Figure 2: Land Layout

2. Terms of Reference

Infrastructure Consulting Engineers (ICE) were requested by the developer to compile a report regarding the provision of access, water supply, stormwater and sewage treatment for the proposed development. ICE has done several other similar projects for Total SA and private developers. These projects are:

- Petroport N1 Touwsrivier
- Petroport N12 Witbank
- Petroport N1 Capricorn
- Petroport N3 Heidelberg
- Petroport N4 Alzu
- Petroport N2 Hluhluwe
- Petroport N2 Mosselbay

ICE was also involved in the design of sewage treatment plants at 9 other highway facilities, and is also involved in the maintenance of these treatment plants.

3. Water Demand

Experience indicates that there is close correlation between water consumption and vehicles entering highway facilities. For purposes of determining water demand, actual consumption from seven other facilities were investigated. The consumption at other facilities is summarised in the table below.

	Daily Water consumption (m^3)	Daily Vehicles Entering	litres / vehicle
N3 Petroport Heidelberg	60	2611	23
N14 Petroport Lanseria	30	3004	10
N4 Petroport Magalies	20	1268	16
N1 Petroport Panorama	80	4470	18
N1 Petroport Capricorn	13	871	14
N12 Petroport Dwarsfontein	41	2487	16.5
Petroport N2 Hluhluwe	18	966	19
Average litres per vehicle			16.67

It can be seen that the average consumption per vehicle entering facilities is approximately 17 litres. The average consumption will however not be used for purposes of this report, but rather the 85th percentile consumption. A daily demand of 19 litre / vehicle will be used. It is estimated that 1650 vehicles will enter the proposed facility per day. Thus a daily demand of 31.5 m^3.

The average anticipated flow is thus 0.365 l/s. A peak demand factor of 5 will be used to determine the peak instantaneous demand.

Thus peak demand = 0.365*5= 1.825l/s.

The water demand can be split into two categories namely;

- potable water and;
- water for toilets and urinals

A separate fire fighting system is proposed.

Potable water

The consumption of potable water is estimated to be 20% of total facility usage. This is water used in the hand wash basins in the restrooms as well as in all other water basins throughout the facility, including restaurants and food preparation areas.

The estimated demand for potable water is 6.3 m^3 per day.

Thus:

Average demand = 0.073 litres/second

Peak demand for potable water (Peak factor of 5) = 0.365 litres per second.

Water for toilets, urinals

It is estimated that 80 % of total daily consumption is for the toilets and urinals, thus 25.2 m^3 per day.

Average demand = 0.291 litres / second

Peak demand (Peak factor of 5) = 1.455 litres/ second

Provision for fire fighting.

A separate fire fighting water supply system is proposed. Fire flow demand of 20 litres per second is required and a storage facility to cope with a 1 hour event must be provided. Thus total volume needed for fire fighting is = 20 x 60 x 60 = 72 m^3

For fire fighting purposes 72 m^3 will have to be stored on site.

4. Water sources

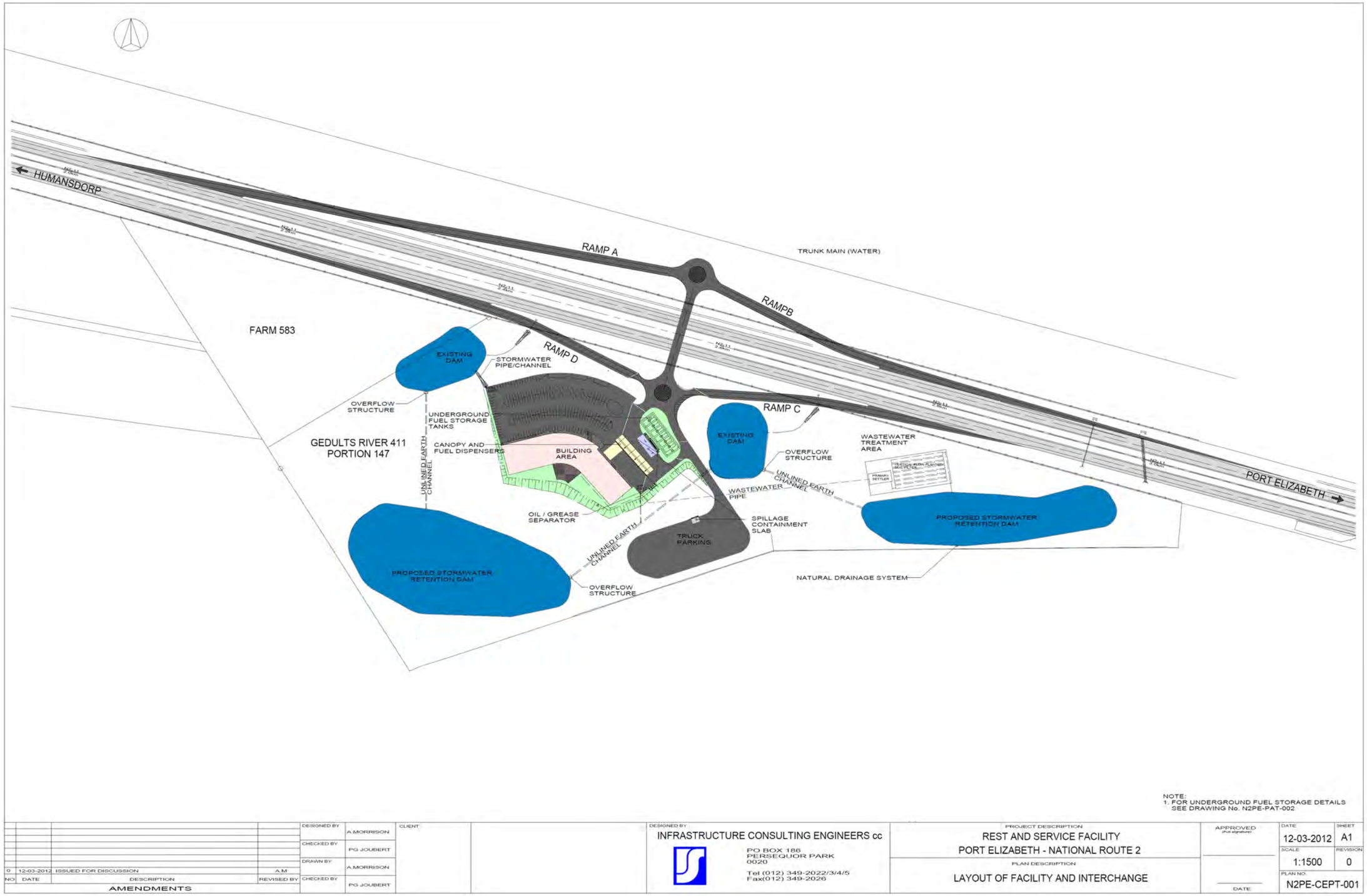
Water will be obtained from 2 sources, namely a municipal trunk main adjacent to the site, as indicated on figure 3, and a borehole system. Treated sewage will also be used for secondary purposes.

Municipal supply

The municipal trunk main intersects portions 86 and 148 of farm Gedultrivier no 411, and is indicated in figure 3. An application has been submitted for a connection on the municipal main to serve the proposed facility. Only potable water will be obtained from the municipal trunk main, thus 6.3 m3 per day.

A supply water main will transport water from the municipal line to the facility. The supply main will be HDPE class 10 pipe. The provisional size of the supply pipe is 63mm. Depending on the pressure on the trunk main a pressure reducing valve will be installed downstream of the junction.

Figure 3: Provisional Layout



Borehole and treated sewage

For toilet, urinal and fire fighting purposes borehole water will be used. The demand for toilets and urinals is 25.2 m^3 per day, whilst 72 m^3 litres needs to be stored for fire fighting purposes. Treated sewage will only be used for irrigation purposes.

The borehole and treated sewage system will consist of the following components;

- The production borehole will be fitted with a submersible pump with a capacity of approximately 5 m^3 per hour. This will allow for the pump to yield the average daily demand within 5 hours.
- The water will be stored in an 80 m^3 litre tank. The size of the tank is determined by the average demand for water from the toilets, urinals and the water needed for fire fighting purposes (72 m^3).
- Supply water mains will transport water from the borehole and sewage treatment plant to the water storage facility.
- The tank will be equipped with a level control system and when the volume in the tank drops below 72 m^3 the borehole pump will start and the tank is automatically refilled up to 80m^3.
- Water is pumped from the water storage facility to the building, fire fighting hydrant and hose reels. Separate pump installations are provided for the two uses. The domestic water pump system consists of a service and a standby pump. The domestic pumps have a yield of 1.5 litre per second each. The fire system consists of a jockey pump and a bulk supply pump with a yield of 20 litres per second.

5. Sewage treatment

Sewage from the facility will be treated in a Subterra Vertical Flow natural filter. A report from Subterra Natural filters is attached in Appendix A. The capacity of the system is designed to cope with the average daily demand as well as peak flows. Subterra natural filters were installed at the following Petroports: N3 Petroport Heidelberg, N14 Petroport Lanseria, N4 Petroport Magalies, N1 Petroport Panorama, N1 Petroport Capricorn, N12 Petroport Dwarsfontein, Petroport N2 Hluhluwe and Petroport N3 Mountain view. The system proved to be reliable and is therefore preferred by Total SA. The effluent from the system will be used for irrigation purposes.

6. Road Access

Access to the site is via a diamond type access interchange from National Route 2. This type of access is superior in terms of road safety if compared to other facilities along the N2. At grade intersections at other facilities require right turn movements across oncoming traffic. The proposed access interchange an indicated in Figure 3, obviates the need for any of these movements.

A further advantage of this access arrangement is that there is only one facility serving both directions of traffic. A common problem experienced at sites where facilities are located at both sides of the

freeway is that pedestrians cross the freeway between the facilities on either side. A further associated problem is that delivery and other service vehicle make unauthorised crossing movements. This is obviously dangerous. For this reason the current design guidelines of SANRAL requires both vehicle and pedestrian crossings between facilities on either side of the freeway. The proposed development conforms to all requirements of SANRAL. The complete second phase of application, according to SANRAL's Procedures for Road Planning and Geometric Design, has been submitted and it has been discussed with SANRAL.

7. Stormwater drainage

The stormwater drainage system is designed for the convenience and safety of facility users and to protect the infrastructure and buildings from up to 1 in 50 year floods. A further design parameter is to reduce flood peaks and to enhance groundwater infiltration. Flood peaks are reduced through the introduction of stormwater retention dams as well as unlined earth channels where possible. The series of retention dams discharge into the natural drainage system. Underground pipes will be limited and unlined earth channels will be promoted. These unlined channels are designed for maximum flow velocities of 1 - 2 m/s. Water from the forecourt area, where vehicles park when refuelling, as well as the spill slabs, where trucks stop to refill the underground tanks, is routed into an oil separator. After the oil and the water have been separated the water flows into the sewage treatment system. The forecourt and the spill slab are the areas where spillage may occur and it must be ensured that no oils or fuels can enter the stormwater network, thus oil separators are implemented that discharge into the sewage treatment system.

8. Conclusion

The investigation of services, access and storm water drainage indicates that acceptable infrastructure can be developed to cope with the demands of the proposed development.

Appendix A

Proposed Stormwater System

PROPOSAL FOR SEWAGE TREATMENT FACILITY FOR PROPOSED N2 FULL REST AND SERVICE FACILITY ON PORTIONS 86, 147 AND 148 OF FARM GEDULTSRIVIER NO 411 UITENHAGE RD. EASTERN CAPE

Contents

1. Terms of Reference

Rest and service facilities generate a very specific and problematic sewage effluent. The effluent is subject to significant changes in volumes. Peak daily discharge volumes have been recorded to be 250% of the average daily flow. These peaks make the use of most package plants unacceptable. The surface area available for biological activity in most package plants is limited and exposed to evaporation. During low flow conditions microorganisms die off. During high flow periods there is insufficient biological activity available to cope with the flow.

Due to the poor performance of package plants at various Total Service Stations, Total SA are replacing all package plants with natural filters.

2. Project needs

Experience has shown that there is a fair correlation between number of vehicles entering the facility and the water consumption. From consumption rates at similar facilities it was determined that the 85th percentile water consumption is 19 litres per vehicle entering the facility. The average number of vehicles expected to enter the facility daily is 1650. This leads to an estimated daily sewage flow of 31.5 m^3, with a peak flow of 78m^3 per day.

3. Concept design of the system.

Implementation of the design philosophy is accomplished by the provision of three unit processes, in series, i.e. a three-chamber septic tank, vertical flow planted soil filter and horizontal flow planted soil filter as indicated in Figure 1. All unit processes are sized on mass-loading basis, i.e. removal of a specific mass of constituents from the water stream at a rate that will prevent accumulation.

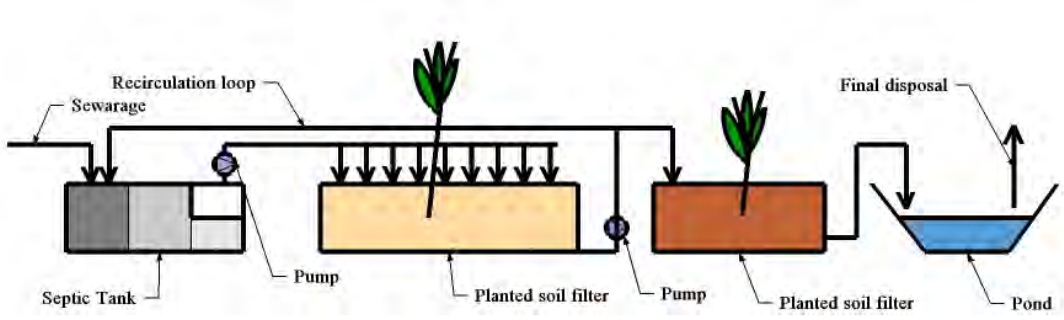


Figure 1: System Overview

Primary wastewater is gravitated into the first chamber of the septic tank in the eastern corner of the site. The septic tank size allows for the deceleration of incoming wastewater, ridding the water of kinetic energy and allowing solids to separate into a top and bottom layer. A scum layer forms at the top of the first chamber of the tank and typically includes substance with a specific gravity of less than

water i.e. fat, oil and grease. The layer at the bottom of the first chamber of the tank contains organic and inorganic matter with a specific gravity of more than one i.e. faecal matter and grit.

Total retention time and lack of oxygen in the septic tank, partial anaerobic liquefaction and digestion of contents are mediated by anaerobes. The exact rate of solid accumulation is dependent on the composition (i.e. biodegradability and nutrient ratio's and concentrations) of the primary wastewater. Monitoring the layer thicknesses ensure that the volume of solids in the tank is known. Solids will have to be removed from the septic tank. Due to uncertainty of the exact composition of the wastewater, the intervals at which removal will be necessary cannot be predicted accurately. It is however expected that the tank will have to be emptied once a year.

A further fraction of suspended solids will settle out in the second chamber of the septic tank. This chamber essentially contains settled wastewater with a relatively low suspended solids concentration. In order to implement the night-time operation of the system, the third chamber of the tank is utilised as a hydraulic buffer.

Settled wastewater, or septic tank effluent, is pumped intermittently into a gravel layer on the entire top surface of the vertical flow planted soil filter. This water percolates through the uniform graded sand layer. Intermittently pumped water ensures temporal varying moisture conditions throughout the sand in the filter, which in turn favours a complex microbial population. The microbial population varies from aerobes in the upper reaches of the sand to anaerobes in the bottom reaches. Potential flow instabilities in the sand layer are addressed by the root system of reeds planted in the soil. An under-drain ensures that the hydraulic conductivity of the filter stays constant.

The effluent from the second unit process is pumped to the top of the third unit process. Physical layout of the filter ensures that the water runs through the sand in a horizontal direction, through plant roots. Effluent from this final stage in the treatment train is drained to a pond from where it is utilised for irrigation purposes or pumped to a storage tank where it can be blended with borehole water for re-use in toilets and urinals.

4. Design standards

Design standards for unit processes specify the size of the processes in terms of a mass-loading rate. Mass-loading implies that the performance (degree of separation) of each of the unit processes depend on the mass of a specific constitute is loaded on the process in a specific time. The mass of a constituent loaded on a process is the product of flow rate and concentration.

Design flow and vertical flow planted soil filter size

The estimated daily water consumption at the proposed development is 31.5 m3. A conservative approach is to assume that all of the potable water produces wastewater. It is expected that the wastewater production will peak during 7 to 9 am and between 4 pm and 6pm.

The design flow of 31.5m³ per day determines the size of the vertical flow planted soil filter. Two different criteria are used to size the filter. The criteria refer to the hydraulic capacity of the filter and the biological capacity of the filter.

The filter is sized according to hydraulic capacity and biological capacity. The hydraulic capacity of the filter is 50 litres per m² per day. If this factor is applied to the design flow a filter size of 650 m² results. This is also based on an application rate of approximately 25mg COD per m2. The proposed design is stable and robust enough to cope with double the mentioned loading for short periods. The planted soil filter is lined to prevent sewage entering the groundwater system. A typical layout is indicated on figures 1, 2 and 3.

Septic tanks

The septic tanks are sized to allow for three-day retention of sewage. For this purpose the average daily flow is used. The total volume of the septic tanks is therefore approximately 90m3. The septic tanks are constructed of reinforced concrete. A buffer tank with capacity of 20m3 is proposed. Two pumps are used to pump effluent from the buffer tank into the Subterra beds. One pump is a service pump and the second a standby pump.

5. Maintenance requirements

The basic philosophy of the design is to minimize maintenance requirements. The following maintenance is required:

- Daily maintenance activities consist of attending to high level alarms from the buffer tank and from the primary treatment discharge pumps. A visual inspection of the Subterra filter is advisable to check for free water. Free water on the surface will result in an unpleasant smell and must be eliminated as soon as possible. An unskilled labourer can be trained to undertake these actions. These actions should not occupy the worker for more than an hour per day.
- Monthly maintenance consists of checking sludge levels in the pre-treatment tank. Sludge must be removed from time to time. Experience indicates that sludge removal form systems treating domestic sewage can be expected to be required once a year.
- Quarterly maintenance consists of downloading data from the pump control system, cleaning pumps, backwashing irrigation pipes, checking irrigation pipes, record plant growth, record sludge levels in pre-treatment and collecting inflow and outflow samples. Pump data is used to predict pump replacements. Plant growth records are used to evaluate the general condition of beds. In and outflow water records are used to evaluate the general condition of beds. In and outflow water quality is used to report to environmental authorities and to evaluate the efficiency of the system.

6. Summary

The following items should be considered when evaluating this proposal:

- The Subterra system is based on natural processes and environmentally friendly
- The design of the system is robust and conservative to cope with local conditions in Africa
- The only moving parts are found in pressure pumps. The best quality pumps are specified to limit operational and maintenance cost.
- The system can be incorporated in the site landscaping
- The life expectancy of the system is at least 10 years without any major rehabilitation.

7. Additional Information

Detail description of Subterra process

The Subterra process is based entirely on natural processes. The pre-treatment of sewage takes place in a conventional septic tank. Secondary treatment takes place in a vertical flow biological filter. The conceptual drawing below shows the components of a typical small installation:

- Pre-treatment in a multi-chamber septic tank;
- Buffer tank to attenuate peaks in demand if necessary
- Pump installation and transportation pipe to transport water from the buffer tank to the Subterra beds.
- Subterra beds.

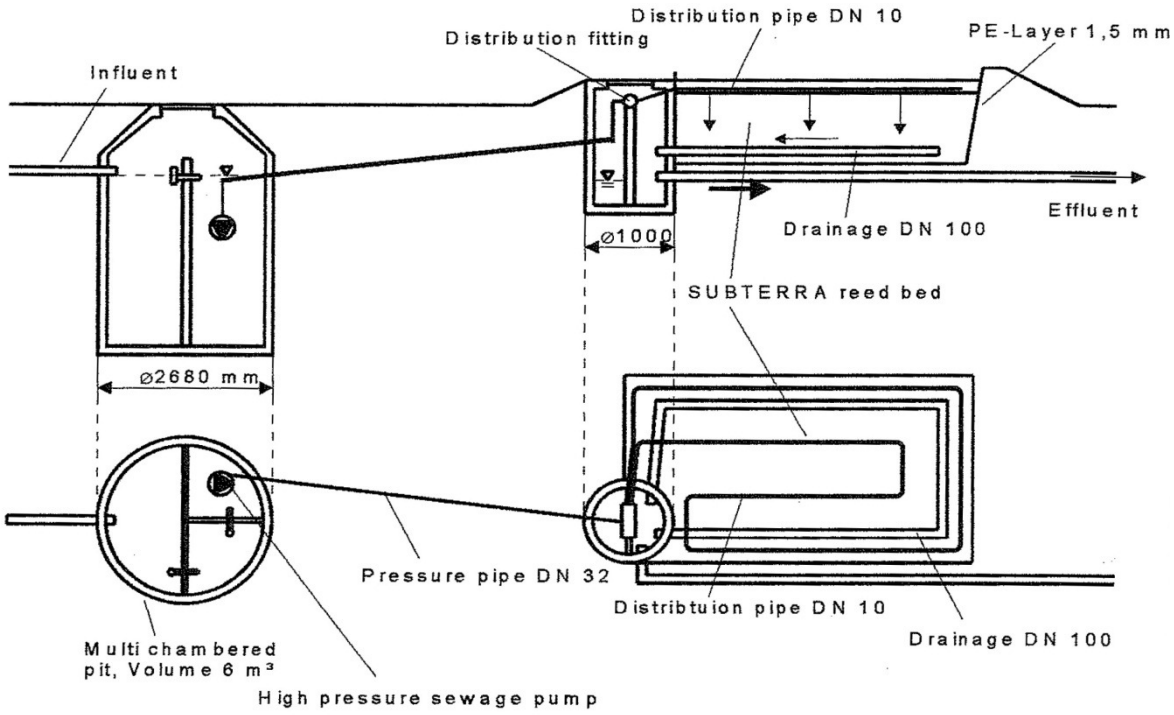


Figure 2: Subterra System

The Subterra system is technically described as a planted vertical flow soil filter. The bed consists of sand and gravel layers and biological substrates to adopt the system to different climates and sewage qualities. An important element of the system is a subsurface irrigation pipe system, which sprays the pre-treated sewage homogeneously over the entire reed-bed into the top stone layer of the filter at a depth of 15cm. Irrigation takes place for 5 to 10 minutes per hour only. This ensures that the bed is

never saturated but only damp. It also ensures almost constant humidity throughout the bed. Figure 3 and 4 shows more detail on the layout and layers of the Subterra.

As mentioned the bed consists of different layers of sand, substrates and gravel and is planted with reeds e.g. phragmytes. The root system of the plants i.e. the rhizomes ensures aeration of the sand. Sand aeration results from the oxygen inflow via the vascular system of the roots and the loosening of the soil by root development. This ensures the hydraulic flow-through on a long term basis.

A layer of microorganisms forms on the roots and substrates. The grading of the substrate is specified in order to ensure large surface areas for microorganisms to grow. Comparing the specific surface areas of this technology with any of the package plants shows the massive advantage of the Subterra natural filters with thousands of square meters of surface area per cubic metre of substrate.

Nitrifiers and denitrifiers break down organic components to such an extent that even benzols and phenols are decomposed.

The purified water is collected in a simple subsurface drainage pipe system, from where it flows to a control tank, where it can be monitored and tested. After that it is discharged to a river, pond or reused for irrigation or secondary water cycle purposes. As the reed bed has a dry surface and is entirely covered by gravel it has no smell. Seasonal fluctuations have minimal effect on this process and therefore satisfactory quality of effluent is also guaranteed during peak periods.

The mechanical pre-treatment of wastewater, before it enters the Subterra beds, takes place in a multi-chambered septic tank. The subsequent transportation of wastewater to the Subterra bed is brought about by a pressure pipe system.

