.	3	2	2	4	2	6 Low
15. Loss of Protected tree species	3	3	4	12	4	12 Medium
16. Disturbance and loss to vegetation species on site.	4	2	4	8	3	12 Medium
17. Spreading of alien and invasive plant species.	3	2	4	8	3	9 Medium
18. Disturbance, trapping and hunting of faunal species on site.	2	2	2	4	2	4 Low
19. Loss of habitat for faunal species	4	2	4	8	3	12 Medium
20. If any cultural or historical artefacts are found during construction it may be destroyed by construction activities.	3	2	2	4	2	6 Low
26. Construction works could have a visual impact during the construction phase if not planned and managed correctly.	3	4	2	8	3	9 Medium
28. The construction activities could disturb surrounding residents in terms of noise.	3	2	2	4	2	6 Low

Impact	Probability Rating	Severity Rating		Severity Factor	Severity Rating	Significance Rating
		Intensity	Duration			
31. Surface water flows will be altered during the construction phase.	5	2	4	8	3	15 Medium
32. The use of insufficient drainage systems during the construction phase (i.e. sub-surface drainage systems & no mechanisms to break the speed of the surface water)	3	4	2	8	3	9 Medium
33. Temporary disruption of services due to relocation and installation of services	3	2	4	8	3	9 Medium
34. The creation of large quantities of builder's waste to be accommodated by local legal landfill sites.	4	2	4	8	3	12 Medium
OPERATION PHASE						
Beneficial Impacts						
10. Due to the topography the filling stations development will be visible from view sheds in the flatter areas around the study area	4	2	4	8	3	12 Medium
21. The proposed land use is in line with current and future land uses in the area	5	4	4	16	5	**25 High**
22. Creation of permanent jobs.	5	4	4	16	5	**25 High**
23. Supply in the need for filling station facility/ies along the N4 in the Brits area, especially the	5	4	4	16	5	**25 High**

Impact	Probability Rating	Severity Rating		Severity Factor	Severity Rating	Significance Rating
		Intensity	Duration			
need for an overnight truck stop.						
25. The proposed development will be in line with the international, national, provincial and local legislation, planning frameworks, guidelines, policies etc.	5	4	4	16	5	**25 High**
27. The location of the study area is desirable for filling stations.	4	4	4	16	5	**20 High**
29. If planned and managed correctly, the proposed development could have a positive impact on the "Sense of Place" of the study area and its surroundings.	3	4	4	16	5	15 Medium
Adverse Impacts						
1. Expansive soils and possible collapsible soils	4	2	4	8	3	12 Medium
8. Surface and ground water pollution due to leaking equipment and spillages associated with the proposed filling stations.	3	4	4	16	5	15 Medium
10. Due to the topography the filling station development will be visible from view sheds in the flatter areas around the study area.	4	2	4	8	3	12 Medium
11. If not planned correctly, roofs and parking areas could reflect	4	2	4	8	3	12 Medium

Impact	Probability Rating	Severity Rating		Severity Factor	Severity Rating	Significance Rating
		Intensity	Duration			
the sun into the eyes of oncoming traffic						
12. If not planned and managed correctly the lights (interior and exterior) and the signage of the development could cause visual pollution.	4	2	4	8	3	12 Medium
15. Loss of Protected tree species	3	3	4	12	4	12 Medium
16. Disturbance and loss to vegetation species on site.	4	2	4	8	3	12 Medium
17. Spreading of alien and invasive plant species.	3	2	4	8	3	9 Medium
19. Loss of habitat for faunal species	4	2	4	8	3	12 Medium
24. Economic impact on existing filling stations in the area.	4	2	4	8	3	12 Medium
26. New buildings during the operational phase could have a visual impact	4	2	4	8	3	12 Medium
28. Noise impact on the surrounding residents.	3	2	2	4	2	6 Low
30. The proposed development will lead to increased hard surfaces and the quantity and the speed of the storm water across the study area and into the water bodies and adjacent properties will increase.	4	2	4	8	3	12 Medium

Impact	Probability Rating	Severity Rating		Severity Factor	Severity Rating	Significance Rating
		Intensity	Duration			
34. The operational phase will create domestic waste and waste associated with the filling stations.	4	2	4	8	3	12 Medium
35. Spillage of an on-site sewerage system	3	4	4	16	5	15 Medium
36. Possible surface water pollution due to unaddressed spillages associated with the proposed filling stations.	4	4	4	16	5	**20 High**
37. Possible ground water pollution due to leaking equipment and spillages associated with the proposed filling stations.	4	4	4	16	5	**20 High**
38. Risk for fires or explosion associated with the proposed filling stations.	4	4	4	16	5	**20 High**

7.3 Discussion of Significance Assessment

Seven beneficial impacts associated with the proposed development are anticipated, of which five have a high significance rating. The Environmental Management Programme **(Refer to Annexure J)** contains measures to achieve maximum gain from the above beneficial impacts. The anticipated beneficial impacts are mostly Socio-economic related and this indicates that the proposed development should contribute to an improvement in the quality of life of the people residing in the broader area and the public travelling along the N4 National Highway.

Of the thirty-three anticipated adverse impacts associated with the construction and occupation phases of the proposed development three of the anticipated impacts have a high significance rating, twenty-two impacts have a medium significance rating and eight have a low significance rating.

It is however also important to note that most of the above-mentioned adverse impacts are construction related impacts that are usually short term impacts that are easy to mitigate.

No "fatal flaw" adverse impacts or adverse impacts that cannot be adequately mitigated are anticipated to be associated with the proposed development of the Q4 City filling stations. The Environmental Management Programme ***(refer to Annexure J)*** and the mitigation measures supplied in this report contains measures to achieve maximum gain from the above-mentioned impacts.

8. CONCLUSION

This report identified the impact of the proposed filling stations on the biophysical, social and economic environment.

Biophysical Environment:

The most significant impact on the biophysical environment is the possible surface and ground water pollution due to spillages and leaking equipment. Furthermore, there is no evidence of a wetland on the development site itself however the proposed filling station facility, south of the N4 highway, is bordered by a drainage feature. The development of the Filling Stations is not expected to have any negative impacts on any water resource in the vicinity, provided that the storm water runoff from the site is appropriately managed in terms of water quality and hydrological considerations (quantity and velocity of storm water run-off).

Generation of storm water should be minimized, during both the construction and operational phases, by limiting the extent of impermeable surfaces to the minimum required for efficient operation of the filling station. The storm water system should further include facilities for retaining any potential fuel spillages on site. Storm water containment by spillages of fuel, oil or other hazardous substances should be separated from clean storm water and should not be discharged into any water resource untreated.
Leak detection facilities must be installed around the storage tanks and vapour samples must be taken according to a monitoring programme. Furthermore, groundwater monitoring should also take place at the existing boreholes on site on regular intervals to ensure there is no contamination of ground water resources and to monitor the level of ground water (as ground water will be the source of water supply).

Social and Economic Environment:

The proposed filling stations could have an economic impact on existing filling stations in the area. However, a feasibility study confirmed that the proposed filling stations are feasible and do not pose a detrimental impact on the surrounding filling stations. The Filling station will serve the traffic between Pretoria and Rustenburg, which includes light vehicles as well as trucks. The truck stop at the proposed filling stations are also considered needed and desired, especially if one has a look at the number of trucks overnighting at the nearby Brits toll plaza. These trucks overnighting on the side of the N4 highway pose a great safety risk to themselves as well as passer-by traffic. A traffic and viability investigation has illustrated that the proposed site will sell approximately 1 051 900 litres of fuel (petrol and diesel) per month in 2017 (without ramp-up) which will make it feasible from a petrol sale view point.

The proposed filling station is supported from a traffic engineer point of view. Principal approval has been obtained from Bakwena and SANRAL. The applicant will be responsible for water and sewer services on the site as there are no water and sewer services available from the local municipality. Electrical services will be obtained from the City of Tshwane.

With regard to the institutional environment, the proposed development will be in line with the international, national, provincial and local legislation, planning frameworks, guidelines, policies etc.

Final Conclusion:

The development will fit in along the N4 highway (in terms of the need for a filling station in each direction with an overnight truck stop) and create numerous job opportunities during the construction and operational phase. If managed correctly, the proposed project could have a significant positive impact on the social and economic environments.

With the assistance of suitably qualified specialists, it was possible to address and mitigate most of the issues identified to acceptable levels. Based on the biophysical and socio-economical characteristics, the study area is suitable for the proposed filling stations development, provided that the project is planned and managed in accordance with an approved Environmental Management Plan.

9. RECOMMENDATIONS

It is believed that the impacts identified have not been of such a nature that short and long term mitigation cannot occur and therefore it is recommended that the proposed filling stations development be approved subject to:

1) The implementation of the mitigation measures contained in the Environmental Management Programme ***(Annexure J)*** to achieve maximum advantage from beneficial impacts, and sufficient mitigation of adverse impacts;
2) All recommendations and mitigation measures in the various specialist reports should be adhered to;
3) The implementation of a Groundwater Monitoring Plan;

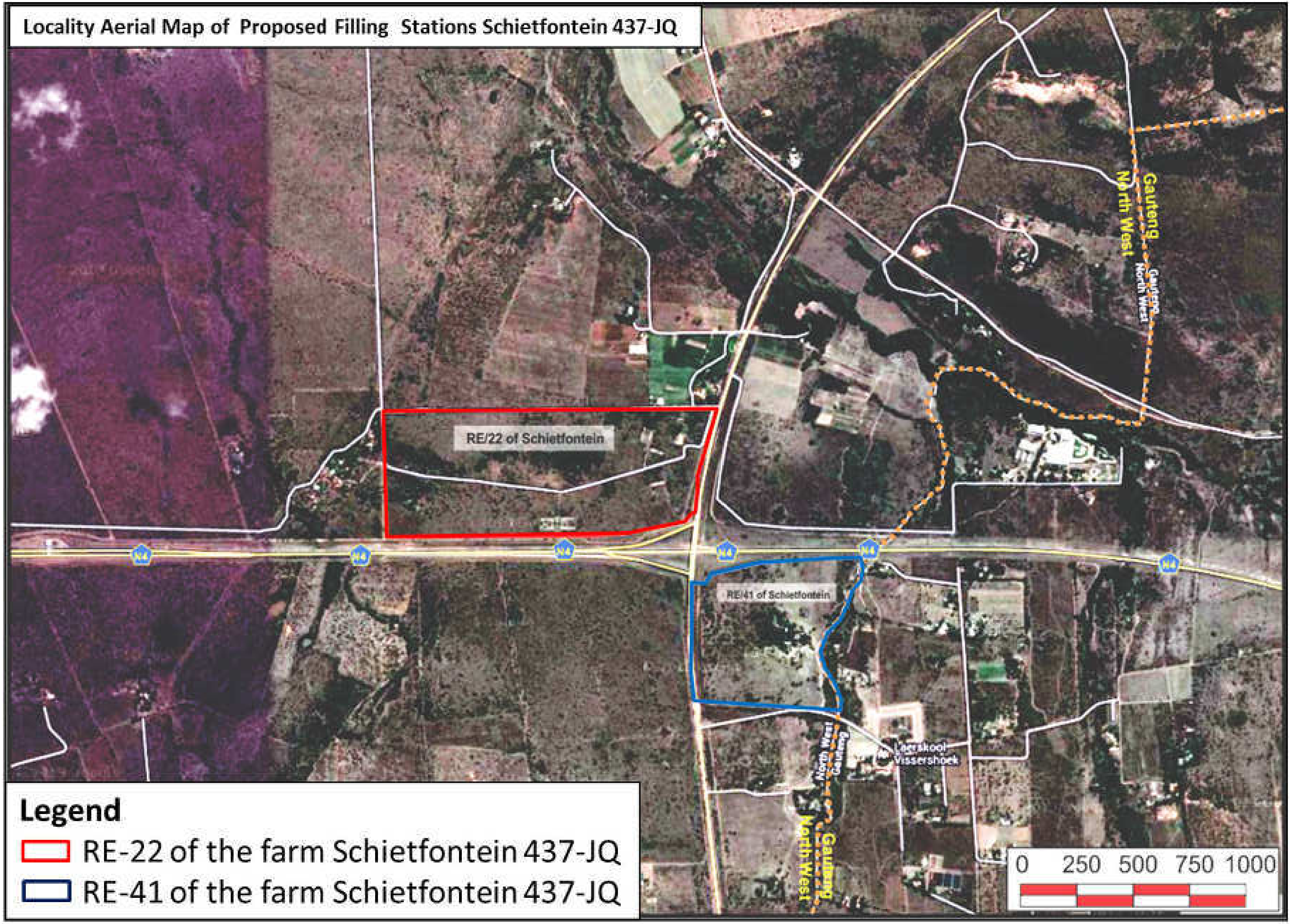
4) Oil traps are recommended to catch oil before entering the storm water stream. These have already been incorporated into the storm water plan and should be adhered to;
5) The implementation of an Emergency Plan ***(refer to Annexure G2)***.

Enlargement of Figures

Annexure A

Aerial Map

Figure 1:

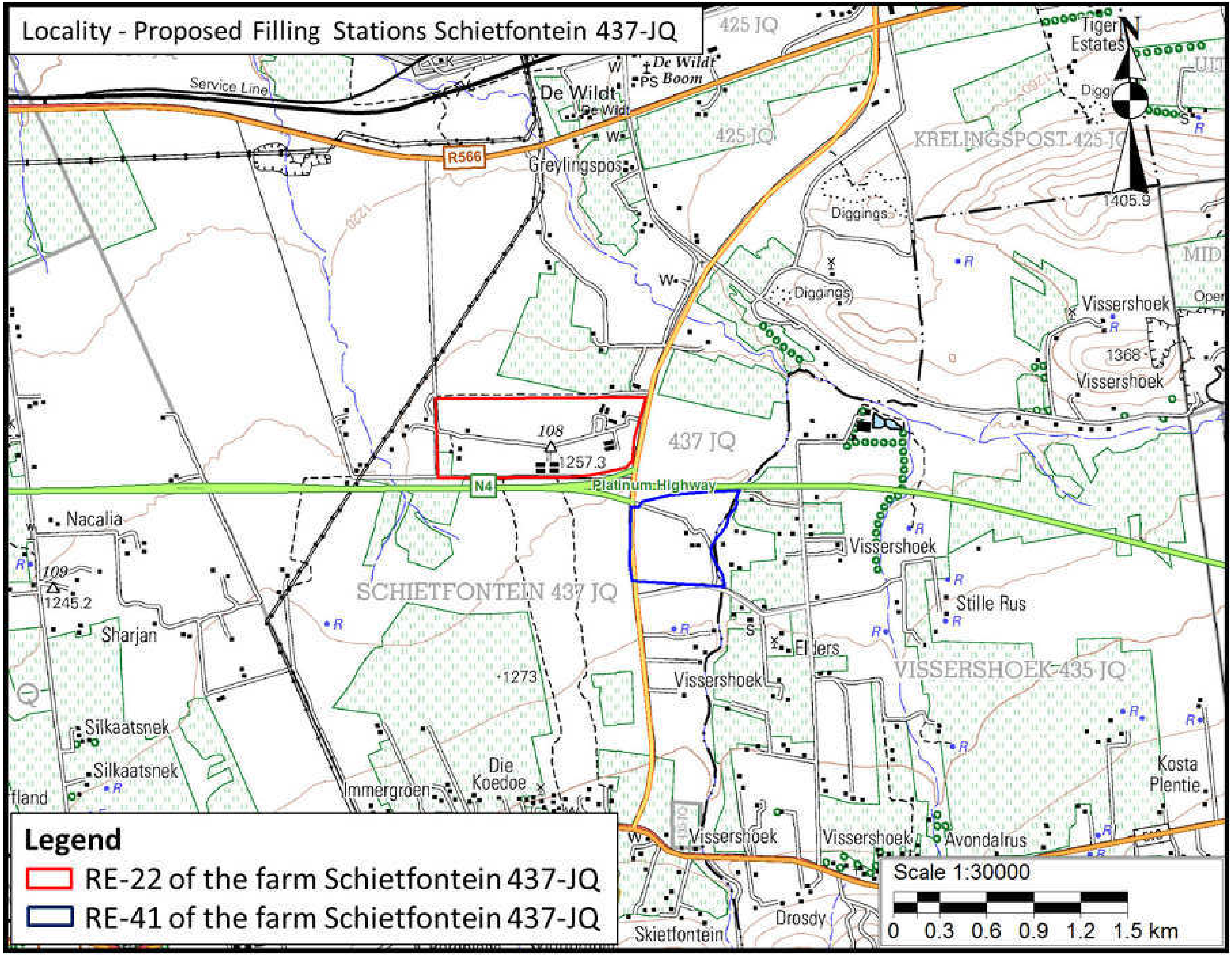


Locality Aerial Map of Proposed Filling Stations Schietfontein 437-JQ

Locality Map

Figure 2:

Locality - Proposed Filling Stations Schietfontein 437-JQ



Legend

🟥 RE-22 of the farm Schietfontein 437-JQ

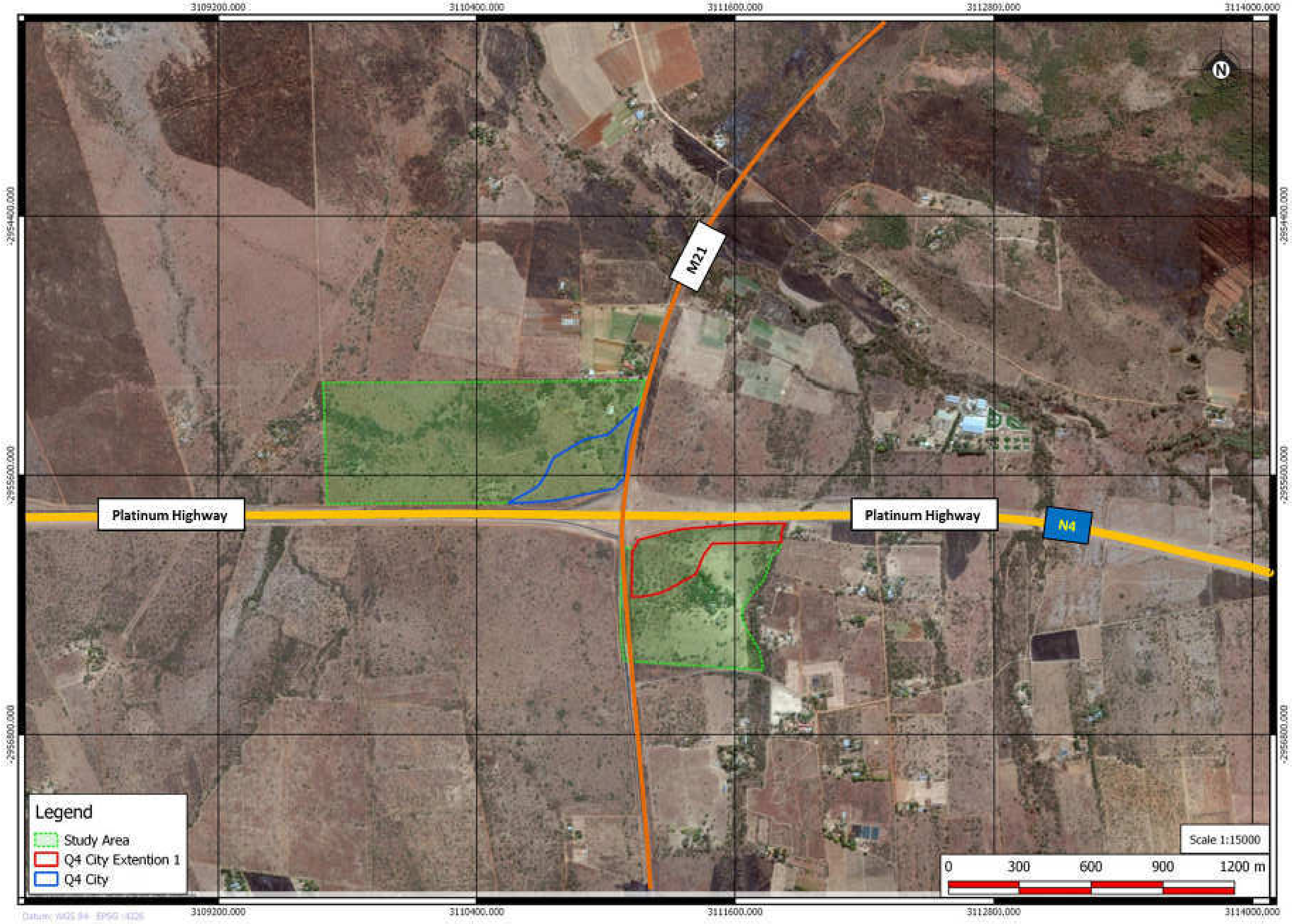
🟦 RE-41 of the farm Schietfontein 437-JQ

Scale 1:30000

0 0.3 0.6 0.9 1.2 1.5 km

Delineation of the filling station study areas

Figure 3: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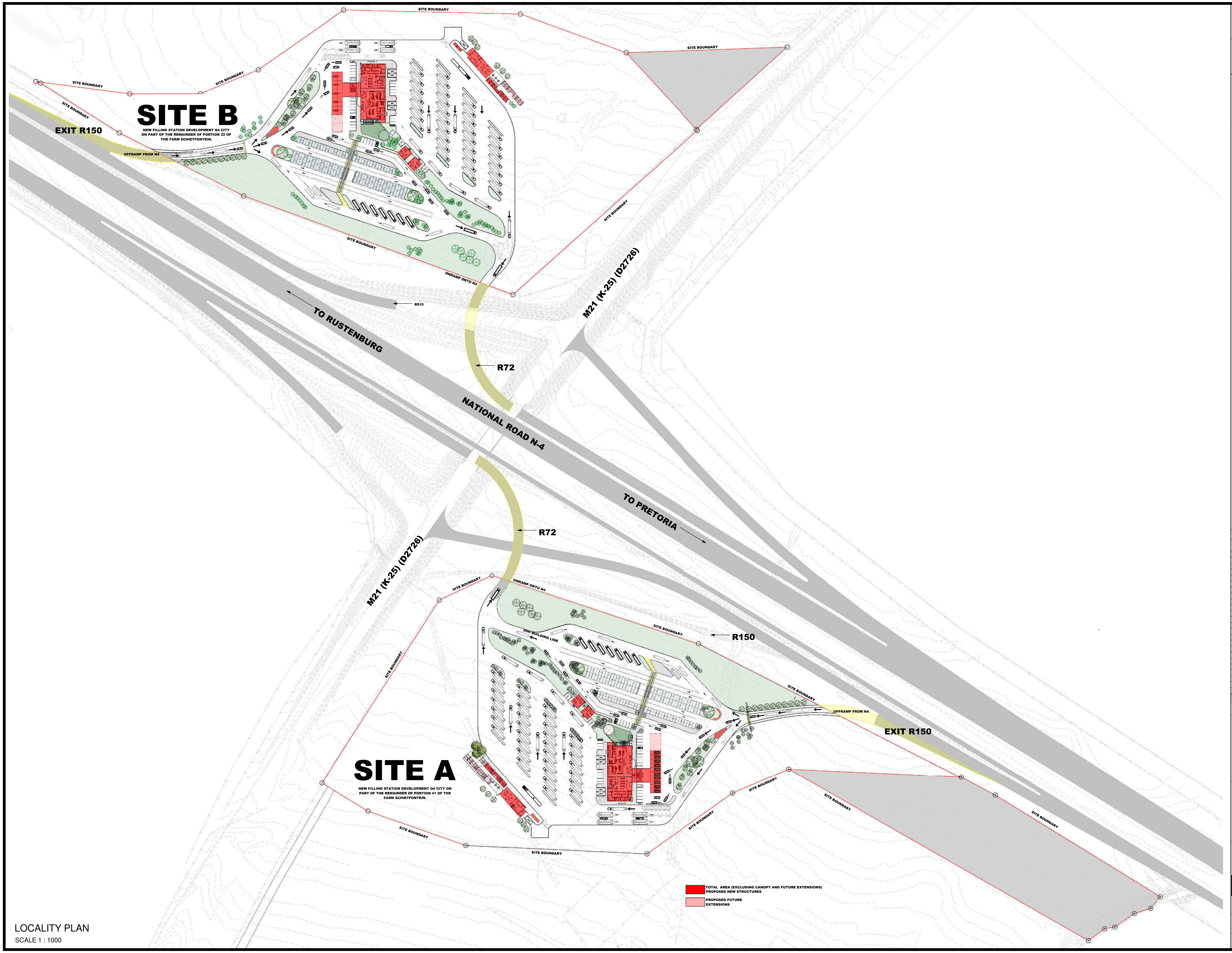
3112800.000
3114000.000
-2954400.000
-2955600.000
-2956800.000
N
M21
Platinum Highway
Platinum Highway
N4
Legend
Study Area
Q4 City Extention 1
Q4 City
Scale 1:15000
0
300
600
900
1200 m
Datum: WGS 84 - EPSG : 4326

Layout Map

Figure 4:



LOCALITY PLAN

SCALE 1 : 1000

ALLE TEKENINGE EN MATES MOET NAGESIEN EN VERGELYK WORD VOORDAT MATERIAAL BESTEL OF MET ENIGE BOUWERK BEGIN WORD. ENIGE VERSKILLE MOET DADELIK ONDER DIE AANDAG VAN DIE ARGITEK GEBRING WORD. KOPIE-REG WORD VOORBEHOU OP ALLE TEKENINGE EN ONTWERPE.

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NOTES:

SITE DATA - SITE A

ERF NO.	**REMAINDER OF PROTION 41 OF THE FARM SCHIETFONTEIN**
ZONING	
SITE AREA	83 433.61m²
BUILDING LINES	AS PER CONDITIONS OF ESTABLISHMENT

BUILDING AREA	**GROSS AREA**	**COVERAGE**
STAFF ABLUTIONS	98.9m²	98.9m²
PUBLIC AREAS	138.7m²	138.7m²
RESTAURANT AND TAKE-AWAY F.O.H & B.O.H AREAS	386.6m²	386.6m²
SERVICE AREAS	103.27m²	103.27m²
MANAGER'S UNITS	153.2m²	153.2m²
CONVENIENCE STORE	284.7m²	284.7m²
FORECOURT (CANOPY & LINK)		494m²
TOKEN ABLUTIONS	115.3m²	115.3m²
TRUCKS - CANTEEN AND KITCHEN	212.2m²	212.2m²
TOTAL	**1 492.87m²**	**1 986.87m²**
URBAN PLANNING REQUIREMENTS	**ALLOWED**	**ACTUAL**
COVERAGE	UNKNOWN%	**2.34%**
FLOOR-AREA RATIO	TO ZONING CERTIFICATE	
PARKING	**REQUIRED**	**PROVIDED**
		144 CAR PARKING BAYS FOR SHOP INCLUDING 2No. 'DISABLED' PARKING SPACES AND 4No. COVERED PARKING BAYS **35 TRUCK** PARKING BAYS **7 BUS** PARKING BAYS **TOTAL 186 PARKING BAYS PROVIDED**
HEIGHT RESTRICTIONS	**ALLOWED**	**ACTUAL**
BUILDING	-	-

SITE DATA - SITE B

ERF NO.	**REMAINDER OF PROTION 41 OF THE FARM SCHIETFONTEIN**
ZONING	
SITE AREA	75 229.234m²
BUILDING LINES	AS PER CONDITIONS OF ESTABLISHMENT

BUILDING AREA	**GROSS AREA**	**COVERAGE**
STAFF ABLUTIONS	98.9m²	98.9m²
PUBLIC AREAS	138.7m²	138.7m²
RESTAURANT AND TAKE-AWAY F.O.H & B.O.H AREAS	386.6m²	386.6m²
SERVICE AREAS	103.27m²	103.27m²
MANAGER'S UNITS	153.2m²	153.2m²
CONVENIENCE STORE	284.7m²	284.7m²
FORECOURT (CANOPY & LINK)		494m²
TOKEN ABLUTIONS	115.3m²	115.3m²
TRUCKS - CANTEEN AND KITCHEN	212.2m²	212.2m²
TOTAL	**1 492.87m²**	**1 986.87m²**
URBAN PLANNING REQUIREMENTS	**ALLOWED**	**ACTUAL**
COVERAGE	UNKNOWN%	**2.64%**
FLOOR-AREA RATIO	TO ZONING CERTIFICATE	
PARKING	**REQUIRED**	**PROVIDED**
		144 CAR PARKING BAYS FOR SHOP INCLUDING 2No. 'DISABLED' PARKING SPACES AND 4No. COVERED PARKING BAYS **35 TRUCK** PARKING BAYS **7 BUS** PARKING BAYS **TOTAL 186 PARKING BAYS PROVIDED**
HEIGHT RESTRICTIONS	**ALLOWED**	**ACTUAL**
BUILDING	-	-

WYSIGINGS - REVISIONS

No. NR.	DATUM DATE	BESKRYWING - DESCRIPTION

HIERDIE TEK. VERVANG TEK. No.
THIS DWG. REPLACE DWG No.

34 BOUVARDIA STREET
LYNWOODRIDGE
0081
PO BOX 75874
LYNNWOOD RIDGE
0040
PRETORIA

TEL: (012)361 1223/6
FAX: (012) 361 1228
E-MAIL : mail @ theunjan.co.za

THEUNISSEN
JANKOWITZ
ARCHITECTS

SKEMA - PROJECT
NEW FILLING STATION DEVELOPMENT Q4 CITY ON PART OF THE REMAINDER OF PORTION 22 & 41 OF THE FARM SCHIETFONTEIN.

TEKENING - DRAWING
LOCALITY PLAN

SKETCHPLANS

PLOT INFO
2015/05/06 02:03:42 PM

GETEKEN/DRAWN
L.VDW / R.C

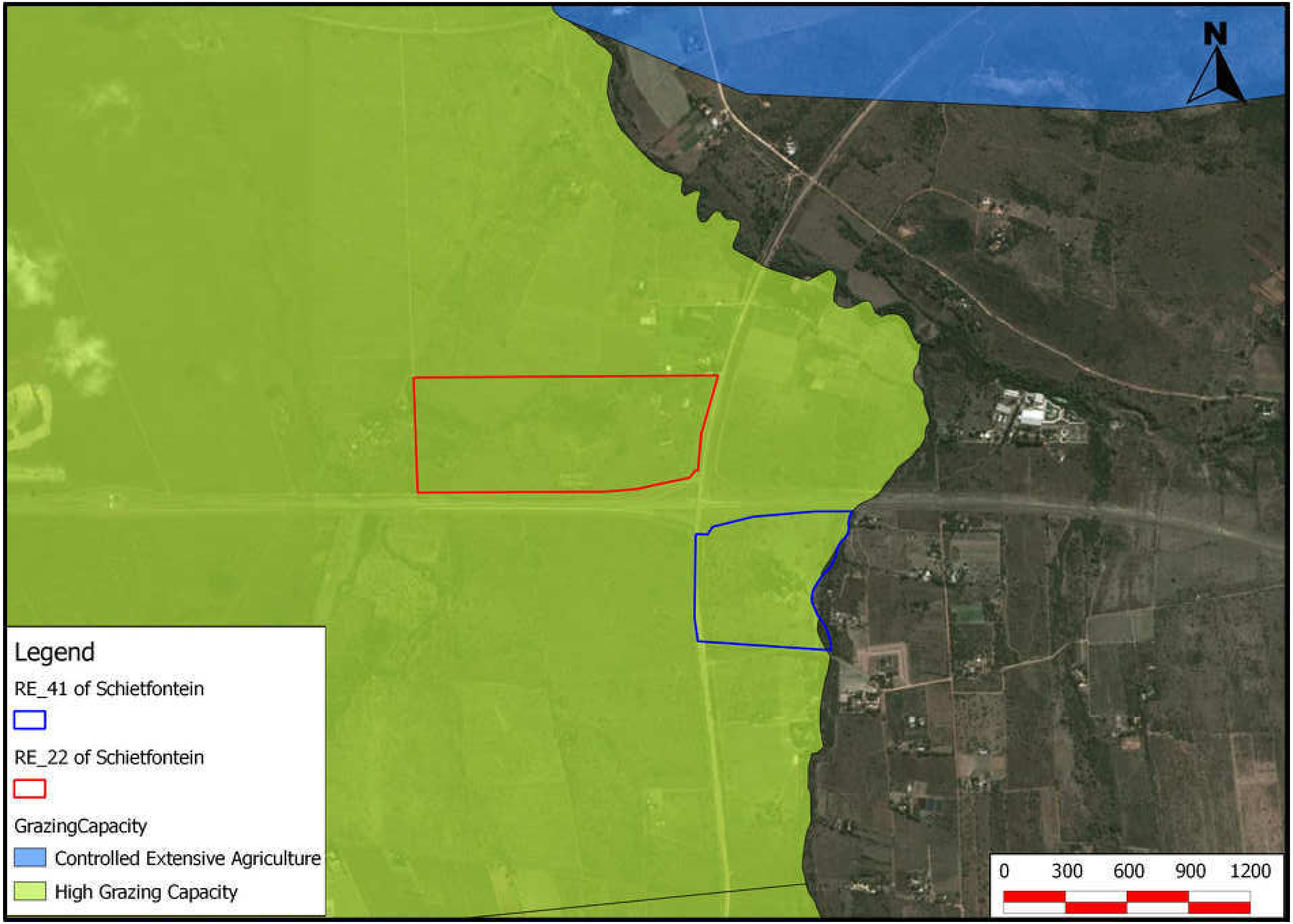
NAGESIEN/CHECKED
R.C

TEK. No. DWG. No.
14-01 / 100

REGISTERED ARCHITECT:
H.L.BOTHA SACAP Regno: 3755

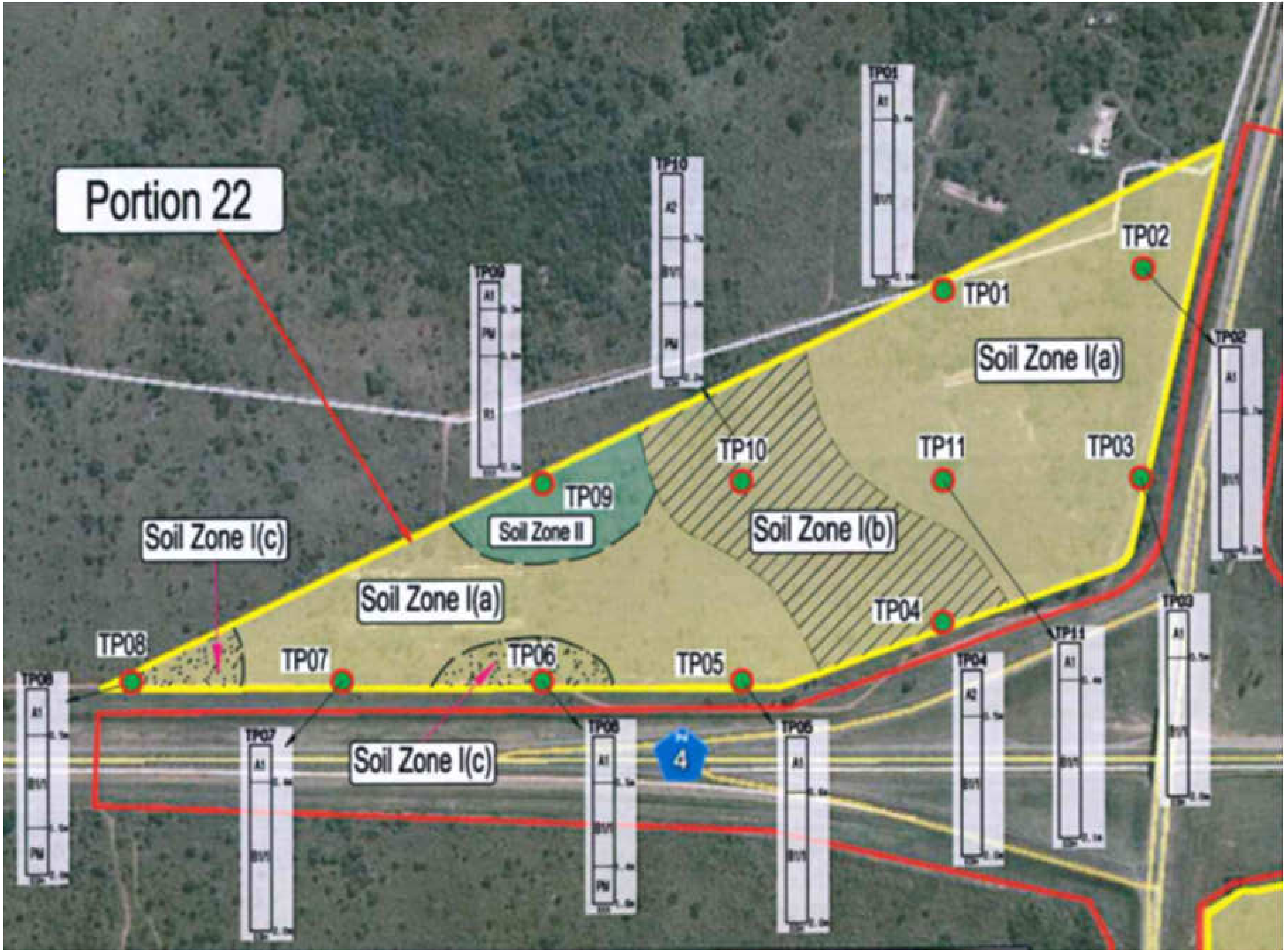
Agricultural Potential

Figure 5:


N
Legend
RE_41 of Schietfontein
RE_22 of Schietfontein
GrazingCapacity
Controlled Extensive Agriculture
High Grazing Capacity
0
300
600
900
1200

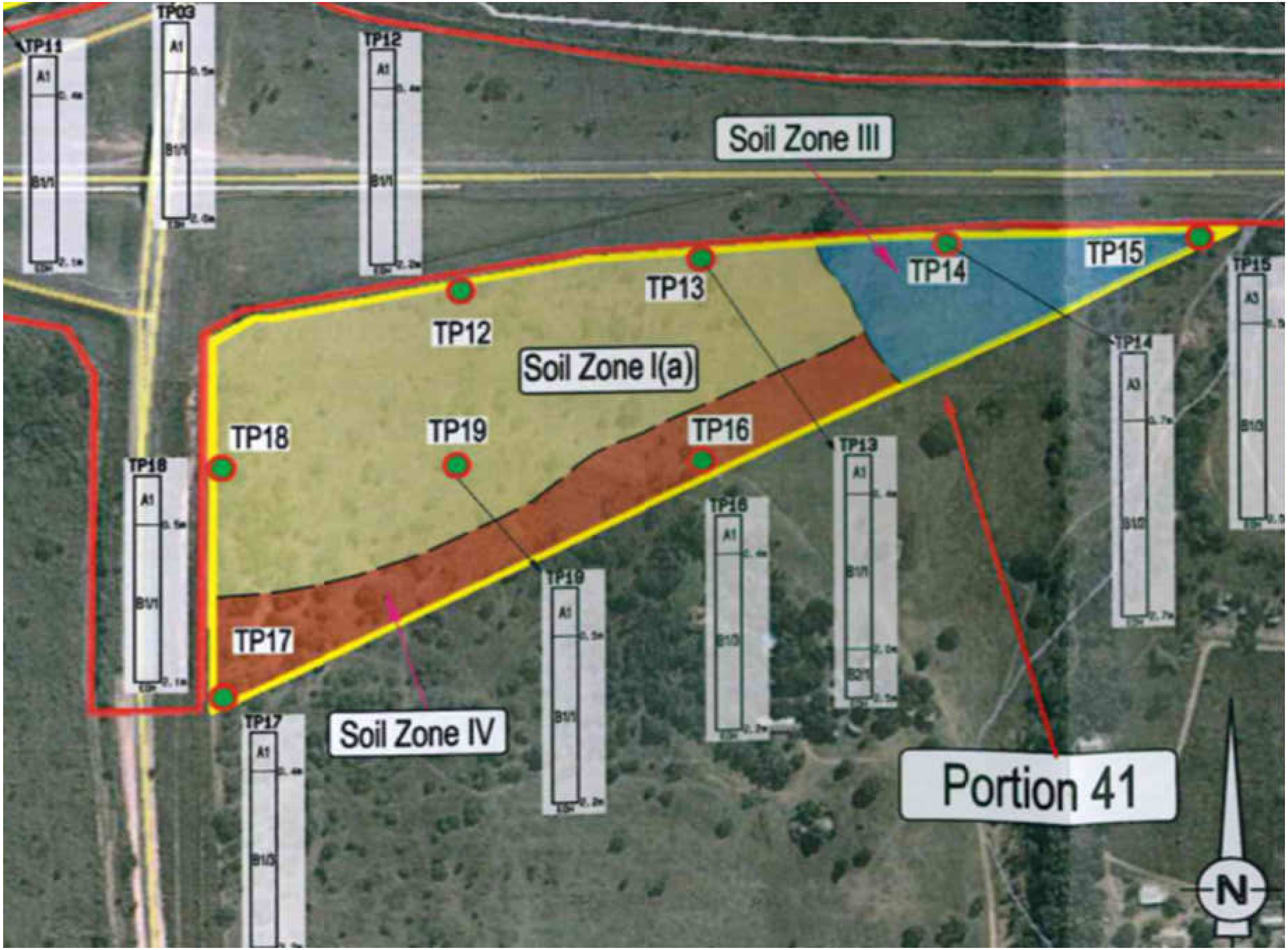
Soil zones on Part of the Remainder of Portion 22

Figure 6:


Portion 22
TP01
TP02
TP03
TP04
TP05
TP06
TP07
TP08
TP09
TP10
TP11
Soil Zone I(a)
Soil Zone I(a)
Soil Zone I(b)
Soil Zone I(c)
Soil Zone I(c)
Soil Zone II
4

Soil zones on Part of the Remainder of Portion 41

Figure 7:


TP03
TP11
TP12
Soil Zone III
TP13
TP14
TP15
TP12
Soil Zone I(a)
TP14
TP15
TP18
TP19
TP16
TP13
TP18
TP16
TP17
TP19
TP17
Soil Zone IV
Portion 41
A1
A3
B1/1
B1/3
B1/2
B2/1
N

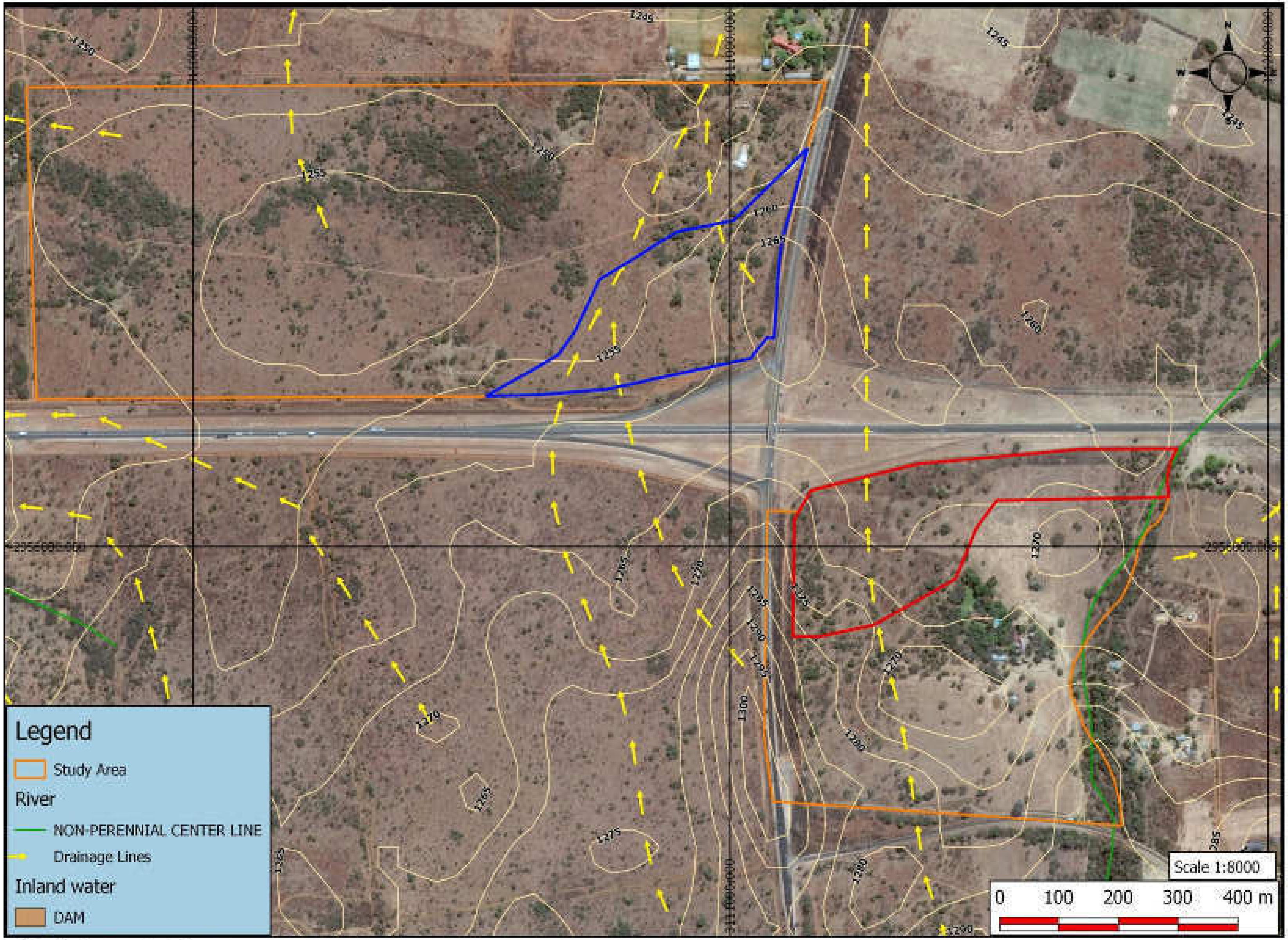
Surface Hydrology Map

Figure 8:

Bokamoso Environmental Consultants
Website: www.bokamoso.biz
E-Mail: Lizelleg@mweb.co.za

Q4 City

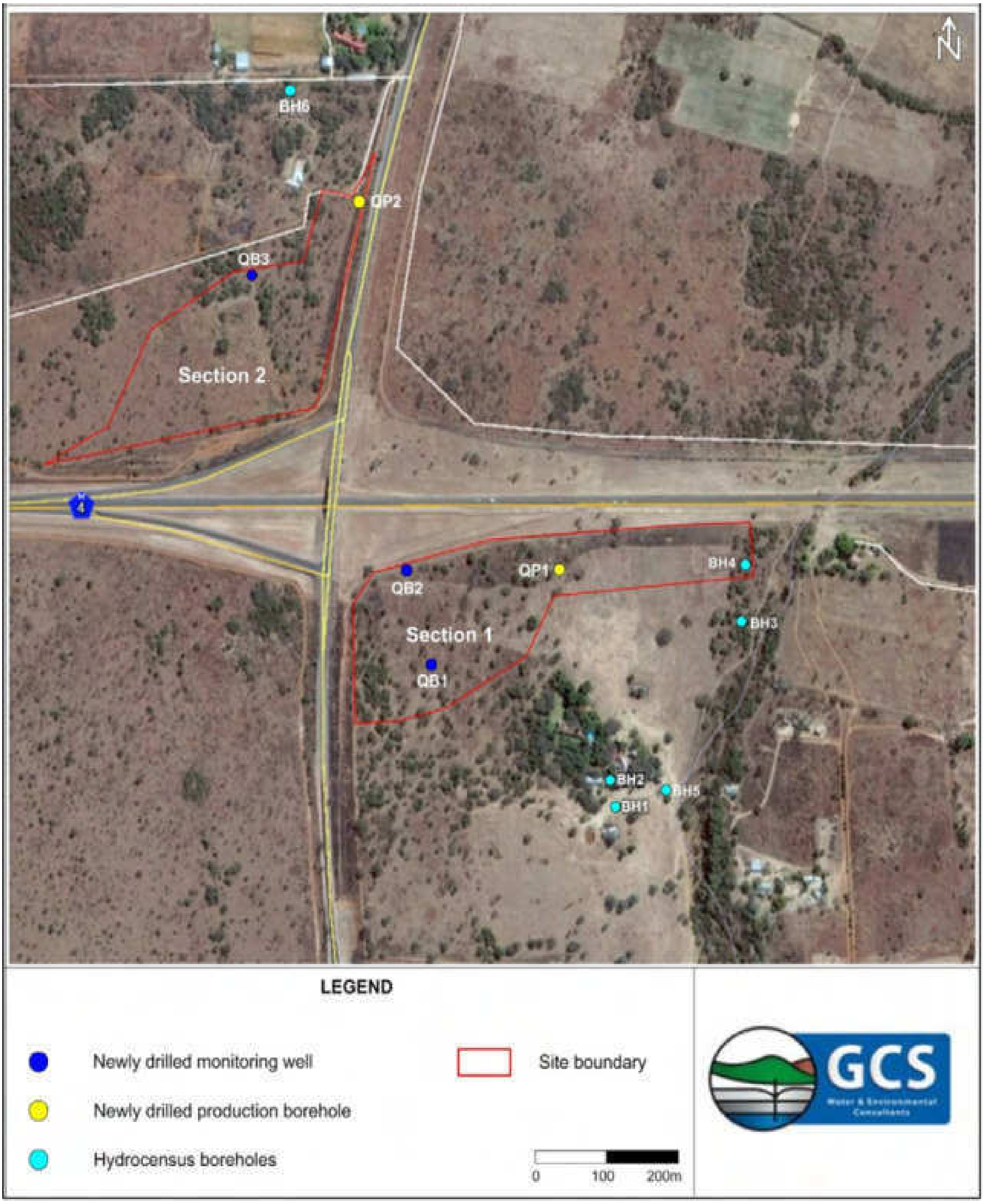
Surface Hydrology



Projection – Transverse Mercator
Datum- Hartebeeshoek 1994
Reference Ellipsoid –WGS 1984
Central Meridian -29

Location of Boreholes

Figure 9:


N
BH6
QP2
QB3
Section 2
4
QP1
BH4
QB2
Section 1
BH3
QB1
BH2
BH5
BH1
LEGEND
● Newly drilled monitoring well
● Newly drilled production borehole
● Hydrocensus boreholes
▭ Site boundary
0
100
200m
GCS
Water & Environmental Consultants

Wetland Delineation

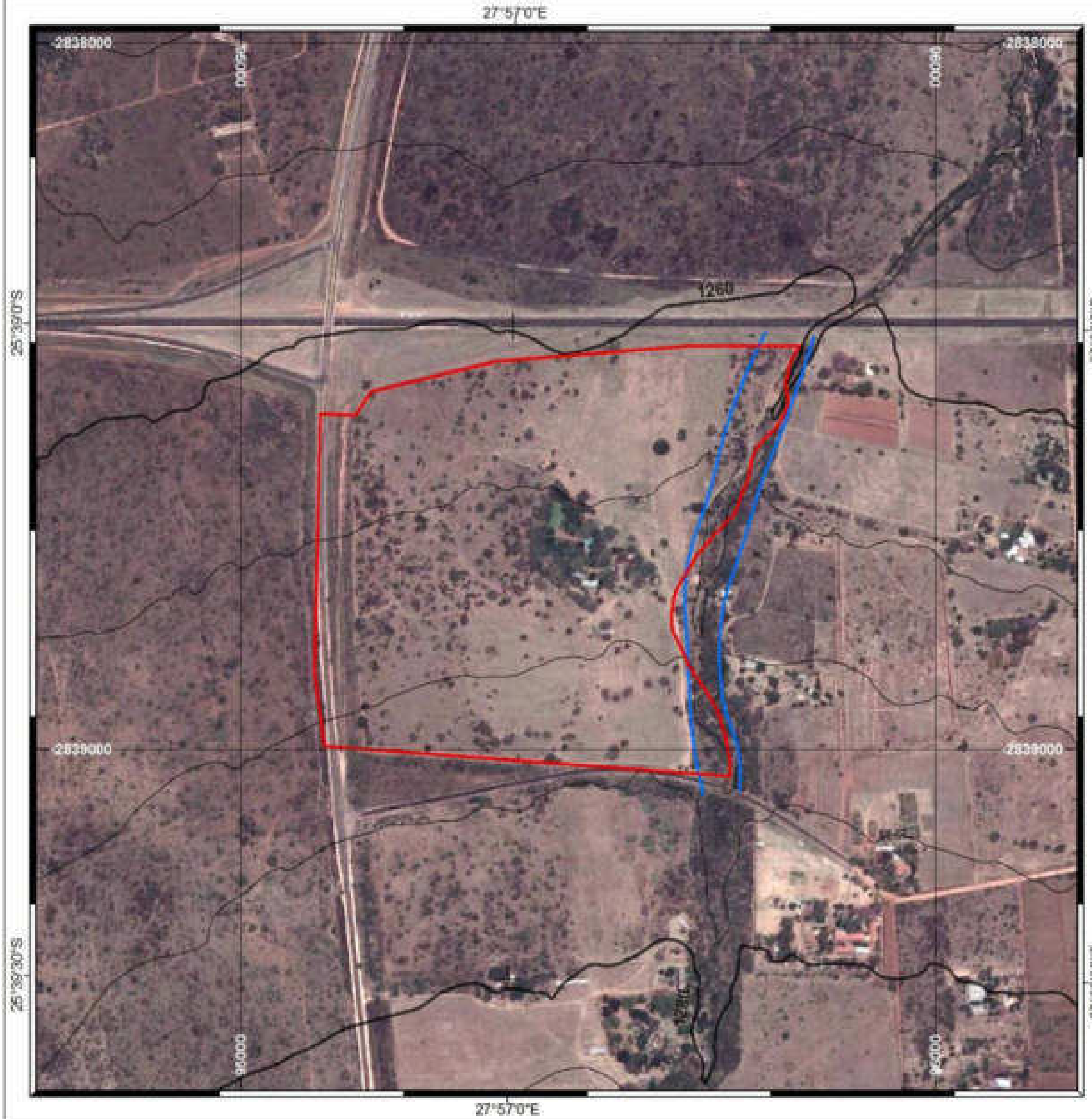
Figure 10:

Lourens G van Zyl
(Mobile) +27 (0)76 371 1151
(Website) www.terragis.co.za
(Email) lourens@terragis.co.za

PTN 41, SCHIETFONTEIN 437-JQ

Water Course and Riparian Zone

Cartography & Spatial Analysis
TERRAGIS

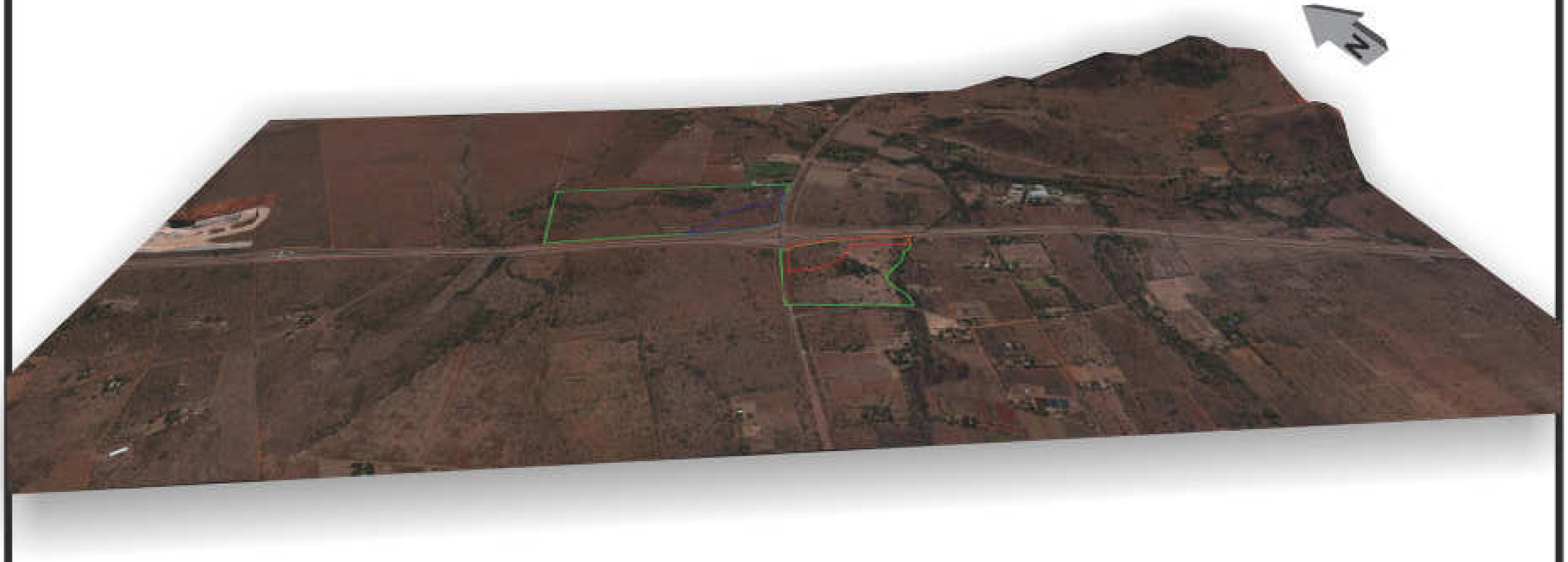


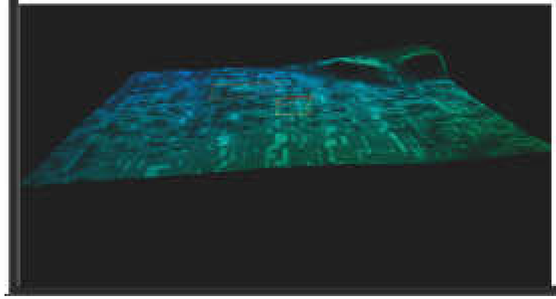
Projection - Transverse Mercator
Datum - Hartebeeshoek 1994
Reference Ellipsoid - WGS 1984
Central Meridian - 27

0 100 200 300 400 500
Meters

Dimensional Illustrations

Figure 11:


N




Visserhoek

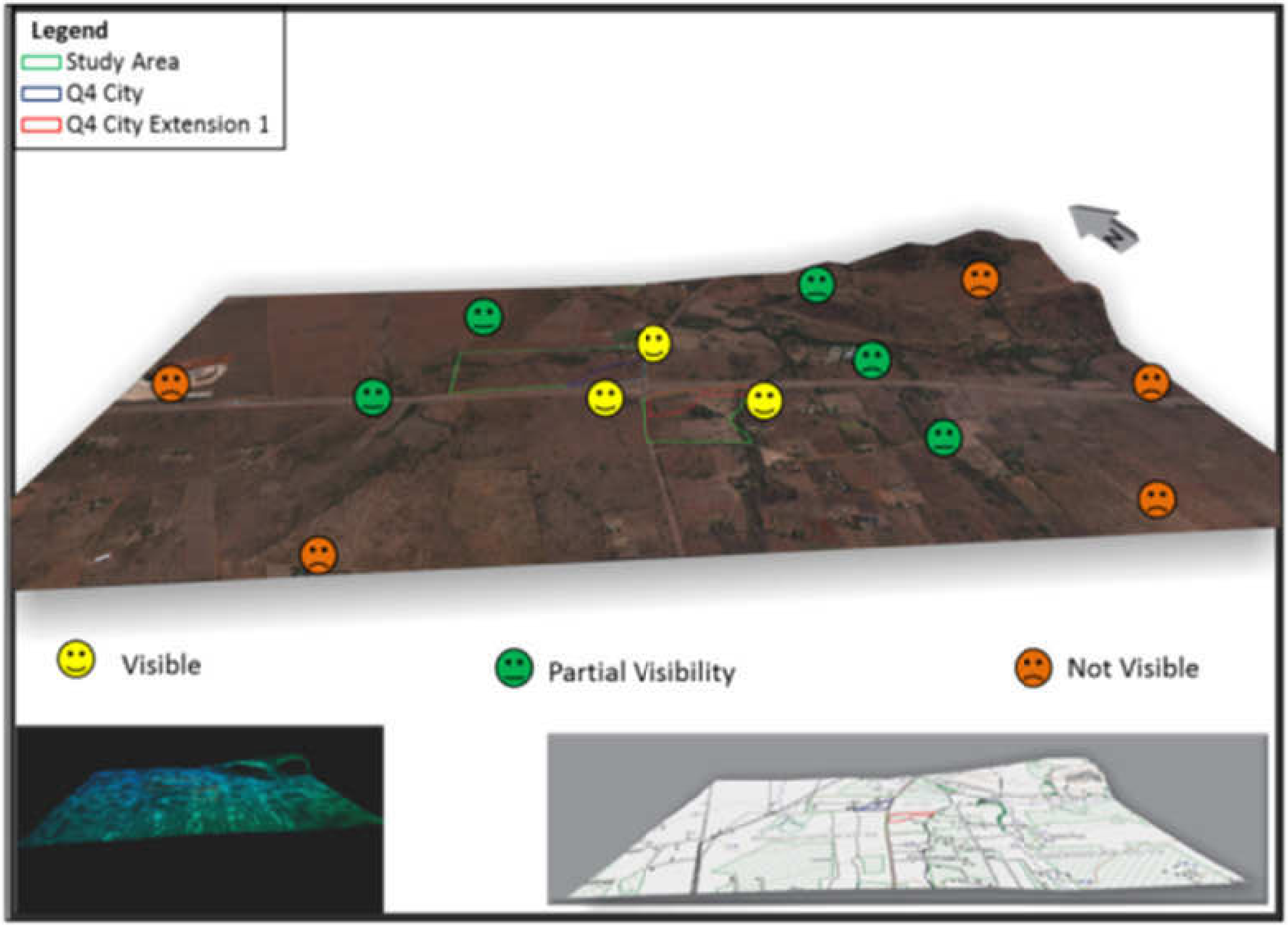
Visibility Map

Figure 12:

Bokamoso Environmental Consultants
Website: www.bokamoso.biz
E-Mail: Lizelleg@mweb.co.za

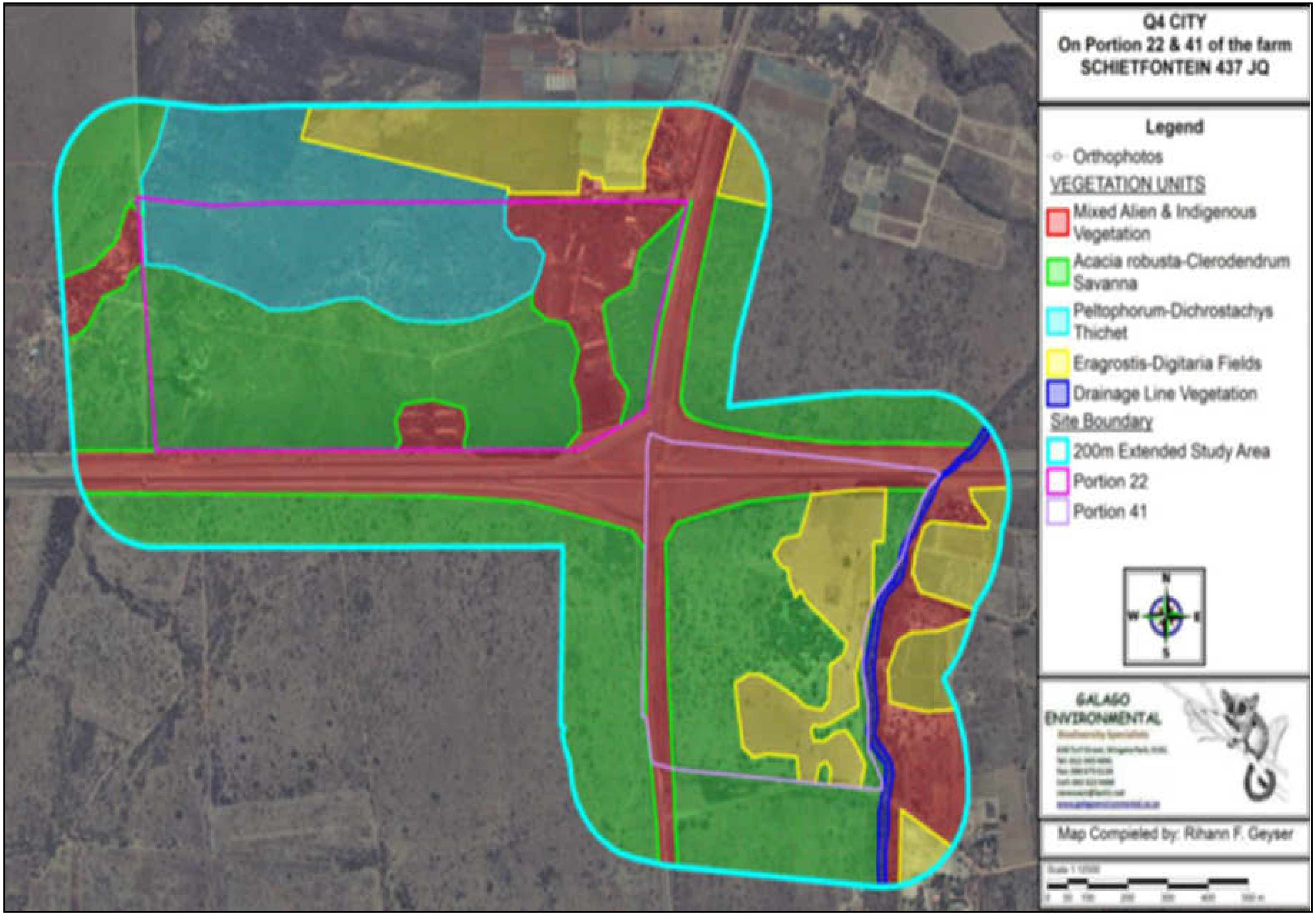
Q4 City

3D Visibility Map



Identified Vegetation Units

Figure 13:


Q4 CITY
On Portion 22 & 41 of the farm
SCHIETFONTEIN 437 JQ
Legend
Orthophotos
VEGETATION UNITS
Mixed Alien & Indigenous Vegetation
Acacia robusta-Clerodendrum Savanna
Peltophorum-Dichrostachys Thichet
Eragrostis-Digitaria Fields
Drainage Line Vegetation
Site Boundary
200m Extended Study Area
Portion 22
Portion 41
N
W
E
S
GALAGO
ENVIRONMENTAL
Map Compieled by: Rihann F. Geyser
0
50
100
200
300
400
500 m

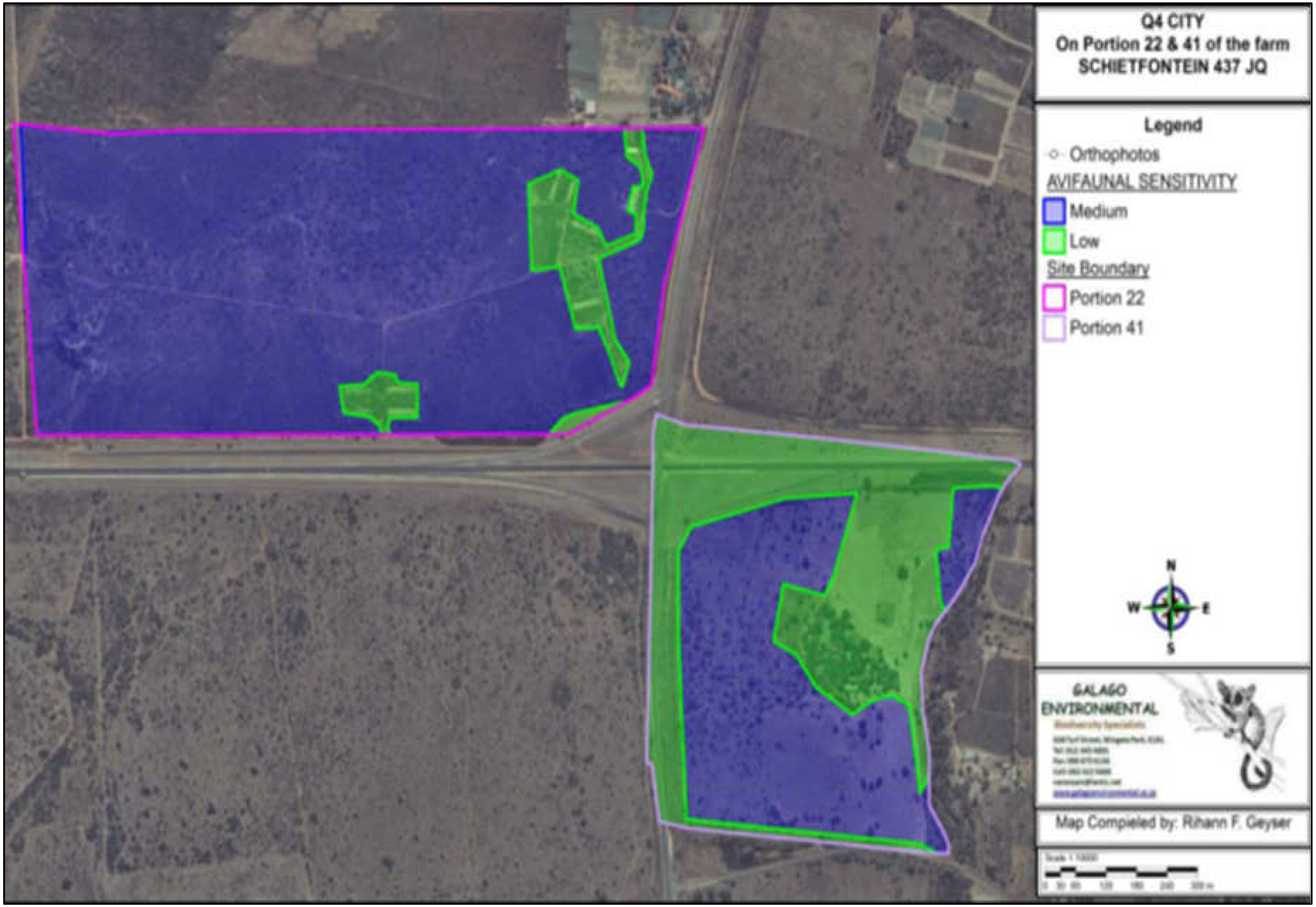
Mammal Sensitivity Map

Figure 14:


Q4 CITY
On Portion 22 & 41 of the farm
SCHIETFONTEIN 437 JQ
Legend
Orthophotos
MAMMAL SENSITIVITY MAP
Low Sensitivity
Site Boundary
Portion 22
Portion 41
N
W
E
S
GALAGO
ENVIRONMENTAL
Map Compeled by: Rihann F. Geyser

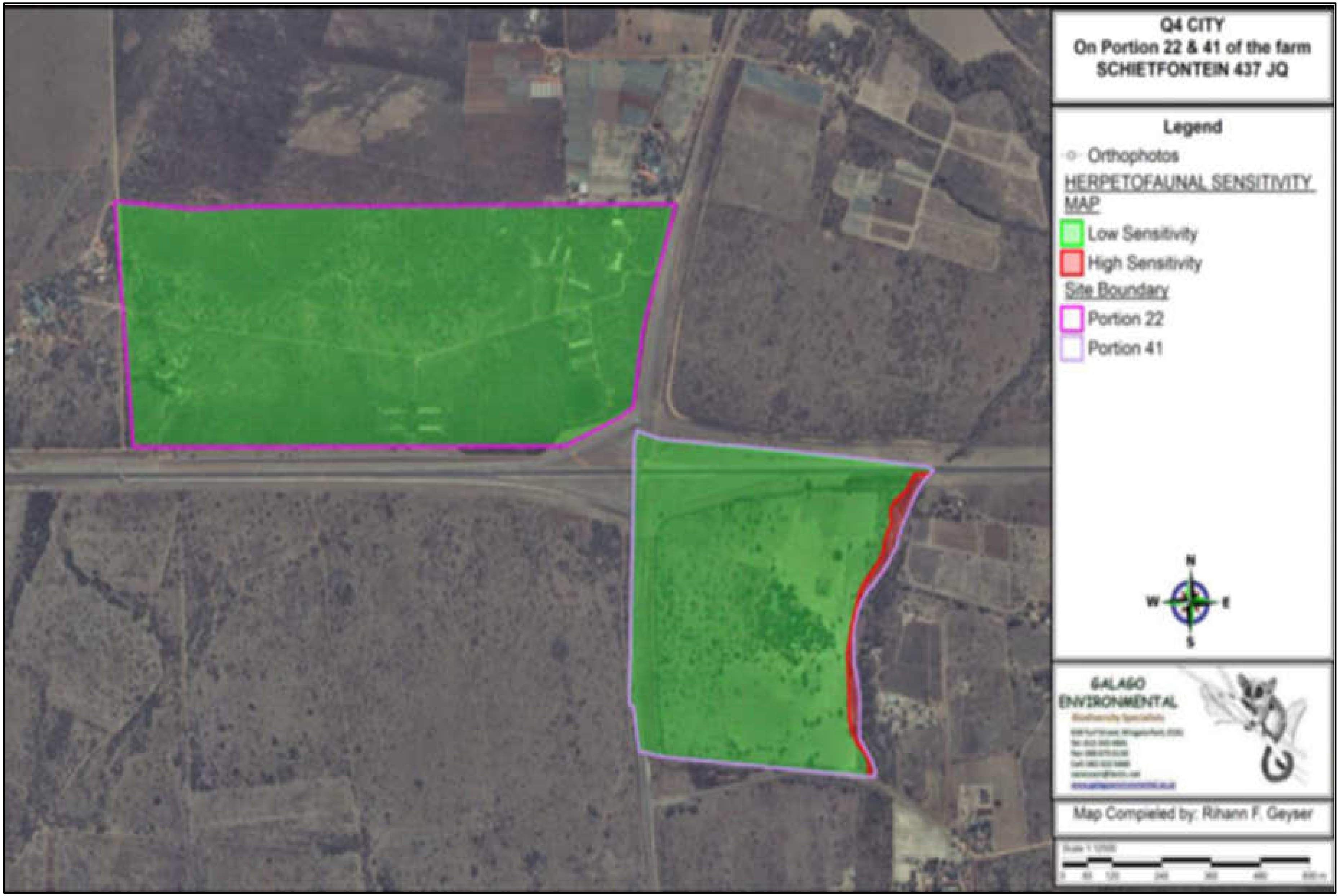
Avifaunal Sensitivity Map

Figure 15:


Q4 CITY
On Portion 22 & 41 of the farm
SCHIETFONTEIN 437 JQ
Legend
Orthophotos
AVIFAUNAL SENSITIVITY
Medium
Low
Site Boundary
Portion 22
Portion 41
N
W
E
S
GALAGO ENVIRONMENTAL
Map Compieled by: Rihann F. Geyser
0 30 60 120 180 240 300 m

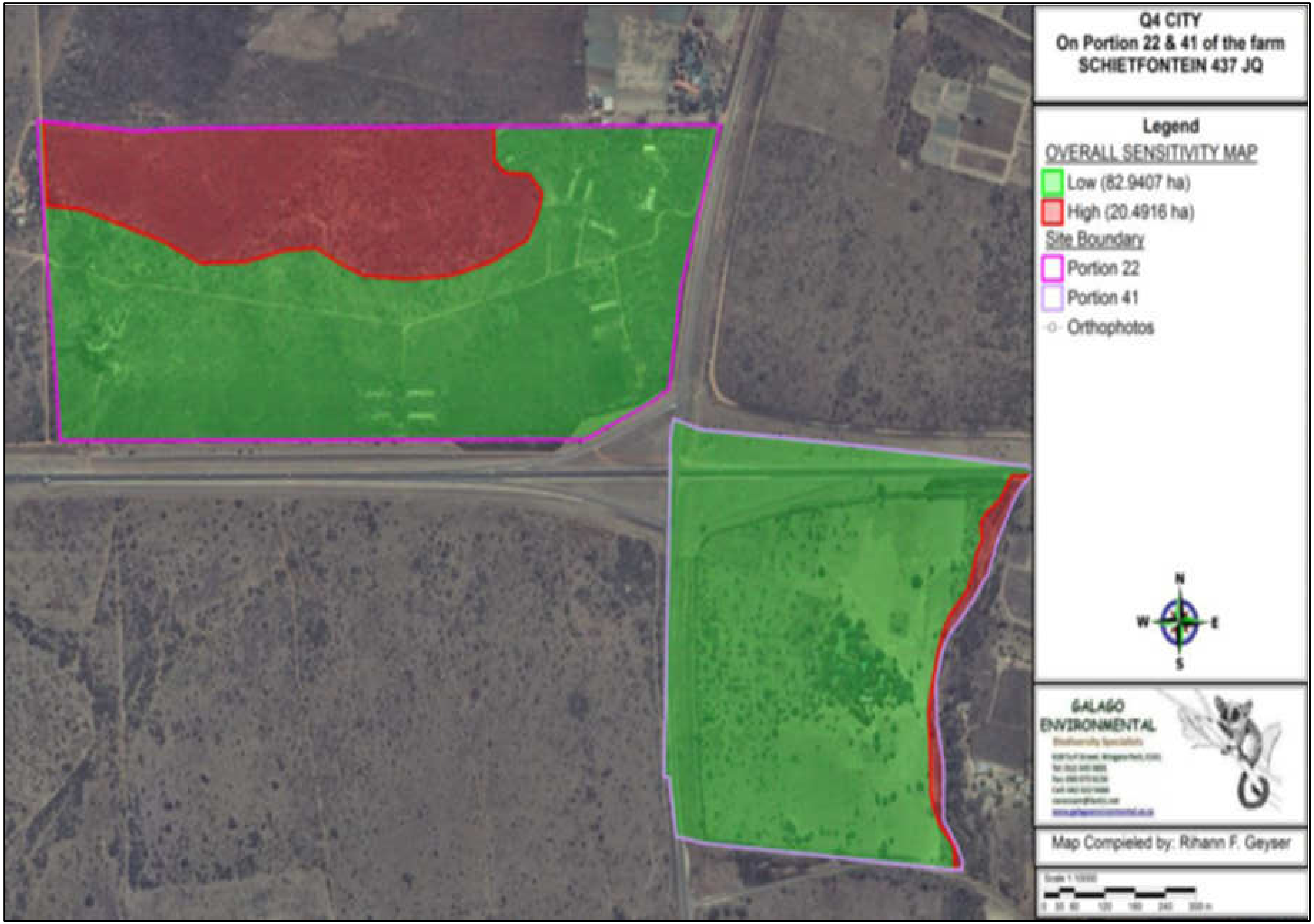
Herpetofaunal Sensitivity Map

Figure 16:


Q4 CITY
On Portion 22 & 41 of the farm
SCHIETFONTEIN 437 JQ
Legend
Orthophotos
HERPETOFAUNAL SENSITIVITY MAP
Low Sensitivity
High Sensitivity
Site Boundary
Portion 22
Portion 41
N
W
E
S
GALAGO
ENVIRONMENTAL
Biodiversity Specialists
Map Compieled by: Rihann F. Geyser
0
60
120
240
360
480
600 m

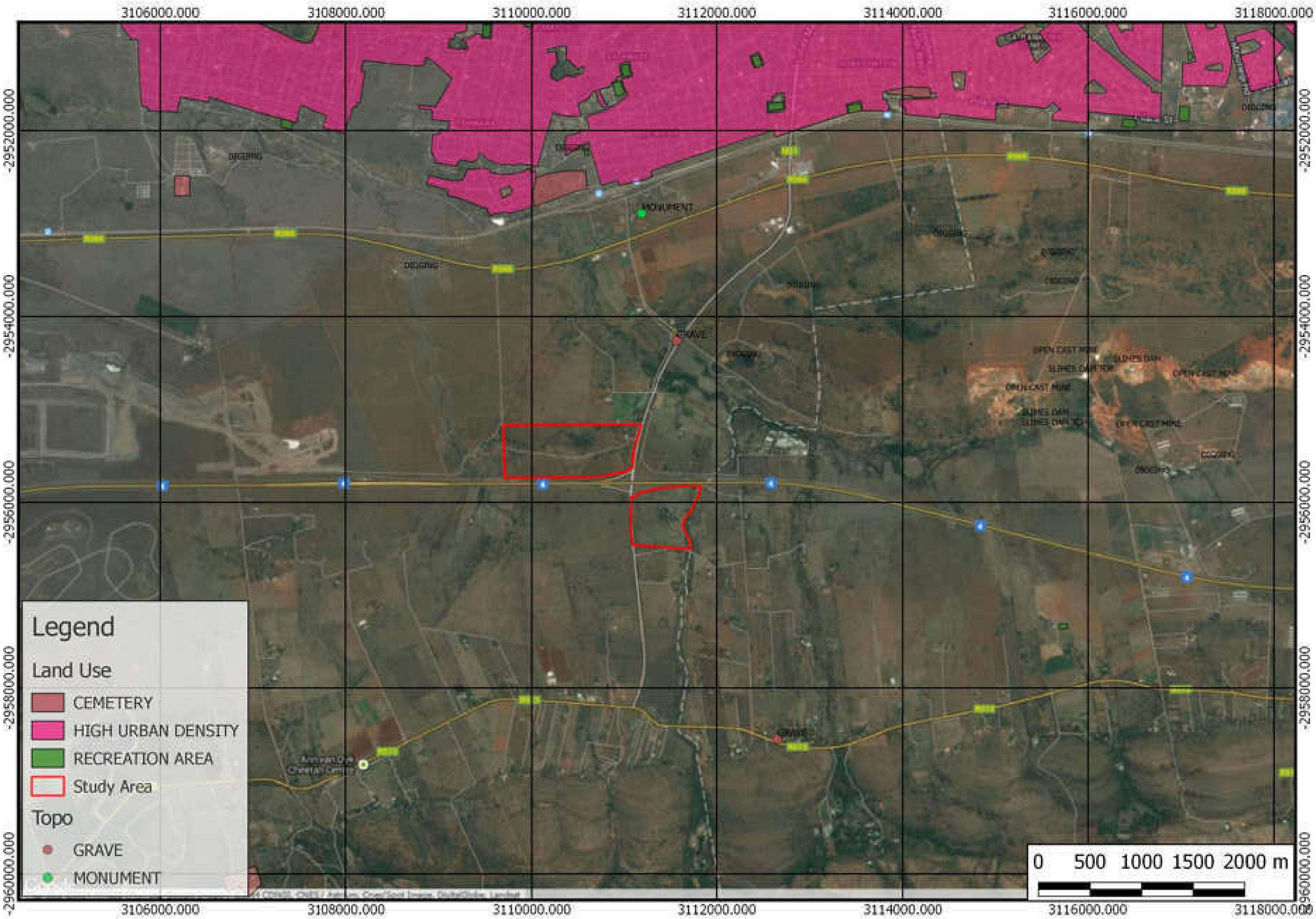
Combined Environmental Sensitivity Map

Figure 17:


