# PHASE 1 GEOTECHNICAL REPORT

## PROPOSED SUBSIDY HOUSING PROJECT, PORTION 111 OF MELKHOUTONTEIN, STILBAAI, WESTERN CAPE PROVINCE

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**Prepared by:**
**OUTENIQUA GEOTECHNICAL SERVICES**
**18 CLYDE ST**
**KNYSNA**
**6571**
**www.outeniqualab.co.za**

**Prepared for:**
**ASLA DEVCO**
**25 CONRADIE CRESCENT, STRAND**
**PO BOX 118, GORDONS BAY, 7151**
**TEL: +27 (0)21 8458335**
**www.asla.co.za**

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| Revision No | Date | Prepared by: | Reviewed by: |
|---|---|---|---|
| 0 | 20.02.2018 | I.Paton Pr.Sci.Nat | S Ngema |
| | |  | |

## Authors qualifications and affiliations:

Iain Paton has a Bachelor's degree in Geology and a Master's degree in Geotechnical Engineering and is a registered professional with the South African Council for Natural and Scientific Professions (Pr Sci Nat # 400236/07) with 19 years' experience in the construction, mining and energy and industries. Iain Paton is a member of the South African Institute of Engineering and Environmental Geologists (SAIEG), the Geotechnical Division of the South African Institute of Civil Engineering (SAICE), the South African Institute of Rock Engineering (SANIRE) and the Institute of Municipal Engineering of South Africa (IMESA).

## Declaration of independence:

The author of this report is independent professional consultant with no vested interest in the project, other than remuneration for work associated with the compilation of this report.

## General limitations:

1. The investigation has been conducted in accordance with generally accepted engineering practice, and the opinions and conclusions expressed in the report are made in good faith based on the information at hand at the time of the investigation.
2. The contents of this report are valid as of the date of preparation. However, changes in the condition of the site can occur over time as a result or either natural processes or human activity. In addition, advancements in the practice of geotechnical engineering and changes in applicable practice codes may affect the validity of this report. Consequently, this report should not be relied upon after an eclipsed period of one year without a review by this firm for verification of validity. This warranty is in lieu of all other warranties, either expressed or implied.
3. Unless otherwise stated, the investigation did not include any specialist studies, including but not limited to the evaluation or assessment of any potential environmental hazards or groundwater contamination that may be present.
4. The investigation is conducted within the constraints of the budget and time and therefore limited information was available. Although the confidence in the information is reasonably high, some variation in the geotechnical conditions should be expected during and after construction. The nature and extent of variations across the site may not become evident until construction. If variations then become apparent this could affect the proposed project, and it may be necessary to re-evaluate recommendations in this report. Therefore, it is recommended that Outeniqua Geotechnical Services is retained to provide specialist geotechnical engineering services during construction in order to observe compliance with the design concepts, specifications and recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction. Any significant deviation from the expected geotechnical conditions should be brought to the author's attention for further investigation.
5. The assessment and interpretation of the geotechnical information and the design of structures and services and the management of risk is the responsibility of the appointed engineer.

## EXECUTIVE SUMMARY

Outeniqua Geotechnical Services was appointed by Asla Devco to undertake a Phase 1 geotechnical site investigation for a proposed subsidy housing project on a greenfield site on Portion 111 of Melkhoutfontein 480 Stilbaai in the Western Cape Province. The project includes the construction of roads, services and numerous single and/or double storey masonry housing units.

The site investigation included a detailed desktop study and a subsurface investigation, involving a series of test pits, *in situ* tests and laboratory tests, culminating in a factual and interpretative report with recommendations for the engineering design.

The climate of the region can be classified as temperate, with cool winters and warm summers, and most rainfall occurring during the winter months. The Weinert Climatic-N No. for the area is 3-4, indicating a moderate climate.

The topography is characterized by gently sloping terrain with several small, wide ephemeral drainage lines traversing the site, which drain the site in a southeast direction into the tributaries of Goukou river. The natural vegetation consists of dense coastal fynbos vegetation. The surface conditions on the site were generally dry at the time of the investigation and access across the site with machinery was relatively easy in areas that had been cleared of vegetation.

The geology of the site consists of Tertiary-age Wankoe Formation of the Bredasdorp Group. This formation is composed of unconsolidated to semi-consolidated aeolian sands and calcarenite rock. The geology is generally suitable for urban development and has a low seismic activity.

The soil profile is quite variable across the site, which is typical in this geological formation, as the pedogenic cementation process of the insitu marine and aeolian sediments varies widely. The soil types are dominated by silty fine aeolian sands and sandy silt (rock flour) or gravelly sands derived from the weathering of the calcarenite/calcrete rock, which is exposed in low outcrops on parts of the site. Several of the test pits refused at shallow depths on this soft rock. The plasticity index and clay content of the soils is low, and the soils will display negligible heave. Some of the weakly cemented soils may display a collapse potential when saturated under load. Groundwater was only encountered in one test pit on the southeast corner of the site (the lowest part of the site), adjacent to a natural drainage line.

Significant bush clearing will be required to clear the site although this should be relatively easy. Buk earthworks, platforming and low retaining walls may be required on moderately sloping parts of the site where slopes exceed 1:10. Excavations to 0.5m are classified as “soft”, and all excavations below this level are classified as “intermediate” or “hard”.

The recommended foundation types for the proposed structures are lightly reinforced strip foundations or light rafts on compacted insitu soils on flat sites; or engineered platforms on sloping sites (cut to fill, using suitable granular insitu soils). Bearing pressures should be limited to 75kPa to minimize settlement.

The site geology and geotechnical conditions are generally considered suitable for the proposed development, but there are some geotechnical constraints that may affect subsidy variations and will require attention from the structural and civil engineers.

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**List of appendices**

# 1. Introduction and terms of reference

Outeniqua Geotechnical Services was appointed by Asla Devco to conduct a Phase 1 geotechnical site investigation for a proposed subsidy housing project on Portion 111 of Melkhoutfonten in Stilbaai, in the Western Cape (see locality map in **Figure 1**).

The project consists of new government subsidy housing units, new access roads and services. The physical and geotechnical nature of the site needs to be investigated in order to facilitate the civil engineering design and project planning process.

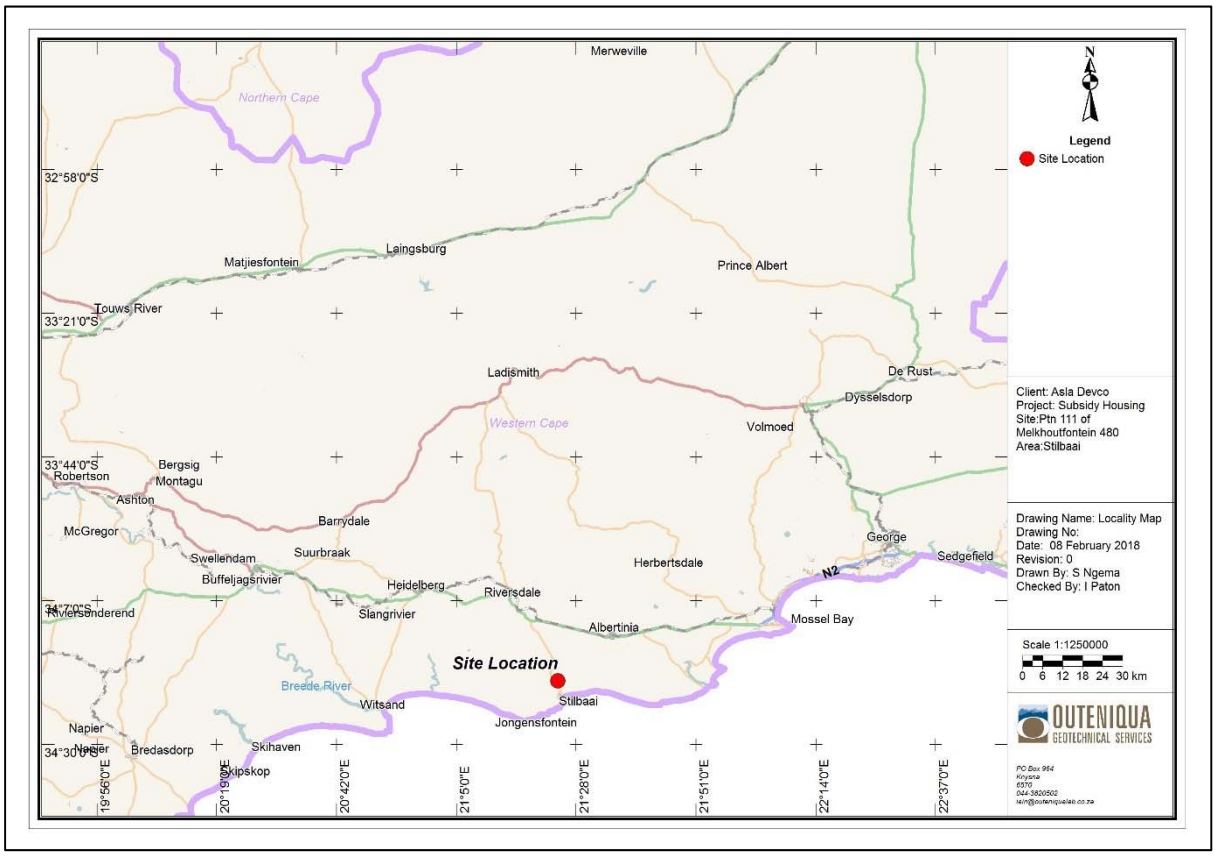



**Figure 1: Locality map**

The investigation is carried out in accordance with SANS 634: Geotechnical Investigations for Township Developments.

The general purpose of the investigation is to:

- Describe the location, topography and geology of the proposed site;
- Investigate and describe the soil types and expected founding conditions;
- Highlight any problem soils, slope stability or drainage issues;
- Estimate the bearing capacity, settlement and/or swell potential of the soil;
- Classify the excavations in terms of SABS 1200D;
- Determine the suitability of the site for housing purposes and make recommendations for the design of earthworks, foundations and engineering services.

## 2. Information available

The following maps and plans were available for reference purposes and may be reproduced in this report:

- Topocadastral data, obtained from the National Geospatial Information Department;
- 1:250 000 and 1:50 000 Geological maps of the area, obtained from the Council for Geoscience;
- 1:1000000 Seismic Hazard Map of SA, obtained from the Council for Geoscience.
- Site layout plans provided by Asla Devco

## 3. Nature of the investigation

The Phase 1 site investigation involved a desktop study and a detailed subsurface investigation on the site. The subsurface investigation involved conducting a total of 19 test pits across the site with a TLB/Backactor to a depth of 2.5m or shallower refusal, to obtain an indication of the expected geotechnical conditions of the area. Test pits were profiled by a qualified geologist and samples of various soil horizons were collected for laboratory tests. Insitu penetration tests by means of a DCP were conducted from ground level next to each test pit.

Soil samples were taken for the following lab tests to determine the engineering characteristics of the soil:

- Foundation Indicator tests (TMH1 and ASTM) to determine gradings, Atterberg limits and potential expansiveness (tested at Outeniqua Lab in George);
- MOD/CBR/Indicator tests (TMH1) to determine the compaction/strength properties (tested at Outeniqua Lab in George);
- pH and Conductivity tests (TMH1) to determine soil aggressiveness (tested at Controlab in East London).
- Swell/Collapse potential tests (ASTM) to determine soil swell, collapse and compressibility characteristics (tested at Controlab in East London).

The confidence in the information gained from the investigation is high, and further investigations are not deemed necessary at this stage of the project.

## 4. Site description

The site is a vacant/greenfield portion of Farm 480, which is located in the Melkhoutfontein area approximately 5km north of the coastal village of Stilbaai. The terrain on the site slopes gently to moderately (1:20 to 1:10) to the south east with localized topographic depressions. The site drains towards the southeast into the tributaries of Goukou river and there are a few ephemeral drainage lines crossing the site (see **Figures 2 & 3**). The vegetation is dominated by thick coastal fynbos bush and small trees (see **Figure 4**). The climate of the area is temperate with a Weinert climatic N-value of 3-4 (moderate). The surface conditions on the site were generally dry at the time of the investigation, and access was easily gained in areas that had been previously cleared of dense bush.

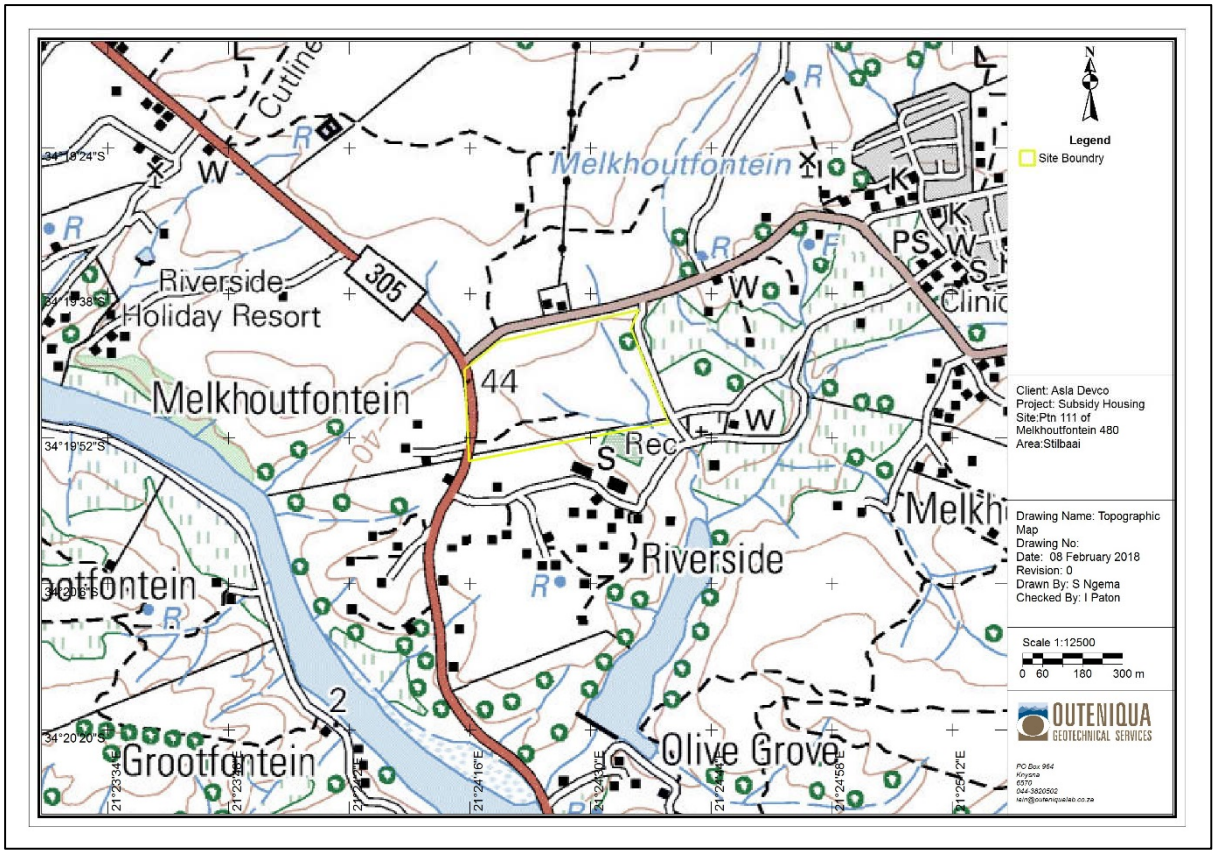



**Figure 2: Topographic map of site**

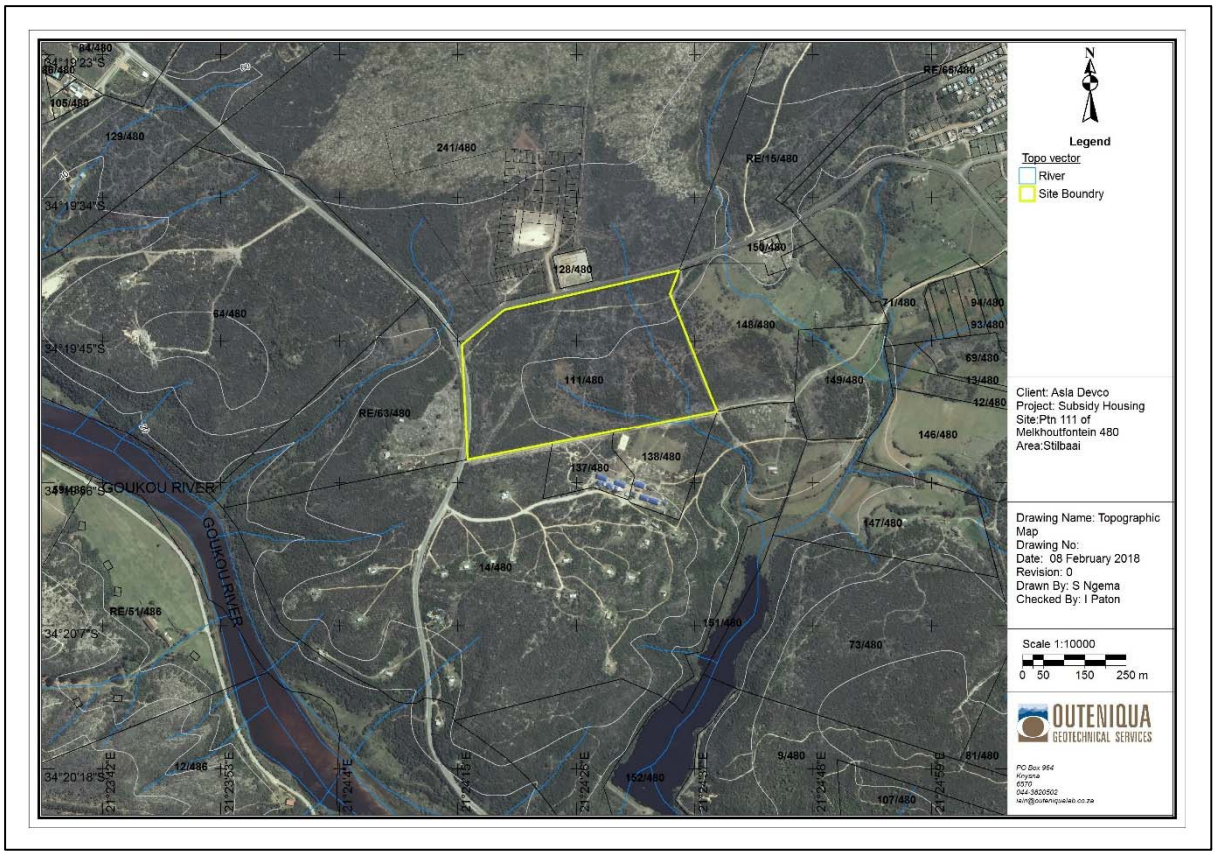



**Figure 3: Aerial photo of site**

**Figure 4: Showing typical topography and vegetation**

# 5. Geology

The geology of the area consists of calcarenite and aeolian sands with calcareous-cemented lenses of the Tertiary-aged Wankoe Formation of the Bredasdorp Group (light green on the map in **Figure 5**). The formation consists of yellowish grey to yellowish orange, well-rounded, well sorted, fine- to coarse-grained quartz grains, glauconite and finely comminuted shell fragments (see **Figure 6**). The formation also consists of unconsolidated to semi-consolidated sands with inconspicuous cross bedding. The Bredasdorp Group is known to contain some localised karstic features which can develop in calcareous formations, mainly consisting of dolines (depressions caused by chemical solution of calcareous rocks), but there are no dolomitic rocks and the risk of any significant sinkholes or unstable geology on this particular site is low. There are no significant geological faults near the site, and the geology is generally suitable for urban development, with a low seismic activity risk.