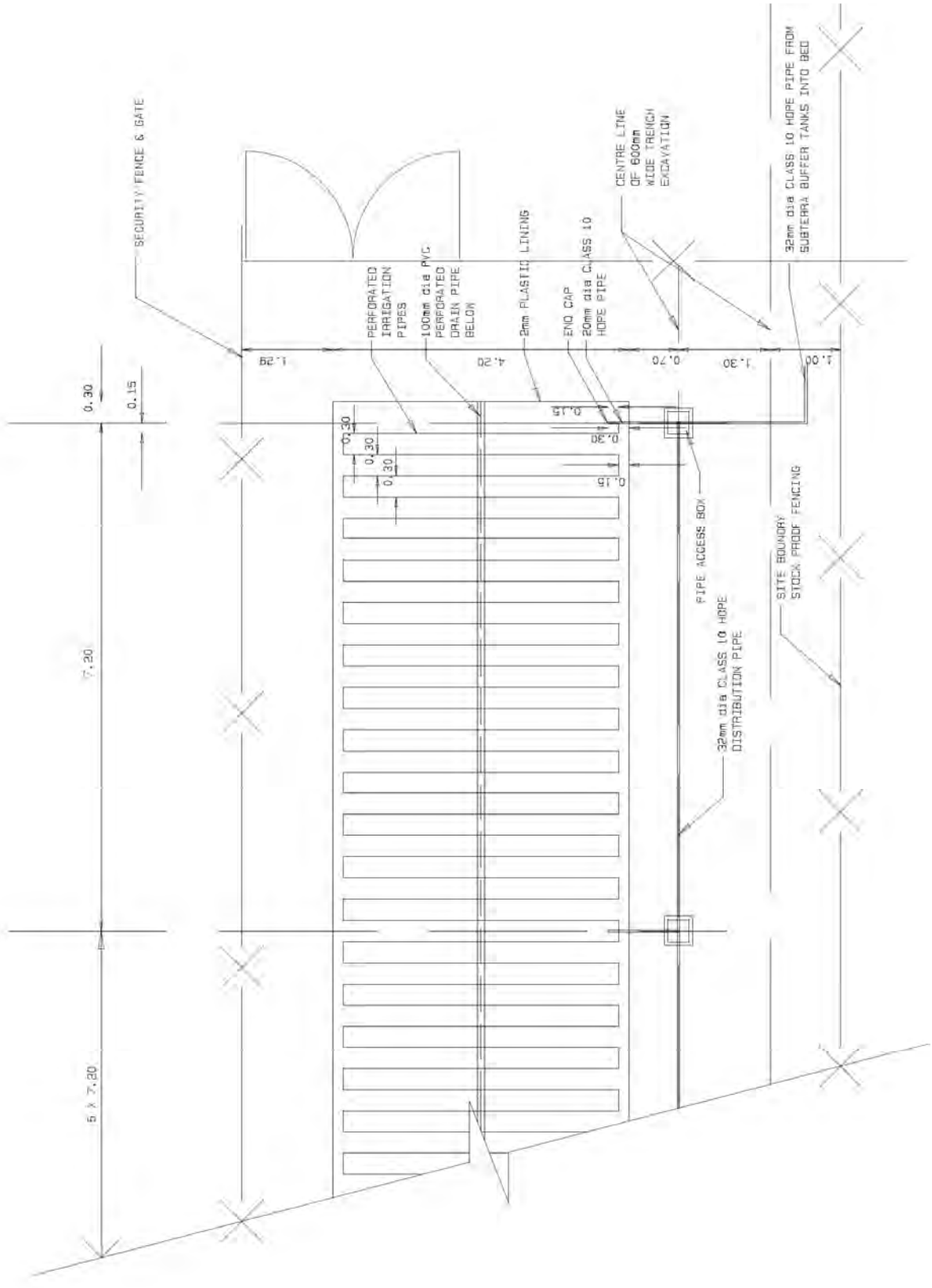


Figure 3: Typical Layout Plan

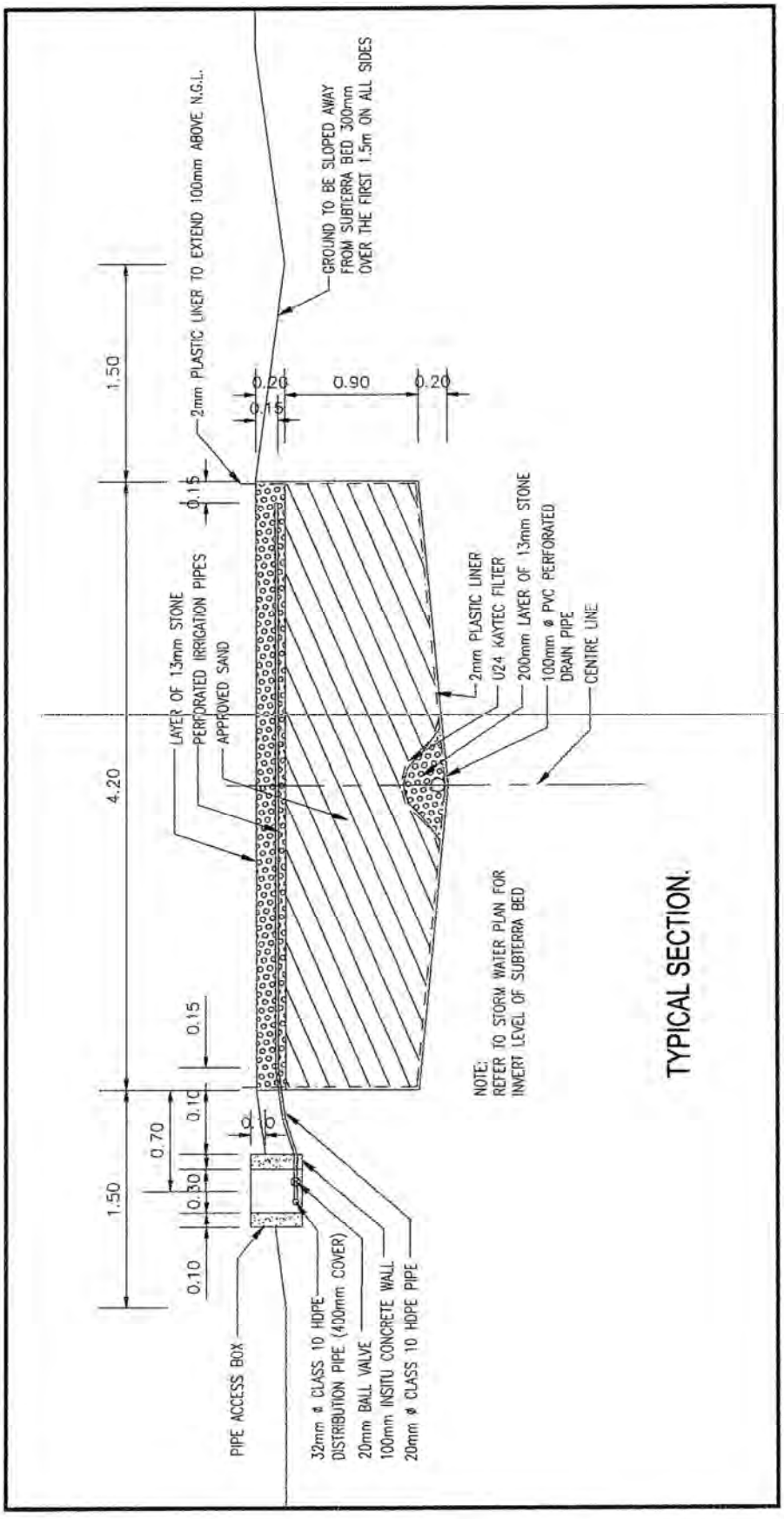


Figure 4. Typical Section

Effluent results from other sites

The effluent results from other sites where Subterra are installed can be seen in the table in figure 5. The irrigation standard is 100 000 faecal coliform bacteria/100ml.

	N3 Petroport Heidelberg	N14 Petroport Lanseria	N4 Petroport Magalies	N1 Petroport Panorama	N1 Petroport Capricorn	N3 Petroport Mountain view	N12 Petroport Dwarsfontein	Petroport N2 Hluhluwe
Consumption (m3/day)	60	30	20	80	13	30	41	18
Analyses in mg/litre unless otherwise specified								
PH at 25 C	7.2	7.3	7.1	7.1	7.1	7.4	8.1	6.9
Sodium absorption ratio	1.5	2.4	1.8	3	7.9	3.3	6.5	11
Chemical Oxygen demand	79	52	126	67	124	48	129	56
Faecal Coliform Bacteria/100 ml	67000	16000	20000	5800	500	7400	14000	1300
Sodium as Na	62	60	94	107	381	120	172	523
Calcium as Ca	69	27	51	45	56	75	27	146
Magnesium as Mg	36	12	91	24	74	17	16	17

Figure 5: Effluent results Subterra sites

WATERLAB

WATERLAB (Pty) Ltd
Reg. No.: 1983/009165/07 V.A.T. No.: 4130107891

Building D
The Woods
41 De Havilland Cresent
Persequor Techno Park
Meiring Naudé Drive
Pretoria

P.O. Box 283
Persequor Park, 0020
Tel: +2712 – 349 – 1066
Fax: +2712 – 349 – 2064
e-mail: admin@waterlab.co.za

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SANAS Accredited Testing Laboratory
No. T0391

CERTIFICATE OF ANALYSES
GENERAL WATER QUALITY PARAMETERS

Date received: 2012 – 01 - 31 **Date completed:** 2012 - 02 - 15

Project number: 197 **Report number:** 33923 **Order number:** -

Client name: Kebokae **Contact person:** Mr. F. Kehrhahn

Address: P.O. Box 186 Persequor Park Pretoria 0020 **e-mail:** liesl@iceisp.co.za

Telephone: 012 349 2022 **Facsimile:** 012 349 2026 **Mobile:** -

Analyses in mg/ℓ (Unless specified otherwise)	Method Identification	Sample Identification:
		Heidelberg
Sample Number		1931
pH – Value at 25°C	WLAB001	7.2
Electrical Conductivity in mS/m at 25°C	WLAB002	172
Sodium Adsorption Ratio (SAR) *	WLAB052	1.5
Chemical Oxygen Demand as O_2 (Total) *	WLAB018	79
Faecal Coliform Bacteria / 100 mℓ *	WLAB021	67 000
Sodium as Na	WLAB015	62
Calcium as Ca	WLAB015	69
Magnesium as Mg	WLAB015	36

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E. Nkabinde

Technical Signatory

WATERLAB

WATERLAB (Pty) Ltd
Reg. No.: 1983/009165/07 V.A.T. No.: 4130107891

Building D
The Woods
41 De Havilland Cresent
Persequor Techno Park
Meiring Naudé Drive
Pretoria

P.O. Box 283
Persequor Park, 0020
Tel: +2712 – 349 – 1066
Fax: +2712 – 349 – 2064
e-mail: admin@waterlab.co.za

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GENERAL WATER QUALITY PARAMETERS

Date received: 2012 - 01 - 19 **Date completed:** 2012 - 01 - 30

Project number: 197 **Report number: 33762** **Order number:**

Client name: Kebokae **Contact person: Mr. F. Kehrhahn**

Address: P.O. Box 186 Persequor Park Pretoria 0020 **e-mail: liesl@iceisp.co.za**

Telephone: 012 349 2022 **Facsimile: 012 349 2026** **Mobile: -**

Analyses in mg/ℓ (Unless specified otherwise)	Method Identification	Sample Identification: Lanseria - B
		Subterra Sump
Sample Number		841
pH – Value at 25°C	WLAB001	7.3
Electrical Conductivity in mS/m at 25°C	WLAB002	109
Sodium Adsorption Ratio (SAR) *	WLAB052	2.4
Chemical Oxygen Demand as O_2 (Total) *	WLAB018	52
Faecal Coliform Bacteria / 100 mℓ *	WLAB021	16 000
Sodium as Na	WLAB015	60
Calcium as Ca	WLAB015	27
Magnesium as Mg	WLAB015	12

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A. van de Wetering

Technical Signatory

WATERLAB

WATERLAB (Pty) Ltd
Reg. No.: 1983/009165/07 V.A.T. No.: 4130107891

Building D
The Woods
41 De Havilland Cresent
Persequor Techno Park
Meiring Naudé Drive
Pretoria

P.O. Box 283
Persequor Park, 0020
Tel: +2712 – 349 – 1066
Fax: +2712 – 349 – 2064
e-mail: admin@waterlab.co.za

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Date received: 2012 - 02 - 28 **Date completed:** 2012 - 03 - 08

Project number: 197 **Report number: 34323** **Order number: -**

Client name: Kebokae **Contact person: Mr. F. Kehrhahn**

Address: P.O. Box 186 Persequor Park Pretoria 0020 **e-mail: liesl@iceisp.co.za**

Telephone: 012 349 2022 **Facsimile: 012 349 2026** **Mobile: -**

Analyses in mg/ℓ (Unless specified otherwise)	Method Identification	Sample Identification
		Magalies
Sample Number		3998
pH – Value at 25°C	WLAB001	7.1
Electrical Conductivity in mS/m at 25°C	WLAB002	165
Sodium Adsorption Ratio (SAR) *	WLAB052	1.8
Chemical Oxygen Demand as O_2 (Total) *	WLAB018	126
Faecal Coliform Bacteria / 100 mℓ *	WLAB021	20 000
Sodium as Na	WLAB015	94
Calcium as Ca	WLAB015	51
Magnesium as Mg	WLAB015	91

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Ard van de Wetering

Technical Signatory:

WATERLAB

WATERLAB (Pty) Ltd
Reg. No.: 1983/009165/07 V.A.T. No.: 4130107891

Building D
The Woods
41 De Havilland Cresent
Persequor Techno Park
Meiring Naudé Drive
Pretoria

P.O. Box 283
Persequor Park, 0020
Tel: +2712 – 349 – 1066
Fax: +2712 – 349 – 2064
e-mail: admin@waterlab.co.za

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GENERAL WATER QUALITY PARAMETERS

Date received: 2012 - 01 - 17 **Date completed:** 2012 - 01 - 30

Project number: 197 **Report number: 33715** **Order number: -**

Client name: Kebokae **Contact person: Mr. F. Kehrhahn**

Address: P.O. Box 186 Persequor Park Pretoria 0020 **e-mail: liesl@iceisp.co.za**

Telephone: 012 349 2022 **Facsimile: 012 349 2026** **Mobile: -**

Analyses in mg/ℓ (Unless specified otherwise)	Method Identification	Sample Identification: Panorama - A
		Subterra Sump New
Sample Number		685
pH – Value at 25°C	WLAB001	7.1
Electrical Conductivity in mS/m at 25°C	WLAB002	152
Sodium Adsorption Ratio (SAR) *	WLAB052	3.0
Chemical Oxygen Demand as O_2 (Total) *	WLAB018	67
Faecal Coliform Bacteria / 100 mℓ *	WLAB021	5 800
Sodium as Na	WLAB015	107
Calcium as Ca	WLAB015	45
Magnesium as Mg	WLAB015	24

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A. van de Wetering

Technical Signatory

WATERLAB

WATERLAB (Pty) Ltd
Reg. No.: 1983/009165/07 V.A.T. No.: 4130107891

Building D
The Woods
41 De Havilland Cresent
Persequor Techno Park
Meiring Naudé Drive
Pretoria

P.O. Box 283
Persequor Park, 0020
Tel: +2712 – 349 – 1066
Fax: +2712 – 349 – 2064
e-mail: admin@waterlab.co.za

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CERTIFICATE OF ANALYSES
GENERAL WATER QUALITY PARAMETERS

Date received: 2012 - 01 - 20 **Date completed:** 2012 - 02 - 13
Project number: 197 **Report number: 33777** **Order number: -**
Client name: Kebokae **Contact person: Mr. F. Kehrhahn**
Address: P.O. Box 186 Persequor Park Pretoria 0020 **e-mail: liesl@iceisp.co.za**
Telephone: 012 349 2022 **Facsimile: 012 349 2026** **Mobile: -**

Analyses in mg/ℓ (Unless specified otherwise)	Method Identification	Sample Identification: Capricorn
		Subterra Sump
Sample Number		944
pH – Value at 25°C	WLAB001	7.1
Electrical Conductivity in mS/m at 25°C	WLAB002	308
Sodium Adsorption Ratio (SAR) *	WLAB052	7.9
Chemical Oxygen Demand as O_2 (Total) *	WLAB018	124
Faecal Coliform Bacteria / 100 mℓ *	WLAB021	500
Sodium as Na	WLAB015	381
Calcium as Ca	WLAB015	56
Magnesium as Mg	WLAB015	74

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WATERLAB (Pty) Ltd
Reg. No.: 1983/009165/07 V.A.T. No.: 4130107891

Building D
The Woods
41 De Havilland Cresent
Persequor Techno Park
Meiring Naudé Drive
Pretoria

P.O. Box 283
Persequor Park, 0020
Tel: +2712 – 349 – 1066
Fax: +2712 – 349 – 2064
e-mail: admin@waterlab.co.za

sanas Testing Laboratory

SANAS Accredited Testing Laboratory
No. T0391

CERTIFICATE OF ANALYSES
GENERAL WATER QUALITY PARAMETERS

Date received: 2012 - 02 - 09 **Date completed:** 2012 - 02 - 24
Project number: 197 **Report number: 34042** **Order number: -**

Client name: Kebokae **Contact person: Mr. F. Kehrhahn**
Address: P.O. Box 186 Persequor Park Pretoria 0020 **e-mail: liesl@iceisp.co.za**
Telephone: 012 349 2022 **Facsimile: 012 349 2026** **Mobile: -**

Analyses in mg/ℓ (Unless specified otherwise)	Method Identification	Sample Identification: Mountain View
		Subterra Sump A
Sample Number		2497
pH – Value at 25°C	WLAB001	7.4
Electrical Conductivity in mS/m at 25°C	WLAB002	173
Sodium Adsorption Ratio (SAR) *	WLAB052	3.3
Chemical Oxygen Demand as O_2 (Total) *	WLAB018	48
Faecal Coliform Bacteria / 100 mℓ *	WLAB021	7 400
Sodium as Na	WLAB015	120
Calcium as Ca	WLAB015	75
Magnesium as Mg	WLAB015	17

*** = Not SANAS Accredited**
Tests marked "Not SANAS Accredited" in this report are not included in the SANAS Schedule of Accreditation for this Laboratory.

[s] = Analyses performed by a Sub-Contracted Laboratory

A. van de Wetering

Technical Signatory

WATERLAB

WATERLAB (Pty) Ltd
Reg. No.: 1983/009165/07 V.A.T. No.: 4130107891

Building D
The Woods
41 De Havilland Cresent
Persequor Techno Park
Meiring Naudé Drive
Pretoria

P.O. Box 283
Persequor Park, 0020
Tel: +2712 – 349 – 1066
Fax: +2712 – 349 – 2064
e-mail: admin@waterlab.co.za

sanas Testing Laboratory
SANAS Accredited Testing Laboratory No. T0391

CERTIFICATE OF ANALYSES
GENERAL WATER QUALITY PARAMETERS

Date received: 2012 - 02 - 22 **Date completed:** 2012 - 03 - 01
Project number: 197 **Report number: 34237** **Order number: -**
Client name: Kebokae **Contact person: Mr. F. Kehrhahn**
Address: P.O. Box 186 Persequor Park Pretoria 0020 **e-mail: liesl@iceisp.co.za**
Telephone: 012 349 2022 **Facsimile: 012 349 2026** **Mobile: -**

Analyses in mg/ℓ (Unless specified otherwise)	Method Identification	Sample Identification: Dwarsfontein
		Subterra Pump
Sample Number		3433
pH – Value at 25°C	WLAB001	8.1
Electrical Conductivity in mS/m at 25°C	WLAB002	285
Sodium Adsorption Ratio (SAR) *	WLAB052	6.5
Chemical Oxygen Demand as O_2 (Total) *	WLAB018	129
Faecal Coliform Bacteria / 100 mℓ *	WLAB021	14 000
Sodium as Na	WLAB015	172
Calcium as Ca	WLAB015	27
Magnesium as Mg	WLAB015	16

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WATERLAB

WATERLAB (Pty) Ltd
Reg. No.: 1983/009165/07 V.A.T. No.: 4130107891

Building D
The Woods
41 De Havilland Cresent
Persequor Techno Park
Meiring Naudé Drive
Pretoria

P.O. Box 283
Persequor Park, 0020
Tel: +2712 – 349 – 1066
Fax: +2712 – 349 – 2064
e-mail: admin@waterlab.co.za

sanas Testing Laboratory

SANAS Accredited Testing Laboratory
No. T0391

CERTIFICATE OF ANALYSES
GENERAL WATER QUALITY PARAMETERS

Date received: 2012 - 02 - 09 **Date completed:** 2012 - 02 - 24
Project number: 197 **Report number: 34043** **Order number: -**

Client name: Kebokae **Contact person: Mr. F. Kehrhahn**
Address: P.O. Box 186 Persequor Park Pretoria 0020 **e-mail: liesl@iceisp.co.za**
Telephone: 012 349 2022 **Facsimile: 012 349 2026** **Mobile: -**

Analyses in mg/ℓ (Unless specified otherwise)	Method Identification	Sample Identification: Hluhluwe
		Subterra Pump
Sample Number		2498
pH – Value at 25°C	WLAB001	6.9
Electrical Conductivity in mS/m at 25°C	WLAB002	453
Sodium Adsorption Ratio (SAR) *	WLAB052	11
Chemical Oxygen Demand as O_2 (Total) *	WLAB018	56
Faecal Coliform Bacteria / 100 mℓ *	WLAB021	1 300
Sodium as Na	WLAB015	523
Calcium as Ca	WLAB015	146
Magnesium as Mg	WLAB015	17

*** = Not SANAS Accredited**
Tests marked "Not SANAS Accredited" in this report are not included in the SANAS Schedule of Accreditation for this Laboratory.

[s] = Analyses performed by a Sub-Contracted Laboratory

A. van de Wetering

Technical Signatory

VELD DU TOIT INCORPORATED

RAADGEWENDE ELEKTRIESE INGENIEURS • CONSULTING ELECTRICAL ENGINEERS
LINJINELI ZOMBANE EZICEBISAYO • ONJINIYELA BEZOGESI ABELULEKAYO

Reg. No. 99/006074/21 / VAT. No. 4110165687

Our Ref: Petro/N2/001
Date: 13 June 2012

Dear Sir,

REZONING OF PORTION 147 OF THE FARM GEDULTS RIVER No. 411 UITENHAGE ELECTRICAL SUPPLY REPORT

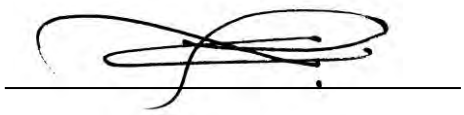
After my telephonic enquiry to Nelson Mandela Metropolitan Electrical Department regarding the availability of an electrical supply to the above property I can report the following:

Mr. Nathaniel Kivido of Nelson Mandela Metropolitan Electrical Department confirms in an e-mail that an Electrical point of supply of 315kVA / 400 Volt can be made available to the above property.

I trust that you will find the above sufficient for your purposes but remain available should you have any further queries in this regard.