Q4 CITY
On Portion 22 & 41 of the farm
SCHIETFONTEIN 437 JQ
Legend
OVERALL SENSITIVITY MAP
🟩 Low (82.9407 ha)
🟥 High (20.4916 ha)
Site Boundary
☐ Portion 22
☐ Portion 41
-○- Orthophotos
N
W
E
S
GALAGO
ENVIRONMENTAL
Map Compieled by: Rihann F. Geyser
0 30 60 120 180 240 300 m

Surrounding Land Uses

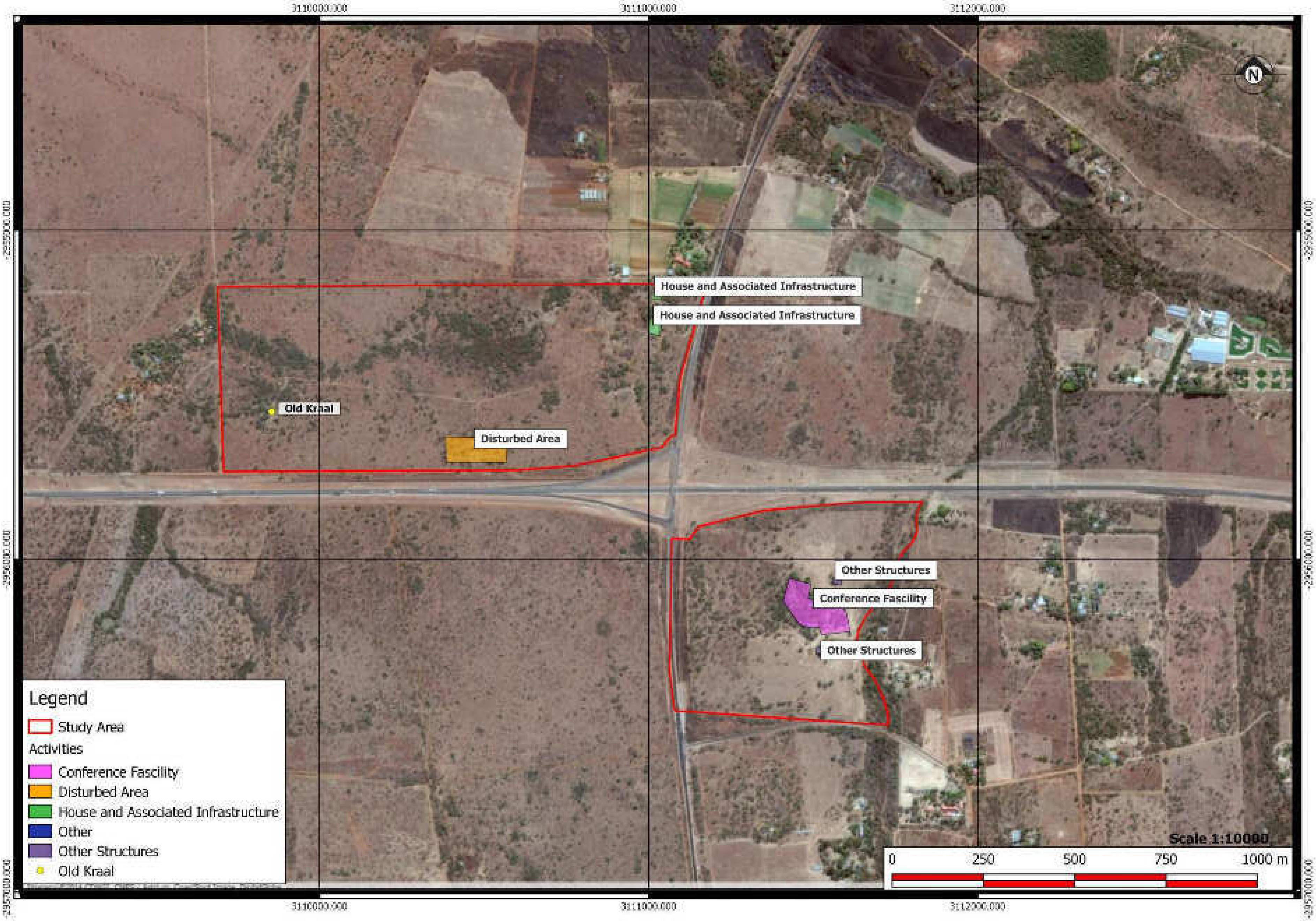
Figure 18:



3106000.000
3108000.000
3110000.000
3112000.000
3114000.000
3116000.000
3118000.000
-2952000.000
-2954000.000
-2956000.000
-2958000.000
-2960000.000
DIGGING
MONUMENT
GRAVE
OPEN CAST MINE
SLIMES DAM
SLIMES DAM TOP
Ann van Dyk Cheetah Centre
Legend
Land Use
CEMETERY
HIGH URBAN DENSITY
RECREATION AREA
Study Area
Topo
GRAVE
MONUMENT
0 500 1000 1500 2000 m

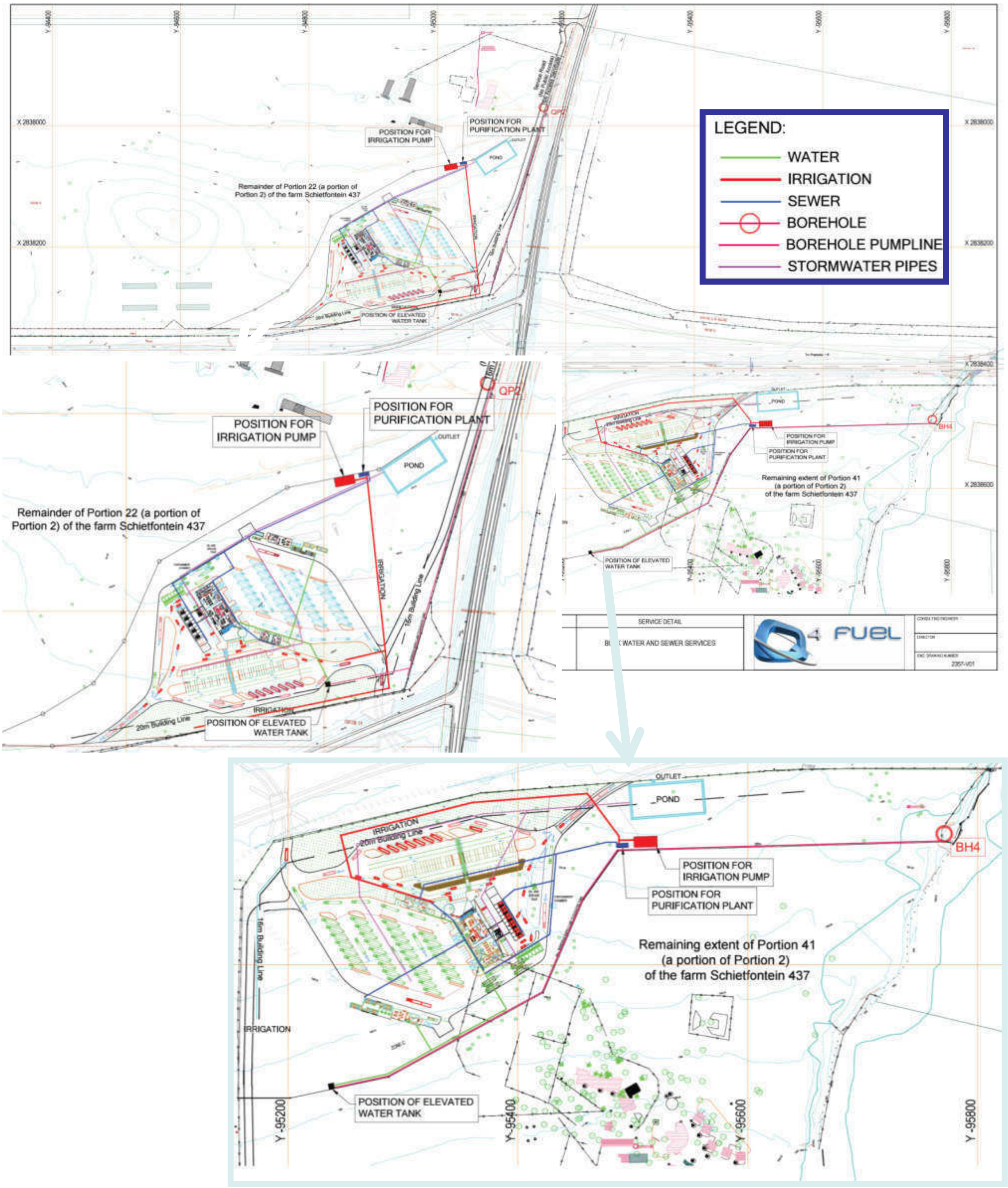
Site Land Uses

Figure 19:


3110000.000
3111000.000
3112000.000
-2955000.000
-2956000.000
-2957000.000
N
House and Associated Infrastructure
House and Associated Infrastructure
Old Kraal
Disturbed Area
Other Structures
Conference Fascility
Other Structures
Legend
Study Area
Activities
Conference Fascility
Disturbed Area
House and Associated Infrastructure
Other
Other Structures
Old Kraal
Scale 1:10000
0
250
500
750
1000 m

Services Layout

Figure 20:


LEGEND:
WATER
IRRIGATION
SEWER
BOREHOLE
BOREHOLE PUMPLINE
STORMWATER PIPES
POSITION FOR IRRIGATION PUMP
POSITION FOR PURIFICATION PLANT
POND
OUTLET
QP2
BH4
IRRIGATION
16m Building Line
20m Building Line
POSITION OF ELEVATED WATER TANK
Remainder of Portion 22 (a portion of Portion 2) of the farm Schietfontein 437
Remaining extent of Portion 41 (a portion of Portion 2) of the farm Schietfontein 437
X 2838000
X 2838200
X 2838400
X 2838600
Y -95200
Y -95400
Y -95600
Y -95800
SERVICE DETAIL
BULK WATER AND SEWER SERVICES
Q4 FUEL
2357-V01

Application Form and acknowledgement letter from NWREAD

Annexure B

LEBOMBO GARDENS BUILDING
36 LEBOMBO ROAD
ASHLEA GARDENS
0081

P.O. BOX 11375
MAROELANA
0161

Tel: (012) 346 3810
Fax: 086 570 5659
E-mail: lizelleg@mweb.co.za
Website: www.bokamoso.biz

Bokamoso
ENVIRONMENTAL
Landscape Architects, Environmental Consultants,
Environmental Auditing, Water License Applications

Department: Economic Development, Environment, Conservation and Tourism
Agricentre Building
Cnr. Dr. James Moroka & Stadium Road
Private Bag X2039
Mmabatho
2735

Tel: 018 389 5156

ATTENTION: Steven Mukhola

3 April 2014

RE: Amended EIA application for the proposed Q4 City Filling Stations
Reference number: NWP/EIA/80/2013

Your letter dated 16 January 2014 has reference as well as the telephonic conversations during March 2014.

Please find attached 3 x hard copies of the application form, amended as discussed, for the abovementioned project. Please note that this application is for the single development of two filling stations on two properties divided by the N4 highway.

We trust you find the above in order. Please do not hesitate to contact our office should you have any questions in this regard.

Sincerely,

AAgenbacht
Ané Agenbacht

Bokamoso Landscape Architects
and Environmental Consultants CC

8. Unless protected by law, all information filled in on this application will become public information on receipt by the competent authority. Any interested and affected party should be provided with the information contained in this application on request, during any stage of the application process.

Queries must be addressed to the contact hereunder:

Departmental Details/Provincial Authority

Postal address:
Department of Agriculture, Conservation, Environment and Rural Development
Attention: Director: Environmental Quality and Protection
Private Bag X2039
Mmabatho
2735

Physical address:
Department of Agriculture, Conservation, Environment and Rural Development
Agricentre Building
Cnr. Dr. James Moroka & Stadium Road
Mmabatho
2735

Queries should be directed to the Directorate: Environmental Quality and Protection at:

Tel: 018-389 5959/5156
Fax: 018-389 5006

Applications to be couried for attention Mr. NS Mukhola Office E10

SITE IDENTIFICATION AND LINKAGE

Please indicate all the Surveyor-general 21 digit site (erf/farm/portion) reference numbers for all sites (including portions of sites) that are part of the application.

T	0	J	Q	0	0	0	0	0	0	0	0	0	4	3	7	0	0	0	2	2
A	N	D																		
T	0	J	Q	0	0	0	0	0	0	0	0	0	4	3	7	0	0	0	4	1

(if there are more that 6, please attach a list with the rest of the numbers)

(These numbers will be used to link various different applications, authorisations, permits etc. that may be connected to a specific site)

PROJECT TITLE

Q4 City Filling Stations

(Total fuel capacity of 644 m^3)

1. BACKGROUND INFORMATION

Project applicant: Q4 Chemicals (Pty) Ltd
Trading name (if any): Q4 Chemicals (Pty) Ltd
Contact person: Carien de Klerk
Physical address: 269 Annette van Zyl Street, Garsfontein, Pretoria
Postal address: -
Postal code: -
Cell: 082 800 9631
Telephone: 012 361 5151
Fax: 012 361 5150
E-mail: carien@q4.co.za

Landowner: **See Annexure D**
Contact person:
Postal address:
Postal code:
Cell:
Telephone:
Fax:
E-mail:

In instances where there is more than one landowner, please attach a list of landowners with their contact details to this application.

Local authority in whose jurisdiction the proposed activity will fall: Madibeng Local Municipality
Nearest town or districts: Brits
Contact person: Motlalekgomo Mmope
Postal address: P O Box 106, Brits
Postal code: 0250
Cell: -
Telephone: 012 318 9561
Fax: 086 265 3616
E-mail: motlalekgomommope@madibeng.gov.za

In instances where there is more than one local authority involved, please attach a list of local authorities with their contact details to this application.

2. ACTIVITIES APPLIED FOR TO BE AUTHORISED

For an application for authorisation that involves more than one listed or specified activity that, together, make up one development proposal, all the listed activities pertaining to this application must be indicated.

<table>
<tr><th>Indicate the number and date of the relevant notice:</th><th>Activity No (s) (in terms of the relevant notice) :</th><th>Describe each listed activity as per project description[1]:</th></tr>
<tr><td>Listing Notice 1,
R544,
18 June 2010</td><td>9</td><td>The construction of facilities or infrastructure exceeding 1000 meters in length for the bulk transportation of water, sewage or storm water –
(i) With an internal diameter of 0,36 meters or more; or
(ii) With a peak throughput of 120 liters per second or more;

excluding where:
a. Such facilities or infrastructure are for bulk transportation of water, sewage or storm water drainage inside a road reserve; or
Where such construction will occur within urban areas but further than 32 meters from a watercourse, measured from the edge of the watercourse.</td></tr>
<tr><td colspan="3">According to the involved civil engineers sewage network is required for the proposed development. The proposed development is also outside any urban areas and therefore it is important to apply for this activity. The stormwater management plan is not yet completed and any of the methods or specifications included in that report could trigger this activity.</td></tr>
<tr><td>R544, (Listing Notice 1), 18 June 2010</td><td>11</td><td>The construction of:
i. Canals;
ii. Channels;
iii. Bridges;
iv. Dams;
v. Weirs;
vi. Bulk storm water outlet structures;
vii. Marinas;
viii. Jetties exceeding 50 square metres in size;
ix. Slipways exceeding 50 square metres in size;</td></tr>
</table>

---

[1] **Please note that this description should not be a verbatim repetition of the listed activity as contained in the relevant** Government Notice, but should be a brief description of activities to be undertaken as per the project description

<table>
<tr><td></td><td></td><td>x. Buildings exceeding 50 square metres in size; or
xi. Infrastructure or structures covering 50 square metres or more

Where such construction occurs within a watercourse or within 32 metres of a watercourse, excluding where such construction will occur behind the development set back line.</td></tr>
<tr><td colspan="3">There is a possibility that a non-perennial stream or wetland might be identified during a wetland study and therefore this activity should be included as there is a possibility for it to be triggered.</td></tr>
<tr><td>R544, (Listing Notice 1), 18 June 2010</td><td>18</td><td>The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 5 cubic metres from:
i. A watercourse;
ii. The sea;
iii. The seashore;
iv. The littoral active zone, an estuary or a distance of 100 metres inland of the high-water mark of the sea or an estuary, whichever distance is the greater –

But excluding where such infilling, depositing, dredging, excavation, removal or moving:
a. is for maintenance purposes undertaken in accordance with a management plan agreed to by the relevant environmental authority; or
b. Occurs behind the development setback line.</td></tr>
<tr><td colspan="3">For the same reason as Activity 11, there is a possibility that a non-perennial stream or wetland might be identified during a wetland study and therefore this activity should be included as there is a possibility for it to be triggered.</td></tr>
<tr><td>R544, (Listing Notice 1), 18 June 2010</td><td>22</td><td>The construction of a road, outside urban areas:
i. With a reserve wider than 13, 5 metres; or
ii. Where no reserve exists where the road is wider than 8 metres; or
iii. For which an environmental authorization was obtained for the route determination in terms of activity 5 in Government Notice</td></tr>
</table>

<table>
<tr><td></td><td></td><td>387 of 2006 or activity 18 in Notice 545 of 2010.</td></tr>
<tr><td colspan="3">Access roads need to be constructed for the proposed filling stations and the development is located outside the urban area and therefore this activity will be triggered.</td></tr>
<tr><td>R544, (Listing Notice 1), 18 June 2010</td><td>23</td><td>The transformation of undeveloped, vacant or derelict land to –
i. Residential, retail, commercial, recreational, industrial or institutional use, inside an urban area, and where the total area to be transformed is 5 hectares or more, but less than 20 hectares; or
ii. Residential, retail, commercial, recreational, industrial or institutional use, outside an urban area and where the total area to be transformed is bigger than 1 hectare but less than 20 hectares; -
Except where such transformation takes place –
a. For linear activities; or
b. For purpose of agriculture or afforestation, in which case Activity 16 of Notice No. R545 applies</td></tr>
<tr><td colspan="3">The proposed development of two filling stations is outside an urban area and where total area to be transformed for the filling station is more than 1 hectare and therefore this activity is applicable.</td></tr>
<tr><td>R545, (Listing Notice 2), 18 June 2010</td><td>3</td><td>The construction of facilities or infrastructure for the storage, or for the storage and handling, of a dangerous good, where such storage occurs in containers with a combined capacity of more than 500 cubic metres.</td></tr>
<tr><td colspan="3">The proposed development of two filling stations will include storage and handling of dangerous goods, namely fuel. The containers for the fuel will have the following specifications: 6 tanks of 46 000ℓ for petrol and 8 tanks of 46 000ℓ for diesel. The total capacity of fuel for the proposed development will be 644 cubic metres.</td></tr>
<tr><td>GNR 546, (Listing Notice 3), 18 June 2010</td><td>4</td><td>The construction of a road wider than 4 metres with a reserve less than 13.5 metres.
(c) In North-West:
i. Outside urban areas, in:</td></tr>
</table>

<table>
<tr><td></td><td></td><td>(aa) ...
(bb) ...
(cc) ...
(dd) ...
(ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional reserves;
(ff) ...
(gg) ...
(hh) ...</td></tr>
<tr><td colspan="3">The proposed development of two filling stations is situated in an area that is classified as a threatened ecosystem and an access road will need to be constructed. The Marikana Thornveld is identified as being vulnerable (not critical) according to the list of threatened ecosystems in terms of NEMBA.</td></tr>
<tr><td>GNR 546, (Listing Notice 3), 18 June 2010</td><td>13</td><td>The clearance of an area of 1 hectare or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation.

(e) In North-West:
i. Outside urban areas in:
(aa) ...
(bb) ...
(cc) ...
(dd) ...
(ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional reserves;
(ff) ...
(gg) ...
(hh) ...</td></tr>
<tr><td colspan="3">The proposed development of two filling stations is situated in an area that is classified as a threatened ecosystem and vegetation will need to be cleared for construction. The Marikana Thornveld is identified as being vulnerable (not critical) according to the list of threatened ecosystems in terms of NEMBA.</td></tr>
<tr><td>GNR 546, (Listing Notice 3), 18 June 2010</td><td>16</td><td>The construction of:
i. ...
ii. ...
iii. Buildings with a footprint exceeding 10 square metres in size; or
iv. Infrastructure covering 10 square metres or</td></tr>
</table>

		more Where such construction occurs within a watercourse, measured 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. **(c) In North-West:** i. Outside urban areas, in: (aa) ... (bb) ... (cc) ... (dd) ... (ee) ... (ff) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional reserves; (gg) ... (hh) ...

The proposed development of two filling stations is situated in an area that is classified as a threatened ecosystem and possibly, construction within close proximity of a water course might occur. The Marikana Thornveld is identified as being vulnerable (not critical) according to the list of threatened ecosystems in terms of NEMBA.

Please note that any authorisation that may result from this application will only cover activities specifically applied for.

3. SOCIO-ECONOMIC BENEFITS

3.1 What is the expected capital value to be contributed for North West Province Growth Domestic Product?

R100 million

3.2 How many new employment opportunities will be created in the development phase?

45

3.3 How many permanent employment opportunities will be created during operational phase?

20

4. OTHER AUTHORISATIONS REQUIRED

4.1 DO YOU NEED ANY AUTHORISATIONS IN TERMS OF ANY OF THE FOLLOWING LAWS?

4.1.1 National Environmental Management: Waste Act	Yes/**No**
4.1.2 National Environmental Management: Air Quality Act	~~Yes~~/**No**
4.1.3 National Environmental Management: Protected Areas Act	~~Yes~~/**No**
4.1.4 National Environmental Management: Biodiversity Act	~~Yes~~/**No**
4.1.5 Mineral Petroleum Development Resources Act	**Yes**/~~No~~
4.1.6 National Water Act	**Maybe**/~~No~~
4.1.7 National Heritage Resources Act	Yes/**Maybe**
4.1.8 Other (please specify)	~~Yes/No~~
4.2 Have such applications been lodged already?	~~Yes~~/**No**

5 ACTIVITY POSTITIONS

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.

List alternative sites, if applicable.

Alternative:	**Latitude (S):**			**Longitude (E):**		
Alternative S1[2] (preferred or only site alternative)	25	38'	50.29"	27°	56'	28.97"
	25°	39'	11.53"	27°	57'	1.44"
Alternative S2 (if any)	°	'	"	°	'	"
Alternative S3 (if any)	°	'	"	°	'	"

In the case of linear activities:

Alternative:	**Latitude (S):**			**Longitude (E):**		
Alternative S1 (preferred or only route alternative)						
• Starting point of the activity	°	'	"	°	'	"
• Middle/Additional point of the activity	°	'	"	°	'	"
• End point of the activity	°	'	"	°	'	"
Alternative S2 (if any)						

---

[2] "Alternative S.." refer to site alternatives.

• 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	°	'	"	°	'	"

Site Location:

6. DECLARATIONS

6.1 The Applicant

I **Q4 Chemicals (Pty) Ltd** declare that I -

- am, or represent[3], the applicant in this application;
- have appointed an environmental assessment practitioner to act as the independent environmental assessment practitioner for this application[4];
- will provide the environmental assessment practitioner and the competent authority with access to all information at my disposal that is relevant to the application;
- will be responsible for the costs incurred in complying with the Environmental Impact Assessment Regulations, 2010, including but not limited to –
  - costs incurred in connection with the appointment of the environmental assessment practitioner or any person contracted by the environmental assessment practitioner;
  - costs incurred in respect of the undertaking of any process required in terms of the Regulations;
  - costs in respect of any fee prescribed by the Minister or MEC in respect of the Regulations;
  - costs in respect of specialist reviews, if the competent authority decides to recover costs; and
  - the provision of security to ensure compliance with conditions attached to an environmental authorisation, should it be required by the competent authority;
- will ensure that the environmental assessment practitioner is competent to comply with the requirements of these Regulations and will take reasonable steps to verify whether the EAP complies with the Regulations;
- will inform all registered interested and affected parties of any suspension of the application as well as of any decisions taken by the competent authority in this regard;
- am responsible for complying with the conditions of any environmental authorisation issued by the competent authority;
- hereby indemnify the Government of the Republic, the competent authority and all its officers, agents and employees, from any liability arising out of the content of any report, any procedure or any action which the applicant or environmental assessment practitioner is responsible for in terms of these Regulations;
- *will not hold the competent authority responsible for any costs that may be incurred by the applicant in proceeding with an activity prior to obtaining an environmental authorisation or prior to an appeal being decided in terms of these Regulations;*
- *will perform all other obligations as expected from an applicant in terms of the Regulations;*
  all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 71 and is punishable in terms of section 24F of the Act.

PRETORIA

Signature of the applicant[5]/ Signature on behalf of the applicant:

2014-04-02 14:39

(SIGNATURE) COMMISSIONER OF OATHS

Q4 Chemicals (Pty) Ltd

Name of company (if applicable):

[illegible]

FULL FIRST NAMES AND SURNAME IN BLOCK LETTERS

02/04/2014

Date:

274 [illegible]

BUSINESS ADDRESS (STREET ADDRESS)

Garsfontein

SUID-AFRIKAANSE POLISIEDIENS
GARSFONTEIN
2014-04-02
CLIENT SERVICE CENTRE
SOUTH AFRICAN POLICE SERVICE

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[3] If this is signed on behalf of the applicant, proof of such authority from the applicant must be attached.

[4] If exemption is obtained from appointing an EAP, the responsibilities of an EAP will automatically apply to the person conducting the environmental impact assessment in terms of the Regulations.

[5] If the applicant is a juristic person, a signature on behalf of the applicant is required as well as proof of such authority. An EAP may not sign on behalf of an applicant.

the DEDECT

Department:
Economic Development, Environment, Conservation and Tourism
North West Provincial Government
Republic of South Africa

Agricentre Building
Cnr. Dr. James Moroka &
Stadium Road
Private Bag X2039,
Mmabatho. 2735

DIRECTORATE: ENVIRONMENTAL QUALITY & PROTECTION

Tel: (018) 389 5959/ 5156
Fax: (018) 389 5006
Smukhola@nwpg.gov.za

DETAILS OF EAP AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	
NEAS Reference Number:	
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010

PROJECT TITLE

Q4 City Filling Stations

(Total fuel capacity of 644 m³)

Environmental Assessment Practitioner (EAP):[1]	Bokamoso Landscape Architects & Environmental Consultants CC		
Contact person:	Lizelle Gregory		
Postal address:	P.O. Box 11375, Maroelana		
Postal code:	0161	Cell:	(012) 346 3810
Telephone:	(012) 346 3810	Fax:	086 570 5659
E-mail:	lizelleg@mweb.co.za		
Professional affiliation(s) (if any)	The South African Council of the Landscape Architects Profession (SACLAP);Institute for Landscape Architects in South Africa (ILASA); and Institute for Environmental Management and Assessment (IEMAS)		

Project Consultant: Ané Agenbacht
Contact person: Ané Agenbacht
Postal address: P.O. Box 11375, Maroelana
Postal code: 0161 Cell: -
Telephone: (012) 346 3810 Fax: 086 570 5659
E-mail: ilzelleg@mweb.co.za

4.2 The Environmental Assessment Practitioner

I, **Anè Agenbacht on behalf of Bokamoso Landscape Architects and Environmental Consultants CC** , declare that –

General declaration:

- I act as the independent environmental practitioner in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting environmental impact assessments, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in regulation 8 of the regulations when preparing the application and any report relating to the application;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;
- I will ensure that the comments of all interested and affected parties are considered and recorded in reports that are submitted to the competent authority in respect of the application, provided that comments that are made by interested and affected parties in respect of a final report that will be submitted to the competent authority may be attached to the report without further amendment to the report;
- **I will keep a register of all interested and affected parties that participated in a public participation process; and**
- **I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not**
- **all the particulars furnished by me in this form are true and correct;**
- **will perform all other obligations as expected from an environmental assessment practitioner in terms of the Regulations; and**
- **I realise that a false declaration is an offence in terms of regulation 71 and is punishable in terms of section 24F of the Act**

Disclosure of Vested Interest (delete whichever is not applicable)

- I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2010;

Signature of the environmental assessment practitioner:

Bokamoso Landscape Architects & Environmental Consultants CC

Name of company:

3 April 2014

Date:

Signature of the Commissioner of Oaths:

Date: 03/04/2014

CHARTERED ACCOUNTANT

Designation:

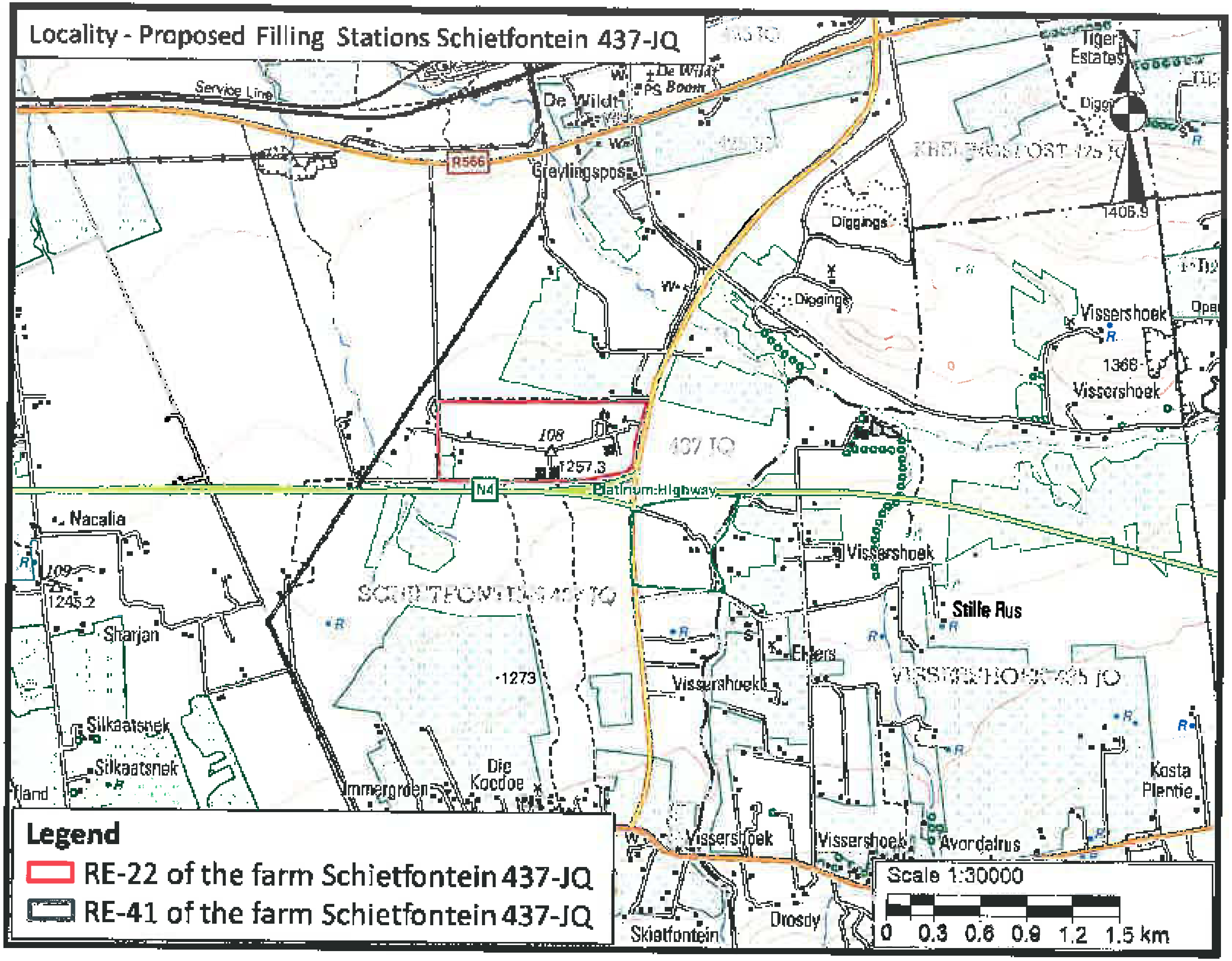
Official stamp (below)

WILLEM JACOBUS MARX
COMMISSIONER OF OATHS
36 LEBOMBO ROAD
ASHLEA GARDENS
PRETORIA 0081
CHARTERED ACCOUNTANT OF SOUTH AFRICA

Annexure A:

Locality and Aerial map

Locality - Proposed Filling Stations Schietfontein 437-JQ



Legend

🟥 RE-22 of the farm Schietfontein 437-JQ

⬛ RE-41 of the farm Schietfontein 437-JQ

Scale 1:30000

0 0.3 0.6 0.9 1.2 1.5 km


R566
Gauteng
North West
Gauteng
North West
RE/22 of Schietfontein
N4
RE/41 of Schietfontein
Laerskool
Vissershoek
Gauteng
North West
Legend
RE/41 of Schietfontein
RE/22 of Schietfontein
0
250
500
750
1000

Annexure B:

Proof of notification to the Land owner-

Proof of receipt of such notice by the owner-

Not applicable.

LEBOMBO GARDEN BUILDING
36 LEBOMBO ROAD
ASHLEA GARDENS
0081

P.O. BOX 11375
MAROELANA
0181

Tel: (012) 346 3810
Fax: 086 570 5659
E-mail: lizelleg@mweb.co.za
Website: www.bokamoso.biz

Bokamoso
ENVIRONMENTAL

Dear Landowner **10 December 2013**

Basic Assessment Process in terms of the National Evironmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010 (Version1) for the Q4 City Filling Station in the Madibeng Local Municipailty area of North West.

The following Farms/Properties will be affected:
Portions 22 & 41 of the Farm Schietfontein 437 JQ.

We hereby confirm that Q4 Chemicals (Pty) Ltd, appointed Bokamoso Landscape Architects and Environmental Consultants cc, to undertake a Basic Assessment Process in terms of the National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment (EIA) Regulations, 2010 for Q4 City Filling Station as listed above.

In terms of the 2010 amended NEMA EIA Regulations, the applicant, if not the land-owner, must notify the land-owner and tenants of a proposed development planned on a property occupied by the land-owner/tenant. In the case of this application the property occupied by you (as the land-owner/ tenant) forms part of the land-parcel earmarked for the above-mentioned project.

This notification therefore represents the formal notification of land-owners and/or tenants of the proposed Q4 City Filling Station in and around the Farm Schietfontein 437 JQ. This notification letter will be submitted as part of the formal application to be submitted to the North West Department of Economic Development, Environment, Conservation and Tourism (DEDECT).

This notification also affords you the opportunity to register (at an early stage) as an Interested and Affected Party (I&AP) in the Basic Assessment Process. In order to register you are requested to fill in your full details on the form supplied below and to fax or e-mail your details to Juanita de Beer (public participation co-ordinator of Bokamoso) for the inclusion of your details onto our public participation database.

Once you are registered as an interested and affected party, we will keep you informed of the progress with the application and we will make all correspondence, documents and other information regarding the application available to you throughout the application process.

Registration as Interested and Affected Party	
Farm Name:	
Erf /Portion Number:	
Street Address:	
Landowner:	Name & Surname: Email address: Telephone: Cell phone: Fax Number: Postal Address:
Tenant Details: (if applicable)	Name & Surname: Email address: Telephone: Cell phone: Fax Number: Postal Address:

Sincerely,

p.p.

Lizelle Gregory
Bokamoso Landscape Architects and Environmental Consultants cc

List of REGISTERED LETTERS
Lys van GEREGISTREERDE BRIEWE
(With an insurance option/met 'n versekeringsopsie)

Post Office

Full tracking and tracing/Volledige volg en spoor

[illegible]
Toll-free number
Tolvry nommer
0800 111 502

Name and address of sender
Naam en adres van afsender: Botameso PO Box 11375, Maroelana 0161
Schietfontein filling station

No	Name and address of addressee Naam en adres van geadresseerde	Insured amount Versekerde bedrag	Insurance fee Versekeringsgeld	Postage Posgeld	Service fee Diensgeld	Affix Track and Trace customer copy Plak Volg-en-Spoor-kliëntafskrif
1	Tenim Investments P.O. Box 1400, Hartbeespoort, 0216					RD 885 058 986 ZA CUSTOMER COPY
2	Joey Theresa Pretorius P.O. Box 1877, Hartbeespoort, 0216					RD 885 058 955 ZA CUSTOMER COPY
3						
4						
5						
6						
7						
8						
9						
10						
	Total Totaal	R	R	R	R	

Number of letters posted
Getal briewe gepos: 2

Signature of client
Handtekening van kliënt: ....

Signature of accepting officer
Handtekening van aanneembeampte: ....

Date stamp
MENLYN
11 DEC 2013
1
0063
Datumstempel

The value of the contents of these letters is as indicated and compensation is not payable for a letter received unconditionally. Compensation is limited to R100,00. No compensation is payable without documentary proof. Optional insurance of up to R2 000,00 is available and applies to domestic registered letters only.

Die waarde van die inhoud van hierdie briewe is soos aangedui en vergoeding sal nie betaal word vir 'n brief wat sonder voorbehoud ontvang word nie. Vergoeding is beperk tot R100,00. Geen vergoeding is sonder dokumentêre bewys betaalbaar nie. Opsionele versekering van tot R2 000,00 is beskikbaar en is slegs op binnelandse geregistreerde briewe van toepassing.

Annexure C:

List of all organs of state and State Departments of where the draft report will be submitted, their full contact details and contact person

Local authority in whose jurisdiction the proposed activity will fall:	**Madibeng Local Municipality**		
Contact person:	Brits		
Postal address:	Motlalekgomo Mmope		
Postal code:	P O Box 106, Brits	**Cell:**	-
Telephone:	0250	**Fax:**	086 265 3616
E-mail:	012 318 9561		

Local authority in whose jurisdiction the proposed activity will fall:	**Department of Water Affairs**		
Contact person:	Mr. Justice Maluleke		
Postal address:	Private Bag X 313, Pretoria		
Postal code:	0001	**Cell:**	
Telephone:	012 – 336 6507	**Fax:**	012 – 336 8311
E-mail:	MalulekeJ@dwa.gov.za		

Local authority in whose jurisdiction the proposed activity will fall:	**Department of Transport**		
Contact person:	Mr. Mangis George Mahlalela		
Postal address:	Private Bag X 193, Pretoria		
Postal code:	0001	**Cell:**	
Telephone:	012 – 309 3698	**Fax:**	012 – 328 3370
E-mail:			

Local authority in whose jurisdiction the proposed activity will fall:	**Department of Human Settlements**		
Contact person:	Mr. Thabane Zulu		
Postal address:	Private Bag X 644, Pretoria		
Postal code:	0001	**Cell:**	
Telephone:	012 – 421 1312	**Fax:**	012 – 341 2998
E-mail:	Nokuthula.mbejo@dhs.gov.za		

Local authority in whose jurisdiction the proposed activity will fall:	**Department of Economic Development**		
Contact person:	Mr. Ebrahim Patel		
Postal address:	Private Bag X 149, Pretoria		
Postal code:	0001	**Cell:**	
Telephone:	012 – 394 1006	**Fax:**	012 - 394 0255
E-mail:			

Annexure D:

Property description list –

Portion 22 OF THE FARM SCHIETFONTEIN 437 JQ

Landowner: **Tenlm Inv CC**
Contact person: –
Postal address: PO Box 1400, Hartebeestpoort
Postal code: 0216
Cell: -
Telephone: –
Fax: -
E-mail: -

Portion 41 OF THE FARM SCHIETFONTEIN 437 JQ

Landowner: **Joey Theresa**
Contact person: –
Postal address: PO Box 1877
Postal code: 0216
Cell: -
Telephone: -
Fax: -
E-mail: -

Annexure E:

Current land use zoning list –

Agricultural

Annexure F:

Other

(PTY) LTD

Q4 Chemicals (Proprietary) Limited - Reg no: 2000/012825/07
P.O. Box 90549, Garsfontein, Pretoria, 0042
259 Annette van Zyl Street, Garsfontein
Vat Reg: 4130201611 - Wholesale no: 0/2006/09/12/0042

24 February 2014

THE DIRECTORATE: ENVIRONMENTAL QUALITY & PROTECTION

AUTHORISATION

I, **(Roelof Dreyer van Niekerk)** with ID number: 700919 5043 082 AND **(Pieter Francois du Preez)** 691213 5266 088 Directors of **Q4 Chemicals (Pty) Ltd** do hereby authorize **Mrs Catharina Johanna de Klerk**, with ID: 6202090083086, being the Project Manager of **Q4 Chemicals (Pty) Ltd** to act as the **REPRESENTATIVE** and are therefore authorized to sign the application form for an environmental authorization on behalf of our company **Q4 Chemicals (Pty) Ltd.**

DATED THIS 14th DAY OF FEBRUARY 2014

R D Van Niekerk- Director
Q4 Chemicals (Pty) Ltd

P F du Preez – Director
Q4 Chemicals (Pty) Ltd

DIRECTORS: P.F DU PREEZ, R.D. VAN NIEKERK
Tel no: 012 361 5151 Fax: 012 361 5150 Email: info@q4.co.za

the DEDECT

Department:
Economic Development, Environment, Conservation and Tourism
North West Provincial Government

AgriCentre Building
Cnr. Dr. James Moroka&
Stadium Road
Private Bag X 15
Mmabatho. 2735

CHIEF DIRECTORATE: ENVIRONMENTAL SERVICES
DIRECTORATE: ENVIRONMENTAL QUALITY MANAGEMENT

Tel: (018) 389 5156
Fax: (018) 389 5006
oskosana@nwpg.gov.za
Enq: Ouma Skosana

Reference: NWP/EIA/80/2013

Attention: Carien de Klerk
Q4 Chemicals (Pty) Ltd
269 Annette van Zyl Street, Gezina
PRETORIA

Tel No.: (012) 361 5151
Cell No.: 082 800 9631
Fax No.: (012) 361 5150

Dear Madam

APPLICATION FOR ENVIRONMENTAL AUTHORISATION FOR PROPOSED Q4 CITY FILLING STATION WITH THE TOTAL FUEL CAPACITY OF 544M^3 ON THE FARM SCHIETFONTEIN 437 JQ, ACTIVITIES NUMBER 9, 11, 13, 18, 22 & 23 IN GN. NO. R. 544, ACTIVITY NUMBER 3 IN GN. NO. R. 545 AND ACTIVITY NUMBER 16 IN GN. NO R. 546, OF NATIONAL ENVIRONMENTAL MANAGEMENT ACT 1998, (Act No 107 of 1998), MADIBENG LOCAL MUNICIPALITY, NORTH WEST PROVINCE

We confirm having received the above mentioned amended Application Form for Environmental Authorisation on 07 April 2014 and the Application Form has been accepted.

Please note the application has been assigned to **Ms. Queen Imasiku**, Rustenburg Office, reachable at (014) 597 3597. This file reference number is **NWP/EIA/80/2013**. Kindly quote this **reference number** and the **name of the officer** it has been assigned to in any future correspondence in respect of the application including notification to be used for public participation.

You are requested to submit future correspondences pertaining to this application to the relevant officer or office where she is based to this address:

80 Kerkstraat
Rustenburg
0299

Please draw the applicant's attention to the fact that the activity may not commence prior to an Environmental Authorisation being granted by the Department.

If you need any clarification about this acknowledgement letter please contact **Mr. Steven Mukhola** at (018) 389 6959.

Yours Faithfully

Mr. Steven Mukhola
Environmental Officer Control Grade B: Development Impact Management
Department of Economic Development, Environment, Conservation and Tourism
Date: 28/04/2014.

Cc: Lizelle Gregory

Fax No: 086 570 5659

read
Department:
Rural, Environment and Agricultural Development
North West Provincial Government
REPUBLIC OF SOUTH AFRICA

80 Kerk Street
Private Bag X82??
Rustenburg
0300

CHIEF DIRECTORATE: ENVIRONMENTAL SERVICES
DIRECTORATE: ENVIRONMENTAL QUALITY MANAGEMENT

Tel: +27 (14) 597 3537
Fax: +27(14) 590 3593
Email: [illegible]

Reference: NWP/EIA/80/2013

Attention: Carien de Klerk
Q4 Chemicals (Pty) Ltd
269 Annetjie van Zyl Street, Garsfontein
PRETORIA
0001

Tel No.: (012) 361 6151
Cell No.: 082 800 9631
Fax No.: (012) 361 6150

Dear Madam

APPLICATION FOR ENVIRONMENTAL AUTHORISATION FOR THE PROPOSED Q4 CITY FILLING STATION WITH THE TOTAL FUEL CAPACITY OF 644M³ ON THE FARM SCHIETFONTEIN 437 JQ, ACTIVITY NUMBERS 9, 11, 18, 22 AND 23 IN GN. NO. R. 544, ACTIVITY NUMBER 3 IN GN. NO. R. 545 AND ACTIVITY NUMBERS 4, 13 AND 16 IN GN. NO. R. 546, OF NATIONAL ENVIRONMENTAL MANAGEMENT ACT 1998, (Act No. 107 of 1998), MADIBENG LOCAL MUNICIPALITY, NORTH WEST PROVINCE

Your letter received by the Department on 22 October 2014 refers.

This Department grants you the right to submit only one EIA to be conducted for two filling station in terms of regulation 14 (1) of EIA regulations of 18 June 2010.

The application is for two filling stations on two properties divided by the N4 highway, that are situated to the north and the south of the N4 highway with a combined total fuel capacity of 644 m³, on the farm Schietfontein 437 JQ.

It must be stressed to the applicant that construction activities on site must not commence until a favourable Environmental Authorisation has been issued.

Please contact this office if you have any queries regarding this correspondence.

Yours Faithfully

Mr. Steven Mukhola
Director: Development Impact Management
North West Department of Rural, Environment and Agricultural Development
Date: 25/11/2014

Bokamoso Environmental
Contact Person: Ms Lizelle Gregory
Fax No: 086 570 5659

WE BELONG WE CARE WE SERVE

read
Department of
Rural, Environmental and Agricultural Development
North West Provincial Government
Republic of South Africa

80 Kock Street
Private Bag X 82080,
Rustenburg 0300
Republic of South Africa

Tel: +27 (14) 5973505/5
Fax: +27(14) 5973 XXX
E-mail: [illegible]@nwpg.gov.za

CHIEF DIRECTORATE: ENVIRONMENTAL SERVICES

DIRECTORATE: ENVIRONMENTAL QUALITY MANAGEMENT

REFERENCE NO.. NWP/EIA/80/2013

Attention: Ms. Mary-Lee van Zyl
Bokamoso Environmental Consultants CC
P.O. Box 11375
MAROELANA
0161

Tel No.: (012) 346 3810
Fax No.: 086 570 5659

Dear Madam

APPLICATION FOR ENVIRONMENTAL AUTHORISATION FOR THE PROPOSED Q4 CITY FILLING STATION WITH THE TOTAL CAPACITY OF $844m^3$ ON THE FARM SCHIETFONTEIN 437 JQ, MADIBENG LOCAL MUNICIPALITY, NORTH WEST PROVINCE

We confirm having received the above mentioned **Draft Scoping Report** on 25 November 2014.

Please note the application has been assigned to **Ms. Queen Imasiku**, Rustenburg Office, reachable at (014) 597 3597. The file reference number is **NWP/EIA/80/2013.** Kindly quote the reference number and the name of the officer it has been assigned to in any future correspondence in respect of the application.

Please draw the applicant's attention to the fact that the activity may not commence prior to an Environmental Authorisation being granted by the Department.

If you need any clarification about this acknowledgement letter please contact **Mr. Rose Molemane** at **(014) 597 3597.**

Yours Faithfully,

....
Ms. Motshabi Mohlaloi
Environmental Officer Control Grade A: Development Impact Management
North West: Department of Rural, Environmental and Agricultural Development
Date: 27/01/2014

WE BELONG WE CARE WE SERVE

read
Department:
Rural, Environmental and Agricultural Development
North West Provincial Government
Republic of South Africa

50 Kerk Street
Private Bag X 82202,
Rustenburg,0300
Republic of South Africa

Tel: +27 (14) 5973760/8
Fax: +27(14) 5923 553
E-mail: [illegible]

CHIEF DIRECTORATE: ENVIRONMENTAL SERVICES

DIRECTORATE: ENVIRONMENTAL QUALITY MANAGEMENT

REFERENCE NO.: NWP/EIA/80/2013

Attention: Ms. Mary-Lee van Zyl
Bokamoso Environmental Consultants CC
P.O. Box 11375
MAROELANA
0161

Tel No.: (012) 346 3810
Fax No.: 086 570 5659

Dear Madam

APPLICATION FOR ENVIRONMENTAL AUTHORISATION FOR THE PROPOSED Q4 CITY FILLING STATION WITH THE TOTAL CAPACITY OF 844M³ ON THE FARM SCHIETFONTEIN 437 JQ, MADIBENG LOCAL MUNICIPALITY, NORTH WEST PROVINCE

We confirm having received the above mentioned **Final Scoping Report on 13 May 2015.**

Please note the application has been assigned to **Ms. Queen Imasiku, Rustenburg Office**, reachable at (014) 597 3597. The file reference number is **NWP/EIA/80/2013.** Kindly quote the reference number and the name of the officer it has been assigned to in any future correspondence in respect of the application.

Please draw the applicant's attention to the fact that the activity may not commence prior to an Environmental Authorisation being granted by the Department.

If you need any clarification about this acknowledgement letter please contact **Ms. Rose Molemane** at (014) 597 3597.

Yours Faithfully,

Ms. Motshabi Mohlalisi
Environmental Officer Control Grade A: Development Impact Management
North West Department of Rural, Environmental and Agricultural Development
Date: 13/05/2015

Approval of Scoping

Annexure C

read
Department:
Rural, Environment and Agricultural Development
North West Provincial Government
REPUBLIC OF SOUTH AFRICA

30 Kerk Street
Private Bag X82298,
Rustenburg
0300
Republic of South Africa
Tel: +27 (14) 597 3597
Fax: +27 (14) 597 3553
E-mail:Qimasiku@nwpg.gov.za
Enquiry: Queen Imasiku

CHIEF DIRECTORATE: ENVIRONMENTAL SERVICES

DIRECTORATE: ENVIRONMENTAL QUALITY MANAGEMENT

Reference: NWP/EIA/80/2013

Attention: **Ms. Mary-Lee van Zyl**
Bokamoso Environmental Consultants CC
P.O Box 11375
MAROELANA
0161

Tel No.: (012) 346 3810
Fax No.: 086 570 5659

Dear Madam

APPLICATION FOR ENVIRONMENTAL AUTHORISATION FOR THE PROPOSED Q4 FILLING STATIONS WITH A TOTAL CAPACITY OF 644M³ ON PORTIONS 22 AND 41 OF THE FARM SCHIETFONTEIN 437 JQ, LISTED ACTIVITIES NUMBER 9, 11, 18, 22 AND 23 IN GN. NO. R.544; 3 IN GN. NO. 545 AND 4, 13 AND 16 IN GN. NO. R546, MADIBENG LOCAL MUNICIPALITY, NORTH WEST PROVINCE

1. The Scoping Report (SR) and plan of study for Environmental Impact Assessment (EIA) which was submitted in terms of Regulation 29 of the EIA Regulations, 2010, for the above-mentioned application and received by the Department on 13 May 2015 refers.

2. This Scoping Report and plan of study for EIA has been reviewed by this Department and it is hereby accepted in terms of Regulation 30 (1)(a). However the following information should be addressed in detail in the EIA Phase of this project.

   a) Geo-hydrological and Geo-technical Study- It is imperative that for a development of this magnitude, sufficient effort and accompanying information regarding the possibilities of the proposed development to pollute or contaminate groundwater in anyhow, must be investigated including the level of reliance of surrounding properties on groundwater, and the ground water reference in terms of quality.

   b) Consultation with the Department of Water and Sanitation -Groundwater is intensely used in the surroundings and therefore the above mentioned Department must be consulted and comments be obtained and incorporated in the EIA.

c) Final Layout Plan- All engineering and design layout plans for the proposed development must be included in the EIA report and also be submitted to the identified interested & affected parties. The layout plan must also show all the sensitive environmental features to be affected by the development, if any.

d) Method of sewage disposal- Sewage disposal method for the proposed development must be investigated and quantity in relation to its suitability and compatibility to the site dynamics. Should municipal borne sewer be the best practicable option, the capacity of the sewage treatment plan must be investigated to establish its capacity in handling the additional sewage resulting from the proposed new development

e) Waste Management- Detailed information regarding the management of solid waste during construction and operational phases of the project must be provided. If it's going to be municipal services, a signed agreement by both applicant and the municipality must be included in the final EIA report, and waste management plan for the proposed development must be established in consultation with the Local Municipality and be incorporated in the EIA report.

f) Services Provisions- Letters as proofs that services will be provided, signed by both applicant and service providers (waste removal/water/electricity), must be submitted to this Department.

g) Consultation with South African National Roads Agency Limited (SANRAL) as the custodian of all national roads in South Africa.

h) The proof of newspaper advertisement in Annexure D3 of the report does not reflect the name of the newspaper and date in which it was placed.

i) All specialist studies identified during the Scoping Phase must be undertaken and included in the Environmental Impact Assessment Report (EIAR).

j) A draft Environmental Impact Assessment Report which includes all specialist studies undertaken must be submitted to all other relevant authorities for comment and their comments including comments from interested and affected parties must be included in the final Environmental Impact Assessment report to be submitted to this Department for consideration.

k) Environmental Management Programme (EMPr) - An EMPr for the construction and operational phases of the project must be developed to identify and mitigate potential environmental and social impacts associated with the proposed activity on the receiving environment. The contents of the EMP must comply with the guidelines as stipulated in Regulation 33 of Government Notice R. 543.

l) Specialists studies must be accompanied by fully completed specialist forms, titled "Details of specialists and declaration of interest".

3. You may accordingly proceed with undertaking the environmental impact assessment in accordance with the requirements of regulation 31 of Government Notice No. R543 of 18 June 2010 and the tasks that are outlined above, and in the plan of study for environmental impact assessment.

It must be stressed to the applicant that construction activities on site must not commence until an Environmental Authorisation has been issued.

Please contact this office if you have any queries regarding this correspondence.

Yours Faithfully

Ms Portia Krisjan
Director: Environmental Quality Management
North West Department of Rural, Environment and Agricultural Development
Date: 14/07/2015

Q4 Chemicals (Pty) Ltd
Contact Person: Carien de Klerk *Fax No: (012) 361 5150*

Company Profile and CV of
Lizelle Gregory
(Environmental Assessment Practitioner)

Annexure D

Bokamoso

Landscape Architects &
Environmental consultants

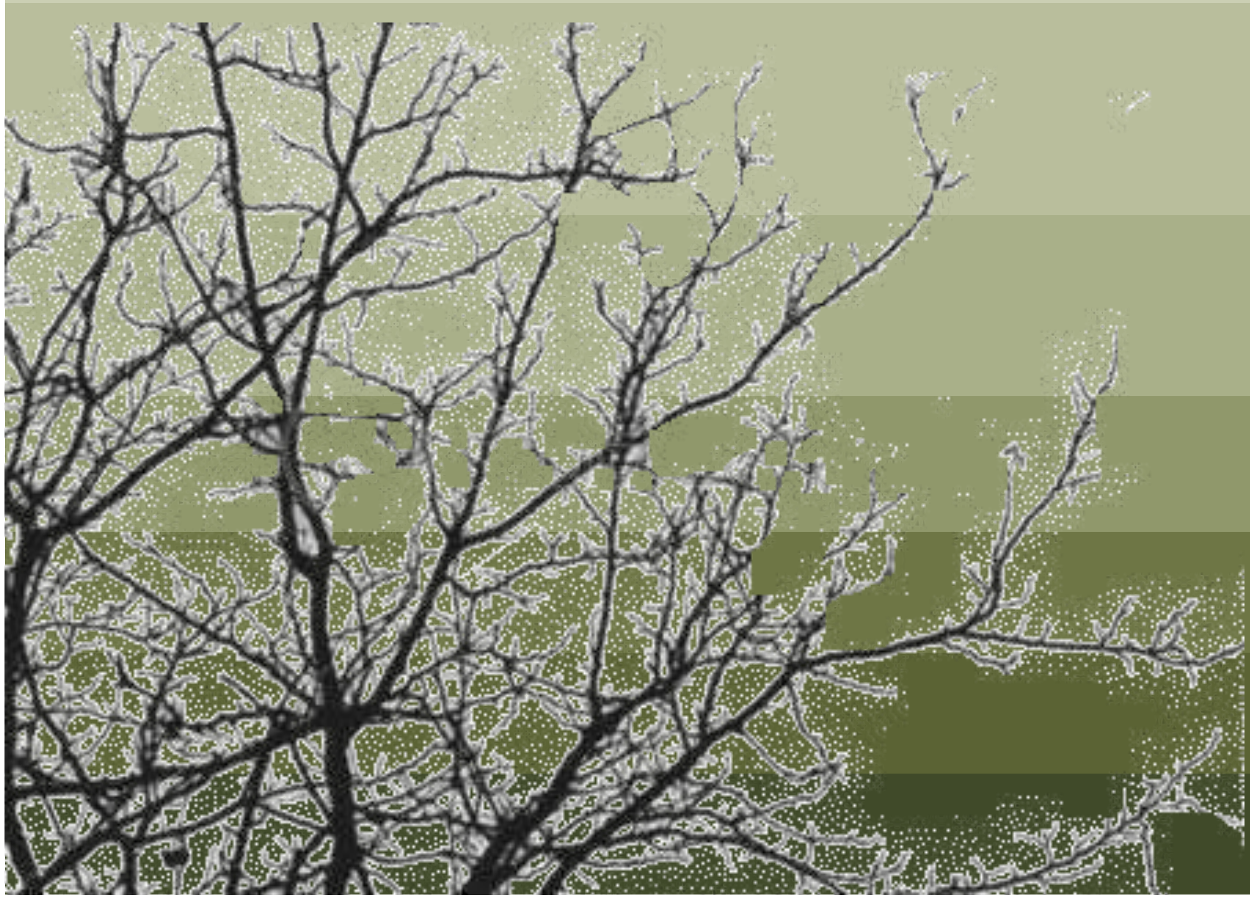
P.O.BOX 11375
Maroelana
0161

Tel: (012) 346 3810
Fax: (086) 570 5559

E-mail: lizelleg@mweb.co.za
Website: www.bokamoso.biz

Bokamoso specialises in the fields of Landscape Architecture and all aspects of Environmental Management and Planning. Bokamoso was founded in 1992 and has shown growth by continually meeting the needs of our clients. Our area of expertise stretches throughout the whole of South Africa. Our projects reflect the competence of our well compiled team. The diversity of our members enables us to tend to a variety of needs. Our integrated approach establishes a basis for outstanding quality. We are well known to clients in the private, commercial as well as governmental sector.

At Bokamoso we stand on a firm basis of environmental investigation in order to find unique solutions to the requirements of our clients and add value to their operations.



Bokamoso

01 Executive Summary

011 Company Overview

Vision:

At Bokamoso we strive to find the best planning solutions by taking into account the functions of a healthy ecosystem. Man and nature should be in balance with each other.

Mission:

We design according to our ethical responsibility, take responsibility for successful completion of projects and constitute a landscape that contributes to a sustainable environment. We add value to the operations of our clients and build long term relationships that are mutually beneficial.

Values:

Integrity

Respect

02 Vision, Mission & Values

Bokamoso stands on the basis of fairness. This include respect within our multicultural team and equal opportunities in terms of gender, nationality and race.

We have a wide variety of projects to tend to, from complicated reports to landscape installation. This wide range of projects enables us to combine a variety of professionals and skilled employees in our team.

Bokamoso further aids in the development of proficiency within the working environment. Each project, whether in need of skilled or unskilled tasks has its own variety of facets to bring to the table.

We are currently in the process of receiving our BEE scorecard. We support transformation in all areas of our company dynamics.

03 Human Resources

031 Employment Equity

Lizelle Gregory (100% interest)

Lizelle Gregory obtained a degree in Landscape Architecture from the University of Pretoria in 1992 and passed her board exam in 1995.
Her professional practice number is PrLArch 97078.

Ms. Gregory has been a member of both the Institute for Landscape Architecture in South Africa (ILASA) and South African Council for the Landscape Architecture Profession (SACLAP), since 1995.

Although the existing Environmental Legislation doesn't yet stipulate the academic requirements of an Environmental Assessment Practitioner (EAP), it is recommended that the Environmental Consultant be registered at the International Association of Impact Assessments (IAIA). Ms. Gregory has been registered as a member of IAIA in 2007.

Ms. Gregory attended and passed an International Environmental Auditing course in 2008.
She is a registered member of the International Environmental Management and Assessment Council (IEMA).

She has lectured at the Tshwane University of Technology (TUT) and the University of Pretoria (UP). The lecturing included fields of Landscape Architecture and Environmental Management.

Ms. Gregory has more than 20 years experience in the compilation of Environmental Evaluation Reports:
Environmental Management Plans (EMP);
Strategic Environmental Assessments;
All stages of Environmental input ;
EIA under ECA and the new and amended NEMA regulations and various other Environmental reports and documents.

Ms. Gregory has compiled and submitted more than 600 Impact Assessments within the last 5-6 years. Furthermore, Ms. L. Gregory is also familiar with all the GDARD/Provincial Environmental policies and guidelines. She assisted and supplied GAUTRANS/former PWV Consortium with Environmental input and reports regarding road network plans, road determinations, preliminary and detailed designs for the past 12 years.

Consulting

Anè Agenbacht	**Introduction to Sustainable Environmental Management—An overview of Principles, Tools,& Issues (Potch 2006)** **Leadership Training School (Lewende Woord 2010)** **BA Environmental Management (UNISA 2011)** **PGCE Education (Unisa 2013) - CUM LAUDE** Project Manager More than 10 years experience in the compilation of various environmental reports
Mary-Lee Van Zyl	**Msc. Plant Science (UP)** **BSc (Hons) Plant Science (UP)** **BSc Ecology (UP)** More than 3 years working experience in the Environmental field Specialises in ECO works, Basic Assessments, EIA's, and Flora Reports Compilation of various Environmental Reports
Dashentha Moodley	**BA Honours Degree in Environmental Management (UNISA) - CUM LAUDE** **Bachelor of Social Science in Geography & Environmental Management (UKZN)** More than 5 years experience in WUL Applications & Integrated Environmental Management within water resource management. Senior Environmental Practitioner & Water Use Licence Consultant Specialises in Water Use License & Compilation of various Env. Reports
Ben Bhukwana	**BSc Landscape Architecture (UP)** More than 6 years experience in the field of Landscape Architecture (Design, Construction, and Implementation). Specialises in Landscape Design, ECO, Rehabilitation Plans and Compilation Basic Assessment Reports Compilation of Tender documents

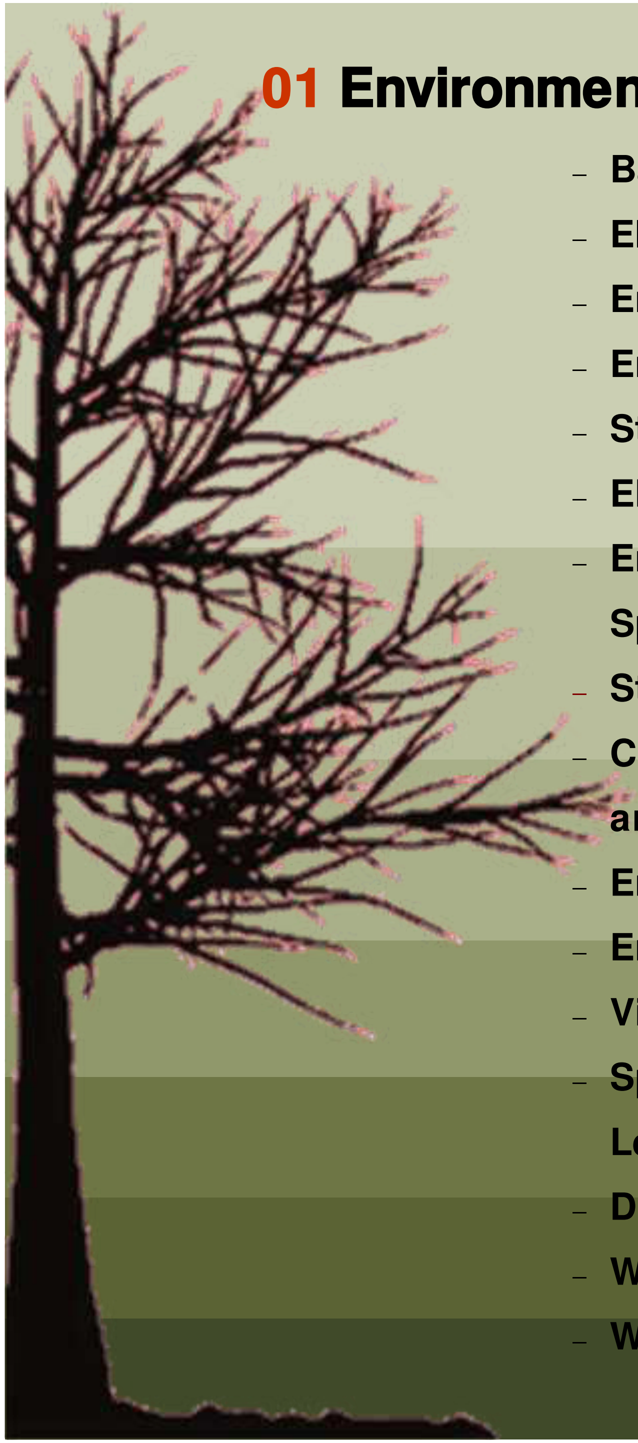
Juanita de Beer	**Diploma Events Management and Marketing (Damelin)** Specializes in Public relations and Public Participation Processes (3 years experience)
Alfred Thomas	**CIW Foundation& Internet Marketing (IT Academy)** 12 years experience in GIS and IT in general. GIS Operator and Multimedia Specialist.
Bianca Reyneke	**Applying SHE Principles and Procedures (NOSA)** **Intro to SAMTRAC Course (NOSA)** **SHEQ Coordinator and compilation of environmental reports** **Specialises in compiling various environmental reports**
A.E. van Wyk	**BSc. Environmental Sciences (Zoology and Geography)** **Specialises in compiling various environmental reports**

Elsa Viviers	**Interior Decorating (Centurion College)** (Accounting/ Receptionist) and Secretary to Lizelle Gregory
Loura du Toit	N. Dip. Professional Teacher (Heidelberg Teachers Training College) Librarian and PA to Project Manager
Merriam Mogalaki	Administration Assistant with in-house training in bookkeeping

Landscape Contracting

Elias Maloka	Site manager overseeing landscape installations. Irrigation design and implementation. Landscape maintenance More than 18 years experience in landscape construction works.

The contracting section compromises of six permanently employed black male workers. In many cases the team consists of up to 12 workers, depending on the quantity of work.



01 Environmental Management Services

- Basic Assessment Reports
- EIA & Scoping Reports
- Environmental Management Plans
- Environmental Scans
- Strategic Environmental Assessments
- EMP for Mines
- Environmental Input and Evaluation of Spatial Development Frameworks
- State of Environmental Reports
- Compilation of Environmental Legislation and Policy Documents
- Environmental Auditing and Monitoring
- Environmental Control Officer (ECO)
- Visual Impact assessments
- Specialist Assistance with Environmental Legislation Issues and Appeals
- Development Process Management
- Water Use License applications to DWA
- Waste License Application

02 Landscape Architecture

- Master Planning
- Sketch Plans
- Planting Plans
- Working Drawings
- Furniture Design
- Detail Design
- Landscape Development Frameworks
- Landscape Development Plans (LDP)
- Contract and Tender Documentation
- Landscape Rehabilitation Works

03 Landscape Contracting

Implementation of Plans for:

- Office Parks
- Commercial/ Retail / Recreational Development
- Residential Complexes
- Private Residential Gardens
- Implementation of irrigation systems

Bokamoso

04 Services

042 Contracting Services

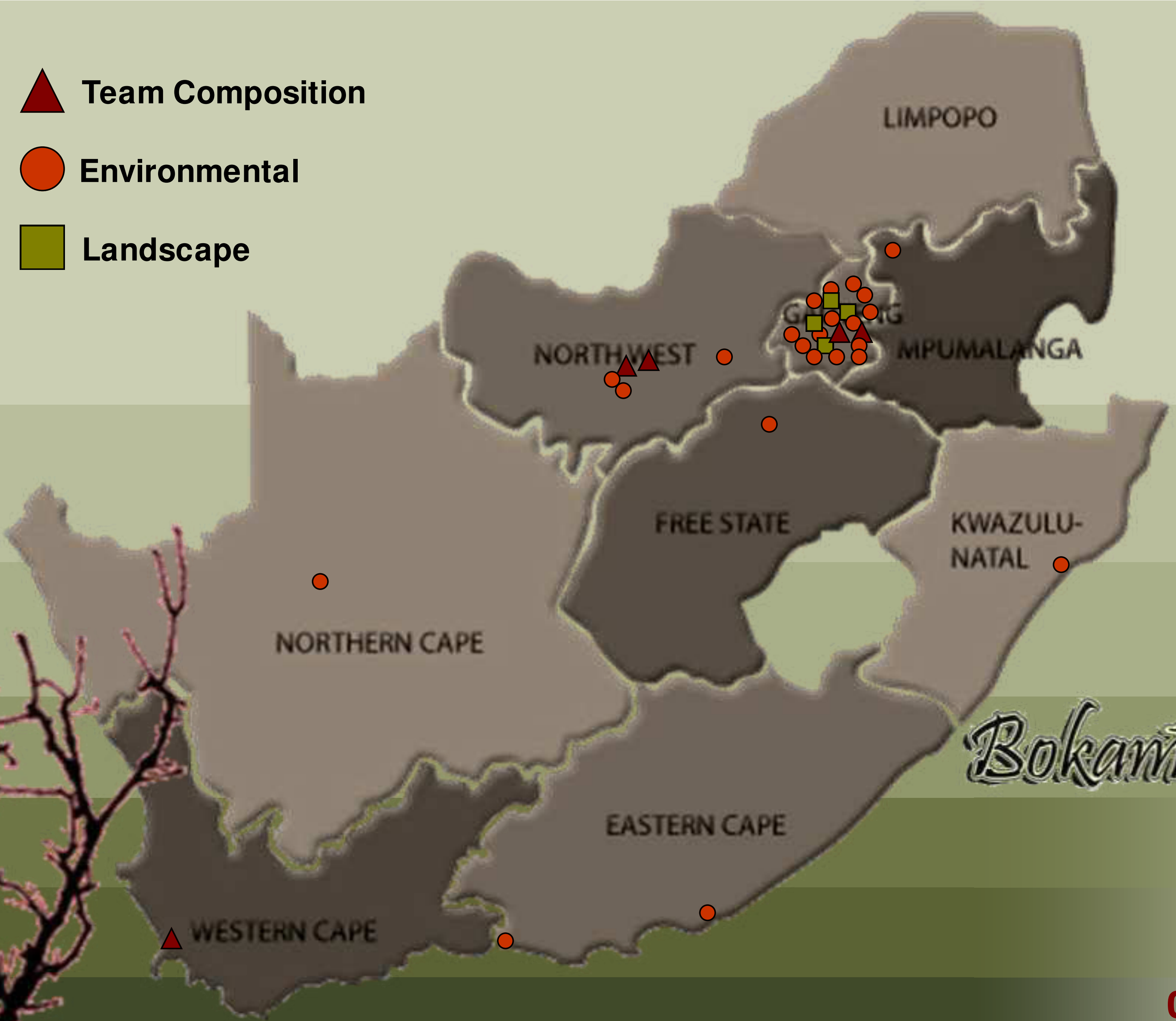
04 Services

043 Orientation

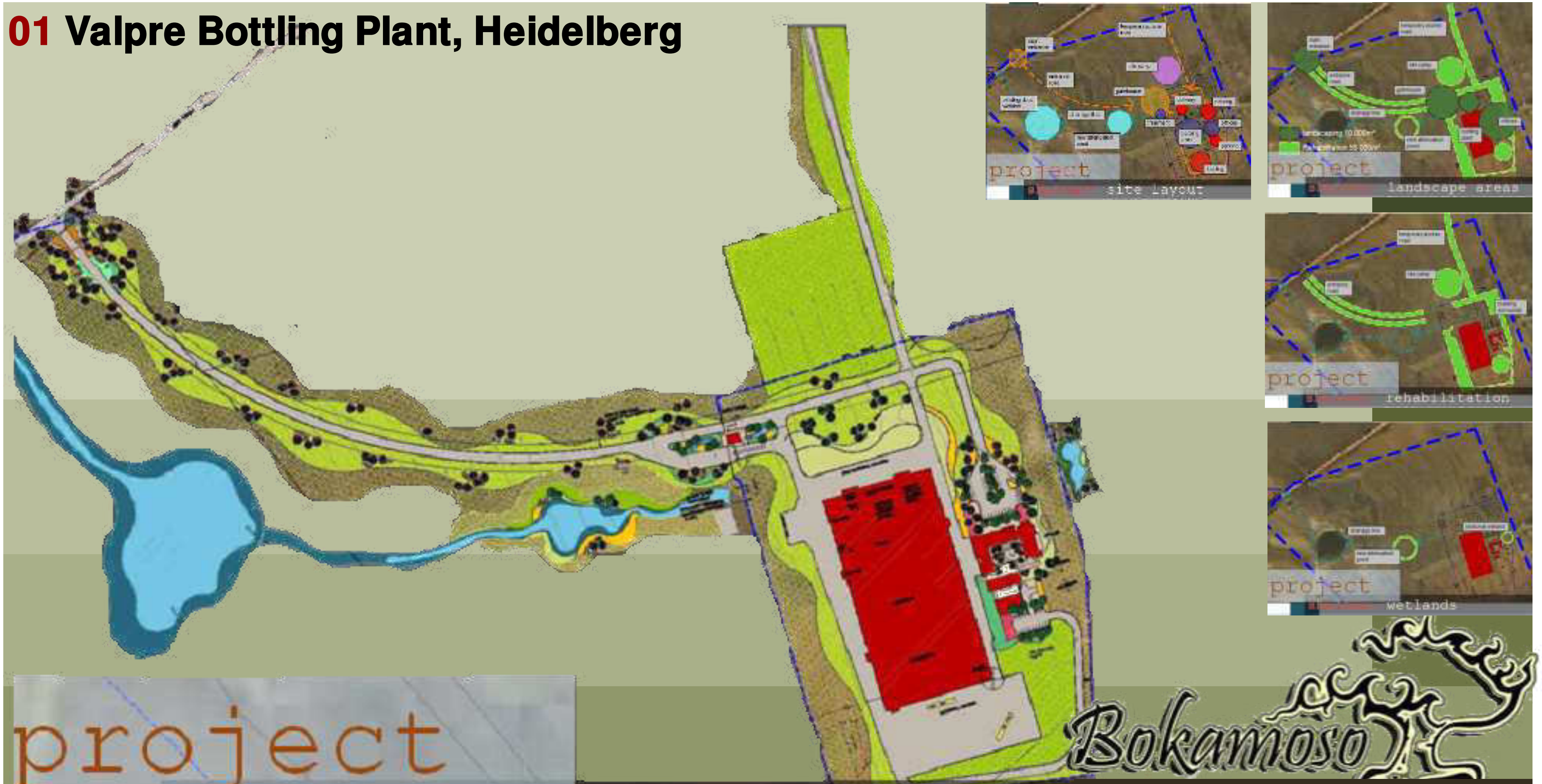
▲ Team Composition

● Environmental

■ Landscape



01 Valpre Bottling Plant, Heidelberg



Bokamoso

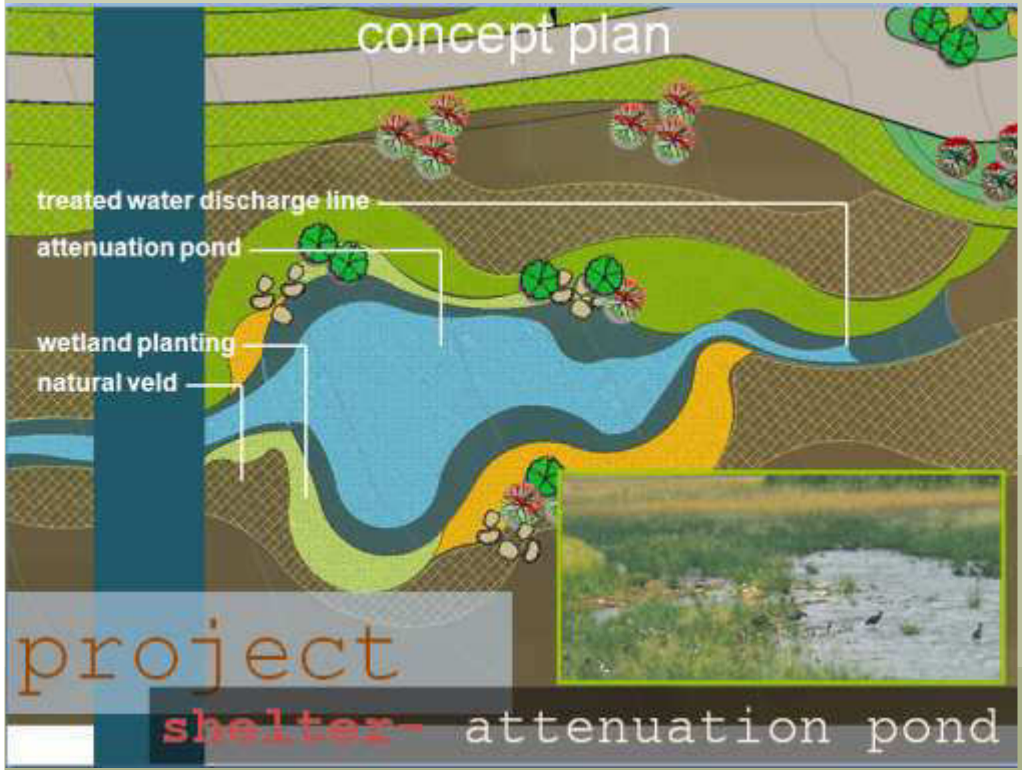
project

shelter- site plan

05 Landscape Projects– Current

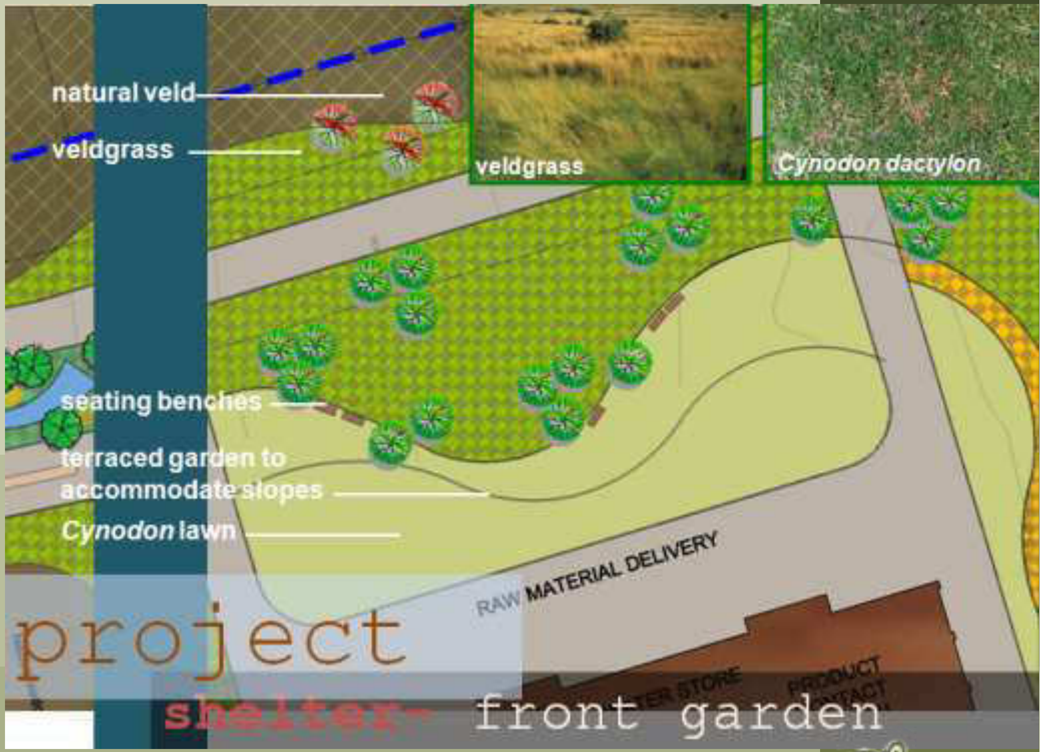
051 Commercial

01 Valpre Bottling Plant, Heidelberg



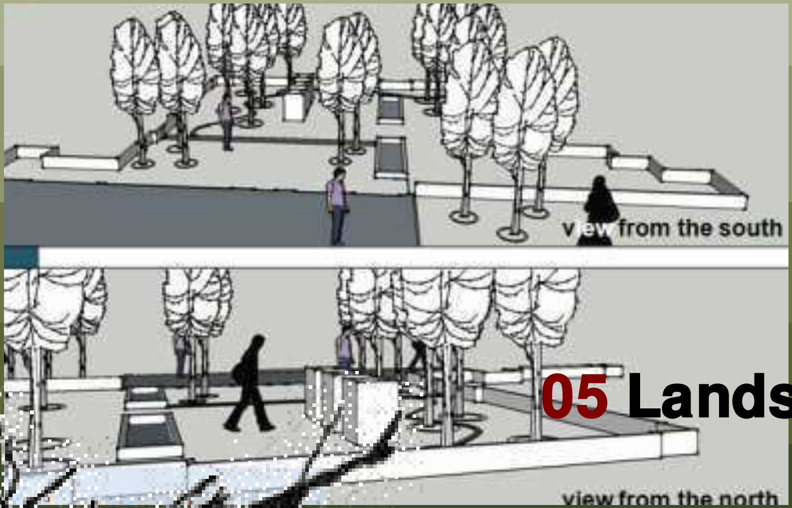
Bokamoso

01 Valpre Bottling Plant, Heidelberg



Bokamoso

01 Valpre Bottling Plant, Heidelberg



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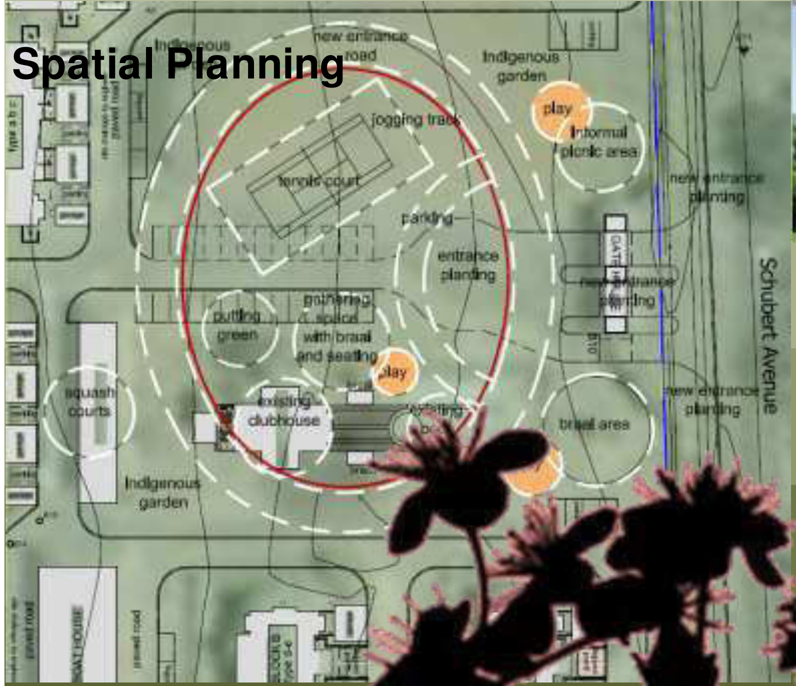
02 Melodie Waters, Hartebeespoortdam