# 6. Geotechnical Evaluation

## 6.1 Engineering and material characteristics

### 6.1.1 Topography, slopes and vegetation cover

**Results of the investigation**

The site is characterized by gentle to moderately sloping terrain which drains to the south east into tributaries of the Goukou river. The slope gradients vary from 1:30 to 1:10 but there are some localized flat areas and even topographic depressions. The vegetation on the site is dominated by thick bush and small trees.

**Effect on the proposed development**

The general topography is suitable for subsidy housing projects. Vegetation clearing will be relatively easy with a bulldozer.

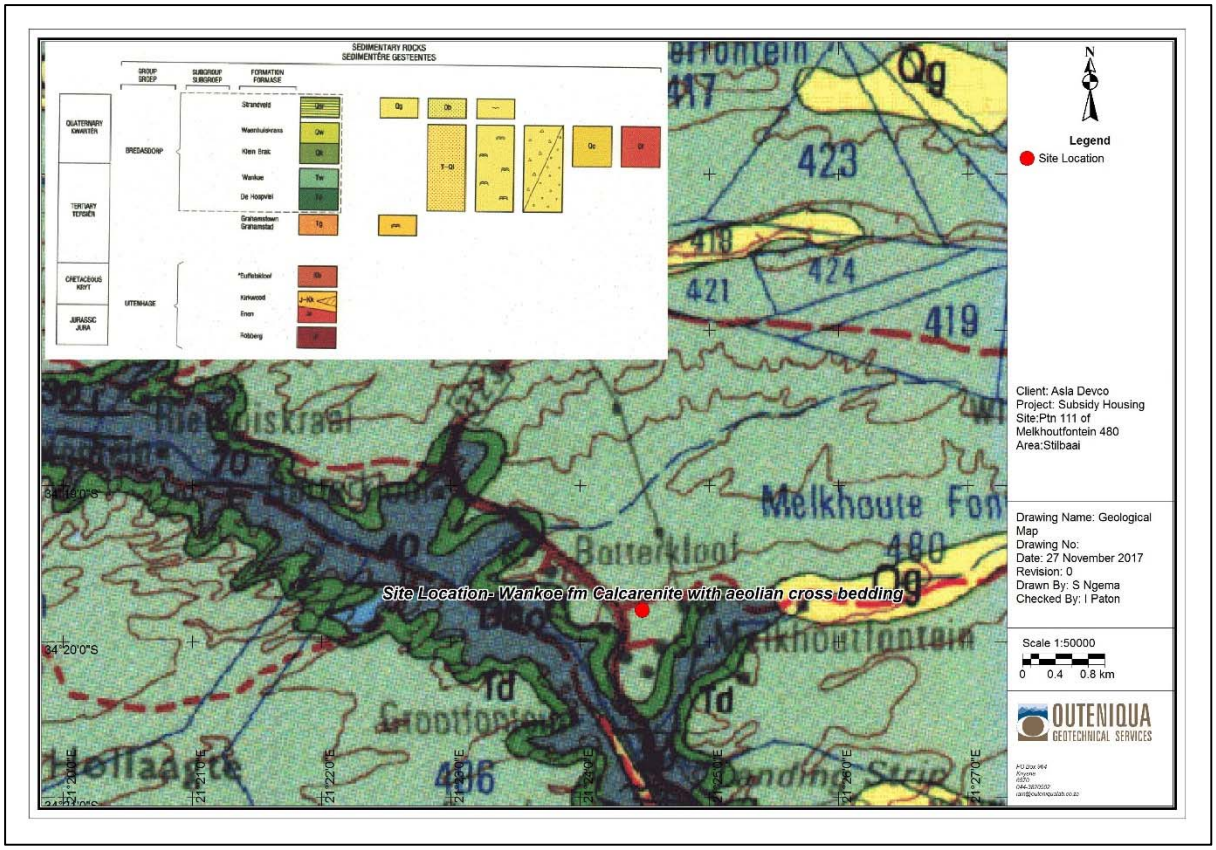



**Figure 5: Geological map**

**Figure 6: Hand specimen of the Calcarenite of the Wankoe Formation**

### 6.1.2 Soil types and rock

**Results of the investigation**

The soil profile is quite variable across the site, but generally consists of a transported topsoil horizon, consisting of silty sand and organic humus, which is underlain by soft to medium hard rock calcarenite or calcrete hardpan, which is underlain by unconsolidated to semi consolidated sand with marine shell fragments (see **Figure 7**). The calcarenite/calcrete hardpan layer is highly to completely weathered in places, resembling residual gravel, angular cobbles and/or small boulders (see **Figure 8**). The calcarenite/calcrete also occurs in low outcrops in several places across the site (see **Figure 9**) and several of the test pits refused at shallow depths on this hard, cemented layer. No significant uncontrolled fill material, such as rubbish or rubble was noted on the site.

**Effect on the proposed development**

The soils are generally not severely problematic but significant variations in soil structure and density warrants a conservative approach to foundation design. Several shallow refusals indicate potentially hard excavation conditions across many parts of the site. Recommendations are given in **Chapter 8**.


**Figure 7: Typical soil profile encountered in test pits**

**Figure 8: Calcarenite cobbles and boulders encountered at TP10**

**Figure 9: Calcarenite outcrop encountered near TP1**

A summary of the test pit data and the thickness of the different soil horizons is provided in **Table 1**.

**Table 1: Summary of soil horizons recorded in test pits (in mm)**

| *Test pos. No.* | *Imported (fill) soil* | *Transported soil* | *Residual soil* | *Rock* | *Total depth of test pit* | *Refusal?* |
|---|---|---|---|---|---|---|
| TP1 | - | - | - | 430 | 430 | Yes |
| TP2 | - | 150 | - | 50 | 200 | Yes |
| TP3 | - | 2300 | - | - | 2300 | No |
| TP4 | - | 2600 | - | - | 2600 | No |
| TP5 | - | 3000 | - | - | 3000 | Yes |
| TP6 | - | 2500 | - | - | 2500 | No |
| TP7 | - | 400 | - | - | 400 | Yes |
| TP8 | - | 1500 | | 400 | 1900 | No |
| TP9 | - | - | 150 | - | 150 | Yes |
| TP10 | - | - | 300 | - | 300 | Yes |
| TP11 | - | 200 | - | - | 200 | Yes |
| TP12 | - | 1600 | - | - | 1600 | Yes |
| TP13 | - | 400 | - | - | 400 | Yes |
| TP14 | - | 2200 | - | - | 2200 | No |
| TP15 | - | 2300 | - | - | 2300 | No |
| TP16 | - | 100 | - | 150 | 250 | Yes |
| TP17 | - | 300 | 400 | 200 | 900 | Yes |
| TP18 | - | 200 | - | - | 200 | Yes |
| TP19 | 150 | - | - | 150 | 300 | Yes |

### 6.1.3 Grading, Atterberg limits and potential expansiveness

**Results of the investigation**

Representative samples of different soil horizons were collected for Foundation Indicator tests in order to determine their basic geotechnical properties, estimate potential expansivity and evaluate their suitability as founding mediums. Abbreviated results of the tests are shown in **Table 2**. The samples tested are classified into the following categories under the Universal Soil Classification system:

ML - Inorganic silts, non-plastic silts, rock flour;
SM-SC – Silty sands, clayey sands;
SP-SM – Poorly graded sands, silty sands.

The tests confirm that all the samples tested are classified as fine granular soils (sands) or rock flour, with significant fines (clay and/or silt) in only a few samples. The plasticity index in all samples is typically less than 5 and the potential expansiveness is low/negligible.

**Table 2: Grading and Atterberg limits test results summary**

| Test Pit No | Sample Depth (mm) | Atterberg Limits | | | Particle Analysis (%) | | | | MC* | PE** | USC *** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | PI | LL | LS | Clay | Silt | Sand | Gravel | | | |
| TP3 | 1700-2300 | 3 | 20 | 1.5 | 19 | 5 | 74 | 2 | 13.2 | Low | SM |
| TP4 | 200-800 | 4 | 23 | 2 | 9 | 9 | 54 | 28 | 16 | Low | SM-SC |
| TP4 | 800-1400 | NP | NP | 0 | 11 | 5 | 83 | 1 | 12.6 | Low | SM |
| TP4 | 1400-3000 | 2 | 18 | 2 | 19 | 6 | 75 | 0 | 23.2 | Low | SM |
| TP6 | 1500-2500 | 2 | 16 | 1 | 13 | 4 | 83 | 0 | 18.9 | Low | SM |
| TP7 | 0-400 | NP | NP | 0 | 2 | 4 | 94 | 0 | 6.9 | Low | SP-SM |
| TP12 | 0-300 | 2 | 21 | 1 | 9 | 9 | 60 | 22 | 15.6 | Low | SM |
| TP12 | 700-1600 | NP | NP | 0 | 24 | 25 | 48 | 3 | 6.5 | Low | ML |
| TP14 | 300-2200 | NP | NP | 0 | 4 | 3 | 47 | 46 | 8.3 | Low | SP-SM |
| TP17 | 300-700 | 3 | 16 | 1 | 24 | 13 | 48 | 15 | 14.4 | Low | SM |

* Moisture content ** Potential expansiveness (Skempton's activity chart) *** Unified Soil Classification System

**Effect on the proposed development**

The insitu soils are not considered too problematic in terms of moisture sensitivity or heave, but may display some compressibility or collapse potential, which may have an impact on earthworks and affect foundation design. Foundation recommendations are given in **Chapter 8**.

### 6.1.4 Moisture/density relationship and CBR

**Results of the investigation**

Representative samples of soils were collected for Mod/CBR/Indicator tests in order to determine the moisture-density relationship, compaction and CBR properties for road subgrade and general filling purposes. The results of the tests are summarised in **Table 3**.

**Table 3: CBR test results summary**

| Test Pit No | Sample Depth (mm) | CBR at | | | | | Swell % | PI % | GM | MDD/OMC | TRH14 Class |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 100 % | 98% | 95% | 93% | 90% | | | | | |
| TP5 | 0-900 | 38 | 33 | 25 | 17 | 10 | 0.00 | NP | 1.01 | 1842/9.7 | G7 |
| TP12 | 300-700 | 68 | 56 | 43 | 28 | 14 | 0.00 | 3 | 1.78 | 1775/15.3 | G6 |
| TP14 | 300-2200 | 52 | 41 | 27 | 20 | 12 | 0.00 | NP | 2.13 | 1858/11.6 | G7 |
| TP15 | 250-800 | 65 | 30 | 31 | 20 | 21 | 0.00 | NP | 2.25 | 1812/15.4 | G7 |

The results indicate that the soils are generally good subgrade quality (G6 to G7 under the TRH14 system, A1 to A2-6 under the AASHTO system) and are potentially useful in engineered fill platforms, filling under floor/raft slabs and selected subgrade layers for roads.

**Effect on the proposed development**

Savings can be made by using the insitu soils as a natural fill material and selected subgrade material and road layerworks. Recommendations for structures and roads are given in **Chapter 8**.

### 6.1.5 pH and conductivity

**Results of the investigation**

Samples of *in situ* soils were collected for soil chemistry tests (pH & Conductivity) in order to determine the aggressiveness of the soil which can affect buried services and concrete foundations. A summary of the results of the pH and conductivity tests are shown in **Table 4**.

**Table 4: pH and conductivity test results summary**

| *Test Position* | *Depth* | *pH* | *Conductivity (mS/m)* |
|---|---|---|---|
| TP4 | 800-1500 | 7.57 | 1843 |
| TP7 | 0-400 | 6.66 | 1441 |
| TP17 | 300-700 | 8.20 | N/A |

Corrosion of metallic pipe fittings and concrete reinforcement may be negatively influenced by low or high pH, and high conductivity (indicating high concentration of dissolved salts in the soils). An indication of the influence of pH and conductivity on the corrosiveness of soil is given in **Table 5**.

**Table 5: Influence of pH and conductivity on the corrosiveness of soil**

| *pH* | *Conductivity (mS/m)* | *Potential Corrosiveness* |
|---|---|---|
| 7-8 | <10 | Non-corrosive |
| 5-6 or 9-10 | 10-20 | Mildly corrosive |
| 3-4 or 11-12 | 20-50 | Corrosive |
| <3 or >12 | >50 | Highly corrosive |

The lab results indicate high salts concentration which will be highly corrosive and aggressive towards buried metallic fittings.

**Effect on the proposed development**

Standard HDPE or uPVC pipe products will be suitable and buried metallic valves and fittings should be epoxy powder coated as standard. A minimum 40mm rebar cover in buried concrete foundations is recommended as a standard.

### 6.1.6 Compressibility, collapse potential and bearing capacity

**Results of the investigation**

In situ penetration tests (DCP) indicate significant variation in the consistency of the soil in the upper 0.7m of the profile, but consistently dense conditions below this level. Observation in test pits indicate significant variation in soil texture, structure and density throughout the profile, which means that compressibility will be difficult to predict. Consolidation/collapse potential tests were not very successful due to the friable nature

of the slightly cohesive or weakly cemented soils, which tended to break up on sampling or preparation. Some soils with low densities and fine pinhole texture were observed in some of test pits, indicating a potentially compressible and/or collapsible fabric. However, bearing capacity for light structures is not considered a major problem due to the presence of significantly dense soil horizons, and even hardpan lenses, which significantly improve bearing capacity. Settlement may be a concern if loose sandy soils are not adequately compacted to increase density.

**Effect on the proposed development**

Improvement (compaction) of the founding conditions and improved/modified foundations will be required to prevent differential settlement. Foundation recommendations are discussed in more detail in **Chapter 8**.

### 6.1.7 Swell / heave

**Results of the investigation**

Foundation Indicator test results reported a low potential expansiveness. No heave is expected.

**Effect on the proposed development**

No extra precautions are required to cater for heave.

### 6.1.8 Soil moisture, permeability and groundwater

**Results of the investigation**

The site is located in a temperate, moderate climatic area which experiences seasonal wet conditions (Weinert-N Climatic No. 4). A detailed study of the contour plan reveals some significant undulations in the surface topography and some poorly defined ephemeral drainage lines crossing the site. Generally, the site drains towards the southeast but there are some localised depressions which could be poorly drained, particularly in the western and southeastern parts of the site. In general, the soil permeability is medium, but the presence of cemented calcarenite rock/ hardpan layers will negatively affect infiltration of storm water, resulting in significant run-off or ponding on surface.

**Effect on the proposed development**

Groundwater is highly unlikely to have a significant effect on foundations or earthworks. The design of stormwater systems must take into account the site topography for suitable stormwater discharge points. Recommendations for site drainage and stormwater design are given in **Chapter 9**.

### 6.1.9 Existing structures

**Results of the investigation**

There are no existing structures onsite.

**Effect on the proposed development**

Demolition of structures and relocation of inhabitants will not be necessary.

## 6.2 Slope stability and erosion

The natural slope gradient is gentle to moderate and there are no signs of macro slope instability on the.

Temporary shallow excavations are likely to be generally stable but deep excavations exceeding 1.5m high should be battered to safe working angle of 35° and assessed by the engineer.

## 6.3 Excavation classification with respect to services

Shallow refusal was recorded with a TLB/back-actor in many of the test pits and depths ranging from 0.1m to 0.5m. In most cases, excavations to a depth of 0.5m can be accomplished with a TLB and are classified as soft in terms of SABS 1200D, but a 30t excavator with a rock bucket attachment will be required to excavate below this depth in many areas, and therefore excavations below 0.5m are classified as "intermediate or hard" for preliminary costing purposes.

## 6.4 Impact of the geotechnical character of the site on subsidy housing developments

The geotechnical subsidy variations are tabulated in **Table 6**.