Yours Faithfully,

VELD DU TOIT INCORPORATED



Ockert Meyer (Director)

CESA
Consulting Engineers South Africa

PRETORIA: ✉ P.O. Box 48, Wapadrand, 0050 ☎ (012) 807 0192 (012) 807 0203 / 086 666 0203
EAST LONDON: ✉ P.O. Box 13085, Vincent, 5217 ☎ (043) 726 3550 (043) 726 3550

Directors:
V du Toit Pr.Eng, PJ van der Merwe Pr.Eng, OJ Meyer Nat. Dip(Elec.Eng)

Appendix D2: Phase 1 Archaeological Heritage Impact Assessment (Dr Johan Binneman)

A LETTER OF RECOMMENDATION (WITH CONDITIONS) FOR THE EXEMPTION OF A FULL PHASE 1 ARCHAEOLOGICAL HERITAGE IMPACT ASSESSMENT FOR THE PROPOSED CONSTRUCTION OF A PETROPORT AND ASSOCIATED INFRASTRUCTURE ON PORTIONS 86, 147 AND 148 OF FARM GEDULTS RIVER N0. 411, DIVISION UITENHAGE, EASTERN CAPE PROVINCE

Prepared for: CEN Integrated Environmental Management Unit
36 River Road
Walmer
Port Elizabeth
6070
Tel: 041 5812983/5817811
Fax: 041 5812983
Contact person: Dr M. Cohen
email: steenbok@aerosat.co.za

Compiled by: Dr Johan Binneman
On behalf of: Eastern Cape Heritage Consultants
P.O. Box 689
Jeffreys Bay
6330
Tel: 042 2960399
Cell: 0728006322
email: kobusreichert@yahoo.com

Date: February 2012

A LETTER OF RECOMMENDATION (WITH CONDITIONS) FOR THE EXEMPTION OF A FULL PHASE 1 ARCHAEOLOGICAL HERITAGE IMPACT ASSESSMENT FOR THE PROPOSED CONSTRUCTION OF A PETROPORT AND ASSOCIATED INFRASTRUCTURE ON PORTIONS 86, 147 AND 148 OF FARM GEDULTS RIVER N0. 411, DIVISION UITENHAGE, EASTERN CAPE PROVINCE

PROJECT INFORMATION

The type of development

The development will be approximately 11.5 ha in size and include the construction of a Petroport, associated infrastructure and a waste water treatment plant. An interchange will also be built with on-and off-ramps to the N2.

The Developer

Suwenda 40 (Pty) Ltd

The Consultant

CEN Integrated Environmental Management Unit
36 River Road
Walmer
Port Elizabeth
6070
Tel: 041 5812983/5817811
Fax: 041 5812983
Contact person: Dr M. Cohen
Email: steenbok@aerosat.co.za

Terms of reference

The original proposal was to conduct a Phase 1 Archaeological Impact Assessment (AIA) for the proposed construction of a Petroport and associated infrastructure on Portion 147 of the farm Gedults River No. 411, Division of Uitenhage, Port Elizabeth, Nelson Mandela Metopole, Eastern Cape Province, to describe and evaluate;

- the importance of possible archaeological sites, features and materials,
- the potential impact of the development on these resources and,
- to propose recommendations to minimize possible damage to these resources.

DESCRIPTION OF THE PROPERTY

Map: 1:50 000 3325 CD & 3425 AB Uitenhage

Location data

The proposed site for the development for the proposed construction of a Petroport, associated infrastructure and waste water treatment works on the farm Gedults River No. 411, Division of Uitenhage, Port Elizabeth, Nelson Mandela Metopole, Eastern Cape Province, is situated approximately 30 kilometres west of Port Elizabeth next to the N2 National Road between Port Elizabeth and Humansdorp. The Petrolport will be built south of the N2 and the off-ramps on the northern side on Portions 148 and 86 of the farm Gedults River No. 411 (Maps 1-2) (General GPS reading: 34.55.12,5S; 25.17.31,34E – south; 34.55.5,00S; 25.17.30,62E - north).

ARCHAEOLOGICAL INVESTIGATION

Methodology and results

The investigation was conducted on foot and GPS readings were taken with a Garmin and all important features were digitally recorded. The proposed property for the development is covered by dense grass, alien trees and bushes. In general the properties adjacent to the N2 National Road were disturbed when the road was constructed (during the late 1960s) and there is also a large old borrow pit on the southern side next to the N2. The properties on the northern side of the N2 have been disturbed in the past by ploughing, planting of grass for grazing and general farming activities. There are two residential dwellings with associated structures, but these are younger than 60 years old (Figs 1-6). The property south of the N2 has also been disturbed in the past by bush clearing and possibly ploughing. There are also informal residential dwellings, a brick lined well and other concrete features (probably associated with the borrow pit), but are younger than 60 years old (Figs 7-10). The well was built with 'modern' bricks and cement and date most probably from the early 1960s (GPS reading: 34.55.10,92S; 25.17.27,9E). According to the landowner there are no graves on the property.

The dense grass cover and other vegetation made archaeological visibility difficult and no archaeological sites/materials were found. Nevertheless, it is unlikely that any archaeological remains will be exposed during the development.

Figs 1-4. Different views of the proposed property for development north of the N2 National Road.

Figs 5-6. Views of one of the residential dwellings and other structures on the proposed property for development north of the N2 National Road.

Figs 1-4. Different views of the proposed property for development south of the N2 National Road. The vegetation cover, the large borrow pit (middle right) and the brick lined well next to the borrow pit (bottom row).

CONDITIONS

Although it is unlikely that archaeological remains will be found *in situ,* or of any contextual significance, there is always a possibility that human remains and/or other archaeological and historical material may be uncovered during the development. Such material must be reported to the nearest museum, archaeologist or to the South African Heritage Resources Agency if exposed, so that a systematic and professional investigation can be undertaken. Sufficient time should be allowed to remove/collect such material (See Appendix B for a list of possible archaeological sites that maybe found in the area).

LETTER OF RECOMMENDATION

It is recommended that the proposed construction of a Petroport and associated infrastructure on Portion 147 of the farm Gedults River No. 411, Division of Uitenhage, Port Elizabeth, Nelson Mandela Metropole, Eastern Cape Province, is exempted from a full Phase 1 Archaeological Impact Assessment. The proposed area for development is of low cultural sensitivity and it is unlikely that any archaeological heritage remains will be found on the property. The proposed development may proceed as planned.

Note that this letter of recommendation only exempts the proposed development from a full Phase 1 Archaeological Impact Assessment, but not for other heritage impact assessments. It must also be clear that this letter of recommendation for exemption of a full Phase 1 archaeological impact assessment will be assessed by the relevant heritage resources authority. The final decision rests with the heritage resources authority, which should give a permit or a formal letter of permission for the destruction of any cultural sites.

The National Heritage Resources Act (Act No. 25 of 1999, section 35) (see Appendix A) requires a full Heritage Impact Assessment (HIA) in order that all heritage resources, that is, all places or objects of aesthetics, architectural, historic, scientific, social, spiritual linguistic or technological value or significance are protected. Thus any assessment should make provision for the protection of all these heritage components, including archaeology, shipwrecks, battlefields, graves, and structures older than 60 years, living heritage, historical settlements, landscapes, geological sites, palaeontological sites and objects.

GENERAL REMARKS AND CONDITIONS

It must be emphasised that this letter of recommendation for exemption of a full Phase 1 archaeological impact assessment is based on the visibility of archaeological sites/material and may not therefore, reflect the true state of affairs. Sites and material may be covered by soil and vegetation and will only be located once this has been removed. In the unlikely event of such finds being uncovered, (during any phase of construction work), archaeologists must be informed immediately so that they can investigate the importance of the sites and excavate or collect material before it is destroyed (see attached list of possible archaeological sites and material). The *onus* is on the developer to ensure that this agreement is honoured in accordance with the National Heritage Act No. 25 of 1999.

APPENDIX A: brief legislative requirements

Parts of sections 35(4), 36(3) and 38(1) (8) of the National Heritage Resources Act 25 of 1999 apply:

Archaeology, palaeontology and meteorites

35 (4) No person may, without a permit issued by the responsible heritage resources authority—

(a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;
(b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;
(d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.

Burial grounds and graves

36. (3) (a) No person may, without a permit issued by SAHRA or a provincial heritage resources authority—

(a) destroy, damage, alter, exhume or remove from its original position or otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves;

(b) destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority; or
(c) bring onto or use at a burial ground or grave referred to in paragraph (a) or (b)any excavation equipment, or any equipment which assists in the detection or recovery of metals.

Heritage resources management

38. (1) Subject to the provisions of subsections (7), (8) and (9), any person who intends to undertake a development categorized as –

(a) the construction of a road, wall, powerline, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;
(b) the construction of a bridge or similar structure exceeding 50m in length;
(c) any development or other activity which will change the character of the site –
  (i) exceeding 5000m^2 in extent, or
  (ii) involving three or more erven or subdivisions thereof; or
  (iii) involving three or more erven or divisions thereof which have been consolidated within the past five years; or
  (iv) the costs of which will exceed a sum set in terms of regulations by SAHRA, or a provincial resources authority;
(d) the re-zoning of a site exceeding 10 000m^2 in extent; or
(e) any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority, must as the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development.

APPENDIX B: IDENTIFICATION OF ARCHAEOLOGICAL FEATURES AND MATERIAL FROM INLAND AREAS: guidelines and procedures for developers

Human Skeletal material

Human remains, whether the complete remains of an individual buried during the past, or scattered human remains resulting from disturbance of the grave, should be reported. In general the remains are buried in a flexed position on their sides, but are also found buried in a sitting position with a flat stone capping and developers are requested to be on the alert for this.

Fossil bone

Fossil bones or any other concentrations of bones, whether fossilized or not, should be reported.

Stone artefacts

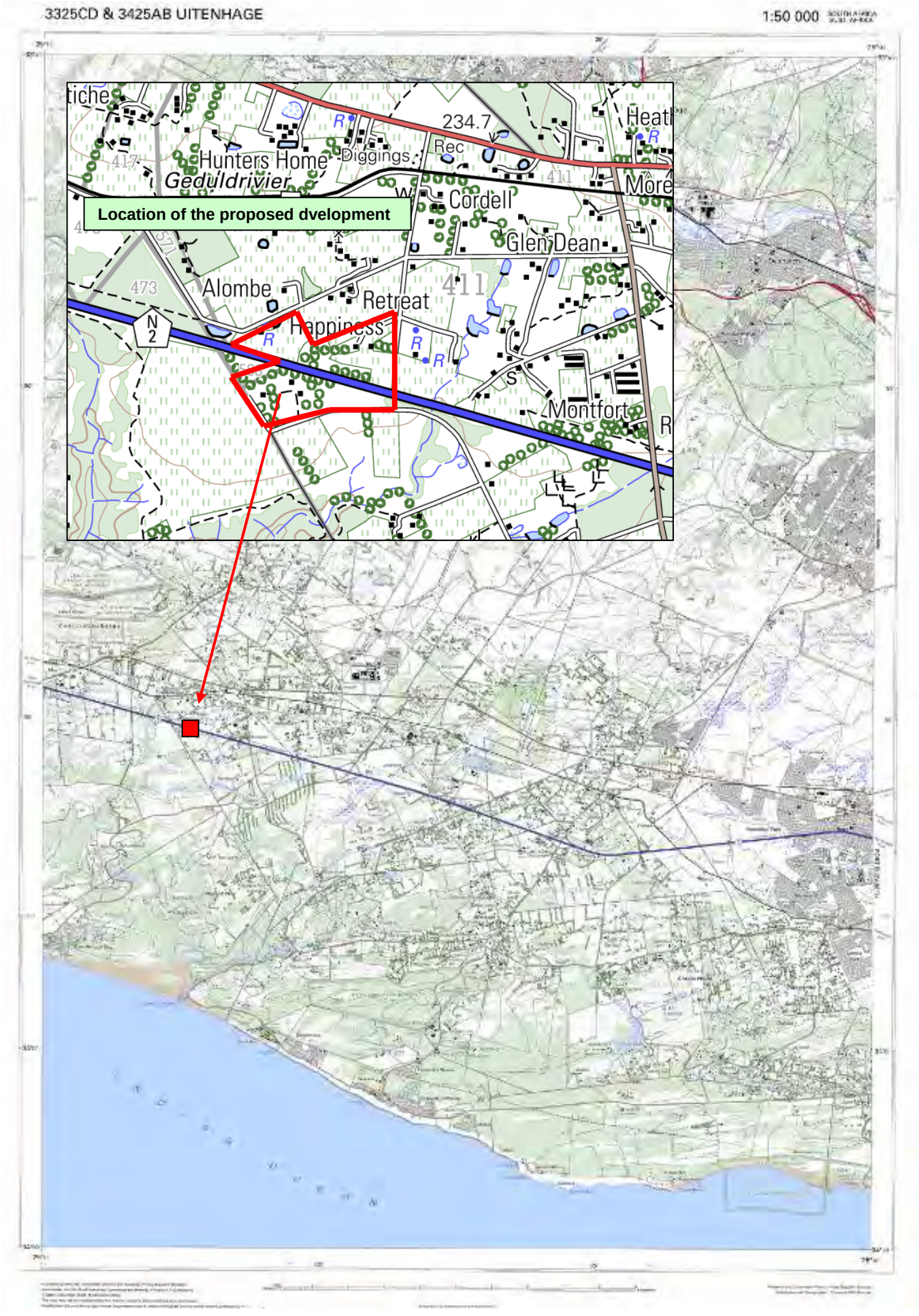
These are difficult for the layman to identify. However, large accumulations of flaked stones which do not appear to have been distributed naturally should be reported. If the stone tools are associated with bone remains, development should be halted immediately and archaeologists notified.

Stone features and platforms

They come in different forms and sizes, but are easy to identify. The most common are roughly circular stone walls (mostly collapsed) and may represent stock enclosures, remains of wind breaks or cooking shelters. Others consist of large piles of stones of different sizes and heights and are known as *isisivane.* They are usually near river and mountain crossings. Their purpose and meaning is not fully understood, however, some are thought to represent burial cairns while others may have symbolic value.

Historical artefacts or features

These are easy to identify and include foundations of buildings or other construction features and items from domestic and military activities.



Map 1. 1:50 000 maps indicate the location of the proposed Petroport development. The approximate size of the property is outline in red.

Map 2. Aerial images of the location of the proposed Petroport development. The approximate size of the property is outline in black (insert map courtesy of CEN).

Appendix D3: Geotechnical Investigation and Soil percolation study

Infrastructure Consulting Engineers

N2 TOTAL FILLING STATION, PORT ELIZABETH

Geotechnical Investigation

J VAN TONDER Pr.Sci.Nat.
Engineering Geologist

DJ MOUTON Pr.Sci.Nat.
Specialist Engineering Geologist

Prepared by

KNIGHT HALL HENDRY

PO Box 72292
LYNNWOOD RIDGE
0040
Tel: +27 12 348 9091
Fax: +27 12 348 9065

e-mail: jvantonder@knightpiesold.com

KHH1922/3110024801

FEBRUARY 2012

KNIGHT HALL HENDRY

N2 TOTAL FILLING STATION, PORT ELIZABETH

Geotechnical Investigation

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FIGURES

APPENDICES

KNIGHT HALL HENDRY

N2 TOTAL FILLING STATION, PORT ELIZABETH

Geotechnical Investigation

1. INTRODUCTION

Knight Hall Hendry (KHH) was appointed by Mr. F Joubert of Infrastructure Consulting Engineers (ICE) to perform a geotechnical investigation for the proposed Total filling station close to Port Elizabeth along the N2 highway.

The filling station will be constructed on a backfilled platform to compensate for the fall of the ground surface from the N2 Road towards the site. The structures to be erected on the platform comprise buildings, a refueling forecourt, parking areas as well as the diesel and petrol tanks to be placed below the new constructed ground level.

The purpose of this investigation was to determine the extent and thickness of the underlying soil at the proposed site and to determine and provide the geotechnical characteristics thereof. This report documents these findings and provides recommendations for the design and construction of the proposed platform. The reuse of in situ material on site for construction purposes is also discussed.

2. SITE DESCRIPTION

The site is located along the N2 Road, approximately 25km west of Port Elizabeth on the south side of the road (refer to Figure 1 at the end of the report). The N2 Road forms the northern boundary, while the access road to the site runs on the south. The east and west side of the site are bounded by fences, as shown on the site layout plan in Figure 2.

The topography on site is gently dipping towards the east, with no distinct drainage features visible. A partially demolished house is present on the north-western portion of the site.

The site is covered by vegetation comprising grass and widespread to dense in places, bushes and trees. A small vlei occurs in the northern central portion of the site which appears to be formed, due to previous removal and stripping of soil. No rock outcrop was visible on site.

3. METHOD OF INVESTIGATION

The geotechnical investigation was conducted by the excavation of test pits with an excavator (20 ton). Eight test pits (TP1 to TP8) were excavated on 25 November 2011. All test pits were excavated to refusal depth or to the maximum reach of the machine and logged in situ by an engineering geologist according to standard practise [1][1].

[1] References are indicated thus and are listed at the back of the report.

Soil samples were taken from representative soil horizons and submitted to an accredited laboratory to determine grading, Atterberg Limits and compaction characteristics. Two undisturbed samples were collected for consolidation and permeability testing. The test pit logs are presented in Appendix A at the end of the report while the results of the laboratory tests are presented in Appendix B.

The positions of the test pits were recorded with a hand-held GPS instrument with an accuracy of 3 metres. The coordinate system is in WGS84 datum, South African grid. The coordinate of each test pit is displayed on each test pit log, while positions are shown in Figure 2.

4. REGIONAL GEOLOGY

According to the published geological map, 3324 Port Elizabeth (1:250 000 scale), the site is underlain by quartzitic sandstone of the Peninsula Formation of the Table Mountain Group, Cape Supergroup. Locally, the site is covered by transported sands of the Nanaga Formation. An extract of the published geological map is produced as Figure 3.

According to Weinert's climatic N value [2], the site falls in an area where the N value is less than 5, indicating that chemical weathering is the general weathering mode. The residual soils formed from the weathering of quartzitic sandstone should generally comprise a silty sandy nature but may include certain kaolinite clays in the profile.

No faults or other structural geological features are visible from the published geological map in the vicinity of the site.

5. SOIL PROFILE

A summary of the test pit results is tabulated below.

Test Pit No.	Total Depth (m)	Layer Thickness (m) – (m)			
		Topsoil	Hillwash		Residual Sandstone
			Sandy	Clayey	
TP1	6,4	0 – 0,2	0,2 – 1,0	1,0 – 2,2	2,2 – 6,4
TP2	5,0	0 – 0,2	0,2 – 1,0	1,0 – 2,6	2,6 – 5,0
TP3	5,2	0 – 0,2	0,2 – 0,8	0,8 – 2,4	2,4 – 5,2
TP4	2,7	0 – 0,2	0,2 – 0,9	0,9 – 1,4	1,4 – 2,7
TP5	5,9	0 – 0,2	0,2 – 0,8	0,8 – 2,7	2,7 – 5,9
TP6	5,6	0 – 0,2	0,2 – 1,0	1,0 – 2,5	2,5 – 5,6
TP7	5,9	0 – 0,2	0,2 – 0,8	0,8 – 1,8	1,8 – 5,9
TP8	6,3	0 – 0,2	0,2 – 1,	1,0 – 2,5	2,5 – 6,3

The typical soil profile on site is described as follows:

- The site is covered by topsoil with a relatively high organic content. This layer is 0,2m thick and comprises loose silty sandy soil.
- Hillwash occurs below the topsoil and extends to depths of between 1,4m and 2,6m. The layer varies in thickness from 1,3m to as much as 2,5m and can be subdivided into an upper sandy horizon and a lower clayey horizon. The upper horizon comprises slightly silty sand, while the lower horizon comprises slightly sandy clayey silt. The upper sandy horizon is generally 1m thick and has a loose consistency. The more clayey hillwash below has a firm consistency. Both these horizons have an intact soil structure.
- Residual sandstone soil occurs below the transported soil as slightly clayey silty sand with a medium dense consistency in the upper portions of the layer increasing to dense and eventually very dense with depth (below about 5m). The soil structure is intact.
- Neither bedrock nor groundwater seepage occurred in any of the test pits.

6. LABORATORY TEST RESULS

The laboratory test results indicate that the lower hillwash material comprising more clayey soil has a relatively low Plasticity Index (PI) value from slightly plastic up to 17% with a Liquid Limit of below 33%. The corresponding clay content is between 13% up to 36% for the same material. The soil's potential expansiveness is low to medium. An undisturbed soil sample was collected of the clayey soil to determine the potential settlement that may occur upon loading. A consolidation test was conducted which revealed that the soil is overconsolidated. Settlement of approximately 25mm may be expected for loads of up to 100kPa. This increases to 34mm settlement for loads of 180kPa. Loads exceeding 180kPa will have settlements of more than 50mm.

The residual sandstone soil below the transported soil comprises a high sand content with a low PI value being either non plastic to slightly plastic. In test pit TP5 the residual sandstone contains a higher PI value of 24% and a clay content of 20%. The potential expansiveness for this material is generally low.

The residual sandstone in the centre portion of the site has a modified AASHTO maximum dry density (MDD) of 2084kg/m³ and an optimum moisture content (OMC) of 10,2%. The residual sandstone soil on the western portion of the site has a lower MDD of between 1977kg/m³ and 1988kg/m³ with a OMC varying from 9,4% to 16,2%. The residual sandstone within the centre portion of the site classifies according to COLTO [3] as G7 quality material while the same material to the west classifies as either G9 or poorer than G9 quality material. This is mainly due to the lower compaction strengths that the material portrays in the laboratory, as indicated by the lower CBR values.

An undisturbed sample of the residual sandstone was taken for permeability test analysis. However, the result was not available from the laboratory during the time of reporting and will be submitted as an addendum report letter afterwards.

7. GEOTECHNICAL EVALUATION

The filling station requires an engineered fill platform to acquire the necessary elevation relative to the N2 Road. The proposed structures comprise a single storey building, the forecourt, parking areas and the fuel tanks which will be located underground.

The topsoil comprises a high organic content and may be stored and utilised for landscaping purposes only. The upper layer of hillwash comprising a loose consistency is not suitable for any foundations due to its high compressibility and erodibility. The firm clayey hillwash material, which occurs from a depth of generally 1m, is expected to have a safe bearing capacity of at least 80kPa, but settlements of less than 25mm can be expected. The residual sandstone below the transported soil should have a safe bearing capacity of at least 100kPa. It is therefore recommended that the base of the engineered fill be placed on the firm, slightly clayey hillwash material occurring at a general depth of 1m. The floor of the excavation must be ripped and in situ densified to at least 95% of the MDD at OMC.

8. CONCLUSIONS AND RECOMMENDATIONS

- The site is underlain by quartzitic sandstone of the Peninsula Formation of the Table Mountain Group, Cape Supergroup, covered locally by transported soils of the Nanaga Formation.
- The transported soil layer covering the site can be divided into two distinct layers. The upper portion of the layer comprises sandy soil with a loose consistency which extends generally to a depth of 1m. The lower portion of the transported soil comprises clayey soil with a firm consistency.
- Residual sandstone occurs below the transported soil to a depth of generally more than 6m. The silty sandy soil has a medium dense consistency which grades to dense and very dense consistency with depth.
- The laboratory tests revealed that the lower clayey transported soil may have settlement of up to 25mm upon loading of 100kPa, which increases rapidly with increasing loads.
- The upper loose transported soil is not suitable for foundations due to its very low bearing capacity.
- It is recommended that the base for the platform should extend to the firm transported soil at generally 1m depth.
- The residual sandstone in the centre portion of the site from below 2,4m depth, classifies as G7 quality material and represents the best quality material on site. It is, however, not considered practical to reuse, due to its central position and depth.

- It is recommended that the engineered fill be constructed with imported G5 quality material and that all structures be founded at shallow depth in the fill, utilizing allowable bearing loads of maximum 150kPa.

- Excavations and backfilling must be properly monitored during construction.

- The engineered fill must preferably be constructed with material of G5 quality. Such quality material is not available on site, mainly due to the relatively fine-grained nature of the residual sandstone soil. G7 quality material occurs in the central portion of the site (TP3 vicinity) from a depth of 2,4m only. It is therefore considered not practical to utilize any of the relatively poor quality materials on site to construct the engineered fill, since the structures and layer works of the access road, parking and forecourt areas will be situated on the fill.

- Imported G5 material must be placed in layers not exceeding 200mm thickness and compacted to 95% of MDD at OMC to construct the fill. Structures can be placed at shallow depth in the fill on strip or pad footings, with allowable bearing loads of up to 150kPa, provided the compaction process has been properly monitored during construction to ensure that suitable material has been used and the specified compactions achieved.

9. REFERENCES

[1] The South African Institute of Engineering Geologists (1996). *Guidelines for Soil and Rock Logging*.