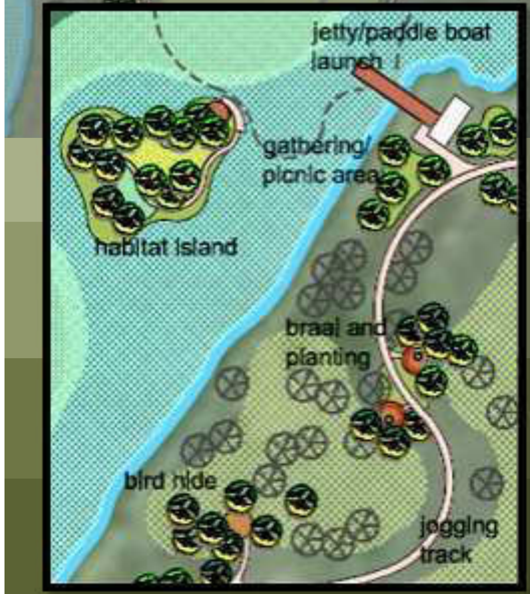
Streetscape

Spatial Planning



Indigenous Planting

02 Melodie waters, Hartebeestpoortdam



Rehabilitation

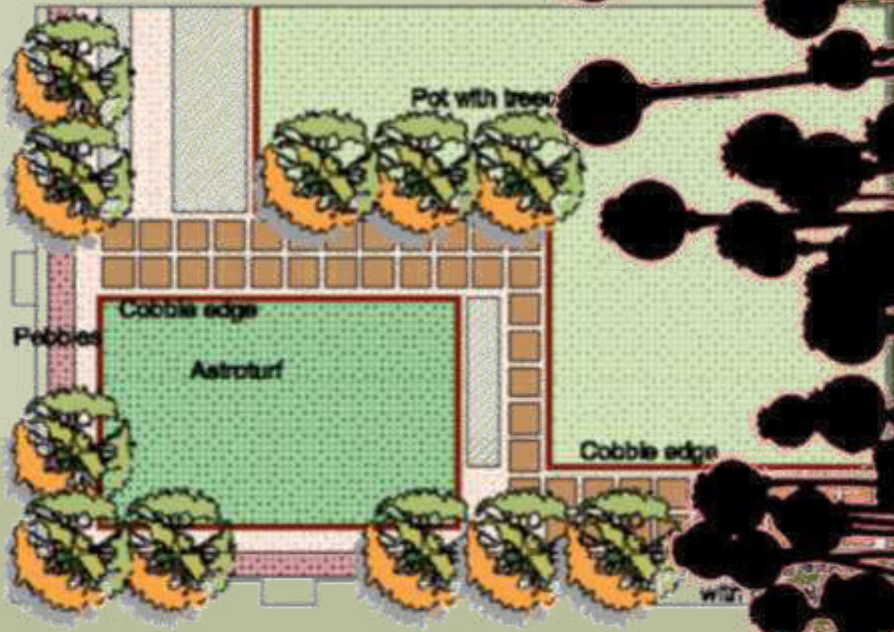
Area Layout

Bokamoso

05 Landscape Projects– Current

052 Commercial/Recreational

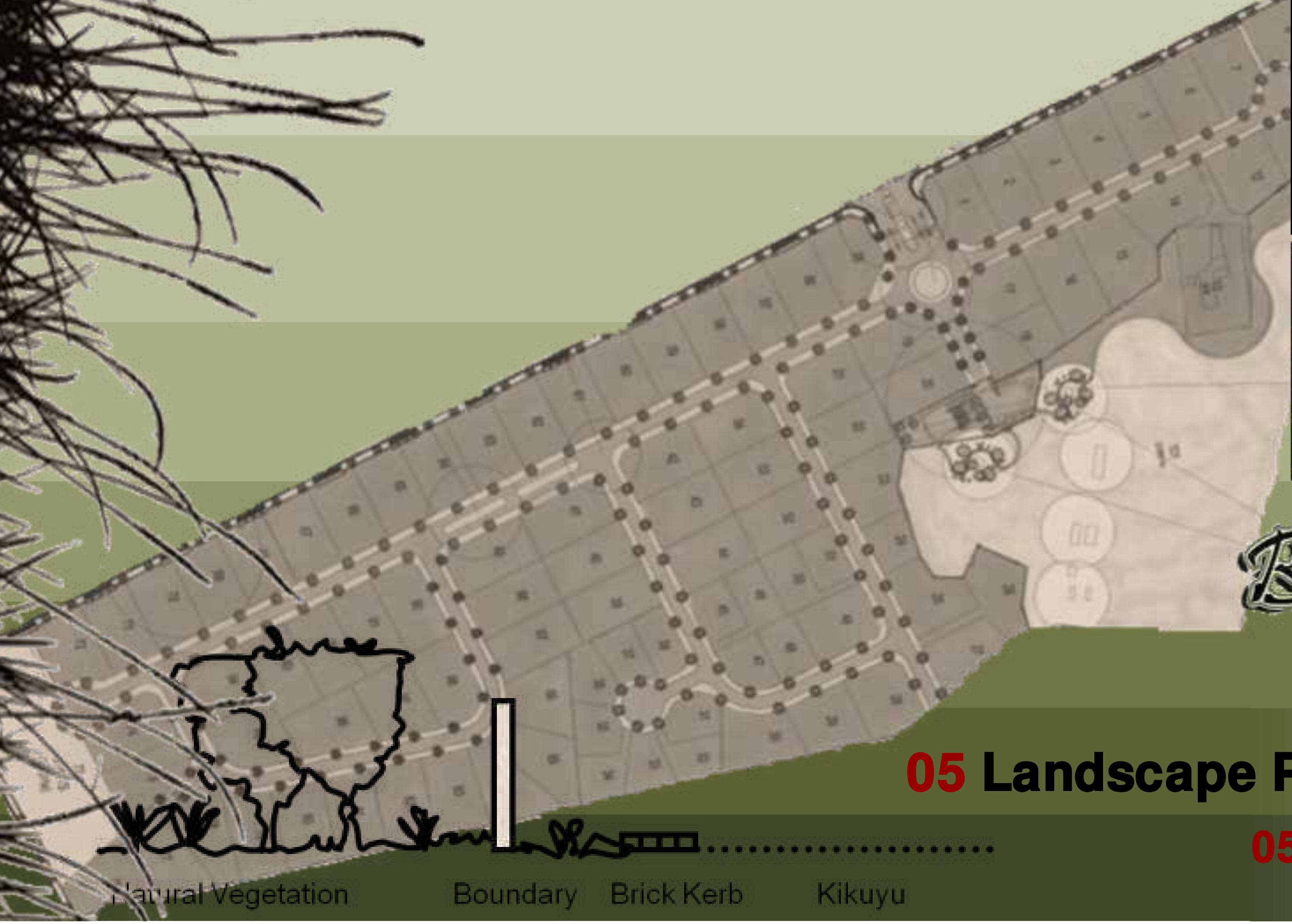
03 Grain Building, Pretoria



Bokamoso

04 Ismail Dawson offices, Pretoria

05 Celtic Manor, Pretoria



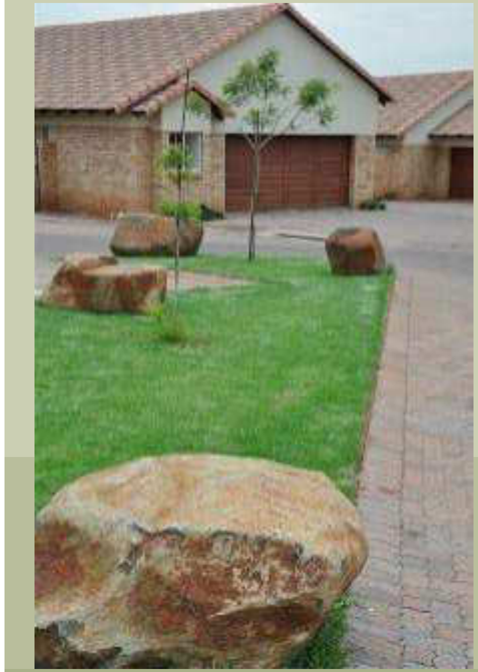
06 The Wilds, Pretoria

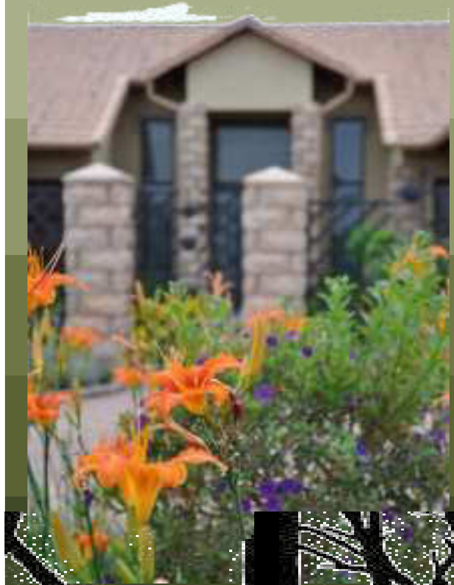
07 The Wilds, Pretoria

08 The Wilds, Pretoria

09 The Wilds, Pretoria

010 The Wilds, Pretoria





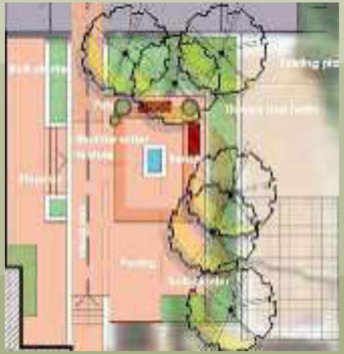
05 Landscape Projects – Completed

055 Residential

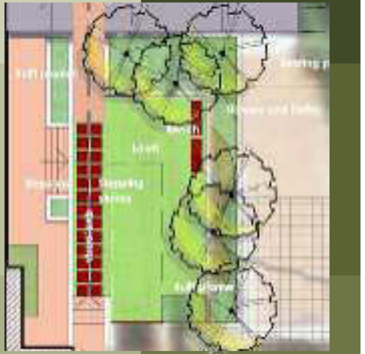
011 Governor of Reserve Bank’s Residence, Pretoria

Plant Palette

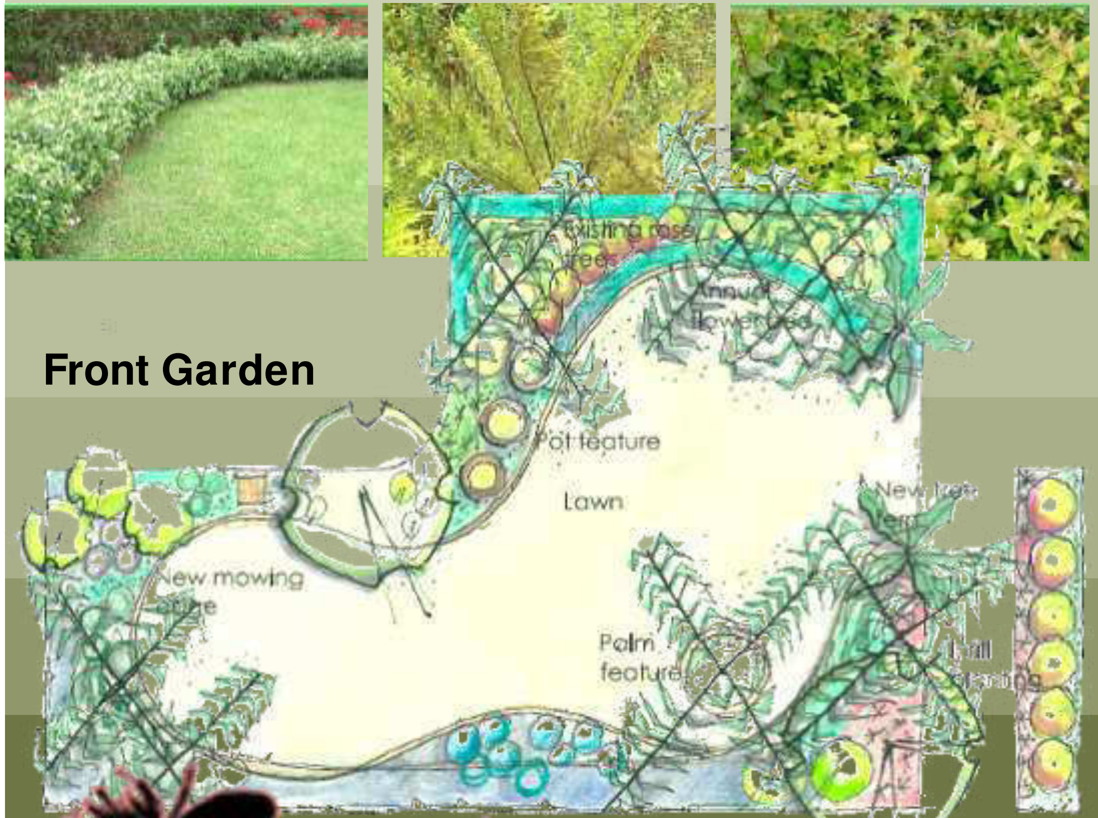
Option 1



Option 2

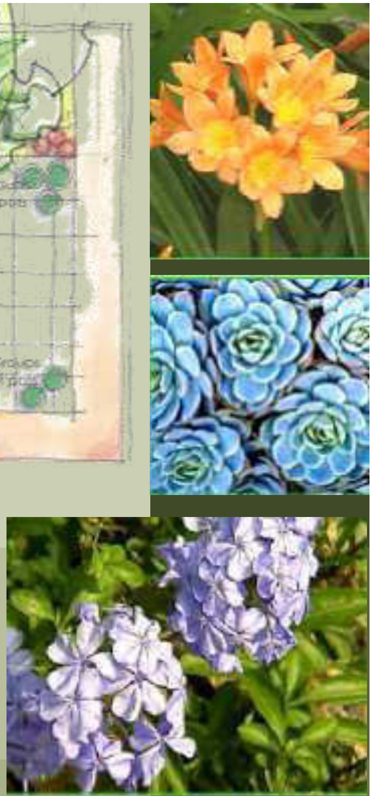


012 House Ismail, Pretoria

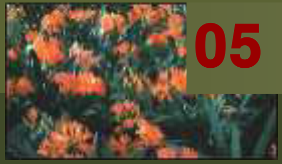


Front Garden

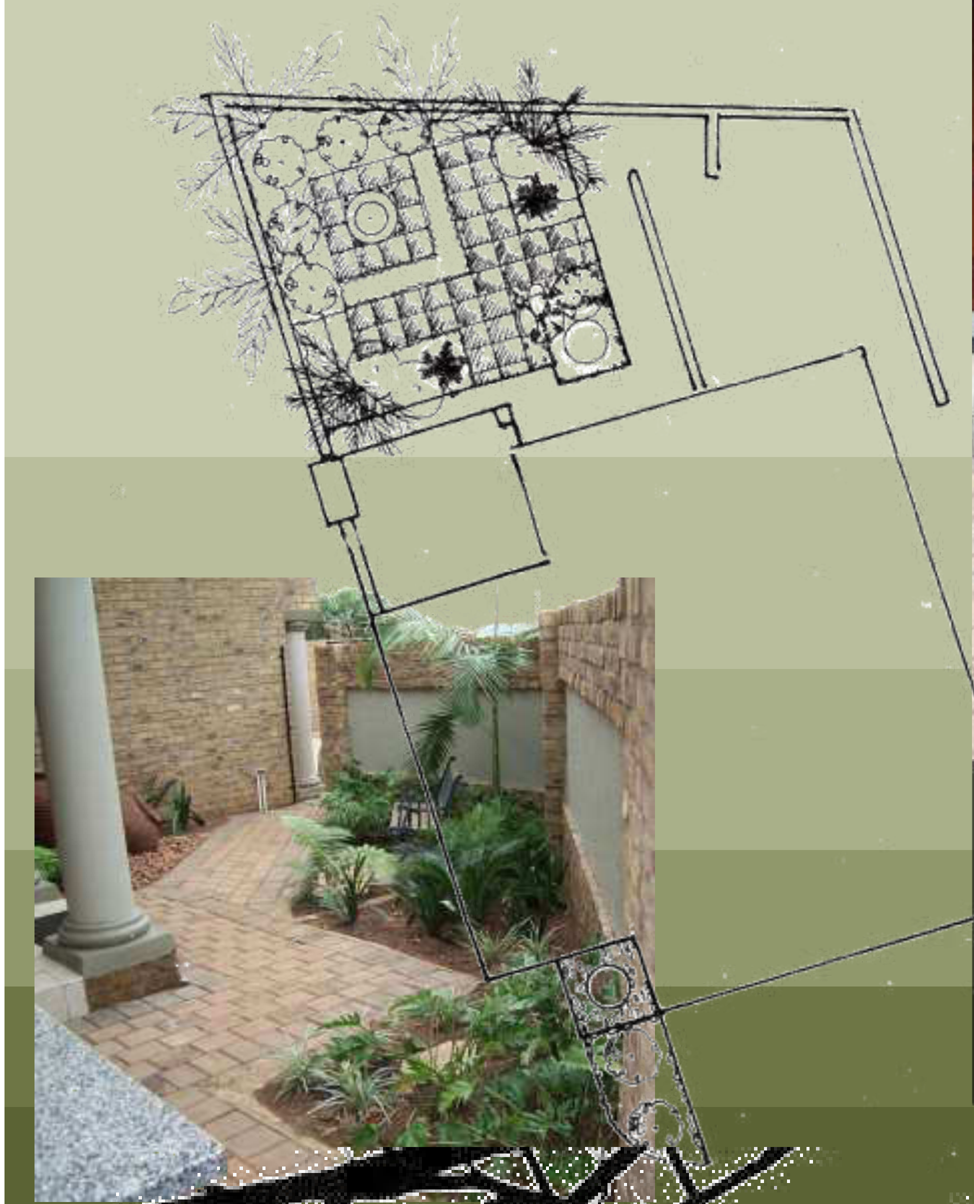
Back Garden



013 Forest Garden, Pretoria



015 Forest Garden, Pretoria



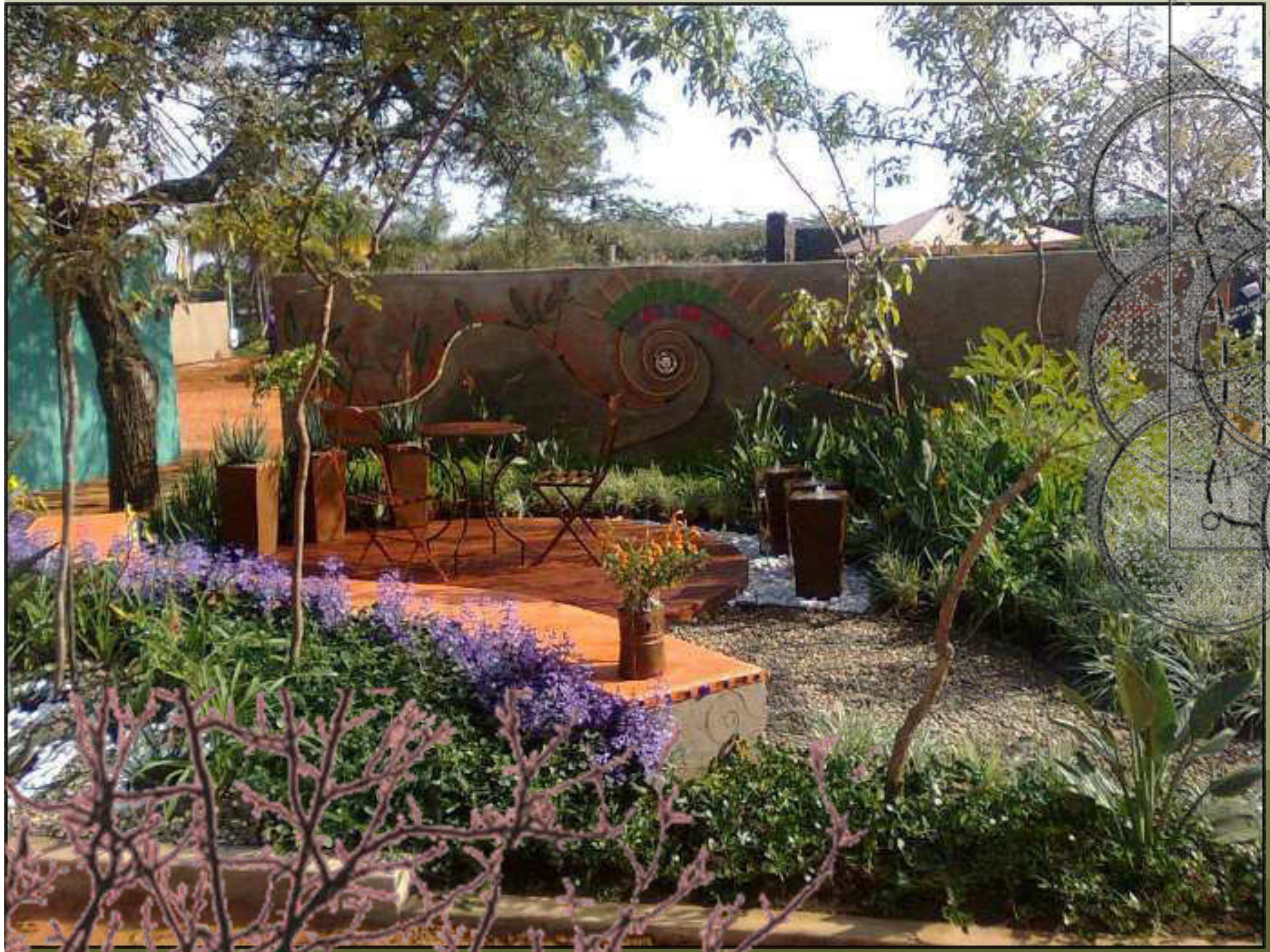
Bokamoso

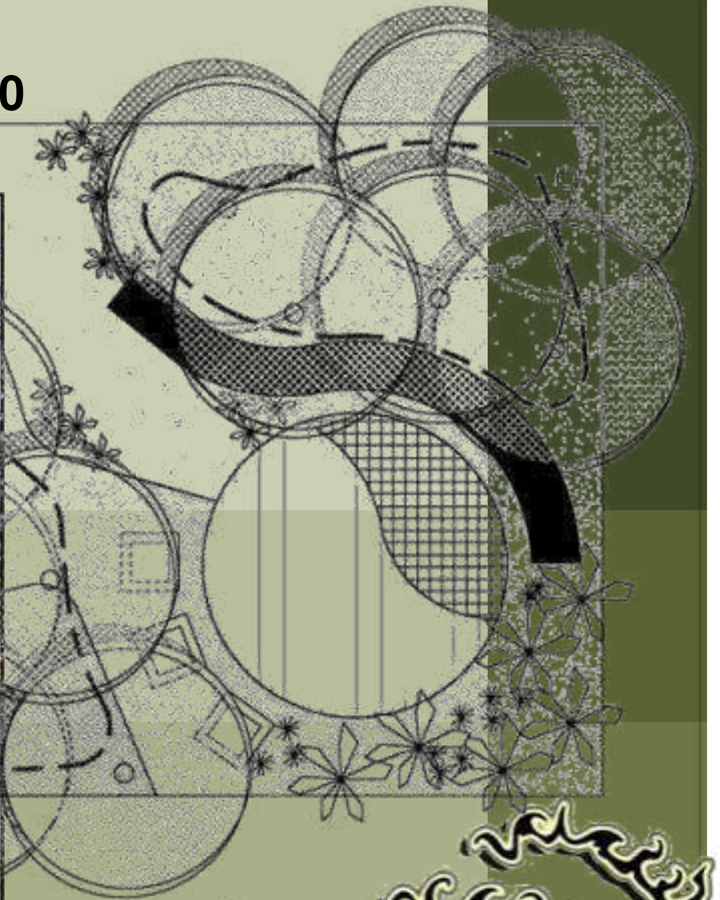
05 Landscape Projects - Completed

055 Residential

01 Safari Garden Expo

Received a Silver Certificate at the Safari Garden Expo, 2010





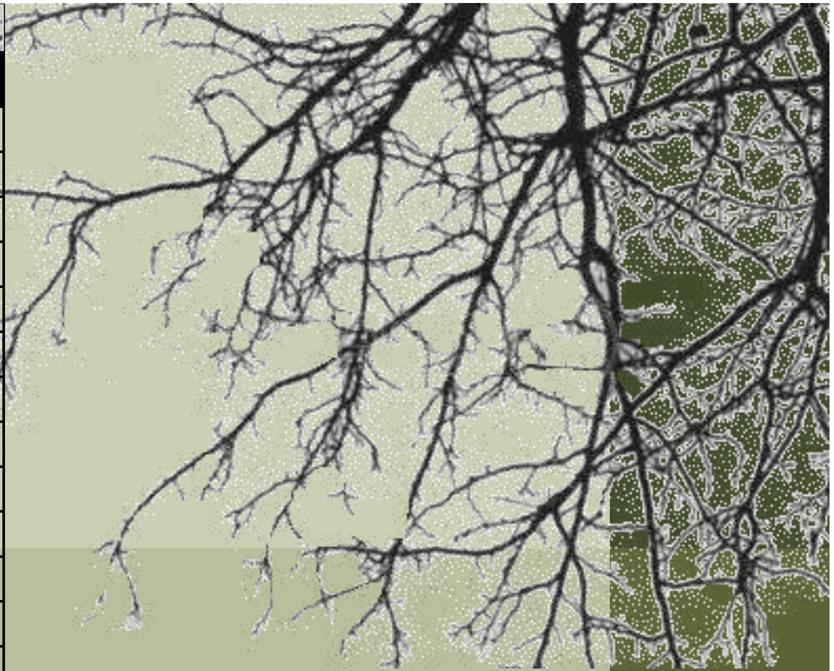
02 UNISA Sunnyside Campus, Pretoria

Best Commercial Paving Plan in Gauteng, 1997

07 Current Environmental Projects

071 EIA, Scoping& Opinion

Project Name	Status	Project
Environmental Impact Assessment(EIA) and Scoping Report		
Junction 21	ROD	EIA
5 O'clock site access	In Progress	EIA
Bokamoso X 1	In Progress	Scoping & EIA
Doornvallei Phase 6 & 7	In Progress	EIA
Engen Interchange	In Progress	Scoping & EIA
Erasmia X15	In Progress	EIA
Franschkloof	In Progress	EIA
K113	Amendment of ROD	EIA
K220 East	ROD	EIA
K220 West	ROD	EIA
K54 ROD conditions	In Progress	EIA
Knopjeslaagte 95/Peachtree	ROD	EIA
Knopjeslaagte portion 20 & 21	ROD	EIA
Lillieslief/Nooitgedacht	In Progress	EIA
Mooiplaats 70 (Sutherland)	In Progress	EIA
Naauwpoort 1 - 12/Valley View	In Progress	EIA
PeachTree X5	In Progress	EIA
Strydfontein 60	In Progress	EIA
Thabe Motswere	In Progress	Scoping & EIA
Vlakplaats	In Progress	EIA
Waterval Valley	In Progress	EIA
Environmental Opinion		
Doornkloof 68 (Ross)	In Progress	Opinion
Monavoni X 53	In Progress	BA & Opinion
Mooikloof (USN)	In Progress	Opinion
Norwood Mall/Sandspruit	In Progress	Opinion
Riversong X 9	In Progress	Opinion
Sud Chemie	In Progress	Opinion
USN Benjoh Fishing Resort	In Progress	Opinion



The adjacent list host the status of our current projects. Only a selected amount of projects are displayed.

Project Name	Status	Project
Basic Assessment(BA)		
Annlin X 138	In Progress	BA
Clubview X 29	ROD	BA
Darrenwood Dam	In Progress	BA
Durley Holding 90 & 91	In Progress	BA
Elim	In Progress	BA
Fochville X 3	In Progress	BA
Hartebeeshoek 251	In Progress	BA
Klerksdorp (Matlosana Mall)	In Progress	BA
Monavoni External Services	ROD	BA
Monavoni X 45	Amendment of ROD	BA
Montana X 146	In Progress	BA
Rooihuiskraal X29	In Progress	BA
Thorntree Mall	In Progress	BA

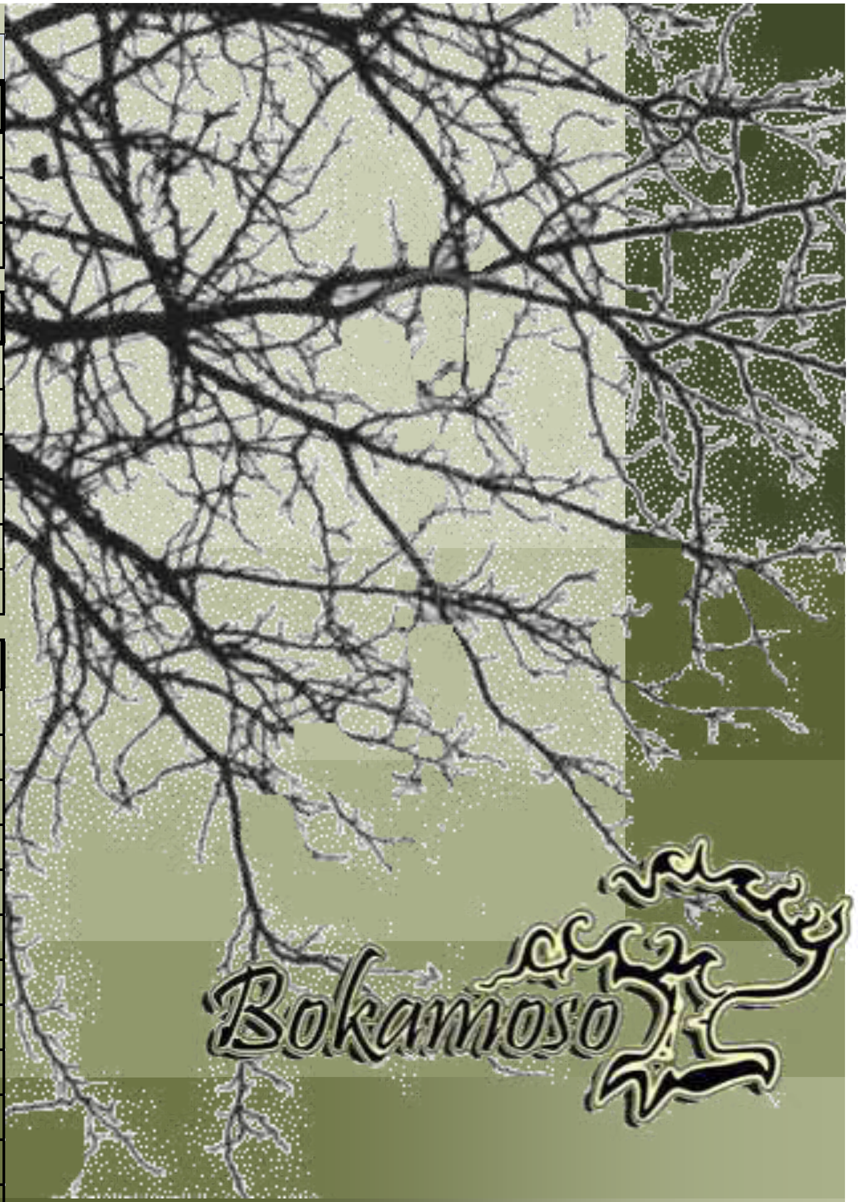
Environmental control officer (ECO)		
Grace Point Church	In Progress	ECO
R 81	In Progress	ECO
Highveld X 61	In Progress	ECO
Mall of the North	In Progress	ECO
Olievenhoutbosch Road	In Progress	ECO
Orchards 39	In Progress	ECO
Pierre van Ryneveld Reservoir	In Progress	ECO
Project Shelter	In Progress	ECO

S24 G		
Wonderboom	In Progress	S24 G
Mogwasi Guest houses	Completed	S24 G

07 Current Environmental Projects

072 BA, ECO & S24 G

Project Name	Status	Project
Objection		
Colesberg WWTW	In Progress	Objection
Nigel Steelmill	Completed	Objection
Chantilly Waters	Completed	Objection
Development facilitation Act- Input (DFA)		
Burgersfort	In Progress	DFA & BA
Doornpoort Filling Station	In Progress	DFA & EIA & Scoping
Eastwood Junction	In Progress	DFA
Ingersol Road (Erf 78, 81 - 83)	In Progress	DFA
Roos Senekal	In Progress	DFA & EIA & Scoping
Thaba Meetse 1	In Progress	DFA & EIA & Scoping
Water Use License Act (WULA)		
Britstown Bulk Water Supply	In Progress	WULA
Celery Road / Green Channel	In Progress	WULA
Clayville X 46	In Progress	WULA
Dindingwe Lodge	In Progress	WULA
Doornpoort Filling Station	In Progress	WULA+DFA+EIA+SC
Eco Park Dam	In Progress	WULA
Groote Drift Potch	In Progress	WULA
Jozini Shopping Centre	In Progress	WULA+BA
K60	Completed	WULA
Maloto Roads	In Progress	WULA
Kwazele Sewage Works	In Progress	WULA
Monavoni External Services	In Progress	WULA+BA
Nyathi Eco Estate	In Progress	WULA
Prairie Giants X 3	In Progress	WULA
Waveside Water Bottling Plant	Completed	WULA



07 Current Environmental Projects

073 Objection, DFA & WULA

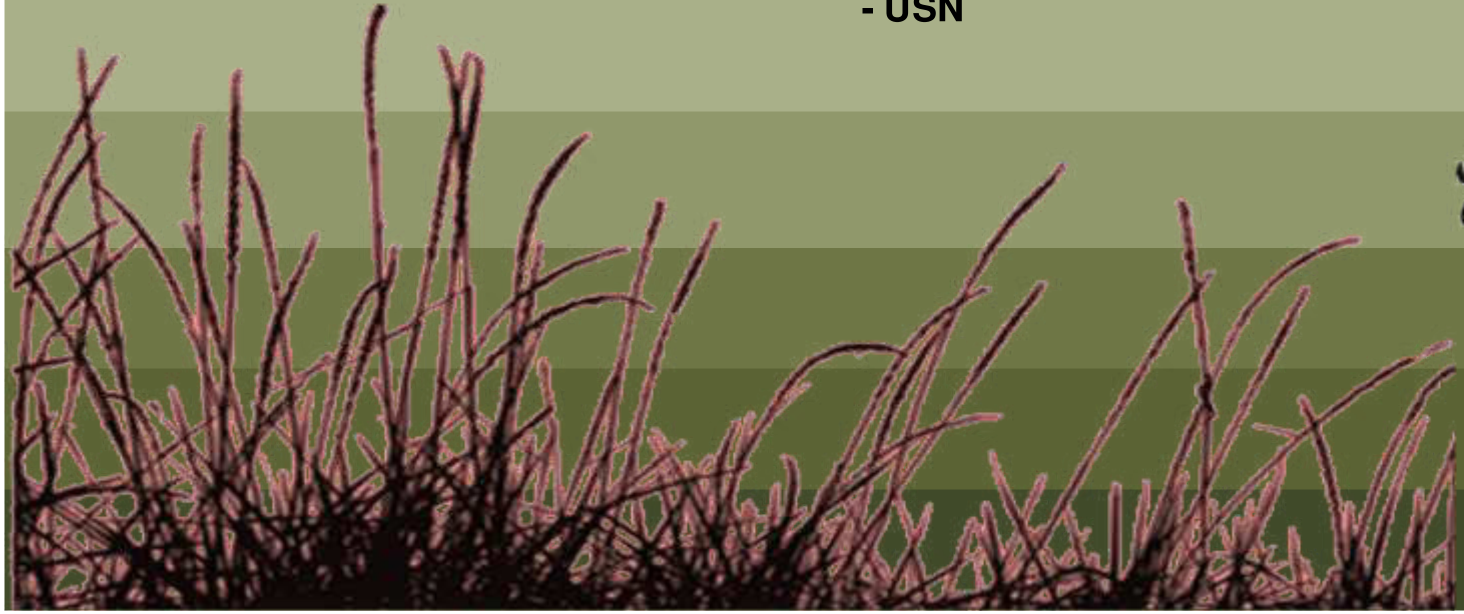
Project Name	Status	Project
Environmental Management Plan(EMP)		
Heidelberg X 12	ROD	EMP
Monavoni Shopping Centre	Completed	EMP
Forest Hill Development	Completed	EMP
Weltevreden Farm 105KQ	Completed	EMP+EIA
Raslouw Holding 93	Completed	EMP+BA
Durley Development	Completed	EMP+BA
Rooihuiskraal North X 28	Completed	EMP
Rehabilitation Plan		
Norwood Mall/Sandspruit	In Progress	Rehabilitation
Project Shelter Heidelberg	In Progress	Rehabilitation
Sagewood Attenuation Pond	ROD	Rehabilitation
Velmore Hotel	Completed	Rehabilitation
Grace Point Church	Completed	Rehabilitation
Mmamelodi Pipeline	Completed	Rehabilitation
Visual Impact Assessment		
Swatzkop Industrial Developme	Completed	Assessment +DFA
Erasmia	Completed	Assessment
Signage Application		
Menlyn Advertising	Completed	Signage
The Villa Mall	Completed	Signage+EMP+BA

07 Current Environmental Projects

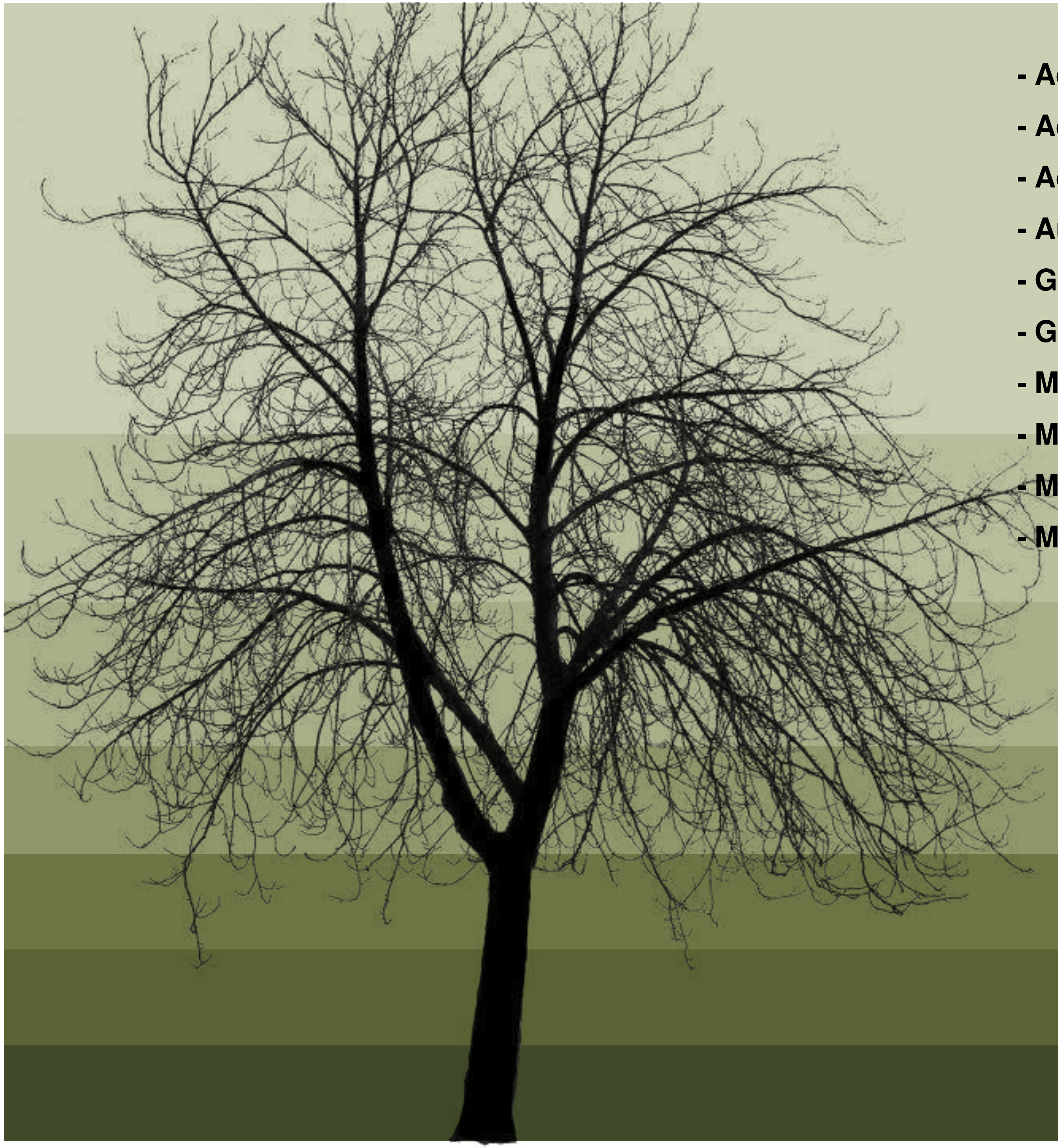
074 EMP, Rehabilitation , Waste Management & Signage Application

08 Indicative Clients

- Billion Property Group
- Cavaleros Developments
- Centro Developers
- Chaimberlains
- Chieftain
- Century Property Group
- Coca Cola
- Elmado Property Development
- Flanagan & Gerard
- Gautrans
- Hartland Property Group
- Moolman Group
- MTN
- M&T Development
- Old Mutual
- Property Investment Company
- Petroland Developments
- RSD Construction
- SAND
- Stephan Parsons
- Twin City Developments
- Urban Construction
- USN



09 Tools



- Adobe Illustrator CS3
- Adobe Photoshop CS3
- Adobe InDesign CS3
- AutoCAD
- Google SketchUP
- GIS
- Microsoft Office Word
- Microsoft Office Excel
- Microsoft Office Publisher
- Microsoft Office Power Point

Bokamoso

Qualifications And Experience In The Field Of Environmental Planning And Management (Lizelle Gregory (Member Bokamoso)):

Qualifications:

*-Qualified as **Landscape Architect** at UP 1991;*
*-Qualified as **Professional Landscape Architect in 1997**;*
*-A Registered Member at The **South African Council for the Landscape Architect Profession (SACLAP)** with Practise Number: **PrLArch97078**;*
*- A Registered Member at the **International Association for Impact Assessment Practitioners (IAIA)**;*
*- Qualified as an **Environmental Auditor in July 2008** and also became a Member of the International Environmental Management Association (IEMAS) in 2008.*

Working Experience:

-Worked part time at Eco-Consult – 1988-1990;
*-Worked part time at **Plan Associates as Landscape Architect in training** – 1990-1991;*
*-Worked as Landscape Architect at **Environmental Design Partnership (EDP)** from 1992 - 1994*
*-Practised under **Lizelle Gregory Landscape Architects** from 1994 until 1999;*
*-**Lectured** at Part-Time at **UP** (1999) – Landscape Architecture and **TUT** (1998- 1999)- Environmental Planning and Plant Material Studies;*
*-Worked as **part time Landscape Architect and Environmental Consultant at Plan Associates** and **managed their environmental division for more that 10 years** – 1993 – 2008 (assisted the **PWV Consortium** with various road planning matters which amongst others included environmental Scans, EIA's, Scoping reports etc.)*
*-Renamed business as **Bokamoso in 2000** and is the only member of Bokamoso Landscape Architects and Environmental Consultants CC;*
*-**More than 20 years experience in the compilation of Environmental Reports,** which amongst others included the compilation of various **DFA Regulation 31 Scoping Reports**, EIA's for EIA applications in terms of the applicable environmental legislation, Environmental Management Plans, Inputs for Spatial Development Frameworks, DP's, EMF's etc. Also included EIA Application on and adjacent to mining land and slimes dams (i.e. Brahm Fisherville, Doornkop)*

Qualifications And Experience In The Field Of Landscape Architecture (Lizelle Gregory (Member Bokamoso)):

Landscape Architecture:

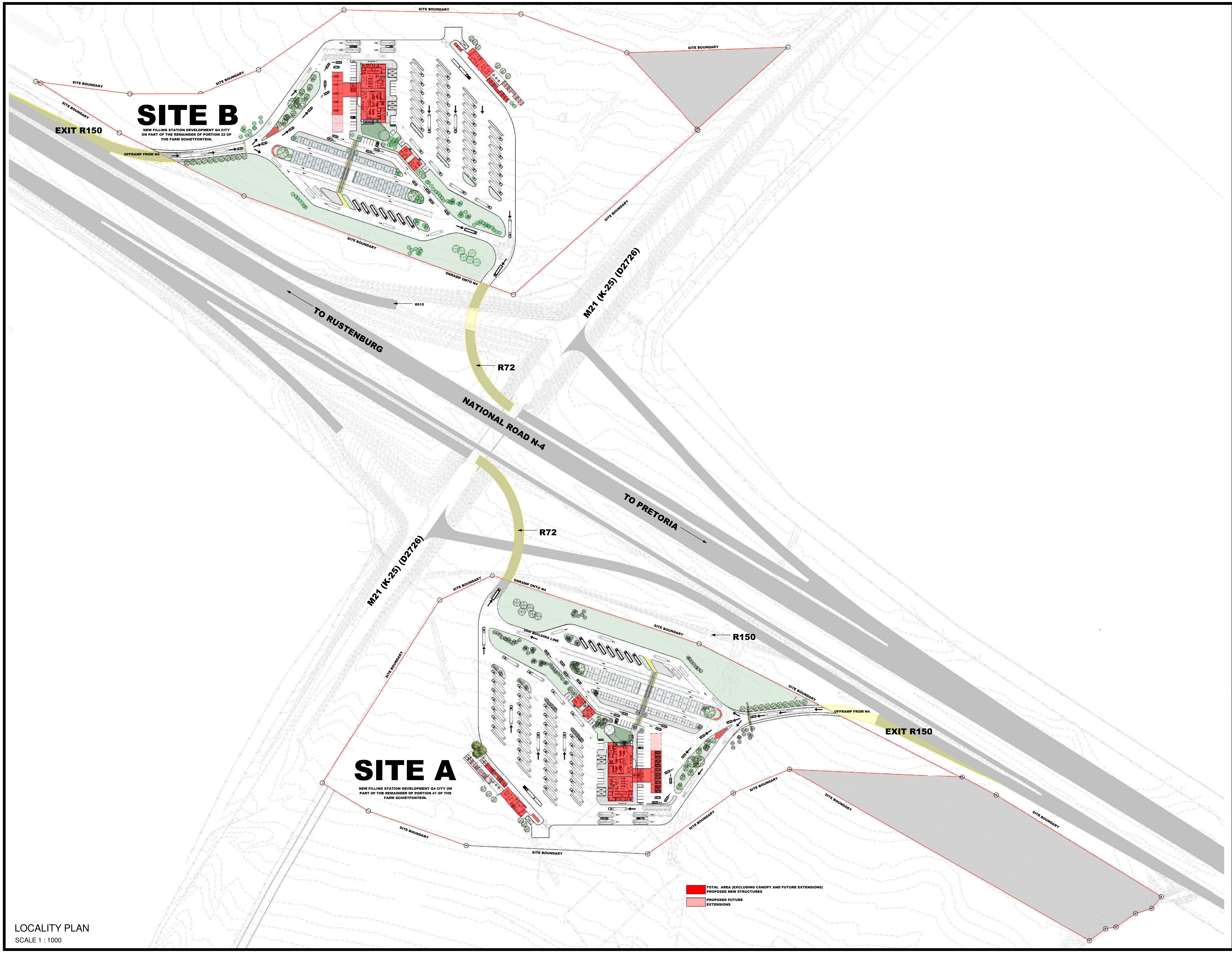
-Compiled landscape and rehabilitation plans for more than 22 years.

The most significant landscaping projects are as follows:
-Designed the Gardens of the Witbank Technicon (a branch of TUT). Also supervised the implementation of the campus gardens (2004);
-Lizelle Gregory was the Landscape Architect responsible for the paving and landscape design at the UNISA Sunnyside Campus and received a Corobrick Golden Award for the paving design at the campus (1998-2004);
-Bokamoso assisted with the design and implementation of a park for the City of Johannesburg in Tembisa (2010);
-The design and implementation of the landscape gardens (indigenous garden) at the new Coca-Cola Valpre Plant (2012-2013);
-Responsible for the rehabilitation and landscaping of Juksei River area at the Norwood Shopping Mall (johannesburg) (2012-2013);
-Designed and implemented a garden of more than 3,5ha in Randburg (Mc Arthurpark). Bokamoso also seeded the lawn for the project (more than 2,5 ha of lawn successfully seeded) (1999);
-Bokamoso designed and implemented more than 800 townhouse complex gardens and submitted more than 500 Landscape Development Plans to CTMM for approval (1995 – 2013);
-Assisted with Landscape Designs and the Masterplan at Eco-Park (M&T Developments) (2005-2011);
-Bokamoso designed and implemented an indigenous garden at an office park adjacent to the Bronberg. In this garden it was also necessary to establish a special garden for the Juliana Golden Mole. During a recent site visit it was established that the moles are thriving in this garden. Special sandy soils had to be imported and special indigenous plants had to be established in the natural section of the garden.

-Lizelle Gregory also owns her own landscape contracting business**. For the past 20 years she trained more than 40 PDI jobless people (sourced from a church in Mamelodi)** to become landscape contracting workers. All the workers are (on a continuous basis) placed out to work at nurserys and other associated industries;
-Over the past 20 years the Bokamoso team compiled more than 800 landscape development plans and also implemented most of the gardens. Bokamoso also designed and implemented the irrigation for the gardens (in cases where irrigation was required). Lizelle regarded it as important to also obtain practical experience in the field of landscape implementation.

Layout Plan

Annexure E



🟥 TOTAL AREA (EXCLUDING CANOPY AND FUTURE EXTENSIONS) PROPOSED NEW STRUCTURES

▨ PROPOSED FUTURE EXTENSIONS

LOCALITY PLAN

SCALE 1 : 1000

ALLE TEKENINGE EN MATES MOET NAGESIEN EN VERGELYK WORD VOORDAT MATERIAAL BESTEL OF MET ENIGE BOUWERK
BEGIN WORD. ENIGE VERSKILLE MOET DADELIK ONDER DIE AANDAG VAN DIE ARGITEK GEBRING WORD. KOPIE-REG WORD VOORBEHOU OP ALLE TEKENINGE EN ONTWERPE.

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ORDERING OR BUILDING WORK COMMENCES. ANY DIFFERENCES MUST BE BROUGHT TO THE ATTENTION OF THE ARCHITECT IMMEDIATELY. COPYRIGHT IS RESERVED ON ALL DRAWINGS AND DESIGNS.

NOTES:

SITE DATA - SITE A

ERF NO.	**REMAINDER OF PROTION 41 OF THE FARM SCHIETFONTEIN**
ZONING	
SITE AREA	83 433.61m²
BUILDING LINES	AS PER CONDITIONS OF ESTABLISHMENT

BUILDING AREA	**GROSS AREA**	**COVERAGE**
STAFF ABLUTIONS	98.9m²	98.9m²
PUBLIC AREAS	138.7m²	138.7m²
RESTAURANT AND TAKE-AWAY F.O.H & B.O.H AREAS	386.6m²	386.6m²
SERVICE AREAS	103.27m²	103.27m²
MANAGER'S UNITS	153.2m²	153.2m²
CONVENIENCE STORE	284.7m²	284.7m²
FORECOURT (CANOPY & LINK)		494m²
TOKEN ABLUTIONS	115.3m²	115.3m²
TRUCKS - CANTEEN AND KITCHEN	212.2m²	212.2m²
TOTAL	**1 492.87m²**	**1 986.87m²**
URBAN PLANNING REQUIREMENTS	**ALLOWED**	**ACTUAL**
COVERAGE	UNKNOWN%	**2.34%**
FLOOR-AREA RATIO	TO ZONING CERTIFICATE	
PARKING	**REQUIRED**	**PROVIDED**
		144 CAR PARKING BAYS FOR SHOP INCLUDING 2No. 'DISABLED' PARKING SPACES AND 4No. COVERED PARKING BAYS
		35 TRUCK PARKING BAYS
		7 BUS PARKING BAYS
		TOTAL 186 PARKING BAYS PROVIDED
HEIGHT RESTRICTIONS	**ALLOWED**	**ACTUAL**
BUILDING	-	-

SITE DATA - SITE B

ERF NO.	**REMAINDER OF PROTION 41 OF THE FARM SCHIETFONTEIN**
ZONING	
SITE AREA	75 229.234m²
BUILDING LINES	AS PER CONDITIONS OF ESTABLISHMENT

BUILDING AREA	**GROSS AREA**	**COVERAGE**
STAFF ABLUTIONS	98.9m²	98.9m²
PUBLIC AREAS	138.7m²	138.7m²
RESTAURANT AND TAKE-AWAY F.O.H & B.O.H AREAS	386.6m²	386.6m²
SERVICE AREAS	103.27m²	103.27m²
MANAGER'S UNITS	153.2m²	153.2m²
CONVENIENCE STORE	284.7m²	284.7m²
FORECOURT (CANOPY & LINK)		494m²
TOKEN ABLUTIONS	115.3m²	115.3m²
TRUCKS - CANTEEN AND KITCHEN	212.2m²	212.2m²
TOTAL	**1 492.87m²**	**1 986.87m²**
URBAN PLANNING REQUIREMENTS	**ALLOWED**	**ACTUAL**
COVERAGE	UNKNOWN%	**2.64%**
FLOOR-AREA RATIO	TO ZONING CERTIFICATE	
PARKING	**REQUIRED**	**PROVIDED**
		144 CAR PARKING BAYS FOR SHOP INCLUDING 2No. 'DISABLED' PARKING SPACES AND 4No. COVERED PARKING BAYS
		35 TRUCK PARKING BAYS
		7 BUS PARKING BAYS
		TOTAL 186 PARKING BAYS PROVIDED
HEIGHT RESTRICTIONS	**ALLOWED**	**ACTUAL**
BUILDING	-	-

WYSIGINGS - REVISIONS

No. NR.	DATUM DATE	BESKRYWING - DESCRIPTION

HIERDIE TEK. VERVANG TEK. No.
THIS DWG. REPLACE DWG No.

34 BOUVARDIA STREET
LYNWOODRIDGE
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PO BOX 75874
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PRETORIA

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NEW FILLING STATION DEVELOPMENT Q4 CITY ON PART OF THE REMAINDER OF PORTION 22 & 41 OF THE FARM SCHIETFONTEIN.

TEKENING - DRAWING
LOCALITY PLAN

SKETCHPLANS

PLOT INFO
2015/05/06 02:03:42 PM

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L.VDW / R.C

NAGESIEN/CHECKED
R.C

TEK. No. DWG. No.
14-01 / 100

REGISTERED ARCHITECT:
H.L.BOTHA SACAP Regno: 3755

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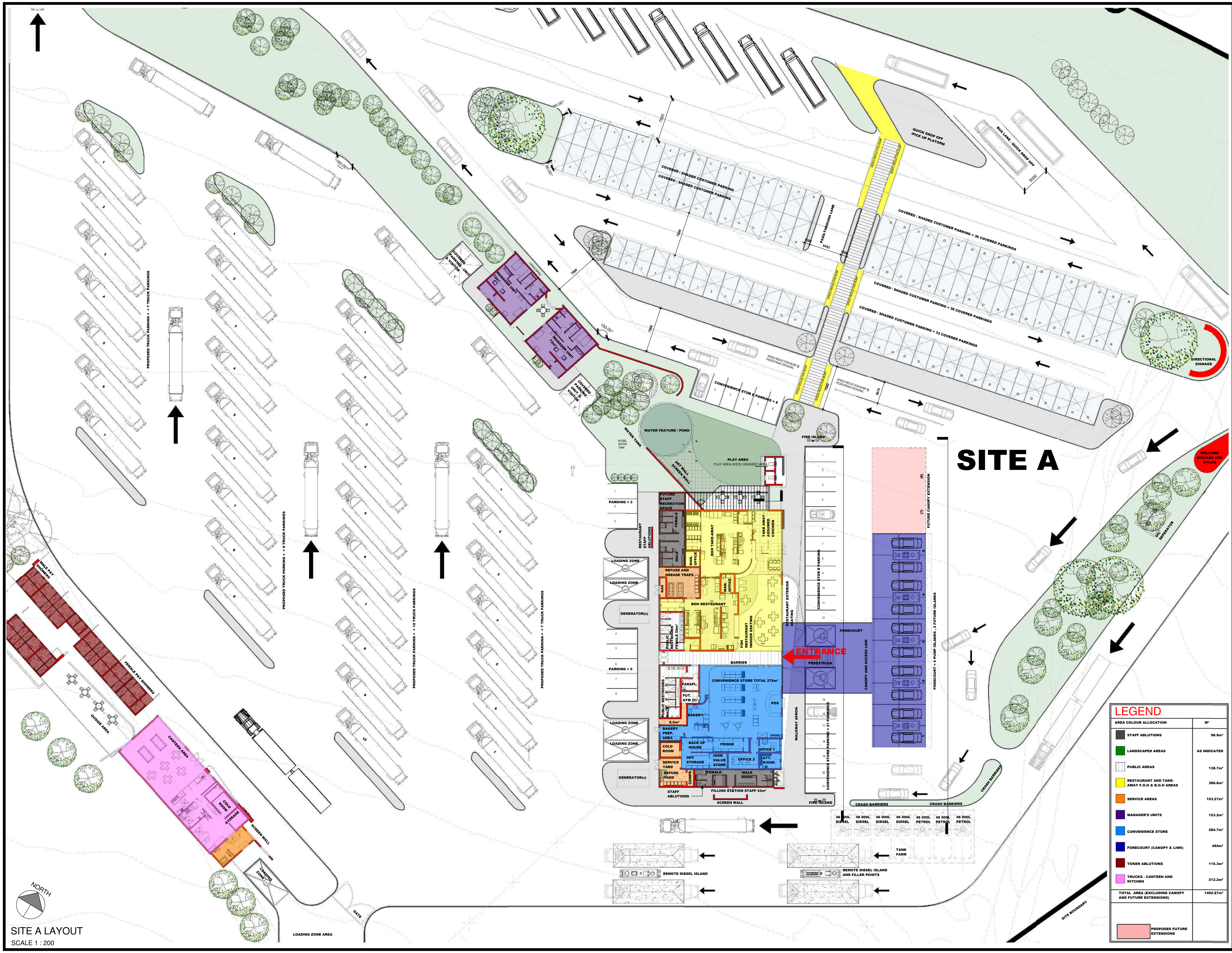

ALLE TEKENINGE EN MATES MOET NAGESIEN EN VERGELYK WORD VOORDAT MATERIAAL BESTEL OF MET ENIGE BOUWERK BEGIN WORD. ENIGE VERSKILLE MOET DADELIK ONDER DIE AANDAG VAN DIE ARGITEK GEBRING WORD. KOPIE-REG WORD VOORBEHOU OP ALLE TEKENINGE EN ONTWERPE.

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NOTES:

SITE DATA - SITE A

ERF NO.	**REMAINDER OF PROTION 41 OF THE FARM SCHIETFONTEIN**
ZONING	
SITE AREA	83 433.61m²
BUILDING LINES	AS PER CONDITIONS OF ESTABLISHMENT

BUILDING AREA	**GROSS AREA**	**COVERAGE**
STAFF ABLUTIONS	98.9m²	98.9m²
PUBLIC AREAS	138.7m²	138.7m²
RESTAURANT AND TAKE-AWAY F.O.H & B.O.H AREAS	386.6m²	386.6m²
SERVICE AREAS	103.27m²	103.27m²
MANAGER'S UNITS	153.2m²	153.2m²
CONVENIENCE STORE	284.7m²	284.7m²
FORECOURT (CANOPY & LINK)		494m²
TOKEN ABLUTIONS	115.3m²	115.3m²
TRUCKS - CANTEEN AND KITCHEN	212.2m²	212.2m²
TOTAL	**1 492.87m²**	**1 986.87m²**
URBAN PLANNING REQUIREMENTS	**ALLOWED**	**ACTUAL**
COVERAGE	UNKNOWN%	**2.34%**
FLOOR-AREA RATIO	TO ZONING CERTIFICATE	
PARKING	**REQUIRED**	**PROVIDED**
		144 CAR PARKING BAYS FOR SHOP INCLUDING 2No. 'DISABLED' PARKING SPACES AND 4No. COVERED PARKING BAYS
		35 TRUCK PARKING BAYS
		7 BUS PARKING BAYS
		TOTAL 186 PARKING BAYS PROVIDED
HEIGHT RESTRICTIONS	**ALLOWED**	**ACTUAL**
BUILDING	-	-

WYSIGINGS - REVISIONS

No. NR.	DATUM DATE	BESKRYWING - DESCRIPTION

HIERDIE TEK. VERVANG TEK. No.
THIS DWG. REPLACE DWG No.

LEGEND

AREA COLOUR ALLOCATION	M²
■ STAFF ABLUTIONS	98.9m²
🟩 LANDSCAPED AREAS	AS INDICATED
▥ PUBLIC AREAS	138.7m²
🟨 RESTAURANT AND TAKE-AWAY F.O.H & B.O.H AREAS	386.6m²
🟧 SERVICE AREAS	103.27m²
🟪 MANAGER'S UNITS	153.2m²
🟦 CONVENIENCE STORE	284.7m²
🟦 FORECOURT (CANOPY & LINK)	494m²
🟥 TOKEN ABLUTIONS	115.3m²
🟪 TRUCKS - CANTEEN AND KITCHEN	212.2m²
TOTAL AREA (EXCLUDING CANOPY AND FUTURE EXTENSIONS)	1492.87m²
🟥 PROPOSED FUTURE EXTENSIONS	

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SKEMA - PROJECT
NEW FILLING STATION DEVELOPMENT Q4 CITY ON PART OF THE REMAINDER OF PORTION 41 OF THE FARM SCHIETFONTEIN.

TEKENING - DRAWING
PROVISIONAL SITE LAYOUT - SITE A

SKETCHPLANS

PLOT INFO
2015/05/06 02:00:10 PM

TEK. No. DWG. No.
14-01 / 101

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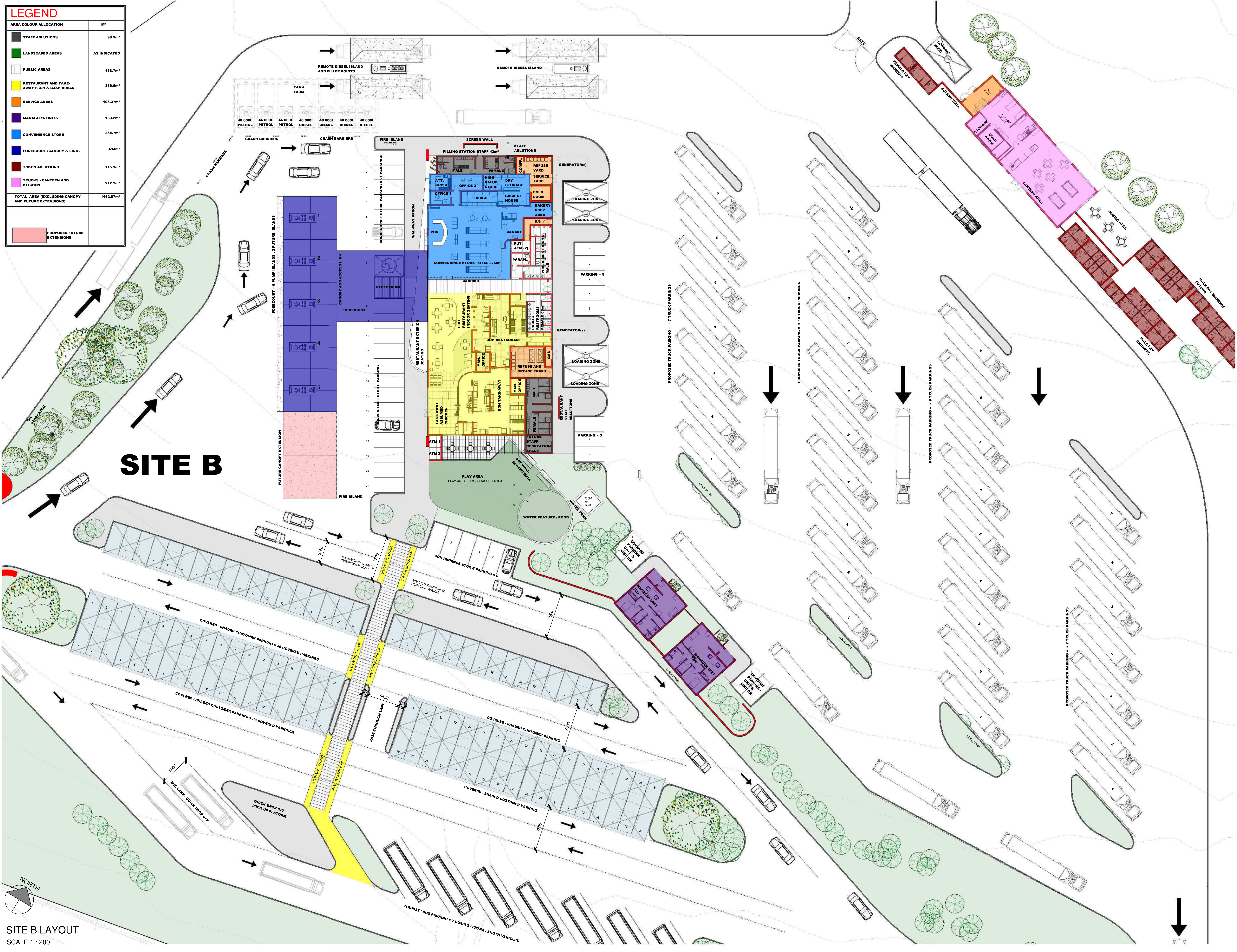

SITE B LAYOUT

SCALE 1 : 200

LEGEND

AREA COLOUR ALLOCATION		M²
■	STAFF ABLUTIONS	98.9m²
🟩	LANDSCAPED AREAS	AS INDICATED
▥	PUBLIC AREAS	138.7m²
🟨	RESTAURANT AND TAKE-AWAY F.O.H & B.O.H AREAS	386.6m²
🟧	SERVICE AREAS	103.27m²
🟪	MANAGER'S UNITS	153.2m²
🟦	CONVENIENCE STORE	284.7m²
🟦	FORECOURT (CANOPY & LINK)	494m²
🟥	TOKEN ABLUTIONS	115.3m²
🟪	TRUCKS - CANTEEN AND KITCHEN	212.2m²
TOTAL AREA (EXCLUDING CANOPY AND FUTURE EXTENSIONS)		1492.87m²
🟥	PROPOSED FUTURE EXTENSIONS	

ALLE TEKENINGE EN MATES MOET NAGESIEN EN VERGELYK WORD VOORDAT MATERIAAL BESTEL OF MET ENIGE BOUWERK BEGIN WORD. ENIGE VERSKILLE MOET DADELIK ONDER DIE AANDAG VAN DIE ARGITEK GEBRING WORD. KOPIE-REG WORD VOORBEHOU OP ALLE TEKENINGE EN ONTWERPE.

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NOTES:

SITE DATA - SITE B

ERF NO.	REMAINDER OF PROTION 41 OF THE FARM SCHIETFONTEIN
ZONING	
SITE AREA	75 229.234m²
BUILDING LINES	AS PER CONDITIONS OF ESTABLISHMENT

BUILDING AREA	GROSS AREA	COVERAGE
STAFF ABLUTIONS	98.9m²	98.9m²
PUBLIC AREAS	138.7m²	138.7m²
RESTAURANT AND TAKE-AWAY F.O.H & B.O.H AREAS	386.6m²	386.6m²
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TOTAL	**1 492.87m²**	**1 986.87m²**

URBAN PLANNING REQUIREMENTS	ALLOWED	ACTUAL
COVERAGE	UNKNOWN%	**2.64%**
FLOOR-AREA RATIO	TO ZONING CERTIFICATE	

PARKING	REQUIRED	PROVIDED
		144 CAR PARKING BAYS FOR SHOP INCLUDING 2No. 'DISABLED' PARKING SPACES AND 4No. COVERED PARKING BAYS
		35 TRUCK PARKING BAYS
		7 BUS PARKING BAYS
		TOTAL 186 PARKING BAYS PROVIDED

HEIGHT RESTRICTIONS	ALLOWED	ACTUAL
BUILDING	-	-

WYSIGINGS - REVISIONS

No. NR.	DATUM DATE	BESKRYWING - DESCRIPTION

HIERDIE TEK. VERVANG TEK. No.
THIS DWG. REPLACE DWG No.

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SKEMA - PROJECT
NEW FILLING STATION DEVELOPMENT Q4 CITY ON PART OF THE REMAINDER OF PORTION 22 OF THE FARM SCHIETFONTEIN.

TEKENING - DRAWING
PROVISIONAL SITE LAYOUT - SITE B

SKETCHPLANS

PLOT INFO
2015/05/06 02:02:14 PM

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L.VDW / R.C	R.C	14-01	102

REGISTERED ARCHITECT:
H.L.BOTHA SACAP Regno: 3755

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Specialist Reports

Annexure F

Engineering Geological Investigation

Annexure F1

Engineering Geological Investigation
for the proposed development of the
Q4 FUEL CITY
to be located on
Portions 22 and 41 of the farm
Schietfontein 437 – JQ –
North West Province

DATE : February 2014
REPORT NO : LM 1016/14

Holland-Muter & Associates CC
Reg. No: 2001/000676/23

Engineering and Environmental Geologists
P.O. Box 1450 Faerie Glen 0043
Tel: (012) 991-2695 Fax: (012) 991-0796 Cell: 083 455 2610
e-mail: lhmuter@lantic.net

ABSTRACT

This report details and comments on the results of an engineering geological investigation conducted for the Q4 Fuel City to be located on Portions 22 and 41 of the farm Schietfontein 437-JQ in the Northwest province. The project was conducted for Messrs. Techworld Consulting, the developers of the project.

The aim of the study was to undertake a geotechnical investigation in terms of the normal requirements for commercial developments. The information gained during the investigation was intended to serve as an input to the planning and initial design phases for a filling station and related facilities development.

INDEX

APPENDIX INDEX

FIGURES

ENGINEERING GEOLOGICAL INVESTIGATION FOR THE PROPOSED DEVELOPMENT OF THE Q4 FUEL CITY TO BE LOCATED ON PORTIONS 22 AND 41 OF THE FARM SCHIETFONTEIN 437-JQ IN THE NORTH-WEST PROVINCE

REPORT NO : LM 1016/14, February 2014
Our Ref : HM&A Techworld Consulting N4 Filling Stations
NO I RE

1. INTRODUCTION

This report details and comments on the results of an engineering geological investigation conducted for the Q4 Fuel City to be located on Portions 22 and 41 of the farm Schietfontein 437-JQ in the Northwest province. The project was conducted for Messrs. Techworld Consulting, the developers of the project.

The aim of the study was to undertake a geotechnical investigation in terms of the normal requirements for commercial developments in which particular attention was devoted to the possible presence of problem soils, perched water tables and shallow bedrock. The information gained during the investigation was intended to serve as an input to the planning and initial design phases for the filling stations and related facilities. The results of the investigation will enable design and construction precautions to be taken for light structures, thus reducing the risk for damage in those areas where such conditions occur.

2. AVAILABLE INFORMATION

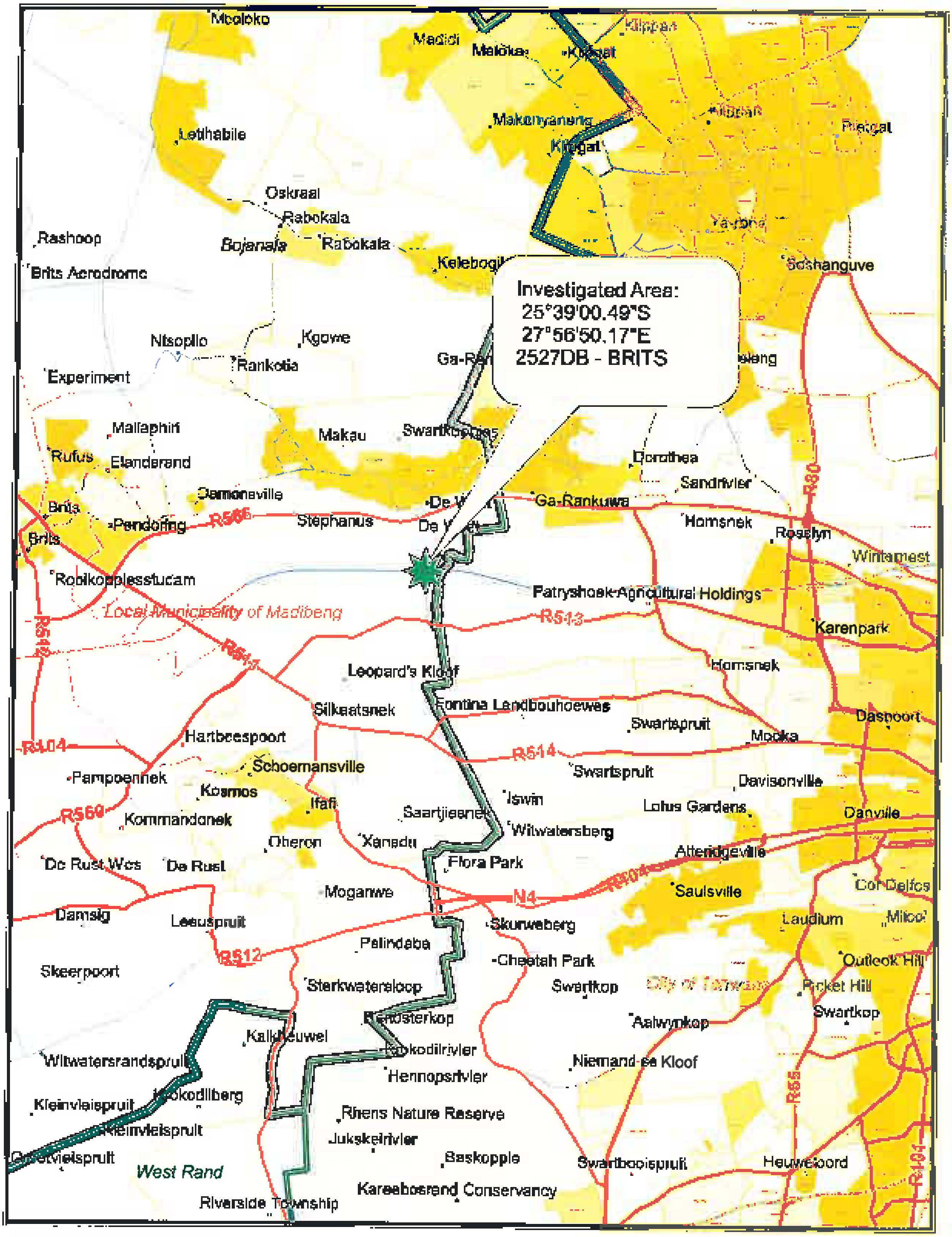
The following information has been used in the investigation and assessment of the designated site namely: -

- Topographical map to scale 1:50 000; Sheet 2527 DB BRITS.
- Geological map: Sheet 2526 RUSTENBURG at a scale of 1:250 000.
- Google Map

3. SITE DESCRIPTION

The proclaimed terrain consists of two separate sites situated on either side of the N4 freeway at the on and off-ramp located immediately east of the Brits toll plaza (See Figure 1: Locality Map).

Portion 22 of the farm Schietfontein covers approximately 13,4 hectares and is situated on the northern side of the freeway and is consequently bounded in the south by the freeway, to the east by the M21 towards Ga-Rankuwa. The northern boundary of the terrain runs diagonally from the north eastern edge to the south western edge of the site's boundaries, creating a boundary which is not bounded by any physical landform or feature, but rather only runs through the farm on which the site is located.



Investigated Area:
25°39'00.49"S
27°56'50.17"E
2527DB - BRITS

Legend

✱ Investigated Area

Scale 1:250000

0 2 4 6 8 10 km

HOLLAND-MUTER & ASSOCIATES CC; P.O. BOX 1450; FAERIE GLEN; 0043

FIGURE 1 : LOCALITY MAP : NORTH WEST PROVINCE :
Q4 FUEL CITY

DATE: FEBRUARY 2014

DRAWING NR : 101

The terrain slopes very little to the north with some small local undulations contained within the grounds of the terrain. The entire site is densely populated with trees and shrubs with grass covering the land in between. Concrete foundations of demolished buildings occur on the eastern part of the terrain as well as the western corner. There is also building rubble strewn in a few isolated areas surrounding the building remnants. A small borrow pit is located in the south eastern corner of the site. No rock outcrops were observed on the site and no water conditions were encountered during the investigation. The site does not have a discernable slope but it can be derived that drainage would be towards the north by means of sheetwash.