**Table 6: Site specific geotechnical subsidy variations**

| ***Geotechnical Conditions*** | ***Category or type*** | ***Criteria*** | ***Precautionary measures*** | ***Applicable areas*** | ***Comment*** |
|---|---|---|---|---|---|
| Seepage / groundwater | Category 1 | Permanent or perched water tables less than 1.0m below ground surface | Subsurface drainage/improved damp-proofing measures to houses, service trenches to be dewatered during construction | None | |
| | Category 2 | Permanent or perched water tables more than 1m but less than 1.5m below ground level | Service trenches to be dewatered during construction | None | |
| Erodability of soil | Category 1 | High risk (Erodability index 1-8) | Retaining walls & earthworks to reduce slopes & surface drainage | None | |
| | Category 2 | Medium risk (Erodability index 9-15) | Retaining walls & earthworks to reduce slopes | Yes | |
| Hard excavation | Category 1 | Hard rock excavation to a depth of 1.5m | Additional cost of trench and foundation excavation | All areas | |
| | Category 2 | Boulder excavation to a depth of 1.5m | Additional cost of trench, foundation and road excavation | None | |
| Dolomite | Category 1 | Risk class 1&2 (Dolomite area class D2) | Additional cost of foundations | None | |
| | Category 2 | Risk class 3&4 (Dolomite area class D3) | Additional cost of foundations | None | |

| ***Geotechnical Conditions*** | ***Category or type*** | ***Criteria*** | ***Precautionary measures*** | ***Applicable areas*** | ***Comment*** |
|---|---|---|---|---|---|
| Expansive Clays | Category 1 | H1 | Foundation design, building procedures and precautionary measures: Modified normal | None | |
| | Category 2 | H2 | Foundation design, building procedures and precautionary measures: Light/medium raft | None | |
| | Category 3 | H3 | Foundation design, building procedures and precautionary measures: Heavy raft | None | |
| Compressible and Collapsible soils | Category 1 | C1 | Foundation design, building procedures and precautionary measures: Modified normal | All areas | |
| | Category 2 | C2 | Foundation design, building procedures and precautionary measures: Light or heavy raft | None | |
| Compressible soils | Category 1 | S1 | Foundation design, building procedures and precautionary measures: Modified normal | None | |
| | Category 2 | S2 | Foundation design, building procedures and precautionary measures: Light or heavy raft | None | |
| Mining subsidence | Category 1 | Old undermining to a depth of between 90-240m below surface where stope closure has ceased | Additional cost of foundations: Compaction below footings or raft | None | |
| | Category 2 | Old undermining to a depth of between 90-240m below surface where total extraction has taken place | Additional cost of foundations: additional earthworks or soil reinforcement | None | |
| Seismic activity | Category 1 | Mining induced seismic activity > 100cm/s$^2$ | Additional cost of foundations: Stiffened strip footings or raft | None | |
| | Category 2 | Natural seismic activity > 100cm/s$^2$ | Additional cost of foundations: Stiffened strip footings or raft | None | |
| Topography | Category 1 | Average ground slope flatter than 1:20 | Increase depth of sewer & provision of pump station | | |
| | Category 2 | Average ground slope of between 1:11 and 1:20 | Terracing for houses & additional earthworks to roads & storm water control measures | All areas | Average slope Estimated |

| Geotechnical Conditions | Category or type | Criteria | Precautionary measures | Applicable areas | Comment |
|---|---|---|---|---|---|
| | Category 3 | Average ground slope of between 1:7.5 and 1:10 | Terracing for houses & additional earthworks to roads & storm water control measures | | |
| | Category 4 | Average ground slope of between 1:5 and 1:7.4 | Terracing for houses & additional earthworks to roads & storm water control measures | | |
| | Category 5 | Average ground slope steeper than 1:5 | Terracing for houses & additional earthworks to roads & storm water control measures | | |
| SCCCA | Southern Cape Coastal Condensation Area | Area subjected to severe condensation conditions | Plaster and paint on all external walls & 6.4mm gypsum plasterboard ceilings & 80mm thick glass fibre insulation | All areas | |
| Location of development site | | Site more than 20km from major centres | Additional cost of transportation | All areas | Mossel Bay 85km |

## 7. Site classification

The site is broadly mapped according to distinguishable geotechnical terrains and the applicable residential site designations, according the SAICE Code of Practice for Single Storey Structures of Masonry Construction (1995), are assigned to each terrain as shown in **Table 7** (also refer to **Figure 10**). The entire the site is classified as one single terrain (Terrain 1) which is characterised by potentially compressible and/or collapsible soils with less than 10mm potential movement (C1), and shallow rock or hardpan at a depth less than 1.5m (R). The presence of hard rock or hardpan may not occur over the entire site, but it is unpredictable and not worth trying to distinguish between areas where shallow refusals occurred and where they didn't, and it is more practical to apply a blanket classification across the entire site.

**Table 7: SAICE site classification**

| Terrain Unit | Geotechnical Constraint | Expected movement (mm) | NHBRC Site Classification |
|---|---|---|---|
| Terrain 1 | Compressible and/or collapsible soil | <10 | C1 |
| | Shallow rock | - | R |

## 8. Foundation recommendations and solutions

The following recommendations are provided in good faith and are based on the information gained from the investigation. Although the confidence in the information is high, some variation can be expected between the data points and the design engineers should take cognisance of this. The design of structures and services remains the responsibility of the appointed engineers. Any significant variation from the expected geotechnical conditions should be brought to the author's attention for comment.

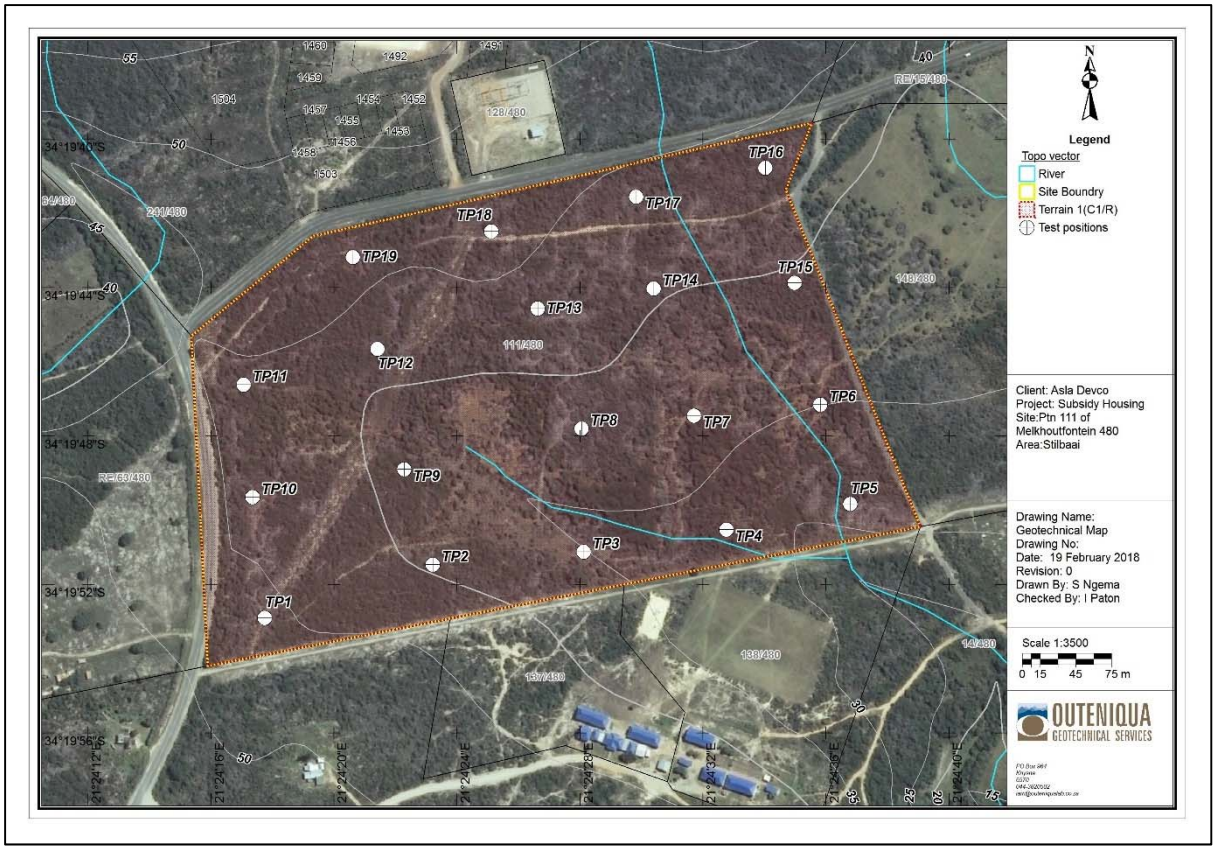



**Figure 10: Geotechnical map**

## 8.1 Earthworks and structural foundations

Earthworks should be conducted in accordance with SABS 1200D, COLTO 3300 and/or other applicable standard specifications. Foundations should be constructed in accordance with the NHBRC Home Builders Manual, SANS 10400-H and/or other applicable standards or as otherwise directed by the engineer.

Organic matter and any organic-rich topsoil and should be cleared from the site area before bulk earthworks commence. The insitu soils are suitable for use as natural fill materials for platforms, bulk fills on roads, and even possibly under floor slabs/rafts with minimal selection required to remove oversize particles (boulders) which may hamper compaction. Boulders exceeding 0.3m should be cut to spoil. At the engineer's discretion, allowance can be made for importation of G7 selected material for high quality filling purposes under floors. Soil obtained from excavations for service trenches and road box cuts should be approved by the civil engineer before placement (minimum G9 recommended quality). Bulk fill compaction should be carried out at optimum moisture content and the minimum recommended density is 93% of the Mod AASHTO maximum dry density. In a case where the insitu soils are deemed unworkable (e.g. too wet), they should be replaced with suitable drier fill material ex insitu or from commercial sources. The presence of shallow rock or outcrops will affect excavations for foundations, service trenches and platforming, and allowance must be made for heavy excavators and rock bucket attachments. No blasting is required, but in places where the calcrete is hard/thick, hydraulic attachments (pecker) may be required to wedge & split.

The recommended foundation system for single and double storey structures across the entire site is lightly reinforced strips or light rafts on well compacted insitu soils or engineered platforms (min G9, compacted to 93% of MDD). Fill under raft floor slabs should be at least G7 material below the foundation (recommend min 0.3m, compacted to 93% Mod AASHTO). Design bearing pressures should be limited to 75kPa.

### 8.2 Road pavements

Roads should be constructed in accordance with SABS 1200, COLTO, TRH4, TRH14, TRH15, The Red Book and/or other applicable specifications and standards, or as directed by the engineer.

Test results indicate that the subgrade quality is highly variable but generally consisting of good/fair subgrade conditions (G7, SG class 1). It is recommended that G7 quality is assumed for design purposes, but at the engineer's discretion, allowance can be made for importation of a G7 upper SSG layer to create a uniform subgrade layer for ease of compaction of the subbase. Subbase and base course material would have to be imported as per normal.

General preparation of the subgrade:

- Cut roadbed to line and level;
- Rip 150mm insitu soil and compact to 90% of Mod. AASHTO density (LSSG). Recommended moisture content before rolling is optimum moisture content (OMC) minus 2%;
- Remove any incompressible or wet soil and reinstate with imported G7 material or suitably drier organic-free *in situ* soil, as directed by the engineer.
- Place 150mm G7 (ex insitu or imported from commercial sources) and compact to 93% MDD (USSG).

**Table 8** serves as a guideline for the design of a Category C flexible pavement in a moderate climatic region with a design life of 15 years with traffic loading of less than 3 x $10^6$ E80s over 20 years (as per TRH4).

**Table 8: Road layerworks recommendations (Cat C in moderate climate)**

| ***Layer*** | ***Material*** | ***Thickness mm*** | ***Required Compaction*** |
|---|---|---|---|
| Seal | Cape Seal | 13/19 | TBD by engineer |
| Base | Imported G2/3 | 150 | 100% MDD |
| Subbase | Imported G5 | 150 | 95% MDD |
| USSG | Insitu/imported G7 | 150 | 93% MDD |
| LSSG | Insitu G7 | 150 | 93% MDD |
| | | | |
| OR | | | |
| | | | |
| Seal | n/a | n/a | n/a |
| Base | Interlocking cement pavers | 80 | n/a |
| Subbase | C4 (Imported G4/5) | 150 | 95% MDD |
| USSG | Insitu/imported G7 | 150 | 93% MDD |
| LSSG | Insitu G7 | 150 | 93% MDD |

## 9. Storm water drainage recommendations

The design and construction of storm water drainage should be carried out in accordance with SABS 1200LE, COLTO, TRH15, The Red Book or other applicable standards, or as directed by the engineer.

Irregular slope gradients, topographic depressions and the presence of natural drainage lines will affect stormwater drainage, and the design of stormwater systems will require

careful attention. Infiltration into the soil can be slow and restricted by shallow rock, and a significant portion of rainfall will end up as run-off or standing water. The design of storm water systems will have to ensure effective site drainage during flood events. Underground piped storm-water systems with drop inlets are recommended to cater for minor flood events, and major flood waters should be accommodated along roads. To this end, raised barrier kerbs, mountable or semi-mountable kerbs along roads are recommended in order to channel storm water along roads and prevent over-topping into erven. Subsoil drains along roads are not envisaged due to the dearth of clayey subgrade soils or shallow water tables.

The ponding of storm water around the exterior of houses can be avoided by shaping the ground levels around the exterior to create a fall away from the house and constructing a 1m wide a concrete apron with a 10% fall away from the house. This will also assist in maintaining ground moistures stable and minimising erosion around the house. The finished floor level of all houses should be a minimum of 150mm above final ground level to prevent flooding.

## 10. Special precautionary measures

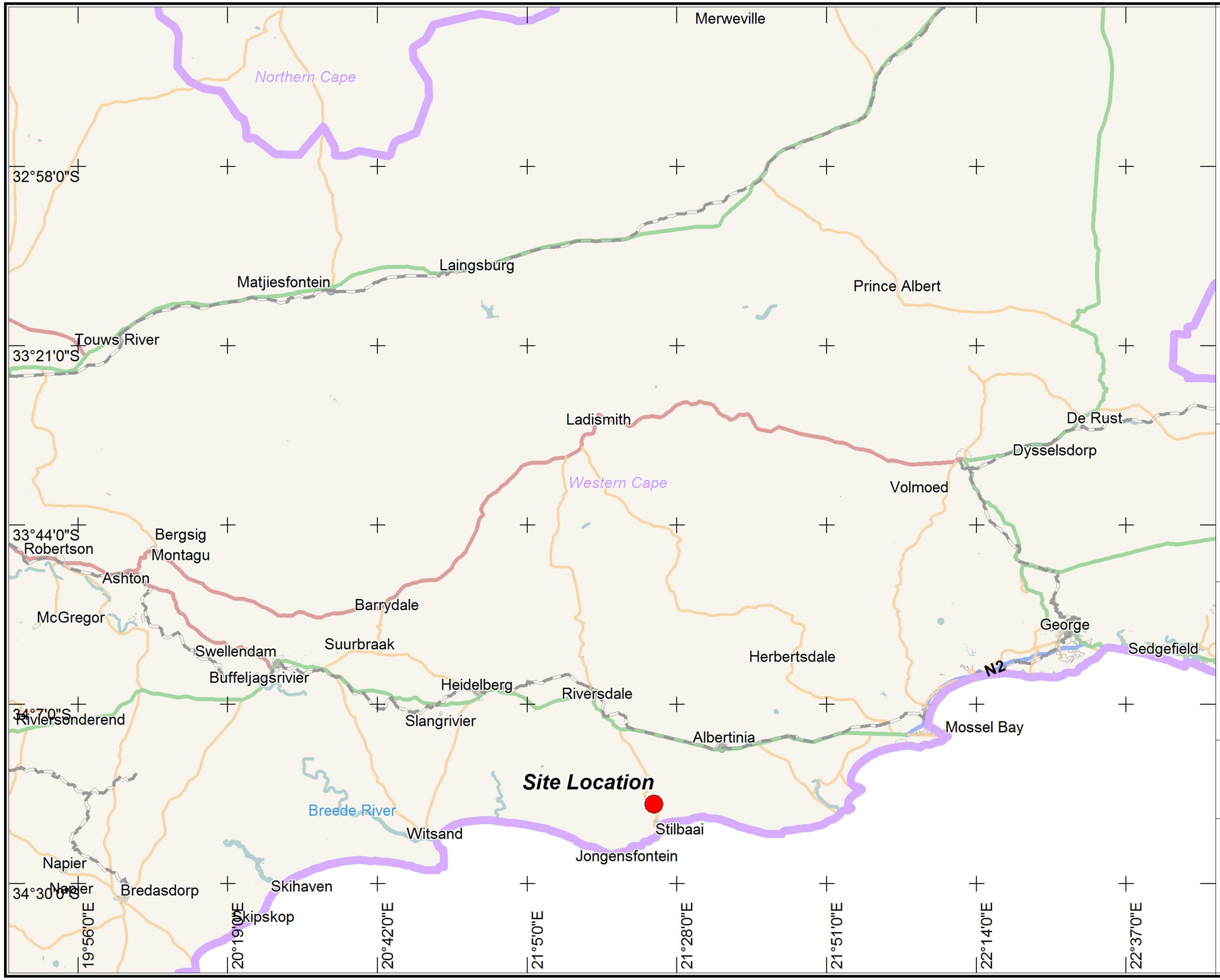
There are no special geotechnical engineering measures envisaged for this site.