[2] COLTO. (1998). Standard Specification for Road and Bridge Works for State Road Authorities.

[3] Brink, A.B.A. (1983). *Engineering Geology of Southern Africa, Volume 3*. Building Publications, Pretoria.

KNIGHT HALL HENDRY

TABLE 1 : SUMMARY OF LABORATORY TEST RESULTS

SAMPLE		DESCRIPTION	GRADING (%) PASSING SIEVE SIZE (mm)					ATTERBERG LIMITS (%)			GM	PE	USC	Mod. AASHTO COMPACTION		CBR AT % COMPACTION			COLTO CLASS
No.	DEPTH (m)		4,75	2,0	0,425	0,075	0,002	LL	PI	LS				MDD (kg/m³)	OMC (%)	98	95	93	
TP3/1	2,4 – 5,0	Residual sandstone	100	100	99	18	4	-	NP	0	0.83	Low	SP & SM	2084	10.2	30	25	17	G7
TP4/1	1,4 – 2,7	Residual sandstone	89	87	85	22	9	-	SP	0	1.06	Low	SP & SM	-	-	-	-	-	-
TP5/1	1,4 – 1,7	Clayey hillwash	100	100	99	48	36	33	17	5	0.52	Medium	SC	-	-	-	-	-	-
TP5/2	2,9 – 3,2	Residual sandstone	100	100	99	31	20	24	12	3	0.69	Low to Medium	SC	-	-	-	-	-	-
TP7/1	1,8 – 5,9	Residual sandstone	100	100	99	18	5	-	NP	0	0.83	Low	SP & SM	1988	16.2	2	2	1	<G9
TP8/1	1,0 – 2,5	Clayey hillwash	100	100	99	29	13	-	SP	0.5	0.72	Low	SP & SM	-	-	-	-	-	-
TP8/2	2,5 – 6,3	Residual sandstone	100	100	99	11	2	-	NP	0	0.9	Low	SP & SM	1977	9.4	30	11	7	G9

LL : Liquid Limit
PI : Plasticity Index
LS : Linear Shrinkage
GM : Grading Modulus
PE : Potential Expansiveness

USC : Unified Soil Classification
MDD : Maximum Dry Density
OMC : Optimum Moisture Content
CBR : California Bearing Ratio
NP : Not plastic

SC : Clayey sand
SM : Silty sand
GP : Poorly graded gravel
GC : Clayey gravel
SP : Slightly plastic

KNIGHT HALL HENDRY

APPENDIX A

SOIL PROFILE LOGS

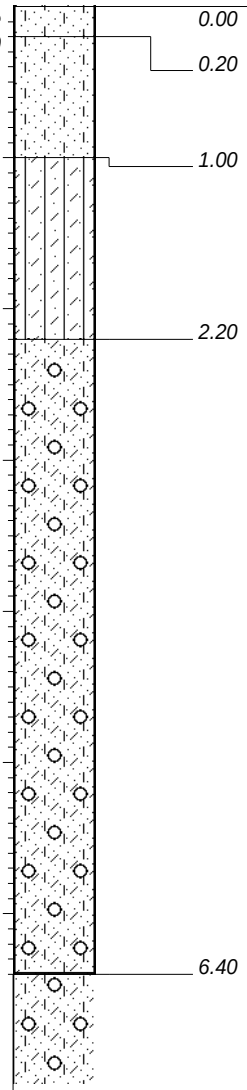
KNIGHT HALL HENDRY
GEOTECHNICAL ENGINEERS
TEL: +27 12 348 9091 FAX: +27 12 348 9065

N2 TOTAL FILLING STATION, PORT ELIZABETH

GEOTECHNICAL INVESTIGATION

HOLE No: TP1
Sheet 1 of 1

JOB: 3110024801



Slightly moist, dark brown, loose, intact, silty SAND. **TOPSOIL**.

Slightly moist, brown speckled grey, loose, intact, slightly silty SAND. **HILLWASH**.

Moist, orange brown stained dark brown speckled grey, firm, intact, slightly sandy clayey SILT. **HILLWASH**.

Moist, orange brown stained light grey and dark brown, medium dense becoming gradually dense, intact, clayey silty SAND, with scattered highly weathered sandstone gravel. **RESIDUAL SANDSTONE**.

EOH: Excavator stopped at end of reach.

NOTES

1) No water encountered.

CONTRACTOR :
MACHINE : Excavator 20T
DRILLED BY :
PROFILED BY : JvT
TYPE SET BY : EM
SETUP FILE : KHHTPC.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 25 November 2011
DATE : 15/02/12 20:35
TEXT : ..\PROFILES\KUG-JVT.PRO

COORDINATE SYSTEM :
X-COORD : 3 754 639
Y-COORD : -27 173

HOLE No: TP1

D079 E Mouton *dotPLOT 6007 PBpH*

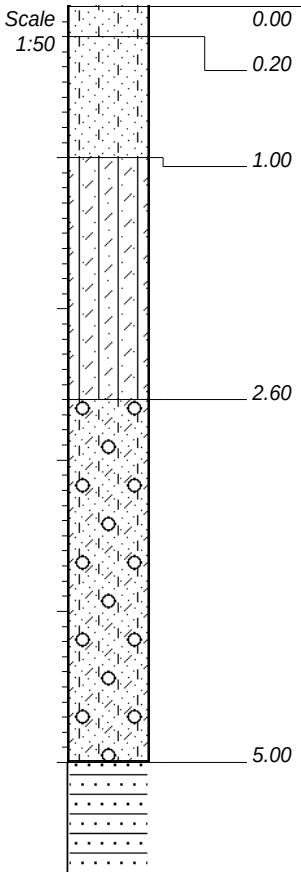
KNIGHT HALL HENDRY
GEOTECHNICAL ENGINEERS
TEL: +27 12 348 9091 FAX: +27 12 348 9065

N2 TOTAL FILLING STATION, PORT ELIZABETH

GEOTECHNICAL INVESTIGATION

HOLE No: TP2
Sheet 1 of 1

JOB: 3110024801



0.00 – 0.20	Slightly moist, dark brown, loose, intact, silty SAND. **TOPSOIL**.
0.20 – 1.00	Slightly moist, brown speckled grey, loose, intact, slightly silty SAND. **HILLWASH**.
1.00 – 2.60	Moist, orange brown speckled grey, firm, intact, sandy clayey SILT. **HILLWASH**. Note: Poorly developed pebble marker present at bottom of layer.
2.60 – 5.00	Moist, orange brown stained and speckled light grey, dense to very dense with depth, clayey silty SAND, with scattered sandstone gravel, increasing in content with depth. **RESIDUAL SANDSTONE**.
5.00	EOH: Excavator stopped in very dense RESIDUAL SANDSTONE.

NOTES

1) No water encountered.

CONTRACTOR :
MACHINE : Excavator 20T
DRILLED BY :
PROFILED BY : JvT
TYPE SET BY : EM
SETUP FILE : KHHTPC.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 25 November 2011
DATE : 15/02/12 20:35
TEXT : ..\PROFILES\KUG-JVT.PRO

COORDINATE SYSTEM :
X-COORD : 3 754 602
Y-COORD : -27 270

HOLE No: TP2

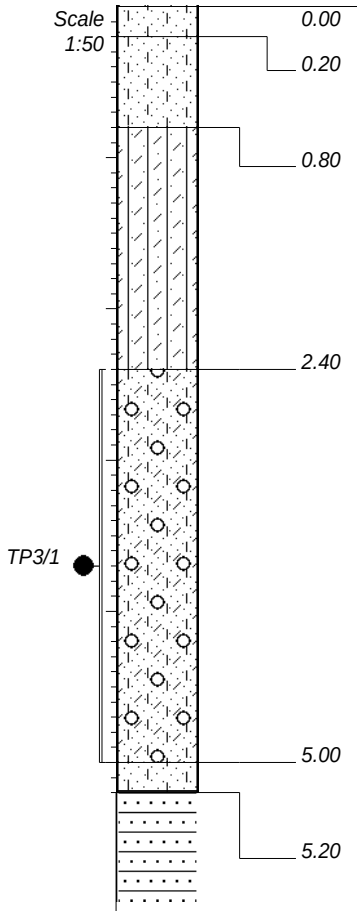
KNIGHT HALL HENDRY
GEOTECHNICAL ENGINEERS
TEL: +27 12 348 9091 FAX: +27 12 348 9065

N2 TOTAL FILLING STATION, PORT ELIZABETH

GEOTECHNICAL INVESTIGATION

HOLE No: TP3
Sheet 1 of 1

JOB: 3110024801



Slightly moist, dark brown, loose, intact, silty SAND. **TOPSOIL**.

Slightly moist, brown speckled grey, loose, intact, slightly silty SAND. **HILLWASH**.

Moist, orange brown speckled grey, firm, intact, sandy clayey SILT. **HILLWASH**.

Note:
Poorly developed pebble marker present at bottom of layer.

Moist, orange brown stained light grey and dark brown speckled grey, dense becoming very dense close to bottom of layer, intact, slightly clayey silty SAND, with scattered gravel. **RESIDUAL SANDSTONE**.

Moist, dark purple to brown, very dense, intact, silty SAND. **RESIDUAL SANDSTONE**.

EOH: Excavator stopped in very dense RESIDUAL SANDSTONE.

NOTES

1) No water encountered.

2) Bulk sample TP3/1 taken between 2,4m--5m.

CONTRACTOR :
MACHINE : Excavator 20T
DRILLED BY :
PROFILED BY : JvT

TYPE SET BY : EM
SETUP FILE : KHHTPC.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 25 November 2011

DATE : 15/02/12 20:35
TEXT : ..\PROFILES\KUG-JVT.PRO

COORDINATE SYSTEM :
X-COORD : 3 754 552
Y-COORD : -27 306

HOLE No: TP3

D079 E Mouton

dotPLOT 6007 PBpH

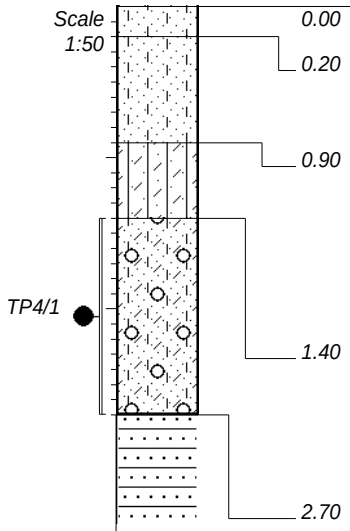
KNIGHT HALL HENDRY
GEOTECHNICAL ENGINEERS
TEL: +27 12 348 9091 FAX: +27 12 348 9065

N2 TOTAL FILLING STATION, PORT ELIZABETH

GEOTECHNICAL INVESTIGATION

HOLE No: TP4
Sheet 1 of 1

JOB: 3110024801



0.00 – 0.20	Slightly moist, dark brown, loose, intact, silty SAND. **TOPSOIL**.
0.20 – 0.90	Slightly moist, brown speckled grey, loose, intact, slightly silty SAND. **HILLWASH**.
0.90 – 1.40	Moist, orange brown speckled grey, firm, intact, sandy clayey SILT. **HILLWASH**. Note: Poorly developed pebble marker present at bottom of layer.
1.40 – 2.70	Moist, orange brown stained grey and brown speckled light grey, dense becoming gradually very dense, intact, slightly clayey silty SAND, with scattered gravel, increasing in content with depth. **RESIDUAL SANDSTONE**.
2.70	EOH: Excavator stopped in very dense RESIDUAL SANDSTONE, tending to very soft rock.

NOTES

1) No water encountered.

2) Small bag sample TP4/1 taken between 1,4m--2,7m.

CONTRACTOR :
MACHINE : Excavator 20T
DRILLED BY :
PROFILED BY : JvT

TYPE SET BY : EM
SETUP FILE : KHHTPC.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 25 November 2011

DATE : 15/02/12 20:35
TEXT : ..\PROFILES\KUG-JVT.PRO

COORDINATE SYSTEM :
X-COORD : 3 754 585
Y-COORD : -27 335

HOLE No: TP4

KNIGHT HALL HENDRY
GEOTECHNICAL ENGINEERS
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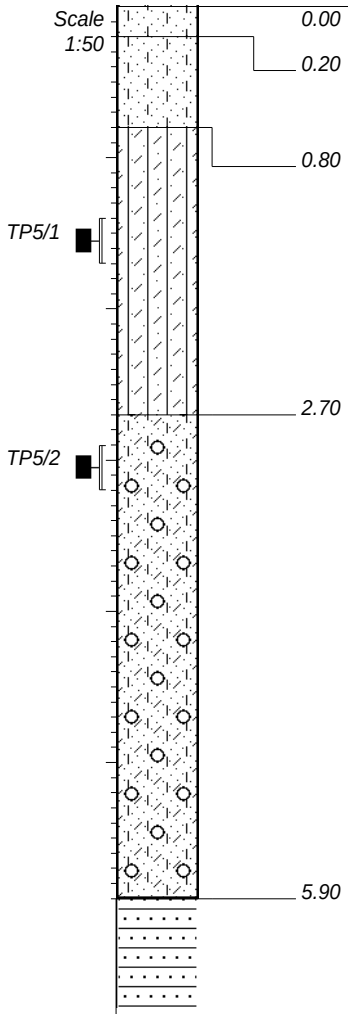
N2 TOTAL FILLING STATION, PORT ELIZABETH

GEOTECHNICAL INVESTIGATION

HOLE No: TP5
Sheet 1 of 1

JOB: 3110024801



0.00 – 0.20: Slightly moist, dark brown, loose, intact, silty SAND. **TOPSOIL**.

0.20 – 0.80: Slightly moist, brown speckled grey, loose, intact, slightly silty SAND. **HILLWASH**.

0.80 – 2.70: Moist, orange brown speckled grey, firm, intact, sandy clayey SILT. **HILLWASH**.

Note:
Poorly developed pebble marker present at bottom of layer.

2.70 – 5.90: Moist, orange brown stained grey and brown speckled light grey, dense becoming gradually very dense, intact, slightly clayey silty SAND, with scattered gravel, increasing in content with depth. **RESIDUAL SANDSTONE**.

5.90: EOH: Excavator stopped in very dense RESIDUAL SANDSTONE.

NOTES

1) No water encountered.

2) Undisturbed sample TP5/1 taken between 1,4m--1,7m.

3) Undisturbed sample TP5/2 taken between 2,9m--3,2m.

CONTRACTOR :
MACHINE : Excavator 20T
DRILLED BY :
PROFILED BY : JvT
TYPE SET BY : EM
SETUP FILE : KHHTPC.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 25 November 2011
DATE : 15/02/12 20:35
TEXT : ..\PROFILES\KUG-JVT.PRO

COORDINATE SYSTEM :
X-COORD : 3 754 545
Y-COORD : -27 167

HOLE No: TP5

D079 E Mouton *dotPLOT 6007 PBpH*

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GEOTECHNICAL ENGINEERS
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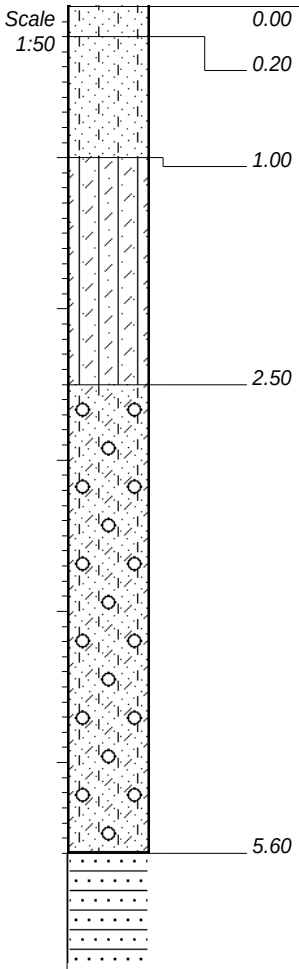
N2 TOTAL FILLING STATION, PORT ELIZABETH

GEOTECHNICAL INVESTIGATION

HOLE No: TP6
Sheet 1 of 1

JOB: 3110024801



Slightly moist, dark brown, loose, intact, silty SAND. **TOPSOIL**.

Slightly moist, brown speckled grey, loose, intact, slightly silty SAND. **HILLWASH**.

Moist, orange brown speckled grey, firm, intact, sandy clayey SILT. **HILLWASH**.

Note:
Poorly developed pebble marker present at bottom of layer.

Moist, orange brown stained grey and brown speckled light grey, medium dense becoming dense with depth, intact, slightly clayey silty SAND, with scattered gravel, increasing in content with depth. **RESIDUAL SANDSTONE**.

EOH: Excavator stopped on very dense RESIDUAL SANDSTONE.

NOTES

1) No water encountered.

CONTRACTOR :
MACHINE : Excavator 20T
DRILLED BY :
PROFILED BY : JvT

TYPE SET BY : EM
SETUP FILE : KHHTPC.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 25 November 2011

DATE : 15/02/12 20:35
TEXT : ..\PROFILES\KUG-JVT.PRO

COORDINATE SYSTEM :
X-COORD : 3 754 587
Y-COORD : -27 183

HOLE No: TP6

KNIGHT HALL HENDRY
GEOTECHNICAL ENGINEERS
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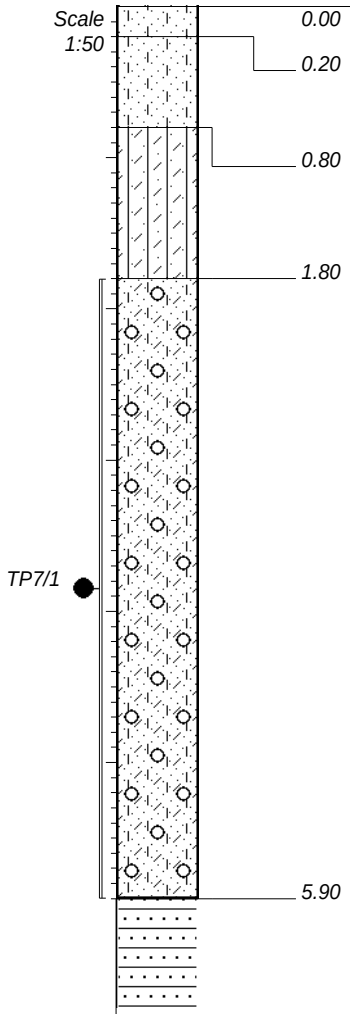
N2 TOTAL FILLING STATION, PORT ELIZABETH

GEOTECHNICAL INVESTIGATION

HOLE No: TP7
Sheet 1 of 1

JOB: 3110024801



0.00 – 0.20	Slightly moist, dark brown, loose, intact, silty SAND. **TOPSOIL**.
0.20 – 0.80	Slightly moist, brown speckled grey, loose, intact, slightly silty SAND. **HILLWASH**.
0.80 – 1.80	Moist, orange brown stained dark brown, firm to slightly stiff, intact, sandy clayey SILT. **HILLWASH**.
1.80 – 5.90	Moist, orange brown stained grey and brown speckled light grey, medium dense becoming dense with depth, intact, slightly clayey silty SAND, with scattered gravel, increasing in content with depth. **RESIDUAL SANDSTONE**.
5.90	EOH: Excavator stopped at end of reach in RESIDUAL SANDSTONE.

NOTES

1) No water encountered.

2) Bulk sample TP7/1 taken between 1,8m--5,9m.

CONTRACTOR :
MACHINE : Excavator 20T
DRILLED BY :
PROFILED BY : JvT
TYPE SET BY : EM
SETUP FILE : KHHTPC.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 25 November 2011
DATE : 15/02/12 20:35
TEXT : ..\PROFILES\KUG-JVT.PRO

COORDINATE SYSTEM :
X-COORD : 3 754 614
Y-COORD : -27 027

HOLE No: TP7

D079 E Mouton *dotPLOT 6007 PBpH*

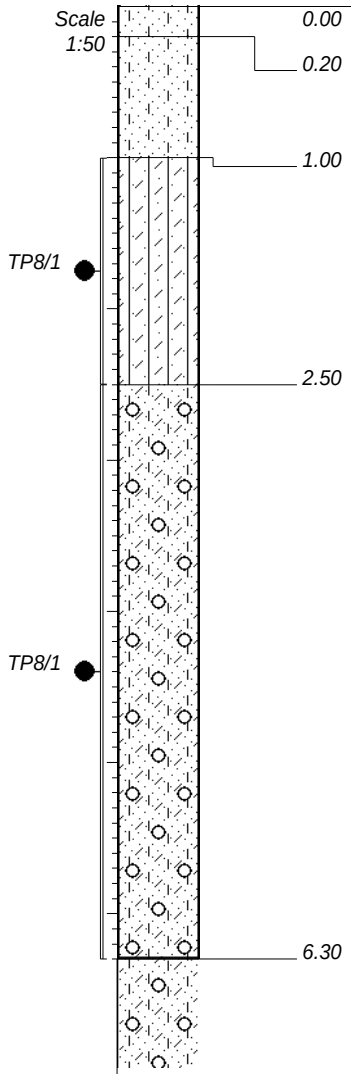
KNIGHT HALL HENDRY
GEOTECHNICAL ENGINEERS
TEL: +27 12 348 9091 FAX: +27 12 348 9065

N2 TOTAL FILLING STATION, PORT ELIZABETH

GEOTECHNICAL INVESTIGATION

HOLE No: TP8
Sheet 1 of 1

JOB: 3110024801



0.00 – 0.20	Slightly moist, dark brown, loose, intact, silty SAND. **TOPSOIL**.
0.20 – 1.00	Slightly moist, brown speckled grey, loose, intact, slightly silty SAND. **HILLWASH**.
1.00 – 2.50	Moist, orange brown speckled grey, firm, intact, sandy clayey SILT. **HILLWASH**. Note: Poorly developed pebble marker present at bottom of layer.
2.50 – 6.30	Moist, orange brown stained grey and brown speckled light grey, dense to very dense with depth, intact, slightly clayey silty SAND, with scattered gravel, increasing in content with depth. **RESIDUAL SANDSTONE**.
6.30	EOH: Excavator stopped at end of reach.

NOTES

1) No water encountered.

2) Small bag sample TP8/1 taken between 1,0m--2,5m.

3) Bulk sample TP8/1 taken between 2,5m--6,3m.