Portion 41 of the farm Schietfontein covers approximately 8,8 hectares and is situated on the southern side of the N4 freeway. The freeway thus creates the northern boundary of the site and the M21 road bounds the site to the west. The southern boundary is formed by a diagonal line that connects the eastern end of the northern boundary to the southern end of the western boundary. There is no natural or physical feature that constitutes the southern boundary. The site has a very gentle slope towards the north and is drained mainly by means of sheetwash towards the north and east towards the river that runs in a northerly direction along the eastern side of the terrain. No wet conditions were observed during the investigation. The eastern side of the terrain consists of a grass field with the eastern corner being populated with trees. The western part of the site is also populated with trees with grass covering the ground surface. A dry river is situated immediately east of the investigated area and runs in a north-south direction. No rock outcrops were encountered on the site.

4. INVESTIGATION METHODS AND PROCEDURES

4.1 FIELDWORK

The soil conditions were investigated by means of nineteen trial pits, ranging in depth from 1,8m to 2,7m below the present ground surface. Eight trial pits were dug on Portion 41 while eleven trial pits were dug on Portion 22.

The trial pits were excavated with a 56 KW CATERPILLAR backhoe while each trial pit was entered and inspected by an engineering geologist who described the soil profiles using the visual and tactile procedures advocated by Jennings et al (1973).

Detail descriptions of the trial pit profiles are provided in Appendix I. The test pit positions are indicated on the appended Soil Zone and Land-use Maps (Figures 2 and 3 respectively, Appendix IV).

4.2 LABORATORY TESTING

The laboratory testing performed consists of Indicator tests carried out on representative disturbed soil samples. These tests were done for accurate classification and identification purposes of the various soil horizons.

The detailed test results appear in Section 5.3.3 (See also Appendix II).

5. GEOLOGY AND SOILS

5.1 GEOLOGY - **See Figure 4, Appendix IV: Regional Geology Map**

Table I is a summary of the stratigraphic sequence occurring on the terrain namely:

TABLE I : STRATIGRAPHIC SEQUENCE

LITHOLOGY	FORMATION	GROUP	SEQUENCE
Pyroxenite/Dunite/Norite	Kroondal norite	Rustenburg Layered Suite	Bushveld Igneous Complex
Sandstone	Rayton	Pretoria	Transvaal

The terrain is situated in an area that overlies the contact region between the sedimentary rocks of the Pretoria group, which are located to the south of the terrain and the Igneous rocks of the Bushveld complex which are located to the north of the terrain. Further to the west, two major faults run parallel through the Pretoria group and continue through the Bushveld complex in a north-south direction. A few small scale faults also manifest in areas surrounding the terrain.

Since the geological materials in the area under investigation fall within a region with a Weinert N-value of 2.4, a distinct weathering process occurs on these materials.

5.2 ROCK

5.2.1 Norite

The norites occur as very hard, greenish grey to black, coarse to fine grained, interbedded rocks when fresh and weather to an olive to brownish red, silty clay or a black, highly plastic clay. The rocks are fairly deeply weathered.

5.2.2 Quartzite

When the quartzite is in its fresh state, it occurs as a hard, yellowish brown to light grey, medium to coarse grained, thickly bedded, jointed rock that dips toward the north. The quartzite weathers to reddish brown, silty sands and gravels.

5.3 SOILS

The soils occurring on the terrain comprise mainly of the following types: -

- Transported material consisting of thick horizons of colluvium.
- Residual soils comprising of decomposed and highly weathered sandstone.

The general soil profile consists of thick horizons of transported soils that have been derived from the nearby Magaliesberg mountain ridge and have textures varying between sandy clay and clayey sand. Alluvial deposits occur on the floodplain area of the river that runs on the eastern side of the investigated site on Portion 41. The terrain has fairly good internal drainage with only three trial pits that encountered pedogenic horizons.

The following table is a summary of the diagnostic soil horizons as well as the most important geomechanical properties of the soils that were encountered in the trial pits. The table was compiled after detail evaluation of all the relevant data obtained from field observations, soil profile descriptions, excavation tempo's, refusal depths as well as the laboratory test results.

5.3.1 Diagnostic Soil Horizons

A - Horizon = Transported materials
B - Horizon = Colluvium
PM - Horizon = Pebble Marker
C - Horizon = Residual Soil
R - Horizon = Weathered Rock

TABLE II: DIAGNOSTIC SOIL HORIZONS

SOIL HORIZON	DESCRIPTION
A1	Slightly moist, dusky red, intact, soft, clayey SAND. Colluvium with abundant roots.
A2	Slightly moist, dusky red, intact, firm, sandy CLAY. Colluvium.
A3	Slightly moist, greyish dark brown, intact, soft, clayey SAND. Alluvium.
B1/1	Slightly moist, dusky red, intact, soft-firm, sandy CLAY. Colluvium.
B1/2	Slightly moist, dusky red, intact-fissured, soft-firm, clayey SAND. Colluvium.
B1/3	Slightly moist, dusky red, intact, firm, clayey SAND. Colluvium.
B2/1	Slightly moist, dark reddish orange, intact, soft-firm, silty clayey SAND. Colluvium.
PM	Dry, reddish dark brown mottled black and yellow, intact, soft-firm, clayey SAND with abundant Ferricrete nodules and sub-angular quartzite pebbles and cobbles. Pebble Marker.
R1	Dark red, highly to moderately weathered rock SANDSTONE.

5.3.2 Soil Description

The trial pitting and results of the soil profiling indicated that the area is underlain by transported soils consisting of hillwash and colluvium. These materials are underlain by residual soils or in situ rocks at depth. The base of the transported zone could not be definitely established as the trial pits did not reach such depths, except for trial pits TP6 and TP10 which were terminated on the pebble marker horizon. Trial pit TP9, which is situated on sandstone, encountered a pebble marker horizon at shallow depth. The mainly sandy composition of the transported materials reflects the nature and types of rock from which they have been derived.

5.3.2.1 Soil Mapping Unit

Four distinctive soil mapping units occur over the entire area as presented in Figure 2, Appendix IV: Soil Zone Map with Trial Pits and have the following characteristic soil profiles:-

SOIL ZONE I(a) – **See Appendix III : Photographs**

This soil zone generally consists of a top layer of transported clayey SAND colluvium to an average depth of 0,5m which is underlain by soft colluvial sandy silty CLAY to depths of 2m and becoming more firm at depth. A typical soil profile of this zone is as follows:

0,0m - 0,7m	Slightly moist, dusky red, intact, soft, clayey SAND. Colluvium with abundant roots.
0,7m – 2,2m	Slightly moist, dusky red, intact, soft-firm, sandy CLAY. Colluvium.

SOIL ZONE I(b) – **See Appendix III : Photographs**

This zone has a firm sandy CLAY top horizon to an average depth of 0,5m which is underlain by soft sandy CLAY materials to an average depth of 1,8m. At depth, the material tends to become more firm again. Trial Pit TP10 intersected a horizon comprising of ferricrete directly overlying a pebble marker horizon at 1,8m. A typical soil profile for this zone is as follows:

0,0m - 0,7m	Slightly moist, dusky red, intact, firm, sandy CLAY. Colluvium.
0,7m - 1,4m	Slightly moist, dusky red, intact, soft-firm, sandy CLAY. Colluvium.
1,4m – 2,2m	Dry, reddish dark brown mottled black and yellow, intact, soft-firm clayey SAND with abundant Ferricrete nodules and sub-angular quartzite pebbles and cobbles.

SOIL ZONE I(c) – See **Appendix III : Photographs**

This zone has a fissured and soft clayey SAND horizon which is underlain by firm sandy CLAY material from 0,4m to the bottom of the trial pit. A typical soil profile for this zone is as follows:

0,0m – 0,5m	Slightly moist, dusky red, intact, soft, clayey SAND. Colluvium with abundant roots.
0,5m – 1,5m	Slightly moist, dusky red, intact, soft-firm, sandy CLAY. Colluvium.
1,5m – 2,0m	Dry, reddish dark brown mottled black and yellow, intact, soft-firm, clayey SAND with abundant Ferricrete nodules and sub-angular quartzite pebbles and cobbles.

SOIL ZONE II – See **Appendix III : Photographs**

In this zone, a thin cover of transported, soft, clayey SAND overlies a pebble marker horizon at 0,3m below surface. The pebble marker horizon consists of sub-angular quartzite pebbles and is underlain by soft clayey SAND. A typical soil profile of this zone is as follows:

0,0m – 0,3m	Slightly moist, dusky red, intact, soft, clayey SAND. Colluvium with abundant roots.
0,3m – 0,8m	Dry, reddish dark brown mottled black and yellow, intact, soft-firm clayey SAND with abundant Ferricrete nodules and sub-angular quartzite pebbles and cobbles.
0,8m – 2,0m	Dark red, highly to moderately weathered rock SANDSTONE.

SOIL ZONE III – See **Appendix III : Photographs**

This soil zone consists of a top layer of soft alluvial clayey SAND underlain by firm clayey SAND from an average depth of 0,6m to the bottom of the trial pit. A typical soil profile in this zone is as follows:

0,0m – 0,7m	Slightly moist, greyish dark brown, intact, soft, clayey SAND. Alluvium.
0,7m – 2,7m	Slightly moist, dusky red, intact-fissured, soft-firm, clayey SAND. Colluvium.

SOIL ZONE IV – See **Appendix III : Photographs**

This soil zone consists of a soft clayey SAND top horizon to an average depth of 0,4m below ground surface which is underlain by firm clayey SAND to depths in excess of 2,2m. A typical soil profile of this soil zone is as follows:

0,0m – 0,4m Slightly moist, dusky red, intact, <u>soft</u>, clayey SAND. Colluvium with abundant roots.
0,4m – 2,2m Slightly moist, dusky red, intact, <u>firm</u> clayey SAND. Colluvium.

5.3.3 Summary of the Geomechanical Properties

Table III is a summary of the mechanical parameters applicable to a diagnostic soil horizon.

TABLE III: GEOMECHANICAL PARAMETERS

SOIL HORIZON	TEST PIT & DEPTH (m)	INDICATOR TEST RESULTS					SOIL CLASS *	ACTIVITY
		LL	PI	LS	GM	CLAY %		
B1/1	TP3: 0,5 – 2,0	30	10	7,0	0,80	29	A-6(3)	Low
B1/1	TP8: 0,5 1,5	30	11	6,5	0,54	10	A-6(5)	Low
B1/1	TP13: 0,4 - 2,0	28	9	6,5	0,86	22	A-6(2)	Low
B1/2	TP14: 0,7 - 2,7	18	3	1,5	1,22	7	A-6-4(0)	Low

<u>ABBREVIATION</u>
LL = Liquid Limit
PI = Plasticity Index
* = PRA Soil Classification
LS = Linear Shrinkage
GM = Grading Modulus

The transported and residual soil horizons which will have an influence on the development can be described according to the PRA Soil Classification as low compressibility silts, with the exception of the B1/2 horizon which is found in Soil Zone III, which can be described according to the PRA soil Classification as sands and gravels with low plasticity silt fines. The tested samples have a low activity. The low activity materials can be considered as potentially compressible or even collapsible in places. All the soil materials can consolidate under pressure. From the grading analysis the coefficient of permeability of the different soil horizons indicates semi-pervious materials.

6. <u>GEOHYDROLOGY</u>

6.1 DRAINAGE

Both the terrains (Portions 22 and 41) are drained by means of sheetwash towards the north while Portion 41 also drains in an easterly direction towards the river that passes along the eastern boundary of the site.

During the time of the field investigation no surface water conditions were observed which will influence the proposed development.

6.2 WATER TABLE

No seepage water was encountered in any of the trial pits excavated on the site. During the more wet season and periods of higher rainfall, shallow water tables may exist in some of the trial pits which contained ferricrete horizons within the profile. No boreholes were observed on either terrain, therefore the depth to the water table could not be determined.

7. ENGINEERING GEOLOGICAL EVALUATION

7.1 GENERAL

Engineering geological evaluations of the terrain conditions within the study area can be done based on the field observations, study of the exposed soil profiles and soil test results. The engineering geological evaluation will be discussed according to the Land-use Classification Zones as indicated in Figure 3, Appendix IV.

7.2 SOILS ENCOUNTERED ON THE SITE

The greater part of both the northern and the southern sites are covered by thick layers of colluvial deposits of a sandy clay texture and generally soft to firm consistencies. Three trial pits encountered pebble marker horizons while another trial pit, (TP 9), encountered highly weathered in-situ sandstone. The transported materials reach average depths of more than 2m below the current ground surface with the exception of trial pit TP 9 which encountered in-situ sandstone at 0,8m below surface. Both the sites are underlain by norite with a small lens of sandstone manifesting in the region surrounding trial pit TP 9 on the northern terrain. Soils encountered in Soil Zone I(a, b and c), Figure 2, Appendix IV have characteristics that exhibit potential heave while soils encountered in Soil Zone II have potential collapsible characteristics. Soils from Soil Zone III and IV have potential compressible and collapsible material characteristics.

7.3 FOUNDATION CONDITIONS

7.3.1 General

Where buildings exerting high pressures on the soils are to be erected, a detailed geotechnical investigation should be executed to determine the underlying soil conditions so that an appropriate foundation can be designed.

Where the foundations straddle the soil/rock contact or the uneven weathered rock profile, this may result in point loads which can cause cracks in the residential structures if differential settlements of more than 5 mm occur. It is therefore recommended that where such conditions may occur appropriate foundations be utilized such as stiffened or cellular rafts for the envisaged structures. Alternatively, the loose materials adjacent to the rock should be excavated to a competent ground layer and backfilled to founding level with the same material compacted at 2% wet of optimum moisture content.

7.3.2 Potential Expansiveness

All the soil horizons, occurring on the site (determined by the Van der Merwe's (1964) method), indicate low activities although, due to the thicknesses of the horizons that exhibit potential expansiveness, greater amounts of heave can be expected at the surface in these areas.

7.3.3 Settlement

The soils in Soil Zones III and IV exhibit characteristics of potential compressibility and collapsibility. If these soils are fully saturated, they can consolidate under applied loads. This slow compaction subsidence can cause differential settlements which can be damaging to structures.

According to the laboratory analysis the transported and residual soil horizons are potentially compressible. Laterally, these soils occur along the southern boundary and eastern corner of the terrain that lies south of the N4 highway, namely Portion 41.

Thicknesses of the horizons that have settling characteristics range from 1,8m to more than 2,0m. The consistencies of the sandy materials are loose to medium dense and have intact structures. The field observed moisture content of the soils can be described as slightly moist.

7.3.4 Collapsing materials

The sandy material occurring in Soil Zone II may potentially collapse when subjected to loads if the materials become wet and pressed into a more dense state. Compaction or removal and recompaction or in-situ compaction should be considered during the construction phase. For shallow collapsible soil profiles, compaction using vibratory or impact rollers can be considered and has been used successfully for collapsible depths up to 1,5m. **It is advisable to consider raft foundations or soil rafts as the construction type for the super structures.**

7.3.5 Erodibility

The transported materials over the site vary between sandy clay and clayey sand. These materials are of low to medium plasticity making them susceptible to water erosion. It is therefore possible that stormwater will cause serious erosion constraints to the development should the veld grass and vegetation be removed during construction.

7.3.6 Slope Stability

No slope stability problems are foreseen but care should be taken during deep excavations especially in the vicinity of trial pits TP13 and TP14 as the sidewalls of excavations may collapse.

7.3.7 Bearing Capacities

Based on the field consistencies, the expected bearing capacity of the soil layers are as follows:-

TABLE V : SOIL CONSISTENCIES

SOIL HORIZON	THICKNESS OF SOIL HORIZON (m)	CONSISTENCY	UNCONFINED COMPRESSIVE STRENGTH (kPa)
A1	0,4 - 0,7	Soft	40-80
A2	0,5 - 0,7	Firm	80-160
A3	0,5 - 0,7	Soft	40 - 80
B1/1	0,7 - 1,7	Soft-firm	40-160
B1/2	0,4 - 1,8	Soft to firm	40 - 160
B1/3	1,8 - 2,0	Firm	80-160
B2/1	0,5	Soft to firm	40 - 160

The slightly moist conditions of the transported and residual materials occurring on the terrain make it possible that the various soil layers can support a load with a bearing capacity of up to 160 kPa or 17,5 kN/m^3. However, compression under load should be expected if the existing moisture content increases during periods of high precipitation or influence of perched water conditions. Therefore, if the allowable bearing pressure, determined by using a factor of 1,5 against failure, of the structures to be erected is exceeding 100 kPa or 5 kN/m^3 a soil raft to found on should be constructed by removing the insitu material to1,0m beyond the perimeter of the building to a depth of 1,5 times the widest foundation or to a competent horizon and replaced with material compacted to 93% MOD AASTHO density at - 1% to + 2% of minimum moisture content.

7.4 EXCAVATION CHARACTERISTICS

The ease of excavation depends on certain parameters such as the consistency and type of material, the portion of boulders in the material, presence or absence of solid rock and the height of the water table. The presence of rock outcrops or shallow rockhead requiring mechanized or very slow manual excavation for services and foundations are a severe constraint on development. If material is not excavatable or rippable then jack-hammering and blasting are required.

No problems are foreseen with the excavatability of the area except for intermediate difficulty in the area of Soil Zone II due to the presence of a possible shallow rockhead.

The overall excavatability for foundations and services can be done with a pick and shovel in the transported and residual soils which classify as *soft excavation* (SABS 1200).

7.5 GROUNDWATER & DRAINAGE CONDITIONS

The terrain on the southern side of the N4 highway (Portion 41) has a very flat slope towards the north. It is unlikely that the relative flat slope may cause the stormwater to scour the site during the construction phase although it is still imperative that the development be conducted in such a manner that minimum velocities of stormwater runoff are created. Control of the stormwater can be done by a well designed road layout. The pH values of the soils are on average 5,3 which may be slightly aggressive to concrete or iron pipes.

No seepage water was observed in any of the trial pits during the investigation however, perched water conditions can be expected in areas where a shallow rockhead occurs during periods of high rainfall.

7.6 WATER-BEARING SERVICES

It is assumed that sanitation will be by means of a water-borne sewerage system. The service trenches should be located at least 1,5m away from any structures. All trenches should be backfilled with the insitu materials compacted to not less than 88% MOD AASHTO density.

7.7 CONSTRUCTION MATERIALS

Possible construction materials can be obtained from Soil Zone II.

Although roadbed materials suitable for fill are available on the site, it is advisable to obtain construction materials from external sources.

8. LAND-USE POTENTIAL

All the parameters used during the geotechnical investigation were utilised to determine and describe the development potential of the investigated area. The land-use potential is indicated in Figure 3, Appendix IV and described as follows :

ZONE A (NHBRC Site Class: H2)

Zone A covers the greater extent of the northern terrain (Portion 22) as well as the southern terrain (Portion 41) and comprises of thick layers of transported claycy sand that overlie sandy clay. This zone has good run-off but with a possible deficiency in deep drainage. It is moderately suited for foundations with heave of up to 30mm that can be expected. No difficulty is expected for excavation. The terrain has a relatively flat slope and is easily accessible. **Soil rafts, stiffened rafts or a split foundation should be used during construction.**

This zone has a GOOD land-use potential and can be utilized for any type of development.

ZONE B (NHBRC Site Class: C2)

Zone B covers a small section of the northern terrain (Portion 22) and comprises mainly of sandy material. This zone is well drained and potential collapse of up to 10mm may be expected in this zone. Slight difficulty with excavation can be expected as bedrock is present at a shallow depth of 0,8m below the current ground surface. This zone may contain possible construction materials. **Modified normal foundations should be used during construction.**

This zone has a GOOD Land-use Potential and can be utilized for any type of development.

ZONE C (NHBRC Site Class: S2)

This zone covers a small portion on the southern boundary of the Portion 41. This zone has good drainage and no difficulty is expected for excavation. Consolidation of more than 20mm can be expected in this zone. **Stiffened rafts or soil rafts should be used during construction.**

This zone has a GOOD Land-use Potential and can be utilized for any type of development.

9. <u>CONCLUSIONS AND RECOMMENDATIONS</u>

9.1 The greater extent of the site is covered by colluvium comprising mainly of transported hillwash underlain at depth by norite. A small portion of sandstone occurs at shallow depth within the northern terrain (Portion 22).

9.2 Soil tests were done on disturbed soil samples from representative soil horizons. The results of these tests were utilised to determine the engineering properties of the various diagnostic soil horizons.

9.3 The in situ materials from Soil Zone II can be used as fill materials. However, it is recommended that construction materials be imported to the site to optimise the development potential of the terrain.

9.4 Adequate bearing capacity exists for the intended structures. However, precautionary measures should be taken during design and construction for the expected differential settlements associated with potential collapse and compression of the transported soils which may occur between the founding depth and bedrock.

9.5 First class site drainage must be provided to reduce the risk of subsurface materials from becoming saturated, the risk of differential settlement and to prevent scouring and erosion of the surface materials.

9.6 No excavatability problems for services are foreseen throughout the entire site except in Soil Zone II where slight difficulty might be experienced as a shallow bedrock head is present.

10. GENERAL

It may be discovered that soil conditions at variance with those discussed in this report do occur in very small localized patches. We are, however, of the opinion that the soils are generally of a somewhat homogeneous nature and little variability is expected, except in the hard rock profile variation.

The proposed development is supported from a geotechnical perspective provided that all the recommendations and precautions, as presented in the report, are adhered to.

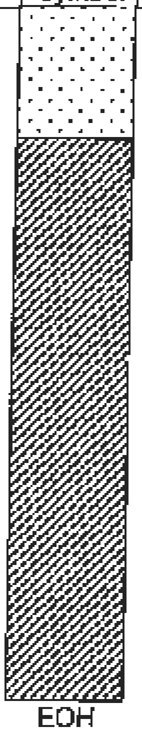
L.M. HOLLAND-MUTER (Pr Sci Nat)

APPENDIX I

SOIL PROFILES

HOLLAND-MUTER & ASSOCIATES - SOIL PROFILE

PROJECT :	**Q4 FUEL CITY: NORTH WEST PROVINCE**
PROFILE NO :	**TP 1**
Logged by : Date :	L. Holland-Muter February 2014



Other Data	Geolog. Data Symbol	Depth (m)	Description	
		0.1_ 0.2_ 0.3_ 0.4_	Slightly moist, dusky red, intact, soft, clayey SAND. Colluvium with abundant roots.	A1
		0.5_ 0.6_ 0.7_ 0.8 0.9_ 1.0_ 1.1_ 1.2_ 1.3_ 1.4_ 1.5_ 1.6_ 1.7_ 1.8_ 1.9_ 2.0_ 2.1_	Slightly moist, dusky red, intact, soft to firm, sandy CLAY. Colluvium.	B1/1
	EOH	2.2_ 2.3_ 2.4_ 2.5_ 2.6_ 2.7_ 2.8_ 2.9_ 3.0_ 3.2_ 3.5_		

KEY:

●	Disturbed Sample
[]	Undisturbed Sample
∇	Water Level
EOH	End of Hole
XXX	Backhoe Refusal
SVSP	Trial pitting terminated due to very slow penetration

HOLLAND-MUTER & ASSOCIATES - SOIL PROFILE

PROJECT :	**Q4 FUEL CITY: NORTH WEST PROVINCE**
PROFILE NO :	**TP 2**
Logged by : Date :	L. Holland-Muter February 2014

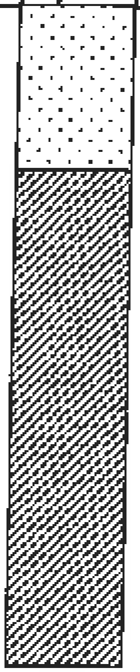
Other Data	Geolog. Data Symbol	Depth (m)	Description	
	░	0.1_	Slightly moist, dusky red, intact, soft, clayey SAND. Colluvium with abundant roots.	A1
	░	0.2_		
	░	0.3_		
	░	0.4_		
	░	0.5_		
	░	0.6_		
	░	0.7_		
	▨	0.8_	Slightly moist, dusky red, intact, soft to firm, sandy CLAY. Colluvium.	B1/1
	▨	0.9_		
	▨	1.0_		
	▨	1.1_		
	▨	1.2_		
	▨	1.3_		
	▨	1.4_		
	▨	1.5_		
	▨	1.6_		
	▨	1.7_		
	▨	1.8_		
	▨	1.9_		
	▨	2.0_		
	▨	2.1_		
	▨	2.2_		
	EOH	2.3_		
		2.4_		
		2.5_		
		2.6_		
		2.7_		
		2.8_		
		2.9_		
		3.0_		
		3.2_		
		3.5_		

KEY :

●	Disturbed Sample
▯	Undisturbed Sample
Y	Water Level
EOH	End of Hole
XXX	Backhoe Refusal
SVSP	Trial pitting terminated due to very slow penetration

HOLLAND-MUTER & ASSOCIATES - SOIL PROFILE

PROJECT :	**Q4 FUEL CITY: NORTH WEST PROVINCE**
PROFILE NO :	**TP 3**
Logged by : Date :	L. Holland-Muter February 2014

Other Data	Geolog. Data Symbol	Depth (m)	Description	
		0.1	Slightly moist, dusky red, intact, soft, clayey SAND. Colluvium with abundant roots.	A1
		0.2		
		0.3		
		0.4		
		0.5		
		0.6	Slightly moist, dusky red, intact, soft to firm, sandy CLAY. Colluvium.	B1/1
		0.7		
		0.8		
		0.9		
		1.0		
		1.1		
		1.2		
		1.3		
		1.4		
		1.5		
		1.6		
		1.7		
		1.8		
		1.9		
●		2.0		
	EOH	2.1		
		2.2		
		2.3		
		2.4		
		2.5		
		2.6		
		2.7		
		2.8		
		2.9		
		3.0		
		3.2		
		3.5		

NOTES:

1. Laboratory Test Results: Foundation Indicator.

Test Depths	0.5m - 2.0m
Soil Horizon	B1/1
Liquid Limit	30
Plasticity Index	10
Linear Shrinkage	7
Grading Modulus	0.8
Clay %	29
Soil Class	A-6(3)
Activity	Low

KEY:

●	Disturbed Sample
[]	Undisturbed Sample
∇	Water Level
EOH	End of Hole
XXX	Backhoe Refusal
SVSP	Trial pitting terminated due to very slow penetration

HOLLAND-MUTER & ASSOCIATES - SOIL PROFILE

PROJECT :	**Q4 FUEL CITY: NORTH WEST PROVINCE**
PROFILE NO :	**TP 4**
Logged by : Date :	L. Holland-Muter February 2014

Other Data	Geolog. Data Symbol	Depth (m)	Description
	▨	0.1_	Slightly moist, dusky red, intact, firm, sandy CLAY. Colluvium. A2
	▨	0.2_	
	▨	0.3_	
	▨	0.4_	
	▨	0.5_	
	▨	0.6_	Slightly moist, dusky red, intact, firm, sandy CLAY Colluvium. B1/1
	▨	0.7_	
	▨	0.8_	
	▨	0.9_	
	▨	1.0_	
	▨	1.1_	
	▨	1.2_	
	▨	1.3_	
	▨	1.4_	
	▨	1.5_	
	▨	1.6_	
	▨	1.7_	
	▨	1.8_	
	▨	1.9_	
	▨	2.0_	
	EOH	2.1_	
		2.2_	
		2.3_	
		2.4_	
		2.5_	
		2.6_	
		2.7_	
		2.8_	
		2.9_	
		3.0_	
		3.2_	
		3.5_	

KEY:

●	Disturbed Sample
[]	Undisturbed Sample
Ɏ	Water Level
EOH	End of Hole
XXX	Backhoe Refusal
SVSP	Trial pitting terminated due to very slow penetration

HOLLAND-MUTER & ASSOCIATES - SOIL PROFILE

PROJECT :	**Q4 FUEL CITY: NORTH WEST PROVINCE**
PROFILE NO :	**TP 5**
Logged by : Date :	L. Holland-Muter February 2014

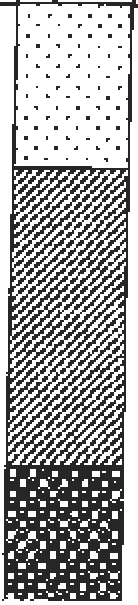
Other Data	Geolog. Data Symbol	Depth (m)	Description
	░	0.1	Slightly moist, dusky red, intact, soft, clayey SAND. Colluvium with abundant roots. A1
	░	0.2	
	░	0.3	
	░	0.4	
	░	0.5	
	░	0.6	
	▨	0.7	Slightly moist, dusky red, intact, soft to firm, sandy CLAY. Colluvium. B1/1
	▨	0.8	
	▨	0.9	
	▨	1.0	
	▨	1.1	
	▨	1.2	
	▨	1.3	
	▨	1.4	
	▨	1.5	
	▨	1.6	
	▨	1.7	
	▨	1.8	
	▨	1.9	
	▨	2.0	
	EOH	2.1	NOTES: 1. TLB refusal.
		2.2	
		2.3	
		2.4	
		2.5	
		2.6	
		2.7	
		2.8	
		2.9	
		3.0	
		3.2	
		3.5	

KEY :

●	Disturbed Sample
[]	Undisturbed Sample
▼	Water Level
EOH	End of Hole
XXX	Backhoe Refusal
SVSP	Trial pitting terminated due to very slow penetration

HOLLAND-MUTER & ASSOCIATES - SOIL PROFILE

PROJECT :	**Q4 FUEL CITY: NORTH WEST PROVINCE**
PROFILE NO :	**TP 6**
Logged by : Date :	L. Holland-Muter February 2014

Other Data	Geolog. Data Symbol	Depth (m)	Description	
		0.1_	Slightly moist, dusky red, intact, soft, clayey SAND. Colluvium with abundant roots.	A1
		0.2_		
		0.3_		
		0.4_		
		0.5_		
		0.6_	Slightly moist, dusky red, intact, soft to firm, sandy CLAY. Colluvium.	B1/1
		0.7_		
		0.8_		
		0.9_		
		1.0_		
		1.1_		
		1.2_		
		1.3_		
		1.4_		
		1.5_	Dry, reddish dark brown mottled black and yellow, intact, soft to firm, clayey SAND with abundant ferricrete nodules and sub-angular quartzite pebbles and cobbles. Pebble Marker.	PM
		1.6_		
		1.7_		
		1.8_		
	XXX	1.9_		
		2.0_		
		2.1_		
		2.2_	NOTES:	
		2.3_		
		2.4_	1. TLB refusal.	
		2.5_		
		2.6_		
		2.7_		
		2.8_		
		2.9_		
		3.0_		
		3.2_		
		3.5_		

KEY :

●	Disturbed Sample
▯	Undisturbed Sample
▼	Water Level
EOH	End of Hole
XXX	Backhoe Refusal
SVSP	Trial pitting terminated due to very slow penetration

HOLLAND-MUTER & ASSOCIATES - SOIL PROFILE

PROJECT :	**Q4 FUEL CITY: NORTH WEST PROVINCE**
PROFILE NO :	**TP 7**
Logged by : Date :	L. Holland-Muter February 2014

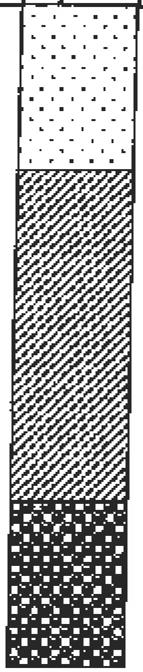
Other Data	Geolog. Data Symbol	Depth (m)	Description	
	░	0.1_	Slightly moist, dusky red, intact, soft, clayey SAND. Colluvium with abundant roots.	A1
	░	0.2_		
	░	0.3_		
	░	0.4_		
	▨	0.5_	Slightly moist, dusky red, intact, soft to firm, sandy CLAY. Colluvium.	B1/1
	▨	0.6_		
	▨	0.7_		
	▨	0.8		
	▨	0.9_		
	▨	1.0_		
	▨	1.1_		
	▨	1.2_		
	▨	1.3_		
	▨	1.4_		
	▨	1.5_		
	▨	1.6		
	▨	1.7_		
	▨	1.8_		
	▨	1.9_		
	▨	2.0_		
	EOH	2.1_		
		2.2_		
		2.3_		
		2.4_		
		2.5_		
		2.6_		
		2.7_		
		2.8_		
		2.9_		
		3.0_		
		3.2_		
		3.5_		

KEY :

●	Disturbed Sample
[]	Undisturbed Sample
∇	Water Level
EOH	End of Hole
XXX	Backhoe Refusal
SVSP	Trial pitting terminated due to very slow penetration

HOLLAND-MUTER & ASSOCIATES - SOIL PROFILE

PROJECT :	**Q4 FUEL CITY: NORTH WEST PROVINCE**
PROFILE NO :	**TP 8**
Logged by : Date :	L. Holland-Muter February 2014

Other Data	Geolog. Data Symbol	Depth (m)	Description	
		0.1	Slightly moist, dusky red, intact, soft, clayey SAND. Colluvium with abundant roots.	A1
		0.2		
		0.3		
		0.4		
		0.5		
		0.6	Slightly moist, dusky red, intact, soft to firm, sandy CLAY. Colluvium.	B1/1
		0.7		
		0.8		
		0.9		
		1.0		
		1.1	Dry, reddish dark brown mottled black and yellow, intact, soft to firm, clayey SAND with abundant ferricrete nodules and sub-angular quartzite pebbles and cobbles. Pebble Marker.	PM
		1.2		
		1.3		
		1.4		
●		1.5		
		1.6		
		1.7		
		1.8		
		1.9		
		2.0	NOTES:	
	EOH	2.1		
		2.2	1. Laboratory Test Results: Foundation Indicator.	
		2.3		
		2.4		
		2.5		
		2.6		
		2.7		
		2.8		
		2.9		
		3.0		
		3.2		
		3.5		

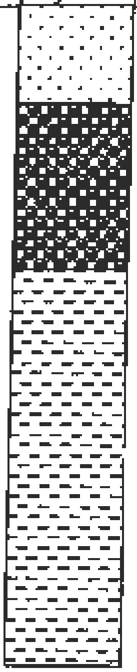
Test Depths	0.5m - 1.5m
Soil Horizon	B1/1
Liquid Limit	30
Plasticity Index	11
Linear Shrinkage	6.5
Grading Modulus	0.54
Clay %	10
Soil Class	A-6(5)
Activity	Low

KEY :

●	Disturbed Sample
▯	Undisturbed Sample
Ÿ	Water Level
EOH	End of Hole
XXX	Backhoe Refusal
SVSP	Trial pitting terminated due to very slow penetration

HOLLAND-MUTER & ASSOCIATES - SOIL PROFILE

PROJECT :	**Q4 FUEL CITY: NORTH WEST PROVINCE**
PROFILE NO :	**TP 9**
Logged by : Date :	L. Holland-Muter February 2014

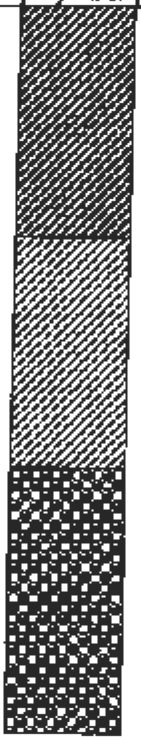
Other Data	Geolog. Data Symbol	Depth (m)	Description	
		0.1 0.2 0.3	Slightly moist, dusky red, intact, soft, clayey SAND. Colluvium with abundant roots.	A1
		0.4 0.5 0.6 0.7 0.8	Dry, reddish dark brown mottled black and yellow, intact, soft to firm, clayey SAND with abundant ferricrete nodules and sub-angular quartzite pebbles and cobbles. Pebble Marker.	PM
		0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0	Dark red, highly to moderately weathered rock SANDSTONE.	R1
	XXX	2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8 2.9 3.0 3.2 3.5	NOTES: 1. TLB refusal.	

KEY :

●	Disturbed Sample
▯	Undisturbed Sample
Y	Water Level
EOH	End of Hole
XXX	Backhoe Refusal
SVSP	Trial pitting terminated due to very slow penetration

HOLLAND-MUTER & ASSOCIATES - SOIL PROFILE

PROJECT :	Q4 FUEL CITY: NORTH WEST PROVINCE
PROFILE NO :	TP 10
Logged by : Date :	L. Holland-Muter February 2014

Other Data	Geolog. Data Symbol	Depth (m)	Description	
		0.1_ 0.2_ 0.3_ 0.4_ 0.5_ 0.6_ 0.7_	Slightly moist, dusky red, intact, firm, sandy CLAY. Colluvium.	A2
		0.8_ 0.9_ 1.0_ 1.1_ 1.2_ 1.3_ 1.4_	Slightly moist, dusky red, intact, soft to firm, sandy CLAY. Colluvium.	B1/1
		1.5_ 1.6_ 1.7_ 1.8_ 1.9_ 2.0_ 2.1_ 2.2_	Dry, reddish dark brown mottled black and yellow, intact, soft to firm, clayey SAND with abundant ferricrete nodules and sub-angular quartzite pebbles and cobbles. Pebble Marker.	PM
	XXX	2.3_ 2.4_ 2.5_ 2.6_ 2.7_ 2.8_ 2.9_ 3.0_ 3.2_ 3.5_	NOTES: 1. TLB refusal.	

KEY :

●	Disturbed Sample
▯	Undisturbed Sample
Y	Water Level
EOH	End of Hole
XXX	Backhoe Refusal
SVSP	Trial pitting terminated due to very slow penetration

HOLLAND-MUTER & ASSOCIATES - SOIL PROFILE

PROJECT :	**Q4 FUEL CITY: NORTH WEST PROVINCE**
PROFILE NO :	**TP 11**
Logged by : Date :	L. Holland-Muter February 2014

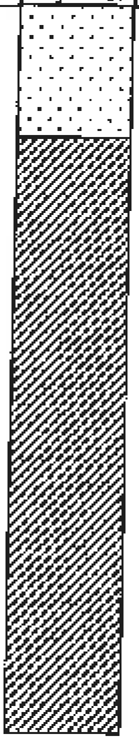
Other Data	Geolog. Data Symbol	Depth (m)	Description	
	░	0.1	Slightly moist, dusky red, intact, soft, clayey SAND. Colluvium with abundant roots.	A1
		0.2		
		0.3		
		0.4		
	▨	0.5	Slightly moist, dusky red, intact, soft to firm, sandy CLAY. Colluvium.	B1/1
		0.6		
		0.7		
		0.8		
		0.9		
		1.0		
		1.1		
		1.2		
		1.3		
		1.4		
		1.5		
		1.6		
		1.7		
		1.8		
		1.9		
		2.0		
		2.1		
	EOH	2.2		
		2.3		
		2.4		
		2.5		
		2.6		
		2.7		
		2.8		
		2.9		
		3.0		
		3.2		
		3.5		

KEY :

●	Disturbed Sample
▯	Undisturbed Sample
▼	Water Level
EOH	End of Hole
XXX	Backhoe Refusal
SVSP	Trial pitting terminated due to very slow penetration

HOLLAND-MUTER & ASSOCIATES - SOIL PROFILE

PROJECT :	**Q4 FUEL CITY: NORTH WEST PROVINCE**
PROFILE NO :	**TP 12**
Logged by : Date :	L. Holland-Muter February 2014

Other Data	Geolog. Data Symbol	Depth (m)	Description
		0.1	
		0.2	Slightly moist, dusky red, intact, soft, clayey SAND. Colluvium with abundant roots. A1
		0.3	
		0.4	
		0.5	
		0.6	
		0.7	Slightly moist, dusky red, intact, soft to firm, sandy CLAY. Colluvium. B1/1
		0.8	
		0.9	
		1.0	
		1.1	
		1.2	
		1.3	
		1.4	
		1.5	
		1.6	
		1.7	
		1.8	
		1.9	
		2.0	
		2.1	
		2.2	
	EOH	2.3	
		2.4	
		2.5	
		2.6	
		2.7	
		2.8	
		2.9	
		3.0	
		3.2	
		3.5	

KEY :

●	Disturbed Sample
▯	Undisturbed Sample
Y	Water Level
EOH	End of Hole
XXX	Backhoe Refusal
SVSP	Trial pitting terminated due to very slow penetration

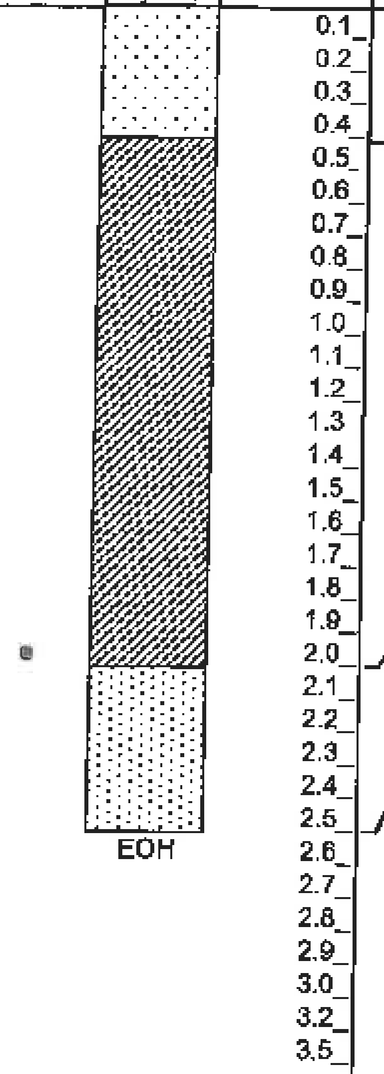
HOLLAND-MUTER & ASSOCIATES - SOIL PROFILE

PROJECT : Q4 FUEL CITY: NORTH WEST PROVINCE

PROFILE NO : TP 13

Logged by : L. Holland-Muter
Date : February 2014

Other Data	Geolog. Data Symbol	Depth (m)	Description



Slightly moist, dusky red, Intact, soft, clayey SAND. Colluvium with abundant roots. A1

Slightly moist, dusky red, intact, soft to firm, sandy CLAY. Colluvium. B1/1

Slightly moist, dark reddish orange, intact, soft to firm, silty clayey SAND. Colluvium. B2/1

NOTES:

1. Laboratory Test Results: Foundation Indicator.

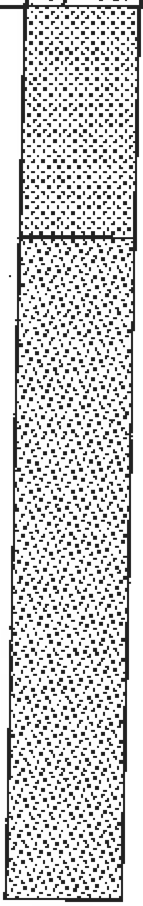
Test Depths	0.4m - 2.0m
Soil Horizon	B1/1
Liquid Limit	28
Plasticity Index	9
Linear Shrinkage	6.5
Grading Modulus	0.86
Clay %	22
Soil Class	A-6(2)
Activity	Low

KEY :

●	Disturbed Sample
▯	Undisturbed Sample
▽	Water Level
EOH	End of Hole
XXX	Backhoe Refusal
SVSP	Trial pitting terminated due to very slow penetration

HOLLAND-MUTER & ASSOCIATES - SOIL PROFILE

PROJECT :	**Q4 FUEL CITY: NORTH WEST PROVINCE**
PROFILE NO :	**TP 14**
Logged by : Date :	L. Holland-Muter February 2014

Other Data	Geolog. Data Symbol	Depth (m)	Description	
		0.1 0.2 0.3 0.4 0.5 0.6 0.7	Slightly moist, greyish dark brown, intact, soft, clayey SAND. Alluvium.	A3
		0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2 2.3 2.4 2.5 2.6	Slightly moist, dusky red, intact to fissured, soft to firm, clayey SAND. Colluvium.	B1/2
●		2.7		
	EOH	2.8 2.9 3.0 3.2 3.5		

NOTES:

1. Laboratory Test Results: Foundation Indicator.

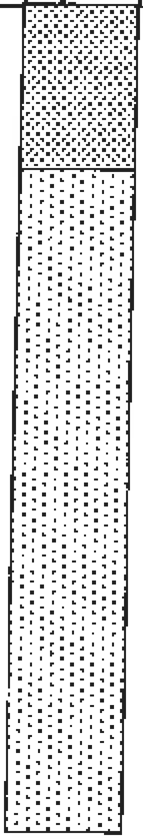
Test Depths	0.7m - 2.7m
Soil Horizon	B1/2
Liquid Limit	18
Plasticity Index	3
Linear Shrinkage	1.5
Grading Modulus	1.22
Clay %	7
Soil Class	A-2-4(0)
Activity	Low

KEY :

●	Disturbed Sample
▯	Undisturbed Sample
▽	Water Level
EOH	End of Hole
XXX	Backhoe Refusal
SVSP	Trial pitting terminated due to very slow penetration

HOLLAND-MUTER & ASSOCIATES - SOIL PROFILE

PROJECT :	**Q4 FUEL CITY: NORTH WEST PROVINCE**
PROFILE NO :	**TP 15**
Logged by : Date :	L. Holland-Muter February 2014



Other Data	Geolog. Data Symbol	Depth (m)	Description
		0.1_	
		0.2_	Slightly moist, greyish dark brown, intact, soft, clayey SAND. Alluvium. A3
		0.3_	
		0.4_	
		0.5_	
		0.6_	
		0.7_	
		0.8_	
		0.9_	
		1.0_	Slightly moist, dusky red, intact, firm, clayey SAND. Colluvium. B1/3
		1.1_	
		1.2_	
		1.3_	
		1.4_	
		1.5_	
		1.6_	
		1.7_	
		1.8_	
		1.9_	
		2.0_	
		2.1_	
		2.2_	
		2.3_	
		2.4_	
		2.5_	
	EOH	2.6_	
		2.7_	
		2.8_	
		2.9_	
		3.0_	
		3.2_	
		3.5_	

KEY :

●	Disturbed Sample
▯	Undisturbed Sample
▼	Water Level
EOH	End of Hole
XXX	Backhoe Refusal
SVSP	Trial pitting terminated due to very slow penetration

HOLLAND-MUTER & ASSOCIATES - SOIL PROFILE

PROJECT :	Q4 FUEL CITY: NORTH WEST PROVINCE
PROFILE NO :	TP 16
Logged by : Date :	L. Holland-Muter February 2014

Other Data	Geolog. Data Symbol	Depth (m)	Description	
	░	0.1_ 0.2_ 0.3_ 0.4_	Slightly moist, dusky red, intact, soft, clayey SAND. Colluvium with abundant roots.	A1
	░	0.5_ 0.6_ 0.7_ 0.8_ 0.9_ 1.0_ 1.1_ 1.2_ 1.3_ 1.4_ 1.5_ 1.6_ 1.7_ 1.8_ 1.9_ 2.0_ 2.1_ 2.2_	Slightly moist, dusky red, intact, firm, clayey SAND. Colluvium.	B1/3
	EOH	2.3_ 2.4_ 2.5_ 2.6_ 2.7_ 2.8_ 2.9_ 3.0_ 3.2_ 3.5_		

KEY :

●	Disturbed Sample
▯	Undisturbed Sample
Y	Water Level
EOH	End of Hole
XXX	Backhoe Refusal
SVSP	Trial pitting terminated due to very slow penetration

HOLLAND-MUTER & ASSOCIATES - SOIL PROFILE

PROJECT :	**Q4 FUEL CITY: NORTH WEST PROVINCE**
PROFILE NO :	**TP 17**
Logged by : Date :	L. Holland-Muter February 2014

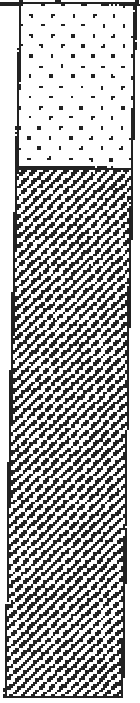
Other Data	Geolog. Data Symbol	Depth (m)	Description	
	░	0.1_ 0.2_ 0.3_ 0.4_	Slightly moist, dusky red, intact, soft, clayey SAND. Colluvium with abundant roots.	A1
	▒	0.5_ 0.6_ 0.7_ 0.8_ 0.9_ 1.0_ 1.1_ 1.2_ 1.3_ 1.4_ 1.5_ 1.6_ 1.7_ 1.8_ 1.9_ 2.0_ 2.1_ 2.2_	Slightly moist, dusky red, intact, firm, clayey SAND. Colluvium.	B1/3
	EOH	2.3_ 2.4_ 2.5_ 2.6_ 2.7_ 2.8_ 2.9_ 3.0_ 3.2 3.5_		

KEY :

●	Disturbed Sample
▯	Undisturbed Sample
Y	Water Level
EOH	End of Hole
XXX	Backhoe Refusal
SVSP	Trial pitting terminated due to very slow penetration

HOLLAND-MUTER & ASSOCIATES - SOIL PROFILE

PROJECT :	**Q4 FUEL CITY: NORTH WEST PROVINCE**
PROFILE NO :	**TP 18**
Logged by : Date :	L. Holland-Muter February 2014

Other Data	Geolog. Data Symbol	Depth (m)	Description
		0.1	Slightly moist, dusky red, intact, soft, clayey SAND. Colluvium with abundant roots. A1
		0.2	
		0.3	
		0.4	
		0.5	
		0.6	Slightly moist, dusky red, intact, soft to firm, sandy CLAY. Colluvium. B1/1
		0.7	
		0.8	
		0.9	
		1.0	
		1.1	
		1.2	
		1.3	
		1.4	
		1.5	
		1.6	
		1.7	
		1.8	
		1.9	
		2.0	
		2.1	
	EOH	2.2	
		2.3	
		2.4	
		2.5	
		2.6	
		2.7	
		2.8	
		2.9	
		3.0	
		3.2	
		3.5	

KEY :

●	Disturbed Sample
▯	Undisturbed Sample
∇	Water Level
EOH	End of Hole
XXX	Backhoe Refusal
SVSP	Trial pitting terminated due to very slow penetration

HOLLAND-MUTER & ASSOCIATES - SOIL PROFILE

PROJECT :	**Q4 FUEL CITY: NORTH WEST PROVINCE**
PROFILE NO :	**TP 19**
Logged by : Date :	L. Holland-Muter February 2014

Other Data	Geolog. Data Symbol	Depth (m)	Description	
	░	0.1_	Slightly moist, dusky red, intact, soft, clayey SAND. Colluvium with abundant roots.	A1
		0.2_		
		0.3_		
		0.4_		
		0.5_		
	▨	0.6_	Slightly moist, dusky red, intact, soft to firm, sandy CLAY. Colluvium.	B1/1
		0.7_		
		0.8_		
		0.9_		
		1.0_		
		1.1_		
		1.2_		
		1.3_		
		1.4_		
		1.5_		
		1.6_		
		1.7_		
		1.8_		
		1.9_		
		2.0_		
		2.1_		
		2.2_		
	EOH	2.3_		
		2.4_		
		2.5_		
		2.6_		
		2.7_		
		2.8_		
		2.9_		
		3.0_		
		3.2_		
		3.5		

KEY :

●	Disturbed Sample
[]	Undisturbed Sample
Y	Water Level
EOH	End of Hole
XXX	Backhoe Refusal
SVSP	Trial pitting terminated due to very slow penetration

APPENDIX II

LABORATORY TEST RESULTS

Unit 4, 144 Edward Avenue, Centurion
P O Box 7661, Centurion, 0046
Tel: +27 (0)12 653-1818/0021 • Fax: +27 (0)12 653-0997
E-mail: frank@civilab.co.za • Website: www.civilab.co.za

Civilab
Civil Engineering Testing Laboratories

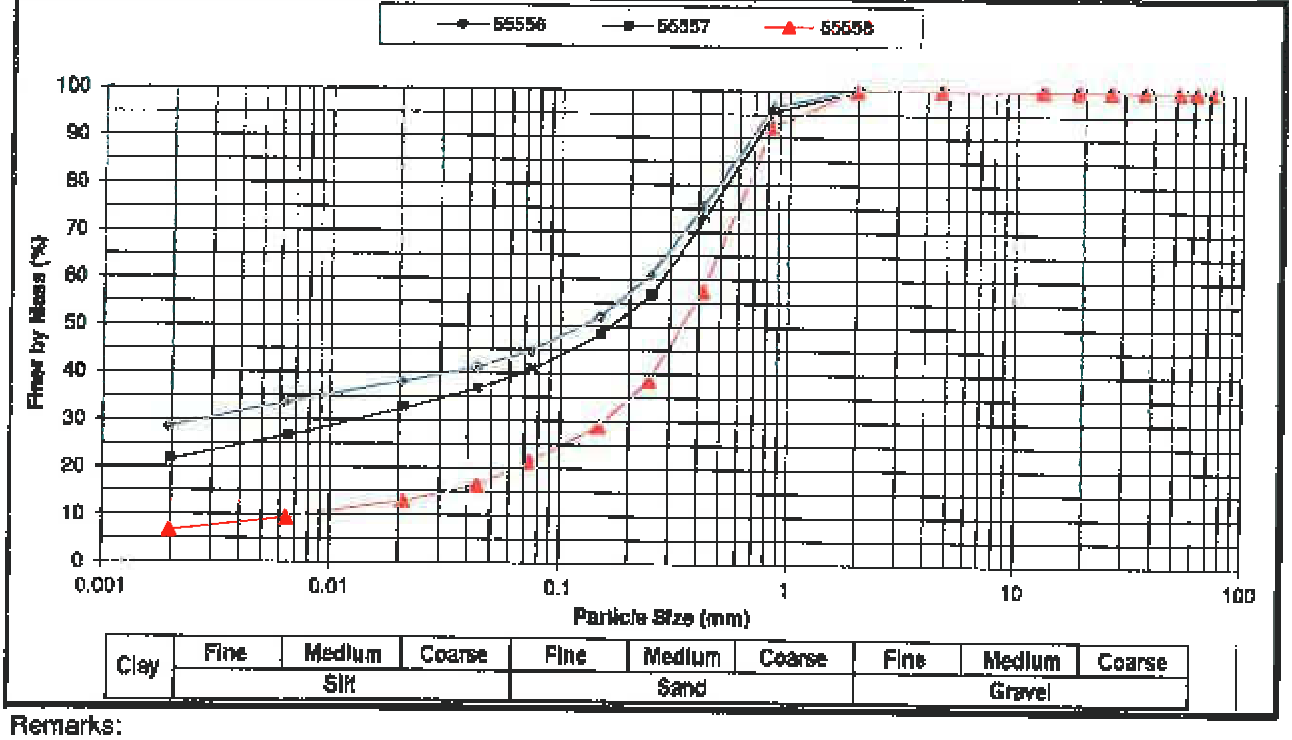
Foundation Indicator Test Data

Project	Holland Muter - Techworld N4 Filling Station		
Project No.	HP/B 394-48	Date	27 January 2014

Sample No.	55556	55557	55558
Field Ref. No.	TP 3	TP 13	TP 14
Depth	0.5-2.0	0.4-2.0	0.7-2.7
Sieve size	%Passing	% Passing	% Passing
75.00	100	100	100
63.00	100	100	100
53.00	100	100	100
37.50	100	100	100
26.50	100	100	100
19.00	100	100	100
13.20	100	100	100
4.75	100	100	100
2.00	100	100	100
0.85	96	96	92
0.425	75	73	57
0.25	61	57	38
0.15	52	48	29
0.075	45	41	21
0.04	41	36	16
0.02	38	32	12
0.006	33	26	9
0.002	29	22	7

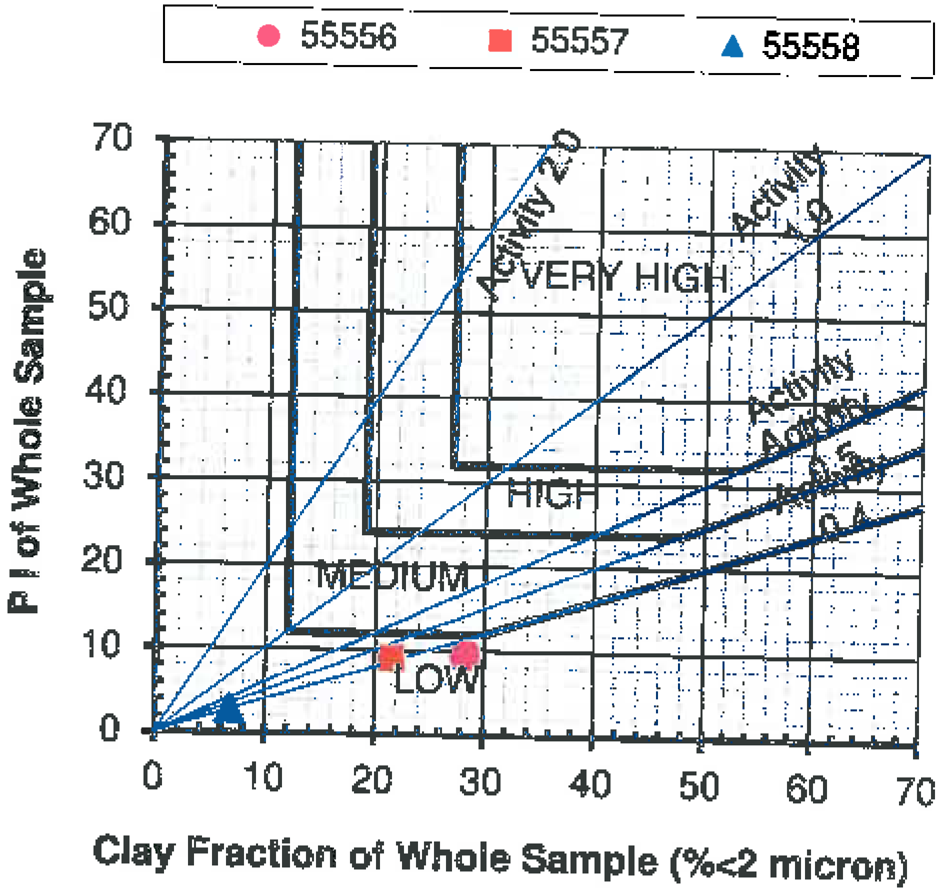
Sample No.	55556	55557	55558
%Gravel	0	0	0
%Sand	57	61	81
%Silt	15	17	12
%Clay	29	22	7
NMC %	Not Tested	Not Tested	Not Tested
Liquid Limit	30	28	18
Plasticity Index	13	12	5
Linear Shrink.	7.	6.5	1.5
Overall P.I.	10	9	3
Grading Modulus	0.80	0.86	1.22
H.R.B.	A-6 (3)	A-6 (2)	A-2-4 (0)
Unified	SC	SC	SC-SM
Weston swell (%) at 1 kPa			

Analysis as per method D422 of ASTM of 1985
The results reported relate only to the samples tested.
Documents may only be reproduced or published in their full context.



Remarks:

Activity Diagram After D H van der Merwe



Plotted Values:

Sample	Clay Frac	PI
55556	28.5	9.5
55557	21.7	9.1
55558	6.7	2.8

Unit 4, 144 Edward Avenue, Centurion
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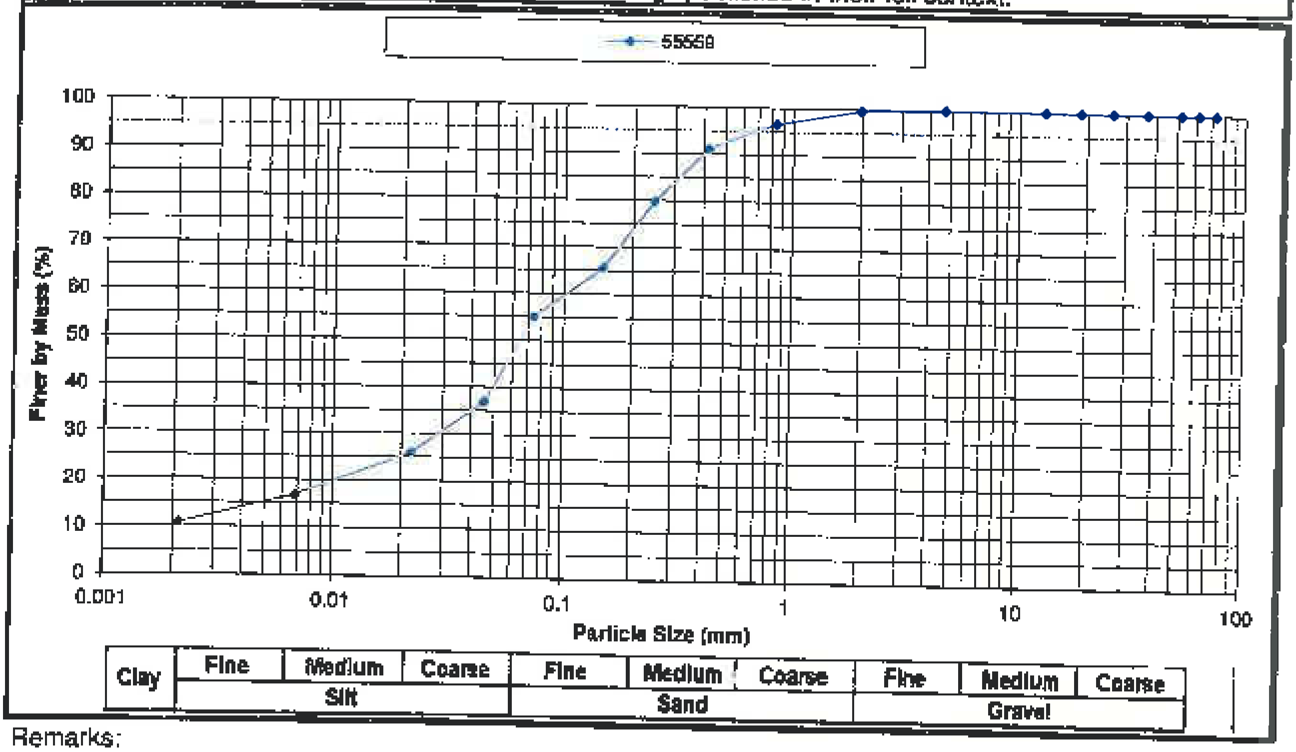
Foundation Indicator Test Data

Project	Holland Muter - Techworld N4 Filling Station		
Project No.	HP/B 394-48	Date	27 January 2014

Sample No.	55559		
Field Ref. No.	TP 8		
Depth	0.5-1.5		
Sieve size	%Passing	% Passing	% Passing
75.00	100		
63.00	100		
53.00	100		
37.50	100		
26.50	100		
19.00	100		
13.20	100		
4.75	100		
2.00	100		
0.85	97		
0.425	91		
0.25	80		
0.15	66		
0.075	55		
0.04	35		
0.02	24		
0.006	16		
0.002	10		

Sample No.	55559		
%Gravel	0		
%Sand	53		
%Silt	36		
%Clay	10		
NMC %	Not Tested		
Liquid Limit	30		
Plasticity Index	12		
Linear Shrink.	6.5		
Overall P.I.	11		
Grading Modulus	0.54		
H.R.B.	A-6 (5)		
Unified	CL		
Weston swell (%) at 1 kPa			

Analysis as per method D422 of ASTM of 1985
The results reported relate only to the samples tested.
Documents may only be reproduced or published in their full context.



Remarks:

Unit 4, 144 Edward Avenue, Centurion
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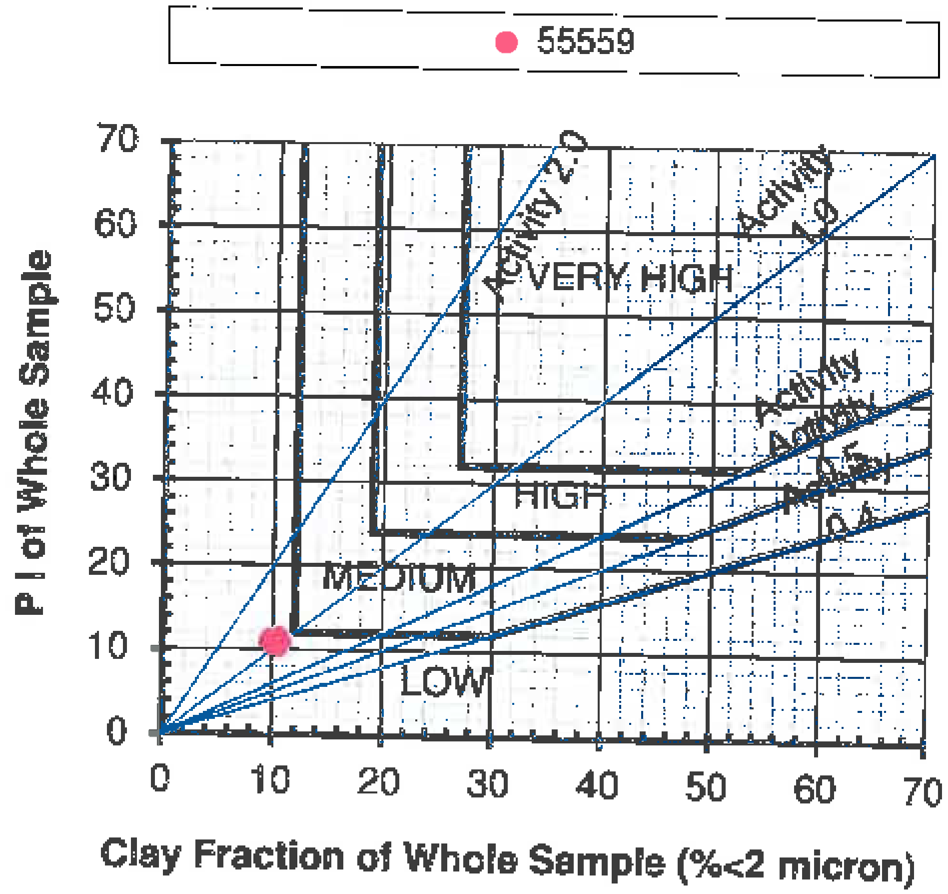
Activity Diagram After D H van der Merwe



Plotted Values:

Sample	Clay Frac	PI
55559	10.4	10.9

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Vat Number: 4330179989

Civilab
Civil Engineering Testing Laboratories

23-Jan-14

Holland Muter & Associates CC
Po Box 1450
Faerie Glen
0043

ATTENTION: LH Muter

pH & CONDUCTIVITY: Techworld N4 Filling Station

Project: Techworld N4 Filling Station
Job Number: HP/B 394-46

YOUR REF:	SAMPLE NUMBER:	pH VALUE	READING IN: µs/cm	ELECTRICAL CONDUCTIVITY (S/m)	RESISTIVITY (Ohm/m)
TP 3	55556	5.06	112.32	0.0112	89.031
TP 13	55557	5.32	146.64	0.0147	68.194
TP 14	55558	5.23	94.016	0.0094	106.365
TP 8	55559	5.71	173.68	0.0174	57.577

Regards,

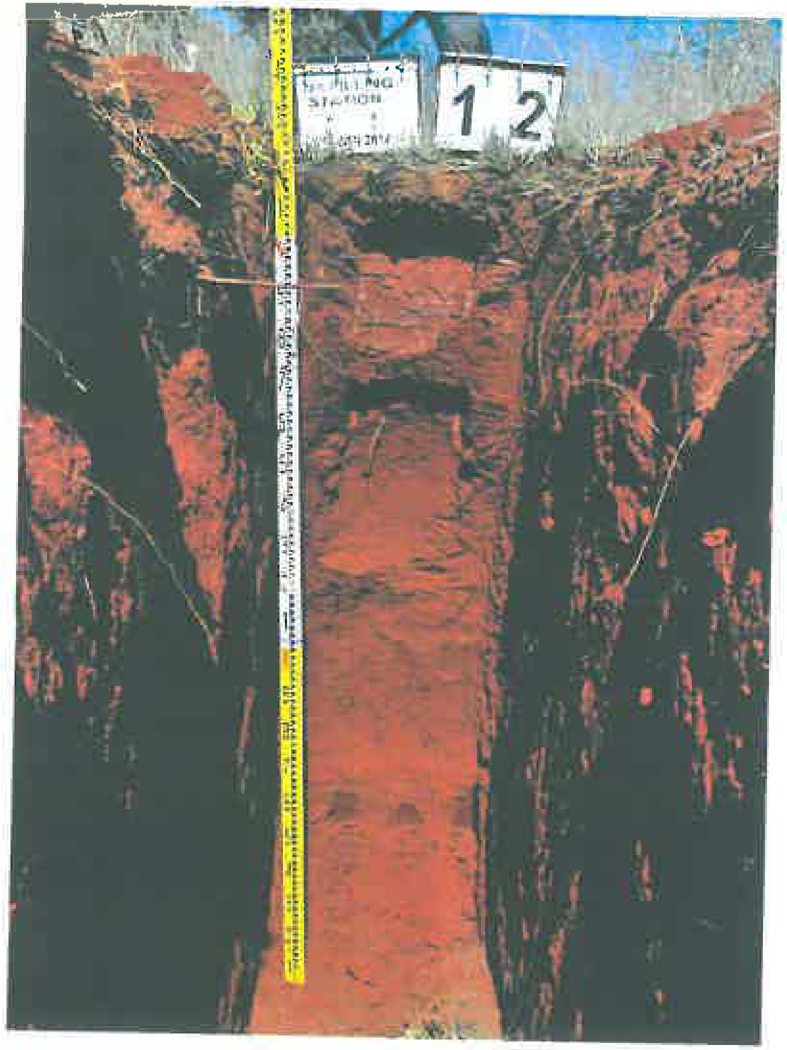
Civilab

APPENDIX III

PHOTOGRAPHS

Typical Soil Profiles of Soil Zone I(a)

Typical Soil Profiles of Soil Zone I(a)



Typical Soil Profiles of Soil Zone I(b)

Typical Soil Profiles of Soil Zone I(c)

Typical Soil Profile of Soil Zone II

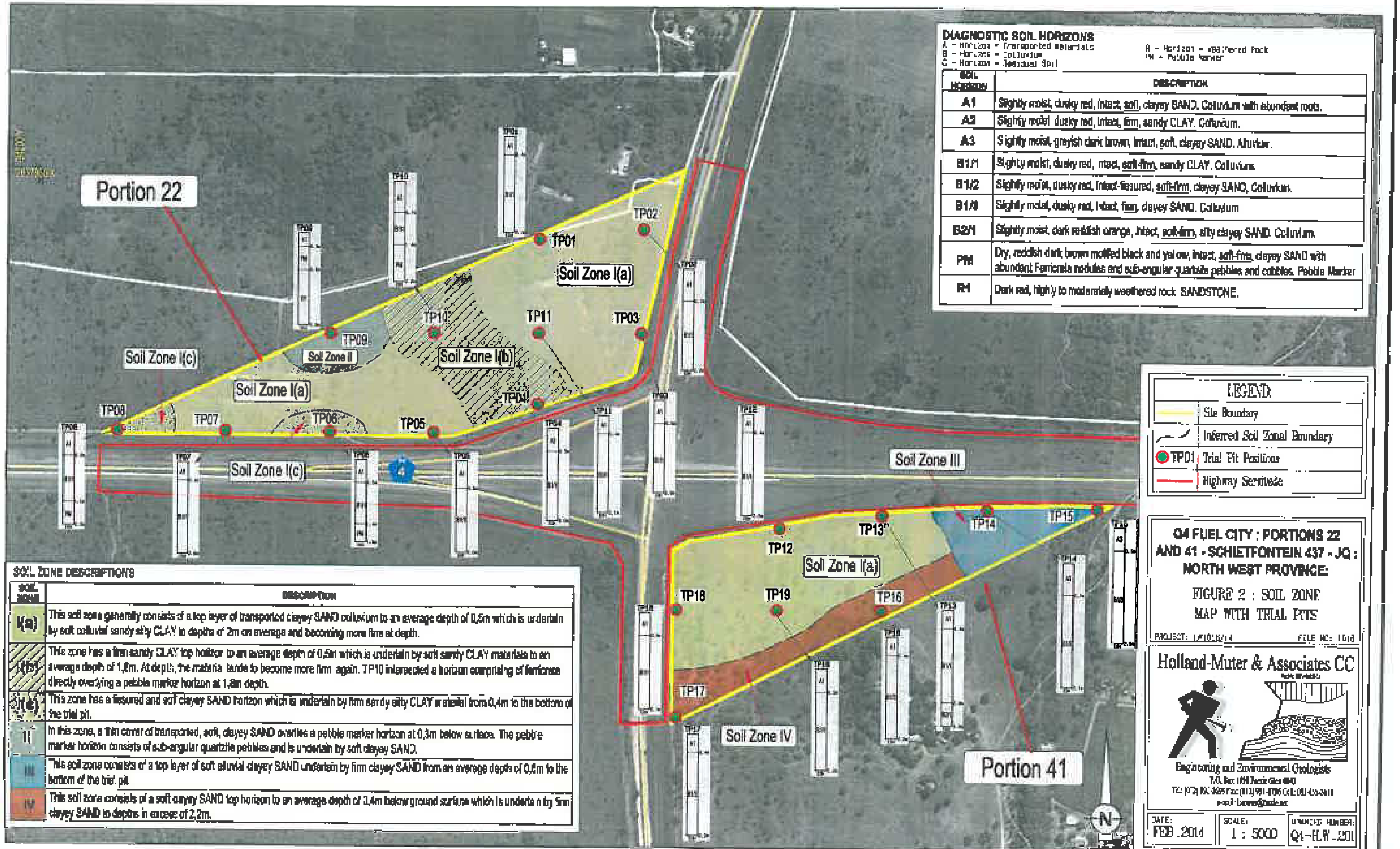
Typical Soil Profiles of Soil Zone III

Typical Soil Profiles for Soil Zone IV

APPENDIX IV

MAPS

Q4 FUEL CITY : PORTIONS 22 AND 41 - SCHIETFONTEIN 437 - JQ : NORTH WEST PROVINCE:
FIGURE 2 : SOIL ZONE MAP WITH TRIAL PITS



DIAGNOSTIC SOIL HORIZONS

A - Horizon = Transported Materials
B - Horizon = Colluvium
C - Horizon = Residual Soil

R - Horizon = Weathered Rock
PM = Pebble Marker

SOIL HORIZON	DESCRIPTION
A1	Slightly moist, dusky red, intact, soft, clayey SAND. Colluvium with abundant roots.
A2	Slightly moist dusky red, intact, firm, sandy CLAY. Colluvium.
A3	Slightly moist, greyish dark brown, intact, soft, clayey SAND. Alluvium.
B1/1	Slightly moist, dusky red, intact, soft-firm, sandy CLAY. Colluvium.
B1/2	Slightly moist, dusky red, intact-fissured, soft-firm, clayey SAND. Colluvium.
B1/3	Slightly moist, dusky red, intact, firm, clayey SAND. Colluvium
B2/1	Slightly moist, dark reddish orange, intact, soft-firm, silty clayey SAND. Colluvium.
PM	Dry, reddish dark brown mottled black and yellow, intact, soft-firm, clayey SAND with abundant Ferricrete nodules and sub-angular quartzite pebbles and cobbles. Pebble Marker
R1	Dark red, highly to moderately weathered rock. SANDSTONE.

SOIL ZONE DESCRIPTIONS

SOIL ZONE	DESCRIPTION
I(a)	This soil zone generally consists of a top layer of transported clayey SAND colluvium to an average depth of 0,5m which is underlain by soft colluvial sandy silty CLAY to depths of 2m on average and becoming more firm at depth.
I(b)	This zone has a firm sandy CLAY top horizon to an average depth of 0,5m which is underlain by soft sandy CLAY materials to an average depth of 1,8m. At depth, the materia tends to become more firm again. TP10 intersected a horizon comprising of ferricrete directly overlying a pebble marker horizon at 1,8m depth.
I(c)	This zone has a fissured and soft clayey SAND horizon which is underlain by firm sandy silty CLAY material from 0,4m to the bottom of the trial pit.
II	In this zone, a thin cover of transported, soft, clayey SAND overlies a pebble marker horizon at 0,3m below surface. The pebble marker horizon consists of sub-angular quartzite pebbles and is underlain by soft clayey SAND.
III	This soil zone consists of a top layer of soft alluvial clayey SAND underlain by firm clayey SAND from an average depth of 0,6m to the bottom of the trial pit.
IV	This soil zone consists of a soft clayey SAND top horizon to an average depth of 1,4m below ground surface which is underlain by firm clayey SAND to depths in excess of 2,2m.

LEGEND	
━	Site Boundary
╌	Inferred Soil Zonal Boundary
● TP01	Trial Pit Position
━	Highway Servitude

Q4 FUEL CITY : PORTIONS 22 AND 41 - SCHIETFONTEIN 437 - JQ : NORTH WEST PROVINCE:

FIGURE 2 : SOIL ZONE MAP WITH TRIAL PITS

PROJECT: 1/10/16/14 FILE NO: 1616

Holland-Muter & Associates CC

Engineering and Environmental Geologists
[illegible]
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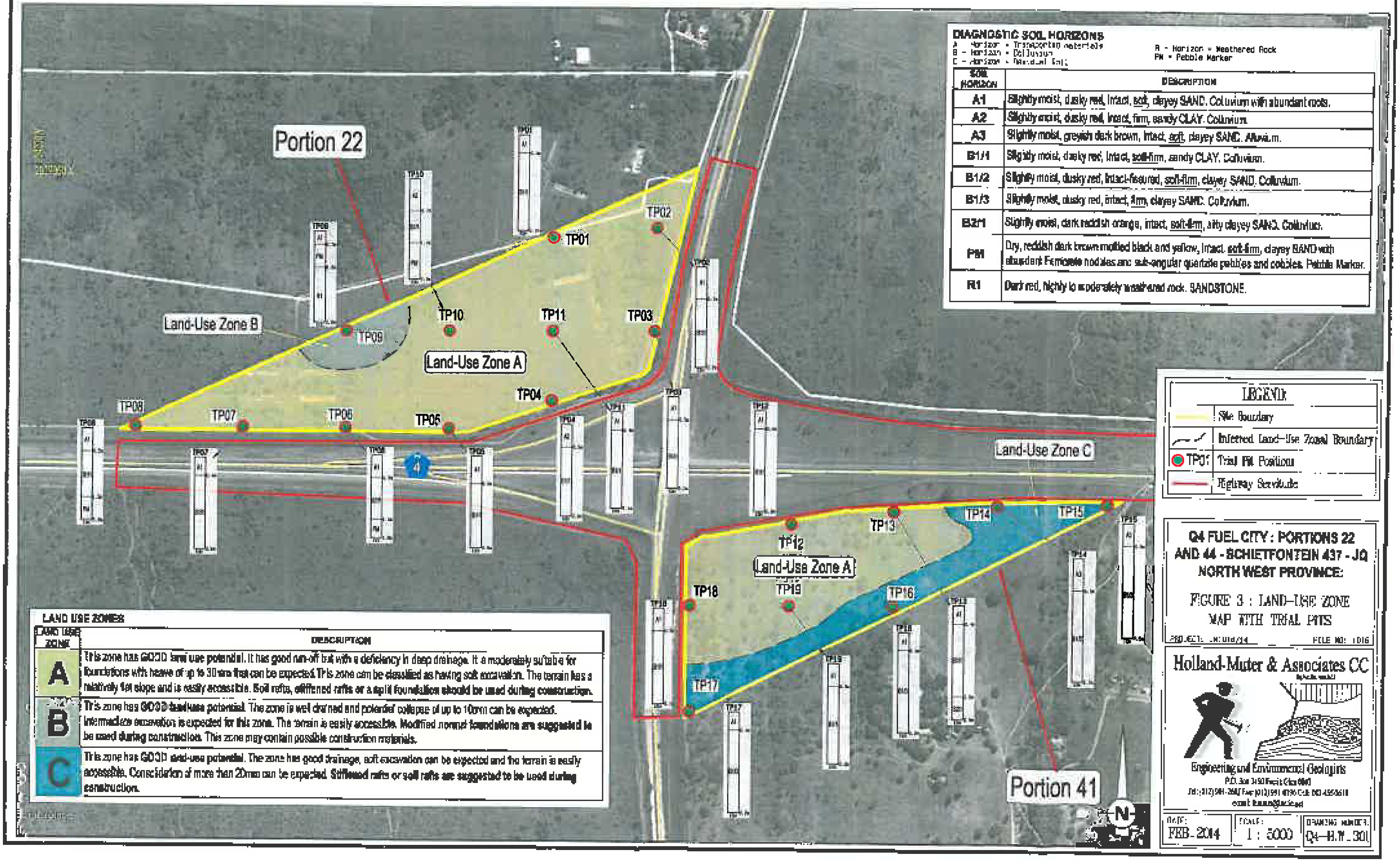
DATE:	SCALE:	DRAWING NUMBER:
FEB 2014	1 : 5000	Q4-HLW-201

Q4 FUEL CITY : PORTIONS 22 AND 41 - SCHIETFONTEIN 437 - JQ : NORTH WEST PROVINCE:
FIGURE 3 : LAND-USE ZONE MAP WITH TRIAL PITS



DIAGNOSTIC SOIL HORIZONS

A - Horizon = Transported materials
B - Horizon = Colluvium
C - Horizon = Residual Soil

R - Horizon = Weathered Rock
PM = Pebble Marker

SOIL HORIZON	DESCRIPTION
A1	Slightly moist, dusky red, intact, soft, clayey SAND. Colluvium with abundant roots.
A2	Slightly moist, dusky red, intact, firm, sandy CLAY. Colluvium.
A3	Slightly moist, greyish dark brown, intact, soft, clayey SAND. Alluvium.
B1/1	Slightly moist, dusky red, intact, soft-firm, sandy CLAY. Colluvium.
B1/2	Slightly moist, dusky red, intact-fissured, soft-firm, clayey SAND. Colluvium.
B1/3	Slightly moist, dusky red, intact, firm, clayey SAND. Colluvium.
B2/1	Slightly moist, dark reddish orange, intact, soft-firm, silty clayey SAND. Colluvium.
PM	Dry, reddish dark brown mottled black and yellow, intact, soft-firm, clayey SAND with abundant Ferricrete nodules and sub-angular quartzite pebbles and cobbles. Pebble Marker.
R1	Dark red, highly to moderately weathered rock. SANDSTONE.