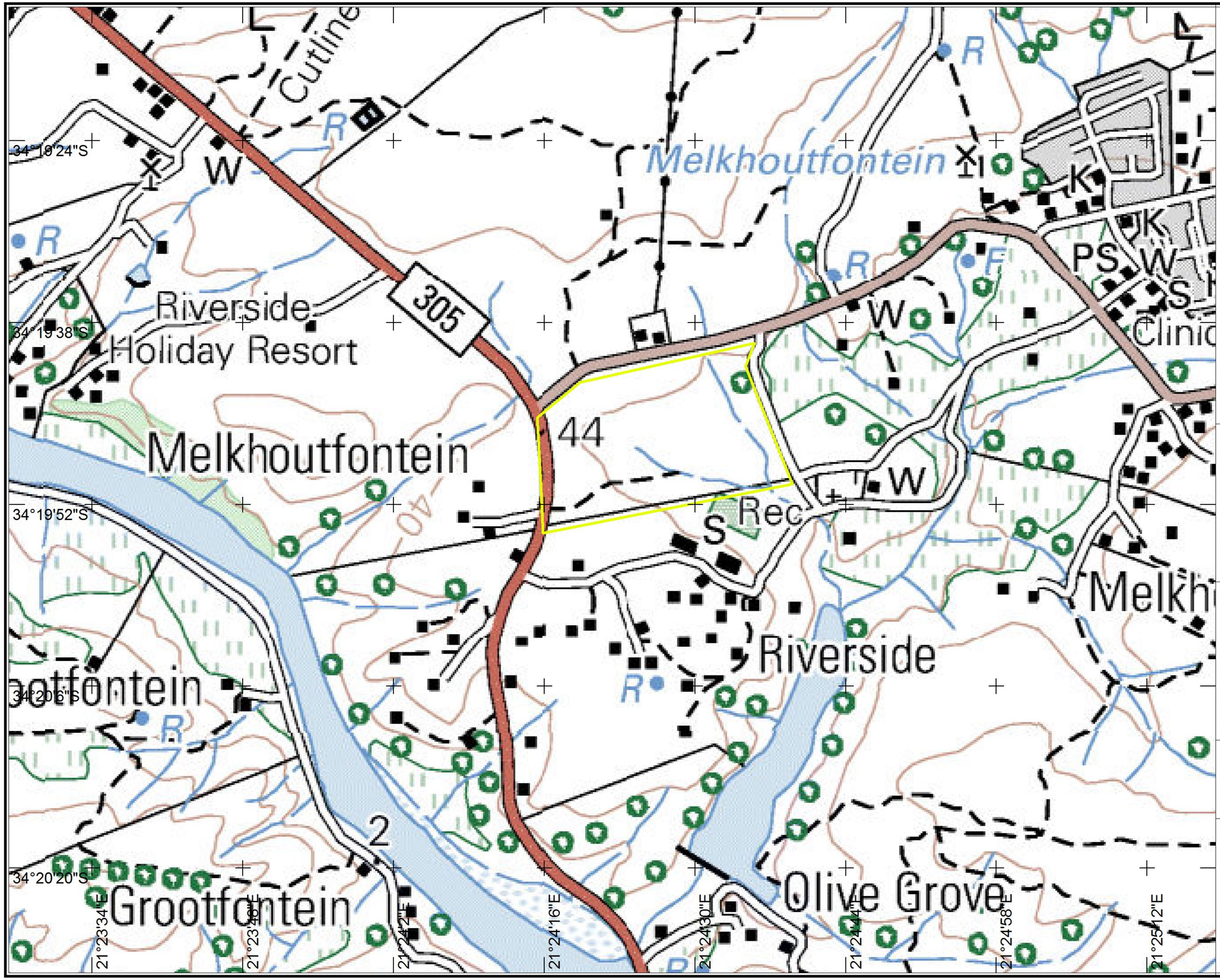
## 11. Conclusions

The geotechnical investigations indicate that the site geology and ground conditions are generally suitable for the proposed development with conventional engineering, but there are some geotechnical constraints which may impact on the engineering design and subsidy variations and will require consideration by the designers.

# Appendix 1

# Maps


Merweville
Northern Cape
32°58'0"S
Laingsburg
Matjiesfontein
Prince Albert
Touws River
33°21'0"S
Ladismith
De Rust
Dysselsdorp
Western Cape
Volmoed
33°44'0"S
Bergsig
Robertson
Montagu
Ashton
Barrydale
McGregor
George
Suurbraak
Swellendam
Sedgefield
Herbertsdale
Buffeljagsrivier
N2
Heidelberg
Riversdale
34°7'0"S
Riviersonderend
Slangrivier
Albertinia
Mossel Bay
Site Location
Breede River
Witsand
Stilbaai
Jongensfontein
Napier
Bredasdorp
Skihaven
34°30'0"S
Skipskop
19°56'0"E
20°19'0"E
20°42'0"E
21°5'0"E
21°28'0"E
21°51'0"E
22°14'0"E
22°37'0"E
N
Legend
Site Location
Client: Asla Devco
Project: Subsidy Housing
Site:Ptn 111 of
Melkhoutfontein 480
Area:Stilbaai
Drawing Name: Locality Map
Drawing No:
Date: 08 February 2018
Revision: 0
Drawn By: S Ngema
Checked By: I Paton
Scale 1:1250000
0 6 12 18 24 30 km
OUTENIQUA
GEOTECHNICAL SERVICES
PO Box 964
Knysna
6570
044-3820502
iain@outeniqualab.co.za




**Legend**

Site Boundry

Client: Asla Devco
Project: Subsidy Housing
Site:Ptn 111 of Melkhoutfontein 480
Area:Stilbaai

Drawing Name: Topographic Map
Drawing No:
Date: 08 February 2018
Revision: 0
Drawn By: S Ngema
Checked By: I Paton

Scale 1:12500

0 60 180 300 m

OUTENIQUA GEOTECHNICAL SERVICES

*PO Box 964*
*Knysna*
*6570*
*044-3820502*
*iain@outeniqualab.co.za*


N

**Legend**

Topo vector

- River
- Site Boundry

Client: Asla Devco
Project: Subsidy Housing
Site:Ptn 111 of Melkhoutfontein 480
Area:Stilbaai

Drawing Name: Topographic Map
Drawing No:
Date: 08 February 2018
Revision: 0
Drawn By: S Ngema
Checked By: I Paton

Scale 1:10000

0 50 150 250 m

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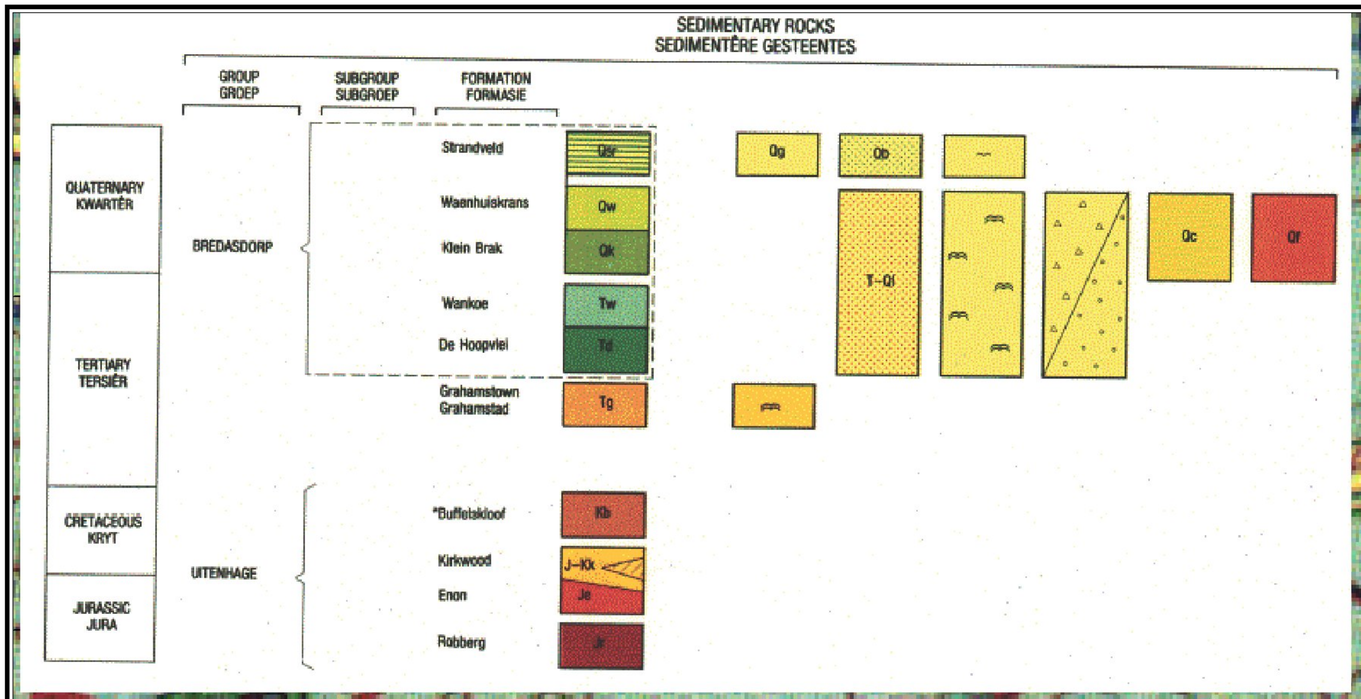
*PO Box 964*
*Knysna*
*6570*
*044-3820502*
*iain@outeniqualab.co.za*







*Site Location- Wankoe fm Calcarenite with aeolian cross bedding*

N

**Legend**

Site Location

Client: Asla Devco
Project: Subsidy Housing
Site:Ptn 111 of
Melkhoutfontein 480
Area:Stilbaai

Drawing Name: Geological Map
Drawing No:
Date: 27 November 2017
Revision: 0
Drawn By: S Ngema
Checked By: I Paton

Scale 1:50000

0 0.4 0.8 km

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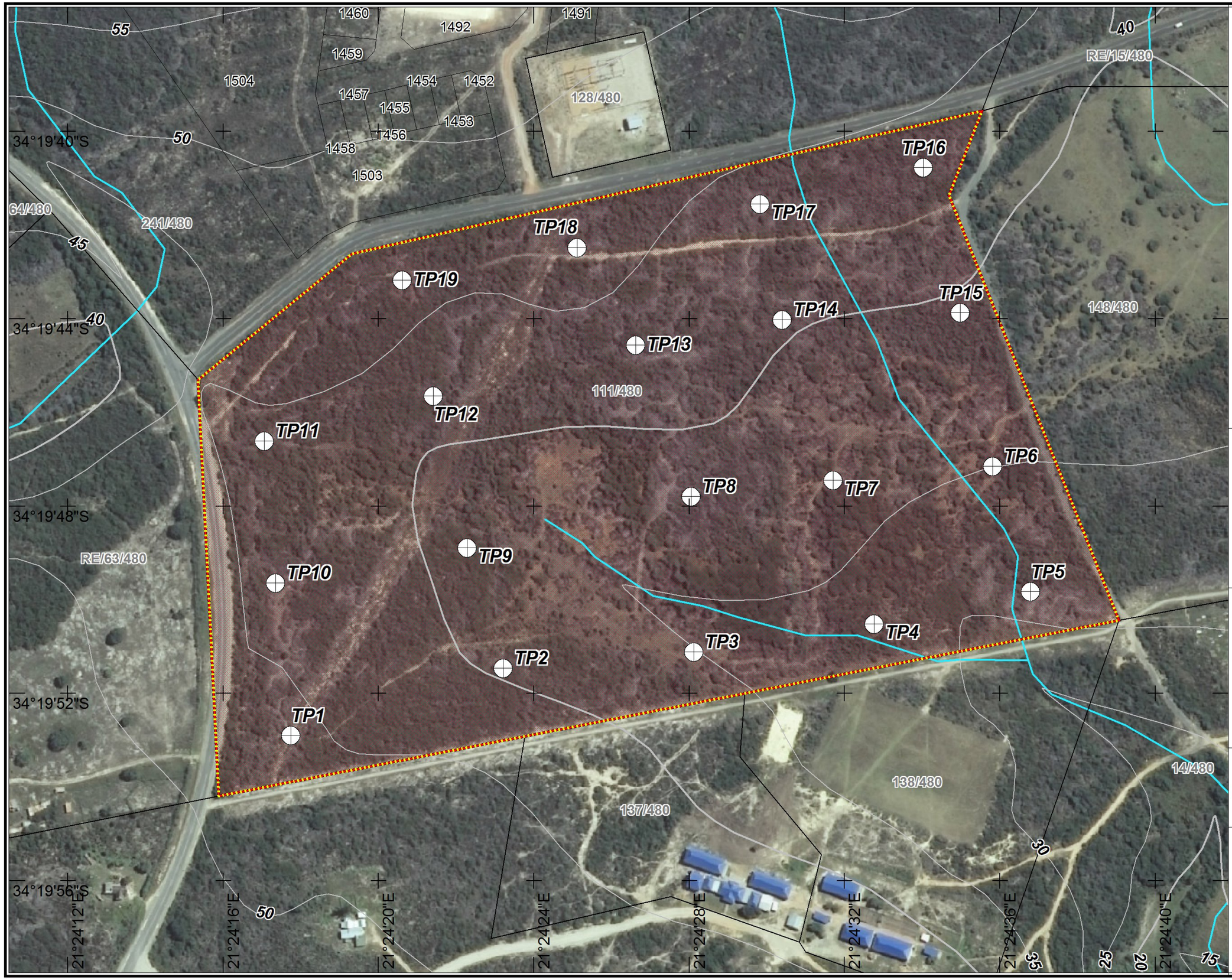
GEOTECHNICAL SERVICES

*PO Box 964*
*Knysna*
*6570*
*044-3820502*
*iain@outeniqualab.co.za*




N

**Legend**

Topo vector

- River
- Site Boundry
- Terrain 1(C1/R)
- Test positions

Client: Asla Devco
Project: Subsidy Housing
Site:Ptn 111 of
Melkhoutfontein 480
Area:Stilbaai

Drawing Name:
Geotechnical Map
Drawing No:
Date: 19 February 2018
Revision: 0
Drawn By: S Ngema
Checked By: I Paton

Scale 1:3500

0 15 45 75 m

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*PO Box 964*
*Knysna*
*6570*
*044-3820502*
*iain@outeniqualab.co.za*

# Appendix 2

# Test pit profiles

OUTENIQUA GEOTECHNICAL SERVICES

# Geotechnical Soil Profile

| | |
|---|---|
| Client: | Asla Devco |
| Project: | Subsidy Housing Project, Portion 111 of Melkhoutfontein 480 |
| Area: | Still Bay |
| Date: | 29.11.17 |
| Excavator: | TLB |

## TP 1

Datum: NGL | Co-ords: 21 Y-037264 X3800492

Key to symbols: ● Sample taken | Groundwater

A

0 200 400 600 800 1000 1200 1400 1600 1800 2000

(0 to 430) Light yellow orange, highly weathered, medium to coarse grained, cross bedded, fractured, soft to medium hard rock, **CALCARENITE**.

**Refusal on rock**
**No water table**

Dynamic Cone Penetrometer (DCP)

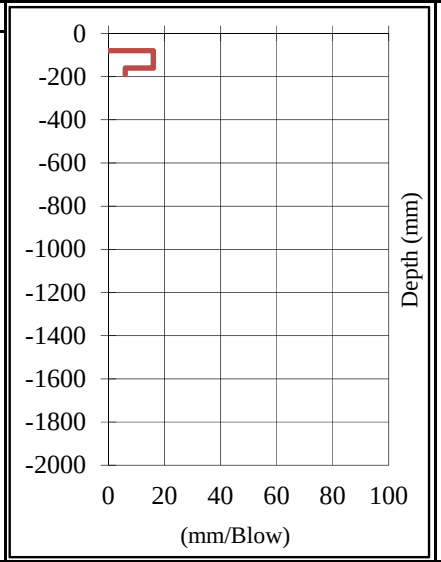



Photo of Test Pit


## TP 2

Datum: NGL | Co-ords: 21 Y-037403 X3800448

Key to symbols: ● Sample taken | Groundwater

A
B

0 200 400 600 800 1000 1200 1400 1600 1800 2000

(0 to 150) Moist, light brown, very loose, intact, organic humus.
(150 to 200) Light yellow orange to white, highly weathered, medium to coarse grained, soft rock **CALCARENITE**.