CONTRACTOR :
MACHINE : Excavator 20T
DRILLED BY :
PROFILED BY : JvT

TYPE SET BY : EM
SETUP FILE : KHHTPC.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 25 November 2011

DATE : 15/02/12 20:35
TEXT : ..\PROFILES\KUG-JVT.PRO

COORDINATE SYSTEM :
X-COORD : 3 754 654
Y-COORD : -26 936

HOLE No: TP8

D079 E Mouton

dotPLOT 6007 PBpH

KNIGHT HALL HENDRY

APPENDIX B

LABORATORY TEST RESULTS

Labco
63b Pickering Street, Newton Park, Port Elizabeth, 6045
PO Box 10114, Linton Grange, Port Elizabeth, 6015
E-Mail: info@labco.co.za Web: www.labco.co.za
Tel: 041 364-1290 Fax: 041 364-1291

sanas Testing Laboratory

CIVIL ENGINEERING MATERIALS TESTING SERVICES (PTY) Ltd T0227

CLIENT : Knight Piesold (Pty) Ltd
P. O. Box 72292
Lynnwood Ridge
0040

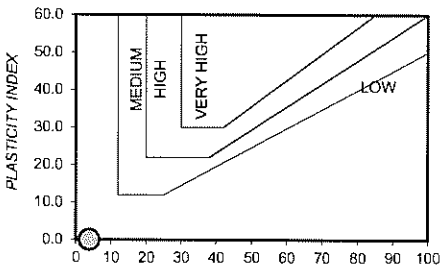
ATT: Mr. J. van Tonder

PROJECT : Port Elizabeth N2 Total Filling Station
JOB CARD NUMBER: C13890 / 3110024801
SUBMISSION DATE: 06.12.2011
DATE TESTED: 13.12.2011
REPORT DATE: 14.12.2011 SD
SECTION: TP3/1 @ 2.4-5.0m

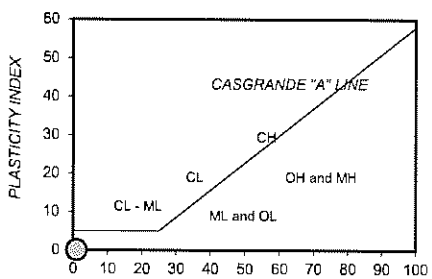
FOUNDATION INDICATOR (TMH 1 :1979 methods A1, A2, A3, A4, A5 & A6*)

S/No. & Description		X133497 Yellowish Siltstone
Sieve analysis Cumulative percentage passing (mm)	75.0	100
	63.0	100
	53.0	100
	37.5	100
	26.5	100
	19.0	100
	13.2	100
	4.75	100
	2.000	100
	0.425	99
	0.075	18
	0.060	13
	0.006	9
	0.0018	4
Soil Mortar Analysis % < 2.00mm	Coarse Sand	1.0
	Coarse Fine Sand	42.0
	Medium Fine Sand	35.0
	Fine Fine Sand	3.0
	Passing 0.075	18.0
Oversize Index		0.0
Shrinkage Product		0.0
Grading Coefficient		0.0
Grading modulus		0.83
Atter-berg Limits	Liquid Limit	-
	Plasticity Index	NP
	Linear Shrinkage	0.0

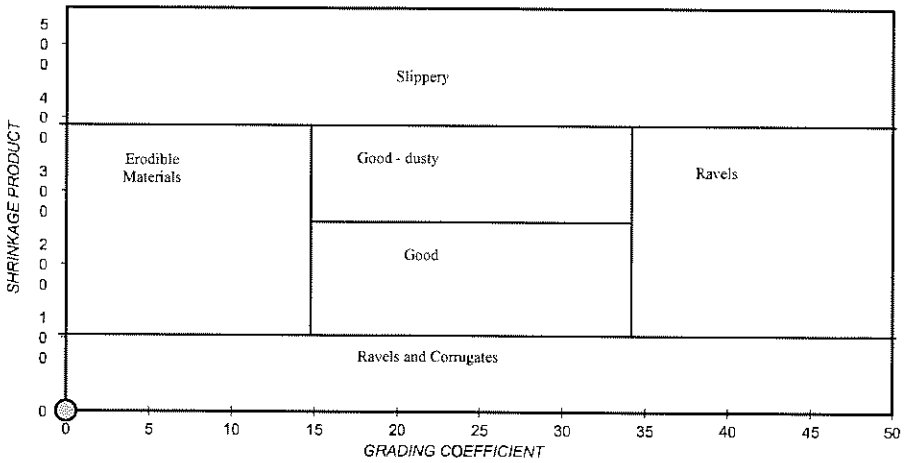
POTENTIAL EXPANSION



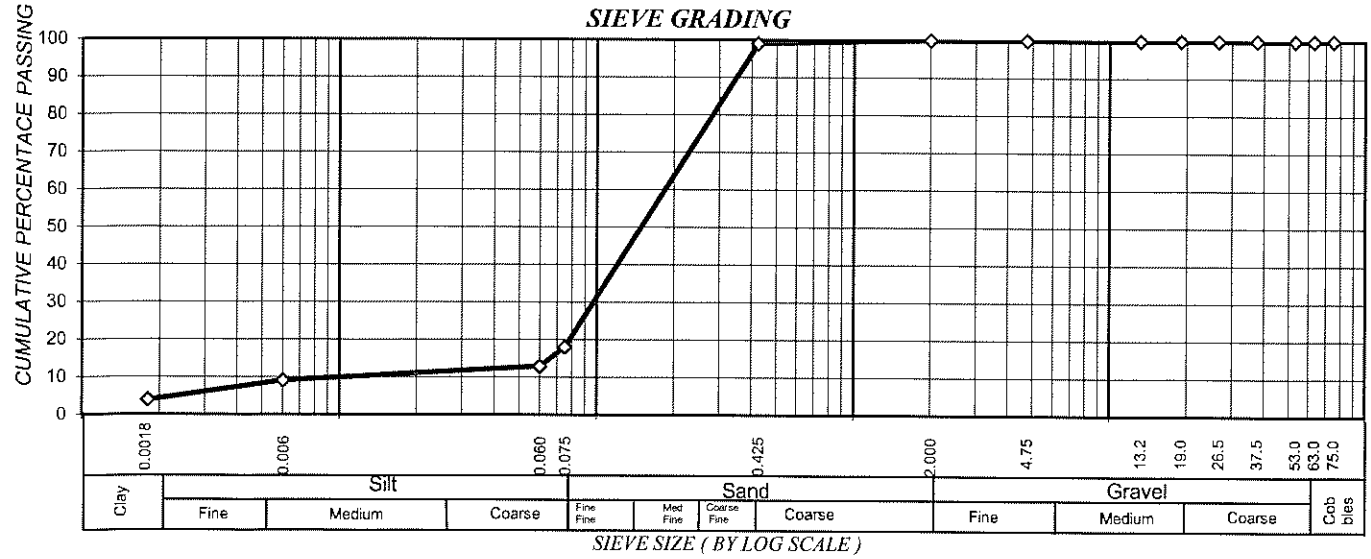
PLASTICITY CHART



PERFORMANCE AS WEARING COURSE



SIEVE GRADING



Tests marked with * are "Not SANAS Accredited" and are not included in the SANAS schedule of Accreditation for this laboratory.

Name: Wouter Steyn
Position: Laboratory Manager

Labco
63b Pickering Street, Newton Park, Port Elizabeth, 6045
PO Box 10114, Linton Grange, Port Elizabeth, 6015
E-Mail: info@labco.co.za Web: www.labco.co.za
Tel: 041 364-1290 Fax: 041 364-1291

sanas Testing Laboratory

CIVIL ENGINEERING MATERIALS TESTING SERVICES (PTY) Ltd T0227

CLIENT : Knight Piesold (Pty) Ltd
P. O. Box 72292
Lynnwood Ridge
0040

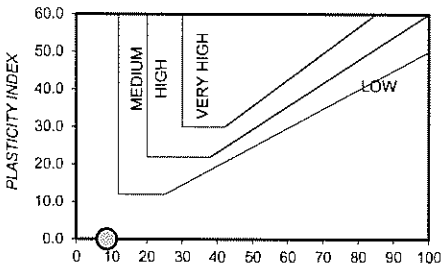
ATT: Mr. J. van Tonder

PROJECT : Port Elizabeth N2 Total Filling Station
JOB CARD NUMBER: C13890 / 3110024801
SUBMISSION DATE: 06.12.2011
DATE TESTED: 13.12.2011
REPORT DATE: 14.12.2011 SD
SECTION: TP4/1 @ 1.4-2.7m

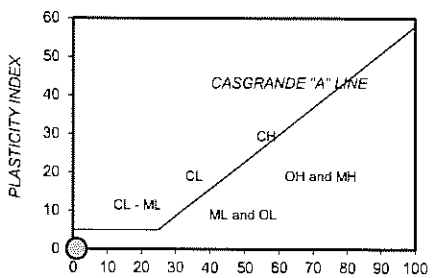
FOUNDATION INDICATOR (TMH 1 :1979 methods A1, A2, A3, A4, A5 & A6*)

S/No. & Description		X133498 Siltstone
Sieve analysis Cumulative percentage passing (mm)	75.0	100
	63.0	100
	53.0	100
	37.5	100
	26.5	100
	19.0	100
	13.2	96
	4.75	89
	2.000	87
	0.425	85
	0.075	22
	0.060	19
	0.006	12
	0.0018	9
Soil Mortar Analysis % < 2.00mm	Coarse Sand	2.0
	Coarse Fine Sand	17.0
	Medium Fine Sand	49.0
	Fine Fine Sand	6.0
	Passing 0.075	25.0
Oversize Index		0.0
Shrinkage Product		0.0
Grading Coefficient		11.6
Grading modulus		1.06
Atter-berg Limits	Liquid Limit	-
	Plasticity Index	SP
	Linear Shrinkage	0.0

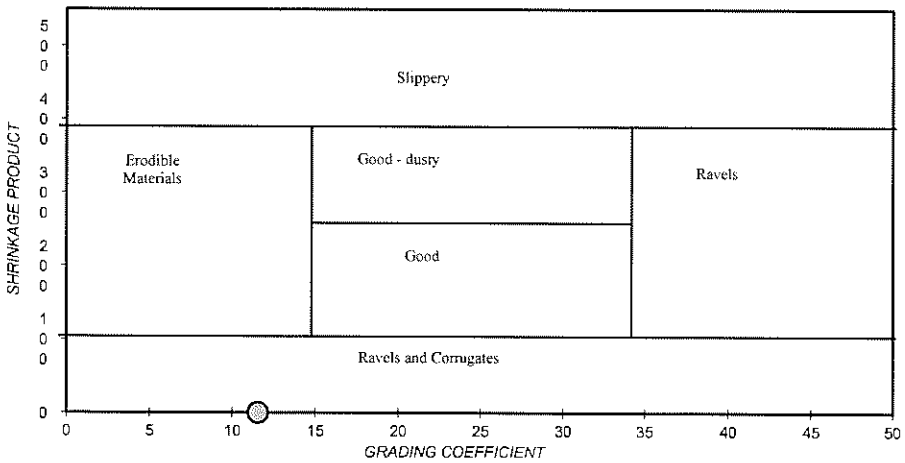
POTENTIAL EXPANSION



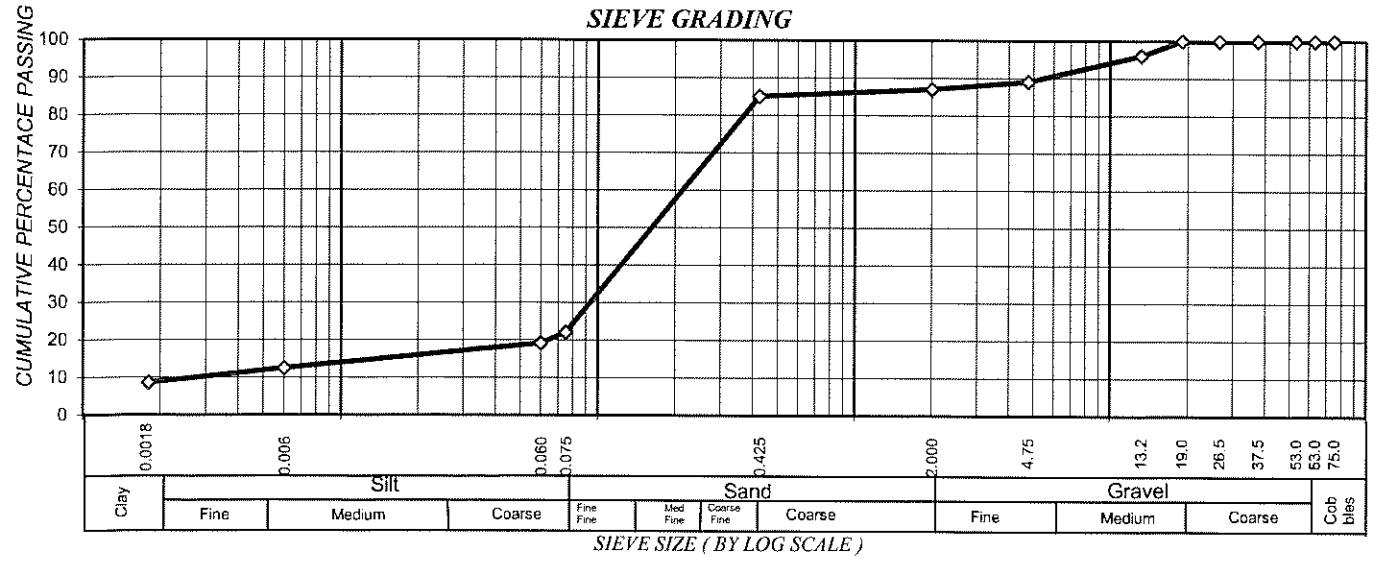
PLASTICITY CHART



PERFORMANCE AS WEARING COURSE



SIEVE GRADING



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Position: Laboratory Manager

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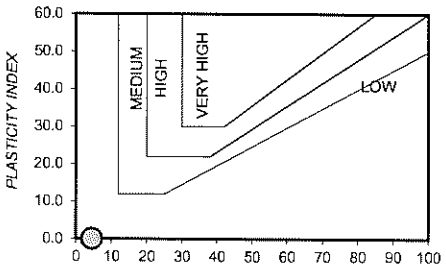
ATT: Mr. J. van Tonder

PROJECT : Port Elizabeth N2 Total Filling Station
JOB CARD NUMBER: C13890 / 3110024801
SUBMISSION DATE: 06.12.2011
DATE TESTED: 13.12.2011
REPORT DATE: 14.12.2011 SD
SECTION: TP7/1 @ 1.8-5.9m

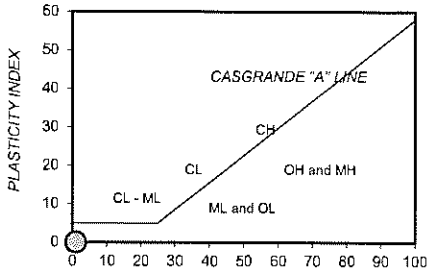
FOUNDATION INDICATOR (TMH 1 :1979 methods A1, A2, A3, A4, A5 & A6*)

S/No. & Description		X133501 Yellowish Siltstone
Sieve analysis Cumulative percentage passing (mm)	75.0	100
	63.0	100
	53.0	100
	37.5	100
	26.5	100
	19.0	100
	13.2	100
	4.75	100
	2.000	100
	0.425	99
	0.075	18
	0.060	15
	0.006	9
	0.0018	5
Soil Mortar Analysis % < 2.00mm	Coarse Sand	1.0
	Coarse Fine Sand	24.0
	Medium Fine Sand	49.0
	Fine Fine Sand	8.0
	Passing 0.075	18.0
Oversize Index		0.0
Shrinkage Product		0.0
Grading Coefficient		0.0
Grading modulus		0.83
Atter-berg Limits	Liquid Limit	-
	Plasticity Index	NP
	Linear Shrinkage	0.0

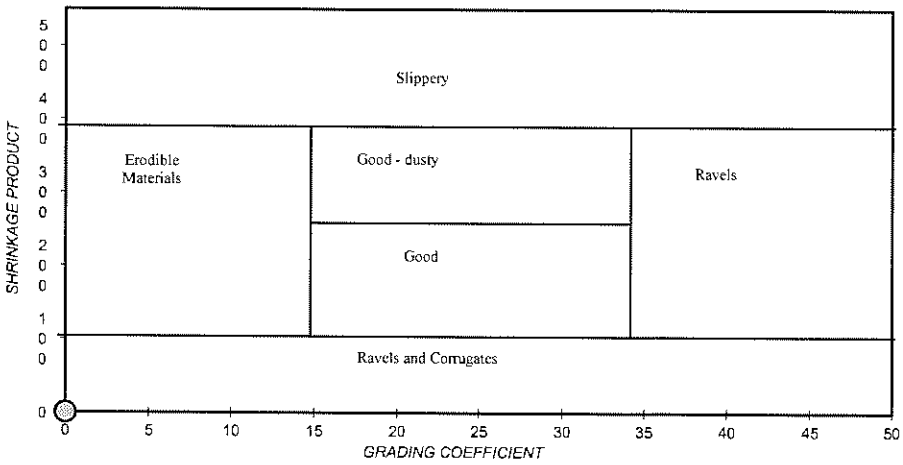
POTENTIAL EXPANSION



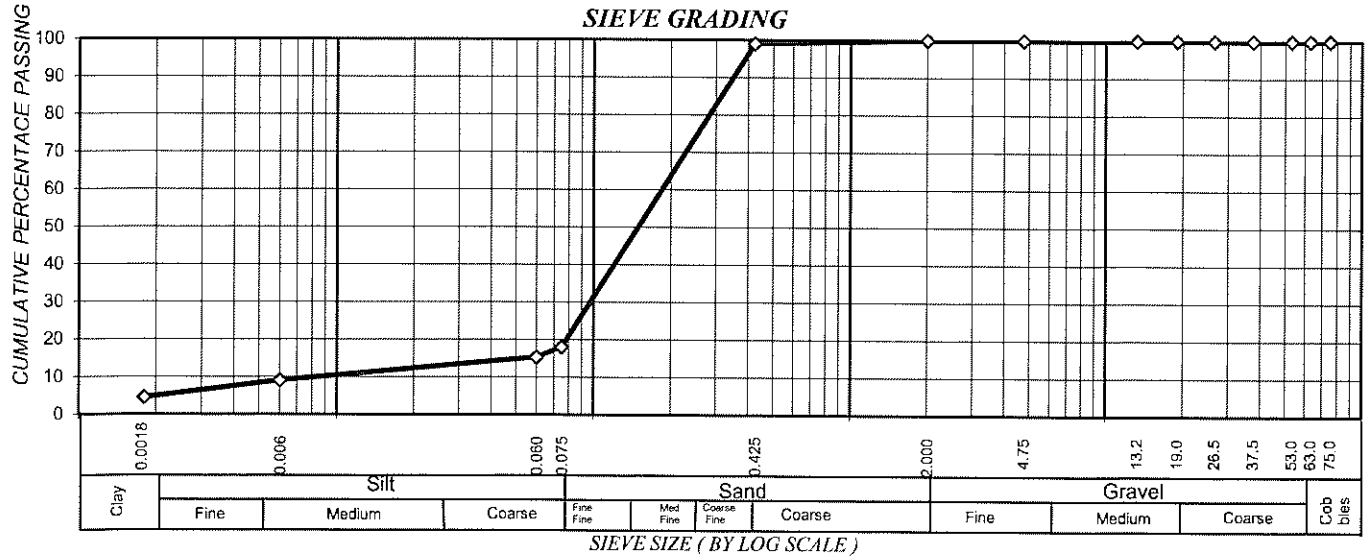
PLASTICITY CHART



PERFORMANCE AS WEARING COURSE



SIEVE GRADING



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Name: Wouter Steyn
Position: Laboratory Manager

Labco
63b Pickering Street, Newton Park, Port Elizabeth, 6045
PO Box 10114, Linton Grange, Port Elizabeth, 6015
E-Mail: info@labco.co.za Web: www.labco.co.za
Tel: 041 364-1290 Fax: 041 364-1291

sanas Testing Laboratory

CIVIL ENGINEERING MATERIALS TESTING SERVICES (PTY) Ltd T0227

CLIENT : Knight Piesold (Pty) Ltd
P. O. Box 72292
Lynnwood Ridge
0040

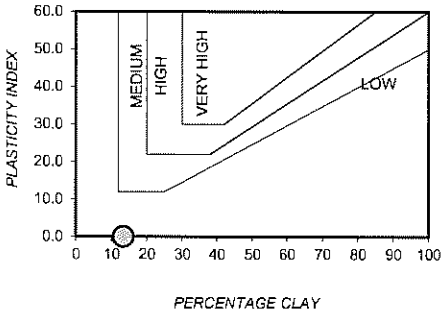
ATT: Mr. J. van Tonder

PROJECT : Port Elizabeth N2 Total Filling Station
JOB CARD NUMBER: C13890 / 3110024801
SUBMISSION DATE: 06.12.2011
DATE TESTED: 13.12.2011
REPORT DATE: 14.12.2011 SD
SECTION: TP8/1 @ 1.0-2.5m

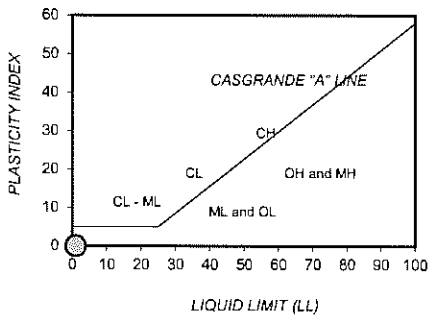
FOUNDATION INDICATOR (TMH 1 :1979 methods A1, A2, A3, A4, A5 & A6*)

S/No. & Description		X133502 Clayey Mudstone
Sieve analysis Cumulative percentage passing (mm)	75.0	100
	63.0	100
	53.0	100
	37.5	100
	26.5	100
	19.0	100
	13.2	100
	4.75	100
	2.000	100
	0.425	99
	0.075	29
	0.060	25
	0.006	18
	0.0018	13
Soil Mortar Analysis % < 2.00mm	Coarse Sand	1.0
	Coarse Fine Sand	38.0
	Medium Fine Sand	26.0
	Fine Fine Sand	6.0
	Passing 0.075	29.0
Oversize Index		0.0
Shrinkage Product		49.5
Grading Coefficient		0.0
Grading modulus		0.72
Atter-berg Limits	Liquid Limit	-
	Plasticity Index	SP
	Linear Shrinkage	0.5

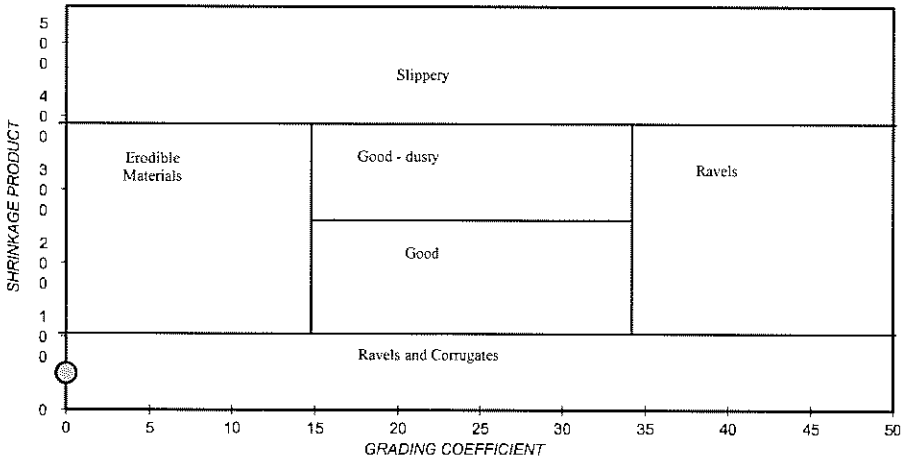
POTENTIAL EXPANSION



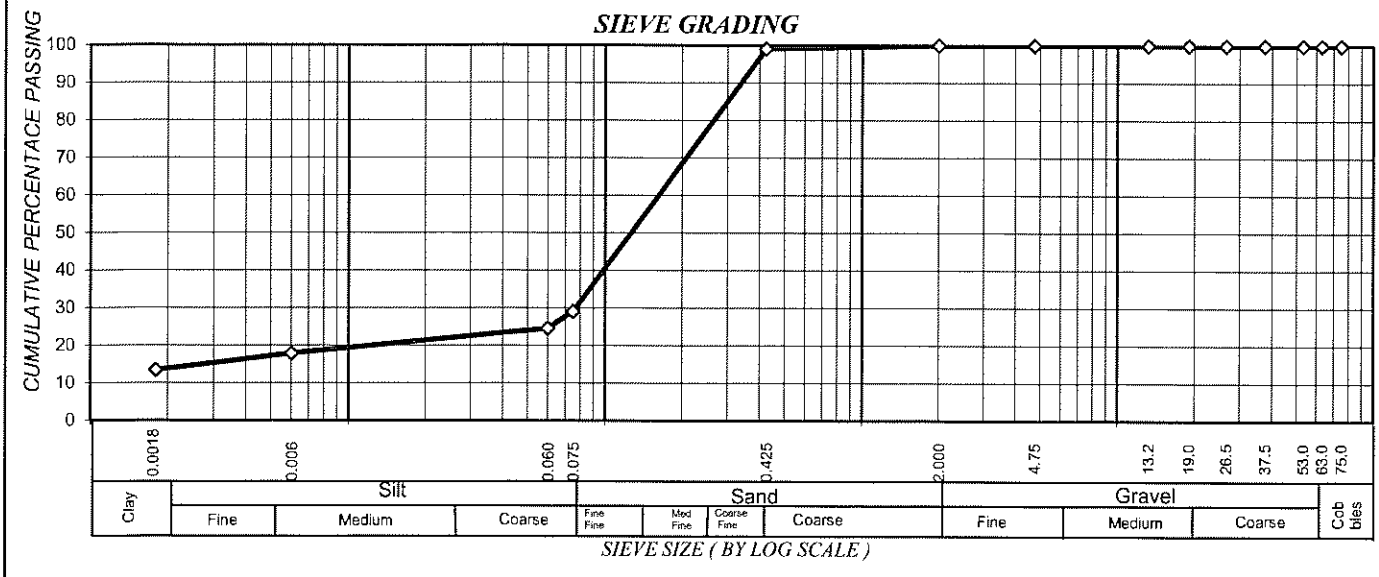
PLASTICITY CHART



PERFORMANCE AS WEARING COURSE



SIEVE GRADING



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Name: Wouter Sleyn
Position: Laboratory Manager