LAND USE ZONES

LAND USE ZONE	DESCRIPTION
A	This zone has GOOD land use potential. It has good run-off but with a deficiency in deep drainage. It a moderately suitable for foundations with heave of up to 30mm that can be expected. This zone can be classified as having soft excavation. The terrain has a relatively flat slope and is easily accessible. Soil rafts, stiffened rafts or a split foundation should be used during construction.
B	This zone has GOOD land-use potential. The zone is well drained and potential collapse of up to 10mm can be expected. Intermediate excavation is expected for this zone. The terrain is easily accessible. Modified normal foundations are suggested to be used during construction. This zone may contain possible construction materials.
C	This zone has GOOD land-use potential. The zone has good drainage, soft excavation can be expected and the terrain is easily accessible. Consolidation of more than 20mm can be expected. Stiffened rafts or soil rafts are suggested to be used during construction.

LEGEND:

🟨	Site Boundary
╱	Inferred Land-Use Zonal Boundary
● TP01	Trial Pit Position
🟥	Highway Servitude

Q4 FUEL CITY : PORTIONS 22 AND 44 - SCHIETFONTEIN 437 - JQ NORTH WEST PROVINCE:

FIGURE 3 : LAND-USE ZONE MAP WITH TRIAL PITS

PROJECT: JN:016/14 FILE NO: 1016

Holland-Muter & Associates CC

Engineering and Environmental Geologists
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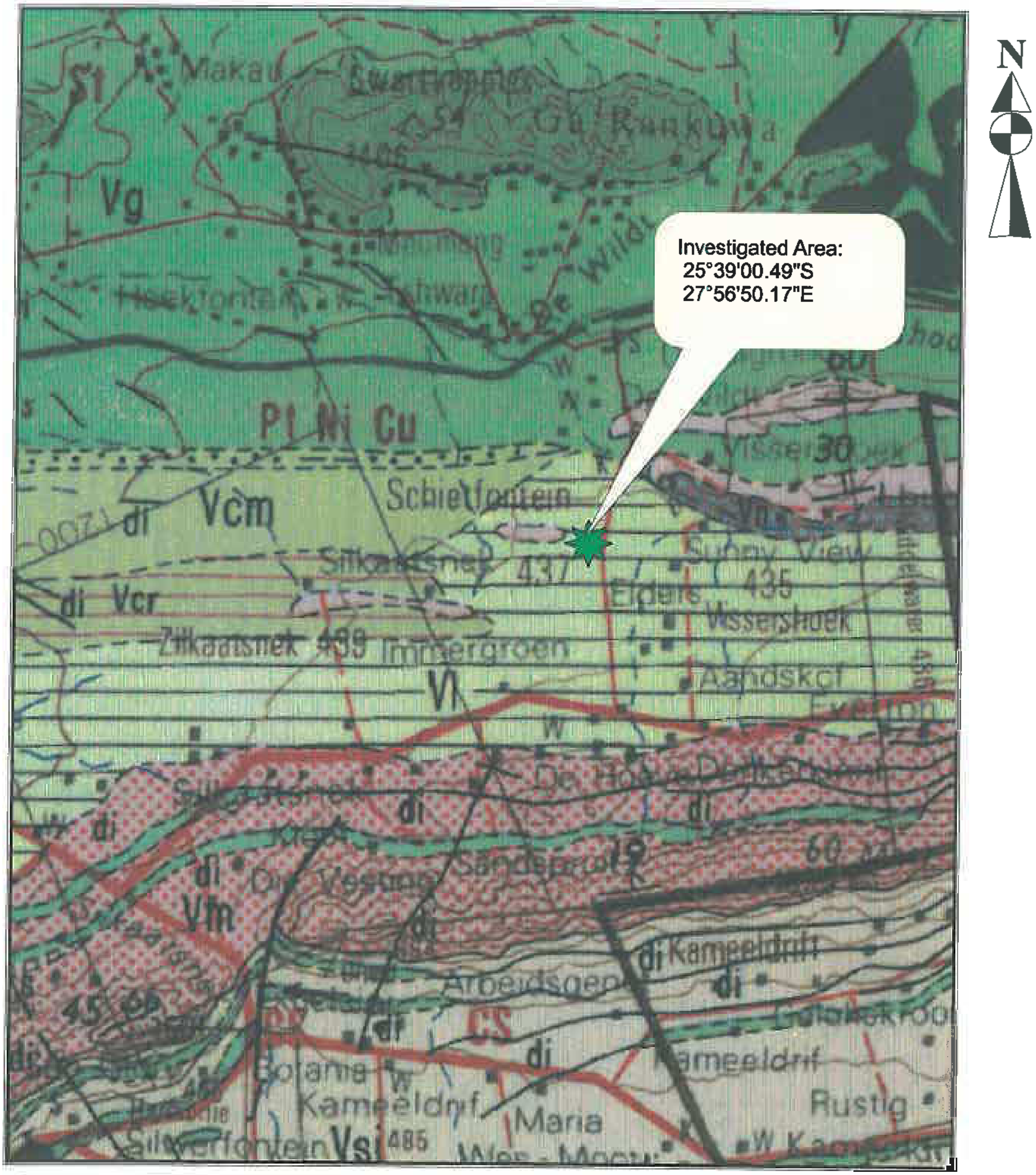
DATE: FEB-2014
SCALE: 1 : 5000
DRAWING NUMBER: Q4-H.M.-301



Investigated Area:
25°39'00.49"S
27°56'50.17"E

Legend

✷ Investigated Area

Scale 1:80000

0 1.2 2.4 km

REGIONAL GEOLOGY OF THE INVESTIGATED AREA :

Sedimentary rocks of the Pretoria group and
the Igneous rocks of the Bushveld Complex.

HOLLAND-MUTER & ASSOCIATES CC; P.O. BOX 1450; FAERIE GLEN; 0043

FIGURE 4 : REGIONAL GEOLOGY :
NORTH WEST PROVINCE : Q4 FUEL CITY

DATE: FEBRUARY 2014

DRAWING NR : 401

Hydrogeological Investigation

Annexure F2

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Hydrogeological Investigation as part of the WULA application - Q4 Fuels, North West Province

Report

Version - 1
May 2015

Q4 Fuels
GCS Project Number: 14-503
Client Reference: Q4 Fuel City

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GEOPHYSICAL AND HYDROGEOLOGICAL INVESTIGATION - Q4 FUEL

Report

Version - 1

May 2015

Q4 Fuels

14-503

DOCUMENT ISSUE STATUS

Report Issue	**1**		
GCS Reference Number	GCS Ref - 14-503		
Client Reference	Q4 Fuel City		
Title	Q4 Fuel - Geophysical and Hydrogeological Investigation as part of the WULA application		
	Name	**Signature**	**Date**
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Document Reviewer	Kobus Troskie		May 2015
Document Authorisation	Alkie Marias		May 2015

LEGAL NOTICE

EXECUTIVE SUMMARY

Introduction

GCS (Pty) Ltd was contracted by Ms. Carien de Klerk from Q4 Fuel to conduct a geophysical and hydrogeological investigation in order to comply with the Water Use License Application (WULA) process for the development of the Q4 Fuel city.

Environmental Setting

The topography of the area slope in a north westerly direction, with the groundwater flow direction from south east to north-west across the site. One non-perennial river is located 400m east of Section 1 while two non-perennial rivers are located 900m north and 1km west of Section 2.

The site is underlain by the Rustenburg Layered Suite of the Bushveld Igneous Complex, and consists of pyroxenite and norite. Diabase and dolerite formations may also be encountered in or around the site due to later geological activity. Section 1 and 2 is mostly covered with colluvium sediments eroded from the Transvaal Supergroup. Colluvium can often be composed of a wide range of sediments ranging from silt to rock fragments of various sizes.

Hydrocensus

During the initial site investigation conducted in April 2014 by GCS, 6 hydrocensus boreholes were identified within close proximity to the site. BH3 and BH4 are located approximately 300m east of Section 1 and are mainly used for potable and irrigational purposes. BH1, BH2 and BH5 are not in use. One hydrocensus borehole, BH6 located 250m north of Section 2, supplies drinking water for cattle. Groundwater levels within BH1, BH3 – BH6 ranged from 28.14 to 35.1mbgl confirming the absence of a shallow (perched) aquifer within close proximity of the site.

Monitoring Well & Production Borehole Installation

Based on the interpretation of the geophysical investigation data, the most suitable groundwater targets were identified. Two monitoring wells, QB1 and QB2, and one production borehole, QP1 were installed on Section 1, while one monitoring well, QB3 and one production borehole, QP2 were installed at Section 2.

Aquifer Tests

Aquifer testing was conducted on hydrocensus boreholes, BH3 and BH4 as well as the newly drilled production borehole, QP2. Based on the aquifer tests, the recommended sustainable borehole yield for BH3, BH4 and QP2 are 0.5l/s, 1l/s and 1.5l/s, respectively.

Water Demand

The water demand calculated for Q4 Fuel City (both Section 1 & 2) was calculated by Mr. Henk Viljoen from VIP consulting to be approximately 0.44l/s (38.4kL/day) for a 24 hour abstraction cycle.

Laboratory Analysis

Groundwater samples were collected from two hydrocensus boreholes, BH3 and BH4 as well as the newly drilled monitoring well, QB3 and production boreholes QP1 and QP2. No volatile petroleum hydrocarbons were detected in the samples collected.

Calcium concentrations recorded in BH3, BH4, QB3, QP1 and QP2 were non-compliant with the DWA water quality standards, while BH4, QP1 and QP2 indicated non-compliant magnesium concentrations. According to the DWA drinking water standards the total hardness (in terms of CaCO3) recorded in BH3 and BH4 is considered hard, while total hardness in QB3, QP1 and QP2 are considered very hard. This may cause scale on heat exchange surfaces or may result in an increase in soap required to produce lather when bathing and in household cleaning.

According to the Piper and Durov diagram all water samples are indicative of recently recharged groundwater rich in calcium, magnesium and bicarbonate.

Source – Pathway – Receptor

No source was identified on site, due to the site being in pre-construction phase and based on the laboratory results which confirmed the absence of contamination within BH3, BH4, QB3, QP1 and QP2.

The average ground water level measured on site ranged between 28 and 29.84 metres below ground level (mbgl), confirming the absence of any shallow (perched) aquifers on site and reduces the aquifer vulnerability due to the barrier (thickness of the formation and the elongated travel time for contaminants) between a potential source (filling station and the waste water discharge areas) and the aquifer underlying the site

Sensitive receptors are present in the form of groundwater users and surface water bodies within close proximity to the site. Six boreholes were identified during the hydrocensus conducted within a 2km radius of Section 1 and Section 2. Hydrocensus boreholes, BH3, BH4 and BH6 are currently in use. A non-perennial river is located 400m east, upgradient of Section 1, while two non-perennial rivers are located 900m north and 1km west, downgradient of Section 2. Based on this, the source-pathway-receptor is incomplete based on the absence of a source found on site.

Recommendations

The following recommendations are made:

- Adherence to the sustainable yield of the production boreholes is crucial to ensure long-term utilisation of the groundwater resource;
- Accurate weekly monitoring of the groundwater levels in the boreholes are recommended when abstraction occurs. If any significant fluctuation in water level occurs, immediate action needs to be taken. The conservative calculations for recharge and proper monitoring plan should prevent over-utilisation of the aquifer;
- Groundwater quality analysis must be done on a quarterly basis, once operational phase has commenced, in order to detect any contamination to the aquifer.

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LIST OF TABLES

LIST OF APPENDICES

1 INTRODUCTION

GCS Pty (Ltd) was requested by Ms. Carien de Klerk from Q4 Fuel to conduct a hydrogeological investigation in order to comply with the Water Use License Application process for the development of the Q4 Fuel city.

2 SCOPE OF WORK

The following components are proposed as the scope of work and in accordance with the requirements from the DWA for a Water Use License Application:

- Geophysical investigations for both Section 1 and Section 2 of the proposed developments (Resistivity);
- Drilling of two production boreholes on each Section of the facility as well as two monitoring wells on Section 1 and one monitoring well on Section 2;
- 24 Hour aquifer testing of production borehole, QP2 located on Section 2 and two hydrocensus boreholes, BH3 and BH4, located on Section 1;
- A review of the tank farms and the drilling of 2 x 20meter groundwater monitoring wells on Section 1 and 1 x 30meter groundwater monitoring well downgradient of the proposed tank farm on Section 2;
- Sampling, analysis and evaluation of the existing groundwater quality on site and hydrocensus boreholes;
- Update the Groundwater Reserve;
- Compilation of a hydrogeological report, with initial recommendations for resource development, management and monitoring and relevant information still required for Water Use License Application.

3 METHOLDOLOGY

3.1 Site Inspection & Data Review

An initial site inspection was undertaken to obtain information about the current status of the site, which included site layout and drainage, adjacent property land use and identifying possible drilling locations.

All topographical, geological and information, available from the public domain was accumulated.

Public domain data included:

- Google satellite images;
- 1: 50 000 Topographical Maps;
- 1: 250 000 Geological Maps;
- 1: 500 000 Hydrogeological Map;
- Groundwater Databases, NGA (National Groundwater Archive).

3.2 Site Investigation

Subsequent to completion of the data review and initial site visit, the site investigation was undertaken. This included the following:

3.2.1 Hydrocensus and Receptor Survey

A detailed hydrocensus was conducted within a 1km radius of the site to identify the presence and use of existing boreholes. Well depths were determined and static water levels were recorded.

3.2.2 Geophysical investigation

Electrical resistivity is the geophysical method that is least affected by power line noise and infrastructure. DC current is directly injected into the ground through 2 current electrodes and the potential difference measured by the 2 potential electrodes. Up to 64 electrodes are inserted at a time and measured in various arrays of potential and current pairs to produce an image of the sub-surface electrical properties which in turn can be interpreted in terms of the local geology and contaminant plume locations. This is the electrical method with the highest resolution for mapping the near surface (app. 0 - 50m) by using a dense electrode distribution. Based on the interpretation of the geophysical investigation data, the most suitable targets will be identified for drilling.

3.2.3 Production Borehole and Monitoring Well Installation

The drilling and construction of two production boreholes as well as three monitoring wells will be conducted by means of an air percussion drill rig. This will consist of 8" boreholes, 30 meters of casing allowed for, and the remainder of the borehole will be drilled 6.5" up to a depth of 80 meters below ground level (or 10m below groundwater level).

3.2.4 Groundwater Sampling and Analyses

The newly drilled monitoring wells and production boreholes were inspected. The static water levels and total depth were recorded. The following parameters were analysed for:

- Anion and cations;
- pH, Total Dissolved Solids (TDS), Bicarbonates, Electrical Conductivity (EC), and Total Hardness;
- Gasoline Range Organics (GRO) - BTEXN - fully speciated (including o- and m,p-Xylenes), MTBE, TAME, Trimethylbenzene (fully speciated 1,2,4 and 1,3,5-trimethylbenzenes);
- Diesel Range Organics (DRO) (C_{10}-C_{20}); and
- Polycyclic Aromatic Compounds (PAH).

4 SITE DESCRIPTION

The site is located between Pretoria and Brits, on the N4 highway where it intersects the M21 secondary road. The proposed sites are on opposite sides of the N4 and are demarcated as Section 1 and Section 2 (Figure 5-1)

Section 1 is situated on a portion of a game lodge and occupies about half of the property. This area contains 5 boreholes of which 4 already have pumps installed and only 2 boreholes are used for water supply to the dam on the property and to a holding tank for the game lodge (refer to Appendix A - Photographic Log). The owner of Section 1 had no previous recorded data for any of the boreholes.

Section 2 is less developed with the area mainly used for grazing of livestock. The site however has running water supplied by the single borehole on site. The pump system is welded to the borehole casing as a preventative measure against theft. The pump is installed to approximately 15 meters below the static water level (swl). The property to the north adjacent to the proposed site, farms with grass which requires large amounts of water.

5 ENVIRONMENTAL SETTING

5.1 Topography

The topography of the area surrounding the site slopes in a north westerly direction according to the observations on site as well as the 1:50 000 topographical map. The presumed groundwater flow direction for the site is from south east to north-west across the site.

5.2 Hydrology

The surface water features identified from the 1:50 000 topographical map as well as the latest Google Earth Imagery have been tabulated below in Table 5-1.

Table 5-1: Hydrological Features in Close Proximity to the Site

Hydrological Feature	Distance from site	Direction
Non-perennial river	400m	East, upgradient of Section 1, flows in a northerly direction
Non-perennial river	900m	North, downgradient of Section 2, flows in a north westerly direction
Non-perennial river	1km	West, downgradient of Section 2, flows in a northerly direction

5.3 Geology & Hydrogeology

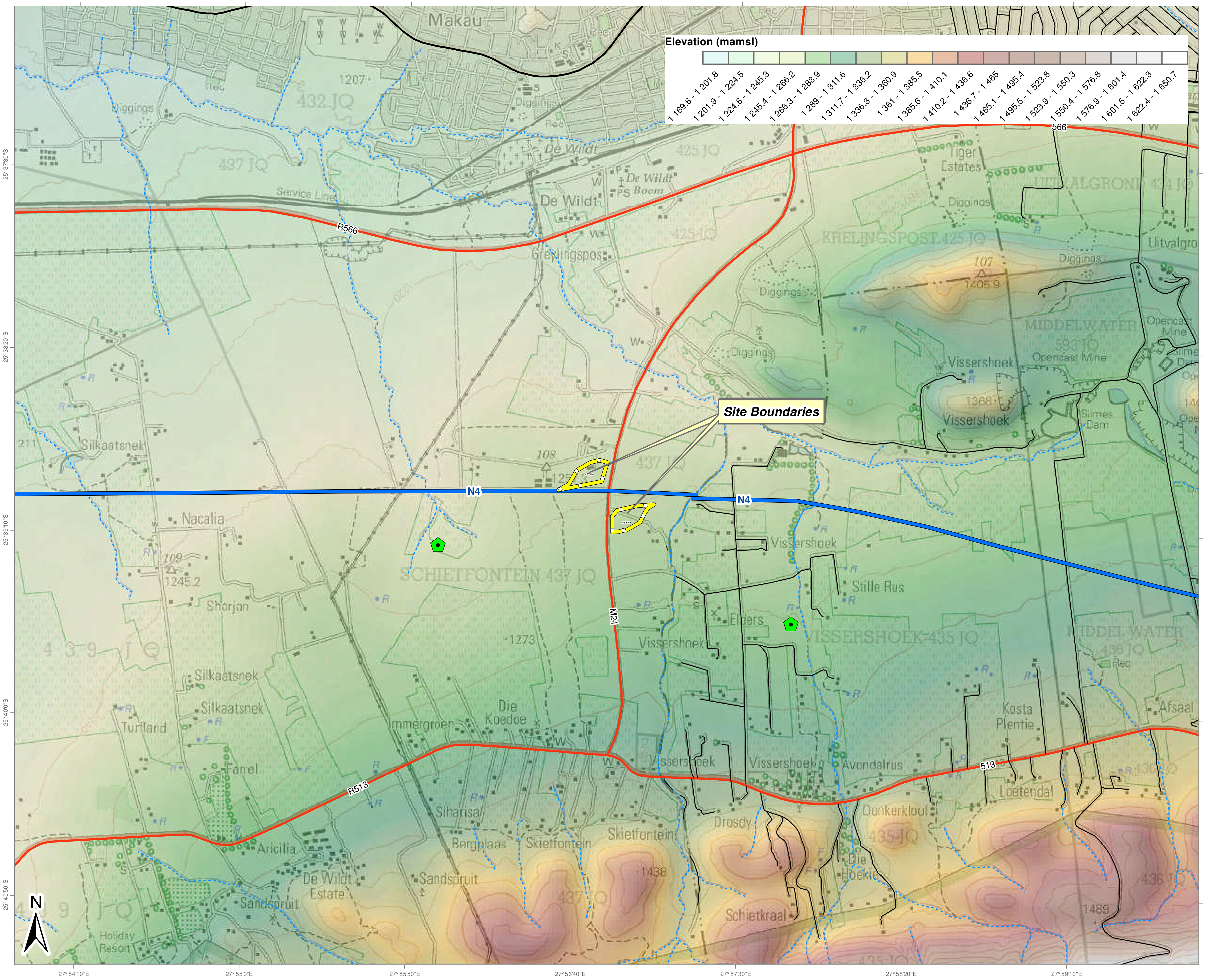
The site is underlain by the Rustenburg Layered Suite of the Bushveld Igneous Complex, and consists of pyroxenite and norite (Figure 5-2). Diabase and dolerite formations may also be encountered in or around the site due to later geological activity. Section 1 and 2 is mainly covered with colluvium sediments eroded from the Transvaal Supergroup. Colluvium is a general name for loose, unconsolidated sediments that have been deposited at the base of hillslopes. Colluvium can be composed of often a wide range of sediments ranging from silt to rock fragments of various sizes.

An evaluation of the geological map sheet Rustenburg (2526), 1:250 000 (Council for Geoscience, 1978 2nd edition) revealed the presence of an contact zone approximately 600m north west of Section 2 consisting of quartzite of Rooiberg Group.

According to the 1:500 000 Hydrogeological map series Johannesburg (2526), the site is underlain by an intergranular and fractured aquifer (ultramafic/mafic intrusive rocks – dolerite, diabase, gabbro, norite, carbonatite, anorthosite and pyroxenite) with an average borehole yield between 0.5 and 2l/s.

Two NGA (National Groundwater Archive) boreholes are located within a 2km radius of the site.

FIGURE 5.1: TOPOGRAPHY



LEGEND

⬠ NGA Boreholes

Road Network

National Route

Main Road

Secondary Road

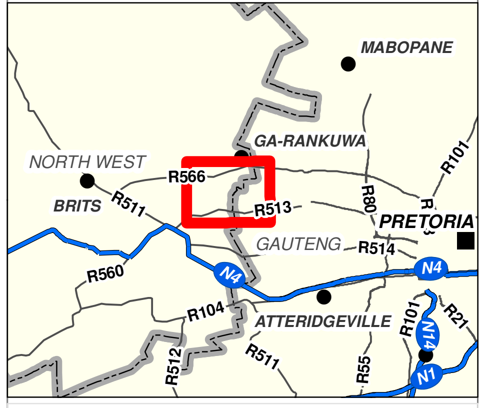
Street

Rivers and Streams

Non-Perennial

Perennial

Site Boundary



DATA SOURCES:
RSA National Geospatial Institute
1:50 000 Topographical Series: 2527BD

0 0.25 0.5 1 Kilometers
SCALE: 1:30 000

FIGURE NO.: -
MAP NUMBER: 14-503-02
DRAWN BY: NK NDALA
GIS TECHNICIAN
REVIEWED BY: A.J. MAIN
GIS SPECIALIST
DATUM: WGS84
PROJECTION: GEOGRAPHIC
DATE: 29 SEPTEMBER 2014
PROJECT: Q4 FUEL CITY - WATER SUPPLY (FUEL CITY N4)
CLIENT: Q4 FUELS

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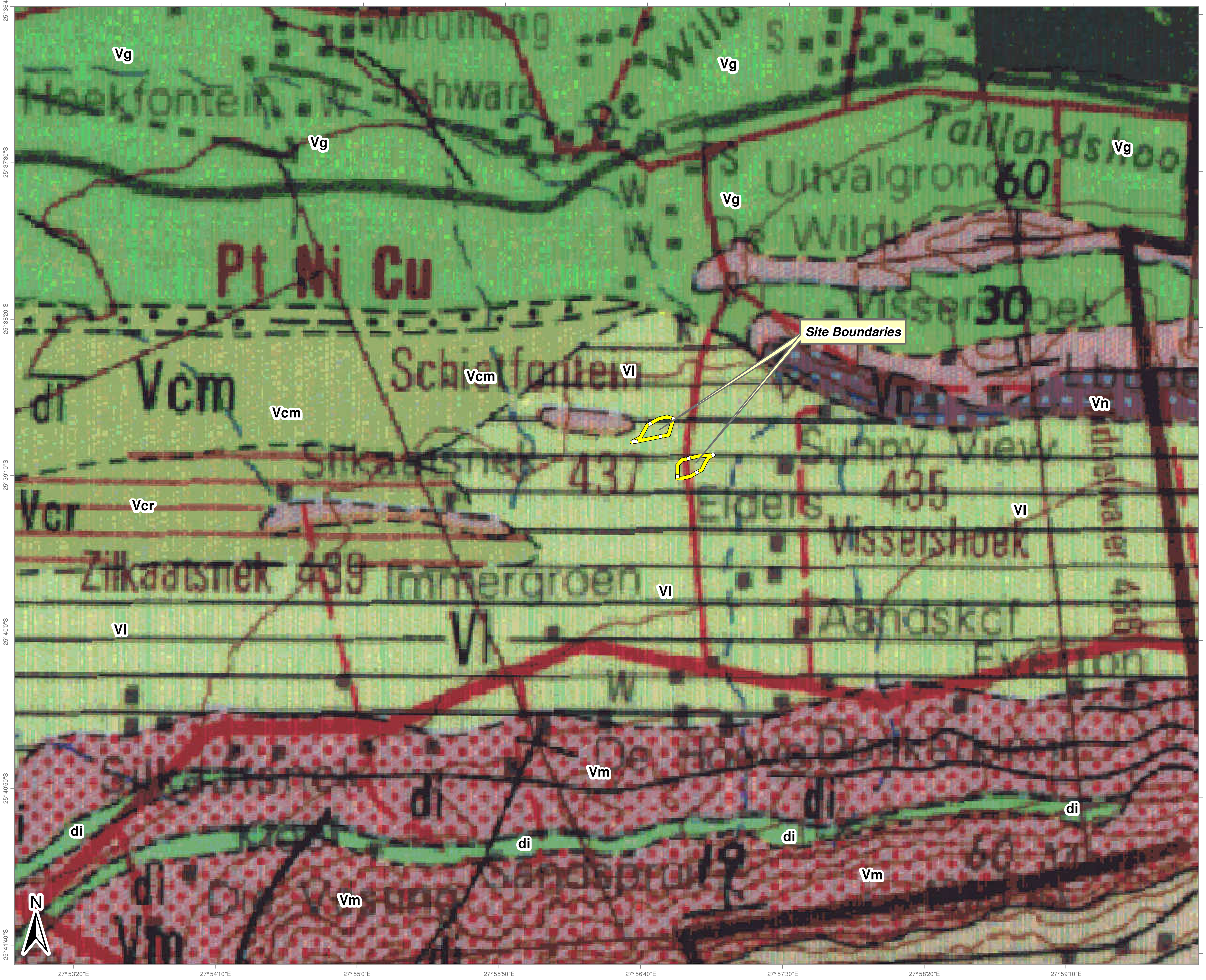
FIGURE 5.2: GEOLOGY



LEGEND

▭ Site Boundary

Lithology

di = Diabase

Vcm = Norite,Anorthosite

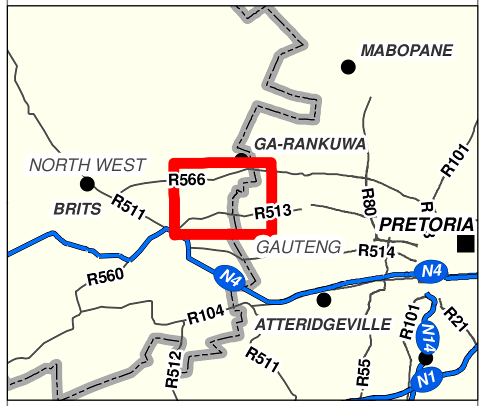
Vcr = Pyroxenite,Lower chromitite
Vl = Hybrid gabbro, gabbro, norite

Vr = Quartzite, shale, subgraywacke

Vg = Gabbro, norite, anorthosite

Vm = Quartzite, minor hornfels

Vn = Norite Hybrid rocks,
diabase,epidiorite



DATA SOURCES:

Council for Geoscience
1:250 000 Geological Series: 2526

0 0.25 0.5 1 Kilometers
SCALE: 1:35 000

FIGURE NO.:	-	MAP NUMBER:	14-503-03
DRAWN BY:	NK NDALA GIS TECHNICIAN	REVIEWED BY:	A.J. MAIN GIS SPECIALIST
DATUM: PROJECTION:	WGS84 GEOGRAPHIC	DATE:	29 SEPTEMBER 2014
PROJECT:	Q4 FUEL CITY - WATER SUPPLY (FUEL CITY N4)		
CLIENT:	Q4 FUELS		

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6 DETAILED SITE INVESTIGATION

This investigation, conducted during September 2014, entailed a site walkover, monitoring well installation, groundwater sampling and aquifer testing. A detailed hydrocensus was conducted by GCS in April 2014.

6.1 Neighbouring land survey

A neighbouring land survey was conducted for the site in order to prepare a list of adjacent land use as detailed in Table 6-1 below.

Table 6-1: Neighbouring Land Use

Locality with regards to site	Land Use
North	Agriculture
East	Open land
South	Residential and open land
West	Residential and open land

6.2 Hydrocensus

During the initial site investigation conducted by GCS in April 2014, 6 hydrocensus boreholes were identified within close proximity to the site. The static water level ranged from 28.14 to 35.1 meters below ground level (mbgl). It was also determined that all of the boreholes are more than 90m deep from interviews with the owners and from the depth that the pumps were installed. The hydrocensus borehole details are tabulated in Table 6-2 below.

Table 6-2: Hydrocensus Borehole Details

Borehole ID	Coordinates		Depth (m)	SWL (mbgl)	Use	Comments
	S	E				
Section 1						
BH1	-25.653596	27.951410	-	33.8	Not in use	Fitted with a submersible pump
BH2	-25.653246	27.951275	-	-	Not in use	
BH3	-25.651373	27.953246	-	33.56	Water supply for lodge, used for both potable and irrigational purposes	
BH4	-25.650690	27.953283	48	35.1		
BH5	-25.653386	27.952118	100m+	32.7	Not in use	No pump installed
Section 2						
BH6	-25.644970	27.946754	-	28.14	Drinking water for cattle	Fitted with a submersible pump

Section 1 is located on a game lodge, which contains a variety of antelope species which depends on the local vegetation and water supplied from the boreholes on site. Currently borehole, BH3 and BH4 are being used simultaneously to provide water to the game lodge.

Section 2 is used for cattle grazing which is dependent on the local vegetation and water supplied to the cattle from a single borehole on site (BH6). This borehole has a pump installed, which, according to the owner (Jannie), is installed about 15 meters below the static water level. The location of all hydrocensus boreholes are presented in Figure 6-4.

6.3 Electrical Resistivity Tomography Method and Survey Design

The ERT was performed with a standard ABEM SAS1000 Lund imaging system with four 100m multicore cables each with 21 electrode take-outs. Three electrical resistivity survey traverses (Q4003, Q4004, Q4005 and Q4006), with electrode spacing of 5m, were surveyed using the standard Wenner protocol around the selected target areas (sections 1 and 2) on the site (Figure 6-1). Traverses Q4003, Q4004 were surveyed around section 1 while the Q4005 and Q4006 were surveyed around section 2. The traverses Q4004 and Q4005 were surveyed 400m almost north-south orientation while Q4003 and Q4006 were surveyed east-west. The traverses Q4004, Q4005 and Q4006 were all 400m long while Q4003 was 600m long.

Once the ERT survey was completed, the 2D measured resistivity data were accordingly edited, processed and ultimately inverted using a 2D inversion algorithm RES2Dinvx64 software package by Geotomo Software. The RES2DINV inversion routines involves a cell-based inversion technique where it automatically divides the 2D pseudo-section into a large number of rectangular blocks that are loosely tied to the distribution of the data points in the pseudo-section. Then an iterative non-linear smoothness-constrained least-squares optimisation technique is used to calculate the resistivity of the model blocks that provide a model response which agrees with the observed data (deGroot-Hedlin and Constable 1990). The resultant 2D tomographs were then interpreted based on the scientifically proven link between apparent resistivity characteristics and subsurface material properties in order to delineate favourable areas to place the production and monitoring targets to be drilled.

Figure 6-1: Location map showing ERT traverses.

6.3.1 Visualisation and Interpretation

The results of the ERT survey profiles for traverses Q004 and Q003 are shown in Figure 6-2. The resistivity model for Q004 exhibit two distinct apparent resistivity ranges, the first (>554 Ωm) being 37.2 mbgl deep. This upper zone represents a weathered lithology underlying which is a more resistive (≈554 Ωm) substratum.

The weathered formation usually serves as a preferred area to place groundwater yielding wells; however, the weathered zone in this case is not deep enough to serve as economical revenue for groundwater over this survey profile. Nevertheless, two low confidence monitoring wells namely QB1 and QB2 are proposed at ≈x=195 m and 215 m respectively.

The 2D resistivity model for Q003 similarly exhibiting two distinct apparent resistivity ranges, the first being ≤554 Ωm overlying a more resistive (>554 Ωm) substratum. The weathered zone is shallower (27.4mbgl) from the start of the model before it begins (at ≈x=240m) to slightly deepen to about 31.3mbgl. The weathered zone is in this case still not adequately deep enough to serve as an economical avenue for groundwater over this survey profile. However, a low confidence production well is proposed at ≈x= 300m where the weathering is relatively deeper.

The results of the ERT survey profiles for traverses Q005 and Q006 are shown in Figure 6-3 shows a 2D resistivity model for Q005 on which large variations in the resistivities of the subsurface materials are apparent giving a good insight on the possible areas to drill a required production well. A very prominent zone of low resistivity (≤67Ωm) is observed at 15.84 mbgl underlain by quite resistive values (≥67Ωm) bedrock. From the start of the model to ≈x=170m, the high resistivity zone degrades to reduced resistivity values (119Ωm-377Ωm) possibly due to the fracturing or deep weathering which may provide perfect avenues for groundwater flow. As a result, a high confidence production well is recommended for drilling at ≈x=170m.

The 2D resistivity model for Q006 is characterised by a relatively resistive (≥554 Ωm) substratum at an average depth of 15.7mbgl. Overtop is a zone with relatively suppressed resistivity values (<554 Ωm) interpreted as a 15.7m thick weathered zone. As indicated earlier, the weathered formation usually serves as a preferred area to place groundwater yielding wells if deep enough. With the shallow weathered zone shown on the model however, neither a production well nor an observation well is proposed along the survey line.

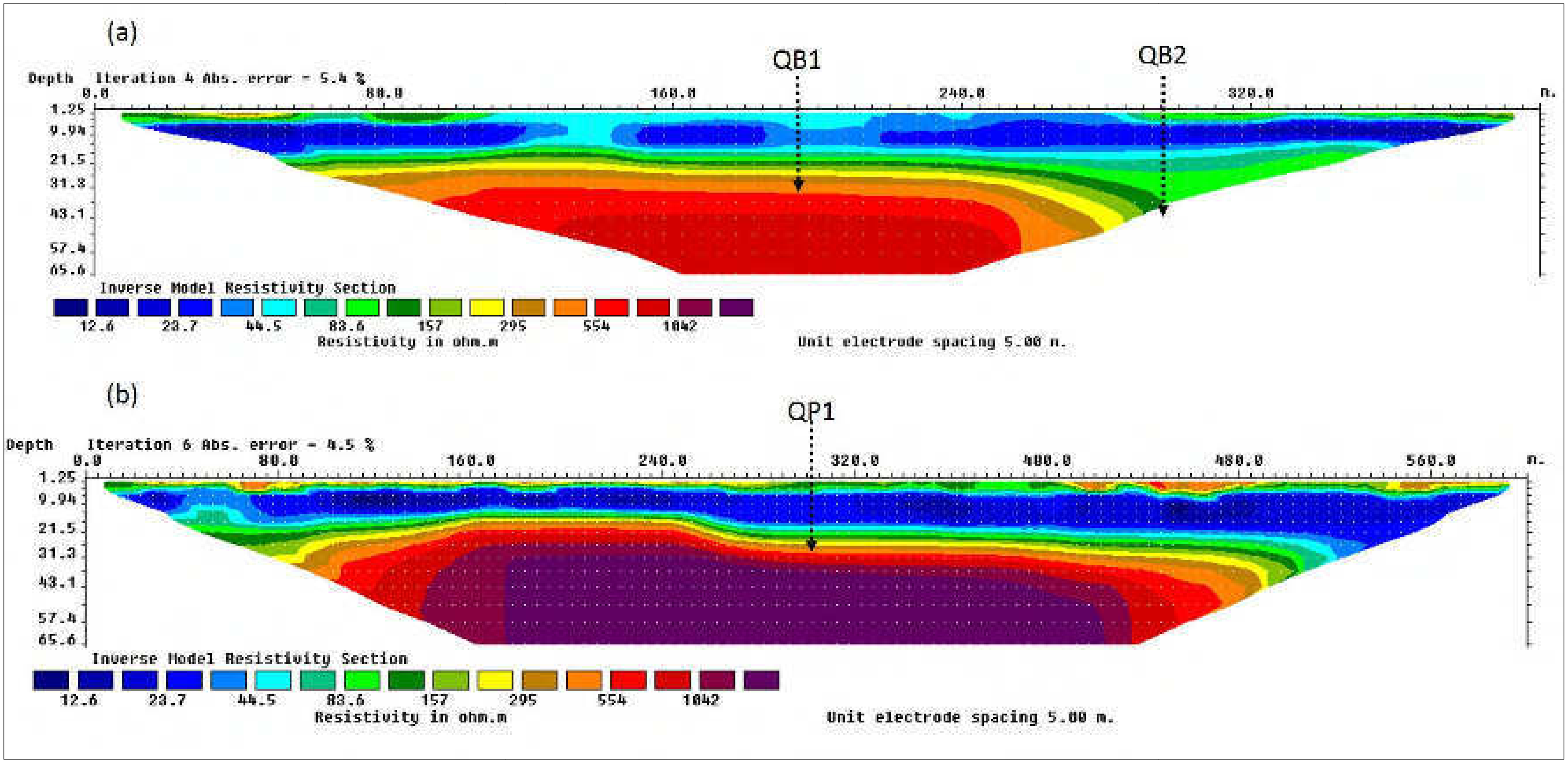


Figure 6-2: A 2D inverted resistivity data for (a) Q004 and (b) Q003 survey lines.

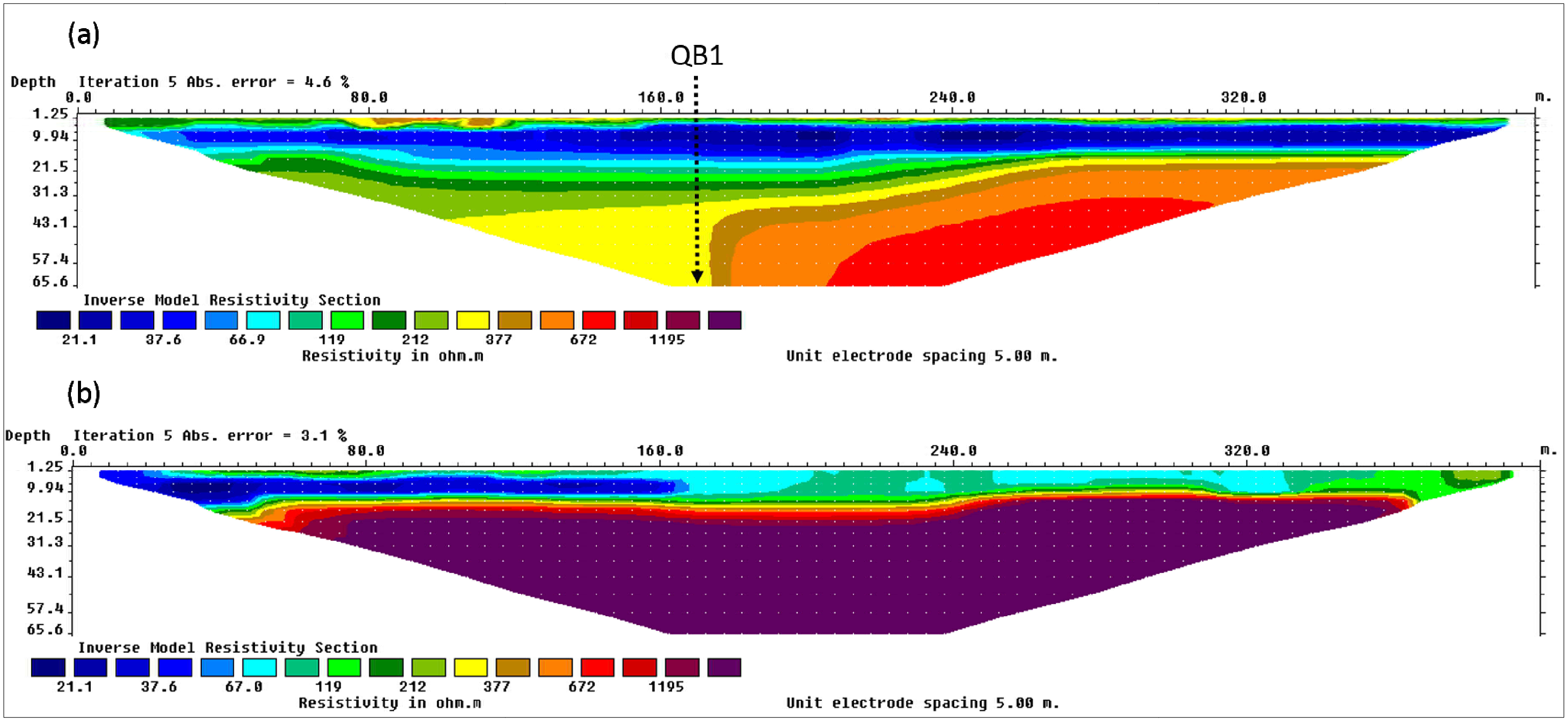


Figure 6-3: A 2D inverted resistivity data for (a) Q005 and (b) Q006 survey lines.

6.4 Borehole Installation

Based on the interpretation of the geophysical data, the most suitable groundwater targets were identified. The drilling and construction of three monitoring wells as well as two production boreholes were conducted during September 2014 by means of air percussion drilling. The borehole logs are compiled in Appendix B. The localities of the monitoring boreholes are illustrated in Figure 6-4. Groundwater was encountered in monitoring well QB3 and production boreholes, QP1 and QP2 at 28 and 29.84mbgl. The monitoring well details are presented in Table 6-3.

Table 6-3: Monitoring well details

Borehole ID	Coordinates (WGS 84, Geographic)		Depth (m)	SWL (mbgl)	Comments
	S	E			
Section 1					
QB1	-25.651795	27.948825	21	Dry	No shallow perched water level
QB2	-25.650733	27.948543	20	Dry	No shallow perched water level
QP1	-25.650752	27.950619	70	28.1	Water encountered
Section 2					
QB3	-25.647109	27.946211	31	28	Water encountered
QP2	-25.646221	27.947667	61	29.84	Water strike at 38m

Groundwater sampling was conducted in September 2014. Groundwater samples were collected from QB3, QP1 and QP2. The samples were analysed for anions, cations, pH, Total Dissolved Solids (TDS), bicarbonates, Electrical Conductivity (EC), total hardness and Volatile Petroleum Hydrocarbons (GRO’s, DRO’s, PAH, MTBE and TAME).

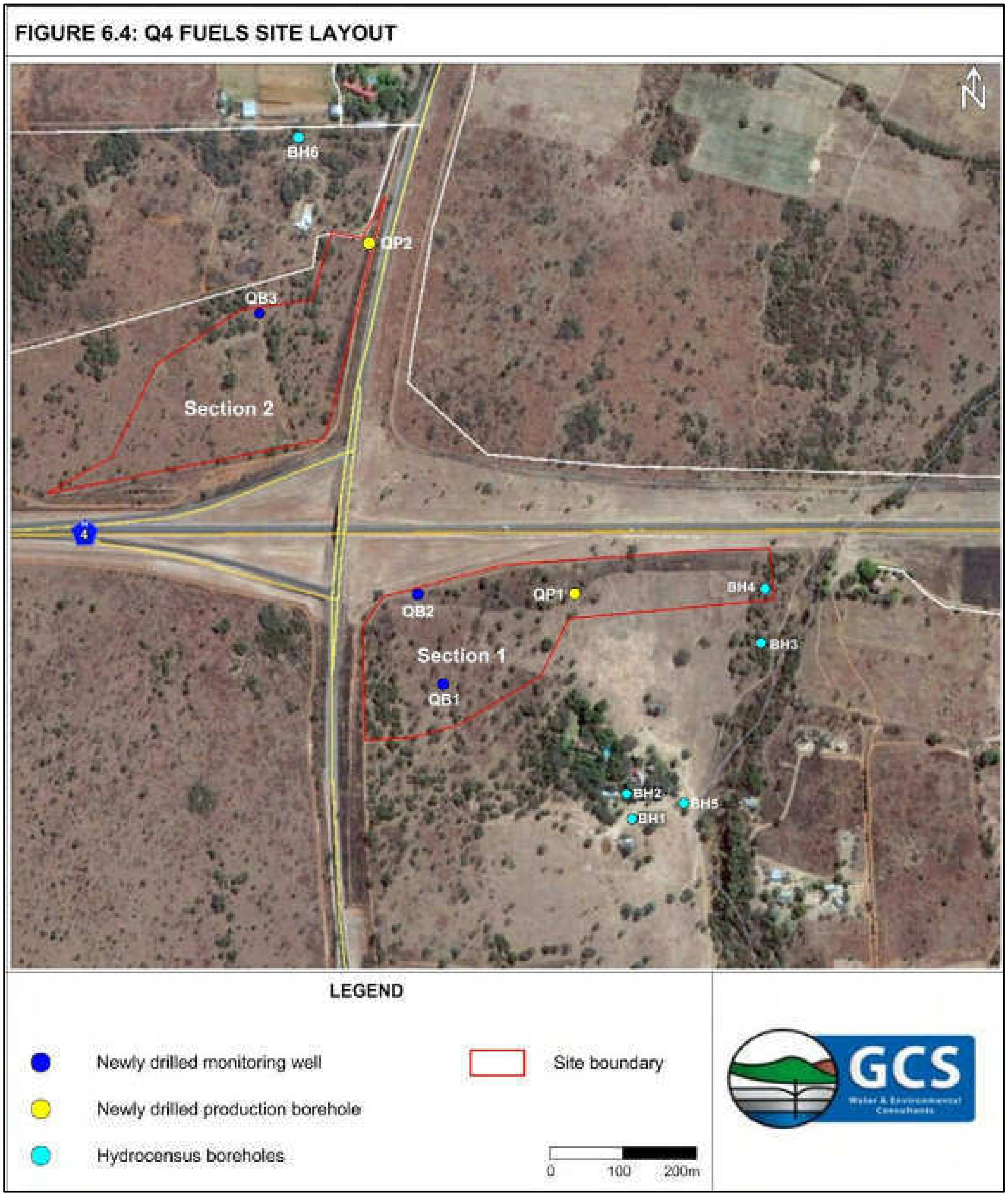


Figure 6-4: Site Layout and Hydrocensus Borehole Locality

6.5 Aquifer Testing

Aquifer testing allows for a better understanding of the hydraulic characteristics of the geological formations. One type of aquifer test, i.e. a constant rate pump test, was conducted on two of the boreholes, BH3 and BH4 as well as the newly drilled production borehole, QP2.

The aquifer testing included the following:

- A twenty four (24) hour constant rate pump test where water is abstracted at a constant rate (determined during the calibration test) and water level measurements were taken at set time intervals;
- Once the constant rate pump test was completed the borehole water level was allowed to recover to at least 90% with measurements being taken at set time intervals.

6.5.1 Borehole 3 - Section 1

The data collected from borehole 3 on Section 1 are compiled in Appendix C. The drawdown in total was 3.64 meters with a recovery time of 2 hours. The borehole was fitted with a pump, thus the test was carried out with the current pump that was installed. Figure 6-5 illustrates the drawdown/recovery versus time recorded in the borehole. According to the pump test data and subsequent analysis, the borehole can be pumped at 0.5l/s over a 24 hour period.

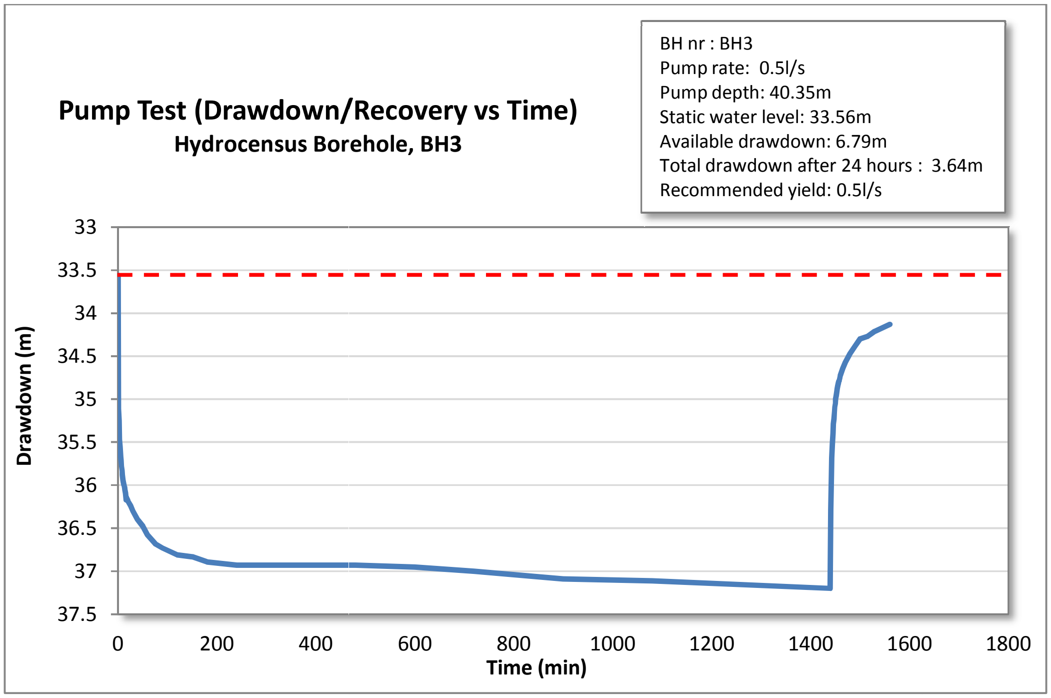


Figure 6-5: Aquifer Test for BH3

6.5.2 *Borehole 4 - Section 1*

The data collected from borehole 4 on Section 1 are compiled in Appendix C. The drawdown in total was 5.82 meters with a recovery time of 5 hours. Figure 6-6 illustrates the drawdown/recovery versus time recorded in the borehole. According to the pump test data and subsequent analysis, the recommended borehole yield is 1l/s over a 24 hour period.

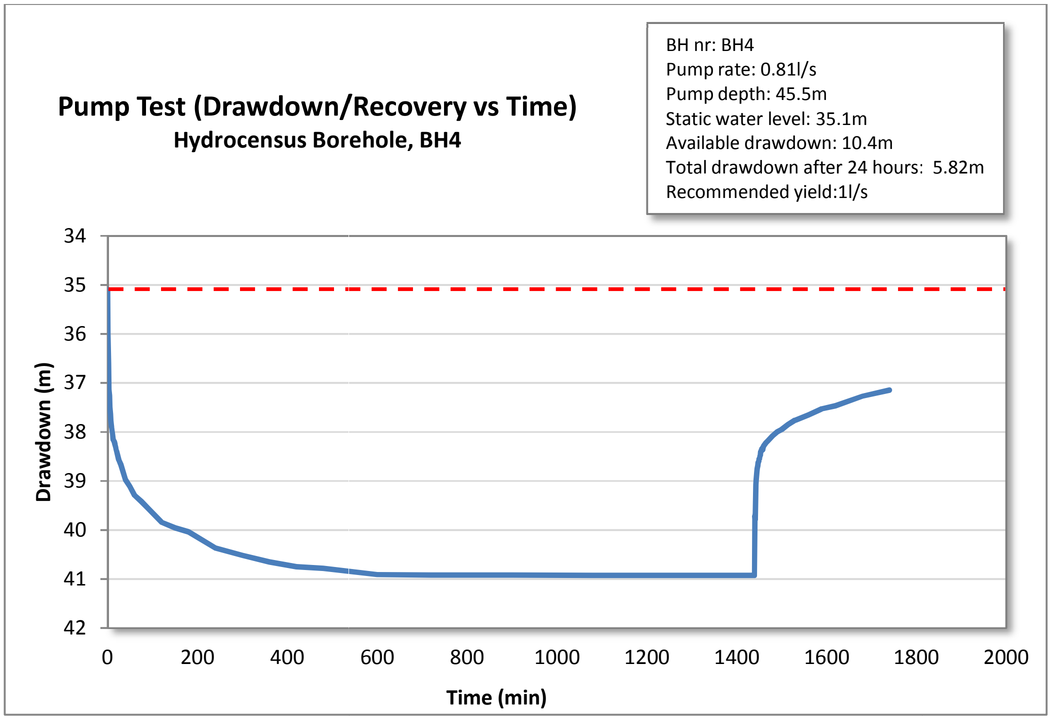


Figure 6-6: Aquifer Test for BH4

6.5.3 *Production borehole, QP2 - Section 2*

The data collected from the newly drilled production borehole, QP2 on Section 2 are compiled in Appendix C. The drawdown in total was 17.8 meters with a recovery time of 1 hour. The available drawdown is 26.16m measured from the static water level. Figure 6-7 illustrates the drawdown/recovery versus time recorded in the borehole. According to the pump test data and subsequent analysis, the recommended borehole yield is 1.5l/s over a 24 hour period, since the 90% recovery takes 1 hour.

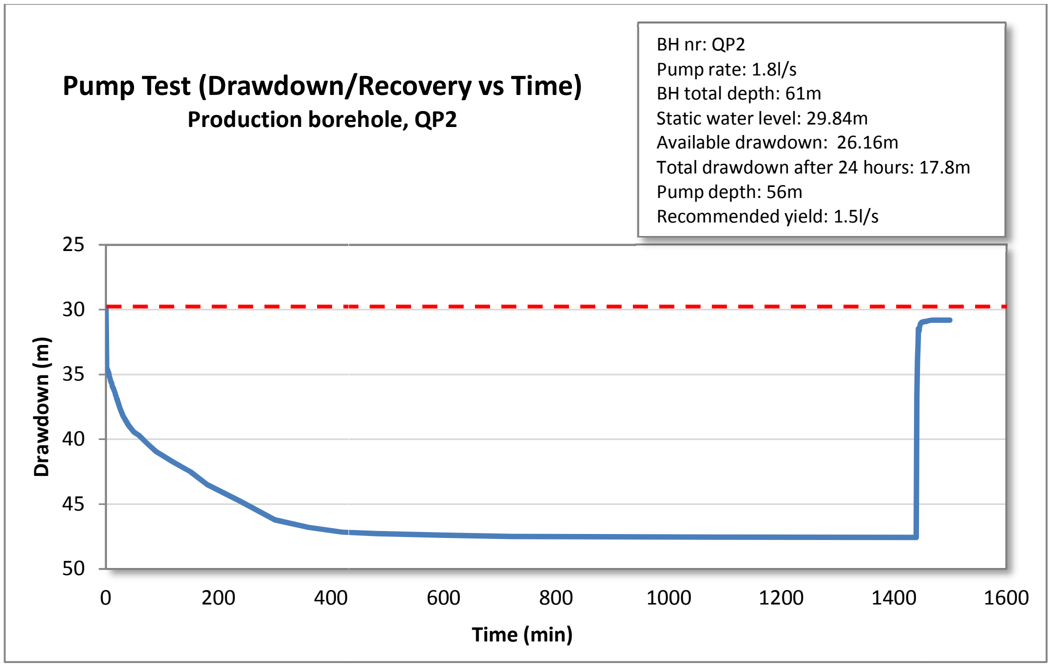


Figure 6-7: Aquifer Test for Production Borehole, QP2

6.5.4 Aquifer test results and abstraction schedules

A summary of the 24 hour pump test results are compiled in Table 6-4 below.

Table 6-4: Pumping Test Results for BH3, BH4 and QP2

Borehole ID	Drawdown (24hr)	SWL (mbgl)	Pumping Rate (l/s)	Pump Depth (m)	Transmissivity (m^2/day)	Aquifer Characterisation
BH3	3.64	33.56	0.5	40.35	**6.61**	Weathered aquifer
BH4	5.82	35.1	0.81	45.5	**8.25**	
QP2	17.75	29.84	1.8	56	**15.5**	Good fracture zone with bilinear flow

L/s - Litres per second
mbgl – Meters below ground level

The sustainable borehole yield is calculated using the FC method over a 12 hour period as tabulated in Table 6-5 below. In total 111.6m^3/day can be abstracted from BH3, BH4 and QP2 as water supply for the Q4 Fuel site.

Table 6-5: Sustainable Borehole Yield from aquifer

Borehole ID	Recommended sustainable yield from FC method 18 hour abstraction *	Daily abstraction m3/day
BH3	0.5l/s for 18 hours	32.4
BH4	1l/s for 18 hours	64.8
QP2	1.5l/s for 18 hours	97.2

7 INTERMEDIATE RESERVE DETERMINANTION

The Intermediate Groundwater Reserve Determination takes into account the following parameters:

- Effective Recharge from Rainfall and specific geological conditions;
- Area of the sub-catchment delineated for the site;
- Basic Human needs for the site;
- Groundwater contribution to surface water (baseflow);
- Existing abstraction (hydrocensus borehole data was used);
- Surplus if any available for abstraction.

7.1 Rainfall Recharge

The effective groundwater recharge from rainfall is the portion of rainfall that reaches the groundwater. The remainder of the rainfall comprises surface water runoff, evapotranspiration and soil moisture.

The effective rainfall-recharge is dependent on the catchment geology, soils, surface run-off and stream morphology but most importantly for the study area, the effective storage.

7.1.1 Literature Review

Data from relevant hydrogeological databases including, the Groundwater Resource Directed Measures (GRDM) was obtained from the Department of Water Affairs. The proposed site area fall within quaternary catchment: A21J, as indicated in Table 7-1 (and Figure 7-2).

Table 7-1: Summarized Quaternary Catchment Information (GRDM, 2012)

Quaternary Catchment	Total Area (km^2)	Recharge mm/a	Current use Mm^3/a	Exploitation Potential Mm^3/a	Rainfall mm/a
A21J	1150.2	26.01	4.64	8	637

According to Brendenkamp et al (1995) the rainfall recharge for the Bushveld Igneous Complex in the quaternary catchment, is between 2-5% of the MAP (Mean Annual Precipitation). However, the aquifer conditions are site specific and need to be recognized for the site.

The entire delineated sub-catchment falls within the A21J quaternary drainage area, therefore the rainfall is seen to be equal across the site, i.e. 637mm/annum. The groundwater recharge is taken as 2.5% of MAP (based on literature review).

Therefore, recharge for the delineated sub-catchment can be calculated as:

2.5% of MAP (637 mm) = 0.015925 m/annum.

Rainfall recharge = 0.015925m x ± 23km^2 (size of the sub-catchment as delineated)

The rainfall recharge to the sub catchment = ±1 003.5m^3/day or 366 275m^3/a.

7.2 Sub-catchment delineation

In order to delineate a sub-catchment within the A21J quaternary catchment the following principles were used in ArcGIS, which provides a method to describe the physical characteristics of a surface. Using a digital elevation model as input, it is possible to delineate a drainage system and then quantify the characteristics of that system. The tools in the extension let you determine, for any location in a grid, the upslope area contributing to that point and the down slope path water would follow.

When delineating watersheds or defining stream networks, you proceed through a step process (see Figure 7-1). Flow across a surface will always be in the steepest down slope direction. Once the direction of flow out of each cell is known, it is possible to determine which and how many cells flow into any given cell. This information can be used to define watershed boundaries and stream networks. The following flowchart shows the process of extracting hydrologic information, such as watershed boundaries and stream networks, from a digital elevation model (DEM).

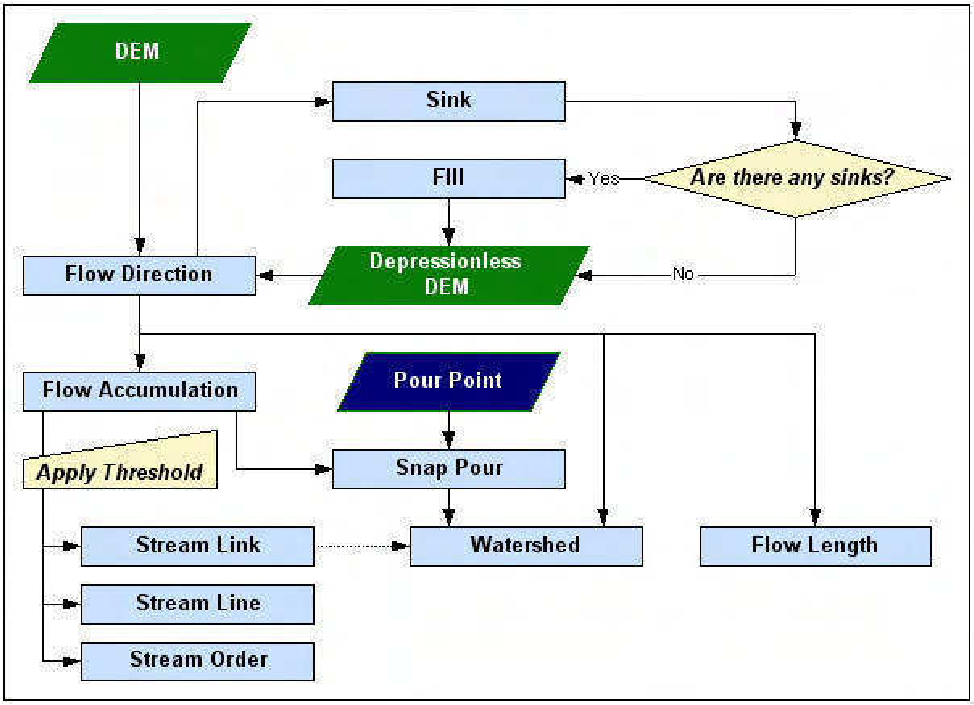


Figure 7-1: Steps to derive surface characteristics from a DEM.

From the DEM you find out the flow direction between cells. However, if there are errors in the DEM there may be some cell locations that are lower than all the surrounding cells. If this is the case, all water travelling into the cell will not travel out. These depressions are called sinks. The hydrologic analysis extension allows you to identify the sinks and gives you tools to fill them. The result is a depressionless DEM. You then determine the flow direction on this depressionless DEM.

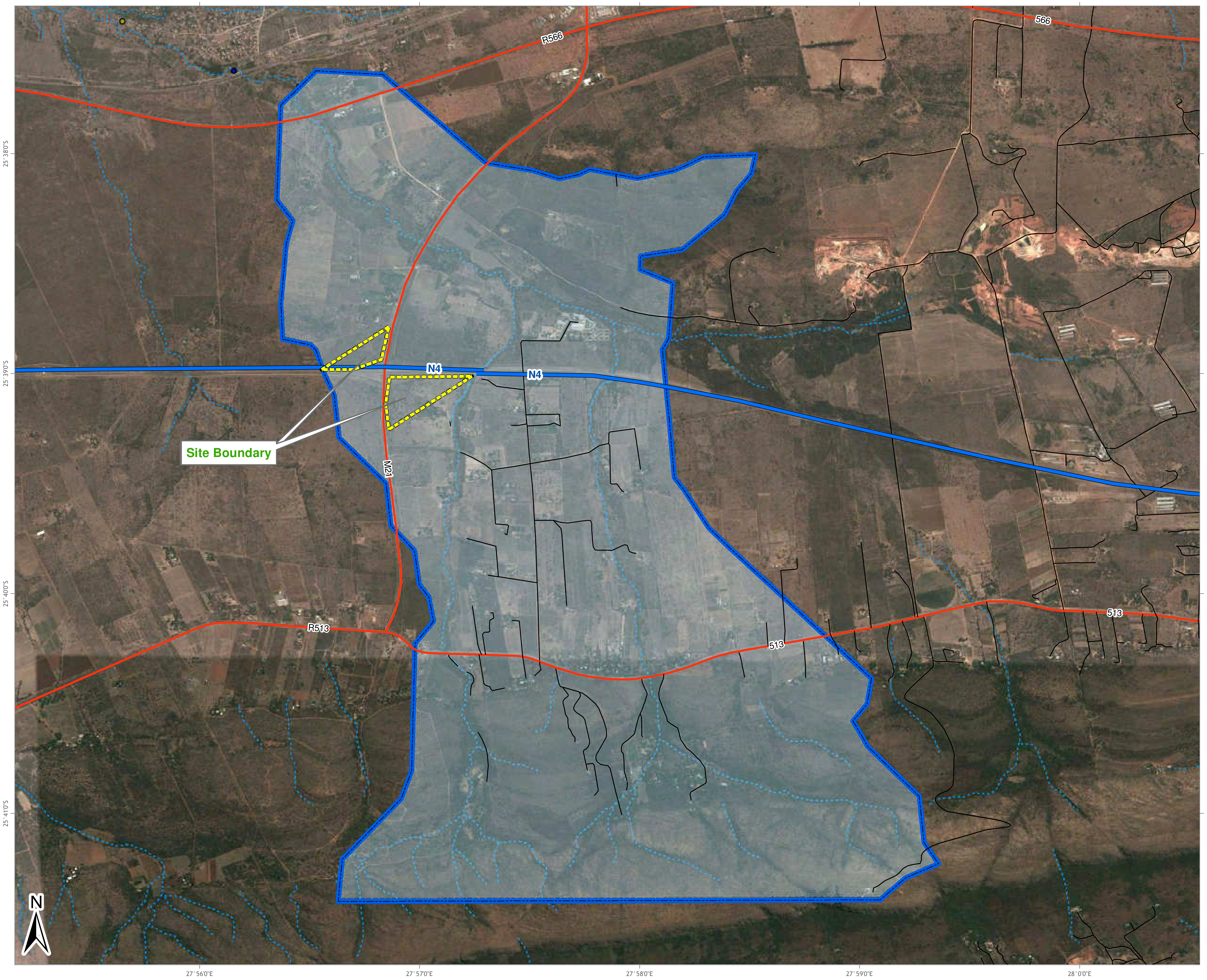
If you are delineating watersheds, you then need to identify pour points, which are locations where you wish to know the contributing watershed. Usually these locations are mouths of streams or some other hydrologic point of interest. In the hydrologic analysis extension, you can specify your pour points or you can use of the stream network as the pour points. In the latter case, to create the stream network you must first calculate the flow accumulation for each cell location.

The next step is to delineate the watershed. A watershed is the up slope area contributing flow to a given location. The watershed is also referred to as a basin, catchment, subwatershed, or contributing area. A subwatershed is simply part of a hierarchy implying that a given watershed is part of a larger watershed.

The input to the “watershed dialog” (tool within the hydrologic analysis extension) defining how the watersheds will be delineated is either by a flow accumulation threshold or pour points in a shapefile. When the threshold is used to define a watershed the pour points for the watershed will be the junctions of a stream network derived from flow accumulation. Therefore, a flow accumulation raster must be specified as well as the minimum number of cells that constitute a stream. The result would be a spatial raster dataset representing the watersheds within the project area with the minimum surface area as specified.

Figure 7-2 shows the sub-catchment, which contains the proposed Q4 Fuels site localities. The sub-catchment covers an area of approximately 23km^2.

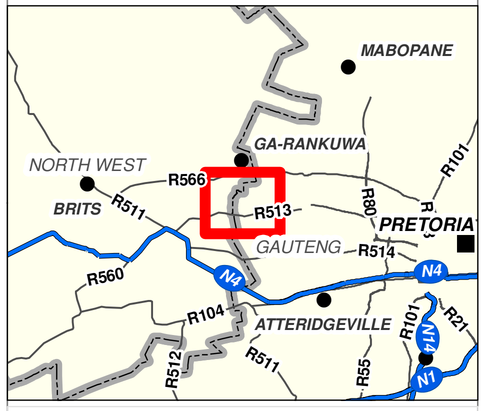
FIGURE 5.3: SUB-CATCHMENT



LEGEND

Rivers and Streams
- Non-Perennial
- Perennial

Road Network
- National Route
- Main Road
- Secondary Road
- Street
- Sub-Catchment Area
- Q4 Fuel Sites



Data Sources:Google Earth™ mapping service: 2014
Imagery Date:26-10-2013

0 0.25 0.5 1 Kilometers

SCALE: 1:30 000

FIGURE NO.:	-	MAP NUMBER:	14-503-04
DRAWN BY:	NK NDALA GIS TECHNICIAN	REVIEWED BY:	A.J. MAIN GIS SPECIALIST
DATUM: PROJECTION:	WGS84 GEOGRAPHIC	DATE:	07 OCTOBER 2014

PROJECT: SASOL PE PHASE I TANK REMOVAL (PORT ELIZABETH)
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7.3 Basic Human Need

The basic human needs are set by the Water Services Act (Act No. 108 of 1997) at 25l per person per day. The reserve is calculated by multiplying the number of people living within the confines of a source unit by 25l/day.

The existing abstraction per household (approximately 73 identified) within the sub-catchment is 2.5m^3/day, this equals to 182.5m^3/day.

7.4 Groundwater Contribution to Baseflow

Baseflow is the low flow in a river during dry or fair weather conditions, but not necessarily all contributing to groundwater, baseflow includes contributions from delayed interflow and groundwater discharge. The baseflow of groundwater into surface water bodies in the study area is recognized to be negligible; around 3mm/a thus 25.185m^3/day (GRDM, 2012).

7.5 Proposed Abstraction

The proposed abstraction at the Q4 Fuel City is 0.44ℓ/s or 1598.4ℓ/hour, which amounts to 38 361.6ℓ if pumped for 24 hours, thus an average of 38.4m^3/day will be used by the Q4 Fuel site. According to the aquifer tests the recommended sustainable abstraction for the Q4 Fuel site is 111.6m^3/day.

7.6 Existing Abstraction

Low scale abstraction is present within the sub-catchment with small scale stock watering taking place on Section 2. The abstraction for approximately 50 cattle is 1000l/day thus 1m^3/day.

The average abstraction for water supply on the game lodge is 15m^3/day.

Based on the Department of Water Affairs and Forestry's "Requirements for Water Use License Application: Groundwater Abstraction [S21(a)]", GCS have revised their hydrogeological report to provide all required data. The Recommended Required Information includes:

- An Initial Regional assessment to determine the amount of information necessary for each new Water Use License Application for abstraction from groundwater, based on the amount of recharge that is used by the applicant in relation to the specified property.

- Categories A, B and C with the applicable list of information requirements for the license application, as should be provided by the applicant to the Department of Water Affairs & Forestry (DWAF).

Regional - Initial

- Size sub-catchment (AREAPROP)
- Recharge - HP (RE)
- Existing use volume (ABSEX)
- New use volume (ABSNEW)
- Scale of abstractions (ABSSCALE)

CALCULATION

AREAPROP * RE – REAREA (m^3/a)
ABSEX + ABSNEW = ABSTOTAL (m3/a)
ABSSCALE = (ABSTOTAL / REAREA) * 100

Small scale abstraction (<60% recharge on catchment)	**Category A**
Medium scale abstraction (60-100% recharge on property)	**Category B**
Large scale abstraction (>100% of recharge on property)	**Category C**

Size of sub-catchment (AREAPROP)	2300 ha = 23 km^2
Recharge - HP (RE) 2.5% of the Annual precipitation (637mm)	= 1 003.5m^3/day
New use volume (ABSNEW)	= 38.4m^3/day
Existing use volume (ABSEX)	= 198.5m^3/day
Scale of abstractions (ABSSCALE)	= 23.61%

Small scale abstraction - Category A: 23.61% of the recharge.

7.7 Summary of Water Balance Calculations

Rainfall Recharge:	+1 003.5m^3/day
Existing Abstraction and Basic Human Need:	-198.5m^3/day
Groundwater Contribution to Baseflow:	-25.185m^3/day
Recommended Abstraction for the Q4 Fuel site:	-38.4m^3/day
Surplus Amount:	**+741.4m^3/day**

From the water balance calculation it is evident that groundwater can be abstracted as a viable source for water supply to the Q4 Fuel station.

8 GROUNDWATER ANALYSIS

Groundwater samples were collected from two hydrocensus boreholes, BH3 and BH4 as well as the newly drilled monitoring well, QB3 and production boreholes QP1 and QP2. These samples were transported to UIS Organics laboratories located in Centurion. The laboratory results are presented in Appendix D.

The results obtained from the laboratory were compared against the RBCA (Risk-Based Corrective Action) Tier 1 Exposure Scenario for each complete or potentially complete exposure pathway and compared to the appropriate representative contaminant concentrations.

The term Risk-Based Corrective Action (RBCA) refers to a consistent, methodical decision-making process used to assess actual or likely human and/or environmental risk of exposure to a chemical release and determine appropriate remedial actions in response to such releases. Petroleum releases vary considerably in their potential risk based on a number of variables, including, but not limited to, the type of petroleum product, amount of released product, duration of the release, extent of the release, site geology/hydrogeology, number and type of exposure pathways and location of human receptors relative to the source.

The laboratory results obtained for groundwater for Volatile Petroleum Hydrocarbons (GRO's, DRO's and PAH's) are presented in Table 8-1 for the hydrocensus boreholes, monitoring well and production boreholes which were sampled.

These results were compared against the Aquatic Water Quality standard adapted from the Department of Environmental Affairs, May 2010 (Framework for the Management of Contaminated Land. Government Printer. Republic of South Africa). However, where published values were not available, values were obtained from United Kingdom Environmental Quality Standards for Salmonoid (2010); British Columbia Aquatic Guidelines (2006) and National Oceanic and Atmospheric Administration (2008).

Table 8-1: Groundwater Laboratory Results – Volatile Petroleum Hydrocarbons

Determinant (µg/l)	Aquatic Water Quality	BH3	BH4	QB3	QP1	QP2
Gasoline Range Organics (GRO's)						
Benzene	30[ii]	<1	<1	<1	<1	<1
Toluene	50[ii]	<10	<10	<10	<10	<10
Ethylbenzene	200[i]	<2	<2	<2	<2	<2
m,p-Xylene		<2	<2	<2	<2	<2
o-Xylene	30[ii]	<2	<2	<2	<2	<2
1,3,5-Trimethylbenzene	-	<2	<2	<2	<2	<2

1,2,4-Trimethylbenzene	-	<2	<2	<2	<2	<2
Naphthalene	1.1[iii]	<2	<2	<2	<2	<2
Polycyclic Aromatic Compounds (PAH's)						
Acenaphtene	-	<1	<1	<1	<1	<1
Acenaphtylene	-	<1	<1	<1	<1	<1
Flourene	-	<1	<1	<1	<1	<1
Phenanthrene	-	<1	<1	<1	<1	<1
Anthracene	-	<1	<1	<1	<1	<1
Fluoranthene	-	<1	<1	<1	<1	<1
Pyrene	0.0025 [iii]	<1	<1	<1	<1	<1
Volatile Organic Hydrocarbons (VOH's)						
MTBE	3400 [i]	<5	<5	<5	<5	<5
TAME	-	<5	<5	<5	<5	<5
Diesel Range Organics (DRO's)						
C10	-	<1	<1	<1	<1	<1
C11	-	<1	<1	<1	<1	<1
C12	-	<1	<1	<1	<1	<1
C13	-	<1	<1	<1	<1	<1
C14	-	<1	<1	<1	<1	<1
C15	-	<1	<1	<1	<1	<1
C16	-	<1	<1	<1	<1	<1
C17	-	<1	<1	<1	<1	<1
C18	-	<1	<1	<1	<1	<1
C19	-	<1	<1	<1	<1	<1
C20	-	<1	<1	<1	<1	<1

NS – Not Specified

[i] BC Aquatics, 2006

[ii] UK EQS Salmonid, Current

[iii] NOAA, 2008

8.1.1 Volatile Petroleum Hydrocarbons

No Gasoline Range Organics (GRO's), Diesel Range Organics (DRO's) or Polycyclic Aromatic Compounds (PAH's) were detected in the groundwater samples collected from BH3, BH4, QB3, QP1 and QP2.

8.1.2 Groundwater Ingestion – RBCA

All constituents analyzed for as tabulated in Table 8-1 indicated compliance with the RBCA Tier 1 Risk Based Screening Level (RBSL) for groundwater ingestion.

8.1.3 *Groundwater Volatilization to Air Inhalation*

Benzene readily volatilises from surface soil given its high vapour pressure and high air-water partition coefficient. Vapour release and inhalation is thus the most important exposure pathway for benzene and benzene is listed as a Hazardous Air Pollutant.

The all constituents analysed were compliant with the RBCA Tier 1 Risk Based Screening Level (RBSL) for the indoor and outdoor air inhalation exposure pathways.

8.1.4 *Inorganic Groundwater Analysis*

Table 8-2 below, tabulates the results for the anions, cations and selected metals for each groundwater sample collected.

Table 8-2: Groundwater Chemical Analysis

Parameter (mg/l)	DWA Drinking Water	SANS 241-1 (2011)	BH3	BH4	QB3	QP1	QP2
TDS [mg/l]	**450**	**<1200**	396	366	399	389	438
P Alkalinity. [mg/l $CaCO_3$]	**NS**	**NS**	<0.6	<0.6	<0.6	<0.6	<0.6
M Alkalinity. [mg/l $CaCO_3$]	**NS**	**NS**	275	238	353	312	365
pH at 25°C	**6-9**	**5 - 9.7**	7.44	7.1	7.07	7.3	7.02
Total Cation [meq/l]	**NS**	**NS**	5.92	5.6	7.39	5.6	7.29
Total Anion [meq/l]	**NS**	**NS**	6.06	5.64	7.6	6.7	7.27
Cation – Anion difference [meq/l]	**NS**	**NS**	-0.14	-0.04	-0.21	-0.04	0.02
% Difference	**NS**	**Ns**	-1.19	-0.38	-1.39	-0.8	0.12
Hardness [mg equivalent $CaCO_3$/l]	**<150**	**NS**	269.14	256.43	323.18	324.33	341.59
Bicarbonate [HCO_3^-]	**NS**	**NS**	333.06	290.36	430.66	414.8	445.3
CATIONS AND METALS							
Silver, Ag	**NS**	**NS**	<0.05	<0.05	<0.05	<0.05	<0.05
Aluminium, Al	**NS**	**<0.3**	<0.05	<0.05	0.15	<0.05	<0.05
Arsenic, As	**<0.01**	**<0.01**	<1	<1	<1	<1	<1
Boron, B	**NS**	**NS**	<0.05	<0.05	<0.05	<0.05	<0.05
Barium, Ba	**NS**	**NS**	<0.05	<0.05	<0.05	<0.05	<0.05
Beryllium, Be	**NS**	**NS**	<0.05	<0.05	<0.05	<0.05	<0.05
Bismuth, Bi	**NS**	**NS**	<0.05	<0.05	<0.05	<0.05	<0.05
Calcium, Ca	**<32**	**NS**	38	40.9	39.4	45.6	45
Cadmium, Cd	**<5**	**<0.003**	<0.05	<0.05	<0.05	<0.05	<0.05
Cobalt, Co	**NS**	**<500**	<0.05	<0.05	<0.05	<0.05	<0.05
Chromium, Cr	**<0.05**	**<0.05**	<0.05	<0.05	<0.05	<0.05	<0.05

Parameter (mg/l)	DWA Drinking Water	SANS 241-1 (2011)	BH3	BH4	QB3	QP1	QP2
Copper, Cu	**<1**	**<2**	<0.05	<0.05	<0.05	<0.05	<0.05
Iron, Fe	**<0.1**	**<0.3**	<0.05	<0.05	0.09	0.3	<0.05
Potassium, K	**<50**	**NS**	0.4	0.2	0.8	1.6	<0.05
Lithium, Li	**NS**	**NS**	<0.05	<0.05	<0.05	<0.05	<0.05
Magnesium, Mg	**<30**	**NS**	8.5	37.5	54.8	51.3	55.7
Manganese, Mn	**<0.05**	**<0.5**	<0.05	<0.05	0.17	<0.05	<0.05
Molybdenum, Mo	**NS**	**NS**	<0.05	<0.05	<0.05	<0.05	<0.05
Sodium, Na	**<100**	**<200**	11.2	10.8	19.9	10.8	10.6
Nickel, Ni	**NS**	**<0.07**	<0.05	<0.05	<0.05	<0.05	<0.05
Phosphorus, P	**NS**	**NS**	<0.05	<0.05	<0.05	<0.05	<0.05
Lead, Pb	**<0.01**	**0.001**	<1	<1	<1	<1	<1
Antimony, Sb	**NS**	**<0.02**	<1	<1	<1	<1	<1
Selenium, Se	**<0.05**	**<0.01**	<1	<1	<1	<1	<1
Silicate, Si	**NS**	**NS**	27.83	23.08	26.02	20.09	30.4
Tin, Sn	**NS**	**NS**	<0.05	<0.05	<0.05	<0.05	<0.05
Strontium, Sr	**NS**	**NS**	0.09	<0.05	<0.05	<0.05	0.11
Thallium, Tl	**NS**	**NS**	<1	<1	<1	<1	<1
Titanium, Ti	**NS**	**NS**	<1	<1	<1	<1	<1
Vanadium, V	**<0.1**	**<0.2**	<0.05	<0.05	<0.05	<0.05	<0.05
Zinc, Zn	**<3**	**<5**	<0.05	<0.05	<0.05	<0.05	<0.05
ANIONS							
Fluoride, F	**<1**	**1.5**	<0.4	<0.4	<0.4	<0.4	<0.4
Chloride, Cl	**<100**	**<300**	8.5	12.4	12.9	31.4	6.1
Bromine, Br	**NS**	**NS**	<0.25	<0.25	<0.25	<0.25	<0.25
Nitrite as NO_2	**NS**	**NS**	<2	<2	<2	<2	<2
Nitrite as NO_3	**NS**	**NS**	25.4	38.4	14.2	<2	12.7
Sulphate, SO_4	**<200**	**<250**	4	4.4	20.4	5.4	<4
Phosphate, PO_4	**NS**	**NS**	<4	<4	<4	<4	<4

BH3: The hardness concentration of 269.14 $CaCO_3$/l recorded in BH3 is considered hard and may cause scale on heat exchange surfaces or may result in an increase in soap required to produce lather when bathing and in household cleaning. A calcium concentration if 38mg/l marginally exceeded the DWA water quality standard of 32mg/l, however was below the SANS 2006 standards. The SANS 241-1:2011 drinking water standards do not specify a standard for magnesium or calcium.