**Refusal on rock**
**No water table**

Dynamic Cone Penetrometer (DCP)

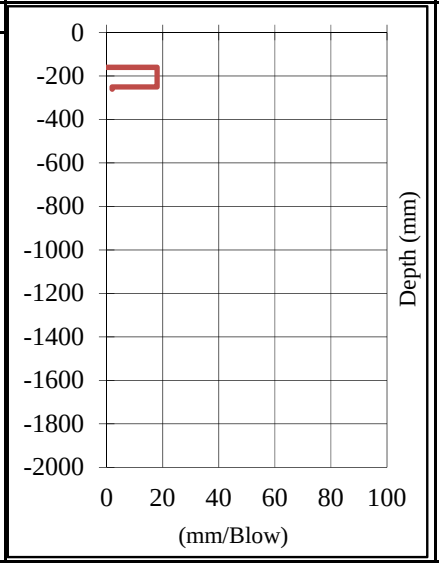



Photo of Test Pit

OUTENIQUA GEOTECHNICAL SERVICES

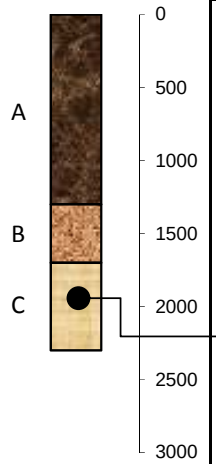
# Geotechnical Soil Profile

| | |
|---|---|
| Client: | Asla Devco |
| Project: | Housing Project, Portion 111 of Melkhoutfontein 480 |
| Area: | Still Bay |
| Date: | 29.11.17 |
| Excavator: | TLB |

## TP 3

Datum: NGL | Co-ords: 21 Y-037529 X3800438

Key to symbols: ● Sample taken | Groundwater




(0 to 1300) Moist, dark red brown, very loose, pinholed, **SILTY SAND**, transported (topsoil)

(1300 to 1700) Moist, light red orange to white, very dense, intact, **GRAVELLY SILTY SAND**, pedogenic (calcarenite)

(1700 to 2300) Very moist, dark yellow orange, medium dense, intact, slightly **CLAYEY SILTY FINE SAND**, transported (with minor calcarenite)

**Foundation Indicator**

**TP stopped**

**No water table**

Dynamic Cone Penetrometer (DCP)

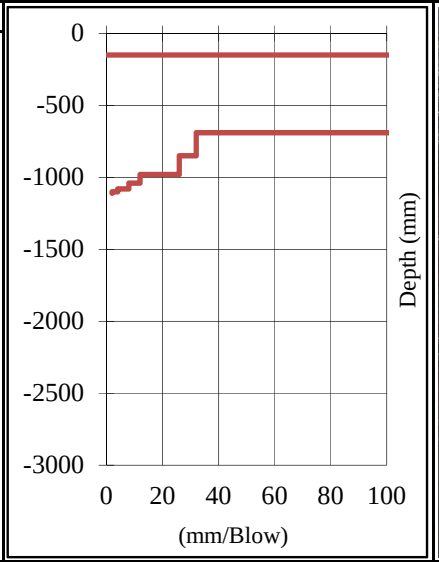
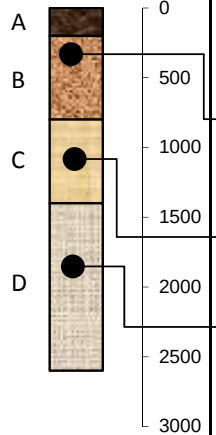



Photo of Test Pit


## TP 4

Datum: NGL | Co-ords: 21 Y-037648 X3800420

Key to symbols: ● Sample taken | Groundwater




(0 to 200) Moist, dark red brown, very loose, intact, **SILTY SAND & HUMUS**, transported (topsoil)

(200 to 800) Moist, light brown, very dense, cross bedded, **GRAVELLY SAND**, residual/pedogenic (weathered calcarenite)

**Foundation Indicator**

(800 to 1400) Moist, dark yellow orange, medium dense, intact, slightly **CLAYEY SILTY FINE SAND**, transported.

**Foundation Indicator**

**pH & Conductivity**

(1400 to 2600) Very moist, light yellow-green, medium dense, intact, slightly **CLAYEY SILTY FINE SAND**, transported.

**Foundation Indicator**

**Consolidation Tests**

**TP stopped**

**No water table**

Dynamic Cone Penetrometer (DCP)

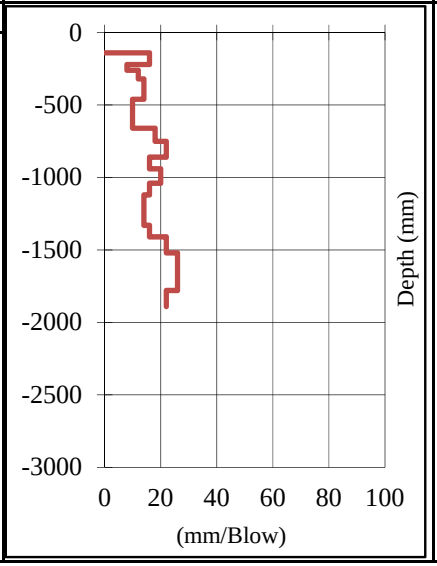
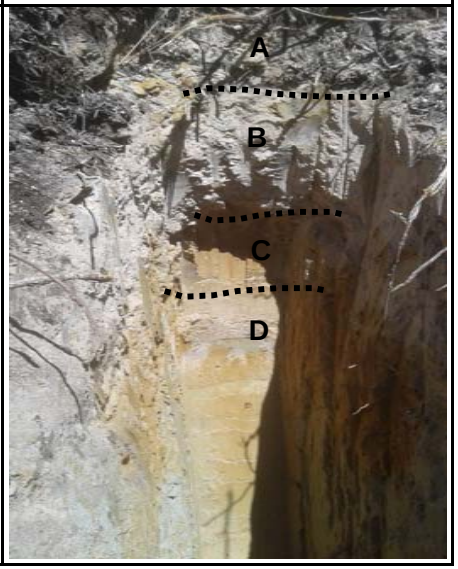



Photo of Test Pit



OUTENIQUA GEOTECHNICAL SERVICES

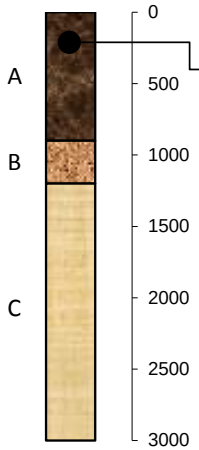
# Geotechnical Soil Profile

| | |
|---|---|
| Client: | Asla Devco |
| Project: | Housing Project, Portion 111 of Melkhoutfontein 480 |
| Area: | Still Bay |
| Date: | 29.11.17 |
| Excavator: | TLB |

## TP 5

Datum: NGL | Co-ords: 21 Y-037751 X3800399

Key to symbols: ● Sample taken | Groundwater




(0 to 900) Moist, dark red brown, very loose, intact, **SILTY SAND & HUMUS**, transported (topsoil)

**MOD/CBR/Indicator**

(900 to 1200) Moist, light brown to light yellow, very dense to medium dense, intact, **GRAVELLY SILTY SAND**, pedogenic/residual (completely weathered calcarenite)

(1200 to 3000) Very moist to wet, dark yellow to light green, medium dense, intact, **GRAVELLY SILTY SAND**, transported.

**Refusal on Shale (rock fragments recovered)**

**Perched water table @ 2800mm**

Dynamic Cone Penetrometer (DCP)

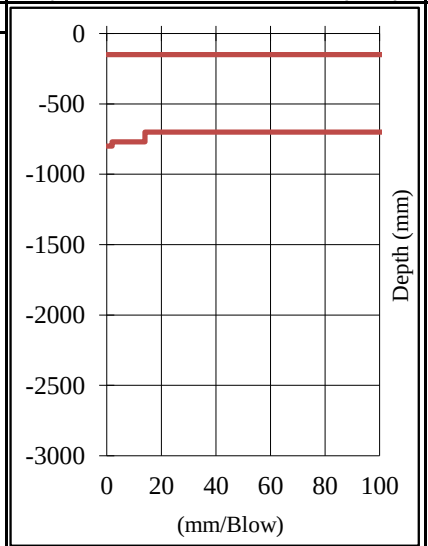
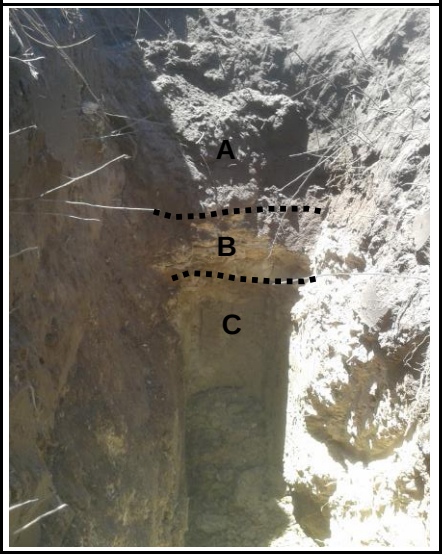


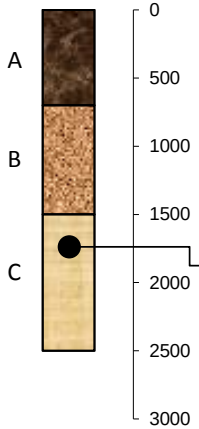

Photo of Test Pit




## TP 6

Datum: NGL | Co-ords: 21 Y-037726 X3800317

Key to symbols: ● Sample taken | Groundwater




(0 to 700) Moist, light red orange, loose, intact, **SILTY SAND,** transported.

(700 to 1500) Moist, light yellow brown to light red, medium dense to very dense, remnant cross bedded, **CLAYEY SILTY SANDY GRAVEL**, pedogenic (calcarenite)

(1500 to 2500) Very moist, light yellow orange to light green, medium dense, intact, **SILTY CLAYEY SAND**, transported.

**Foundation Indicator**

**TP stopped**

**No water table**

Dynamic Cone Penetrometer (DCP)

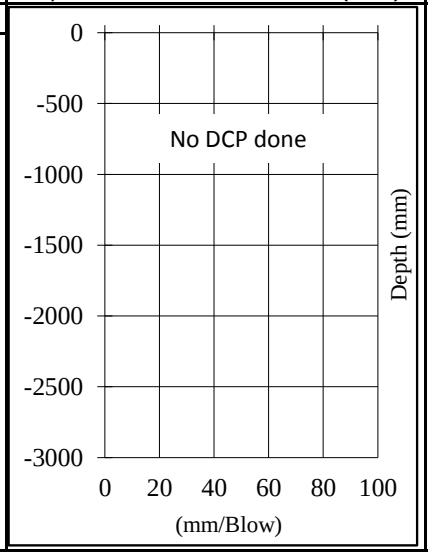
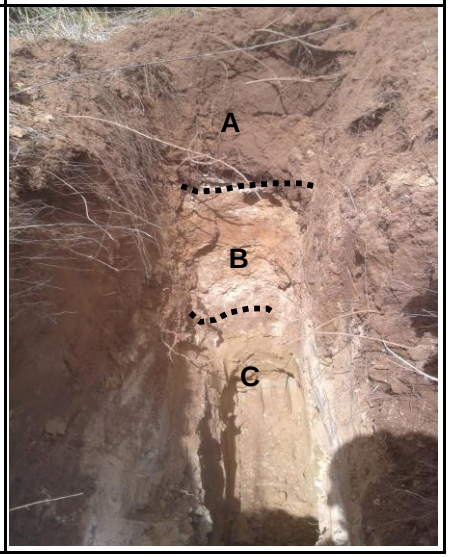



Photo of Test Pit



# Geotechnical Soil Profile

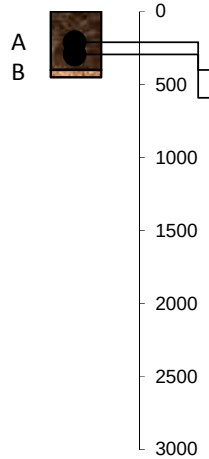
OUTENIQUA GEOTECHNICAL SERVICES

| | |
|---|---|
| Client: | Asla Devco |
| Project: | Housing Project, Portion 111 of Melkhoutfontein 480 |
| Area: | Still Bay |
| Date: | 29.11.17 |
| Excavator: | TLB |

## TP 7

Datum: NGL | Co-ords: 21 Y-037621 X3800325

Key to symbols: ● Sample taken | Groundwater




(0 to 400) Moist, dark red brown, very loose, intact, **SILTY SAND,** transported.

**Foundation Indicator**

**pH & Conductivity**

(400 to 450) Light brown, highly weathered, soft rock **CALCARENITE**

**Refusal on calcarenite**

**No water table**

Dynamic Cone Penetrometer (DCP)

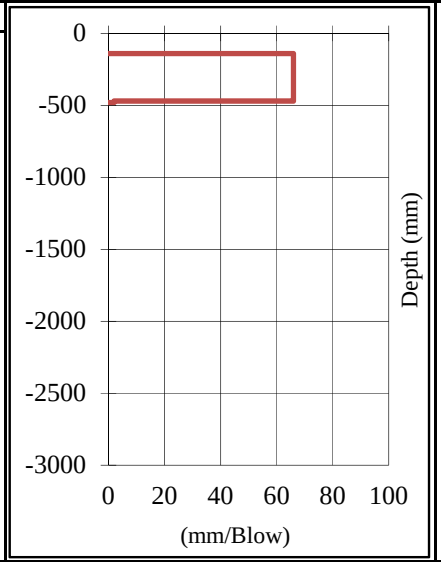
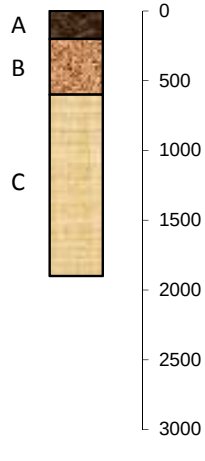



Photo of Test Pit


## TP 8

Datum: NGL | Co-ords: 21 Y-037528 X3800336

Key to symbols: ● Sample taken | Groundwater




(0 to 200) Moist, dark red brown, very loose, intact, **SILTY SAND & HUMUS,** transported.

(200 to 600) Light yellow orange, highly weathered, coarse to medium grained, very soft becoming medium hard **CALCARENITE**.

(600 to 1900) Moist, light yellow orange, dense to very dense, intact, calcareous **SILTY SAND**, aeolian/pedogenic.

**Tp stopped due to very slow progress**

**No water table**

Dynamic Cone Penetrometer (DCP)

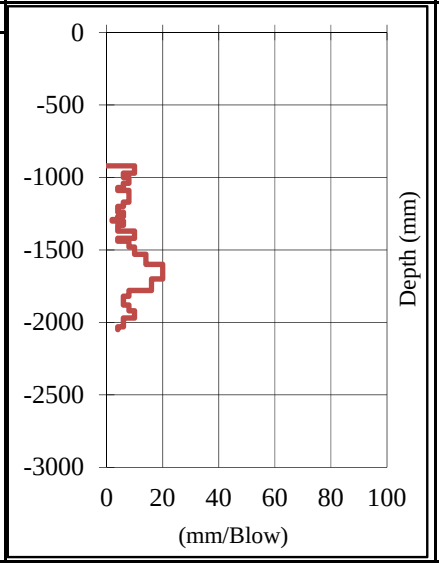
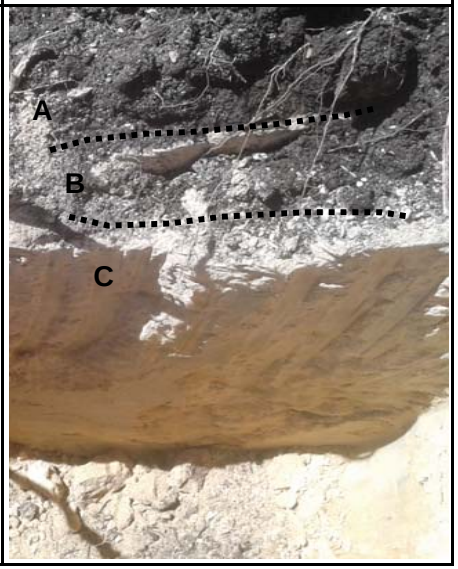



Photo of Test Pit



OUTENIQUA GEOTECHNICAL SERVICES

# Geotechnical Soil Profile

| | |
|---|---|
| Client: | Asla Devco |
| Project: | Housing Project, Portion 111 of Melkhoutfontein 480 |
| Area: | Still Bay |
| Date: | 29.11.17 |
| Excavator: | TLB |

## TP 9

Datum: NGL | Co-ords: 21 Y-037380 X3800369

Key to symbols: Sample taken | Groundwater

A

0 / 500 / 1000 / 1500 / 2000 / 2500 / 3000

(0 to 150) Moist, light brown, medium dense, intact, **SILTY SANDY GRAVEL & COBBLES & BOULDERS,** completely weathered calcarenite

(150 to 200) Light brown, highley weatehred, soft rock **CALCARENITE**

**Refusal on rock**
**No water table**

Dynamic Cone Penetrometer (DCP)

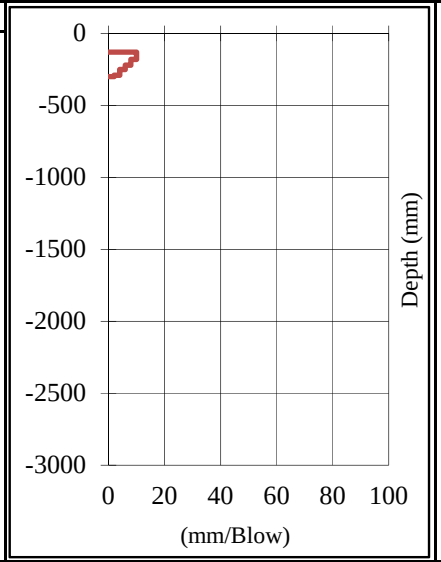



Photo of Test Pit


## TP 10

Datum: NGL | Co-ords: 21 Y-037254 X3800392

Key to symbols: Sample taken | Groundwater

A

0 / 500 / 1000 / 1500 / 2000 / 2500 / 3000

(0 to 300) Moist, light brown, medium dense, intact, **BOULDERS**, residual weathered calcarenite

(300 to 350) Light brown, highley weatehred, soft rock **CALCARENITE**

**Refusal on rock**
**No water table**

Dynamic Cone Penetrometer (DCP)

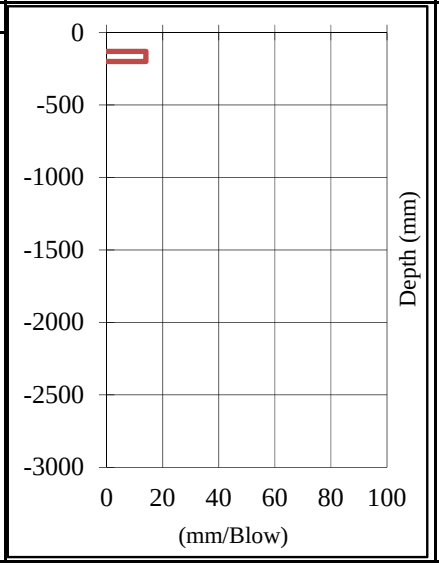



Photo of Test Pit

# Geotechnical Soil Profile

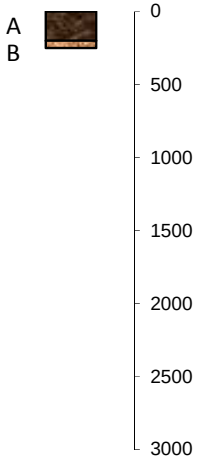
OUTENIQUA GEOTECHNICAL SERVICES

| | |
|---|---|
| Client: | Asla Devco |
| Project: | Housing Project, Portion 111 of Melkhoutfontein 480 |
| Area: | Still Bay |
| Date: | 29.11.17 |
| Excavator: | TLB |