Labco
63b Pickering Street, Newton Park, Port Elizabeth, 6045
PO Box 10114, Linton Grange, Port Elizabeth, 6015
E-Mail: info@labco.co.za Web: www.labco.co.za
Tel: 041 364-1290 Fax: 041 364-1291

sanas Testing Laboratory

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CLIENT : Knight Piesold (Pty) Ltd
P. O. Box 72292
Lynnwood Ridge
0040

ATT: Mr. J. van Tonder

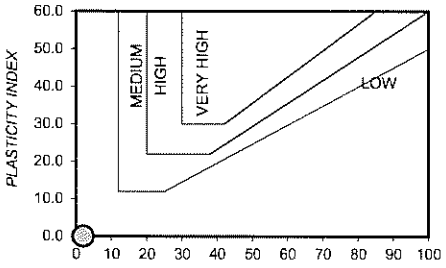
PROJECT : Port Elizabeth N2 Total Filling Station
JOB CARD NUMBER: C13890 / 3110024801
SUBMISSION DATE: 06.12.2011
DATE TESTED: 13.12.2011
REPORT DATE: 14.12.2011 SD
SECTION: TP8/2 @ 2.5-6.3m

FOUNDATION INDICATOR (TMH 1 :1979 methods A1, A2, A3, A4, A5 & A6*)

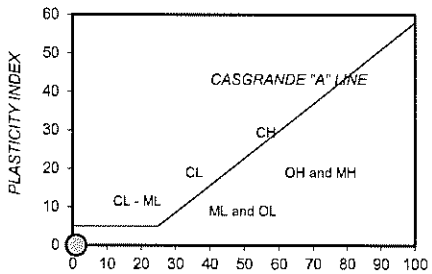
S/No. & Description		X133503
Sieve analysis Cumulative percentage passing (mm)	75.0	100
	63.0	100
	53.0	100
	37.5	100
	26.5	100
	19.0	100
	13.2	100
	4.75	100
	2.000	100
	0.425	99
	0.075	11
	0.060	8
	0.006	5
	0.0018	2
Soil Mortar Analysis % < 2.00mm	Coarse Sand	1.0
	Coarse Fine Sand	37.0
	Medium Fine Sand	47.0
	Fine Fine Sand	5.0
	Passing 0.075	10.0
Oversize Index		0.0
Shrinkage Product		0.0
Grading Coefficient		0.0
Grading modulus		0.90
Atter-berg Limits	Liquid Limit	-
	Plasticity Index	NP
	Linear Shrinkage	0.0

Reddish brown silty Sand

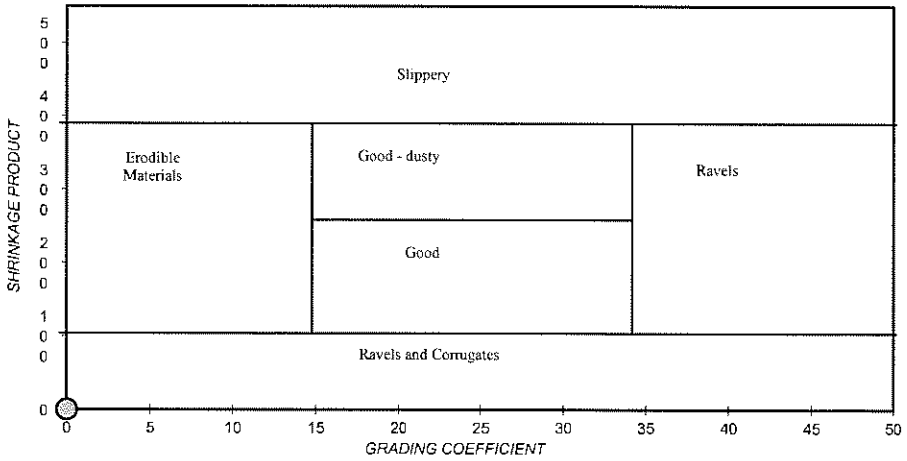
POTENTIAL EXPANSION



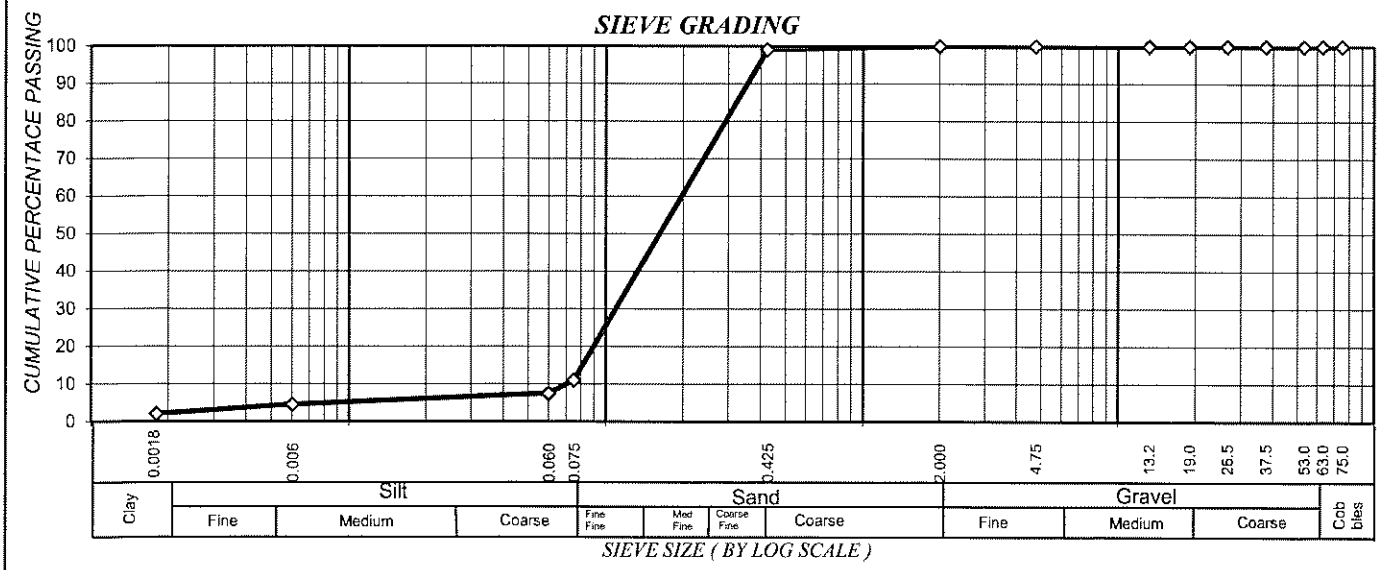
PLASTICITY CHART



PERFORMANCE AS WEARING COURSE



SIEVE GRADING



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Name: Wouter Steyn
Position: Laboratory Manager

Labco
63b Pickering Street, Newton Park, Port Elizabeth, 6045
PO Box 10114, Linton Grange, Port Elizabeth, 6015
E-Mail: info@labco.co.za Web: www.labco.co.za
Tel: 041 364-1290 Fax: 041 364-1291

sanas Testing Laboratory

CIVIL ENGINEERING MATERIALS TESTING SERVICES (PTY) Ltd T0227

CUSTOMER : Knight Piesold (Pty) Ltd
P. O. Box 72292
Lynnwood Ridge
0040

ATTENTION : Mr. J. van Tonder

JOB CARD No. : C13890 / 3110024801

PROJECT : Port Elizabeth N2 Total Filling Station

SUBMISSION DATE : 06.12.2011

DATE TESTED : 14.14.2011

REPORT DATE : 14.14.2011

SAMPLING PROCEDURE: Delivered to the laboratory SD

INDICATOR / CBR RESULT SUMMARY

SAMPLE NUMBER	X133497	X133501	X133503			
LAYER						
CO-ORDINATES						
STAKE VALUE	TP 3/1	TP 7/1	TP 8/2			
OFF SET						
DEPTH mm	2.4-5.0	1.8-5.9	2.5-6.3			
DESCRIPTION	Yellowish Siltstone	Yellowish Siltstone	Reddish brown silty Sand			
AASHTO CLASSIFICATION						
Indicator & CBR results comply to TRH14 Specification of	G8		G9			

SIEVE ANALYSIS - TMH 1 Test Method A1(a)

% PASSING 105.0 mm						
75.0 mm						
63.0 mm						
53.0 mm						
37.5 mm						
26.5 mm						
19.0 mm						
13.2 mm						
4.75 mm						
2.00 mm						
0.425 mm						
0.075 mm						

SOIL MORTAR ANALYSIS - TMH 1 Test Method A5

COARSE SAND (%)						
COARSE FINE SAND (%)						
MEDIUM FINE SAND (%)						
FINE FINE SAND (%)						
PASSING 0.075mm (%)						
GRADING MODULUS						

ATTERBERG LIMITS : TMH 1 Test Method A2 - A4

LIQUID LIMIT						
PLASTICITY INDEX						
LINEAR SHRINKAGE						

C.B.R. : TMH 1 Test Method A7 - A8

MOD AASHTO (Kg/m^3)	2084	1988	1977			
O.M.C. (%)	10.2	16.2	9.4			
C.B.R. @ 100% COMPACTION	34	2	56			
C.B.R. @ 98 % COMPACTION	30	2	30			
C.B.R. @ 95 % COMPACTION	25	2	11			
C.B.R. @ 93 % COMPACTION	17	1	7			
C.B.R. @ 90 % COMPACTION	7	1	4			
SWELL (MAASHTO) %	0.6	0.1	0.2			

Deviation from Test Method : Moisture Contents dried overnight at 105 - 110°C.

Name : Wouter Steyn

Position : Laboratory Manager

A SANAS accredited testing laboratory No T0062
36/38 Fourth Street, Booysens Reserve, Johannesburg 2091
P O Box 82223, Southdale 2135
Tel: +27 (0)11 835-3117 • Fax: +27 (0)11 835-2503
Email: jhb@civilab.co.za • Website: www.civilab.co.za

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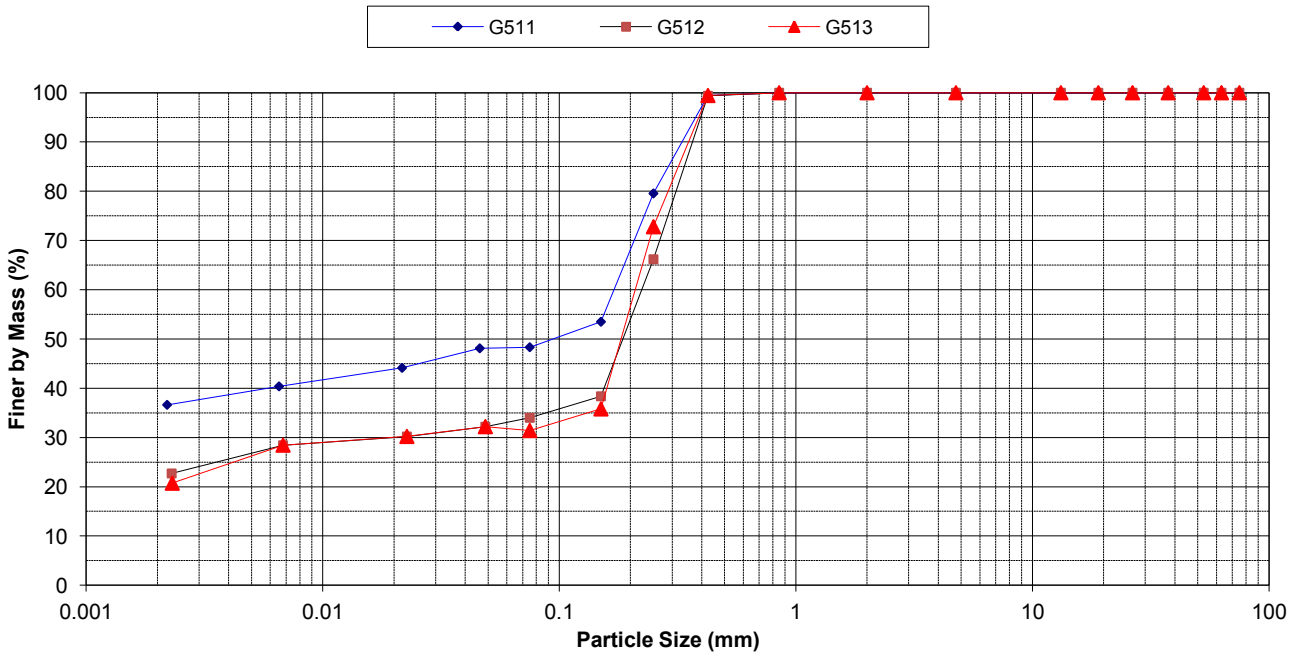
Foundation Indicator Test Data

Project	P.E.NZ TOTAL FILLING STATION		
Project No.	1039/F33/12/2011	Date	19 January 2012

Sample No.	G511	G512	G513
Field Ref. No.	TP 5	TP 5	TP 5
Depth	1.4 - 1.7	2.9 - 3.2	2.9 - 3.2
Sieve size	%Passing	% Passing	% Passing
75	100	100	100
63	100	100	100
53	100	100	100
37.5	100	100	100
26.5	100	100	100
19.0	100	100	100
13.2	100	100	100
4.75	100	100	100
2.00	100	100	100
0.85	100	100	100
0.425	99	99	99
0.250	80	66	73
0.150	53	38	36
0.075	48	34	31
0.04	47	32	32
0.02	44	30	30
0.006	40	28	28
0.002	36	22	20

Sample No.	G511	G512	G513
%Gravel	0	0	0
%Sand	52	67	68
%Silt	12	11	12
%Clay	36	22	20
NMC %	Not Tested	Not Tested	Not Tested
Liquid Limit	33	SP	24
Plasticity Index	17	SP	12
Linear Shrink.	5.	1.	3.
Overall P.I.	17	SP	12
Grading Modulus	0.52	0.67	0.69
H.R.B.	A-6 (5)	A-2-4 (0)	A-2-6 (0)
Unified	SC	SM	SC
Weston swell (%) at 1 kPa			

Analysis as per method D422 of ASTM of 1985
The results reported relate only to the samples tested.



Remarks:

A SANAS accredited testing laboratory No T0062
36/38 Fourth Street, Booysens Reserve, Johannesburg 2091
P O Box 82223, Southdale 2135
Tel: +27 (0)11 835-3117 • Fax: +27 (0)11 835-2503
Email: jhb@civilab.co.za • Website: www.civilab.co.za

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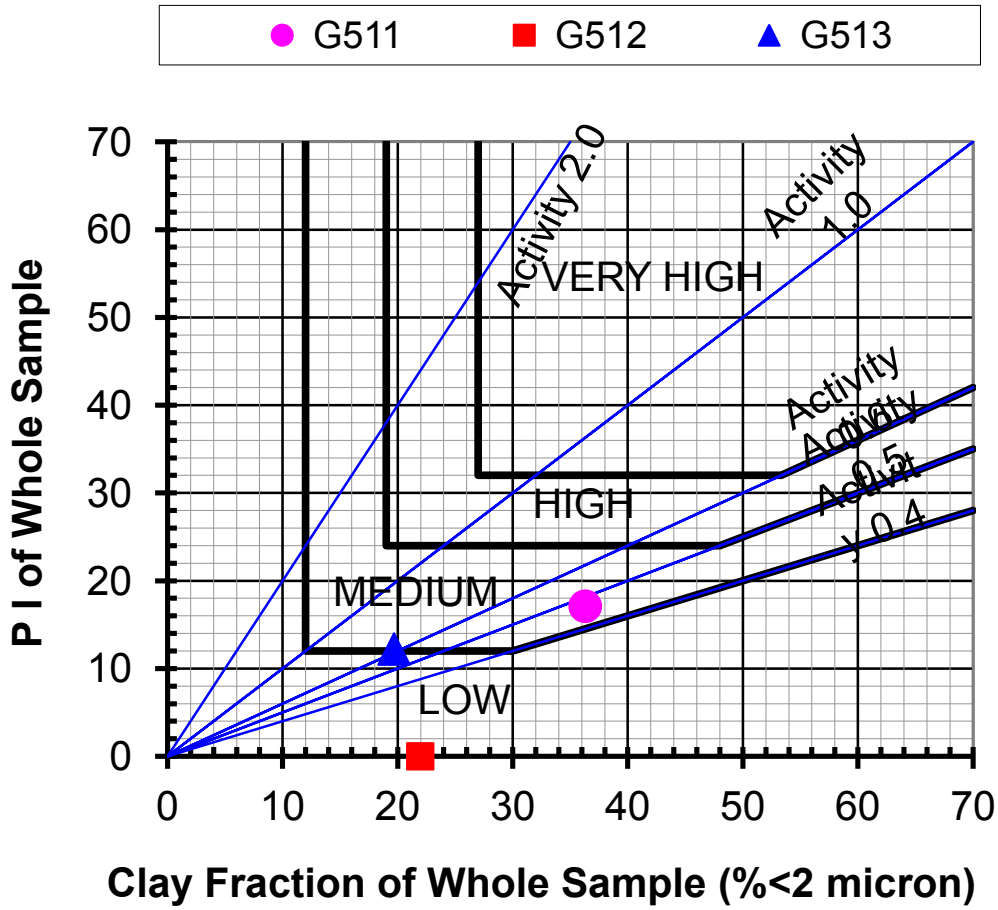
Activity Diagram After D H van der Merwe



Plotted Values:

Sample	Clay Frac	PI
G511	36.3	17.1
G512	22.0	#VALUE!
G513	19.7	12.2

36/38 Fourth Street, Booysens Reserve, Johannesburg 2091
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Tel: +27 (0)11 835-3117 • Fax: +27 (0)11 835-2503
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Consolidation Tests

Project:	P.E.NZ TOTAL FILLING STATION						Test 1
Project No.:	1039/F33/12/2011			Sample No.:	G511		
Borehole No:	TP 5			Depth:	1.4 - 1.7		
Date Received:	12/12/2011			Date Tested:	20/01/2012		
Remarks:	An undisturbed sample tested soaked.						
Machine No.	15	Ring No.	H	Height (mm)	19.15	Diameter (mm)	69.35

Masses for Water Content Determination (g)

Wet Sample and Ring		Dry Sample and Ring	Ring Only	Water Content	
Before Test	After Test			Before Test	After Test
218.5	220.0	197.6	81.86	18.1%	19.4%

Pre-Determined Particle Specific Gravity	2.744

Initial Parameters

Void Ratio	0.7150	Degree of Saturation (%)	69.3	Dry Density (Kg/m3)	1600

Effect. Stress (kPa)		10	52	102	202	402	802	1602	402	102	10	0
Dial Correction (u)		0	16	29	47	67	106	167	67	29	0	0
HH:MM:SS	√Minutes	Dial Readings in Microns									Initial Dial Reading	13312
00:00:00	0.00	13312										
02:00:00	10.95								11180	11415		
03:00:00	13.42										11848	
18:00:00	32.86	13301										
24:00:00	37.95		13120	12915		12098	11546	10954				
72:00:00	65.73				12599							

36/38 Fourth Street, Booysens Reserve, Johannesburg 2091
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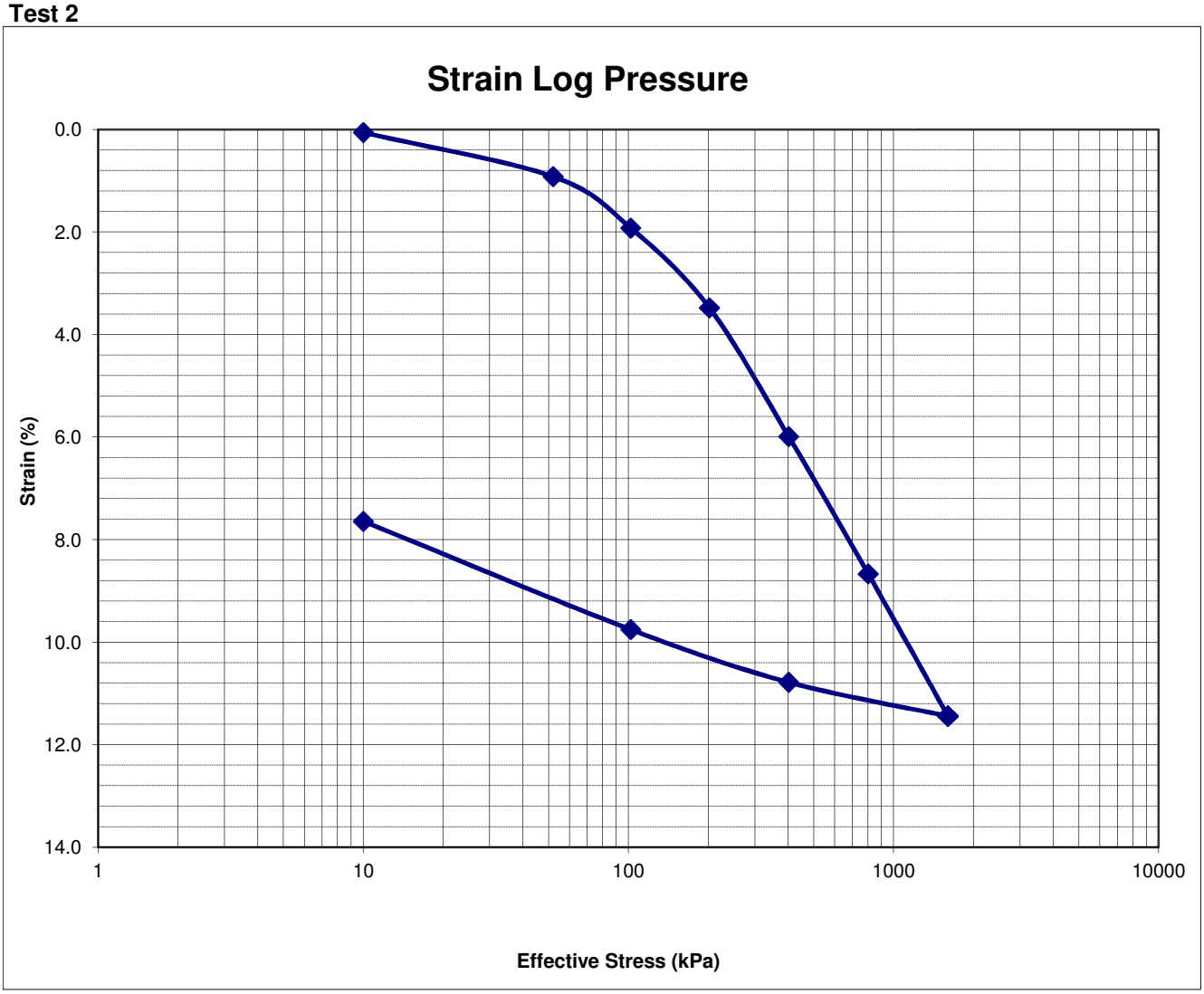
Consolidation Tests

Project:	P.E.NZ TOTAL FILLING STATION		
Project No.:	1039/F33/12/2011	Sample No.:	G511
Borehole No:	TP 5	Depth:	1.4 - 1.7
Date Received:	12/12/2011	Date Tested:	20/01/2012