BH4: The hardness concentration of 256.43 $CaCO_3$/l recorded in BH4 is also considered hard. Non-compliant calcium and magnesium were recorded, which marginally exceeded the DWA water quality standards.

QB3: The hardness concentration of 323.18 $CaCO_3$/l recorded in QB3 is considered very hard. Non-compliant calcium, magnesium and manganese concentrations were recorded, which marginally exceeded the DWA and SANS 241-1:2011 drinking water quality standards.

QP1: The hardness concentration of 324.33 $CaCO_3$/l recorded in QP1 is considered very hard. Non-compliant calcium, iron and magnesium were recorded, which marginally exceeded the DWA water quality standards.

QP2: The hardness concentration of 341.59 $CaCO_3$/l recorded in QP2 is considered very hard. Non-compliant calcium and magnesium were recorded, which exceeded the DWA water quality standards. Bicarbonate salts of calcium and magnesium precipitate on heating and cause scaling in hot water systems and appliances.

8.1.5 Piper Diagram

According to the Piper Diagram below (Figure 8-1), all water samples are indicative of recently recharged groundwater rich in calcium, magnesium and bicarbonate.

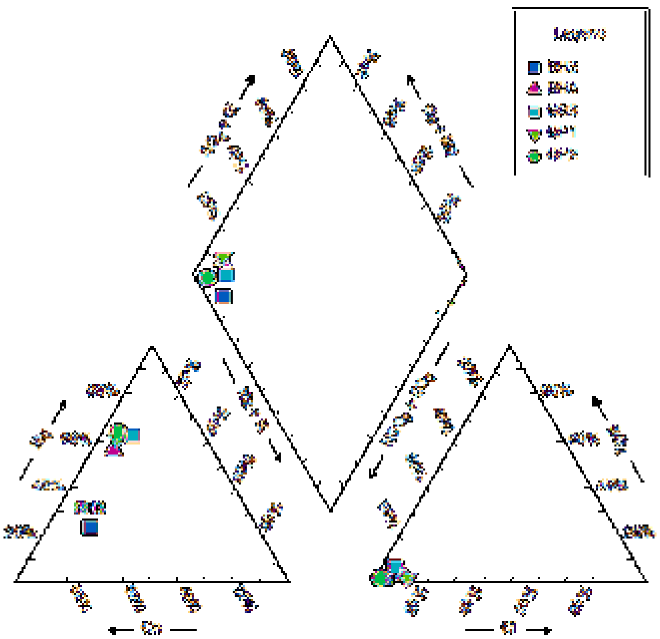


Figure 8-1: Piper Diagram

8.1.6 Durov Diagram

According to the Durov diagram below (Figure 8-2), water samples are indicative of fresh, clean, relatively young groundwater recently recharged with HCO^{3-} dominated ions and that has started to undergo magnesium ion exchange.

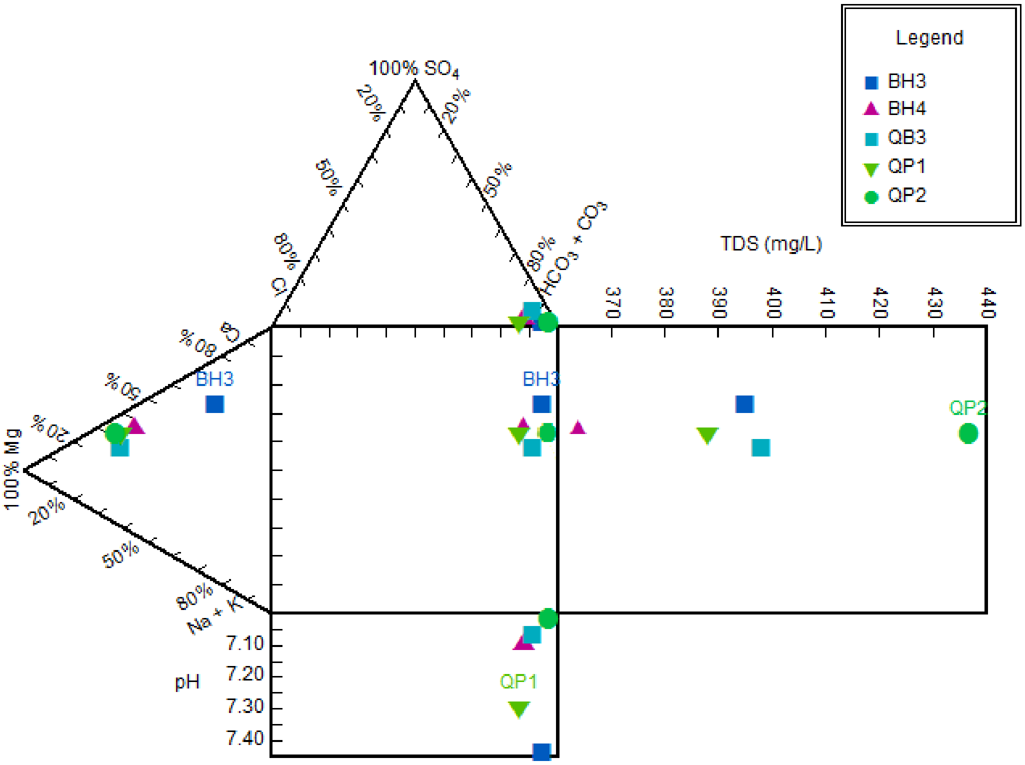


Figure 8-2: Durov Diagram

9 RISK PROFILE

A first order vulnerability profile was established for the site based on environmental and human receptors and also by means of incorporation of the source-pathway-receptor principle and with data as obtained during the scope of work set out as part of the risk matrix screening evaluation.

9.1 Source

During the site investigation conducted in September 2014, no source was identified on site, due to the site being in pre-construction phase and based on the laboratory results which confirmed the absence of contamination (ambient groundwater quality) within boreholes BH3, BH4, QB3, QP1 and QP2.

9.2 Pathway

The average ground water level measured on site ranged between 28 and 29.84 metres below ground level (mbgl), confirming the absence of any shallow perched aquifers on site and reduces the aquifer vulnerability due to the barrier (thickness of the formation and the elongated travel times) between a potential source (filling station and the waste water discharge areas) and the aquifer underlying the site.

9.3 Receptor

Sensitive receptors are present in the form of groundwater users and surface water bodies within close proximity to the site. Six boreholes were identified during the hydrocensus conducted within a 2km radius of Section 1 and Section 2. Hydrocensus boreholes, BH3, BH4 and BH6 are currently in use. A non-perennial river is located 400m east, upgradient of Section 1, while two non-perennial rivers are located 900m north and 1km west, downgradient of Section 2. Based on this, the source-pathway-receptor is incomplete based on the absence of a source found on site (refer to Figure 9-1).

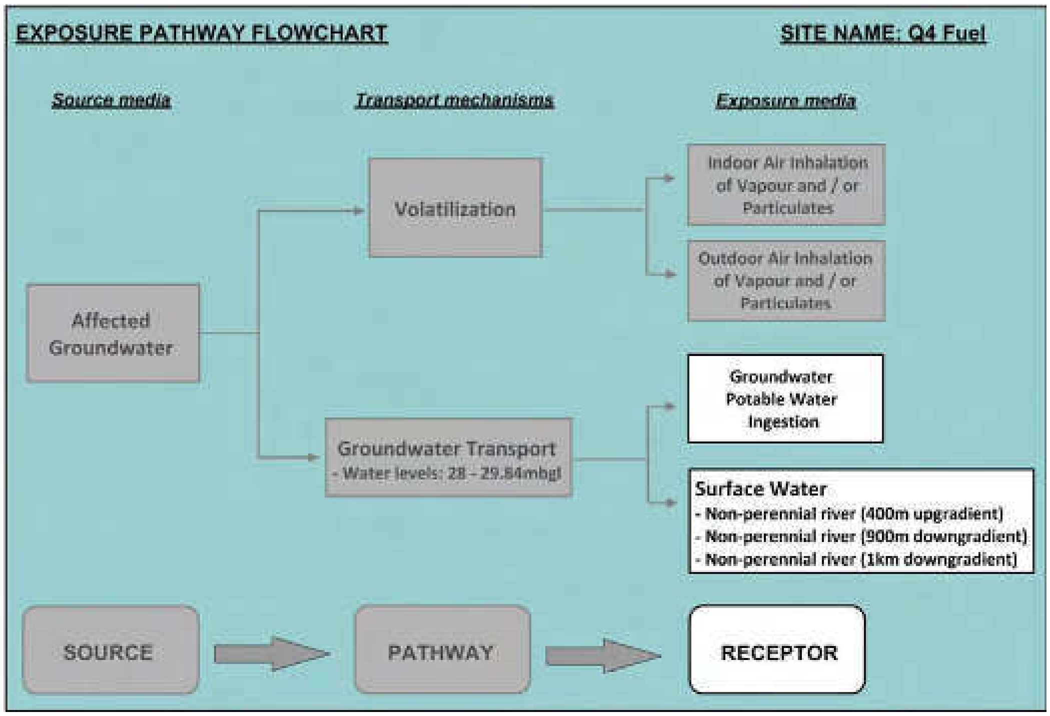


Figure 9-1: Exposure Pathway Flowchart

9.3.1 Monitoring Strategy

It is recommended that a monitoring strategy be implemented which include the monitoring of the three newly drilled monitoring wells and two production boreholes located on site as tabulated in Table 9-1 below. Quarterly monitoring should be conducted once operational phase has commenced.

Table 9-1: Monitoring Strategy

Borehole ID	Coordinates		Type of monitoring	Monitoring frequency	Analysis
	S	E			
Monitoring wells					
QB1	-25.651795	27.948825	Vapour measurements	Quarterly	-
QB2	-25.650733	27.948543	Vapour measurements	Quarterly	-
QB3	-25.647109	27.946211	Groundwater sampling	Quarterly	- Anions and cations - Volatile Petroleum Hydrocarbons (GRO, DRO and PAH) - pH, TDS, bicarbonates, EC and total hardness
Production Boreholes					
QP1	-25.650752	27.950619	Groundwater sampling	Quarterly	- Anions and cations - Volatile Petroleum

QP2	-25.646221	27.947667	Groundwater sampling	Quarterly	Hydrocarbons (GRO, DRO and PAH) - pH, TDS, bicarbonates, EC and total hardness

10 CONCLUSIONS

Following the site investigation and pump test conducted at Section 1 on borehole 4, the following may be concluded concerning the required water demand:

- Five hydrocensus boreholes were identified within close proximity of Section 1, however only BH3 and BH4 are used by the lodge located on the property;
- One hyrocensus borehole, BH6 was located within close proximity of Section 2 which is used for cattle water supply;
- The static water level within the hydrocensus boreholes ranged from 28.14 to 35.1mbgl (confirming the absence of a shallow perched water level on site);
- Two monitoring wells, QB1 and QB2 as well as and one production borehole, QP1 were installed on Section 1;
- One monitoring well, QB3 and one production borehole, QP2 were installed on Section 2;
- Groundwater was encountered at depths ranging from 28 to 29.84mbgl within QB3, QP1 and QP2;
- 24 Hour aquifer testing was conducted on hydrocensus boreholes, BH3 and BH4 as well as newly drilled production borehole, QP2;
- According to the pump test data and the subsequent analysis, the recommended borehole yield for hydrocensus boreholes, BH3 and BH4 are 0.5l/s and 1l/s over a 18 hour period;
- According to the pump test data and the subsequent analysis, the recommended borehole yield for production borehole, QP2 is 1.5l/s over a 18hour period;
- The proposed abstraction at the Q4 Fuel City is 38.4m^3/day. According to the aquifer tests the recommended sustainable abstraction from BH3, BH4 and QP1 for the Q4 Fuel site is 111.6m^3/day;
- According to the water balance calculations small scale abstraction (<60% recharge on catchment) will be present on site;
- Laboratory analysis for groundwater samples collected from BH3, BH4, QB3, QP1 and QP2 indicated the absence of volatile petroleum hydrocarbons;
- Relatively hard water (in terms of $CaCO_3$) was recorded in all groundwater samples;
- Calcium and magnesium concentrations marginally exceeded the standards, and is not considered source of contamination, rather naturally occurring within the groundwater due to the water rock interaction;
- Based on this the source-pathway-receptor is not complete as no source was identified on site.

Recommendations

The following recommendations are made:

- Adherence to the sustainable yield of the production boreholes is crucial to ensure long-term utilisation of the groundwater resource;
- Accurate weekly monitoring of the groundwater levels in the boreholes are recommended when abstraction occurs. If any significant fluctuation in water level occurs, immediate action needs to be taken. The conservative calculations for recharge and proper monitoring plan should prevent over-utilisation of the aquifer;
- Groundwater quality analysis must be done on a quarterly basis, once operational phase has commenced, in order to detect any contamination to the aquifer.

11 REFERENCES

Bredenkamp, D.B., Botha, L.J., Van Tonder, G.J. and Van Rensburg, H.J. (1995). Manual on Quantitative Estimation of Groundwater Recharge and Aquifer Storativity. Water Research Commission. TT 73/95.

DeGroot-Hedlin, C. and Constable, S. (1990). Occam's inversion to generate smooth, two-dimensional models form magnetotelluric data. Geophysics, 55, 1613-1624.

Groundwater Resource Directed Measures (GRDM) (2012). Department of Water Affairs (DWA). Software.

APPENDIX A - PHOTO LOG

		PHOTOGRAPHIC LOG	
Client Name: Q4 Fuels		**Site Location:** Ga-Rankuwa	**Project No.** 14-503
Photo No. **1**	**Date:** Sep 2014		
Direction Photo Taken: From North West to South East			
Description: Borehole 1 located on section 1. Has not been opened for 10 years and has no electricity.			
Photo No. **2**	**Date:** Sep 2014		
Direction Photo Taken: N/A			
Description: Close up of hydrocensus borehole 1. The cover is stuck.			

PHOTOGRAPHIC LOG

Client Name: Q4 Fuels	**Site Location:** Ga-Rankuwa	**Project No.** 14-503

Photo No. **3**	**Date:** Sep 2014

Direction Photo Taken:

West to East

Description:

Location of hydrocensus borehole 2, BH2, located on section 1.

Photo No. **4**	**Date:** Sep 2014

Direction Photo Taken:

North East to South West

Description:

Close up of BH2. This hole has its own control box and electricity, but is not in use.

PHOTOGRAPHIC LOG

Client Name: Q4 Fuels	**Site Location:** Ga-Rankuwa	**Project No.** 14-503

Photo No. **5**	**Date:** Sep 2014	
Direction Photo Taken: South to North		
Description: General site layout.		
Photo No. **6**	**Date:** Sep 2014	
Direction Photo Taken: N/A		
Description: Hydrocensus borehole 3, BH3 is located in a small brick house with its own control box and electricity on section1.		

PHOTOGRAPHIC LOG

Client Name: Q4 Fuels	**Site Location:** Ga-Rankuwa	**Project No.** 14-503

Photo No. **7**	**Date:** Sep 2014

Direction Photo Taken:

South East to North West

Description:

Location of hydrocensus borehole 4, BH4 located on section 1, the borehole is covered with corrugated iron roofing.

Photo No. **8**	**Date:** Sep 2014

Direction Photo Taken:

N/A

Description:

BH4 is located about a 70m from BH3.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Q4 Fuels	Ga-Rankuwa	13-816

Photo No. 9

Date: Sep 2014

Direction Photo Taken:

North East to South West

Description:

Location of hydrocensus borehole, BH6 on section 2. The control box is in the brick house and the borehole supplies water directly to the JoJo Tank in blue on the photo.

Photo No. 10

Date: Sep 2014

Direction Photo Taken:

N/A

Description:

BH6 with solid steel cap.

PHOTOGRAPHIC LOG

Client Name: Q4 Fuels	**Site Location:** Ga-Rankuwa	**Project No.** 14-503

Photo No. 11

Date: Sep 2014

Direction Photo Taken:

N/A

Description:

Water supply pipes from BH3 and BH4, which runs into a dam and is used for water supply to the lodge. BH3 and BH4 are pumped simultaneously.

Photo No. 12

Date: Sep 2014

Direction Photo Taken:

North West to South East

Description:

Location of the brick dam. The water from BH3 and BH4 are pumped at approximately 3l/s.

PHOTOGRAPHIC LOG

Client Name: Q4 Fuels	**Site Location:** Ga-Rankuwa	**Project No.** 13-816

Photo No. **13**	**Date:** Sep 2014

Direction Photo Taken:

N/A

Description:

Borehole log of production borehole, QP1.

Photo No. **14**	**Date:** Sep 2014

Direction Photo Taken:

N/A

Description:

Monitoring well, QM3 after borehole installation.

PHOTOGRAPHIC LOG

Client Name: Q4 Fuels	**Site Location:** Ga-Rankuwa	**Project No.** 14-503

Photo No. **15**	**Date:** Sep 2014	
Direction Photo Taken: North West to South East		
Description: Control box under the roof for BH3 and BH4. Irrigation pump is abstract water from the brick dam.		
Photo No. **16**	**Date:** October 2014	
Direction Photo Taken: N/A		
Description: Monitoring well, QB1		

PHOTOGRAPHIC LOG

Client Name: Q4 Fuels	**Site Location:** Ga-Rankuwa	**Project No.** 14-503

Photo No. **17**

Date: October 2014

Direction Photo Taken:

N/A

Description:

Monitoring well, QB2

Photo No. **18**

Date: October 2014

Direction Photo Taken:

N/A

Description:

Production borehole, QP1

PHOTOGRAPHIC LOG

Client Name: Q4 Fuels	**Site Location:** Ga-Rankuwa	**Project No.** 14-503

Photo No. **19**	**Date:** October 2014

Direction Photo Taken:

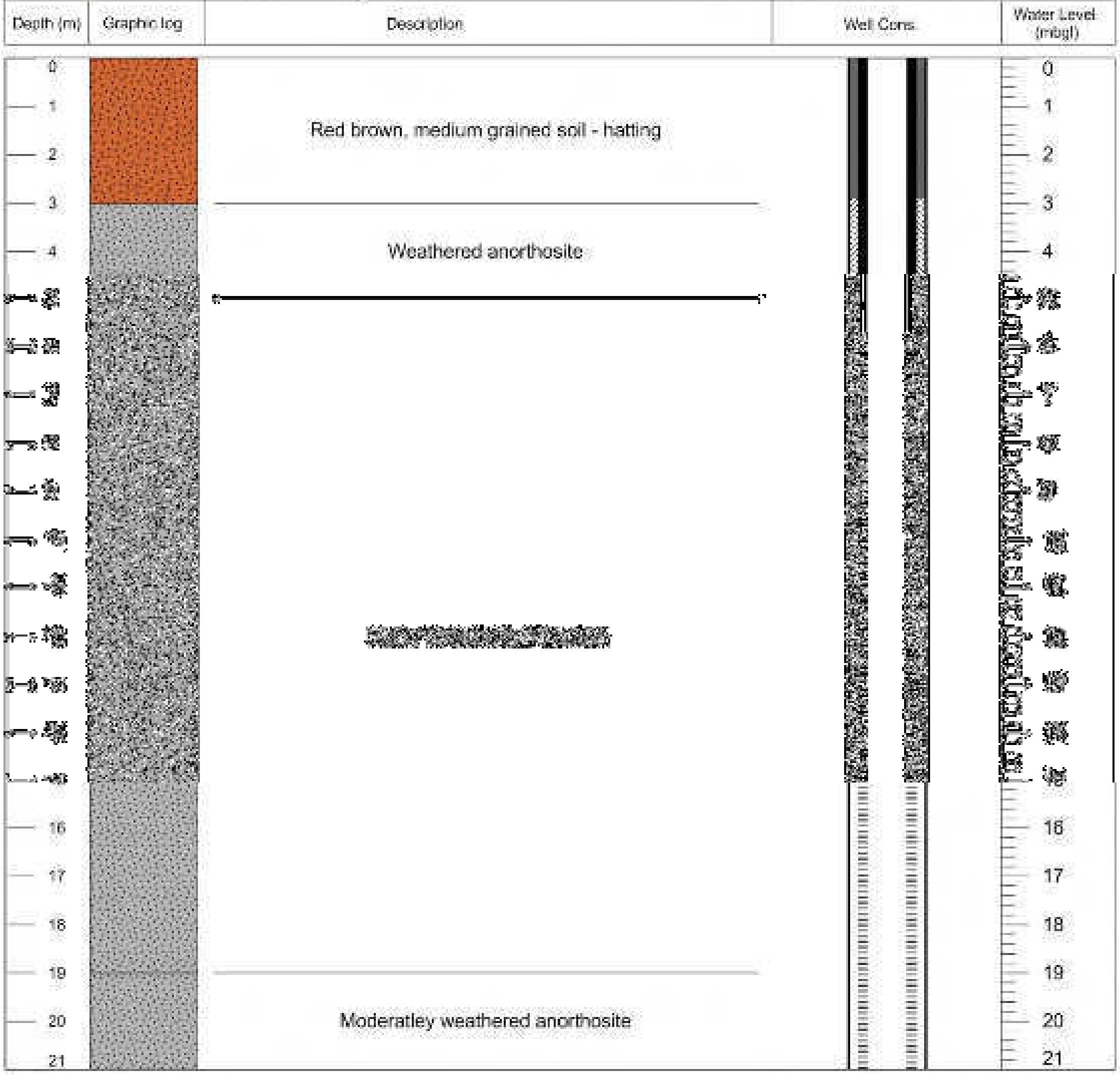
N/A

Description:

Monitoring well, QB3 a month since installation. The lock has broken off, most likely by cattle.

APPENDIX B – BOREHOLE LOGS

PROJECT: Q4 Fuels	BOREHOLE ID: QB1
LOCATION: Ga-Rankuwa	LONGITUDE: 27.948825
DRILLING CONTRACTOR: Sample	LATITUDE: -25.651795
DRILLLING METHOD: Percussion drilling	WATER LEVEL: Dry
DATE COMPLETED: 04/09/2014	WATER STRIKE: None
PURPOSE: Monitoring Well	DEPTH: 21m



Well Construction Legend

≡ Perforated Casing

■ Solid Casing

■ BH diameter

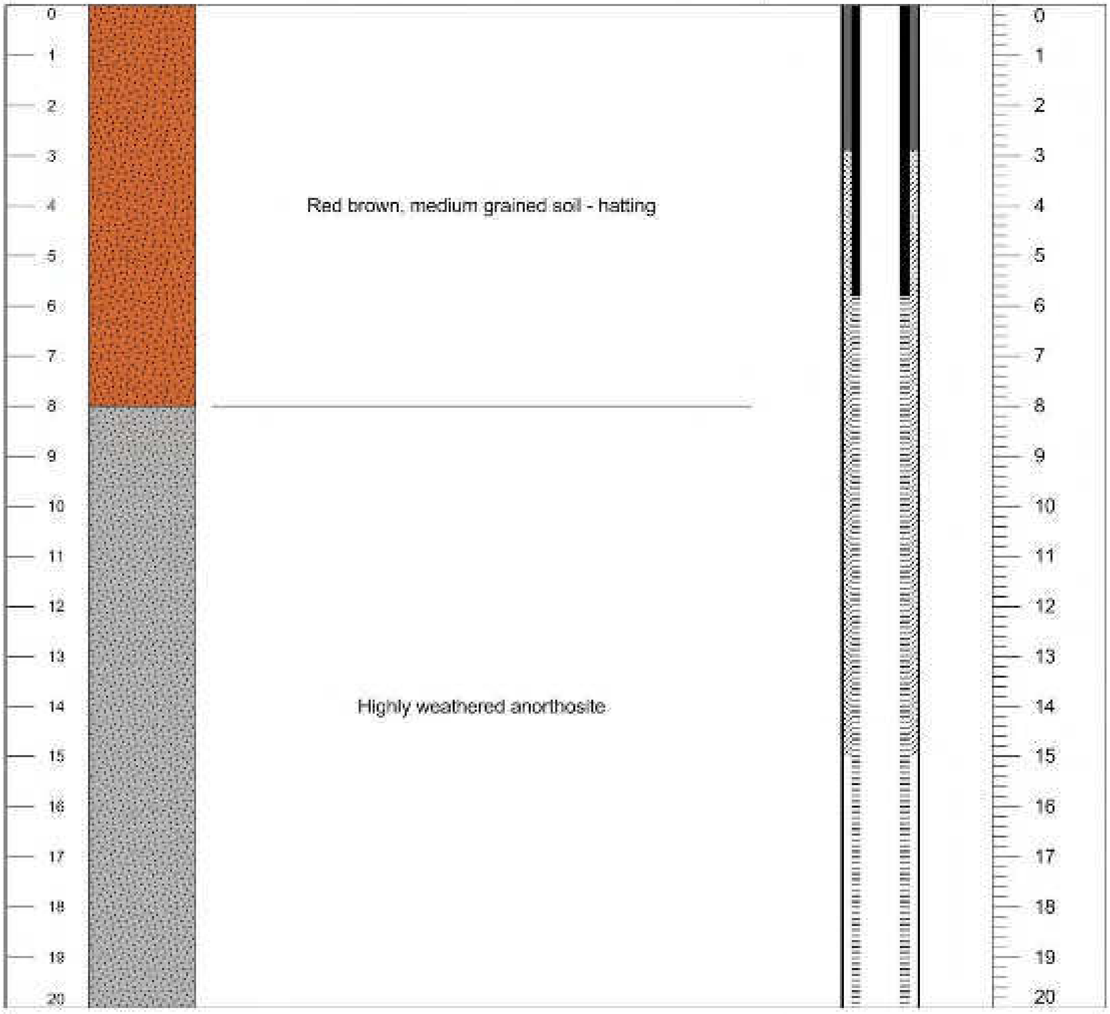
▨ Gravel pack

■ Sanitary seal

PROJECT: Q4 Fuels
LOCATION: Ga-Rankuwa
DRILLING CONTRACTOR: Sampie
DRILLLING METHOD: Percussion drilling
DATE COMPLETED: 04/09/2014
PURPOSE: Monitoring Well

BOREHOLE ID: QB2
LONGITUDE: 27.948543
LATITUDE: -25.650733
WATER LEVEL: Dry
WATER STRIKE: None
DEPTH: 20m

Depth (m)	Graphic log	Description	Well Cons.	Water Level (mbgl)



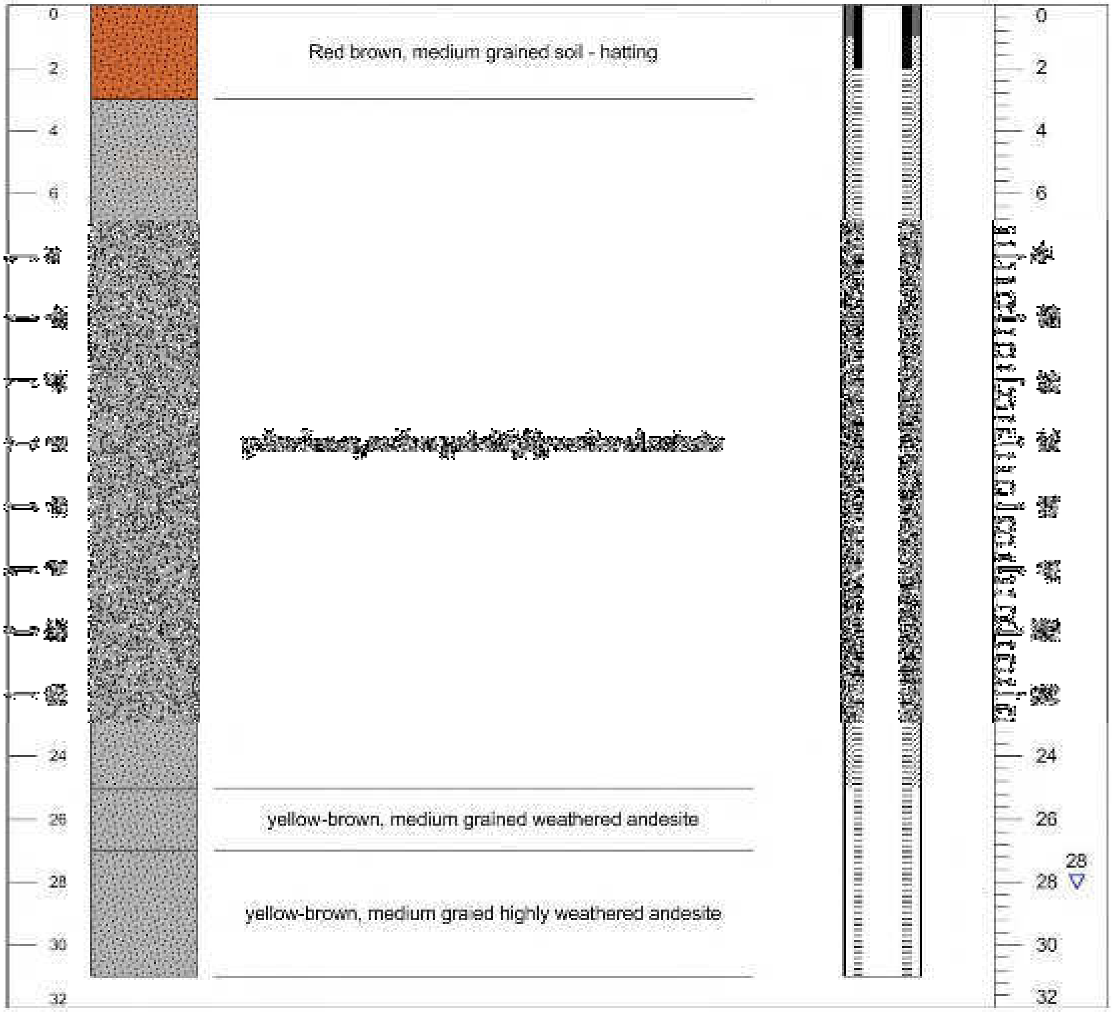
Well Construction Legend

- ☰ Perforated Casing
- ■ Solid Casing
- ■ BH diameter
- ▨ Gravel pack
- ■ Sanitary seal

PROJECT: Q4 Fuels
LOCATION: Ga-Rankuwa
DRILLING CONTRACTOR: Sampie
DRILLLING METHOD: Percussion drilling
DATE COMPLETED: 04/09/2014
PURPOSE: Monitoring Well

BOREHOLE ID: QB3
LONGITUDE: 27.946211
LATITUDE: -25.647109
WATER LEVEL: 28 mbgl
WATER STRIKE: Seepage
DEPTH: 31m

Depth (m)	Graphic log	Description	Well Cons.	Water Level (mbgl)



Red brown, medium grained soil - hatting

[illegible]

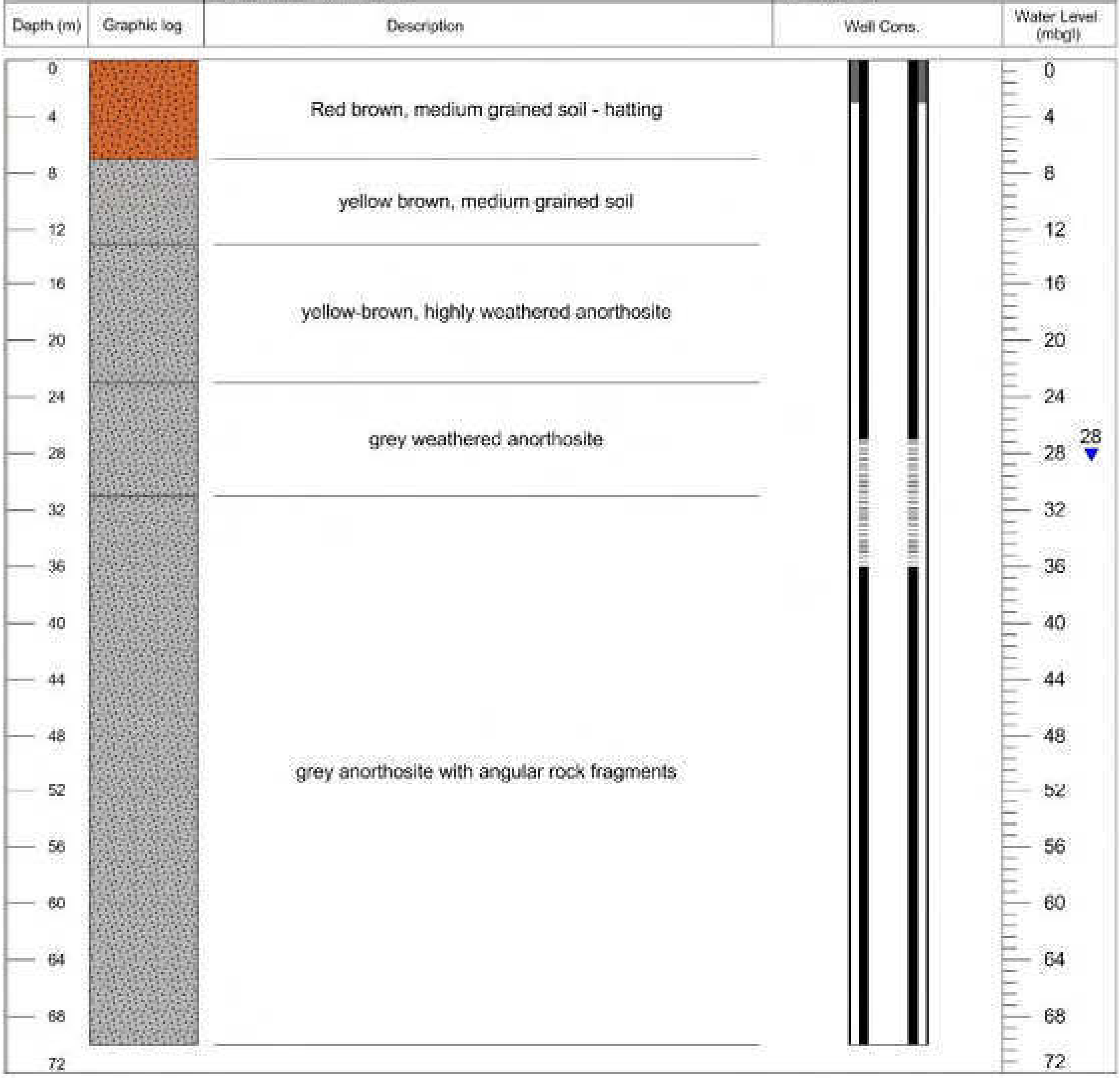
yellow-brown, medium grained weathered andesite

yellow-brown, medium graied highly weathered andesite

Well Construction Legend
- ▤ Perforated Casing
- ■ Solid Casing
- ■ BH diameter
- ▨ Gravel pack
- ■ Sanitary seal

PROJECT: Q4 Fuels
LOCATION: Ga-Rankuwa
DRILLING CONTRACTOR: Sample
DRILLLING METHOD: Percussion drilling
DATE COMPLETED: 04/09/2014
PURPOSE: Production Well

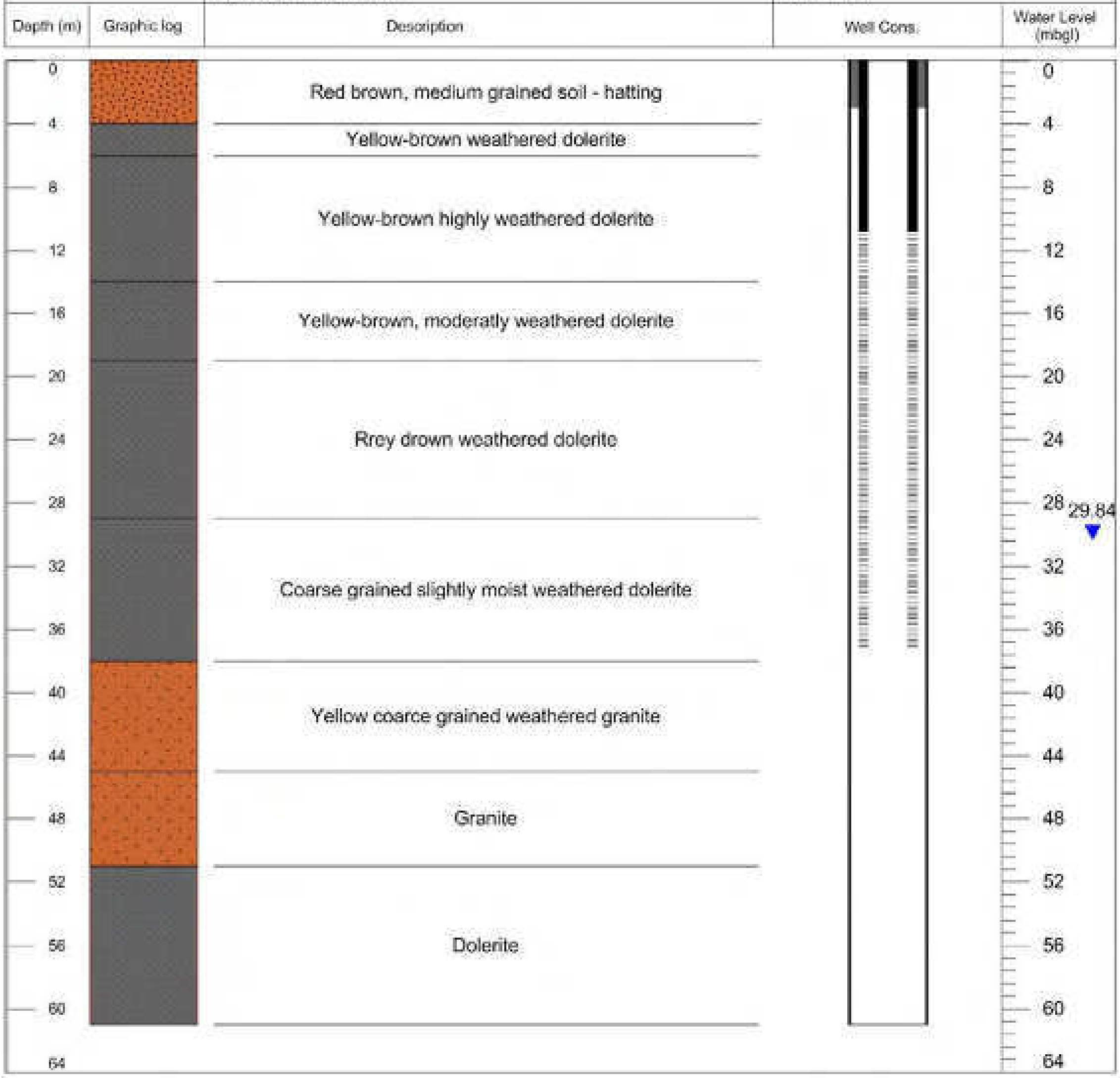
BOREHOLE ID: QP1
LONGITUDE: 27.960819
LATITUDE: -25.650752
WATER LEVEL: 28.1 (mbgl)
WATER STRIKE: Seepage
DEPTH: 70m



Well Construction Legend
- ▤ Perforated Casing
- ■ Solid Casing
- ■ BH diameter
- ▒ Gravel pack
- ▨ Sanitary seal

PROJECT: Q4 Fuels
LOCATION: Ga-Rankuwa
DRILLING CONTRACTOR: Sampie
DRILLLING METHOD: Percussion drilling
DATE COMPLETED: 04/09/2014
PURPOSE: Production Well

BOREHOLE ID: QP2
LONGITUDE: 27.947867
LATITUDE: -25.646221
WATER LEVEL: 29.84mbgl
WATER STRIKE: 38 (mbgl)
DEPTH: 61m



Red brown, medium grained soil - halting

Yellow-brown weathered dolerite

Yellow-brown highly weathered dolerite

Yellow-brown, moderatly weathered dolerite

Rrey drown weathered dolerite

Coarse grained slightly moist weathered dolerite

Yellow coarce grained weathered granite

Granite

Dolerite

Well Construction Legend
- ▤ Perforated Casing
- ■ Solid Casing
- ■ BH diameter
- ▒ Gravel pack
- ■ Sanitary seal

APPENDIX C - AQUIFER TEST

CONSTANT DISCHARGE TEST DATA SHEET – QP2

General Information

Project No:	14-503
Borehole No:	QP-2
Site Name:	Q4 Fuels
Section:	Section 2
Latitude:	-25.646771
Longitude:	27.947667

Pumping Borehole Information

Depth of Pump (m):	56
Collar Height (m):	0.49
BH diameter (m):	180mm
Depth of BH (m):	61
Static water level (m):	29.84

Test Started

Date:	12/09/2014
Time:	14:34

Test Ended

Date:	13/09/2014
Time:	13:34
Duration (min):	1440

Time (min)	Drawdown s (m)	Yield (l/s)	Time (min)	Recovery s' (m)
1	34.37	1.4	1	36.63
2	34.57	1.4	2	33.9
3	34.67	1.4	3	32.47
4	34.8	1.4	4	31.47
5	34.87	1.4	5	31.64
6	35.13	1.4	6	31.37
7	35.25	1.4	7	31.15
8	35.39	1.4	8	31.07
9	35.58	1.4	9	31
10	35.65	1.4	10	30.98
11	35.88	1.4	11	30.97
12	35.97	1.4	12	30.96
13	36.02	1.4	13	30.95
14	36.17	1.4	14	30.94
15	36.28	1.4	15	30.93
16	36.39	1.4	16	30.92
17	36.56	1.4	17	30.91
18	36.68	1.4	18	30.9
19	36.8	1.4	19	30.89
20	36.9	1.4	20	30.88
25	37.6	1.6	25	30.84
30	38.17	1.6	30	30.81
40	38.9	2	40	30.81
50	39.44	2	50	30.8
60	39.74	2	60	30.8
75	40.38	2		
90	40.97	2.3		
120	41.75	2.3		
150	42.5	2.3		

180	43.5	2.3
240	44.8	2.3
300	46.2	2.3
360	46.8	2.3
420	47.15	2.3
480	47.28	2.3
600	47.4	2.3
720	47.49	2.3
900	47.5	2.3
1080	47.54	2.3
1440	47.59	2.3
1800		1.785

CONSTANT DISCHARGE TEST DATA SHEET – BH3

General Information	
Project No:	14-503
Borehole No:	BH3
Site Name:	Q4 Fuels
Section	Section 1
Latitude:	-25.651373
Longitude:	27.953246
Pumping Borehole Information	
Depth of Pump (m):	40.35
Collar Height (m):	0.2
BH diameter (m):	0.12
Depth of BH (m):	Fitted with pump
Static water level (m):	33.56
Test Started	
Date:	16/09/2014
Time:	08h00
Test Ended	
Date:	17/09/2014
Time:	08h00
Duration (min):	1440
Remarks	
The test was undertaken using an existing pump	

Time (min)	Drawdown s (m)	Yield (l/s)	Time (min)	Recovery s' (m)
1	35.11	0.5	1	36.28
2	35.25	0.5	2	35.89
3	35.47	0.5	3	35.68
4	35.55	0.5	4	35.52
5	35.67	0.5	5	35.4
6	35.71	0.5	6	35.29
7	35.78	0.5	7	35.23
8	35.83	0.5	8	35.15
9	35.88	0.5	9	35.09
10	35.94	0.5	10	35.05
11	35.96	0.5	11	35
12	36	0.5	12	34.96
13	36.02	0.5	13	34.91
14	36.05	0.5	14	34.88

15	36.09	0.5	15	34.84
16	36.17	0.5	16	34.81
17	36.14	0.5	17	34.8
18	36.16	0.5	18	34.78
19	36.17	0.5	19	34.75
20	36.18	0.5	20	34.73
25	36.24	0.5	25	34.64
30	36.3	0.5	30	34.57
40	36.4	0.5	40	34.47
50	36.48	0.5	50	34.38
60	36.58	0.5	60	34.3
75	36.68	0.5	75	34.27
90	36.73	0.5	90	34.21
120	36.81	0.5	120	34.13
150	36.83	0.5		
180	36.89	0.5		
240	36.93	0.5		
300	36.93	0.5		
360	36.93	0.5		
420	36.93	0.5		
480	36.93	0.5		
600	36.95	0.5		
720	37	0.5		
900	37.09	0.5		
1080	37.11	0.5		
1440	37.2	0.5		

CONSTANT DISCHARGE TEST DATA SHEET – BH4

General Information

Project No:	14-503
Borehole No:	BH4
Site Name:	Q4 Fuels
Section:	Section 1
Latitude:	-25.65069
Longitude:	27.953783

Pumping Borehole Information

Depth of Pump (m):	45.5
Collar Height (m):	0.2
BH diameter (m):	180mm
Depth of BH (m):	48m
Static water level (m):	35.1

Test Started

Date:	10/09/2014
Time:	16h00

Test Ended

Date:	11/09/2014
Time:	6h00
Duration (min):	1440

Time	**Drawdown**	**Yield**	**Time**	**Recovery**
(min)	**s (m)**	**(l/s)**	**(min)**	**s' (m)**
1	36	0.81	1	39.71
2	36.61	0.81	2	39.78
3	37.13	0.81	3	39.07

4	37.26	0.81	4	38.97
5	37.49	0.81	5	38.82
6	37.64	0.81	6	38.75
7	37.77	0.81	7	38.69
8	37.89	0.81	8	38.63
9	37.9	0.81	9	38.6
10	38	0.81	10	38.56
11	38.04	0.81	11	38.54
12	38.14	0.81	12	38.5
13	38.17	0.81	13	38.46
14	38.19	0.81	14	38.4
15	38.2	0.81	15	38.38
16	38.25	0.81	16	38.36
17	38.27	0.81	17	38.34
18	38.32	0.81	18	38.37
19	38.36	0.81	19	38.3
20	38.4	0.81	20	38.29
25	38.57	0.81	25	38.22
30	38.67	0.81	30	38.18
40	38.97	0.81	40	38.08
50	39.11	0.81	50	38
60	39.29	0.81	60	37.95
75	39.42	0.81	75	37.85
90	39.56	0.81	90	37.76
120	39.84	0.81	120	37.65
150	39.96	0.81	150	37.53
180	40.04	0.81	180	37.47
240	40.37	0.81	240	37.27
300	40.52	0.81	300	37.15
360	40.65	0.81		
420	40.75	0.81		
480	40.78	0.81		
600	40.91	0.81		
720	40.92	0.81		
900	40.92	0.81		
1080	40.93	0.81		
1440	40.93	0.81		

APPENDIX D – LABORATORY RESULTS

UIS ORGANIC LABORATORY

UIS Organic Laboratory (Pty) Ltd • Reg. No. 2007/001896/07
VAT No 4340243221
Unit 3 Carrera House • 17 Sovereign Drive • Route 21 Corporate Park
PO Box 9025 • Centurion • 0046
Tel. +27 12 3451004 • Fax. +27 12 3451004
willieh@uisol.co.za • http://www.uisol.co.za

CLIENT INFORMATION

GCS (Pty) Ltd
Claudia Brites
PO Box 2597
Rivonia

TEST REPORT

TEST INFORMATION **SCREENING FOR VOLATILE PETROLEUM HYDROCARBONS (VPHs)**

ANALYTICAL METHOD: SPME Extraction and GC-MS METHOD Number: UISOL-T-012

DATE RECEIVED 27/10/2014 **DATE COMPLETED** 27/10/2014 **DATE ISSUED** 27/10/2014

SAMPLE INFORMATION **Lab No :** 8709 A **Matrix:** Water

SAMPLE No **QB3 (water)** **Dilution Factor** No Dilution

Project number 14/503 **Project name** 14-503 Q4 Fuels

GASOLINE RANGE ORGANICS (GROs)

MTBE*	<5	µg/liter
TAME*	<5	µg/liter
Benzene	<1	µg/liter
Toluene	<10	µg/liter
Ethyl Benzene	<2	µg/liter
m+p-Xylene	<2	µg/liter
o-Xylene	<2	µg/liter
1,3,5 Trimethyl benzene	<2	µg/liter
1,2,4 Trimethyl benzene	<2	µg/liter
Naphthalene	<2	µg/liter

POLYCYCLIC AROMATIC COMPOUNDS

Acenaphthene *	<1	µg/liter
Acenaphthylene *	<1	µg/liter
Flourene *	<1	µg/liter
Phenanthrene *	<1	µg/liter
Anthracene *	<1	µg/liter
Fluoranthene *	<1	µg/liter
Pyrene *	<1	µg/liter

DIESEL RANGE ORGANICS (DROs)

C10 *	<1	µg/liter
C11 *	<1	µg/liter
C12 *	<1	µg/liter
C13 *	<1	µg/liter
C14 *	<1	µg/liter
C15 *	<1	µg/liter
C16 *	<1	µg/liter
C17 *	<1	µg/liter
C18 *	<1	µg/liter
C19 *	<1	µg/liter
C20 *	<1	µg/liter

DIAGNOSTIC RATIOS

1,3,5TMB : 1,2,4TMB	#Error
(B+T)/(E+X)	#Error

Total VPHs Identified	<10	µg/liter
Estimated VPHs Unidentified	<10	µg/liter
Estimated TOTAL VPHs	<10	µg/liter

Authorised Signatory that approved this report

Reinardt Cromhout

sanas
Testing laboratory
T0419

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Parameters marked " * " in this Report are not included in the SANAS Schedule of Accreditation for this laboratory".

Results marked "A" - Concentration outside calibration range, estimate only

27/10/2014

UIS ORGANIC LABORATORY

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willieh@uisol.co.za • http://www.uisol.co.za

CLIENT INFORMATION

GCS (Pty) Ltd
Claudia Brites
PO Box 2597
Rivonia

TEST REPORT

TEST INFORMATION **SCREENING FOR VOLATILE PETROLEUM HYDROCARBONS (VPHs)**

ANALYTICAL METHOD: SPME Extraction and GC-MS METHOD Number: UISOL-T-012

DATE RECEIVED 27/10/2014 DATE COMPLETED 27/10/2014 **DATE ISSUED** 27/10/2014

SAMPLE INFORMATION **Lab No :** 8709 A **Matrix:** Water

SAMPLE No **QP1 (water)** Dilution Factor No Dilution

Project number 14/503 Project name 14-503 Q4 Fuels

GASOLINE RANGE ORGANICS (GROs)

MTBE*	<5	µg/liter
TAME*	<5	µg/liter
Benzene	<1	µg/liter
Toluene	<10	µg/liter
Ethyl Benzene	<2	µg/liter
m+p-Xylene	<2	µg/liter
o-Xylene	<2	µg/liter
1,3,5 Trimethyl benzene	<2	µg/liter
1,2,4 Trimethyl benzene	<2	µg/liter
Naphthalene	<2	µg/liter

POLYCYCLIC AROMATIC COMPOUNDS

Acenaphthene *	<1	µg/liter
Acenaphthylene *	<1	µg/liter
Flourene *	<1	µg/liter
Phenanthrene *	<1	µg/liter
Anthracene *	<1	µg/liter
Fluoranthene *	<1	µg/liter
Pyrene *	<1	µg/liter

DIESEL RANGE ORGANICS (DROs)

C10 *	<1	µg/liter
C11 *	<1	µg/liter
C12 *	<1	µg/liter
C13 *	<1	µg/liter
C14 *	<1	µg/liter
C15 *	<1	µg/liter
C16 *	<1	µg/liter
C17 *	<1	µg/liter
C18 *	<1	µg/liter
C19 *	<1	µg/liter
C20 *	<1	µg/liter

DIAGNOSTIC RATIOS

1,3,5TMB : 1,2,4TMB	#Error
(B+T)/(E+X)	#Error

Total VPHs Identified	<10	µg/liter
Estimated VPHs Unidentified	<10	µg/liter
Estimated TOTAL VPHs	<10	µg/liter

Authorised Signatory that approved this report

Reinardt Cromhout

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Results marked "A" - Concentration outside calibration range, estimate only

27/10/2014

Client Information

Company :	GCS (Pty) Ltd
Attention:	Claudia Brites
Tel:	(011) 803 5726
Fax:	
Address	63 Wessel Road
	Woodmead, Rivonia
	2128

Analysis Report

Lab No: 3842

SAMPLE INFORMATION

PROJECT NAME	Q4 Fuels	DATE RECEIVED	27/10/2014
PROJECT NUMBER	14-503	DATE COMPLETED	27/10/2014
PURCHASE ORDER	N/A	DATE ISSUED	27/10/2014

Sample ID	Hardness mg equivalent CaCO3/l	Bicarbonate [HCO3-] mg/l	Electrical Conductivity uS/cm
QP1	324.33	414.8	686
QB3	323.18	430.66	672

Authorized Signatory

WJ. HAVENGA

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U.T.D. - Unable To Determine

UIS sediba
laboratory

CLIENT INFORMATION

GCS (Pty) Ltd
Attention: Claudia Brites
63 Wessel Road Woodmead
Rivonia

Water Test Report

LABORATORY NUMBER 3842 A **DATE RECEIVED** 2014/10/27

SAMPLE NUMBER QB3

REPORTING UNIT mg/l [ppm] **(unless elsely stated)**

TASK PO Nr 14-503 **TASK STARTING DATE** 2014/10/27

Cations and Metals

(Method UISSL-WL-007) [NA]

Ag	<0.05	**Cd**	<0.05	**Mn**	0.17	**Si**	26.02
Al	0.15	**Co**	<0.05	**Mo**	<0.05	**Sn**	<0.05
As	<1	**Cr**	<0.05	**Na**	19.9	**Sr**	<0.05
B	<0.05	**Cu**	<0.05	**Ni**	<0.05	**Tl**	<1
Ba	<0.05	**Fe**	0.09	**P**	<0.05	**Ti**	<1
Be	<0.05	**K**	0.8	**Pb**	<1	**V**	<0.05
Bi	<0.05	**Li**	<0.05	**Sb**	<1	**Zn**	<0.05
Ca	39.4	**Mg**	54.8	**Se**	<1		

Anions

(Method UISSL-WL-005) [A]

F	<0.4	**[NA]**
Cl	12.9	
Br	<0.25	**[NA]**
NO2	<2	**[NA]**
NO3	14.2	
NO2 + NO3 as N =	3.2	
SO4	20.4	
PO4	<4	

Other Parameters

TDS	(Method UISSL-WL-004 @ 110 deg C) [A]	399
P-Alk as CaCO3	(Method UISSL-WL-002) [A]	<0.6
M-Alk as CaCO3	(Method UISSL-WL-002) [A]	353
pH	(Method UISSL-WL-003 @ 25 deg C) [A]	7.07
Total Cation meq/l		7.39
Total Anion meq/l		7.60
Cation - Anion Difference in meq/l		-0.21
% Difference		-1.39

Results approved by *WJ Havenga (Approved Signatory)*

NOTE: [NA] = Indicate that the test is not accredited

Reporting date: *27 October 2014*

sanas
Testing Laboratory
Facility No T 0584

CLIENT INFORMATION

GCS (Pty) Ltd
Attention: Claudia Brites
63 Wessel Road Woodmead
Rivonia

Water Test Report

LABORATORY NUMBER 3842 A **DATE RECEIVED** 2014/10/27

SAMPLE NUMBER QP1

REPORTING UNIT mg/l [ppm] **(unless elsely stated)**

TASK PO Nr 14-503 **TASK STARTING DATE** 2014/10/27

Cations and Metals

(Method UISSL-WL-007) [NA]

Ag	<0.05	**Cd**	<0.05	**Mn**	<0.05	**Si**	20.09
Al	<0.05	**Co**	<0.05	**Mo**	<0.05	**Sn**	<0.05
As	<1	**Cr**	<0.05	**Na**	10.8	**Sr**	<0.05
B	<0.05	**Cu**	<0.05	**Ni**	<0.05	**Tl**	<1
Ba	<0.05	**Fe**	0.30	**P**	<0.05	**Ti**	<1
Be	<0.05	**K**	1.6	**Pb**	<1	**V**	<0.05
Bi	<0.05	**Li**	<0.05	**Sb**	<1	**Zn**	<0.05
Ca	45.6	**Mg**	51.3	**Se**	<1		

Anions

(Method UISSL-WL-005) [A]

F	<0.4	**[NA]**
Cl	31.4	
Br	<0.25	**[NA]**
NO2	<2	**[NA]**
NO3	<2	

NO2 + NO3 as N = 0.0

SO4	5.4
PO4	<4

Other Parameters

TDS	(Method UISSL-WL-004 @ 110 deg C) [A]	452
P-Alk as CaCO3	(Method UISSL-WL-002) [A]	<0.6
M-Alk as CaCO3	(Method UISSL-WL-002) [A]	340
pH	(Method UISSL-WL-003 @ 25 deg C) [A]	7.47
Total Cation meq/l		7.02
Total Anion meq/l		7.20
Cation - Anion Difference in meq/l		-0.18
% Difference		-1.30

Results approved by *WJ Havenga (Approved Signatory)*

NOTE: [NA] = Indicate that the test is not accredited

Reporting date: *27 October 2014* ***Page 2 of 2***

sanas Testing Laboratory
Facility No T 0584

UIS ORGANIC LABORATORY

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CLIENT INFORMATION

GCS (Pty) Ltd
Claudia Brites
PO Box 2597
Rivonia

TEST REPORT

TEST INFORMATION **SCREENING FOR VOLATILE PETROLEUM HYDROCARBONS (VPHs)**

ANALYTICAL METHOD: SPME Extraction and GC-MS METHOD Number: UISOL-T-012

DATE RECEIVED 18/09/2014 DATE COMPLETED 22/09/2014 **DATE ISSUED** 22/09/2014

SAMPLE INFORMATION **Lab No :** 8513 A **Matrix:** Water

SAMPLE No **BH3 (water)** Dilution Factor No Dilution

Project number 14-503 Project name Q4 Fuels

GASOLINE RANGE ORGANICS (GROs)

MTBE*	<5	µg/liter
TAME*	<5	µg/liter
Benzene	<1	µg/liter
Toluene	<10	µg/liter
Ethyl Benzene	<2	µg/liter
m+p-Xylene	<2	µg/liter
o-Xylene	<2	µg/liter
1,3,5 Trimethyl benzene	<2	µg/liter
1,2,4 Trimethyl benzene	<2	µg/liter
Naphthalene	<2	µg/liter

POLYCYCLIC AROMATIC COMPOUNDS

Acenaphthene *	<1	µg/liter
Acenaphthylene *	<1	µg/liter
Flourene *	<1	µg/liter
Phenanthrene *	<1	µg/liter
Anthracene *	<1	µg/liter
Fluoranthene *	<1	µg/liter
Pyrene *	<1	µg/liter

DIESEL RANGE ORGANICS (DROs)

C10 *	<1	µg/liter
C11 *	<1	µg/liter
C12 *	<1	µg/liter
C13 *	<1	µg/liter
C14 *	<1	µg/liter
C15 *	<1	µg/liter
C16 *	<1	µg/liter
C17 *	<1	µg/liter
C18 *	<1	µg/liter
C19 *	<1	µg/liter
C20 *	<1	µg/liter

DIAGNOSTIC RATIOS

1,3,5TMB : 1,2,4TMB	#Error
(B+T)/(E+X)	#Error

Total VPHs Identified	<10	µg/liter
Estimated VPHs Unidentified	<10	µg/liter
Estimated TOTAL VPHs	<10	µg/liter

Authorised Signatory that approved this report

Reinardt Cromhout

sanas Testing Laboratory T0419

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Results marked "A" - Concentration outside calibration range, estimate only

22/09/2014

UIS ORGANIC LABORATORY
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CLIENT INFORMATION

GCS (Pty) Ltd
Claudia Brites
PO Box 2597
Rivonia

TEST REPORT

TEST INFORMATION **SCREENING FOR VOLATILE PETROLEUM HYDROCARBONS (VPHs)**

ANALYTICAL METHOD: SPME Extraction and GC-MS METHOD Number: UISOL-T-012

DATE RECEIVED 18/09/2014 DATE COMPLETED 22/09/2014 DATE ISSUED 22/09/2014

SAMPLE INFORMATION **Lab No :** 8513 A **Matrix:** Water

SAMPLE No **BH4 (water)** Dilution Factor No Dilution

Project number 14-503 Project name Q4 Fuels

GASOLINE RANGE ORGANICS (GROs)

MTBE*	<5	µg/liter
TAME*	<5	µg/liter
Benzene	<1	µg/liter
Toluene	<10	µg/liter
Ethyl Benzene	<2	µg/liter
m+p-Xylene	<2	µg/liter
o-Xylene	<2	µg/liter
1,3,5 Trimethyl benzene	<2	µg/liter
1,2,4 Trimethyl benzene	<2	µg/liter
Naphthalene	<2	µg/liter

POLYCYCLIC AROMATIC COMPOUNDS

Acenaphthene *	<1	µg/liter
Acenaphthylene *	<1	µg/liter
Flourene *	<1	µg/liter
Phenanthrene *	<1	µg/liter
Anthracene *	<1	µg/liter
Fluoranthene *	<1	µg/liter
Pyrene *	<1	µg/liter

DIESEL RANGE ORGANICS (DROs)

C10 *	<1	µg/liter
C11 *	<1	µg/liter
C12 *	<1	µg/liter
C13 *	<1	µg/liter
C14 *	<1	µg/liter
C15 *	<1	µg/liter
C16 *	<1	µg/liter
C17 *	<1	µg/liter
C18 *	<1	µg/liter
C19 *	<1	µg/liter
C20 *	<1	µg/liter

DIAGNOSTIC RATIOS

1,3,5TMB : 1,2,4TMB	#Error
(B+T)/(E+X)	#Error

Total VPHs Identified	<10	µg/liter
Estimated VPHs Unidentified	<10	µg/liter
Estimated TOTAL VPHs	<10	µg/liter

Authorised Signatory that approved this report

Reinardt Cromhout

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Testing Laboratory
T0419

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22/09/2014

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CLIENT INFORMATION

GCS (Pty) Ltd
Claudia Brites
PO Box 2597
Rivonia

TEST REPORT

TEST INFORMATION **SCREENING FOR VOLATILE PETROLEUM HYDROCARBONS (VPHs)**

ANALYTICAL METHOD: SPME Extraction and GC-MS METHOD Number: UISOL-T-012

DATE RECEIVED 18/09/2014 **DATE COMPLETED** 22/09/2014 **DATE ISSUED** 22/09/2014

SAMPLE INFORMATION **Lab No :** 8513 A **Matrix:** Water

SAMPLE No **QP2 (water)** **Dilution Factor** No Dilution

Project number 14-503 **Project name** Q4 Fuels

GASOLINE RANGE ORGANICS (GROs)

MTBE*	<5 µg/liter
TAME*	<5 µg/liter
Benzene	<1 µg/liter
Toluene	<10 µg/liter
Ethyl Benzene	<2 µg/liter
m+p-Xylene	<2 µg/liter
o-Xylene	<2 µg/liter
1,3,5 Trimethyl benzene	<2 µg/liter
1,2,4 Trimethyl benzene	<2 µg/liter
Naphthalene	<2 µg/liter

POLYCYCLIC AROMATIC COMPOUNDS

Acenaphthene *	<1 µg/liter
Acenaphthylene *	<1 µg/liter
Flourene *	<1 µg/liter
Phenanthrene *	<1 µg/liter
Anthracene *	<1 µg/liter
Fluoranthene *	<1 µg/liter
Pyrene *	<1 µg/liter

DIESEL RANGE ORGANICS (DROs)

C10 *	<1 µg/liter
C11 *	<1 µg/liter
C12 *	<1 µg/liter
C13 *	<1 µg/liter
C14 *	<1 µg/liter
C15 *	<1 µg/liter
C16 *	<1 µg/liter
C17 *	<1 µg/liter
C18 *	<1 µg/liter
C19 *	<1 µg/liter
C20 *	<1 µg/liter

DIAGNOSTIC RATIOS

1,3,5TMB : 1,2,4TMB	#Error
(B+T)/(E+X)	#Error

Total VPHs Identified	<10 µg/liter
Estimated VPHs Unidentified	<10 µg/liter
Estimated TOTAL VPHs	<10 µg/liter

Authorised Signatory that approved this report

Reinardt Cromhout

sanas
Testing laboratory
T0419

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22/09/2014

Results marked "A" - Concentration outside calibration range, estimate only

UIS sediba laboratory

Client Information

Company :	GCS (Pty) Ltd
Attention:	Claudia Brites
Tel:	(011) 803 5726
Fax:	
Address	63 Wessel Road
	Woodmead, Rivonia
	2128

Analysis Report

Lab No: **3836**

SAMPLE INFORMATION

PROJECT NAME	Q4 Fuels	DATE RECEIVED	18/09/2014
PROJECT NUMBER	14-503	DATE COMPLETED	22/09/2014
PURCHASE ORDER	N/A	DATE ISSUED	22/09/2014

Sample ID	Hardness mg equivalent CaCO3/l	Bicarbonate [HCO3-] mg/l
BH 3	269.14	333.06
BH 4	256.43	290.36
QP 2	341.59	445.3

Authorized Signatory

WJ. HAVENGA

U.T.D. - Unable To Determine

UIS sediba laboratory

CLIENT INFORMATION

GCS (Pty) Ltd
Attention: Claudia Brites
63 Wessel Road Woodmead
Rivonia

Water Test Report

LABORATORY NUMBER 3836 A **DATE RECEIVED** 2014/09/18

SAMPLE NUMBER BH 4

REPORTING UNIT mg/l [ppm] **(unless elsely stated)**

TASK PO Nr 14-503 **TASK STARTING DATE** 2014/09/18

Cations and Metals

(Method UISSL-WL-007) [NA]

Ag	<0.05	**Cd**	<0.05	**Mn**	<0.05	**Si**	23.08
Al	<0.05	**Co**	<0.05	**Mo**	<0.05	**Sn**	<0.05
As	<1	**Cr**	<0.05	**Na**	10.8	**Sr**	<0.05
B	<0.05	**Cu**	<0.05	**Ni**	<0.05	**Tl**	<1
Ba	<0.05	**Fe**	<0.05	**P**	<0.05	**Ti**	<1
Be	<0.05	**K**	0.2	**Pb**	<1	**V**	<0.05
Bi	<0.05	**Li**	<0.05	**Sb**	<1	**Zn**	<0.05
Ca	40.9	**Mg**	37.5	**Se**	<1		

Anions

(Method UISSL-WL-005) [A]

F	<0.4
Cl	12.4
Br	<0.25
NO2	<2
NO3	38.4
NO2 + NO3 as N =	8.7
SO4	4.4
PO4	<4

Other Parameters

TDS	(Method UISSL-WL-004 @ 110 deg C) [A]	366
P-Alk as CaCO3	(Method UISSL-WL-002) [A]	<0.6
M-Alk as CaCO3	(Method UISSL-WL-002) [A]	238
pH	(Method UISSL-WL-003 @ 25 deg C) [A]	7.10
Total Cation meq/l		5.60
Total Anion meq/l		5.64
Cation - Anion Difference in meq/l		-0.04
% Difference		-0.38

Results approved by *WJ Havenga (Technical Manager)*

NOTE: [A]= accredited and [NA] = Not accredited

Reporting date: *22 September 2014* *Page 1 of 3*

sanas Testing Laboratory
Facility No T 0584

UIS sediba laboratory

CLIENT INFORMATION

GCS (Pty) Ltd
Attention: Claudia Brites
63 Wessel Road Woodmead
Rivonia

Water Test Report

LABORATORY NUMBER 3836 A **DATE RECEIVED** 2014/09/18

SAMPLE NUMBER BH 3

REPORTING UNIT mg/l [ppm] **(unless elsely stated)**

TASK PO Nr 14-503 **TASK STARTING DATE** 2014/09/18

Cations and Metals

(Method UISSL-WL-007) [NA]

Ag	<0.05	**Cd**	<0.05	**Mn**	<0.05	**Si**	27.83
Al	<0.05	**Co**	<0.05	**Mo**	<0.05	**Sn**	<0.05
As	<1	**Cr**	<0.05	**Na**	11.2	**Sr**	0.09
B	<0.05	**Cu**	<0.05	**Ni**	<0.05	**Tl**	<1
Ba	<0.05	**Fe**	<0.05	**P**	<0.05	**Ti**	<1
Be	<0.05	**K**	0.4	**Pb**	<1	**V**	<0.05
Bi	<0.05	**Li**	<0.05	**Sb**	<1	**Zn**	<0.05
Ca	38.0	**Mg**	42.8	**Se**	<1		

Anions

(Method UISSL-WL-005) [A]

F	<0.4
Cl	8.5
Br	<0.25
NO2	<2
NO3	25.4

NO2 + NO3 as N = 5.7

SO4	4.0
PO4	<4

Other Parameters

TDS	(Method UISSL-WL-004 @ 110 deg C) [A]	396
P-Alk as CaCO3	(Method UISSL-WL-002) [A]	<0.6
M-Alk as CaCO3	(Method UISSL-WL-002) [A]	275
pH	(Method UISSL-WL-003 @ 25 deg C) [A]	7.44
Total Cation meq/l		5.92
Total Anion meq/l		6.06
Cation - Anion Difference in meq/l		-0.14
% Difference		-1.19

Results approved by *WJ Havenga (Technical Manager)*

NOTE: [A]= accredited and [NA] = Not accredited

Reporting date: *22 September 2014* ***Page 2 of 3***

sanas Testing Laboratory
Facility No T 0584

CLIENT INFORMATION

GCS (Pty) Ltd
Attention: Claudia Brites
63 Wessel Road Woodmead
Rivonia

Water Test Report

LABORATORY NUMBER 3836 A **DATE RECEIVED** 2014/09/18

SAMPLE NUMBER QP 2

REPORTING UNIT mg/l [ppm] **(unless elsely stated)**

TASK PO Nr 14-503 **TASK STARTING DATE** 2014/09/18

Cations and Metals

(Method UISSL-WL-007) [NA]

Ag	<0.05	**Cd**	<0.05	**Mn**	<0.05	**Si**	30.40
Al	<0.05	**Co**	<0.05	**Mo**	<0.05	**Sn**	<0.05
As	<1	**Cr**	<0.05	**Na**	10.6	**Sr**	0.11
B	<0.05	**Cu**	<0.05	**Ni**	<0.05	**Tl**	<1
Ba	<0.05	**Fe**	<0.05	**P**	<0.05	**Ti**	<1
Be	<0.05	**K**	<0.05	**Pb**	<1	**V**	<0.05
Bi	<0.05	**Li**	<0.05	**Sb**	<1	**Zn**	<0.05
Ca	45.0	**Mg**	55.7	**Se**	<1		

Anions

(Method UISSL-WL-005) [A]

F	<0.4
Cl	6.1
Br	<0.25
NO2	<2
NO3	12.7
NO2 + NO3 as N =	2.9
SO4	<4
PO4	<4

Other Parameters

TDS	(Method UISSL-WL-004 @ 110 deg C) [A]	438
P-Alk as CaCO3	(Method UISSL-WL-002) [A]	<0.6
M-Alk as CaCO3	(Method UISSL-WL-002) [A]	365
pH	(Method UISSL-WL-003 @ 25 deg C) [A]	7.02
Total Cation meq/l		7.29
Total Anion meq/l		7.27
Cation - Anion Difference in meq/l		0.02
% Difference		0.12

Results approved by *WJ Havenga (Technical Manager)*

NOTE: [A]= accredited and [NA] = Not accredited

Reporting date: *22 September 2014* ***Page 3 of 3***

sanas Testing Laboratory
Facility No T 0584

Wetland Delineation

Annexure F3

REPORT

WETLAND / WATER COURSE IDENTIFICATION AND MANAGEMENT REPORT:

PORTION 22 OF THE FARM SCHIETFONTEIN 437-JQ IN THE NORTH-WEST PROVINCE

12th May, 2014

Compiled by:
J.H. van der Waals
(PhD Soil Science, Pr.Sci.Nat)
Member of:
Soil Science Society of South Africa (SSSSA)

Accredited member of:
South African Soil Surveyors Organisation (SASSO)

Registered with:
The South African Council for Natural Scientific Professions
Registration number: 400106/08

Declaration

I, Johan Hilgard van der Waals, declare that I –

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

J.H. VAN DER WAALS
TERRA SOIL SCIENCE

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WETLAND / WATER COURSE IDENTIFICATION AND MANAGEMENT REPORT: PORTION 22 OF THE FARM SCHIETFONTEIN 437-JQ IN THE NORTH-WEST PROVINCE

1. INTRODUCTION

1.1 TERMS OF REFERENCE

Terra Soil Science was appointed by **Q4 Chemicals** to determine the presence and status of wetlands on Portion 22 of the Farm Schietfontein 437-JQ in the North-West Province.

1.2 PROBLEM STATEMENT

At present it is not clear whether a wetland occurs on the investigation site.

1.3 AIM OF THIS REPORT

The aim of this report is to provide a perspective on the requirements for the identification of a wetland as well as to address the presence and status of a wetland / water course on the site. In addition, this report aims to provide a hydropedological perspective on the site and broader area to aid in the identification and management of water impacts through the elucidation of broad surface hydrology and hydropedology principles.

1.4 METHODOLOGY

1.4.1 Brief Background

The identification and delineation of wetlands rest on several parameters that include topographic, vegetation and soil indicators. Apart from the inherent flaws in the wetland delineation process, as discussed later in this report, the concept of wetland delineation implies an emphasis on the wetlands themselves and very little consideration of the processes driving the functioning and presence of the wetlands. One discipline that encompasses a number of tools to elucidate landscape hydrological processes is "hydropedology" (Lin, 2012). The crux of the understanding of hydropedology lies in the fact that pedology is the description and classification of soil on the basis of morphology that is the result of soil and landscape hydrological, physical and chemical processes. But, the soils of which the morphology are described, also take part in and intimately influence the hydrology of the landscape. Soil is therefore both an indicator as well as a participator in the processes that require elucidation.

Wetlands are merely those areas in a landscape where the morphological indicators point to prolonged or intensive saturation near the surface to influence the distribution of wetland vegetation. Wetlands therefore form part of a larger hydrological entity that they cannot be separated from.

1.4.2 Proposed Methodology

In order to provide detailed pedohydrological information both detailed soil surveys and hydrological investigations are needed. In practice these intensive surveys are expensive and very seldom conducted. However, with the understanding of soil morphology, pedology and basic soil physics parameters as well as the collection and interpretation of existing soil survey information, assessments at different levels of detail and confidence can be conducted. In this sense four levels of investigation are proposed namely:

1. Level 1 Assessment: This level includes the collection and generation of all applicable remote sensing, topographic and land type parameters to provide a "desktop" product. This level of investigation rests on adequate experience in conducting such information collection and interpretation exercises and will provide a broad overview of dominant hydropedological parameters of a site. Within this context the presence, distribution and functioning of wetlands will be better understood than without such information.
2. Level 2 Assessment: This level of assessment will make use of the data generated during the Level 1 assessment and will include a reconnaissance soil and site survey to verify the information as well as elucidate many of the unknowns identified during the Level 1 assessment.
3. Level 3 Assessment: This level of assessment will build on the Level 1 and 2 assessments and will consist of a detailed soil survey with sampling and analysis of representative soils. The parameters to be analysed include soil physical, chemical and mineralogical parameters that elucidate and confirm the morphological parameters identified during the field survey.
4. Level 4 Assessment: This level of assessment will make use of the data generated during the previous three levels and will include the installation of adequate monitoring equipment and measurement of soil and landscape hydrological parameters for an adequate time period. The data generated can be used for the building of detailed hydrological models (in conjunction with groundwater and surface hydrologists) for the detailed water management on specific sites.

For most wetland delineation exercises a Level 2 or Level 3 assessment should be adequate.

1.4.3 Methodology Employed in this Investigation

The report was generated through:

1. The collection and presentation of baseline land type and topographic data for the site;
2. The thorough consideration of the statutory context of wetlands and the process of wetland delineation;
3. The identification of water related landscape parameters (conceptual and real) for the site for the generation of Level 1 hydropedology information;
4. Aerial photograph interpretation of the site to aid in the Level 1 hydropedology assessment;

5. Assessment of historical impacts and changes on the site through the accessing of various historical aerial photographs and topographic maps;
6. Reconnaissance soil and site survey in terms of soil properties as well as drainage feature properties to generate a Level 2 hydrology assessment; and
7. Presentation of the findings of the various components of the investigation.

2. SITE LOCALITY AND DESCRIPTION

2.1 SURVEY AREA BOUNDARY

The site lies between 25° 38’ 39’’ and 25° 39’ 02’’ south and 27° 56’ 03’’ and 27° 56’ 56’’ east 15 km west of the town of Brits in the North-West Province (**Figure 1**).

2.2 GENERALISED GEOLOGY

The area surrounding and including the site consists predominantly of basic igneous geology (ferrogabbro, ferrodiorite, diorite, gabbro, norite and anorthosite) with limited and enclosed quartzite, hornfels and shale. The implications of the specific geology on the identification of wetlands and hydromorphy in soils will be discussed later in the report.

2.3 LAND TYPE DATA

Land type data for the site was obtained from the Institute for Soil Climate and Water (ISCW) of the Agricultural Research Council (ARC). The land type data is presented at a scale of 1:250 000 and entails the division of land into land types, typical terrain cross sections for the land type and the presentation of dominant soil types for each of the identified terrain units (in the cross section). The soil data is classified according to the Binomial System (MacVicar et al., 1977). The soil data was interpreted and re-classified according to the Taxonomic System (Soil Classification Working Group, 1991).

The Schietfontein site is situated in the **Ae21** land type (Land Type Survey Staff, 1972 - 2006) with **Figure 2** providing the land type distribution for the area. Below follows a brief description of the land type in terms of soils as well as expected hydromorphic indicators.

Land Type Ae21

Land Type – General: Ae dominantly red high base status (mesotrophic and lime containing) apedal soils, without dunes, that are deeper than 300 mm.

Soils: Soils are predominantly deep and high clay content red apedal and red structured soils from crests to footslope positions with structured swelling soils dominating in valley bottom and drainage depression positions. Due to the geology and local variation structured swelling soils can occur in any level terrain area even if this is in higher lying parts of the landscape.