## TP 11

Datum: NGL | Co-ords: 21 Y-037247 X3800298

Key to symbols: ● Sample taken | Groundwater




(0 to 200) Moist, dark red brown, very loose, intact, **SILTY SAND,** transported (topsoil)

(200 to 250) Light brown, highly weathered, soft rock **CALCARENITE**

**Refusal on calcarenite rock**

**No water table**

Dynamic Cone Penetrometer (DCP)

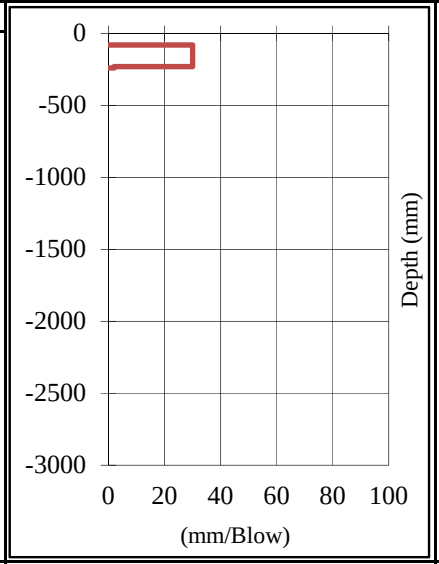
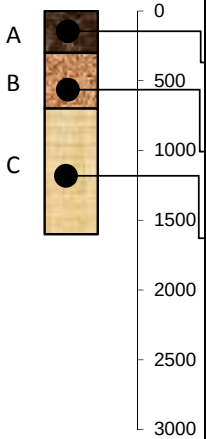



Photo of Test Pit


## TP 12

Datum: NGL | Co-ords: 21 Y-037358 X3800269

Key to symbols: ● Sample taken | Groundwater




(0 to 300) Moist, dark red brown, medium dense, intact, **GRAVELLY SAND,** transported (topsoil)

**Foundation Indicator**

(300 to 700) Moist, light brown, very dense, pinholed, **SILTY SANDY GRAVEL & COBBLES**, pedogenic (completely weathered calcarenite)

**MOD/CBR/Indicator**

(700 to 1600) Moist, light yellow orange, dense to very dense, intact, semi-consolidated **SAND**, aeolian.

**Foundation Indicator**

**Slow refusal on very dense soil**

**No water table**

Dynamic Cone Penetrometer (DCP)

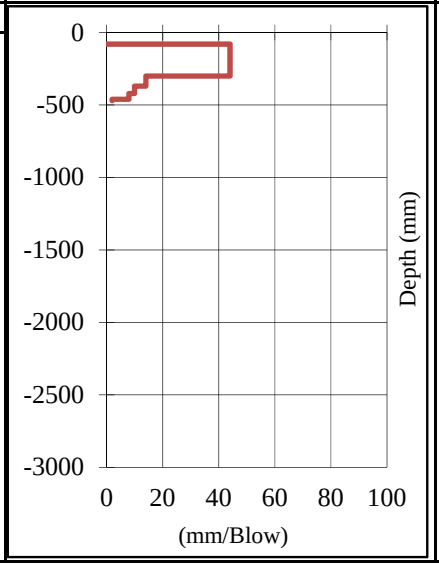



Photo of Test Pit

# OUTENIQUA GEOTECHNICAL SERVICES

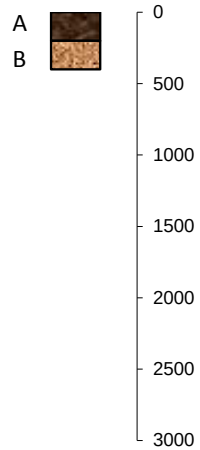
# Geotechnical Soil Profile

| | |
|---|---|
| Client: | Asla Devco |
| Project: | Housing Project, Portion 111 of Melkhoutfontein 480 |
| Area: | Still Bay |
| Date: | 29.11.17 |
| Excavator: | TLB |

## TP 13

Datum: NGL | Co-ords: 21 Y-037491 X3800236

Key to symbols: Sample taken | Groundwater




(0 to 200) Moist, dark red brown, very loose, intact, **SILTY SAND & HUMUS,** transported.

(200 to 400) Light yellow orange speckled light red orange, highly weathered, medium grained, soft to medium hard rock, **CALCARENITE**.

**Refusal on rock**
**No water table**

Dynamic Cone Penetrometer (DCP)

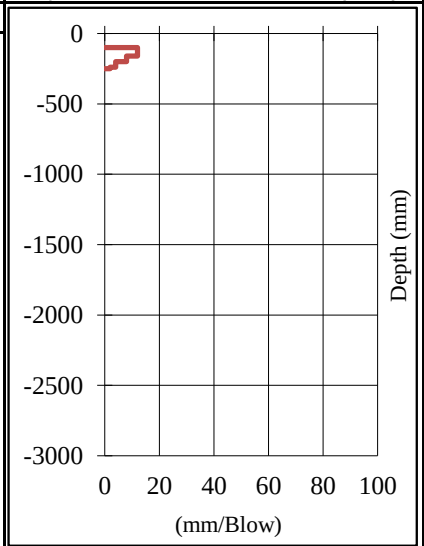
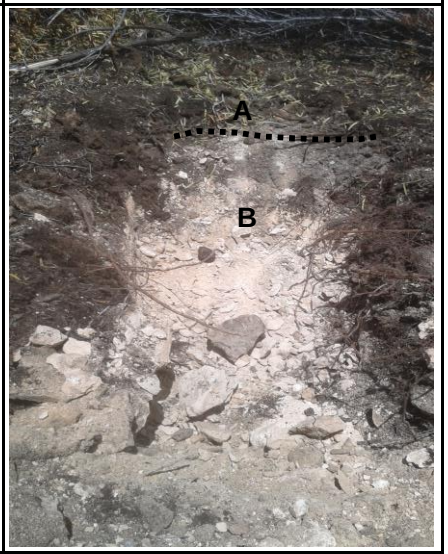


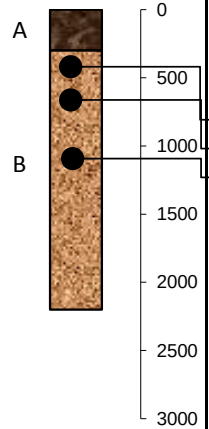

Photo of Test Pit




## TP 14

Datum: NGL | Co-ords: 21 Y-037588 X3800220

Key to symbols: Sample taken | Groundwater




(0 to 300) Moist, dark red brown, very loose, intact, **SILTY SAND & HUMUS,** transported (topsoil)

(300 to 2200) Moist, light yellow orange, very dense to dense, intact, **GRAVELLY SAND & COBBLES & BOULDERS**, aeolian.

**MOD/CBR/Indicator**
**Foundation Indicator**
**pH & Conductivity**

**Tp stopped**
**No water table**

Dynamic Cone Penetrometer (DCP)

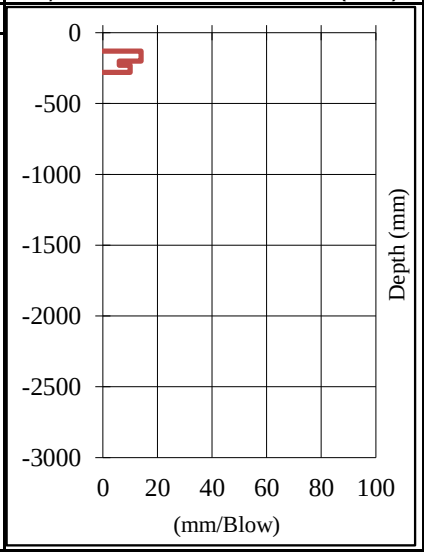
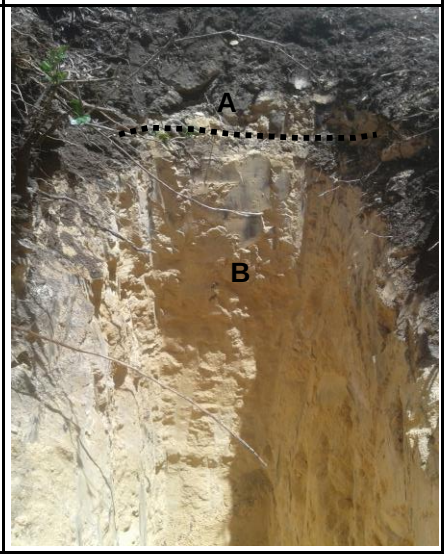



Photo of Test Pit



# Geotechnical Soil Profile

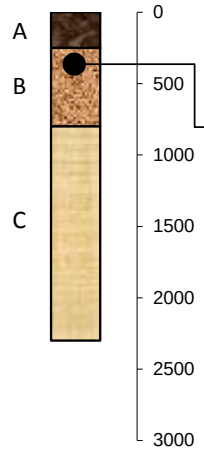
OUTENIQUA GEOTECHNICAL SERVICES

| | |
|---|---|
| Client: | Asla Devco |
| Project: | Housing Project, Portion 111 of Melkhoutfontein 480 |
| Area: | Still Bay |
| Date: | 29.11.17 |
| Excavator: | TLB |

## TP 15

Datum: NGL | Co-ords: 21 Y-037705 X3800216

Key to symbols: Sample taken | Groundwater




(0 to 250) Moist, dark red brown, very loose, intact, **SILTY SAND & HUMUS,** transported (topsoil)

(250 to 800) Moist, light yellow orange to white, very dense, intact, **GRAVEL & COBBLES & BOULDERS**, pedogenic (calcrete hardpan)

**MOD/CBR/Indicator**

(800 to 2300) Moist, light yellow orange to light green, medium dense, intact, semi-consolidated **SILTY SAND**, aeolian.

**TP stopped**

**No water table**

Dynamic Cone Penetrometer (DCP)

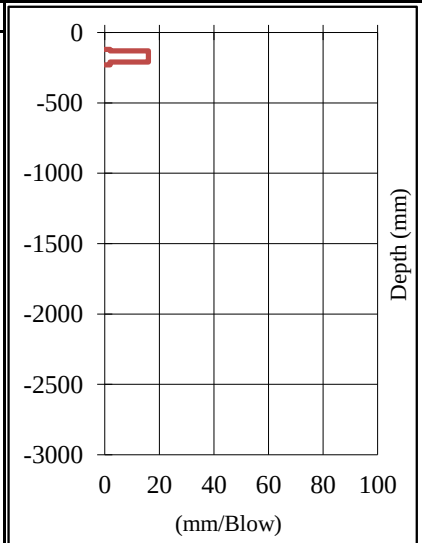
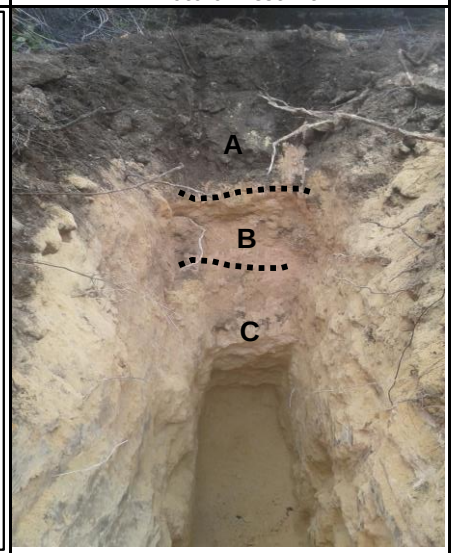


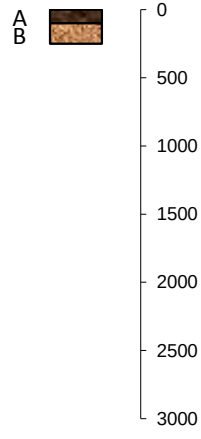

Photo of Test Pit




## TP 16

Datum: NGL | Co-ords: 21 Y-037681 X3800120

Key to symbols: Sample taken | Groundwater




(0 to 100) Moist, dark red brown, very loose, intact, **SILTY SAND & HUMUS,** transported.

(100 to 250) Light yellow to pale red, highly weathered, medium grained, soft to medium hard rock, **CALCARENITE**.

**Refusal on rock**

**No water table**

Dynamic Cone Penetrometer (DCP)

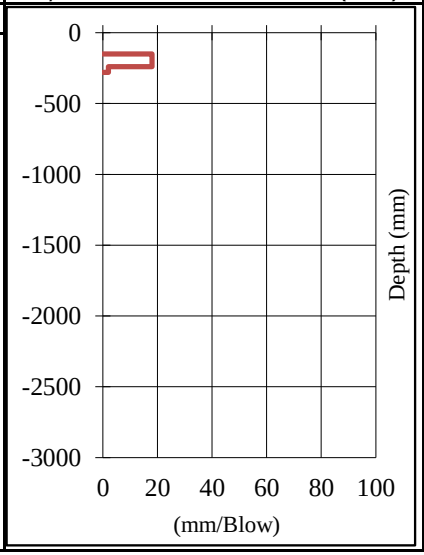



Photo of Test Pit

OUTENIQUA GEOTECHNICAL SERVICES

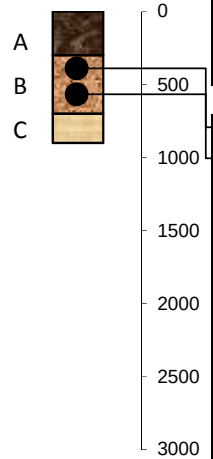
# Geotechnical Soil Profile

| | |
|---|---|
| Client: | Asla Devco |
| Project: | Housing Project, Portion 111 of Melkhoutfontein 480 |
| Area: | Still Bay |
| Date: | 29.11.17 |
| Excavator: | TLB |

## TP 17

Datum: NGL | Co-ords: 21 Y-037574 X3800144

Key to symbols: ● Sample taken | Groundwater




(0 to 300) Moist, dark red brown, very loose, intact, **SILTY SAND & HUMUS,** transported.

(300 to 700) Moist, light grey, medium dense, intact, **GRAVELLY CLAYEY SILTY SAND**, residual (completely weathered calcarenite)

**Foundation Indicator**

**pH & Conductivity**

(700 to 900) Light grey speckled light red orange, highly weathered, massive, soft to medium hard rock, **CALCARENITE**.

**Refusal on rock.**

**No water table**

Dynamic Cone Penetrometer (DCP)

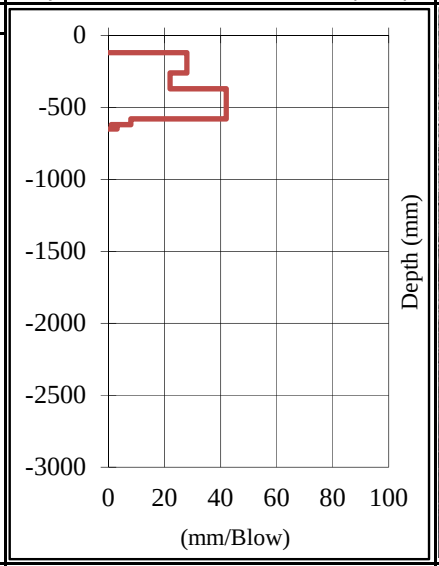
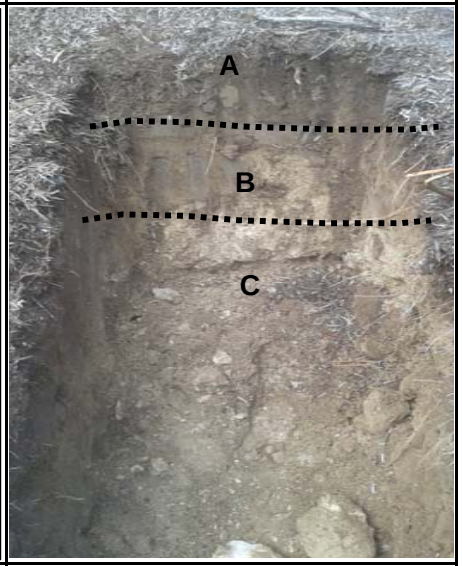


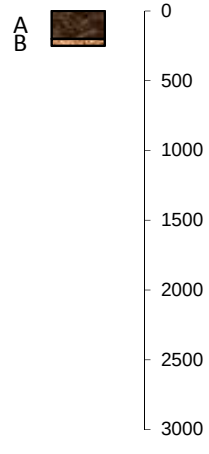

Photo of Test Pit




## TP 18

Datum: NGL | Co-ords: 21 Y-037453 X3800172

Key to symbols: ● Sample taken | Groundwater




(0 to 200) Moist, dark red brown, very loose, intact, **SILTY SAND & HUMUS,** transported.

(200 to 250) Light grey speckled light red orange, highly weathered, massive, soft to medium hard rock, **CALCARENITE**.