Test 1

Effect.Stress (kPa)	10	52	102	202	402	802	1602	402	102	10	
Strain (%)	0.06	0.92	1.92	3.48	5.99	8.67	11.44	10.78	9.75	7.64	
Mv (1/MPa)		0.2051	0.2005	0.1556	0.1256	0.0670	0.0347	0.0055	0.0343	0.2293	
Void Ratio	0.714	0.6992	0.682	0.6553	0.6122	0.5663	0.5187	0.53	0.5477	0.5838	

Test 2



36/38 Fourth Street, Booysens Reserve, Johannesburg 2091
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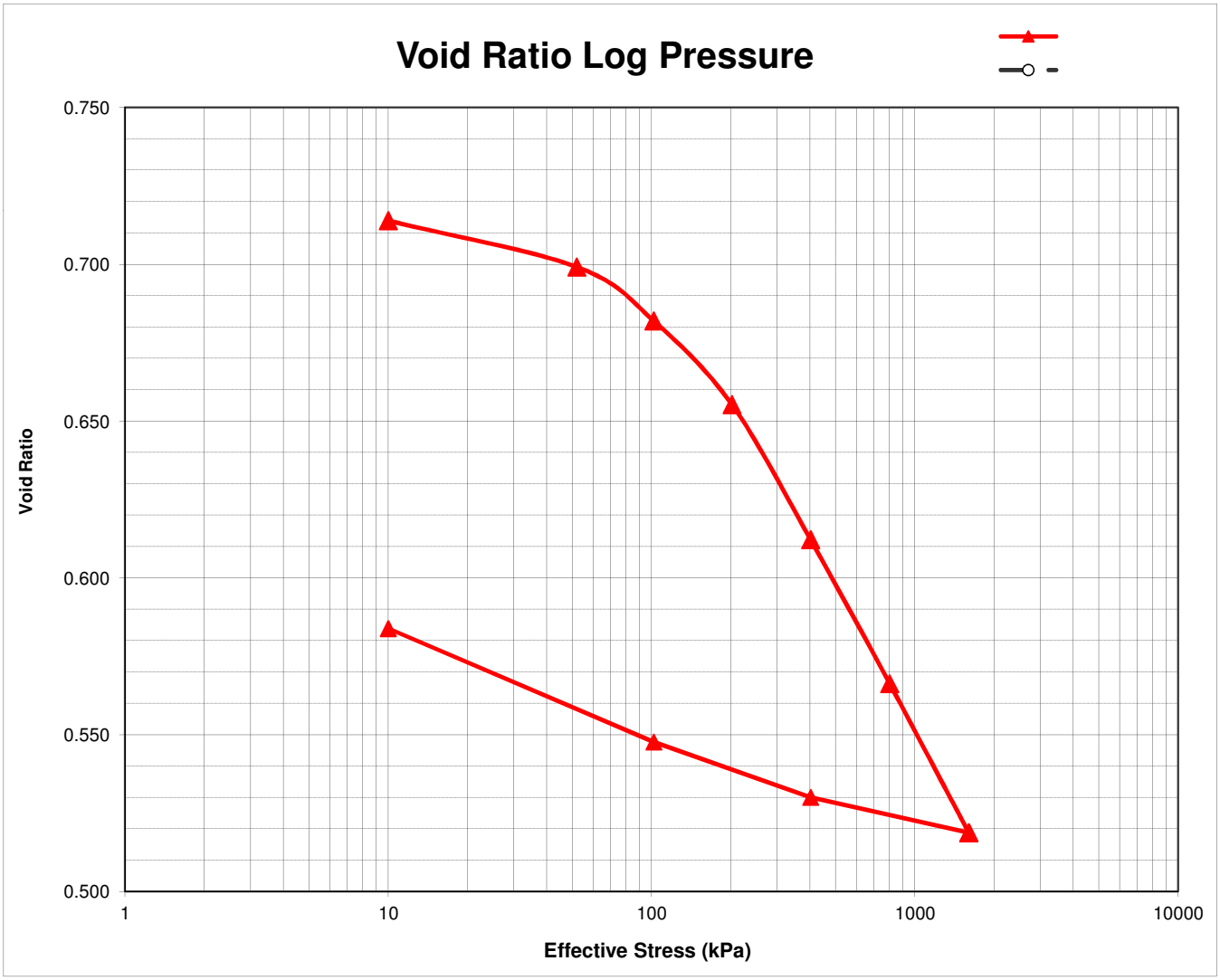
Consolidation Tests

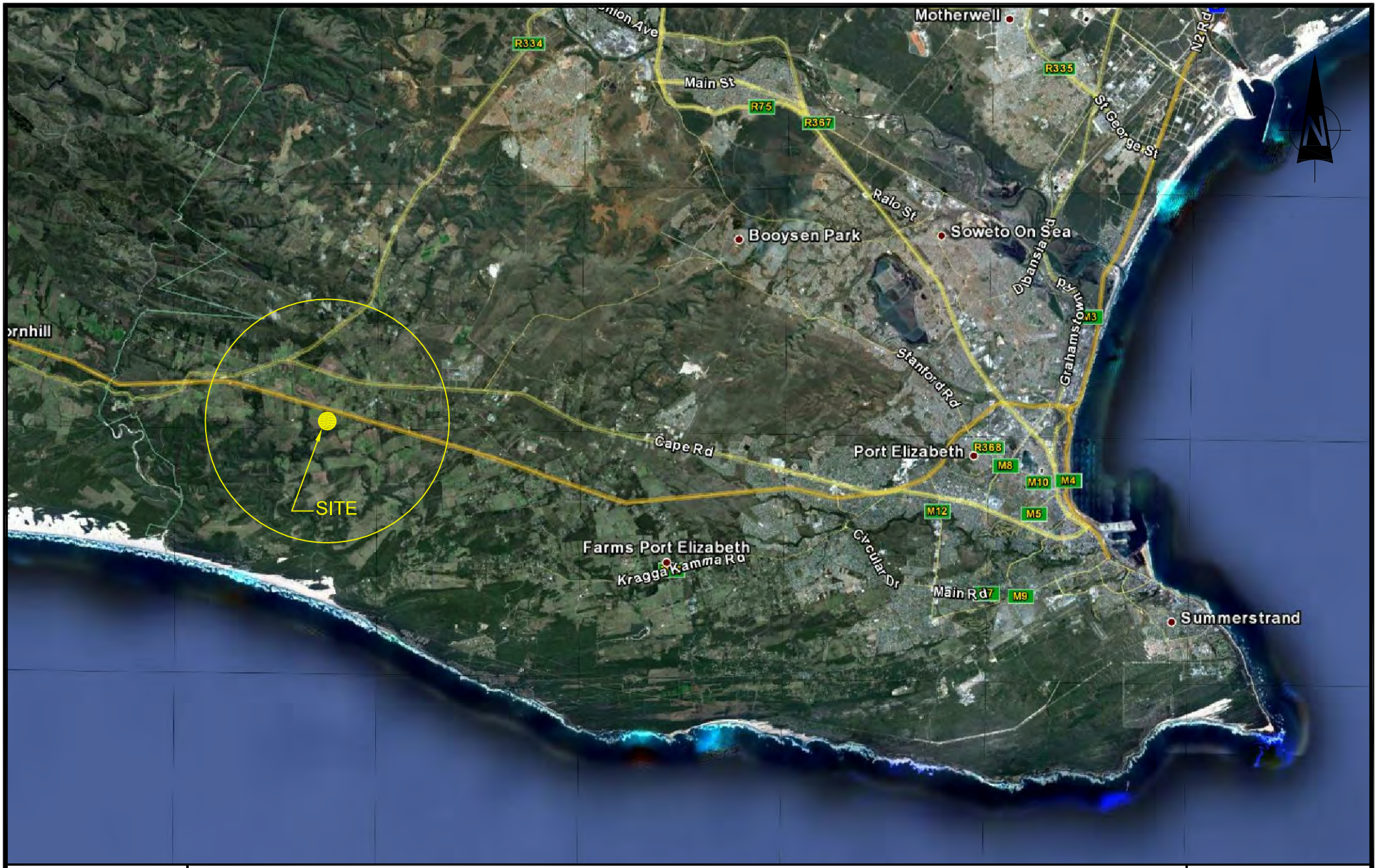
Project:	P.E.NZ TOTAL FILLING STATION		
Project No.:	1039/F33/12/2011	Sample No.:	G511
Borehole No:	TP 5	Depth:	1.4 - 1.7
Date Receivec	12/12/2011	Date Tested:	20/01/2012

Test 1

Effect. Stress (kPa)	10	52	102	202	402	802	1602	402	102	10	
Strain (%)	0.06	0.92	1.92	3.48	5.99	8.67	11.44	10.78	9.75	7.64	
Mv (1/MPa)		0.2051	0.2005	0.1556	0.1256	0.0670	0.0347	0.0055	0.0343	0.2293	
Void Ratio	0.71397	0.69919	0.682	0.65531	0.61223	0.56629	0.51874	0.53002	0.54767	0.58385	

Test 2





KNIGHT HALL HENDRY

CONSULTANTS IN CIVIL GEOTECHNICAL ENGINEERING AND ENGINEERING GEOLOGY

N2 TOTAL FILLING STATION PORT ELIZABETH
GEOTECHNICAL INVESTIGATION

LOCALITY MAP

JOB NO 31100248/01
FIGURE NO 1
SCALE N.T.S.

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N2 TOTAL FILLING STATION PORT ELIZABETH
GEOTECHNICAL INVESTIGATION

SITE PLAN SHOWING TEST PIT POSITIONS

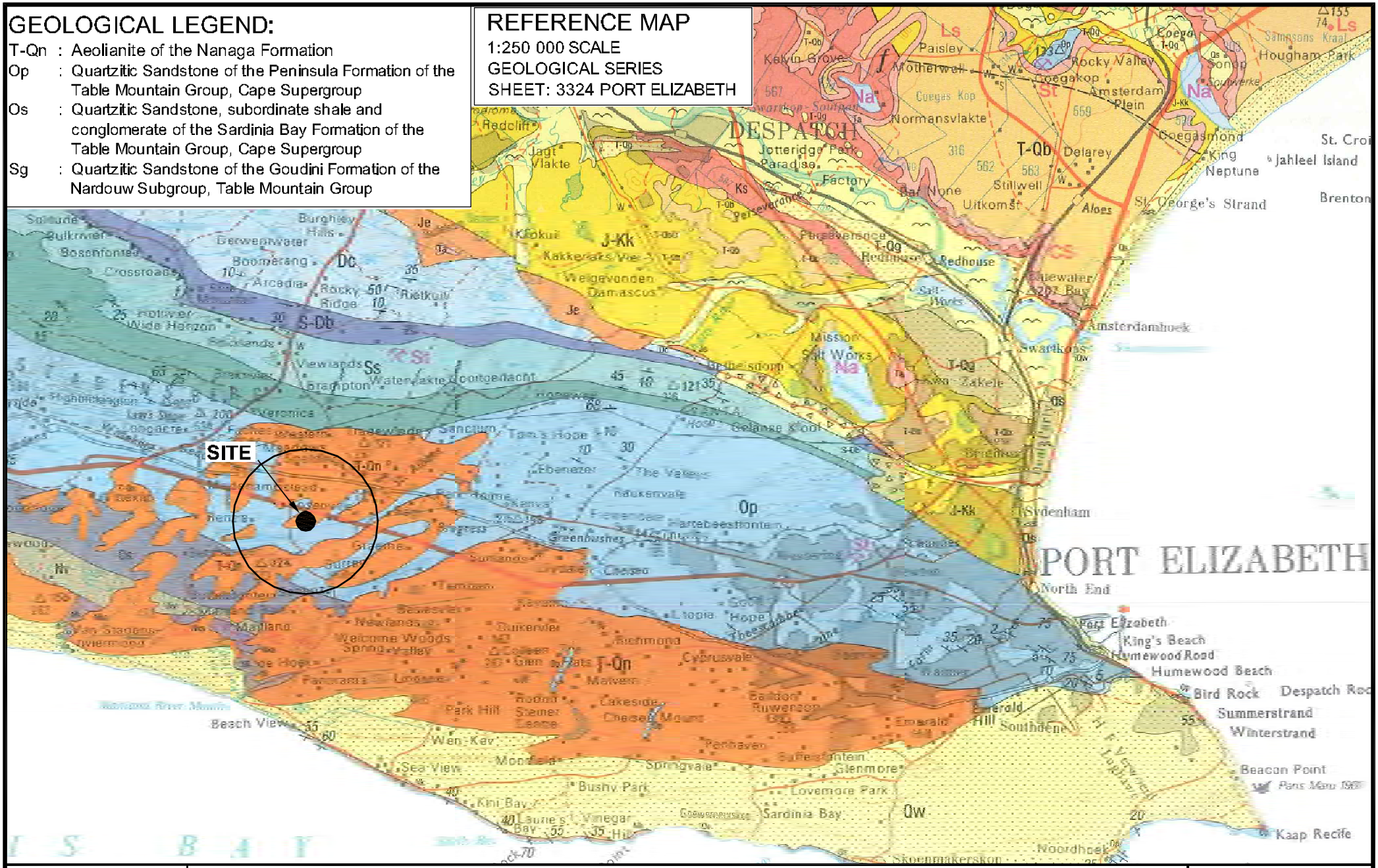
JOB NO 31100248/01
FIGURE NO 2
SCALE N.T.S.

GEOLOGICAL LEGEND:

T-Qn : Aeolianite of the Nanaga Formation
Op : Quartzitic Sandstone of the Peninsula Formation of the Table Mountain Group, Cape Supergroup
Os : Quartzitic Sandstone, subordinate shale and conglomerate of the Sardinia Bay Formation of the Table Mountain Group, Cape Supergroup
Sg : Quartzitic Sandstone of the Goudini Formation of the Nardouw Subgroup, Table Mountain Group

REFERENCE MAP

1:250 000 SCALE
GEOLOGICAL SERIES
SHEET: 3324 PORT ELIZABETH



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CONSULTANTS IN CIVIL GEOTECHNICAL ENGINEERING AND ENGINEERING GEOLOGY

N2 TOTAL FILLING STATION PORT ELIZABETH
GEOTECHNICAL INVESTIGATION
GEOLOGY MAP

JOB NO 31100248/01
FIGURE NO 3
SCALE N.T.S.

KNIGHT HALL HENDRY

CONSULTANTS IN CIVIL GEOTECHNICAL ENGINEERING AND ENGINEERING GEOLOGY

RAADGEWENDE SIVIELE GEOTEGNIESE INGENIEURS EN INGENIEURSGEOLOË

DOMUS Building, Ground Floor
Cnr Kasteel & Ingersol Roads
LYNNWOOD GLEN
0086
e-mail: jvantonder@knightpiesold.com

Reg. 1995/012742/07

VAT Reg. 4460156054

PO Box 72292
LYNNWOOD RIDGE
0040
Tel: +27 12 348 9091
Fax:27 12 348 9065

Our Ref.: 3110024801

28 February 2012

Infrastructure Consulting Engineers
PO Box 186
PERSEQUOR PARK
0020

Attention: Mr. Francois Joubert

Dear Sir

PORT ELIZABETH N2 TOTAL FILLING STATION: PERMEABILITY TEST RESULTS OF N2 TOTAL FILLING STATION

The geotechnical investigation that was completed by KHH for the above project, refers.

An undisturbed sample was collected from test pit TP5 which was excavated in the central portion of the site. Two permeability tests were conducted on the same sample to get a relatively accurate result. Sample TP5/2 was collected at a depth of between 2,9m and 3,2m in residual sandstone which comprises slightly clayey silty sand. The permeability test results (attached to this letter) of the residual sandstone soil represent the soil horizon with highest permeability when compared to the clayey transported soil above.

The results indicate the coefficient of permeability to vary from 8,2 x 10^{-10}m/s to 4,5 x 10^{-10}m/s which is very low. The results can be mainly attributed to the dense and very dense consistency of the soil as well as the intact soil structure.

Kind regards,

J VAN TONDER Pr.Sci.Nat
for *Knight Hall Hendry*

36/38 Fourth Street, Booysens Reserve, Johannesburg 2091
P O Box 82223, Southdale 2135
Tel: +27 (0)11 835-3117 • Fax: +27 (0)11 835-2503
E-mail: jhb@civilab.co.za • Website: www.civilab.co.za

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Falling Head Permeability Test Results

Project:	P.E.NZ TOTAL FILLING STATION		
Project No:	F33/12/2011	Date:	16/02/2012

Lab. Sample Reference	Field Sample Reference	Depth (m)	Moisture Contents		Dry density Kg/m^3		Coefficient of Permeability (m/s)		
			Before Test (%)	After Test (%)	Initial	As tested	Range Minimum	Range Maximum	Average
G512	TP 5	2.9 - 3.2	10.6	15.2	1841	2003	4.2E-10	4.7E-10	**4.5E-10**
G513	TP 5	2.9 - 3.2	12.3	16.9	1753	1923	7.8E-10	9.0E-10	**8.2E-10**

Remarks: Undisturbed samples.
Saturated and tested under a load of 100kPa.

Appendix D4: Traffic Impact Assessment

TRAFFIC IMPACT ASSESMENT AND SECOND STAGE OF APPLICATION FOR FULL REST AND SERVICE FACILITY ON PORTIONS 86, 147 AND 148 OF FARM GEDULTSRIVIER NO 411

N2 SECTION 11 – 2.4KM

UITENHAGE RD.

EASTERN CAPE

Report by: JF Joubert
Infrastructure
Consulting Engineers
PO Box 186
Persequor Park
0020

Date: March 2012

Contents

1. Background

The purpose of this report is to determine the traffic impact of a proposed rest and service facility between Port Elizabeth and Jeffeys Bay on the National Route N2, section 11 at approximately kilometer distance 2.4. The report goes beyond the typical requirements of a traffic impact study in order to address other issues required for the second stage of application for direct access to class 3 service areas along national roads, according to SANRAL's Procedures for Road Planning and Geometric Design.

The assessment has been prepared in accordance with the South African Traffic Impact Assessment Manual.

Suwenda Trading 40 (Pty) Ltd have secured portions 86, 147 and 148 of the Farm Gedultsriver no 411 within Registration Division Uitenhage RD, Province of the Eastern Cape (see Figures 1 and 2). The land is adjacent to the N2 between the St. Albans and Van Stadens Pass Interchanges. The intention is to develop a direct access rest and service facility to serve the traveling public along the National Route N2.

The site has been visited by the author on several occasions. The latest visit was on the 25th of November 2011

The location of the proposed facility is indicated on Figure 1. The proposed service facility is located between Port Elizabeth to the east and Humansdorp to the west. Figure 2 shows a strip map which provides a more exact indication of the location of the facility.

2. Need for service facility.

Rest and Service Facilities are crucial elements of road systems. This is evident from research that indicates interception rates of between 15 and 20 % at similar locations. Research furthermore indicates that less than 50% of vehicles turning into Rest and Service Facilities refuel at the facility. The facilities are therefore primarily used for relaxation and use of the toilets, convenience store and food offering. The research has shown that between 50 and 60% of persons entering the facility make use of the toilets.

There are no similar facilities on the N2 for approximately 140 km to the west and more than 80 km to the east. The facility to the west is the Total Petroport at the Storms River Bridge. To the west the nearest rest area with toilet and other facilities is the Nanaga Farm Stall at the crossing of the N2 and the R72 (which, however, does not have direct access from the

N2). There is also no fuel installation at the Nanaga facility. The proposed direct access rest and service facility will thus fulfill in a significant need on this section of the road where the spacing between rest facilities is relatively long. SANRAL acknowledges the important role of rest and service facilities in their Policy in Respect of Road Planning and Design. In fact, paragraph 4.4.1 of this policy states that “Road users travelling on the network have a need for roadside services and rest areas along the network of national roads at reasonable intervals, in balance with road safety and sound traffic management.”

The role that these facilities have to play is acknowledged worldwide. The Australian Pacific Highway Review, May 2004, concluded that rest and service areas should be spaced at a maximum of 50km and that a spacing of 35 km is preferred. The report furthermore concludes that rest areas are provided to reduce the number of road accidents related to driver fatigue as well as the number of fatigued drivers on New South Wales roads. Rest areas enable long distance driver s to increase the frequency, duration and quality of rest breaks. They improve the driving experience on NSW roads and support tourism.

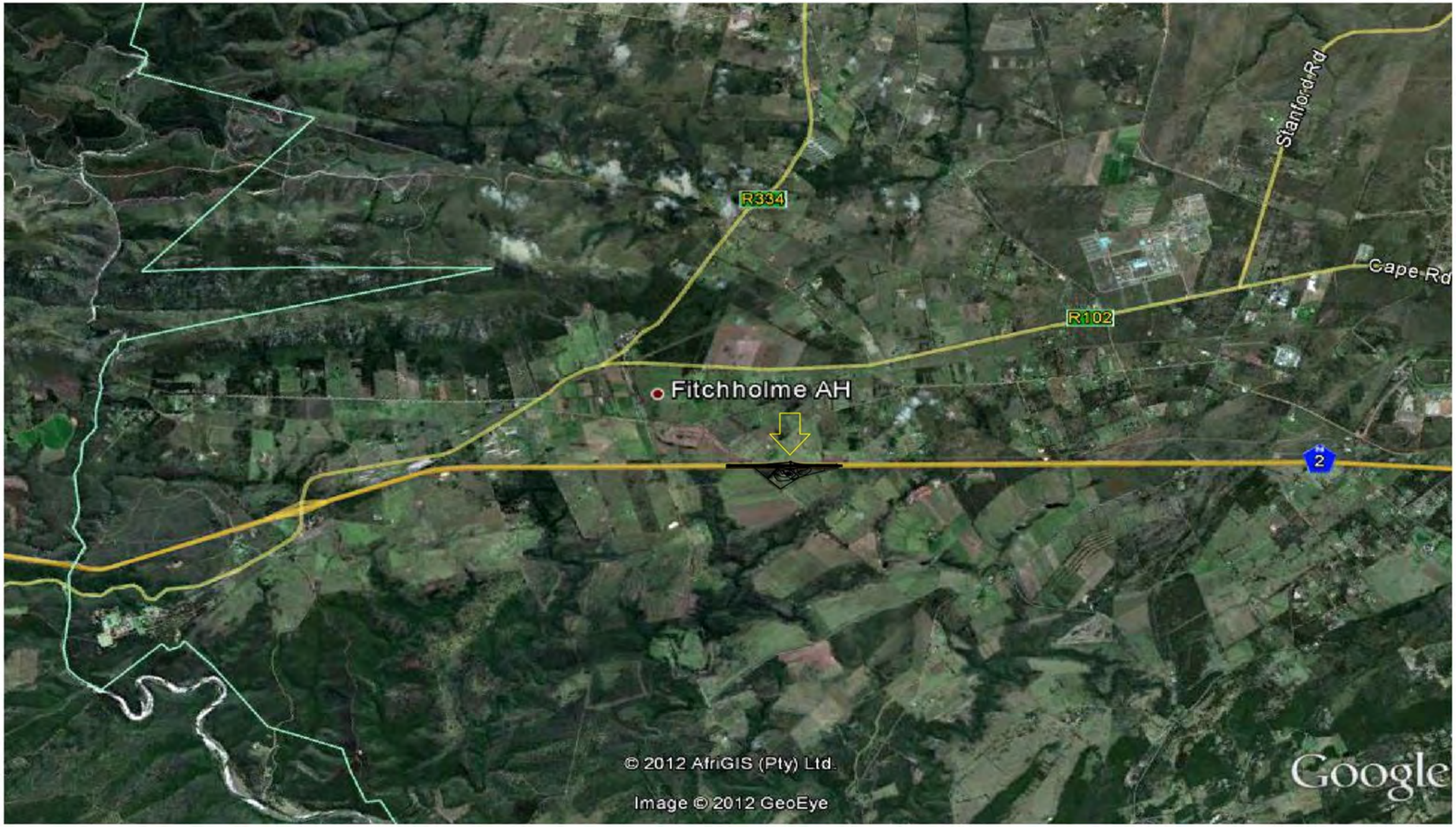

Figure 1 Locality Plan

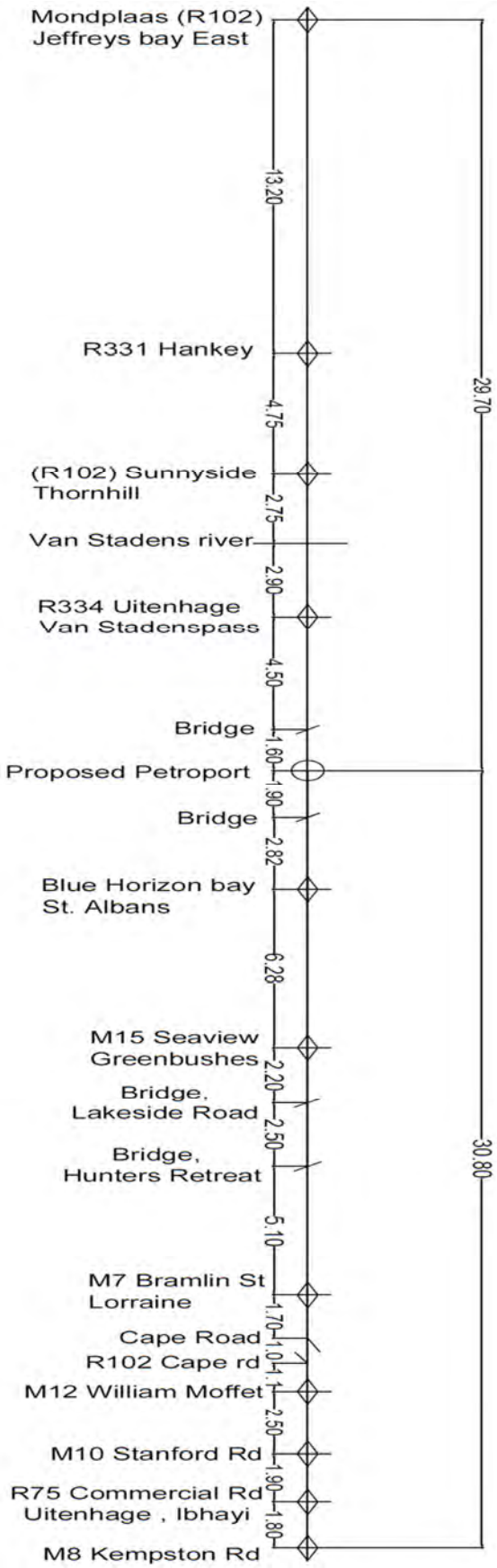

Figure 2: Strip map

3. Development information

The facility is to be located on portion 147 of Farm 411, Gedultsrivier. The eastbound off- and on-ramps will be located on servitudes to be registered over Portions 86 and 148 of Farm 411. The involved land portions are shown in Figure 3 and on the preliminary layout in Appendix A1.