Indicators of Hydromorphy: Due to the specific geology and other soil forming factors and processes soils in basic igneous geology environments express no signs of wetness in the form of mottles. The only reliable indicator of saturation in the soils is grey low chroma matrix colours, which occur in drainage depressions only. The specific challenges regarding these landscapes are discussed in more detail later in the report

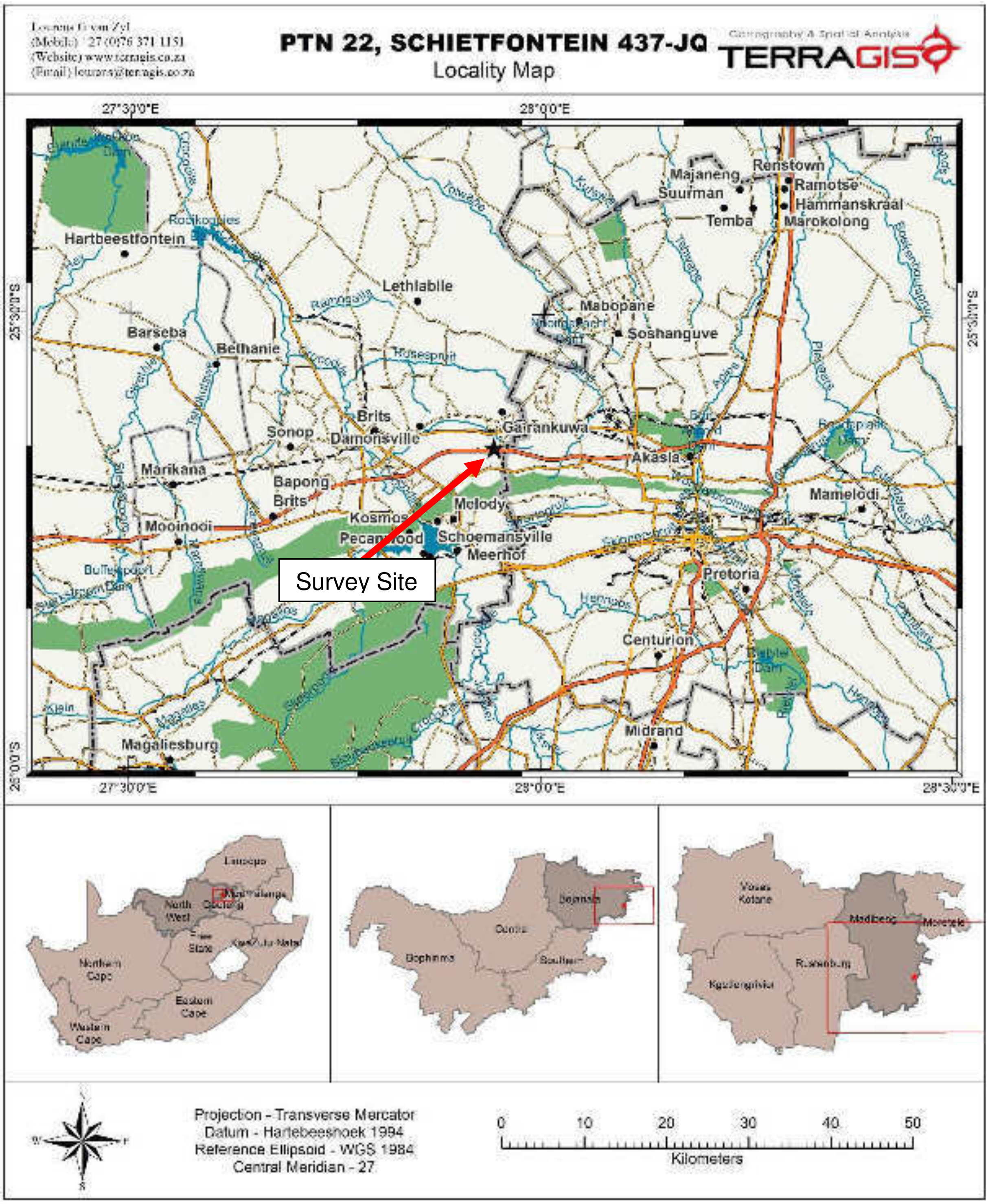

Figure 1 Locality of the survey site

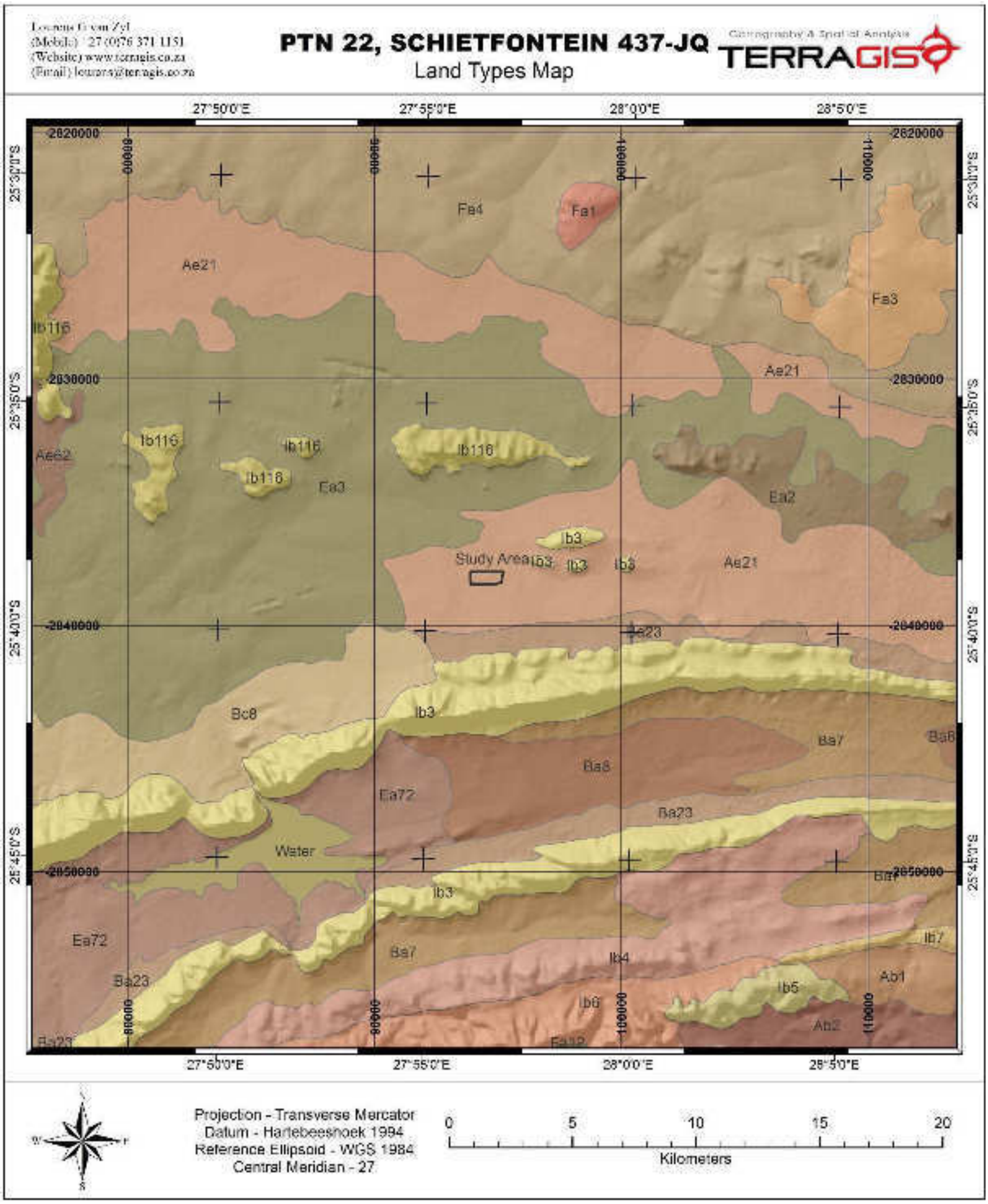

Figure 2 Land type map of the survey site

2.4 TOPOGRAPHY

The topography of the site is flat with a very slight slope towards the north-west (**Figure 3**).

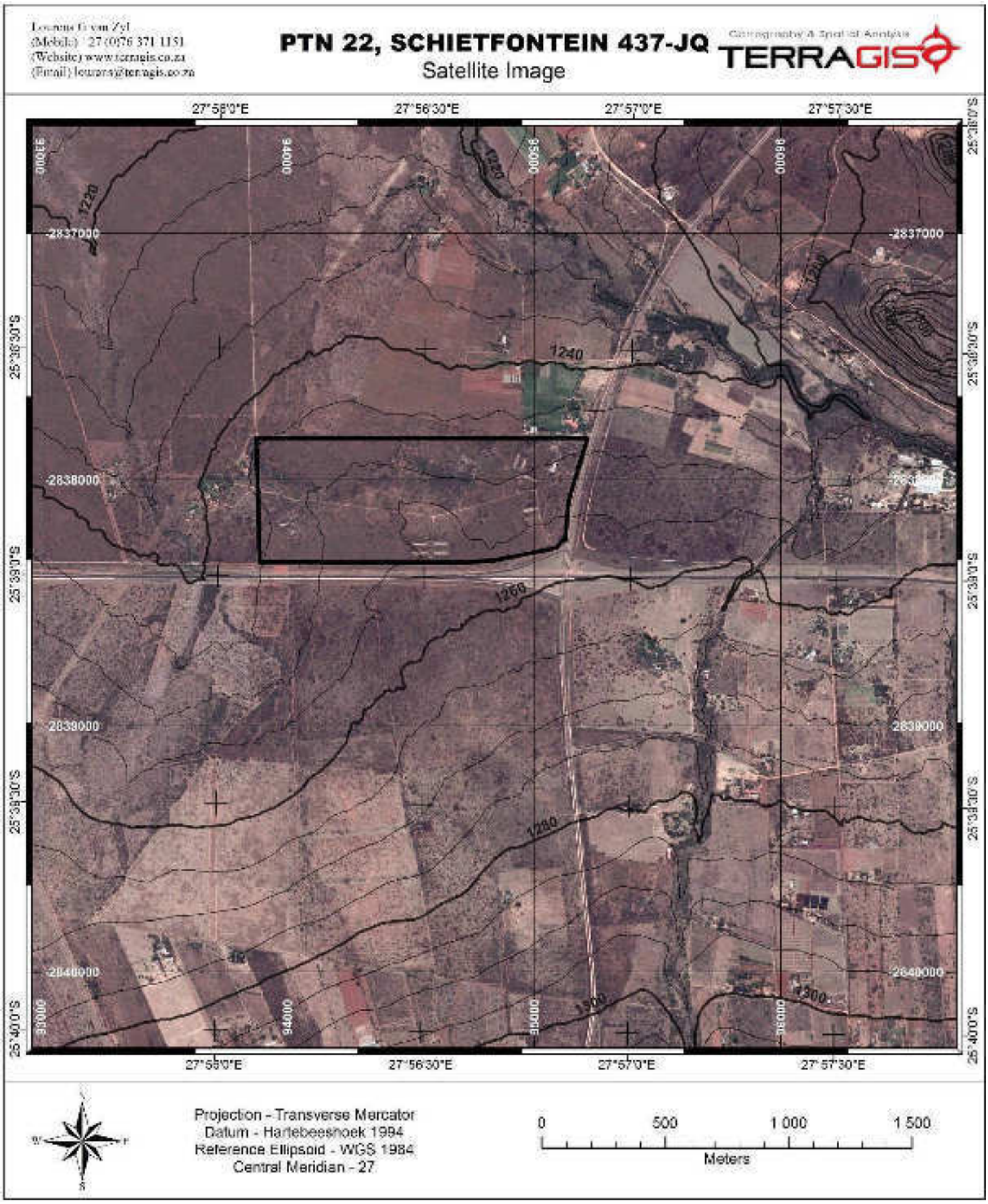

Figure 3 Contours of the general area superimposed on a satellite image

From the contour data a digital elevation model (DEM) was generated for the area and site (**Figure 4**).

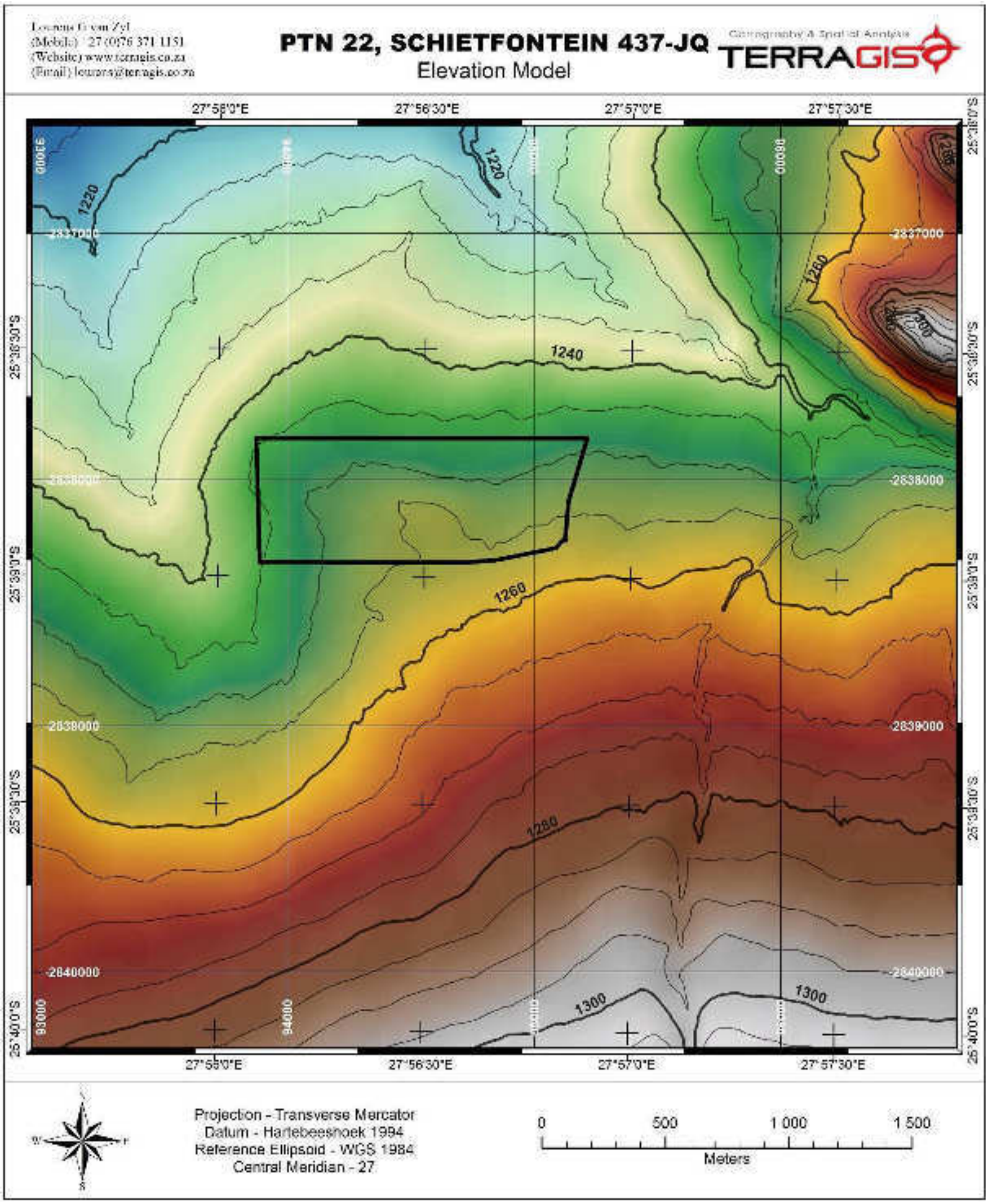

Figure 4 DEM of the survey site and surrounding area

From the contour data a slope map was generated (**Figure 5**) and from this data in turn a topographic wetness index (TWI) was calculated for the site and general area (**Figure 6**). The TWI provides a very accurate indication of water flow paths and areas of water accumulation, which is a function of the topography of the site. On the specific site no distinct drainage depressions were identified.

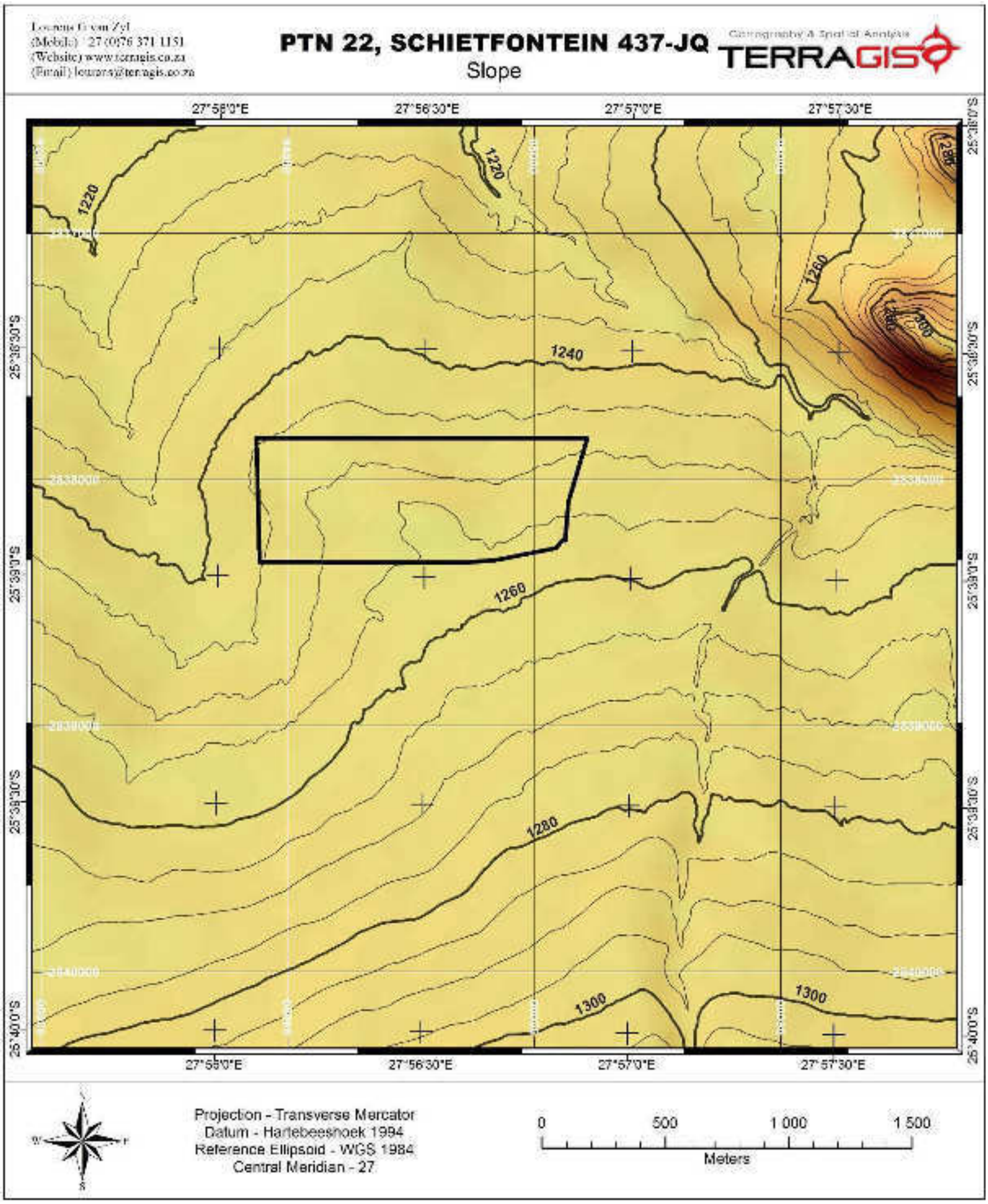

Figure 5 Slope map of the survey site and general area

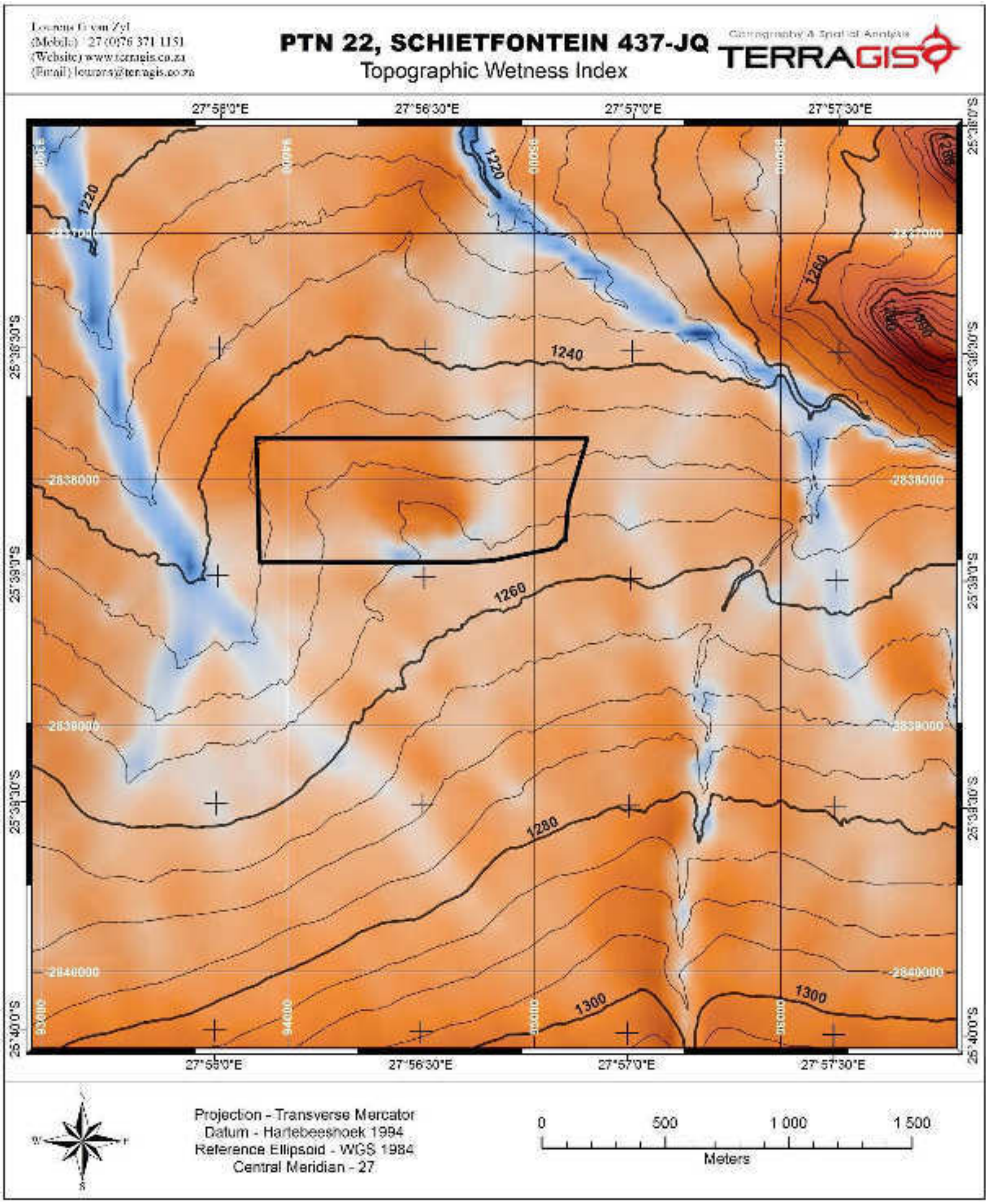

Figure 6 Topographic wetness index (TWI) for the survey site and surrounding area

2.5 AERIAL PHOTOGRAPH INTERPRETATION

An aerial photograph interpretation exercise was conducted through the use of Google Earth images of the site. Historical images spanning the period from 2004 to 2012 were used for the purpose of identifying land use characteristics associated with the site. In addition, the images were used to identify possible wetland areas that could be targeted for investigation during the field survey (addressed in the next section).

2.6 SITE VISIT AND SOIL SURVEY

A site visit and soil survey was conducted on the 26th of March 2014. The site was traversed on foot and soil characteristics were assessed in terms of soil form and hydromorphy (morphological signs of signs of wetness).

Disclaimer: The following sections (3 and 4) represents sections of a discussion that I use as standard in describing the challenges regarding wetland delineation and management in a range of landscapes. This implies that the section is predominantly verbatim the same as in other reports provided to clients and the authorities. Copyright is strictly reserved.

3. WETLANDS: STATUTORY CONTEXT

3.1 WETLAND DEFINITION

Wetlands are defined, in terms of the National Water Act (Act no 36 of 1998) (NWA), as:

"Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."

From a scientific, practical and legal perspective the interpretation of the definition poses a number of challenges. In order to address the challenges it is necessary to disaggregate the definition and discuss the challenges as follows:

1. "Land which is transitional between terrestrial and aquatic systems …": this implies areas with variable hydrological and ecological characteristics of which the variation can be described as the linear (assumed) transition from one pole (terrestrial/dry) to another (aquatic/wet).
2. "… where the water is usually at or near the surface …": Although the regular condition is implied there is no reference to any empirical interpretation. This aspect therefore introduces uncertainty and the potential for significantly variable interpretation.
3. "… or the land is periodically covered with shallow water …": This statement introduces and alternative to the above statement but, again there is no reference to any empirical interpretation and it therefore introduces uncertainty and the potential for significantly variable interpretation

4. “and which land in normal circumstances …”: Normal circumstances are not defined with a subsequent introduction of uncertainty and variability in interpretation. According to Mernewecke and Kotze (1999) “normal circumstances” in the definition refers to “without human modifications”.
5. “… supports or would support vegetation typically adapted …”: Vegetation species and communities can be described and named and can provide distinctly measurable indicators of wetland conditions. This is therefore a clear indicator if the requisite scientific knowledge is available.
6. “… to life in saturated soil.”: Soil saturation (degree, intensity and duration) can be measured empirically (although at significant financial and time cost) or deduced from the soil morphology to varying degrees of certainty. The soil morphological indictors (all functions of soil forming factors and processes) have been studied and described extensively in the soil science literature.

An evaluation of the disaggregation above yields that the only certain descriptors, from a scientific, practical and legal perspective, are vegetation and soil indicators. In this sense the then Department of Water Affairs and Forestry (DWAF) generated “Resource Directed Measures for the Protection of Water Resources” (DWAF, 1999). In Appendix W6 of the document guidelines for the delineation of wetlands are provided (Mernewecke and Kotze, 1999). In this document distinct emphasis is placed on the use of soil characteristics in conjunction with vegetation characteristics (if present) for the delineation of wetlands. The document also refers specifically to the fact that a certain degree of proficiency in terms of soil classification with the SA Taxonomic System (Soil Classification Working Group, 1991) is required for such surveys. In the event of challenging sites it advises that qualified soils scientists conduct the delineation exercises.

Additionally, from the definition and the purpose of the water act it can be assumed that wetlands are merely the expression of wetness in landscapes and that the water resource can occur in landscapes in many other forms. One form that is not explicitly mentioned is seasonally perched water tables and their associated vadose zones that are instrumental in the “feeding” of wetlands through lateral flow mechanisms in the landscape. From the purpose of the NWA it is assumed that these water resources are included explicitly in the NWA.

3.2 WATERCOURSE DEFINITION

“Catchment” is defined, in terms of the National Water Act (Act no 36 of 1998) (NWA), as:

“…, in relation to a watercourse or watercourses or part of a watercourse, means the area from which any rainfall will drain into the watercourse or watercourses or part of a watercourse, through surface flow to a common point or common points;”

“Watercourse” is defined, in terms of the National Water Act (Act no 36 of 1998) (NWA), as:

“*(a)* a river or spring;

(b) a natural channel in which water flows regularly or intermittently;
(c) a wetland, lake or dam into which, or from which, water flows; and
(d) any collection of water which the Minister may, by notice in the *Gazette*, declare to be a water course,
and a reference to a watercourse includes, where relevant, its bed and banks;"

3.3 THE RESOURCE DIRECTED MEASURES FOR PROTECTION OF WATER RESOURCES.

The following are specific quotes from the "Resource Directed Measures for Protection of Water Resources. Volume 4: Wetland Ecosystems" as published by DWAF (1999).

From the Introduction:

"This set of documents on Resource Directed Measures (RDM) for protection of water resources, issued in September 1999 in Version 1.0, presents the procedures to be followed in undertaking **preliminary determinations of the class, Reserve and resource quality objectives for water resources**, as specified in sections 14 and 17 of the South African National Water Act (Act 36 of 1998).

The development of procedures to determine RDM was initiated by the Department of Water Affairs and Forestry in July 1997. Phase 3 of this project will end in March 2000. Additional refinement and development of the procedures, and development of the full water resource classification system, will continue in Phase 4, until such time as the detailed procedures and full classification system are ready for publication in the Government Gazette.

It should be noted that until the final RDM procedures are published in the Gazette, and prescribed according to section 12 of the National Water Act, all determinations of RDM, whether at the rapid, the intermediate or the comprehensive level, will be considered to be preliminary determinations."

The following components of the RDM document has bearing on this report and these will be discussed in more detail later.

In Appendix W6 the methodology is provided for the delineation of wetland boundaries and zones. The emphasis in this document is on the interpretation of soil characteristics for the identification of the wetland boundaries. This document was the precursor of the wetland delineation guidelines as published by DWAF (2005).

3.4 WETLAND DELINEATION GUIDELINES

In 2005 the Department of Water Affairs and Forestry published a manual entitled "A practical field procedure for identification and delineation of wetland and riparian areas" (DWAF, 2005). The "…manual describes field indicators and methods for determining whether an area is a wetland or riparian area, and for finding its boundaries.” The definition of a wetland in the guidelines is that of the NWA and it states that wetlands must have one or more of the following attributes:

- “**Wetland (hydromorphic) soils** that display characteristics resulting from prolonged saturation”
- “The presence, at least occasionally, of **water loving plants (hydrophytes)**”
- “A **high water table** that results in saturation at or near the surface, leading to anaerobic conditions developing in the top 50cm of the soil.”

The guidelines further list four indicators to be used for the finding of the outer edge of a wetland. These are:

- Terrain Unit Indicator. The terrain unit indicator does not only identify valley bottom wetlands but also wetlands on steep and mild slopes in crest, midslope and footslope positions.
- Soil Form Indicator. A number of soil forms (as defined by MacVicar et al., 1991) are listed as indicative of permanent, seasonal and temporary wetland zones.
- Soil Wetness Indicator. Certain soil colours and mottles are indicated as colours of wet soils. The guidelines stipulate that this is the primary indicator for wetland soils. (Refer to the guidelines for a detailed description of the colour indicators.) In essence, the reduction and removal of Fe in the form of “bleaching” and the accumulation of Fe in the form of mottles are the two main criteria for the identification of soils that are periodically or permanently wet.
- Vegetation Indicator. This is a key component of the definition of a wetland in the NWA. It often happens though that vegetation is disturbed and the guidelines therefore place greater emphasis on the soil form and soil wetness indicators as these are more permanent whereas vegetation communities are dynamic and react rapidly to external factors such as climate and human activities.

The main emphasis of the guidelines is therefore the use soils (soil form and wetness) as the criteria for the delineation of wetlands.”

3.5 WETLAND INDICATORS

The wetland indicators discussed above are limited to a degree in the following manner:

1. The topographic indicator is limited to wetlands that are associated with surface topographical variation and it is therefore limited to specific landscape positions. The topographic indicator does not make allowance for variation in physical properties below the soil surface. In this sense aspects such as return-flow zones and interflow zones (that often occur in midslope or footslope positions) are not accommodated. In practice these areas prove the most problematic in terms of interpretation and delineation.
2. The vegetation indicator is limited predominantly by regional and local variation in edaphic and climatic conditions. The regionalization of vegetation guidelines should address this aspect satisfactorily.
3. The soil form indicator suffers from a number of limitations namely:

   a. Soil forms present in an area do not necessarily indicate wetlands. Soil forms have to be viewed in wider context as their classification is also not an auditable process. (Unfortunately pedologists often have significant variation in interpretation!) The presence of a specific soil form may indicate the presence of a wetland though but this aspect will have to be confirmed on the site through additional indicators.
   b. Certain soil forms are erroneously assigned to specific wetland conditions viz. the Rensburg that is assigned to permanent wetland areas but which is actually characterized by dominance of smectite clay minerals that can only form in seasonal wetland conditions. This discussion warrants a report in itself and will therefore not be further elucidated in this report.
   c. Improved elucidation of the presence of soil forms in landscapes is required. This is especially relevant as the roles of the soils in wetlands and wetland functioning is often poorly understood. On this topic there are current research projects underway that focus on the description of hillslope hydrology and the soil morphological indicators of such hydrology. Linked to this is the established concept of soil variation along a topographic sequence (catena concept) for specific environments or land types. This aspect links up to the concept of soil formation (pedogenesis) and hydropedology which is finding new and very relevant application in the elucidation of environmental processes.
4. The soil wetness indicator is in all probability the most problematic as there are numerous physical and chemical determinants. The main indicator of reduction is the very handy redox morphological variation of Fe – and this is the assumption that most wetland delineation exercises are based upon. (A dedicated discussion of this aspect is provided later in the report.) There is a distinct variability in expression of the quantity / intensity parameters of mottles in different soil environments. This variation is in most cases linear for simple parameters but soils always exhibit combinations of variable parameters that make linear interpretation highly suspect and problematic. A brief elucidation of the problem components include:
   a. The Fe content and reserve of soils and parent material vary significantly and impart varying expression of Fe redox morphology with consequent challenges in interpretation. This aspect induces variation between landscapes with homogenous parent materials (within the specific landscape) or within landscapes where variation in parent materials is found within the landscape.
   b. The Mn content of soils influence redox poise processes that in turn influence the expression of Fe redox morphology. Additional sources of variation include:
      i. Textural influences on expression of mottles;
      ii. Climatic / rainfall gradients; and
      iii. Variation in pH gradients linked to electron activity (Eh). The redox morphology changes linearly with these parameters with the distinct expression of mottles (intensity, colour, contrast) decreasing linearly with increasing pH (even if Eh remains constant).
      iv. In neutral to low pH soils the dominant Fe minerals are Fe oxides and hydroxides – all with bright colours leading to the expression of discernible

mottling. In high pH soils the dominant secondary Fe mineral is siderite ($FeCO_3$) which is white in colour that is often associated with lime accumulations (also white). Therefore, alkaline soil environments often do not exhibit distinctly discernible Fe redox morphology. Linked to this is the fact that lime accumulation is also a factor of climate and aridity and lime accumulations can therefore not be used as an indication of reduction even though there are distinct links.

    c. Soil colour varies significantly between different chemical and physical environments (even if pH and Eh remains relatively similar) and as such one set of wetness criteria cannot be applied universally.
    d. With the advancement of science concepts that were accepted to be true 30 years ago are now considered erroneous. A distinct example of this is references to "blue green colouration" in soils classification texts that indicate conditions of distinct saturation in those texts. This colouration has, with recent research, been proven to occur under very specific redox conditions that indicate only intermediate reduction, even though the soil may be saturated. The historically held conviction that "saturation equals reduction" has been proven to not apply religiously in all environments. It is therefore imperative that the application (wetland delineation) keeps up with the science.

3.6 PROPOSED IMPROVEMENTS

Having indicated that there are numerous limitations to the current wetland delineation approach it is important to focus on dedicated improvements that can implemented/incorporated easily. These improvements include:

1. Updating of the current delineation guidelines (including the draft version from 2008) to serve as a national standard document indicating variability in SA (broadly) through:
    a. Improvement of the landscape indicator to include seepage (including interflow, seepage and return-flow wetlands)
    b. Improvement and correction of the soil form indicator description. Introduction of the concept of "driest soils on crests and wettest soils in depressions" as a method of determining the range of soil variation in specific landscapes.
    c. Improvement and correction of the soil wetness indicator description to reflect differing pH/Eh/parent material environments. Linking of soil wetness indicators to the concept of "driest soils on crests and wettest soils in depressions" as a method of determining range of soil variation in different landscapes.
    d. Introduction of measuring and inference tools for generation of empirical data on wetness.
    e. Introduction of regional and/or land type based detailed guidelines that will include:
        i. Localized topographic indicators and pointers / aids;
        ii. Localized soil form sequences (catena) and soil form variability. (Utilize method of soil form variation range in land type); and

    iii. Localized variation in terms of soil wetness indicators. (Utilize method of soil form variation range in land type).

2. Correction of scientific inaccuracies and inconsistencies in the current documents and improvement of the principles and guidelines to a proper standard through focused research, peer review and formal publication.

4. CHALLENGES REGARDING WETLAND DELINEATION IN ALKALINE SOILS

In order to discuss the procedures followed and the results of the wetland identification exercise it is necessary at the outset to provide some theoretical background on soil forming processes, soil wetness indicators, water movement in soils and topographical sequences of soil forms (catena).

4.1 PEDOGENESIS

Pedogenesis is the process of soil formation. Soil formation is a function of five (5) factors namely (Jenny, 1941):

- Parent material;
- Climate;
- Topography;
- Living Organisms; and
- Time.

These factors interact to lead to a range of different soil forming processes that ultimately determine the specific soil formed in a specific location. Central to all soil forming processes is water and all the reactions (physical and chemical) associated with it. The physical processes include water movement onto, into, through and out of a soil unit. The movement can be vertically downwards, lateral or vertically upwards through capillary forces and evapotranspiration. The chemical processes are numerous and include dissolution, precipitation (of salts or other elements) and alteration through pH and reduction and oxidation (redox) changes. In many cases the reactions are promoted through the presence of organic material that is broken down through aerobic or anaerobic respiration by microorganisms. Both these processes alter the redox conditions of the soil and influence the oxidation state of elements such as Fe and Mn. Under reducing conditions Fe and Mn are reduced and become more mobile in the soil environment. Oxidizing conditions, in turn, lead to the precipitation of Fe and Mn and therefore lead to their immobilization. The dynamics of Fe and Mn in soil, their zones of depletion through mobilization and accumulation through precipitation, play an important role in the identification of the dominant water regime of a soil and could therefore be used to identify wetlands and wetland conditions.

4.2 WATER MOVEMENT IN THE SOIL PROFILE

In a specific soil profile, water can move upwards (through capillary movement), horizontally (owing to matric suction) and downwards under the influence of gravity.

The following needs to be highlighted in order to discuss water movement in soil:

- Capillary rise refers to the process where water rises from a deeper lying section of the soil profile to the soil surface or to a section closer to the soil surface. Soil pores can be regarded as miniature tubes. Water rises into these tubes owing to the adhesion (adsorption) of water molecules onto solid mineral surfaces and the surface tension of water.

  The height of the rise is inversely proportional to the radius of the soil pore and the density of the liquid (water). It is also directly proportional to the liquid's surface tension and the degree of its adhesive attraction. In a soil-water system the following simplified equation can be used to calculate this rise:

  $$\text{Height} = 0.15/\text{radius}$$

  Usually the eventual height of rise is greater in fine textured soil, but the rate of flow may be slower (Brady and Weil, 1999; Hillel, 1983).

- Matric potential or suction refers to the attraction of water to solid surfaces. Matric potential is operational in unsaturated soil above the water table while pressure potential refers to water in saturated soil or below the water table. Matric potential is always expressed as a negative value and pressure potential as a positive value.

  Matric potential influences soil moisture retention and soil water movement. Differences in the matric potential of adjoining zones of a soil results in the movement of water from the moist zone (high state of energy) to the dry zone (low state of energy) or from large pores to small pores.

  The maximum amount of water that a soil profile can hold before leaching occurs is called the field capacity of the soil. At a point of water saturation, a soil exhibits an energy state of 0 $J.kg^{-1}$. Field capacity usually falls within a range of -15 to -30 $J.kg^{-1}$ with fine textured soils storing larger amounts of water (Brady and Weil, 1999; Hillel, 1983).

- Gravity acts on water in the soil profile in the same way as it acts on any other body; it attracts towards earth's centre. The gravitational potential of soil water can be expressed as:

  $$\text{Gravitational potential} = \text{Gravity} \times \text{Height}$$

  Following heavy rainfall, gravity plays an important part in the removal of excess water from the upper horizons of the soil profile and recharging groundwater sources below.

  Excess water, or water subject to leaching, is the amount of water that falls between soil saturation (0 $J.kg^{-1}$) or oversaturation (> 0 $J.kg^{-1}$), in the case of heavy rainfall resulting in a pressure potential, and field capacity (-15 to -30 $J.kg^{-1}$). This amount of water differs according to soil type, structure and texture (Brady and Weil, 1999; Hillel, 1983).

- Under some conditions, at least part of the soil profile may be saturated with water, resulting in so-called saturated flow of water. The lower portions of poorly drained soils are often saturated, as are well-drained soils above stratified (layers differing in soil texture) or impermeable layers after rainfall.

  The quantity of water that flows through a saturated column of soil can be calculated using Darcy's law:

  $$Q = Ksat.A.\Delta P/L$$

  Where Q represents the quantity of water per unit time, Ksat is the saturated hydraulic conductivity, A is the cross sectional area of the column through which the water flows, ΔP is the hydrostatic pressure difference from the top to the bottom of the column, and L is the length of the column.

  Saturated flow of water does not only occur downwards, but also horizontally and upwards. Horizontal and upward flows are not quite as rapid as downward flow. The latter is aided by gravity (Brady and Weil, 1999; Hillel, 1983).

- Mostly, water movement in soil is ascribed to the unsaturated flow of water. This is a much more complex scenario than water flow under saturated conditions. Under unsaturated conditions only the fine micropores are filled with water whereas the macropores are filled with air. The water content, and the force with which water molecules are held by soil surfaces, can also vary considerably. The latter makes it difficult to assess the rate and direction of water flow. The driving force behind unsaturated water flow is matric potential. Water movement will be from a moist to a drier zone (Brady and Weil, 1999; Hillel, 1983).

The following processes influence the amount of water to be leached from a soil profile:

- Infiltration is the process by which water enters the soil pores and becomes soil water. The rate at which water can enter the soil is termed infiltration tempo and is calculated as follows:

  $$I = Q/A.t$$

  Where I represents infiltration tempo ($m.s^{-1}$), Q is the volume quantity of infiltrating water (m^3), A is the area of the soil surface exposed to infiltration (m^2), and t is time (s).

  If the soil is quite dry when exposed to water, the macropores will be open to conduct water into the soil profile. Soils that exhibit a high 2:1 clay content (swelling-shrinking clays) will exhibit a high rate of infiltration initially. However, as infiltration proceeds, the macropores will become saturated and cracks, caused by dried out 2:1 clay, will swell and close, thus leading to a decline in infiltration (Brady and Weil, 1999; Hillel, 1983).

- Percolation is the process by which water moves downward in the soil profile. Saturated and unsaturated water flow is involved in the process of percolation, while the rate of percolation is determined by the hydraulic conductivity of the soil.

During a rain storm, especially the down pouring of heavy rain, water movement near the soil surface mainly occurs in the form of saturated flow in response to gravity. A sharp boundary, referred to as the wetting front, usually appears between the wet soil and the underlying dry soil. At the wetting front, water is moving into the underlying soil in response to both matric and gravitational potential. During light rain, water movement at the soil surface may be ascribed to unsaturated flow (Brady and Weil, 1999; Hillel, 1983).

The fact that water percolates through the soil profile by unsaturated flow has certain ramifications when an abrupt change in soil texture occurs (Brady and Weil, 1999; Hillel, 1983). A layer of course sand, underlying a fine textured soil, will impede downward movement of water. The macropores of the coarse textured sand offer less attraction to the water molecules than the macropores of the fine textured soil. When the unsaturated wetting front reaches the coarse sand, the matric potential is lower in the sand than in the overlying material. Water always moves from a higher to a lower state of energy. The water can, therefore, not move into the coarse textured sand. Eventually, the downward moving water will accumulate above the sand layer and nearly saturate the fine textured soil. Once this occurs, the water will be held so loosely that gravitational forces will be able to drag the water into the sand layer (Brady and Weil, 1999; Hillel, 1983).

A coarse layer of sand in an otherwise fine textured soil profile will also inhibit the rise of water by capillary movement (Brady and Weil, 1999; Hillel, 1983).

Field observations and laboratory based analysis can aid in assessing the soil-water relations of an area. The South African soil classification system (Soil Classification Working Group, 1991.) comments on certain field observable characteristics that shed light on water movement in soil. The more important of these are:

- Soil horizons that show clear signs of leaching such as the E-horizon – an horizon where predominantly lateral water movement has led to the mobilisation and transport of sesquioxide minerals and the removal of clay material;
- Soil horizons that show clear signs of a fluctuating water table where Fe and Mn mottles, amongst other characteristics, indicate alternating conditions of reduction and oxidation (soft plinthic B-horizon);
- Soil horizons where grey colouration (Fe reduction and redox depletion), in an otherwise yellowish or reddish matrix, indicate saturated (or close to saturated) water flow for at least three months of the year (Unconsolidated/Unspecified material with signs of wetness);
- Soil horizons that are uniform in colouration and indicative of well-drained and aerated (oxidising) conditions (e.g. yellow brown apedal B-horizon).

4.3 WATER MOVEMENT IN THE LANDSCAPE

Water movement in a landscape is a combination of the different flow paths in the soils and geological materials. The movement of water in these materials is dominantly subject to gravity and as such it will follow the path of least resistance towards the lowest point. In the landscape there are a number of factors determining the paths along which this water moves. **Figure 7** provides a simplified schematic representation of an idealised landscape (in "profile curvature". The total precipitation (rainfall) on the landscape from the crest to the lowest part or valley bottom is taken as 100 %. Most geohydrologists agree that total recharge, the water that seeps into the underlying geological strata, is less than 4 % of total precipitation for most geological settings. Surface runoff varies considerably according to rainfall intensity and distribution, plant cover and soil characteristics but is taken as a realistic 6 % of total precipitation for our idealised landscape. The total for surface runoff and recharge is therefore calculated as 10 % of total precipitation. If evapotranspiration (from plants as well as the soil surface) is taken as a very high 30 % of total precipitation it leaves 60 % of the total that has to move through the soil and/or geological strata from higher lying to lower lying areas. In the event of an average rainfall of 750 mm per year it results in 450 mm per year having to move laterally through the soil and geological strata. In a landscape there is an accumulation of water down the slope as water from higher lying areas flow to lower lying areas.

To illustrate: If the assumption is made that the area of interest is 100 m wide it follows that the first 100 m from the crest downwards has 4 500 m^3 (or 4 500 000 litres) of water moving laterally through the soil (100 m X 100 m X 0.45 m) per rain season. The next section of 100 m down the slope has its own 4 500 m^3 of water as well as the added 4 500 m^3 from the upslope section to contend with, therefore 9 000 m^3. The next section has 13 500 m^3 to contend with and the following one 18 000 m^3. It is therefore clear that, the longer the slope, the larger the volume of water that will move laterally through the soil profile.

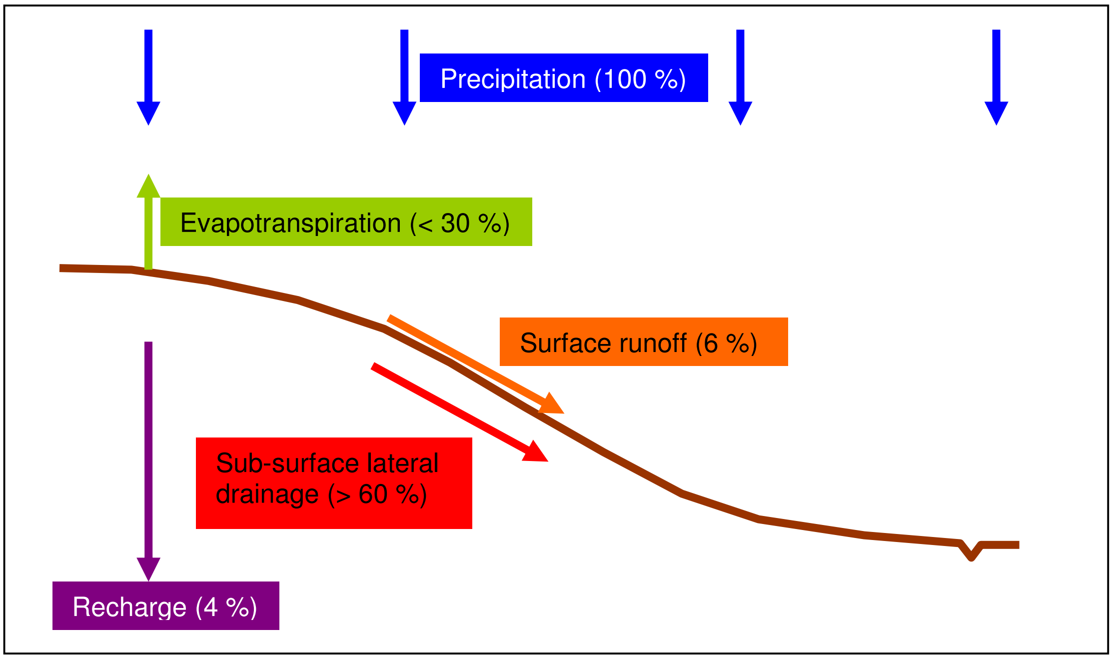

Figure 7 Idealised landscape with assumed quantities of water moving through the landscape expressed as a percentage of total precipitation (100 %).

Flow paths through soil and geological strata, referred to as “interflow” or “hillslope water”, are very varied and often complex due to difficulty in measurement and identification. The difficulty in identification stems more from the challenges related to the physical determination of these in soil profile pits, soil auger samples and core drilling samples for geological strata. The identification of the morphological signs of water movement in permeable materials or along planes of weakness (cracks and seams) is a well-established science and the expression is mostly referred to as “redox morphology”. In terms of the flow paths of water large variation exists but these can be grouped into a few simple categories. **Figure 8** provides a schematic representation of the different flow regimes that are usually encountered. The main types of water flow can be grouped as 1) recharge (vertically downwards) of groundwater; 2) lateral flow of water through the landscape along the hillslope (interflow or hillslope water); 3) return flow water that intercepts the soil/landscape surface; and 4) surface runoff. Significant variation exists with these flow paths and numerous combinations are often found. The main wetland types associated with the flow paths are: a) valley bottom wetlands (fed by groundwater, hillslope processes, surface runoff, and/or in-stream water); b) hillslope seepage wetlands (fed by interflow water and/or return flow water); and wetlands associated with surface runoff, ponding and surface ingress of water anywhere in the landscape.

Amongst other factors, the thickness of the soil profile at a specific point will influence the intensity of the physical and chemical reactions taking place in that soil. **Figure 9** illustrates the difference between a dominantly thick and a dominantly thin soil profile. If all factors are kept the same except for the soil profile thickness it can be assumed with confidence that the chemical and physical reactions associated with water in the landscape will be much more intense for the thin soil profile than for the thick soil profile. Stated differently: The volume of water moving through the soil per surface area of an imaginary plane perpendicular to the direction of water flow is much higher for the thin soil profile than for the thick soil profile. This aspect has a significant influence on the expression of redox morphology in different landscapes of varying soil/geology/climate composition.

4.4 THE CATENA CONCEPT

Here it is important to take note of the “catena” concept. This concept is one of a topographic sequence of soils in a homogenous geological setting where the water movement and presence in the soils determine the specific characteristics of the soils from the top to the bottom of the topography. **Figure 10** illustrates an idealised topographical sequence of soils in a catena for a quartz rich parent material. Soils at the top of the topographical sequence are typically red in colour (Hutton and Bainsvlei soil forms) and systematically grade to yellow further down the slope (Avalon soil form). As the volume of water that moves through the soil increases, typically in midslope areas, periodic saturated conditions are experienced and consequently Fe is reduced and removed in the laterally flowing water. In the event that the soils in the midslope positions are relatively sandy the resultant soil colour will be bleached or white due to the colour dominance of the sand quartz particles. The soils in these positions are typically of the Longlands and Kroonstad forms. Further down the slope there is an accumulation of clays and leaching products from higher lying soils and this leads to typical illuvial and clay rich horizons. Due to the regular presence of water the dominant conditions are anaerobic and reducing and the soils exhibit grey colours often with bright yellow and grey mottles (Katspruit soil form). In the event that there is a large depositional environment with prolonged saturation soils of the Champagne form may develop (typical peat land). Variations on this sequence (as is often found on the Mpumalanga Highveld) may include the presence of hard plinthic materials instead of soft plinthite with a consequent increase in the occurrence of bleached soil profiles. Extreme examples of such landscapes are discussed below.

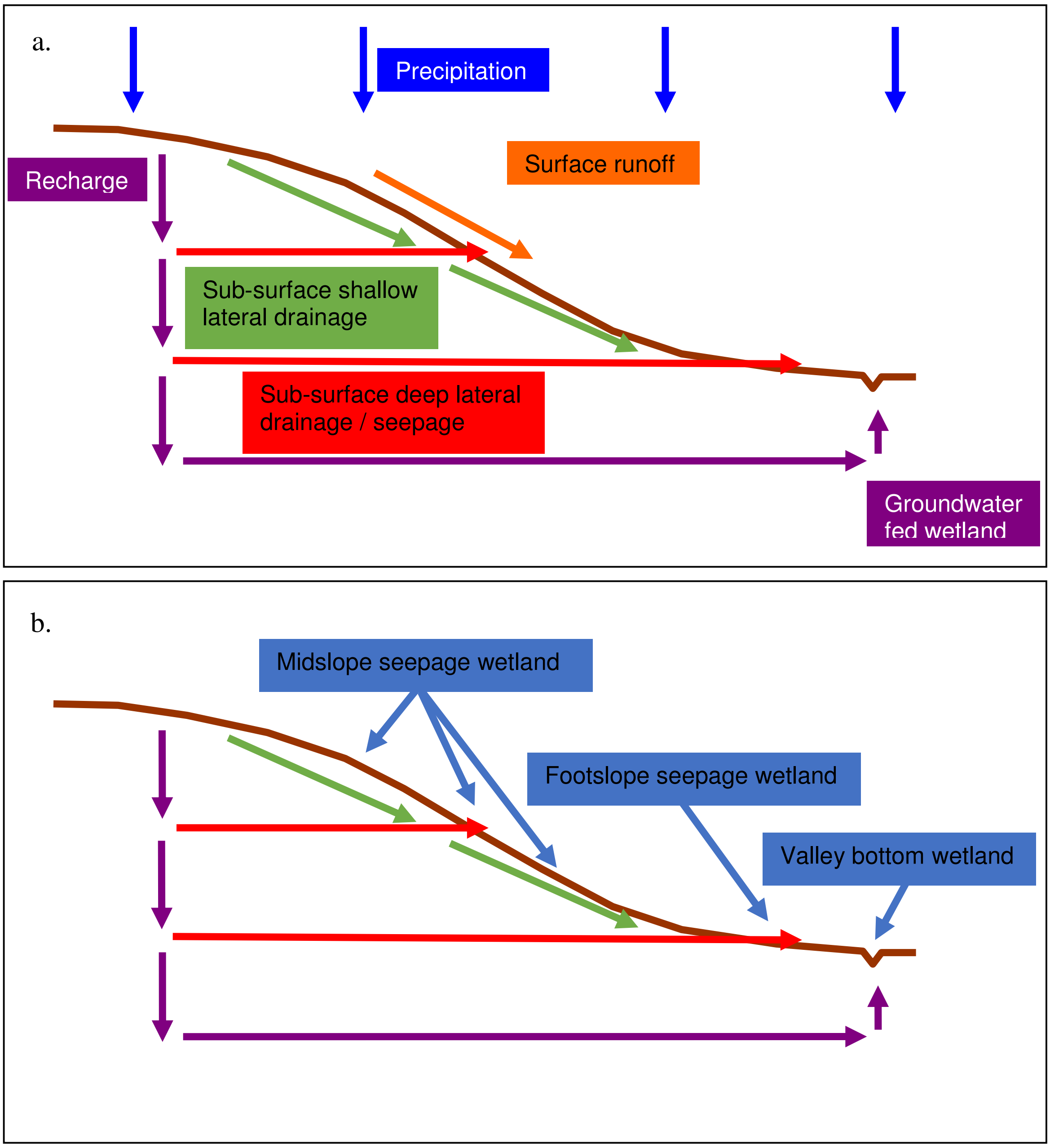

Figure 8 Different flow paths of water through a landscape (a) and typical wetland types associated with the water regime (b)

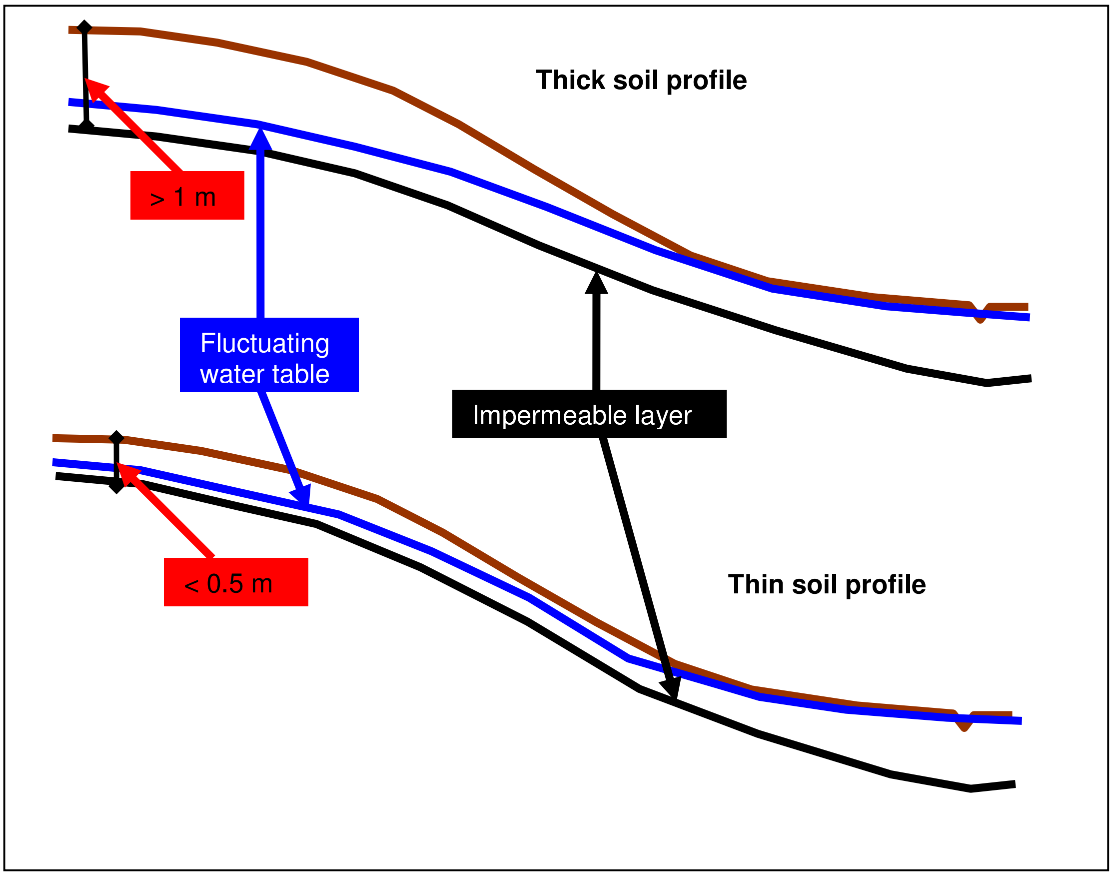

Figure 9 The difference in water flow between a dominantly thick and dominantly thin soil profile.

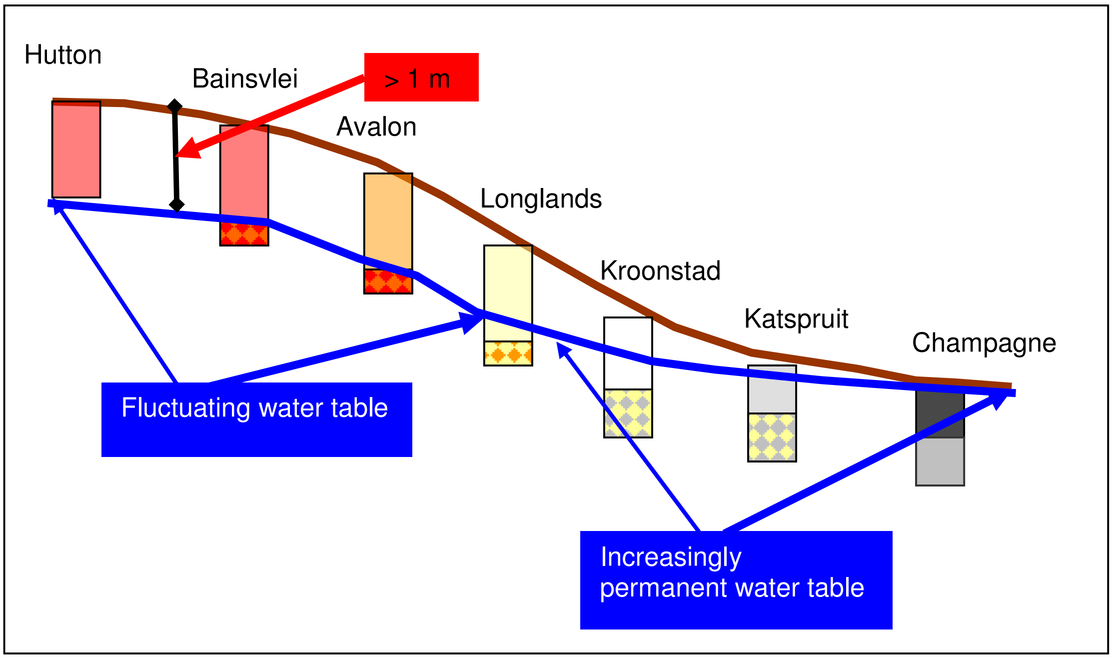

Figure 10 Idealised catena on a quartz rich parent material.

4.5 CONVEX VERSUS CONCAVE LANDSCAPES IN AN IDEALISED CATENA

An additional factor of variation in all landscapes is the shape of the landscape along contours (referred to a “plan curvature”). Landscapes can be either concave or convex, or flat. The main difference between these landscapes lies in the fact that a convex landscape is essentially a watershed with water flowing in diverging directions with a subsequent occurrence of “dryer” soil conditions. In a concave landscape water flows in converging directions and soils often exhibit the wetter conditions of “signs of wetness” such as grey colours, organic matter and subsurface clay accumulation. **Figure 11** presents the difference between these landscapes in terms of typical soil forms encountered in an idealised catena. In the convex landscape the subsurface flow of water removes clays and other weathering products (including Fe) in such a way that the midslope position soils exhibit an increasing degree of bleaching and relative accumulation of quartz (E-horizons).

In the concave landscapes clays and weathering products are transported through the soils into a zone of accumulation where soils start exhibiting properties of clay and Fe accumulation. In addition, coarse sandy soils in convex environments tend to be thinner due to the removal of sand particles through erosion and soils in concave environments tend to be thicker due to colluvial accumulation of material transported from upslope positions. Similar patterns are observed for other geological areas with the variation being consistent with the soil variation in the catena.

Often these concave and convex topographical environments occur in close proximity or in one topographical sequence of soils. This is often found where a convex upslope area changes into a concave environment as a drainage depression is reached (**Figure 12**). The processes in this landscape are the same as those described for the convex and concave landscapes above.

4.6 THE AE21 LAND TYPE CATENA

The typical catena that forms in the **Ae21** land type (**Figure 13**) differs from the idealised one discussed above in that this land type is characterised by high clay content and often structured soils with a high base status with above neutral pH values. The subsoils are structured and grading into weathered rock. The lower landscape positions are characterised by similar soils but with darker A horizons as well as an increase in the clay content and degree of structure development. The specific clay minerals (2:1 swelling and non-swelling clays) that occur in these landscapes form under above neutral pH conditions. This aspect has very specific implications for the identification of morphological signs of wetness. Wetlands are invariably associated with the lowest points in the landscape and as such this aspect is critical (and therefore addressed in more detail later). Due to the high clay content (and often swelling nature) the soils are characterised predominantly by surface flow of water with very slow percolation rates through the profiles. Lateral flow of water on impervious layers is therefore not encountered with the exception being planes of weakness in the underlying weathered and hard rock. The drainage depressions in these landscapes often exhibit signs of high energy flow events in the form of eroded soils as well as young recently transported soil material.

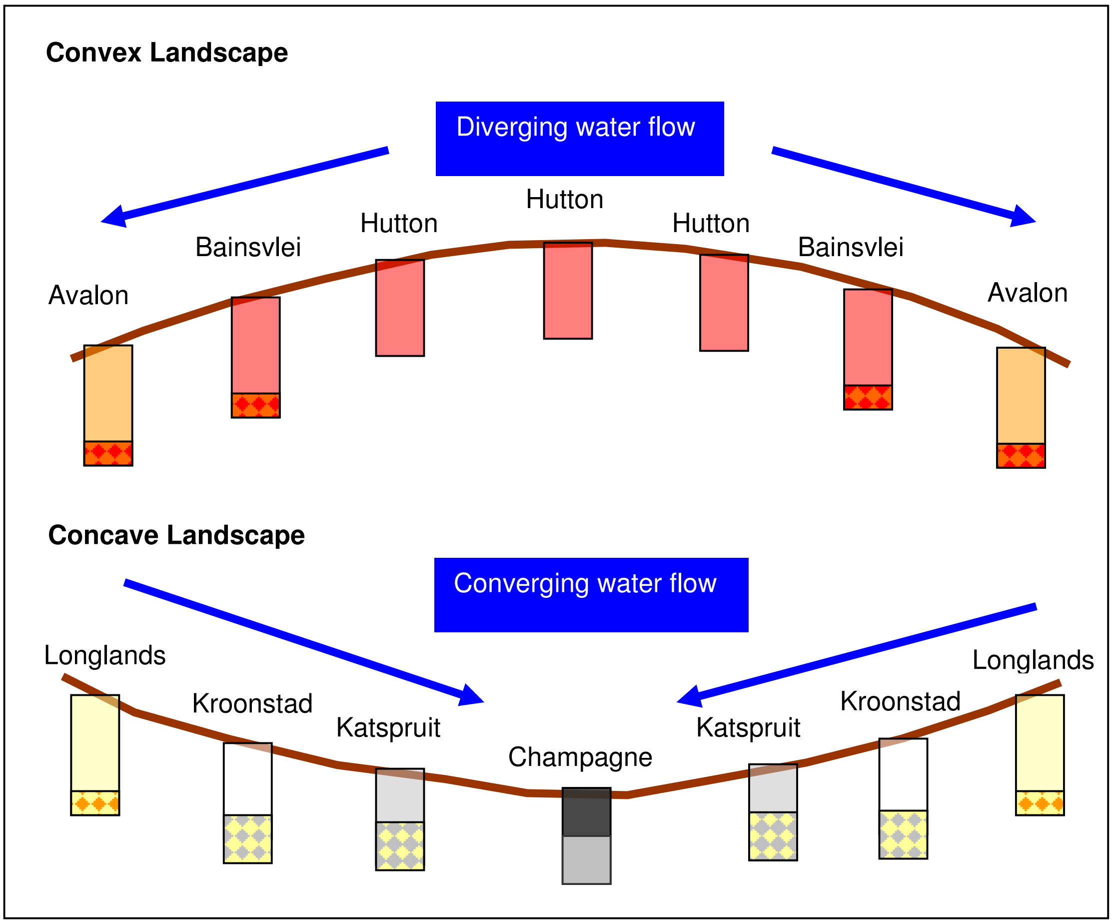

Figure 11 Schematic representation of the soils in convex and concave landscapes in an idealised catena

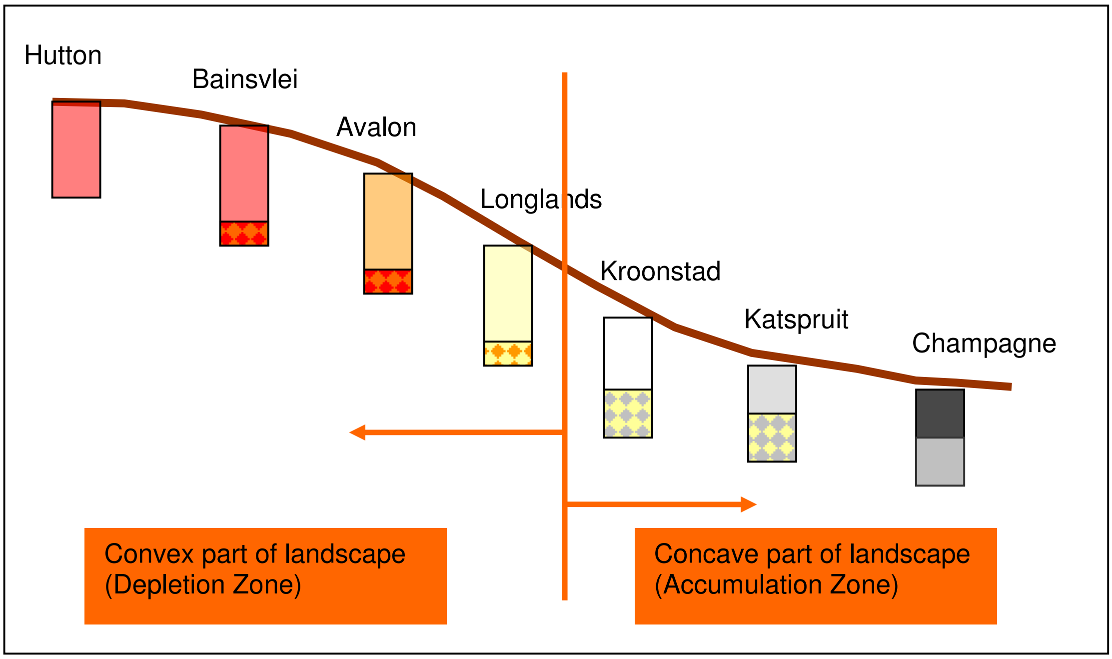

Figure 12 Schematic representation of the soils in a combined convex and concave landscape in an idealised catena.

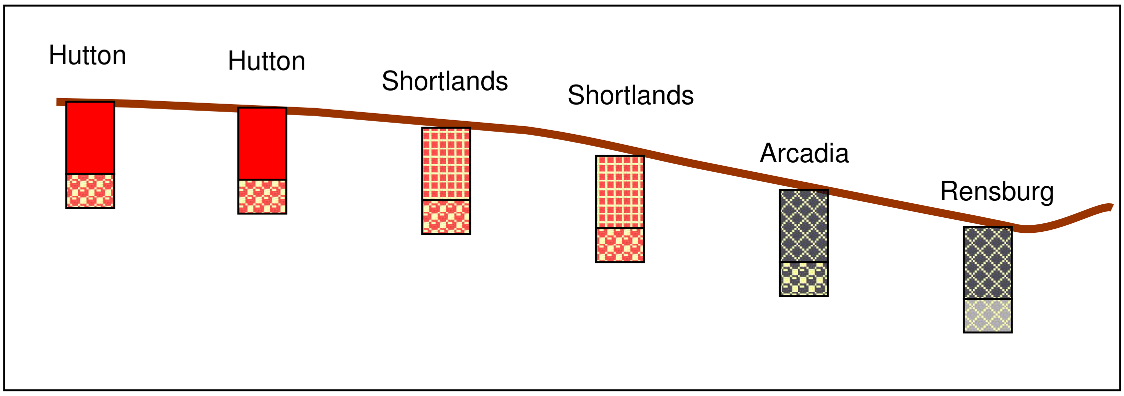

Figure 13 Idealised catena in the Ae21 land type

4.7 REDOX MORPHOLOGY IN ALKALINE SOILS

Wetland delineation is a very challenging exercise in areas dominated by alkaline soils such as lime containing and/or vertic/melanic soils. This is mainly due to the almost complete absence of Fe-mottles in the soils that grade from the terrestrial to the wetland areas. There are a number of reasons that will be explained in more detail below.

In order to illustrate the stability and distribution of Fe minerals in soils the figure provided below (**Figure 14**) was copied from page 124 of a book entitled "Soil Chemistry" by Bohn, et al., (1990). The essence is that when reduction and oxidation reactions of Fe (in this case) are considered in soils both the electron activity (driver of reducing conditions) and pH have to be considered as they are intimately linked and dependent on each other. Suffice to say that for redox and mineral stability purposes they are indicated on the same graph. From Figure 4.6 (**Figure 14**) it is clear that as the Eh decreases (increasing reducing conditions) the dominant Fe species in solution changes from Fe^{3+} (insoluble and forming brightly coloured minerals) to Fe^{2+} (soluble and essentially colourless). Once pH is included in the observation it is clear that distinct Fe minerals come into play. Applying the decreasing Eh values to Fe minerals at high pH it is clear that the dominant Fe mineral under oxidizing conditions is FeOOH (Goethite – predominantly yellow). As the conditions become more reducing the equilibrium shifts to $FeCO_3$ (Siderite – white) and thereafter to FeS_2 (Pyrite). Whereas goethite has a distinct colour in soil, siderite and pyrite are less conspicuous in small quantities. It follows therefore that Fe minerals are much less visible in high pH reduced soils than in oxidised soils. In addition, vertic and melanic soils are dark coloured and it is therefore also clear that this dark colour will mask the presence of the above mentioned Fe minerals.

Another factor related to pH is the degree of reduction that is required to reduce Fe from its oxidised to its reduced state. From the graph it is clear that there is a steep decreasing gradient as the pH of the soil increases. This implies that much more intensive reducing conditions are required for the same degree of Fe reduction when high pH conditions (as those experienced in vertic and melanic soils) are compared to low pH conditions.

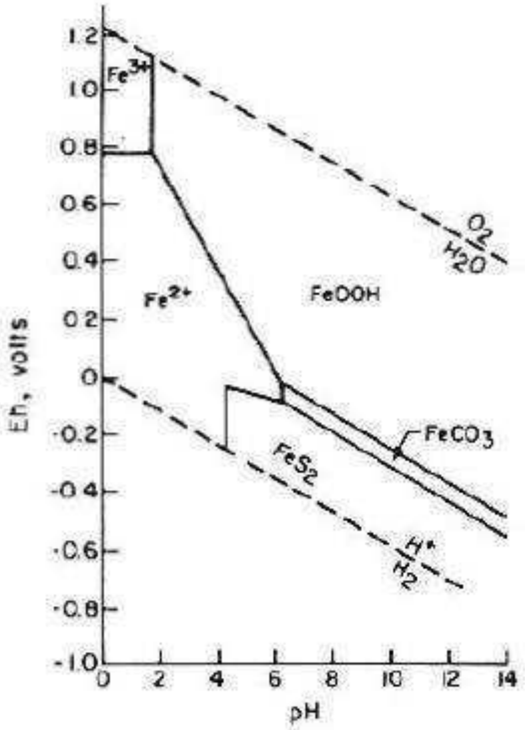

FIGURE 4.6. The *Eh*–pH diagram of various iron ions and compounds.

Figure 14 Eh pH diagram as sourced from Bohn, et al., (1990) p124

The situation becomes even more complex as other intermediate Fe minerals (blue green rusts) come into play. The essence of the presence of blue-green rusts is that they are tints that occur extensively in poorly drained and poorly aerated soils such as G-horizons under vertic and/or melanic A-horizons. These minerals are not stable and often disappear within a few minutes of exposure to the atmosphere. They in all probability form some of the most important Fe phases in vertic soils but disappear rapidly. Before they disappear it is also evident that these minerals are visible against a grey matrix but poorly visible against a black or dark background.

In essence therefore, a number of factors, including degree of reduction, soil pH and dominant Fe minerals, conspire against the use of Fe indicators in vertic, melanic and lime containing soils for the delineation of wetlands. There is no quick solution to this problem and delineators should use as many other indicators of wetland conditions in such soils as they can.

One word of caution: The wetland delineation guidelines (DWAF, 2005) indicate the Rensburg and Willowbrook soil forms as occurring in the permanent wetland zone. This is somewhat erroneous. Although these can occur in permanent wetland zones their formation is dependent on distinct cycling between wet and dry seasons. The development of 2:1 clays (found in these soils) depends on the accumulation of weathering products and clays in lower lying landscape positions. These clays are, depending on a range of factors, either swelling or non-swelling and their formation requires a distinct time (seasonally) where evaporation exceeds precipitation, with consequent drying of the soil, to lead to a concentration of bases (Ca and Mg). These clay minerals (such as smectite) often express themselves in the form of distinct cracks in Vertic soils. From this discussion it follows that the Rensburg and Willowbrook soils could only have formed in conditions that resemble a **seasonal wetland**. Drainage lines on the site can, if dominated by Rensburg or Willowbrook soils, therefore not be classified as permanent wetlands unless there are other characteristics indicating conditions of permanent saturation.

5. SITE SURVEY RESULTS AND DISCUSSION

The soils encountered on the site were of the Hutton, Shortlands and Arcadia forms. None of the soils exhibited any morphological signs of wetness (hydromorphism) – an aspect that is ascribed to the processes described above.

No distinct drainage features were observed on the site.

From the above it is stated with confidence that there is no wetland on the site. The surrounding area outside the site is characterised by two drainage depressions that qualify as water courses with associated riparian zones. Due to the geology and specific soils these features also do not exhibit distinct signs of wetness (hydromorphism).

6. CONCLUSIONS AND RECOMMENDATIONS

It is concluded that there is no wetland on the site.

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REPORT

WETLAND / WATER COURSE IDENTIFICATION AND MANAGEMENT REPORT:

PORTION 41 OF THE FARM SCHIETFONTEIN 437-JQ IN THE NORTH-WEST PROVINCE

12th May, 2014

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Declaration

I, Johan Hilgard van der Waals, declare that I –

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

J.H. VAN DER WAALS
TERRA SOIL SCIENCE

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WETLAND / WATER COURSE IDENTIFICATION AND MANAGEMENT REPORT: PORTION 41 OF THE FARM SCHIETFONTEIN 437-JQ IN THE NORTH-WEST PROVINCE

1. INTRODUCTION

1.1 TERMS OF REFERENCE

Terra Soil Science was appointed by **Q4 Chemicals** to determine the presence and status of wetlands on Portion 41 of the Farm Schietfontein 437-JQ in the North-West Province.

1.2 PROBLEM STATEMENT

At present it is not clear whether a wetland occurs on the investigation site.

1.3 AIM OF THIS REPORT

The aim of this report is to provide a perspective on the requirements for the identification of a wetland as well as to address the presence and status of a wetland / water course on the site. In addition, this report aims to provide a hydropedological perspective on the site and broader area to aid in the identification and management of water impacts through the elucidation of broad surface hydrology and hydropedology principles.

1.4 METHODOLOGY

1.4.1 Brief Background

The identification and delineation of wetlands rest on several parameters that include topographic, vegetation and soil indicators. Apart from the inherent flaws in the wetland delineation process, as discussed later in this report, the concept of wetland delineation implies an emphasis on the wetlands themselves and very little consideration of the processes driving the functioning and presence of the wetlands. One discipline that encompasses a number of tools to elucidate landscape hydrological processes is “hydropedology” (Lin, 2012). The crux of the understanding of hydropedology lies in the fact that pedology is the description and classification of soil on the basis of morphology that is the result of soil and landscape hydrological, physical and chemical processes. But, the soils of which the morphology are described, also take part in and intimately influence the hydrology of the landscape. Soil is therefore both an indicator as well as a participator in the processes that require elucidation.

Wetlands are merely those areas in a landscape where the morphological indicators point to prolonged or intensive saturation near the surface to influence the distribution of wetland vegetation. Wetlands therefore form part of a larger hydrological entity that they cannot be separated from.

1.4.2 Proposed Methodology

In order to provide detailed pedohydrological information both detailed soil surveys and hydrological investigations are needed. In practice these intensive surveys are expensive and very seldom conducted. However, with the understanding of soil morphology, pedology and basic soil physics parameters as well as the collection and interpretation of existing soil survey information, assessments at different levels of detail and confidence can be conducted. In this sense four levels of investigation are proposed namely:

1. Level 1 Assessment: This level includes the collection and generation of all applicable remote sensing, topographic and land type parameters to provide a "desktop" product. This level of investigation rests on adequate experience in conducting such information collection and interpretation exercises and will provide a broad overview of dominant hydropedological parameters of a site. Within this context the presence, distribution and functioning of wetlands will be better understood than without such information.
2. Level 2 Assessment: This level of assessment will make use of the data generated during the Level 1 assessment and will include a reconnaissance soil and site survey to verify the information as well as elucidate many of the unknowns identified during the Level 1 assessment.
3. Level 3 Assessment: This level of assessment will build on the Level 1 and 2 assessments and will consist of a detailed soil survey with sampling and analysis of representative soils. The parameters to be analysed include soil physical, chemical and mineralogical parameters that elucidate and confirm the morphological parameters identified during the field survey.
4. Level 4 Assessment: This level of assessment will make use of the data generated during the previous three levels and will include the installation of adequate monitoring equipment and measurement of soil and landscape hydrological parameters for an adequate time period. The data generated can be used for the building of detailed hydrological models (in conjunction with groundwater and surface hydrologists) for the detailed water management on specific sites.

For most wetland delineation exercises a Level 2 or Level 3 assessment should be adequate.

1.4.3 Methodology Employed in this Investigation

The report was generated through:

1. The collection and presentation of baseline land type and topographic data for the site;
2. The thorough consideration of the statutory context of wetlands and the process of wetland delineation;
3. The identification of water related landscape parameters (conceptual and real) for the site for the generation of Level 1 hydropedology information;
4. Aerial photograph interpretation of the site to aid in the Level 1 hydropedology assessment;

5. Assessment of historical impacts and changes on the site through the accessing of various historical aerial photographs and topographic maps;
6. Reconnaissance soil and site survey in terms of soil properties as well as drainage feature properties to generate a Level 2 hydrology assessment; and
7. Presentation of the findings of the various components of the investigation.