**Refusal on Calcarenite**

**No water table**

Dynamic Cone Penetrometer (DCP)

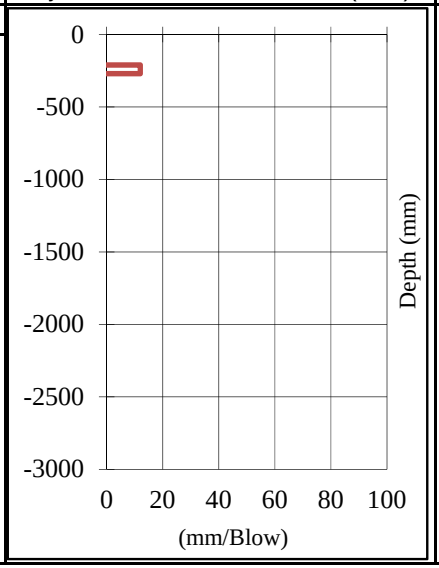



Photo of Test Pit

OUTENIQUA GEOTECHNICAL SERVICES

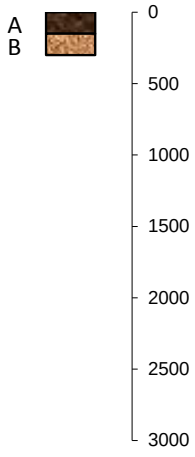
# Geotechnical Soil Profile

| | |
|---|---|
| Client: | Asla Devco |
| Project: | Housing Project, Portion 111 of Melkhoutfontein 480 |
| Area: | Still Bay |
| Date: | 29.11.17 |
| Excavator: | TLB |

## TP 19

Datum: NGL | Co-ords: 21 Y-037338 X3800193

Key to symbols: ● Sample taken | Groundwater




| | |
|---|---|
| (0 to 150) | Moist, black, medium dense, intact, **SHALE GRAVEL**, imported (fill) |
| (150 to 300) | Light brown to light yellow, highly weathered, medium grained, cross bedded, soft to medium hard rock, **CALCARENITE**. |

**Refusal on rock**
**No water table**

Dynamic Cone Penetrometer (DCP)

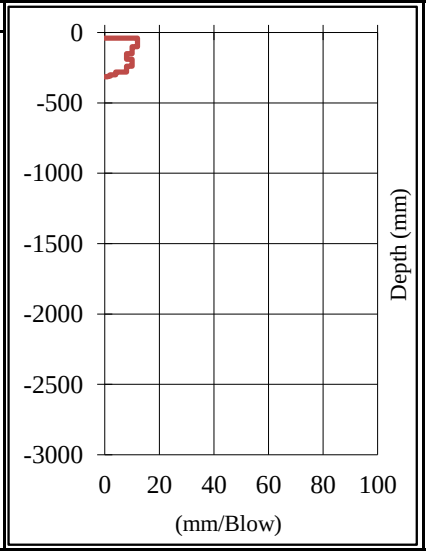



Photo of Test Pit

# Appendix 3

# Lab test data

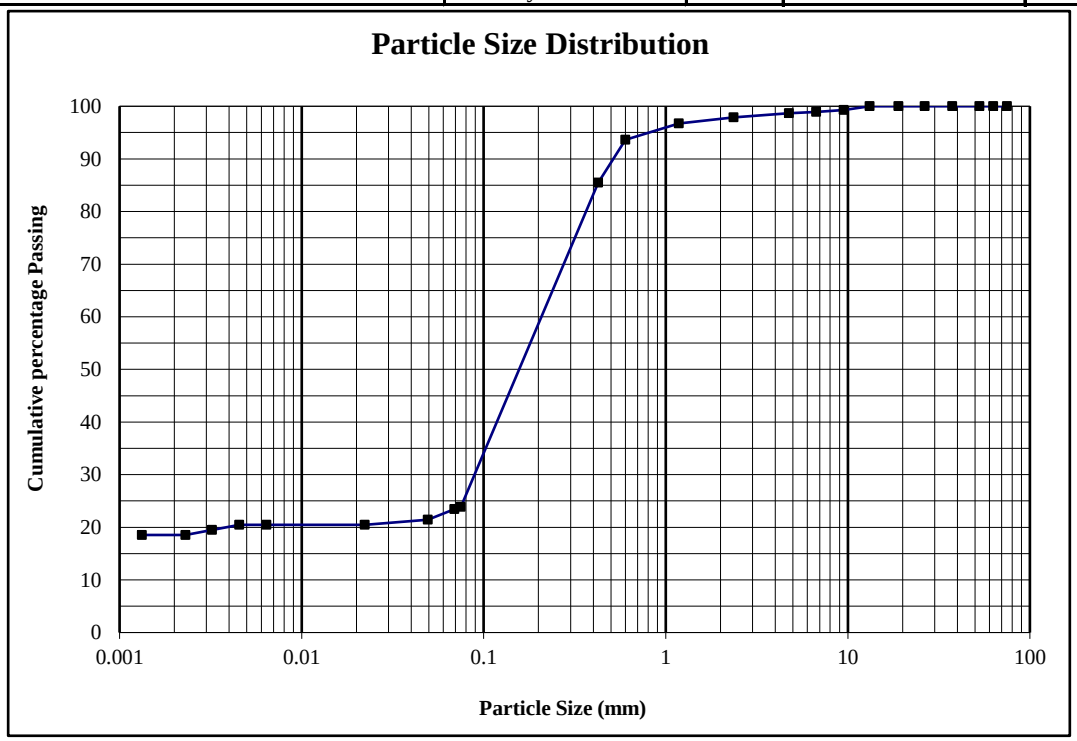
# OUTENIQUA LAB (Pty) Ltd
Materials Testing Laboratory
Registration No. 95/07742/07
6 Mirrorball Street, George : PO Box 3186, George Industria, 6536
Tel: 044 8743274 : Fax: 044 8745779 : e-mail: llewelyn@outeniqualab.co.za


| | | | |
|---|---|---|---|
| Customer : | Asla Devco | Project : | Subsidy Housing Projects on Portion 111 of Melkhoutfontein 480 - Still Bay |
| | P O Box 118 | Date Received : | 05/12/17 |
| | Gordons Bay | Date Reported : | 25/01/18 |
| | 7151 | Req. Number : | 4026/17 |
| Attention : | David Douglas | No. of Pages : | 1/12 |

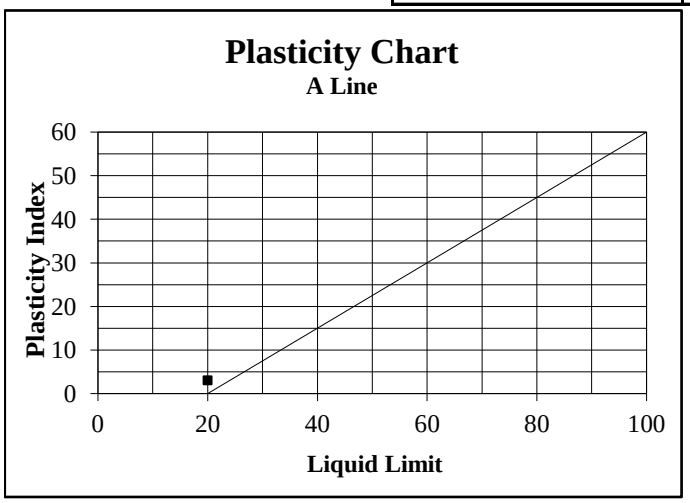
## TEST REPORT
## FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

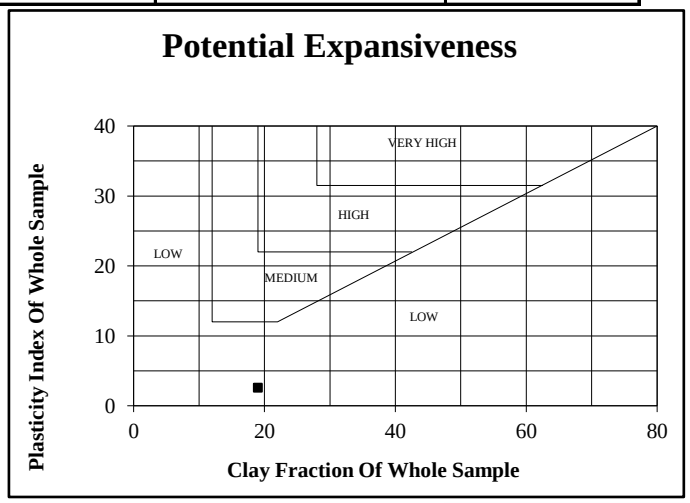
| | | | | | |
|---|---|---|---|---|---|
| Material Description: | Dark Yellowish Orange Clayey Sand | Sample Number: | 68642 | | |
| Position: | TP3 - Layer 3 | Liquid Limit | 20 | Linear Shrinkage | 1.5 |
| Depth: | 1700-2300 | Plasticity Index | 3 | Insitu M/C% | 13.2 |

| Sieve Size(mm) | % Passing |
|---|---|
| 75.0 | 100 |
| 63.0 | 100 |
| 53.0 | 100 |
| 37.5 | 100 |
| 26.5 | 100 |
| 19.0 | 100 |
| 13.2 | 100 |
| 9.5 | 99 |
| 6.7 | 99 |
| 4.75 | 99 |
| 2.36 | 98 |
| 1.18 | 97 |
| 0.600 | 94 |
| 0.425 | 86 |
| 0.075 | 24 |
| 0.0690 | 23 |
| 0.0494 | 21 |
| 0.0223 | 20 |
| 0.0064 | 20 |
| 0.0045 | 20 |
| 0.0032 | 20 |
| 0.0023 | 19 |
| 0.0013 | 19 |




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| % Clay | 19 | % Silt | 5 | % Sand | 74 | % Gravel | 2 |
| Unified Soil Classification | | SM | | PRA Soil Classification | | A-2-4 | |




**Notes:**

- **Specimens sampled by Outeniqua Lab according to sampling Plan TMH 5 Methods MB1 & MC1**
- **All specimen sampled by : 0**
- **The weather conditions are such that there is no detrimental effect on the sample taken.**

L Heathcote (Director)
For Outeniqua Lab (Pty) Ltd.

1. **Sampling falls outside the scope of Outeniqua Lab's SANAS accreditation.**
2. The test results are reported with an approximate 95% level of confidence.
3. This report (with attachments) is the correct record of all measurements made, and may not be reproduced other than with full written approval from the Technical Director of Outeniqua Lab (Pty) Ltd.
4. Results reported in this Test Report relate only to the items tested and are an indication only of the sample provided and/or taken.
5. Measuring Equipment, traceable to National Standards is used where applicable.
6. While every care is taken to ensure the correctness of all tests and reports, neither Outeniqua Lab nor its employees shall be liable in any way whatever for any error made in the execution or reporting of tests or any erroneous conclusions drawn therefrom or for any consequence thereof.

# OUTENIQUA LAB (Pty) Ltd
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6 Mirrorball Street, George : PO Box 3186, George Industria, 6536
Tel: 044 8743274 : Fax: 044 8745779 : e-mail: llewelyn@outeniqualab.co.za

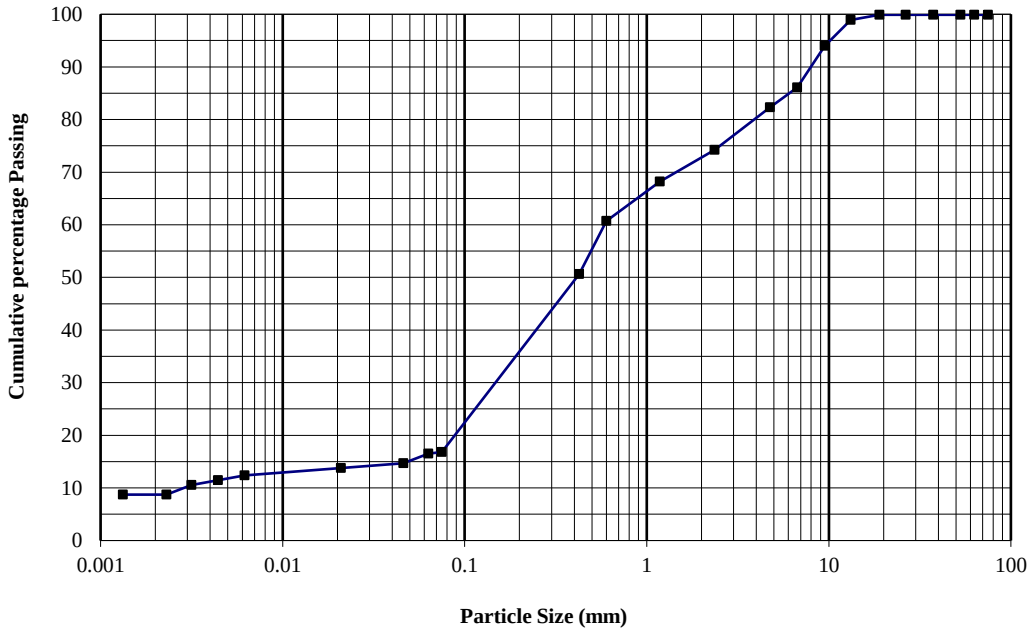

| | | | |
|---|---|---|---|
| Customer : | Asla Devco | Project : | Subsidy Housing Projects on Portion 111 of Melkhoutfontein 480 - Still Bay |
| | P O Box 118 | Date Received : | 05/12/17 |
| | Gordons Bay | Date Reported : | 25/01/18 |
| | 7151 | Req. Number : | 4026/17 |
| Attention : | David Douglas | No. of Pages : | 2/12 |

## TEST REPORT
## FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

| | | | | | |
|---|---|---|---|---|---|
| Material Description: | Light Brown Gravelly Sand | Sample Number: | 68643 | | |
| Position: | TP4 - Layer 2 | Liquid Limit | 23 | Linear Shrinkage | 2 |
| Depth: | 200-800 | Plasticity Index | 4 | Insitu M/C% | 16 |

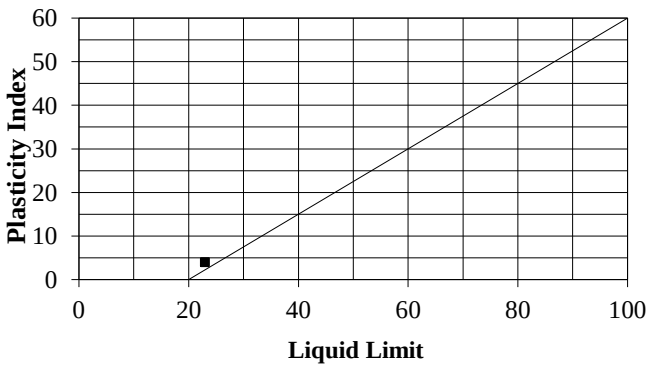
| Sieve Size(mm) | % Passing |
|---|---|
| 75.0 | 100 |
| 63.0 | 100 |
| 53.0 | 100 |
| 37.5 | 100 |
| 26.5 | 100 |
| 19.0 | 100 |
| 13.2 | 99 |
| 9.5 | 94 |
| 6.7 | 86 |
| 4.75 | 82 |
| 2.36 | 74 |
| 1.18 | 68 |
| 0.600 | 61 |
| 0.425 | 51 |
| 0.075 | 17 |
| 0.0632 | 17 |
| 0.0462 | 15 |
| 0.0209 | 14 |
| 0.0062 | 12 |
| 0.0044 | 11 |
| 0.0032 | 11 |
| 0.0023 | 9 |
| 0.0013 | 9 |

### Particle Size Distribution

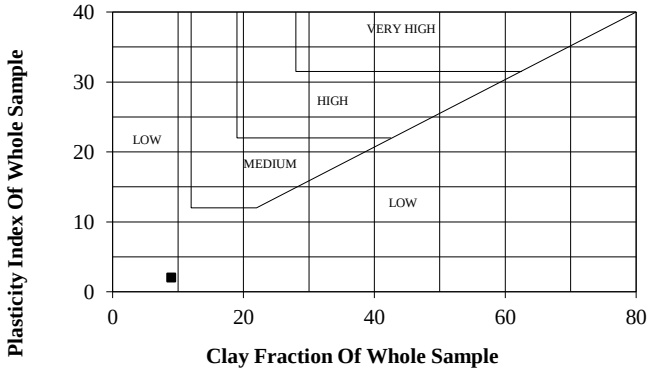



| | | | | | | | |
|---|---|---|---|---|---|---|---|
| % Clay | 9 | % Silt | 9 | % Sand | 54 | % Gravel | 28 |
| Unified Soil Classification | | SM-SC | | PRA Soil Classification | | A-2-4 | |

### Plasticity Chart
**A Line**




### Potential Expansiveness




**Notes:**

- **Specimens sampled by Outeniqua Lab according to sampling Plan TMH 5 Methods MB1 & MC1**
- **All specimen sampled by : 0**
- **The weather conditions are such that there is no detrimental effect on the sample taken.**

L Heathcote (Director)
For Outeniqua Lab (Pty) Ltd.