The land is currently zoned as Agricultural and will be rezoned to Business Zone 5. Rezoning is currently in progress. The Environmental Impact Assessment for the proposed facility is currently being undertaken.

The total area of the site is 11.53 ha and the total gross building area will be approximately 5000 m^2.

The following facilities will be provided at the facility:

- Fuel storage and dispensing facility with 6 islands for light vehicles and 1 island for heavy vehicles
- 1500 m^2 Restaurant and take away
- 500 m^2 Restrooms
- 2000 m^2 Retail area
- 20 m^2 Kiosk for heavy vehicle drivers

Development Ratios

The floor area ratio of the development will be in the order of 3.5% and the coverage approximately 4.3%.

General

Due to the location of the service facility, it is highly unlikely that the proposed facilities will attract primary traffic and is only likely to attract passer-by traffic from the N2.

The facility will only be accessible from the N2. No access will be provided to vehicles or pedestrians from the back of the facility.

Figure 3: Land layout

4. Study Area

The impact of this facility on the road network is limited to the on- and off ramps on the interchange that will give access to the facility. The interchange will be designed according to the ***SANRAL Geometric Design Guidelines and Toegang van en na Fasiliteite langs Nasionale Deurpaaie, September 1991*** .

5. Traffic Volumes.

Design hour flows

The nearest counting station to the facility is Site No 736 located immediately west of the St Albans Interchange as shown in Figure 4. The latest available counts at this site were obtained from the SANRAL yearbook 2010. This counting station is a temporary station and the latest counts were undertaken from 02 November 2010 to 24 November 2010 (data available for 528 hours or about three weeks). An extract from the yearbook showing the counts at the station is provided in Appendix B.

Since the above counting station is a temporary station, it was also necessary to identify a permanent counting station for purposes of expanding the counts obtained from the short term counting station. The nearest permanent counting station to the facility on the N2 is Site No 735 located west of the Van Stadens Interchange as shown in Figure 4. It can be seen

that both sites 735 and 736 are very close to the proposed facility. An extract from the yearbook showing the counts at the station is provided in Appendix C

For Site 735, full hourly traffic counts for 2010 and 2011 are available, thus the design hour flow that was determined for the site is the 30th highest hourly flow in a particular year.

The 30th highest hourly flow for Site 735 towards Port Elizabeth in 2010 was 705 vehicles per hour. The 30th highest hourly flow for Site 735 in the direction of Humansdorp in 2010 was 758 vehicles per hour. There was no growth in design hour flow between 2010 and 2011 at this site, thus for the purpose of this report no provision will be made for growth in design hour flow from 2010 to 2011 for Site 736.

A comparison of hourly counts between 2 November 2010 and 24 November 2010 between Sites 735 and 736 indicated that the traffic counts at Site 735 are 88% of that of Site 736. The 30th highest hour flows at Site 736 where therefore taken as 88% of the flows at Site 735, namely 0.88x705=620 towards Port Elizabeth and 0.88x758=667 towards Humansdorp.

Hourly flow data are available for 528 hours at Site 736 and all of these hours fall within normal days. The highest hourly flow of these was used to determine the normal day design flow. The highest hourly flow in the direction of Port Elizabeth was determined as 439 vehicles per hour and in the direction of Humansdorp 520 vehicles per hour.

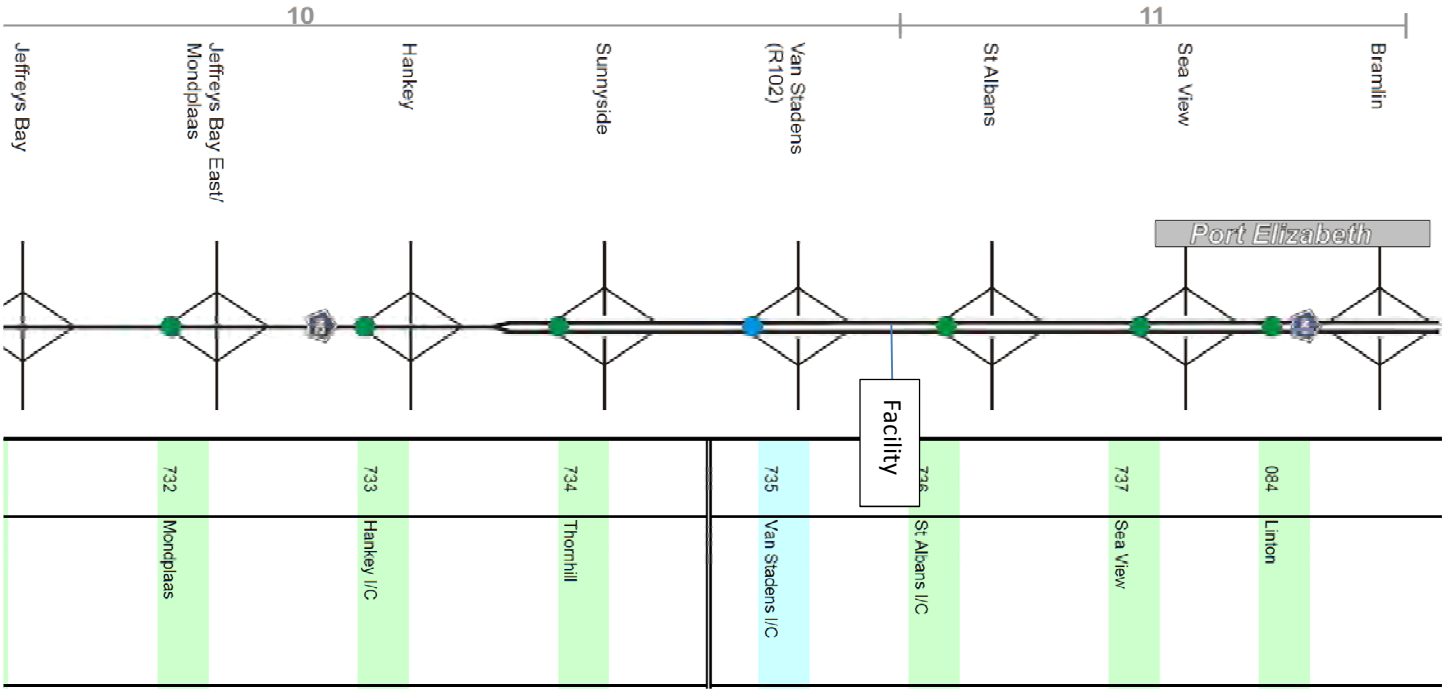

Figure 4: Position of Counting Stations

Anticipated growth

Historic growth figures for the site where determined from the permanent counting station at Site 735. At this site, no growth in traffic occurred from 2010 to 2011. This lack of growth was probably due to the economic climate at the time.

For the purposes of this row, a future growth rate of 3% per annum is assumed. The estimated Annual Average Daily Traffic (AADT) volumes over a period of 10 years are provided in the following table. The percentage of heavy vehicles is in the order of 12%.

	ADT		
	Dir. PE	Dir. Humansdorp	Total on road
2011	4061	4031	8092
2012	4183	4152	8335
2013	4308	4276	8585
2014	4438	4405	8842
2015	4571	4537	9108
2016	4708	4673	9381
2017	4849	4813	9662
2018	4995	4958	9952
2019	5144	5106	10251
2020	5299	5260	10558
2021	5458	5417	10875

6. Particulars of the N2

The N2 is a dual carriageway freeway at the location of the proposed facility. The width of the road reserve on the N2 is approximately 60 m. The carriageway widths are 11 m each.

The width of the road verge between the edge of the carriageway to the reserve boundary on both sides is approximately 12.5 m and the median is also approximately 12.5 m wide.

Should a widening of the N2 be required in future, additional lanes will have to be provided on the median of the road due to the design of the road. In Figures 5 and 6 it can be seen that no space is available for widening on sides of the road but space is available on the median for such widening. The construction of a new access interchange to the proposed facility will thus not inhibit future widening of the road. A cross section of the N2 is shown in Figure 7.

Figure 5: Bridge to the east of proposed facility

Figure 6 Bridge to the west of proposed facility

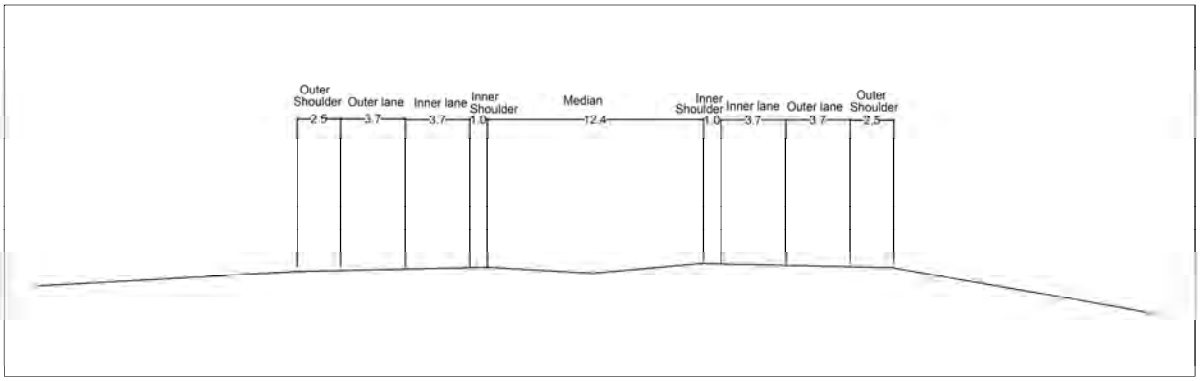

Figure 7 Typical cross section of the N2

7. Traffic safety aspects

7.1 Visibility of the facility

Visibility of the facility is not only important from a road safety point of view but is also an important commercial consideration. Good visibility promotes early decision making and prevents last minute decisions. The proposed new bridge for the facility will be visible for a distance of more than 2 km in each direction.

7.2 Anticipatory Sight distances

The general visibility of the site is very good. The anticipatory sight distance to off ramps to the proposed facility complies with SANRAL's standards. The preliminary layout of the proposed interchange is attached in Appendix A1. The yellow line breakpoint of Ramp A is continuously visible for a distance of 1.45 km in advance of the breakpoint itself. The nose becomes visible 1,8km upstream, but due to the sag curve approaching the ramp the visibility of the nose is obstructed from 1km to 210m upstream of the nose. The gore sign at the nose as well as the countdown signs are continuously visible from 1.5km before the nose. This sight distance therefore complies with requirements. The longitudinal section for Ramp A is provided in Appendix A2.

For Ramp C the road geometry is such that the nose is continuously visible from 1.275km upstream of the nose itself. This complies with the sight distance requirements. The longitudinal section for ramp C is attached in Appendix A3.

7.3 Acceleration and deceleration distances

The available acceleration and deceleration distances along the on-and-off ramps are shown in the tables below.

ACCLERATION DISTANCES ALONG ON-RAMPS

Ramp	Average gradient	Prescribed length	Design length
Direction East (Ramp B)	-2%	530	580
Direction West(Ramp D)	-1%	540	570

DECELERATION DISTANCES ALONG OFF-RAMPS

Ramp	Average gradient	Prescribed length	design length
Direction East (Ramp A)	1%	260	500
Direction West(Ramp C)	2%	250	280

The ramp lengths therefore comply with the requirements of ***SANRAL Geometric Design Guidelines*** and ***Toegang van en na Fasiliteite langs Nasionale Deurpaaie***.

The deceleration length on ramp A is significantly longer than prescribed. This is to ensure satisfactory anticipatory sight distances. The longitudinal sections for ramps B and D are attached in Appendix A4 an A5.

7.4 Interchange spacing.

The distances between yellow line breakpoints of existing interchanges and the proposed facility are indicated on Figure 8 below.

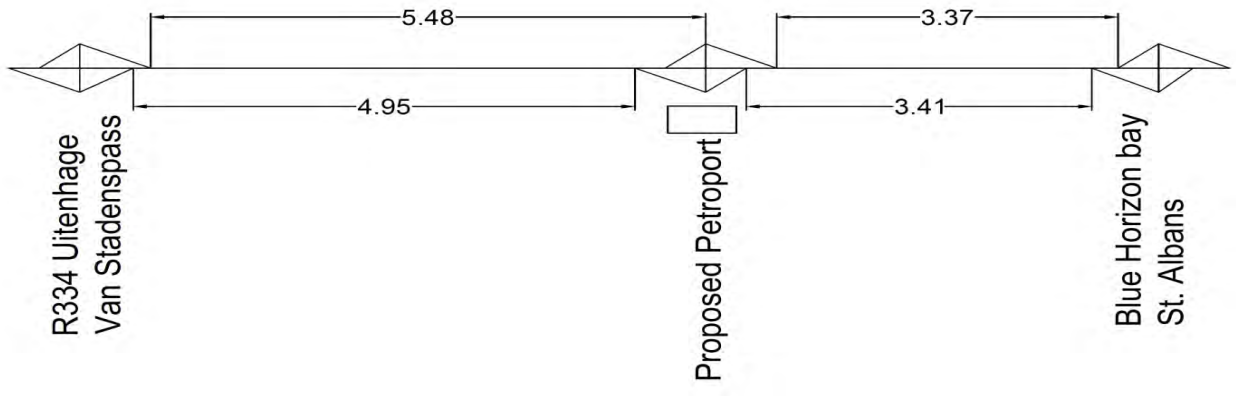

Figure 8: Interchange spacing

These distances are in compliance with the prescribed distances in Table 7.1 of the SANRAL Geometric Design Guidelines.

8. Level of service for merges and diverges.

The levels of service for the merge and diverge influence areas were determined by means of the Highway Capacity manual 2000. The design hour flow in a westerly direction is higher than that in an easterly direction, so for purposes of this report Ramp C and D were analysed. The current traffic volumes on this stretch of N2 are far below capacity and high levels of service were determined.

The design hour flows as calculated in Section 5 of this report were used in level of service calculations. To make provision for heavy vehicles, the hourly volume is adjusted with a

heavy vehicle adjustment factor. A heavy vehicle factor of 12% was used as from SANRAL counts. (See appendix B)

An interception rate of between 15 and 25% is anticipated for the facility. For the level of service calculations an interception rate of 20% was used.

The Level of Service calculations are shown in Figure 9. According to these calculations, a service level A is achieved for the merge influence area of ramp D and the N2. The space mean speed for vehicles within the merge influence area is 105,5km/hour. Design hour flow of 660 vehicles per hour was used. Similar results were obtained for Ramp B for an hourly flow of 620 vehicles per hour.

The diverge influence area of ramp C and the N2 was analysed and the results are shown in Figure 10. The level of service for the diverge area is also level A with a space mean speed of 98 km/hour for a design hour flow of 660 vehicles per hour.

It can be concluded that the on and off-ramps to the proposed facility comply with SANRAL's standards. Significant growth will need to take place before the level of service for merge or diverge influence areas drops to level B. The level of service for merge and diverge area will only deteriorate to level B once design hour flows of more than 1100 vehicle per direction is reached.

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information				***Site Information***	
Analyst:	Francois Joubert			Freeway	N2 Direction Humansdorp
Agency or Company:	Infrastructure Consulting Engineers			Junction:	N2 West and entrance ramp
Date Performed:	8/2/2012			Jurisdiction	Eastern Cape
				Analysis Year:	2011

Inputs

			Terrain:	Rolling					
Upstream Adjacent Ramp:		132 veh/h on ramp							***Downstream Adjacent Ramp:***
Yes ____	On ____			220m					Yes ____ On ____
No X	Off ____			527 veh/h on N2					No X Off ____
L_{up} = _____ m				LA	220				L_{down} = _____ m
		S_{FF}	120	km/h	S_{FR}	60	km/h		
V_u = _____veh/h									V_d = _____veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/h)	K	D	V (veh/h)	PHF	%HV	f_{HV}	f_p	$v = \frac{V}{PHF\, f_{HV}\, f_p}$
v_F				527	1	12	0.943396		559
v_R				132	1	5	0.97561		135
v_u									
v_d									

MERGE AREAS			DIVERGE AREAS		
Estimation of v_{12}			***Estimation of v_{12}***		
$v_{12} = v_F * P_{FM}$			$v_{12} = v_R + (v_F - v_R) * P_{FD}$		
L_{EQ} =	NA for 2 lanes per direction		L_{EQ} =	_____	(Eqn 25-13 or 25-14)
P_{FM} =	1	For 2 lanes per direction	P_{FM} =	_____	using Eqn ____ (Exh 25-12)
v_{12} =	559	pc/h	v_{12} =	_____	pc/h
			v_3 or v_{av34}	_____	pc/h (Eqn 25-15 or 25-16)
			Is v_3 or v_{av34} > 2,700 pc/h?		Yes ____ No ____
			Is v_3 or v_{av34} > v_{12}/2 ?		Yes ____ No ____
			If Yes, v_{12a} = _____		(Eqns 25-18)

Capacity Checks					***Capacity Checks***				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
					v_F		Exh 25-14		
v_{FO}	694	4800		No	$v_{FO}=v_F-v_R$		Exh 25-14		
					v_R		Exh 25-3		

Flow Entering Merge Influence Area					***Flow Entering Diverge Influence Area***				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
v_{R12}	694	4600		No	v_{12}		Exh 25-14		

Level of Service Determination (if not F)				***Level of Service Determination (if not F)***	
	Dr=3.402+0.00456VR + 0.0048V12 - 0.01278LA			$D_R = 4.252+0.0086v_{12}-0.0009L_D$	
D_R =	3.887809		pc/km/ln	D_R =	_____ pc/km/ln
LOS =	A			LOS =	_____ (Exhibit 25-4)

Speed Determination			***Speed Determination***	
M_s =	0.276004		D_s =	_____ (Exh 25-19)
S_R =	105.3718		S_R =	_____ (Exh 25-19)
S_o =	NA for 2 lanes per direction		S_o =	_____ (Exh 25-19)
S =	_____ (Eqn 25-14)		S =	_____ (Eqn 25-15)

Figure 9 : Level of service calculation for merge

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		***Site Information***	
Analyst:	Francois Joubert	Freeway	N2 Direction Humansdorp
Agency or Company:	Infrastructure Consulting Engineers	Junction:	N2 West and exit ramp
Date Performed:	8/2/2012	Jurisdiction	Eastern Cape
		Analysis Year:	2011

Inputs

			Terrain:	Rolling					
Upstream Adjacent Ramp:						132 veh/h on ramp			***Downstream Adjacent Ramp:***
Yes ____	On ____								Yes ____ On ____
				527 veh/h on N2					
No X	Off ____								No X Off ____
L_{up} = _____ m				LA	220				L_{down} = _____ m
		S_{FF}	120	km/h	S_{FR}	60	km/h		
V_u = _____veh/h									V_d = _____veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/h)	K	D	V (veh/h)	PHF	%HV	f_{HV}	f_p	$v = \frac{V}{PHF f_{HV} f_p}$
v_F				527	1	12	0.943396		559
v_R				132	1	5	0.97561		135
v_u									
v_d									

MERGE AREAS		DIVERGE AREAS	
Estimation of v_{12}		***Estimation of v_{12}***	
$v_{12} = v_F * P_{FM}$		$v_{12} = v_R + (v_F - v_R) * P_{FD}$	
L_{EQ} =		L_{EQ} =	NA for 2 lanes per direction
P_{FM} =		P_{FD} =	1 using Eqn ____ (Exh 25-12)
v_{12} =		v_{12} =	559 pc/h

Capacity Checks

	Actual	Capacity		LOS F?
v_{FO}				No

Capacity Checks

	Actual	Capacity		LOS F?
v_F	559	Exh 25-14	4800	no
$v_{FO}=v_F-v_R$	424	Exh 25-14		no
v_R	135	Exh 25-3		no

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
v_{R12}				No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
v_{12}	559	Exh 25-14	4400	no

Level of Service Determination (if not F)

	Dr=3.402+0.00456VR + 0.0048V12 - 0.01278LA		
D_R =	pc/km/ln	D_R =	1.942686
LOS =		LOS =	A

Level of Service Determination (if not F)

D_R = 2.642+0.0053V12-0.0183LD

Speed Determination

M_s =		D_s =	0.415159
S_R =		S_R =	97.9966
S_o =		S_o =	0
S =	_____ (Eqn 25-14)	S =	_____ (Eqn 25-15)

Figure 10 : Level of service calculation for diverge

9. Conclusions and Recommendations

The analysis of the proposed facility has shown that it complies with SANRAL's Geometric Design Standards and the impact on the operation along the N2 is within standards. With an anticipated interception rate of between 15 and 25 % the proposed facility will enhance road safety and road user convenience. It is recommended that SANRAL approves this Traffic Impact Assessment and that consent is given for the third stage of application to commence.

This report is in accordance with the second stage of the SANRAL's application procedures and contains the following items, amongst others, as required for this stage:

- Locality map of a scale not smaller than 1:50 000
- Development plan with basic layout of the Service Area to a scale of 1:2000
- Locality of adjacent interchanges, if within 2,0km from the proposed facility
- Distance to nearest other existing facilities
- AADT, 30th highest hour traffic volume, historic and projected traffic growth rates and the percentage of heavy vehicles on the road
- The Developer and Property details
- Traffic impact study