2. SITE LOCALITY AND DESCRIPTION

2.1 SURVEY AREA BOUNDARY

The site lies between 25° 38’ 58” and 25° 39’ 24” south and 27° 56’ 49” and 27° 57’ 14” east 15 km west of the town of Brits in the North-West Province (**Figure 1**).

2.2 GENERALISED GEOLOGY

The area surrounding and including the site consists predominantly of basic igneous geology (ferrogabbro, ferrodiorite, diorite, gabbro, norite and anorthosite) with limited and enclosed quartzite, hornfels and shale. The implications of the specific geology on the identification of wetlands and hydromorphy in soils will be discussed later in the report.

2.3 LAND TYPE DATA

Land type data for the site was obtained from the Institute for Soil Climate and Water (ISCW) of the Agricultural Research Council (ARC). The land type data is presented at a scale of 1:250 000 and entails the division of land into land types, typical terrain cross sections for the land type and the presentation of dominant soil types for each of the identified terrain units (in the cross section). The soil data is classified according to the Binomial System (MacVicar et al., 1977). The soil data was interpreted and re-classified according to the Taxonomic System (Soil Classification Working Group, 1991).

The Schietfontein site is situated in the **Ae21** land type (Land Type Survey Staff, 1972 - 2006) with **Figure 2** providing the land type distribution for the area. Below follows a brief description of the land type in terms of soils as well as expected hydromorphic indicators.

Land Type Ae21

Land Type – General: Ae dominantly red high base status (mesotrophic and lime containing) apedal soils, without dunes, that are deeper than 300 mm.

Soils: Soils are predominantly deep and high clay content red apedal and red structured soils from crests to footslope positions with structured swelling soils dominating in valley bottom and drainage depression positions. Due to the geology and local variation structured swelling soils can occur in any level terrain area even if this is in higher lying parts of the landscape.

Indicators of Hydromorphy: Due to the specific geology and other soil forming factors and processes soils in basic igneous geology environments express no signs of wetness in the form of mottles. The only reliable indicator of saturation in the soils is grey low chroma matrix colours, which occur in drainage depressions only. The specific challenges regarding these landscapes are discussed in more detail later in the report

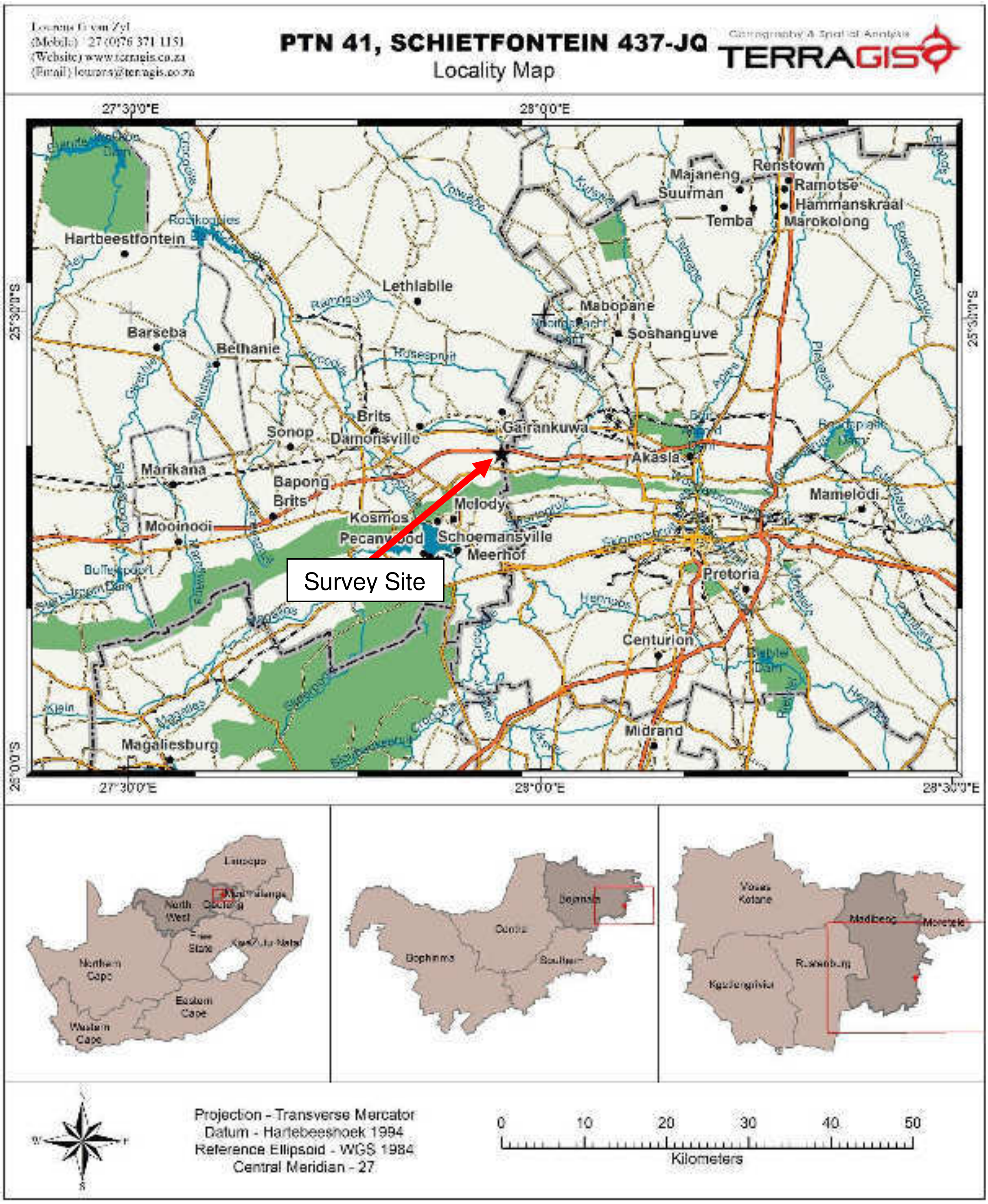

Figure 1 Locality of the survey site

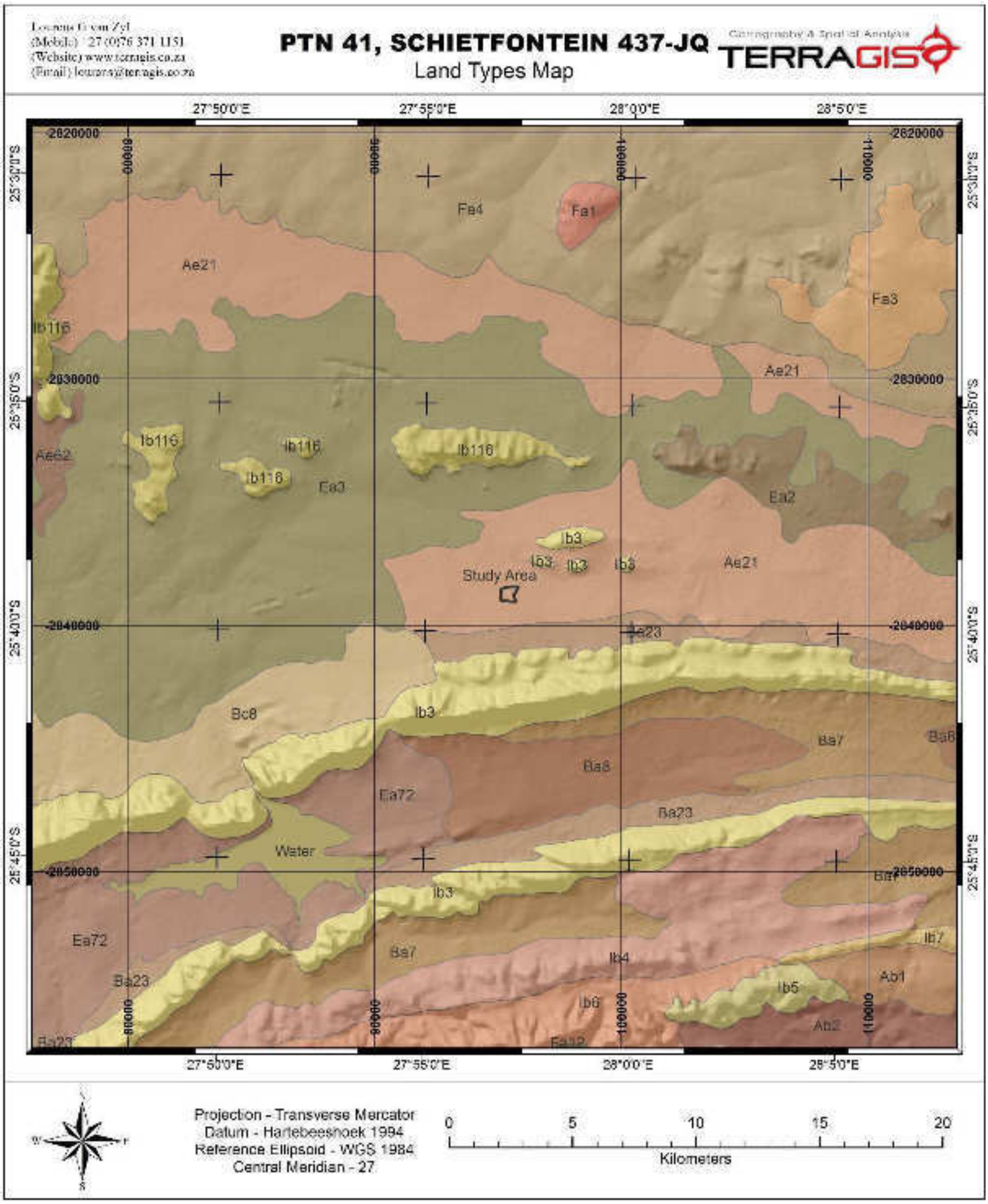

Figure 2 Land type map of the survey site

2.4 TOPOGRAPHY

The topography of the site is flat with a very slight slope towards the north-west (**Figure 3**).

Figure 3 Contours of the general area superimposed on a satellite image

From the contour data a digital elevation model (DEM) was generated for the area and site (**Figure 4**).

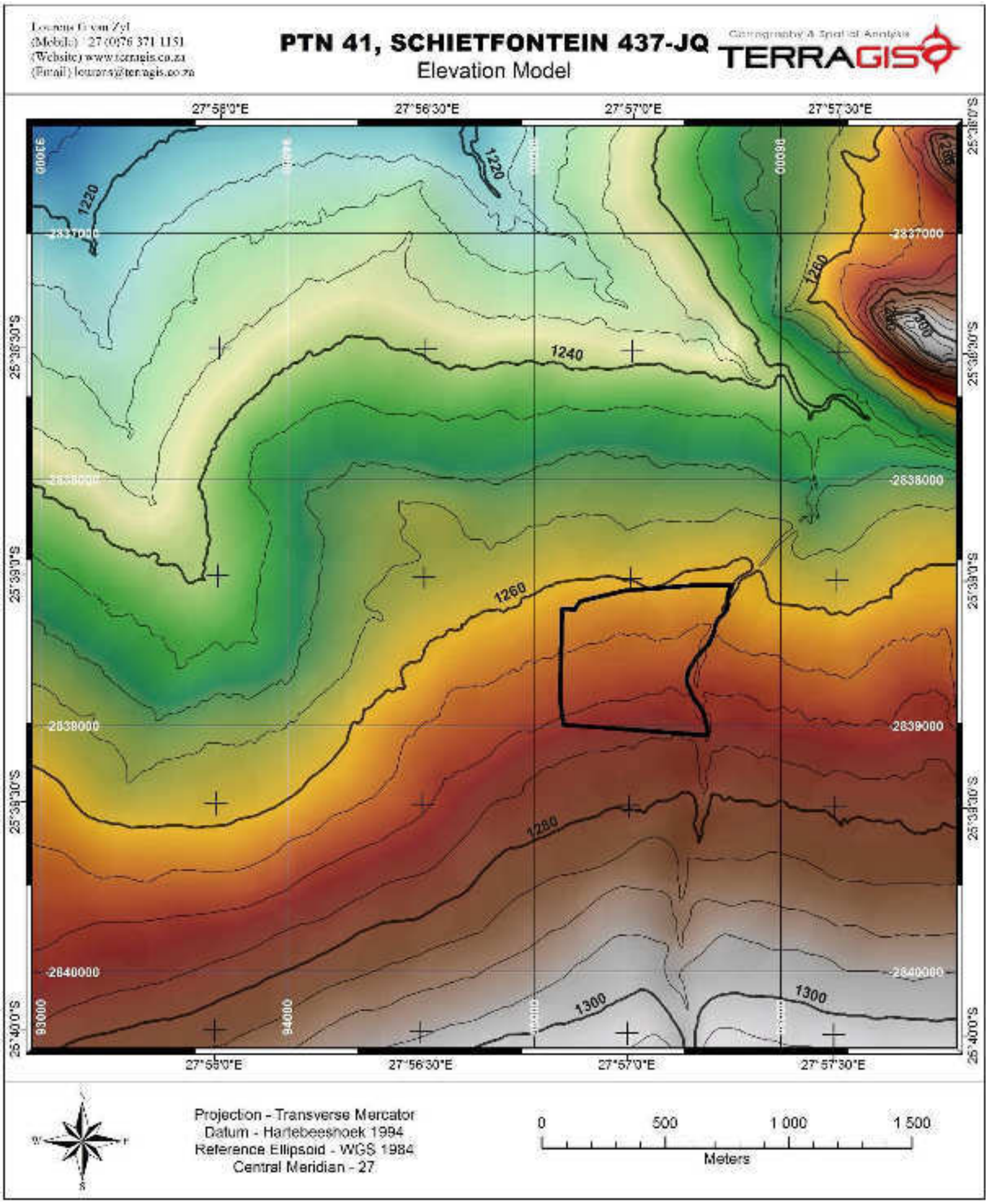

Figure 4 DEM of the survey site and surrounding area

From the contour data a slope map was generated (**Figure 5**) and from this data in turn a topographic wetness index (TWI) was calculated for the site and general area (**Figure 6**). The TWI provides a very accurate indication of water flow paths and areas of water accumulation, which is a function of the topography of the site. On the specific site no distinct drainage depressions were identified.

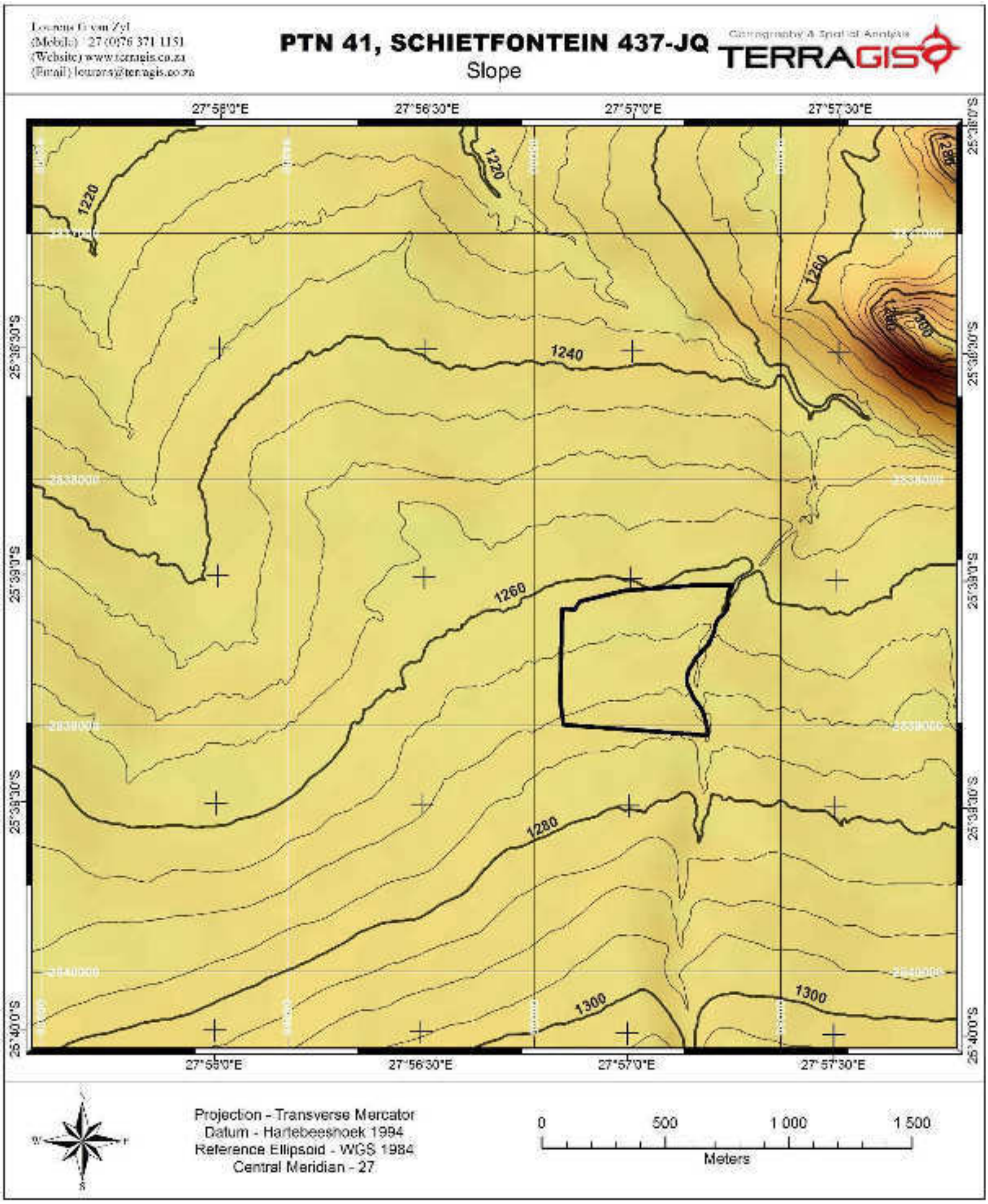

Figure 5 Slope map of the survey site and general area

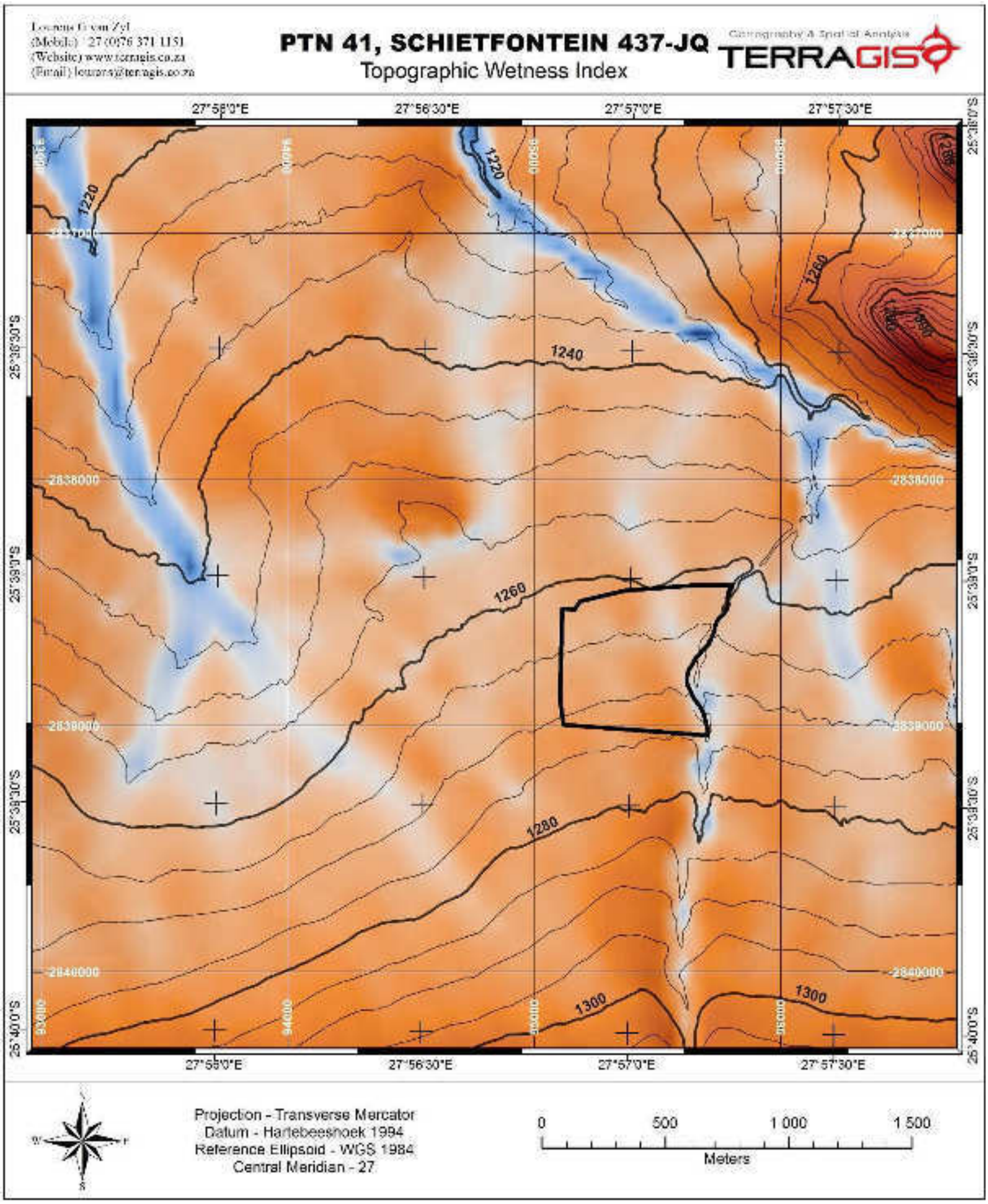

Figure 6 Topographic wetness index (TWI) for the survey site and surrounding area

2.5 AERIAL PHOTOGRAPH INTERPRETATION

An aerial photograph interpretation exercise was conducted through the use of Google Earth images of the site. Historical images spanning the period from 2004 to 2012 were used for the purpose of identifying land use characteristics associated with the site. In addition, the images were used to identify possible wetland areas that could be targeted for investigation during the field survey (addressed in the next section).

2.6 SITE VISIT AND SOIL SURVEY

A site visit and soil survey was conducted on the 26th of March 2014. The site was traversed on foot and soil characteristics were assessed in terms of soil form and hydromorphy (morphological signs of signs of wetness).

Disclaimer: The following sections (3 and 4) represents sections of a discussion that I use as standard in describing the challenges regarding wetland delineation and management in a range of landscapes. This implies that the section is predominantly verbatim the same as in other reports provided to clients and the authorities. Copyright is strictly reserved.

3. WETLANDS: STATUTORY CONTEXT

3.1 WETLAND DEFINITION

Wetlands are defined, in terms of the National Water Act (Act no 36 of 1998) (NWA), as:

"Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."

From a scientific, practical and legal perspective the interpretation of the definition poses a number of challenges. In order to address the challenges it is necessary to disaggregate the definition and discuss the challenges as follows:

1. "Land which is transitional between terrestrial and aquatic systems …": this implies areas with variable hydrological and ecological characteristics of which the variation can be described as the linear (assumed) transition from one pole (terrestrial/dry) to another (aquatic/wet).
2. "… where the water is usually at or near the surface …": Although the regular condition is implied there is no reference to any empirical interpretation. This aspect therefore introduces uncertainty and the potential for significantly variable interpretation.
3. "… or the land is periodically covered with shallow water …": This statement introduces and alternative to the above statement but, again there is no reference to any empirical interpretation and it therefore introduces uncertainty and the potential for significantly variable interpretation
4. "and which land in normal circumstances …": Normal circumstances are not defined with a subsequent introduction of uncertainty and variability in interpretation. According to

Mernewecke and Kotze (1999) “normal circumstances” in the definition refers to “without human modifications”.

5. “… supports or would support vegetation typically adapted …”: Vegetation species and communities can be described and named and can provide distinctly measurable indicators of wetland conditions. This is therefore a clear indicator if the requisite scientific knowledge is available.
6. “… to life in saturated soil.”: Soil saturation (degree, intensity and duration) can be measured empirically (although at significant financial and time cost) or deduced from the soil morphology to varying degrees of certainty. The soil morphological indictors (all functions of soil forming factors and processes) have been studied and described extensively in the soil science literature.

An evaluation of the disaggregation above yields that the only certain descriptors, from a scientific, practical and legal perspective, are vegetation and soil indicators. In this sense the then Department of Water Affairs and Forestry (DWAF) generated “Resource Directed Measures for the Protection of Water Resources” (DWAF, 1999). In Appendix W6 of the document guidelines for the delineation of wetlands are provided (Mernewecke and Kotze, 1999). In this document distinct emphasis is placed on the use of soil characteristics in conjunction with vegetation characteristics (if present) for the delineation of wetlands. The document also refers specifically to the fact that a certain degree of proficiency in terms of soil classification with the SA Taxonomic System (Soil Classification Working Group, 1991) is required for such surveys. In the event of challenging sites it advises that qualified soils scientists conduct the delineation exercises.

Additionally, from the definition and the purpose of the water act it can be assumed that wetlands are merely the expression of wetness in landscapes and that the water resource can occur in landscapes in many other forms. One form that is not explicitly mentioned is seasonally perched water tables and their associated vadose zones that are instrumental in the “feeding” of wetlands through lateral flow mechanisms in the landscape. From the purpose of the NWA it is assumed that these water resources are included explicitly in the NWA.

3.2 WATERCOURSE DEFINITION

“Catchment” is defined, in terms of the National Water Act (Act no 36 of 1998) (NWA), as:

“…, in relation to a watercourse or watercourses or part of a watercourse, means the area from which any rainfall will drain into the watercourse or watercourses or part of a watercourse, through surface flow to a common point or common points;”

“Watercourse” is defined, in terms of the National Water Act (Act no 36 of 1998) (NWA), as:

> “*(a)* a river or spring;
> *(b)* a natural channel in which water flows regularly or intermittently;
> *(c)* a wetland, lake or dam into which, or from which, water flows; and
> *(d)* any collection of water which the Minister may, by notice in the *Gazette*, declare to be a water course,
> and a reference to a watercourse includes, where relevant, its bed and banks;”

3.3 THE RESOURCE DIRECTED MEASURES FOR PROTECTION OF WATER RESOURCES.

The following are specific quotes from the "Resource Directed Measures for Protection of Water Resources. Volume 4: Wetland Ecosystems" as published by DWAF (1999).

From the Introduction:

"This set of documents on Resource Directed Measures (RDM) for protection of water resources, issued in September 1999 in Version 1.0, presents the procedures to be followed in undertaking **preliminary determinations of the class, Reserve and resource quality objectives for water resources**, as specified in sections 14 and 17 of the South African National Water Act (Act 36 of 1998).

The development of procedures to determine RDM was initiated by the Department of Water Affairs and Forestry in July 1997. Phase 3 of this project will end in March 2000. Additional refinement and development of the procedures, and development of the full water resource classification system, will continue in Phase 4, until such time as the detailed procedures and full classification system are ready for publication in the Government Gazette.

It should be noted that until the final RDM procedures are published in the Gazette, and prescribed according to section 12 of the National Water Act, all determinations of RDM, whether at the rapid, the intermediate or the comprehensive level, will be considered to be preliminary determinations."

The following components of the RDM document has bearing on this report and these will be discussed in more detail later.

In Appendix W6 the methodology is provided for the delineation of wetland boundaries and zones. The emphasis in this document is on the interpretation of soil characteristics for the identification of the wetland boundaries. This document was the precursor of the wetland delineation guidelines as published by DWAF (2005).

3.4 WETLAND DELINEATION GUIDELINES

In 2005 the Department of Water Affairs and Forestry published a manual entitled "A practical field procedure for identification and delineation of wetland and riparian areas" (DWAF, 2005). The "…manual describes field indicators and methods for determining whether an area is a wetland or riparian area, and for finding its boundaries." The definition of a wetland in the guidelines is that of the NWA and it states that wetlands must have one or more of the following attributes:

- "**Wetland (hydromorphic) soils** that display characteristics resulting from prolonged saturation"
- "The presence, at least occasionally, of **water loving plants (hydrophytes)**"
- "A **high water table** that results in saturation at or near the surface, leading to anaerobic conditions developing in the top 50cm of the soil."

The guidelines further list four indicators to be used for the finding of the outer edge of a wetland. These are:

- Terrain Unit Indicator. The terrain unit indicator does not only identify valley bottom wetlands but also wetlands on steep and mild slopes in crest, midslope and footslope positions.
- Soil Form Indicator. A number of soil forms (as defined by MacVicar et al., 1991) are listed as indicative of permanent, seasonal and temporary wetland zones.
- Soil Wetness Indicator. Certain soil colours and mottles are indicated as colours of wet soils. The guidelines stipulate that this is the primary indicator for wetland soils. (Refer to the guidelines for a detailed description of the colour indicators.) In essence, the reduction and removal of Fe in the form of "bleaching" and the accumulation of Fe in the form of mottles are the two main criteria for the identification of soils that are periodically or permanently wet.
- Vegetation Indicator. This is a key component of the definition of a wetland in the NWA. It often happens though that vegetation is disturbed and the guidelines therefore place greater emphasis on the soil form and soil wetness indicators as these are more permanent whereas vegetation communities are dynamic and react rapidly to external factors such as climate and human activities.

The main emphasis of the guidelines is therefore the use soils (soil form and wetness) as the criteria for the delineation of wetlands."

3.5 WETLAND INDICATORS

The wetland indicators discussed above are limited to a degree in the following manner:

1. The topographic indicator is limited to wetlands that are associated with surface topographical variation and it is therefore limited to specific landscape positions. The topographic indicator does not make allowance for variation in physical properties below the soil surface. In this sense aspects such as return-flow zones and interflow zones (that often occur in midslope or footslope positions) are not accommodated. In practice these areas prove the most problematic in terms of interpretation and delineation.
2. The vegetation indicator is limited predominantly by regional and local variation in edaphic and climatic conditions. The regionalization of vegetation guidelines should address this aspect satisfactorily.
3. The soil form indicator suffers from a number of limitations namely:
    a. Soil forms present in an area do not necessarily indicate wetlands. Soil forms have to be viewed in wider context as their classification is also not an auditable process. (Unfortunately pedologists often have significant variation in interpretation!) The presence of a specific soil form may indicate the presence of a wetland though but this aspect will have to be confirmed on the site through additional indicators.
    b. Certain soil forms are erroneously assigned to specific wetland conditions viz. the Rensburg that is assigned to permanent wetland areas but which is actually characterized by dominance of smectite clay minerals that can only form in seasonal wetland conditions. This discussion warrants a report in itself and will therefore not be further elucidated in this report.

   c. Improved elucidation of the presence of soil forms in landscapes is required. This is especially relevant as the roles of the soils in wetlands and wetland functioning is often poorly understood. On this topic there are current research projects underway that focus on the description of hillslope hydrology and the soil morphological indicators of such hydrology. Linked to this is the established concept of soil variation along a topographic sequence (catena concept) for specific environments or land types. This aspect links up to the concept of soil formation (pedogenesis) and hydropedology which is finding new and very relevant application in the elucidation of environmental processes.
4. The soil wetness indicator is in all probability the most problematic as there are numerous physical and chemical determinants. The main indicator of reduction is the very handy redox morphological variation of Fe – and this is the assumption that most wetland delineation exercises are based upon. (A dedicated discussion of this aspect is provided later in the report.) There is a distinct variability in expression of the quantity / intensity parameters of mottles in different soil environments. This variation is in most cases linear for simple parameters but soils always exhibit combinations of variable parameters that make linear interpretation highly suspect and problematic. A brief elucidation of the problem components include:
   a. The Fe content and reserve of soils and parent material vary significantly and impart varying expression of Fe redox morphology with consequent challenges in interpretation. This aspect induces variation between landscapes with homogenous parent materials (within the specific landscape) or within landscapes where variation in parent materials is found within the landscape.
   b. The Mn content of soils influence redox poise processes that in turn influence the expression of Fe redox morphology. Additional sources of variation include:
      i. Textural influences on expression of mottles;
      ii. Climatic / rainfall gradients; and
      iii. Variation in pH gradients linked to electron activity (Eh). The redox morphology changes linearly with these parameters with the distinct expression of mottles (intensity, colour, contrast) decreasing linearly with increasing pH (even if Eh remains constant).
      iv. In neutral to low pH soils the dominant Fe minerals are Fe oxides and hydroxides – all with bright colours leading to the expression of discernible mottling. In high pH soils the dominant secondary Fe mineral is siderite ($FeCO_3$) which is white in colour that is often associated with lime accumulations (also white). Therefore, alkaline soil environments often do not exhibit distinctly discernible Fe redox morphology. Linked to this is the fact that lime accumulation is also a factor of climate and aridity and lime accumulations can therefore not be used as an indication of reduction even though there are distinct links.
   c. Soil colour varies significantly between different chemical and physical environments (even if pH and Eh remains relatively similar) and as such one set of wetness criteria cannot be applied universally.
   d. With the advancement of science concepts that were accepted to be true 30 years ago are now considered erroneous. A distinct example of this is references to “blue green colouration” in soils classification texts that indicate conditions of distinct saturation in those texts. This colouration has, with recent research, been proven to

occur under very specific redox conditions that indicate only intermediate reduction, even though the soil may be saturated. The historically held conviction that “saturation equals reduction” has been proven to not apply religiously in all environments. It is therefore imperative that the application (wetland delineation) keeps up with the science.

3.6 PROPOSED IMPROVEMENTS

Having indicated that there are numerous limitations to the current wetland delineation approach it is important to focus on dedicated improvements that can implemented/incorporated easily. These improvements include:

1. Updating of the current delineation guidelines (including the draft version from 2008) to serve as a national standard document indicating variability in SA (broadly) through:
    a. Improvement of the landscape indicator to include seepage (including interflow, seepage and return-flow wetlands)
    b. Improvement and correction of the soil form indicator description. Introduction of the concept of “driest soils on crests and wettest soils in depressions” as a method of determining the range of soil variation in specific landscapes.
    c. Improvement and correction of the soil wetness indicator description to reflect differing pH/Eh/parent material environments. Linking of soil wetness indicators to the concept of “driest soils on crests and wettest soils in depressions” as a method of determining range of soil variation in different landscapes.
    d. Introduction of measuring and inference tools for generation of empirical data on wetness.
    e. Introduction of regional and/or land type based detailed guidelines that will include:
        i. Localized topographic indicators and pointers / aids;
        ii. Localized soil form sequences (catena) and soil form variability. (Utilize method of soil form variation range in land type); and
        iii. Localized variation in terms of soil wetness indicators. (Utilize method of soil form variation range in land type).
2. Correction of scientific inaccuracies and inconsistencies in the current documents and improvement of the principles and guidelines to a proper standard through focused research, peer review and formal publication.

4. CHALLENGES REGARDING WETLAND DELINEATION IN ALKALINE SOILS

In order to discuss the procedures followed and the results of the wetland identification exercise it is necessary at the outset to provide some theoretical background on soil forming processes, soil wetness indicators, water movement in soils and topographical sequences of soil forms (catena).

4.1 PEDOGENESIS

Pedogenesis is the process of soil formation. Soil formation is a function of five (5) factors namely (Jenny, 1941):

- Parent material;
- Climate;
- Topography;
- Living Organisms; and
- Time.

These factors interact to lead to a range of different soil forming processes that ultimately determine the specific soil formed in a specific location. Central to all soil forming processes is water and all the reactions (physical and chemical) associated with it. The physical processes include water movement onto, into, through and out of a soil unit. The movement can be vertically downwards, lateral or vertically upwards through capillary forces and evapotranspiration. The chemical processes are numerous and include dissolution, precipitation (of salts or other elements) and alteration through pH and reduction and oxidation (redox) changes. In many cases the reactions are promoted through the presence of organic material that is broken down through aerobic or anaerobic respiration by microorganisms. Both these processes alter the redox conditions of the soil and influence the oxidation state of elements such as Fe and Mn. Under reducing conditions Fe and Mn are reduced and become more mobile in the soil environment. Oxidizing conditions, in turn, lead to the precipitation of Fe and Mn and therefore lead to their immobilization. The dynamics of Fe and Mn in soil, their zones of depletion through mobilization and accumulation through precipitation, play an important role in the identification of the dominant water regime of a soil and could therefore be used to identify wetlands and wetland conditions.

4.2 WATER MOVEMENT IN THE SOIL PROFILE

In a specific soil profile, water can move upwards (through capillary movement), horizontally (owing to matric suction) and downwards under the influence of gravity.

The following needs to be highlighted in order to discuss water movement in soil:

- Capillary rise refers to the process where water rises from a deeper lying section of the soil profile to the soil surface or to a section closer to the soil surface. Soil pores can be regarded as miniature tubes. Water rises into these tubes owing to the adhesion (adsorption) of water molecules onto solid mineral surfaces and the surface tension of water.

  The height of the rise is inversely proportional to the radius of the soil pore and the density of the liquid (water). It is also directly proportional to the liquid's surface tension and the degree of its adhesive attraction. In a soil-water system the following simplified equation can be used to calculate this rise:

Height = 0.15/radius

Usually the eventual height of rise is greater in fine textured soil, but the rate of flow may be slower (Brady and Weil, 1999; Hillel, 1983).

- Matric potential or suction refers to the attraction of water to solid surfaces. Matric potential is operational in unsaturated soil above the water table while pressure potential refers to water in saturated soil or below the water table. Matric potential is always expressed as a negative value and pressure potential as a positive value.

  Matric potential influences soil moisture retention and soil water movement. Differences in the matric potential of adjoining zones of a soil results in the movement of water from the moist zone (high state of energy) to the dry zone (low state of energy) or from large pores to small pores.

  The maximum amount of water that a soil profile can hold before leaching occurs is called the field capacity of the soil. At a point of water saturation, a soil exhibits an energy state of 0 $J.kg^{-1}$. Field capacity usually falls within a range of -15 to -30 $J.kg^{-1}$ with fine textured soils storing larger amounts of water (Brady and Weil, 1999; Hillel, 1983).

- Gravity acts on water in the soil profile in the same way as it acts on any other body; it attracts towards earth's centre. The gravitational potential of soil water can be expressed as:

  Gravitational potential = Gravity x Height

  Following heavy rainfall, gravity plays an important part in the removal of excess water from the upper horizons of the soil profile and recharging groundwater sources below.

  Excess water, or water subject to leaching, is the amount of water that falls between soil saturation (0 $J.kg^{-1}$) or oversaturation (> 0 $J.kg^{-1}$), in the case of heavy rainfall resulting in a pressure potential, and field capacity (-15 to -30 $J.kg^{-1}$). This amount of water differs according to soil type, structure and texture (Brady and Weil, 1999; Hillel, 1983).

- Under some conditions, at least part of the soil profile may be saturated with water, resulting in so-called saturated flow of water. The lower portions of poorly drained soils are often saturated, as are well-drained soils above stratified (layers differing in soil texture) or impermeable layers after rainfall.

  The quantity of water that flows through a saturated column of soil can be calculated using Darcy's law:

  $$Q = Ksat.A.\Delta P/L$$

  Where Q represents the quantity of water per unit time, Ksat is the saturated hydraulic conductivity, A is the cross sectional area of the column through which the water flows, ΔP is the hydrostatic pressure difference from the top to the bottom of the column, and L is the length of the column.

Saturated flow of water does not only occur downwards, but also horizontally and upwards. Horizontal and upward flows are not quite as rapid as downward flow. The latter is aided by gravity (Brady and Weil, 1999; Hillel, 1983).

- Mostly, water movement in soil is ascribed to the unsaturated flow of water. This is a much more complex scenario than water flow under saturated conditions. Under unsaturated conditions only the fine micropores are filled with water whereas the macropores are filled with air. The water content, and the force with which water molecules are held by soil surfaces, can also vary considerably. The latter makes it difficult to assess the rate and direction of water flow. The driving force behind unsaturated water flow is matric potential. Water movement will be from a moist to a drier zone (Brady and Weil, 1999; Hillel, 1983).

The following processes influence the amount of water to be leached from a soil profile:

- Infiltration is the process by which water enters the soil pores and becomes soil water. The rate at which water can enter the soil is termed infiltration tempo and is calculated as follows:

$$I = Q/A.t$$

Where I represents infiltration tempo ($m.s^{-1}$), Q is the volume quantity of infiltrating water (m^3), A is the area of the soil surface exposed to infiltration (m^2), and t is time (s).

If the soil is quite dry when exposed to water, the macropores will be open to conduct water into the soil profile. Soils that exhibit a high 2:1 clay content (swelling-shrinking clays) will exhibit a high rate of infiltration initially. However, as infiltration proceeds, the macropores will become saturated and cracks, caused by dried out 2:1 clay, will swell and close, thus leading to a decline in infiltration (Brady and Weil, 1999; Hillel, 1983).

- Percolation is the process by which water moves downward in the soil profile. Saturated and unsaturated water flow is involved in the process of percolation, while the rate of percolation is determined by the hydraulic conductivity of the soil.

During a rain storm, especially the down pouring of heavy rain, water movement near the soil surface mainly occurs in the form of saturated flow in response to gravity. A sharp boundary, referred to as the wetting front, usually appears between the wet soil and the underlying dry soil. At the wetting front, water is moving into the underlying soil in response to both matric and gravitational potential. During light rain, water movement at the soil surface may be ascribed to unsaturated flow (Brady and Weil, 1999; Hillel, 1983).

The fact that water percolates through the soil profile by unsaturated flow has certain ramifications when an abrupt change in soil texture occurs (Brady and Weil, 1999; Hillel, 1983). A layer of course sand, underlying a fine textured soil, will impede downward movement of water. The macropores of the coarse textured sand offer less attraction to the water molecules than the macropores of the fine textured soil. When the unsaturated wetting front reaches the coarse sand, the matric potential is lower in the sand than in the overlying material. Water always moves from a higher to a lower state of energy. The water can, therefore, not move into the coarse textured sand. Eventually, the downward moving water will accumulate above the sand layer and nearly saturate the fine textured soil. Once this occurs, the water will be held so loosely that gravitational forces will be able to drag the water into the sand layer (Brady and Weil, 1999; Hillel, 1983).

A coarse layer of sand in an otherwise fine textured soil profile will also inhibit the rise of water by capillary movement (Brady and Weil, 1999; Hillel, 1983).

Field observations and laboratory based analysis can aid in assessing the soil-water relations of an area. The South African soil classification system (Soil Classification Working Group, 1991.) comments on certain field observable characteristics that shed light on water movement in soil. The more important of these are:

- Soil horizons that show clear signs of leaching such as the E-horizon – an horizon where predominantly lateral water movement has led to the mobilisation and transport of sesquioxide minerals and the removal of clay material;
- Soil horizons that show clear signs of a fluctuating water table where Fe and Mn mottles, amongst other characteristics, indicate alternating conditions of reduction and oxidation (soft plinthic B-horizon);
- Soil horizons where grey colouration (Fe reduction and redox depletion), in an otherwise yellowish or reddish matrix, indicate saturated (or close to saturated) water flow for at least three months of the year (Unconsolidated/Unspecified material with signs of wetness);
- Soil horizons that are uniform in colouration and indicative of well-drained and aerated (oxidising) conditions (e.g. yellow brown apedal B-horizon).

4.3 WATER MOVEMENT IN THE LANDSCAPE

Water movement in a landscape is a combination of the different flow paths in the soils and geological materials. The movement of water in these materials is dominantly subject to gravity and as such it will follow the path of least resistance towards the lowest point. In the landscape there are a number of factors determining the paths along which this water moves. **Figure 7** provides a simplified schematic representation of an idealised landscape (in “profile curvature”. The total precipitation (rainfall) on the landscape from the crest to the lowest part or valley bottom is taken as 100 %. Most geohydrologists agree that total recharge, the water that seeps into the underlying geological strata, is less than 4 % of total precipitation for most geological settings. Surface runoff varies considerably according to rainfall intensity and distribution, plant cover and soil characteristics but is taken as a realistic 6 % of total precipitation for our idealised landscape. The total for surface runoff and recharge is therefore calculated as 10 % of total precipitation. If evapotranspiration (from plants as well as the soil surface) is taken as a very high 30 % of total precipitation it leaves 60 % of the total that has to move through the soil and/or geological strata from higher lying to lower lying areas. In the event of an average rainfall of 750 mm per year it results in 450 mm per year having to move laterally through the soil and geological strata. In a landscape there is an accumulation of water down the slope as water from higher lying areas flow to lower lying areas.

To illustrate: If the assumption is made that the area of interest is 100 m wide it follows that the first 100 m from the crest downwards has 4 500 m^3 (or 4 500 000 litres) of water moving laterally through the soil (100 m X 100 m X 0.45 m) per rain season. The next section of 100 m down the slope has its own 4 500 m^3 of water as well as the added 4 500 m^3 from the upslope section to contend with, therefore 9 000 m^3. The next section has 13 500 m^3 to contend with and the following one 18 000 m^3. It is therefore clear that, the longer the slope, the larger the volume of water that will move laterally through the soil profile.

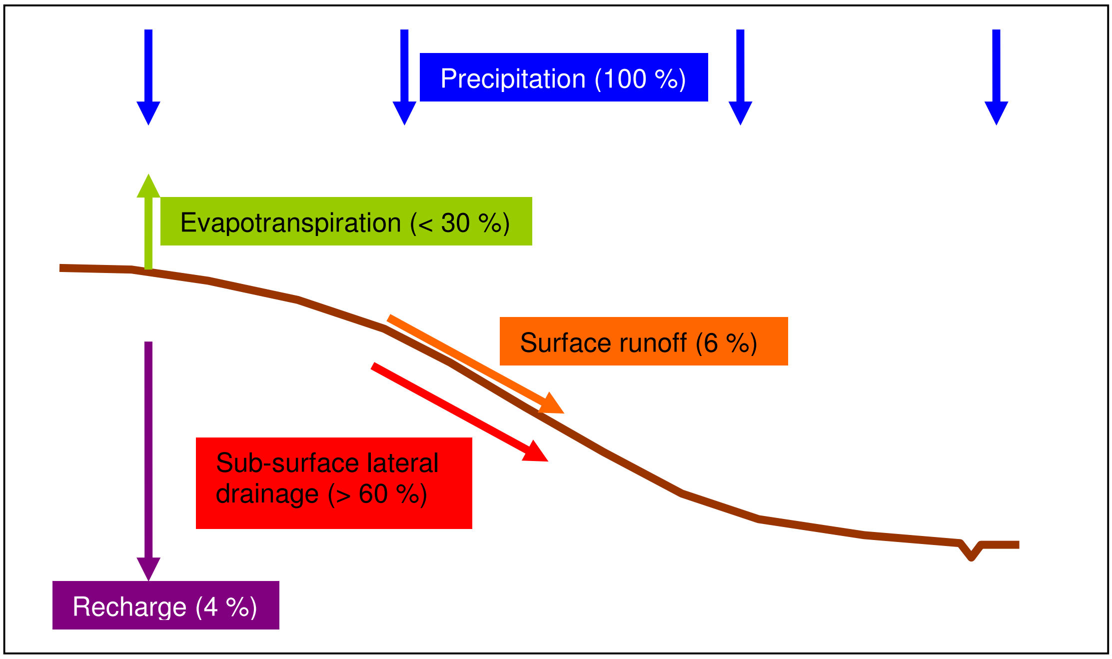

Figure 7 Idealised landscape with assumed quantities of water moving through the landscape expressed as a percentage of total precipitation (100 %).

Flow paths through soil and geological strata, referred to as “interflow” or “hillslope water”, are very varied and often complex due to difficulty in measurement and identification. The difficulty in identification stems more from the challenges related to the physical determination of these in soil profile pits, soil auger samples and core drilling samples for geological strata. The identification of the morphological signs of water movement in permeable materials or along planes of weakness (cracks and seams) is a well-established science and the expression is mostly referred to as “redox morphology”. In terms of the flow paths of water large variation exists but these can be grouped into a few simple categories. **Figure 8** provides a schematic representation of the different flow regimes that are usually encountered. The main types of water flow can be grouped as 1) recharge (vertically downwards) of groundwater; 2) lateral flow of water through the landscape along the hillslope (interflow or hillslope water); 3) return flow water that intercepts the soil/landscape surface; and 4) surface runoff. Significant variation exists with these flow paths and numerous combinations are often found. The main wetland types associated with the flow paths are: a) valley bottom wetlands (fed by groundwater, hillslope processes, surface runoff, and/or in-stream water); b) hillslope seepage wetlands (fed by interflow water and/or return flow water); and wetlands associated with surface runoff, ponding and surface ingress of water anywhere in the landscape.

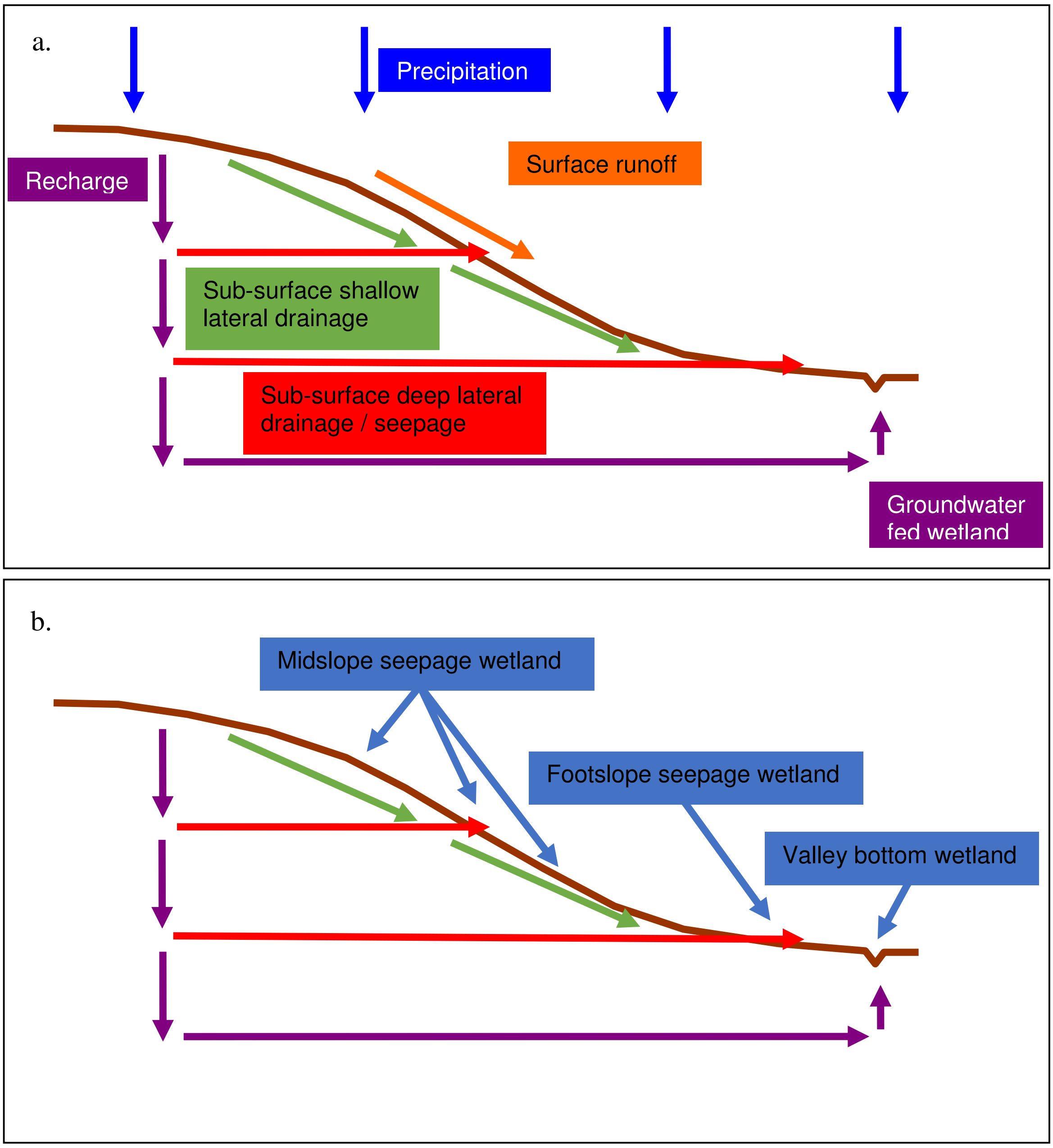

Figure 8 Different flow paths of water through a landscape (a) and typical wetland types associated with the water regime (b)

Amongst other factors, the thickness of the soil profile at a specific point will influence the intensity of the physical and chemical reactions taking place in that soil. **Figure 9** illustrates the difference between a dominantly thick and a dominantly thin soil profile. If all factors are kept the same except for the soil profile thickness it can be assumed with confidence that the chemical and physical reactions associated with water in the landscape will be much more intense for the thin soil profile than for the thick soil profile. Stated differently: The volume of water moving through the soil per surface area of an imaginary plane perpendicular to the direction of water flow is much higher for the thin soil profile than for the thick soil profile. This aspect has a significant influence on the expression of redox morphology in different landscapes of varying soil/geology/climate composition.

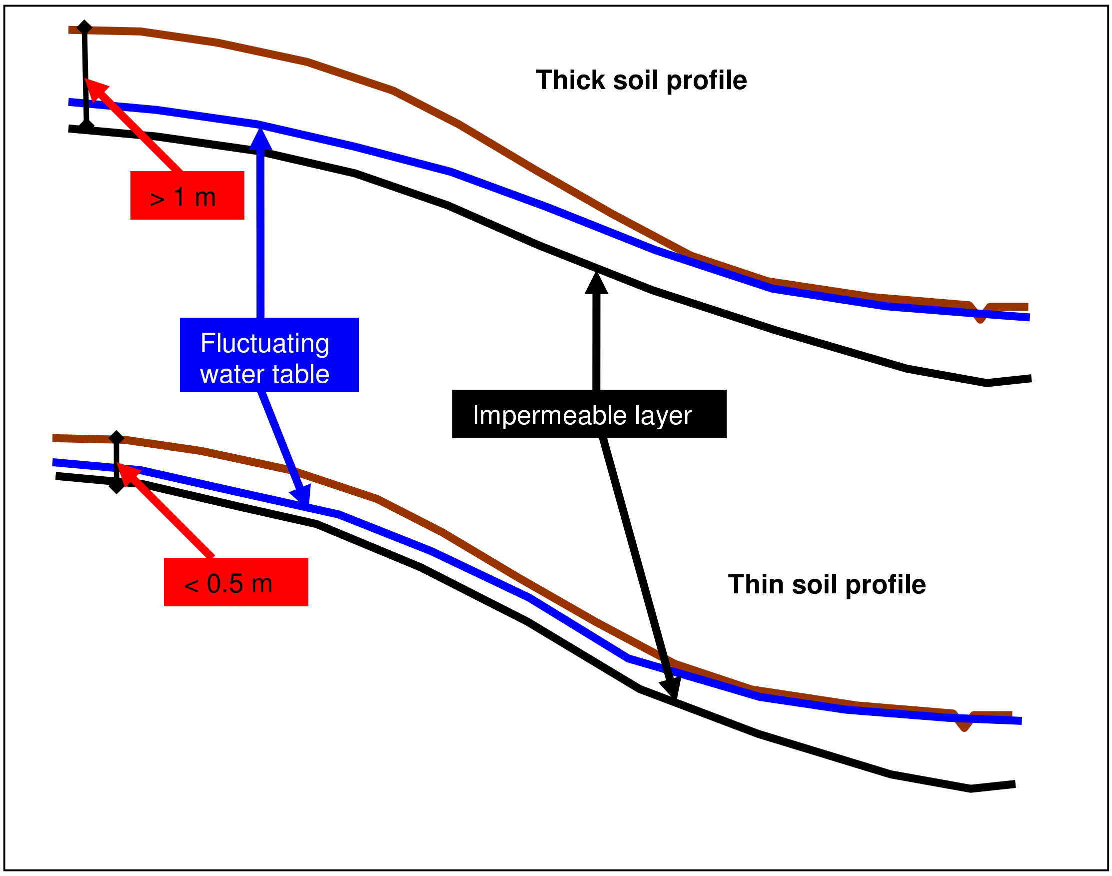

Figure 9 The difference in water flow between a dominantly thick and dominantly thin soil profile.

4.4 THE CATENA CONCEPT

Here it is important to take note of the "catena" concept. This concept is one of a topographic sequence of soils in a homogenous geological setting where the water movement and presence in the soils determine the specific characteristics of the soils from the top to the bottom of the topography. **Figure 10** illustrates an idealised topographical sequence of soils in a catena for a quartz rich parent material. Soils at the top of the topographical sequence are typically red in colour (Hutton and Bainsvlei soil forms) and systematically grade to yellow further down the slope (Avalon soil form). As the volume of water that moves through the soil increases, typically in midslope areas, periodic saturated conditions are experienced and consequently Fe is reduced and removed in the laterally flowing water. In the event that the soils in the midslope positions are relatively sandy the resultant soil colour will be bleached or white due to the colour dominance of the sand quartz particles. The soils in these positions are typically of the Longlands and Kroonstad forms. Further down the slope there is an accumulation of clays and leaching products from higher lying soils and this leads to typical illuvial and clay rich horizons. Due to the regular presence of water the dominant conditions are anaerobic and reducing and the soils exhibit grey colours often with bright yellow and grey mottles (Katspruit soil form). In the event that there is a large depositional environment with prolonged saturation soils of the Champagne form may develop (typical peat land). Variations on this sequence (as is often found on the Mpumalanga Highveld) may include the presence of hard plinthic materials instead of soft plinthite with a consequent increase in the occurrence of bleached soil profiles. Extreme examples of such landscapes are discussed below.

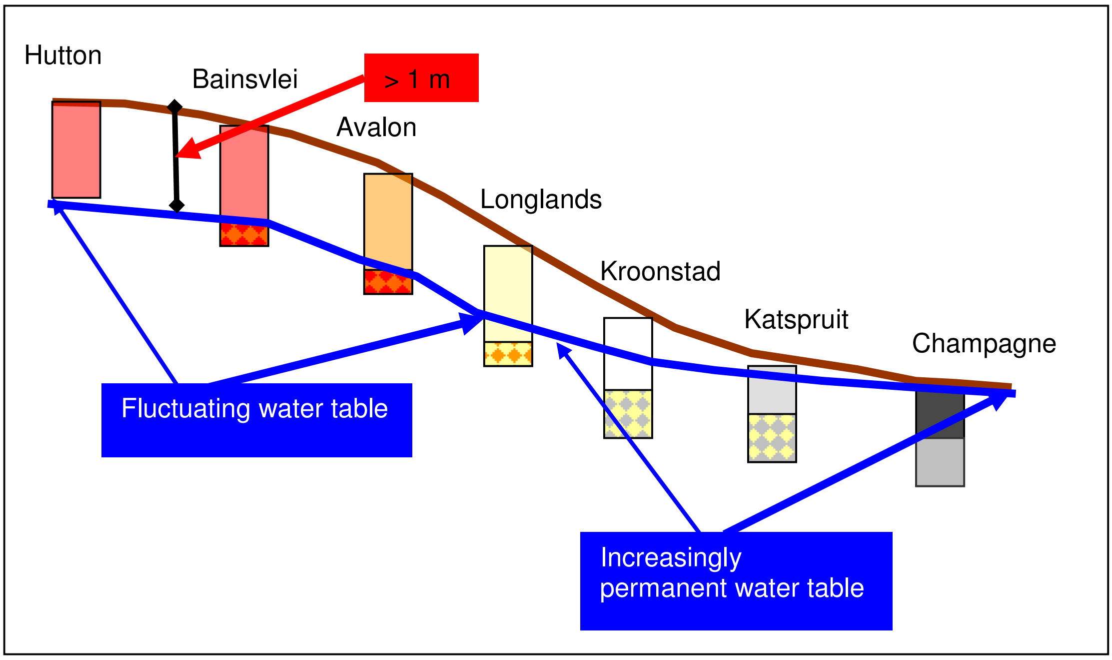

Figure 10 Idealised catena on a quartz rich parent material.

4.5 CONVEX VERSUS CONCAVE LANDSCAPES IN AN IDEALISED CATENA

An additional factor of variation in all landscapes is the shape of the landscape along contours (referred to a "plan curvature"). Landscapes can be either concave or convex, or flat. The main difference between these landscapes lies in the fact that a convex landscape is essentially a watershed with water flowing in diverging directions with a subsequent occurrence of "dryer" soil conditions. In a concave landscape water flows in converging directions and soils often exhibit the wetter conditions of "signs of wetness" such as grey colours, organic matter and subsurface clay accumulation. **Figure 11** presents the difference between these landscapes in terms of typical soil forms encountered in an idealised catena. In the convex landscape the subsurface flow of water removes clays and other weathering products (including Fe) in such a way that the midslope position soils exhibit an increasing degree of bleaching and relative accumulation of quartz (E-horizons).

In the concave landscapes clays and weathering products are transported through the soils into a zone of accumulation where soils start exhibiting properties of clay and Fe accumulation. In addition, coarse sandy soils in convex environments tend to be thinner due to the removal of sand particles through erosion and soils in concave environments tend to be thicker due to colluvial accumulation of material transported from upslope positions. Similar patterns are observed for other geological areas with the variation being consistent with the soil variation in the catena.

Often these concave and convex topographical environments occur in close proximity or in one topographical sequence of soils. This is often found where a convex upslope area changes into a concave environment as a drainage depression is reached (**Figure 12**). The processes in this landscape are the same as those described for the convex and concave landscapes above.

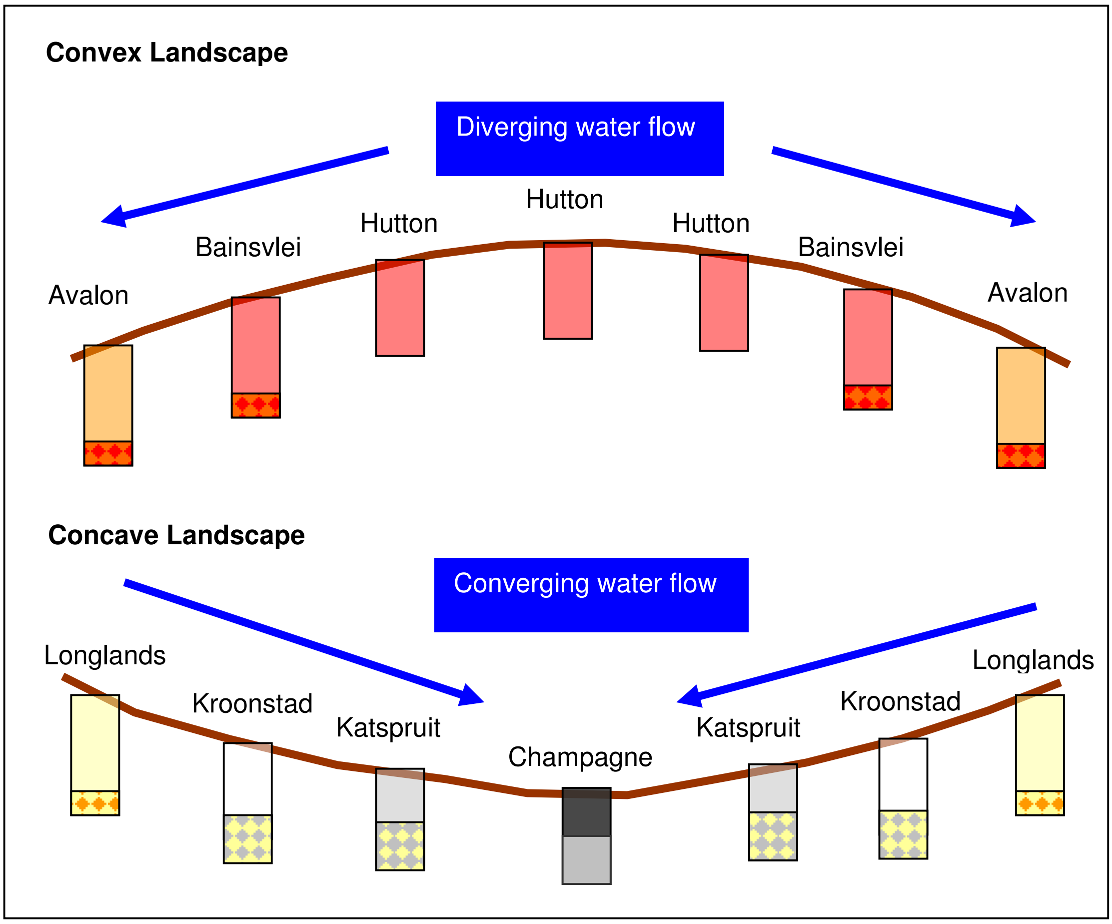

Figure 11 Schematic representation of the soils in convex and concave landscapes in an idealised catena

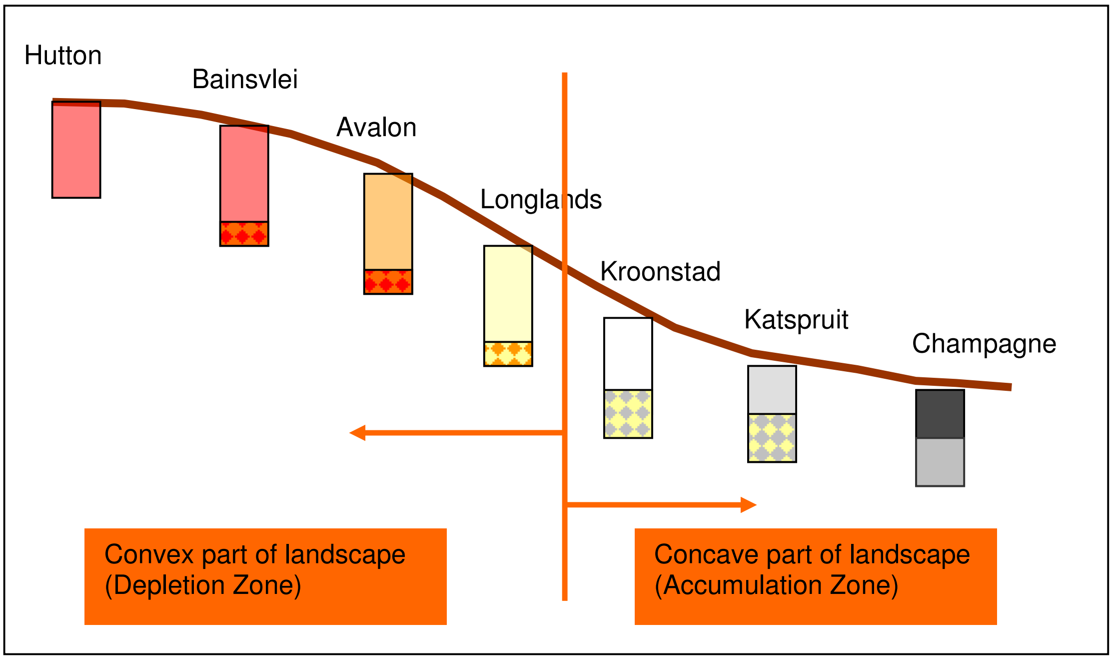

Figure 12 Schematic representation of the soils in a combined convex and concave landscape in an idealised catena.

4.6 THE AE21 LAND TYPE CATENA

The typical catena that forms in the **Ae21** land type (**Figure 13**) differs from the idealised one discussed above in that this land type is characterised by high clay content and often structured soils with a high base status with above neutral pH values. The subsoils are structured and grading into weathered rock. The lower landscape positions are characterised by similar soils but with darker A horizons as well as an increase in the clay content and degree of structure development. The specific clay minerals (2:1 swelling and non-swelling clays) that occur in these landscapes form under above neutral pH conditions. This aspect has very specific implications for the identification of morphological signs of wetness. Wetlands are invariably associated with the lowest points in the landscape and as such this aspect is critical (and therefore addressed in more detail later). Due to the high clay content (and often swelling nature) the soils are characterised predominantly by surface flow of water with very slow percolation rates through the profiles. Lateral flow of water on impervious layers is therefore not encountered with the exception being planes of weakness in the underlying weathered and hard rock. The drainage depressions in these landscapes often exhibit signs of high energy flow events in the form of eroded soils as well as young recently transported soil material.

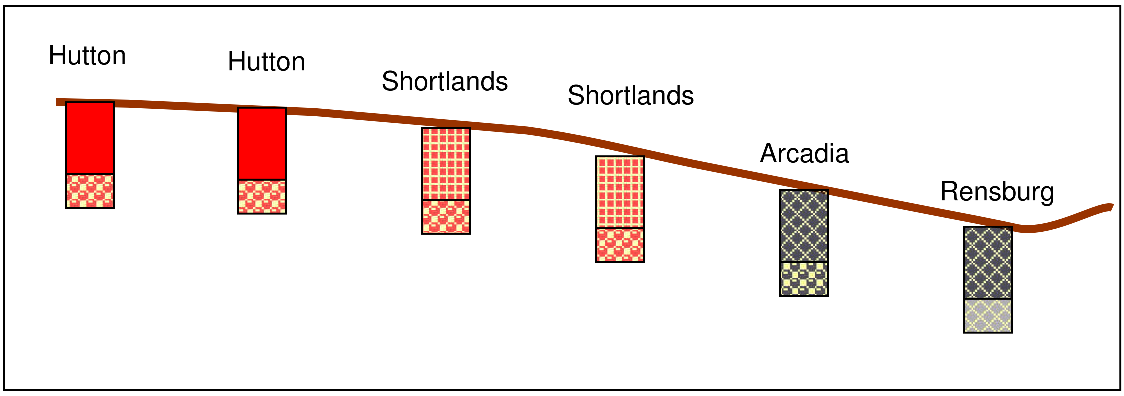

Figure 13 Idealised catena in the Ae21 land type

4.7 REDOX MORPHOLOGY IN ALKALINE SOILS

Wetland delineation is a very challenging exercise in areas dominated by alkaline soils such as lime containing and/or vertic/melanic soils. This is mainly due to the almost complete absence of Fe-mottles in the soils that grade from the terrestrial to the wetland areas. There are a number of reasons that will be explained in more detail below.

In order to illustrate the stability and distribution of Fe minerals in soils the figure provided below (**Figure 14**) was copied from page 124 of a book entitled "Soil Chemistry" by Bohn, et al., (1990). The essence is that when reduction and oxidation reactions of Fe (in this case) are considered in soils both the electron activity (driver of reducing conditions) and pH have to be considered as they are intimately linked and dependent on each other. Suffice to say that for redox and mineral stability purposes they are indicated on the same graph. From Figure 4.6 (**Figure 14**) it is clear that as the Eh decreases (increasing reducing conditions) the dominant Fe species in solution changes from Fe^{3+} (insoluble and forming brightly coloured minerals) to Fe^{2+} (soluble and essentially colourless).

Once pH is included in the observation it is clear that distinct Fe minerals come into play. Applying the decreasing Eh values to Fe minerals at high pH it is clear that the dominant Fe mineral under oxidizing conditions is FeOOH (Goethite – predominantly yellow). As the conditions become more reducing the equilibrium shifts to $FeCO_3$ (Siderite – white) and thereafter to FeS_2 (Pyrite). Whereas goethite has a distinct colour in soil, siderite and pyrite are less conspicuous in small quantities. It follows therefore that Fe minerals are much less visible in high pH reduced soils than in oxidised soils. In addition, vertic and melanic soils are dark coloured and it is therefore also clear that this dark colour will mask the presence of the above mentioned Fe minerals.

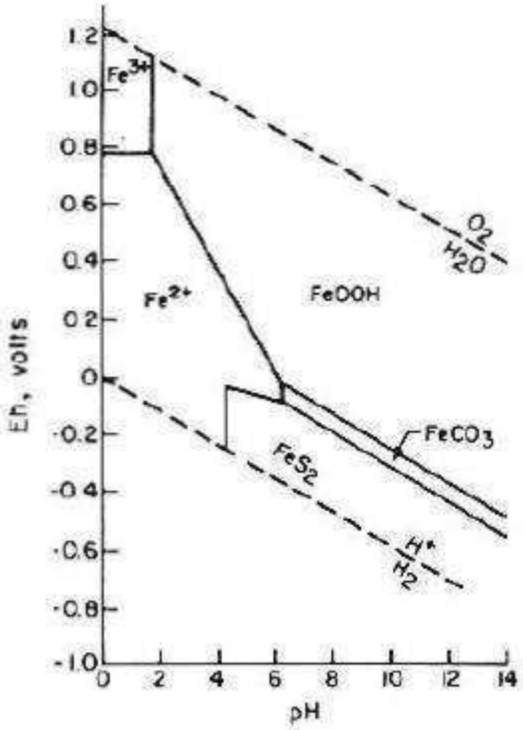

FIGURE 4.6. The *Eh*–pH diagram of various iron ions and compounds.

Figure 14 Eh pH diagram as sourced from Bohn, et al., (1990) p124

Another factor related to pH is the degree of reduction that is required to reduce Fe from its oxidised to its reduced state. From the graph it is clear that there is a steep decreasing gradient as the pH of the soil increases. This implies that much more intensive reducing conditions are required for the same degree of Fe reduction when high pH conditions (as those experienced in vertic and melanic soils) are compared to low pH conditions.

The situation becomes even more complex as other intermediate Fe minerals (blue green rusts) come into play. The essence of the presence of blue-green rusts is that they are tints that occur extensively in poorly drained and poorly aerated soils such as G-horizons under vertic and/or melanic A-horizons. These minerals are not stable and often disappear within a few minutes of exposure to the atmosphere. They in all probability form some of the most important Fe phases in vertic soils but disappear rapidly. Before they disappear it is also evident that these minerals are visible against a grey matrix but poorly visible against a black or dark background.

In essence therefore, a number of factors, including degree of reduction, soil pH and dominant Fe minerals, conspire against the use of Fe indicators in vertic, melanic and lime containing soils for the delineation of wetlands. There is no quick solution to this problem and delineators should use as many other indicators of wetland conditions in such soils as they can.

One word of caution: The wetland delineation guidelines (DWAF, 2005) indicate the Rensburg and Willowbrook soil forms as occurring in the permanent wetland zone. This is somewhat erroneous. Although these can occur in permanent wetland zones their formation is dependent on distinct cycling between wet and dry seasons. The development of 2:1 clays (found in these soils) depends on the accumulation of weathering products and clays in lower lying landscape positions. These clays are, depending on a range of factors, either swelling or non-swelling and their formation requires a distinct time (seasonally) where evaporation exceeds precipitation, with consequent drying of the soil, to lead to a concentration of bases (Ca and Mg). These clay minerals (such as smectite) often express themselves in the form of distinct cracks in Vertic soils. From this discussion it follows that the Rensburg and Willowbrook soils could only have formed in conditions that resemble a **seasonal wetland**. Drainage lines on the site can, if dominated by Rensburg or Willowbrook soils, therefore not be classified as permanent wetlands unless there are other characteristics indicating conditions of permanent saturation.

5. SITE SURVEY RESULTS AND DISCUSSION

The soils encountered on the site ranged from red apedal profiles in the north-west to soils with yellow-brown apedal profiles with quartzite rocks in the south – indicating a transition from igneous geology in the north to more quartzite dominated geology in the south. This aspect in itself imposes a colour gradient that is not associated with wetness (hydromorphy) but rather parent material differences in terms of Fe reserve and redox buffering (as a function of soil physical processes and pH). Within this context the only wetland feature that could be identified is the drainage depression on the eastern boundary of the site (**Figure 15**). The soils fit the description provided above under section 4.6 with the added variation of yellower colours in the terrestrial soils to the south. The feature fits the description of a “watercourse” with a riparian zone as wetland signs in the form of mottles and wetland vegetation are sporadic in the more recently transported alluvial soils in channel. The limitations regarding expression of wetland signs as discussed above in terms of alkaline soil environments applies to this site. No sign of lateral feeding mechanisms through the soils could be observed and it is therefore deduced that the main driver of the wetland/watercourse feature is surface runoff water from the site as well as upslope in the feature’s catchment.

A buffer was not included in **Figure 15** as the best buffer concept on the site is adequate storm water management measures for any developments to take place on the site. An ecological buffer can be included and this should be the outcome of any ecological assessment of the site.

6. CONCLUSIONS AND RECOMMENDATIONS

The following conclusions are drawn from the investigation:

1. The soils on the site consist of a grading between soils derived from basic igneous geology in the north and sedimentary (quartz dominated) geology in the south.

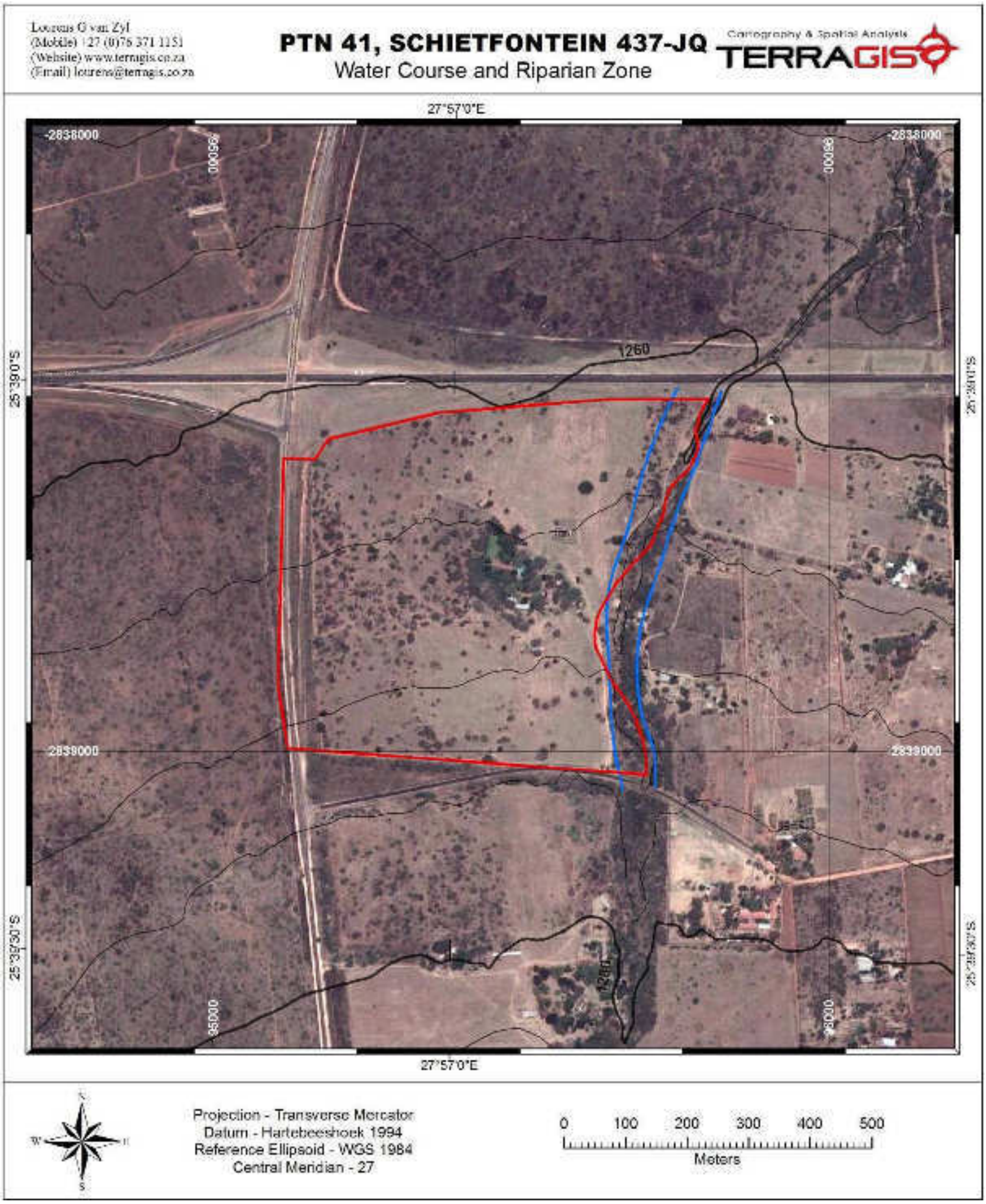

Figure 15 Eh pH diagram as sourced from Bohn, et al., (1990) p124

2. The site has a drainage feature on the eastern edge with a distinct riparian character, even though the vegetation is altered and consisting of numerous exotics.
3. The expression of wetness in the form of mottles or soil forms indicating wetland conditions is limited due to the basic igneous geology leading to high pH values in the soil as well as high clay content that limits lateral flow of water through the soil profiles. The dominant water movement is therefore surface flow from the site as well as from the upslope areas in the catchment.
4. The drainage feature is considered to qualify as a water course as large areas do not have the required expression of hydromorphy indicating long periods of saturation. The feature can therefore not be considered to be a permanent wetland but rather indicates event driven high energy flows of water through the system with persistence of water only in man-made containment structures.

It is recommended that adequate storm water management structure be included for developments on the site in order to protect the drainage feature against erosion. Soil environments with swelling clays are readily susceptible to erosion as the clays are inherently dispersive in nature, therefore leading to rapid erosion and degradation once vegetation cover is altered.

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