1. **Sampling falls outside the scope of Outeniqua Lab's SANAS accreditation.**
2. The test results are reported with an approximate 95% level of confidence.
3. This report (with attachments) is the correct record of all measurements made, and may not be reproduced other than with full written approval from the Technical Director of Outeniqua Lab (Pty) Ltd.
4. Results reported in this Test Report relate only to the items tested and are an indication only of the sample provided and/or taken.
5. Measuring Equipment, traceable to National Standards is used where applicable.
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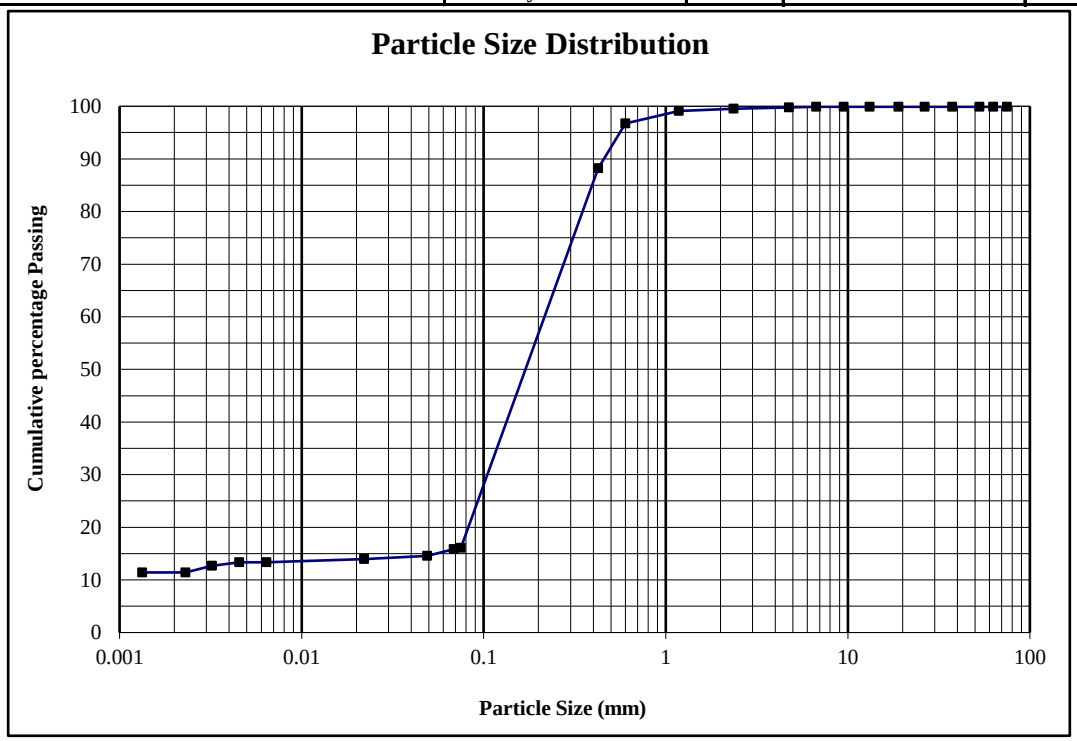
Tel: 044 8743274 : Fax: 044 8745779 : e-mail: llewelyn@outeniqualab.co.za


| | | | |
|---|---|---|---|
| Customer : | Asla Devco | Project : | Subsidy Housing Projects on Portion 111 of Melkhoutfontein 480 - Still Bay |
| | P O Box 118 | Date Received : | 05/12/17 |
| | Gordons Bay | Date Reported : | 25/01/18 |
| | 7151 | Req. Number : | 4026/17 |
| Attention : | David Douglas | No. of Pages : | 3/12 |

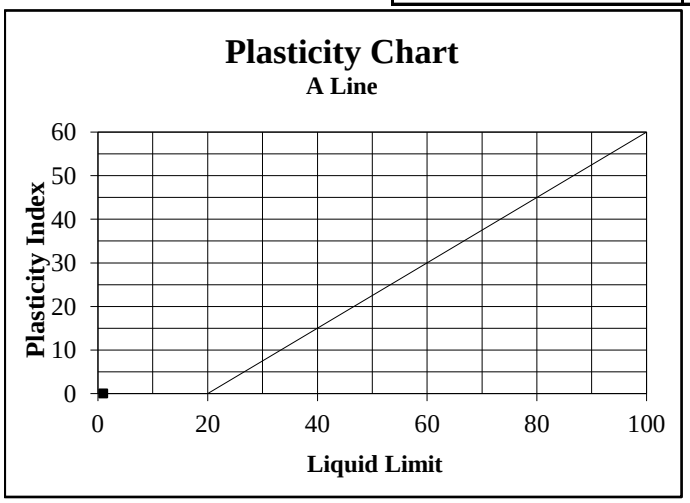
## TEST REPORT
## FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

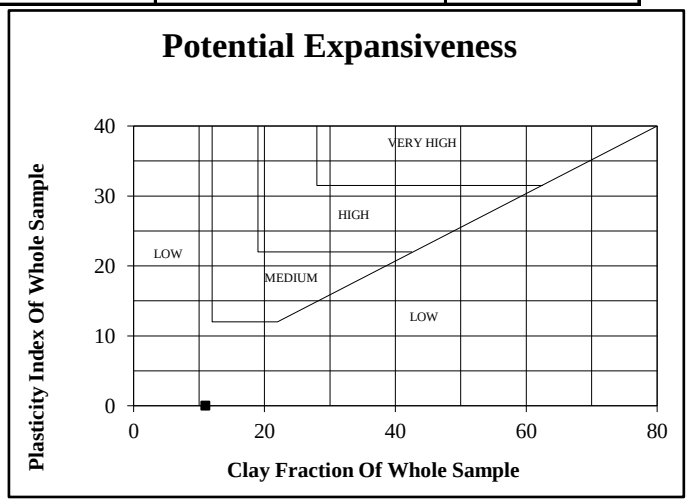
| | | | | | |
|---|---|---|---|---|---|
| Material Description: | Dark Yellowish Orange Clayey Sand | Sample Number: | 68644 | | |
| Position: | TP4 - Layer 3 | Liquid Limit | NP | Linear Shrinkage | 0 |
| Depth: | 800-1400 | Plasticity Index | NP | Insitu M/C% | 12.6 |

| Sieve Size(mm) | % Passing |
|---|---|
| 75.0 | 100 |
| 63.0 | 100 |
| 53.0 | 100 |
| 37.5 | 100 |
| 26.5 | 100 |
| 19.0 | 100 |
| 13.2 | 100 |
| 9.5 | 100 |
| 6.7 | 100 |
| 4.75 | 100 |
| 2.36 | 100 |
| 1.18 | 99 |
| 0.600 | 97 |
| 0.425 | 88 |
| 0.075 | 16 |
| 0.0685 | 16 |
| 0.0490 | 15 |
| 0.0221 | 14 |
| 0.0064 | 13 |
| 0.0045 | 13 |
| 0.0032 | 13 |
| 0.0023 | 11 |
| 0.0013 | 11 |




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| % Clay | 11 | % Silt | 5 | % Sand | 83 | % Gravel | 1 |
| Unified Soil Classification | | SM | | PRA Soil Classification | | A-2-4 | |




**Notes:**

- **Specimens sampled by Outeniqua Lab according to sampling Plan TMH 5 Methods MB1 & MC1**
- **All specimen sampled by : 0**
- **The weather conditions are such that there is no detrimental effect on the sample taken.**

L Heathcote (Director)
For Outeniqua Lab (Pty) Ltd.

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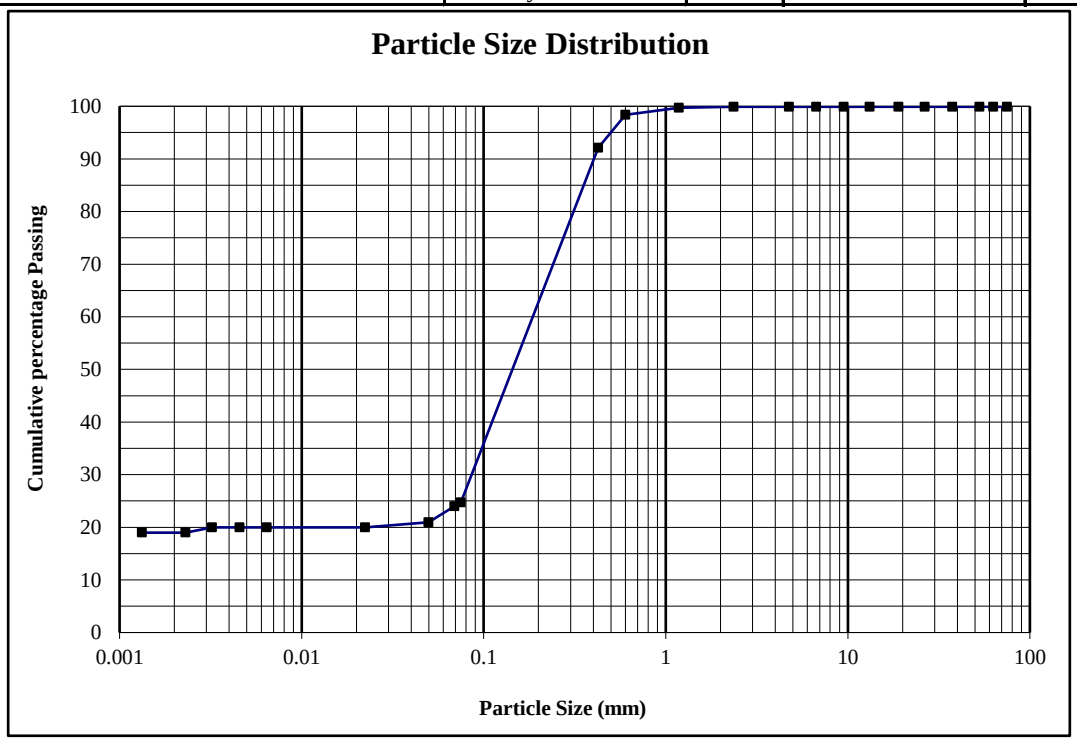
| | P O Box 118 | Date Received : | 05/12/17 |
| | Gordons Bay | Date Reported : | 25/01/18 |
| | 7151 | Req. Number : | 4026/17 |
| Attention : | David Douglas | No. of Pages : | 4/12 |

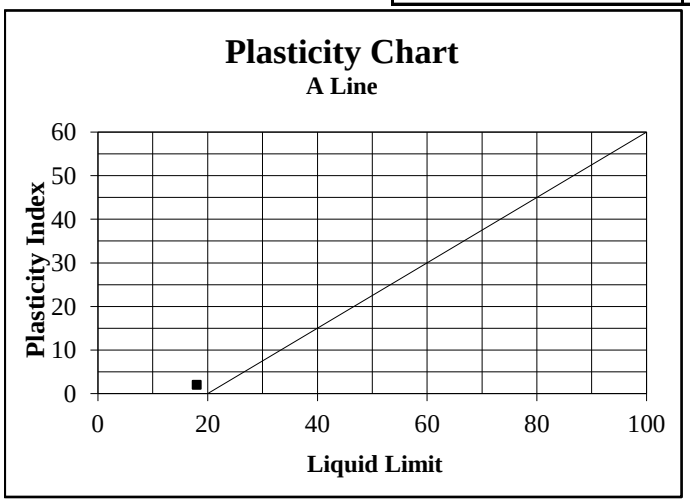
## TEST REPORT
## FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

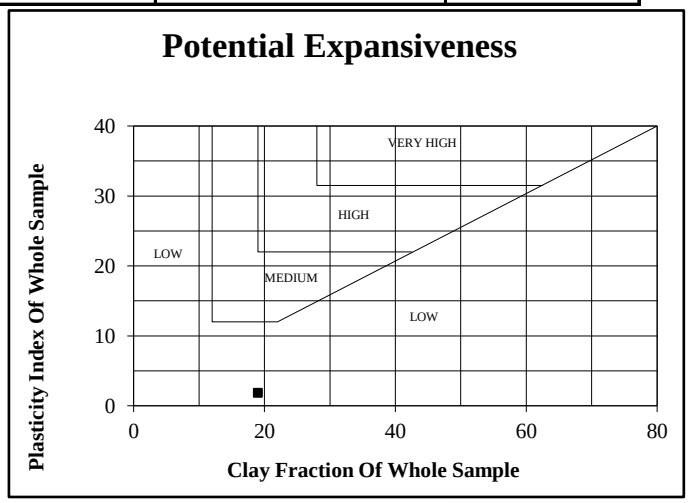
| | | | | | |
|---|---|---|---|---|---|
| Material Description: | Light Green Clayey Sand | Sample Number: | 68645 | | |
| Position: | TP4 - Layer 4 | Liquid Limit | 18 | Linear Shrinkage | 2 |
| Depth: | 1400-3000 | Plasticity Index | 2 | Insitu M/C% | 23.2 |

| Sieve Size(mm) | % Passing |
|---|---|
| 75.0 | 100 |
| 63.0 | 100 |
| 53.0 | 100 |
| 37.5 | 100 |
| 26.5 | 100 |
| 19.0 | 100 |
| 13.2 | 100 |
| 9.5 | 100 |
| 6.7 | 100 |
| 4.75 | 100 |
| 2.36 | 100 |
| 1.18 | 100 |
| 0.600 | 98 |
| 0.425 | 92 |
| 0.075 | 25 |
| 0.0690 | 24 |
| 0.0498 | 21 |
| 0.0223 | 20 |
| 0.0065 | 20 |
| 0.0046 | 20 |
| 0.0032 | 20 |
| 0.0023 | 19 |
| 0.0013 | 19 |




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| % Clay | 19 | % Silt | 6 | % Sand | 75 | % Gravel | 0 |
| Unified Soil Classification | | SM | | PRA Soil Classification | | A-2-4 | |




**Notes:**

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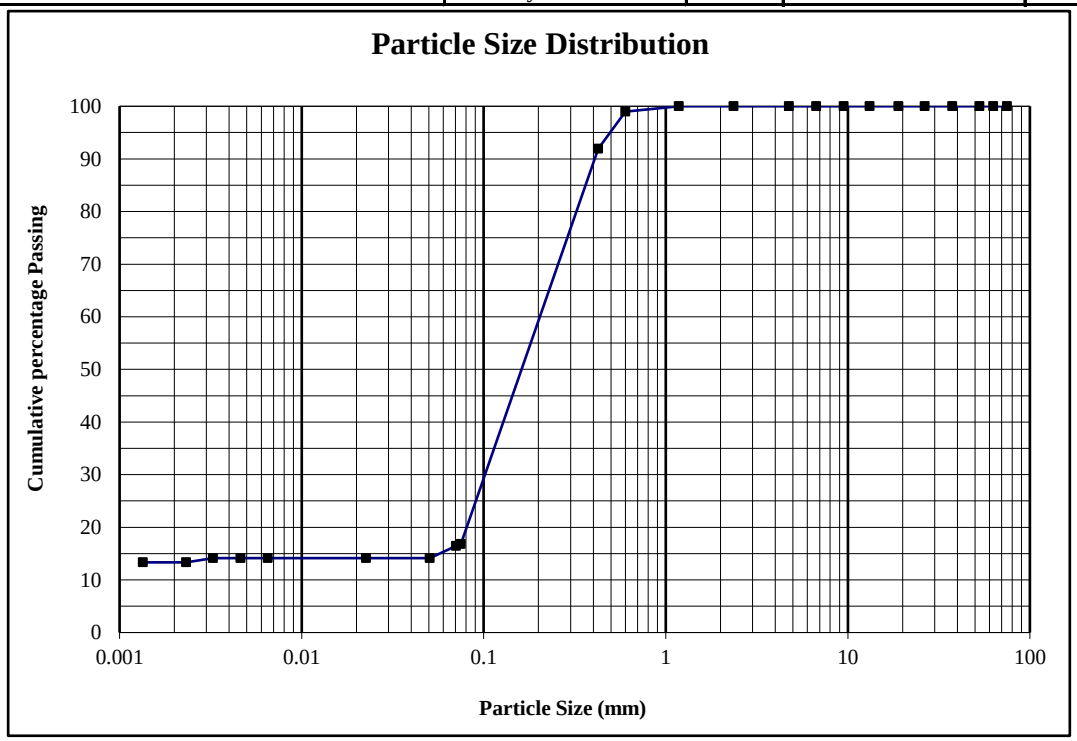
| Attention : | David Douglas | No. of Pages : | 5/12 |

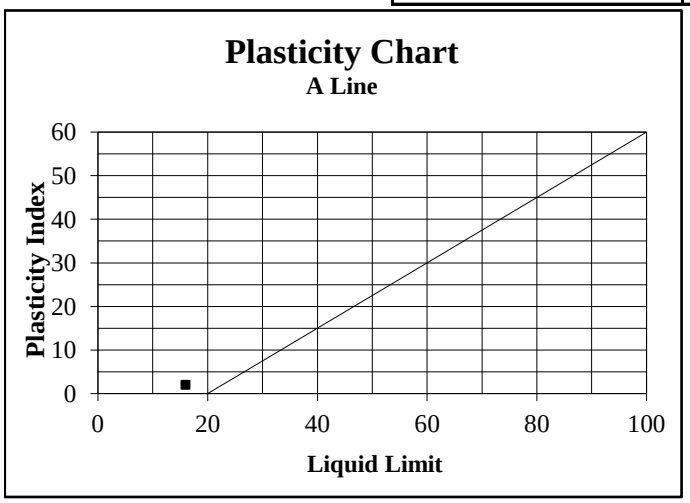
## TEST REPORT
## FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

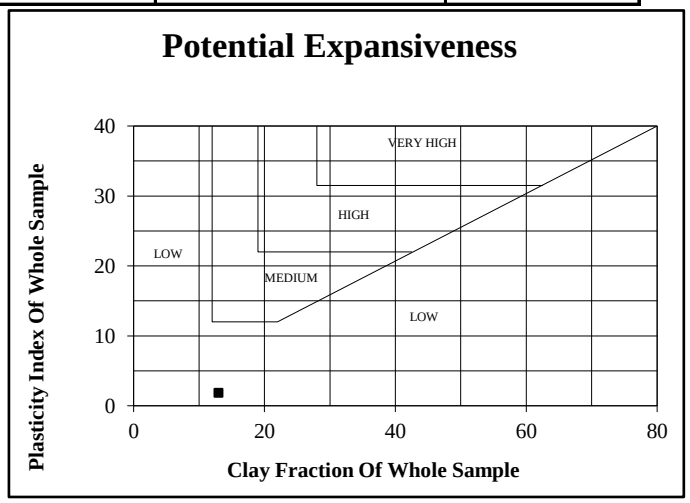
| | | | | | |
|---|---|---|---|---|---|
| Material Description: | Light Yellowish Orange to Light Green Clayey Sand | Sample Number: | 68647 | | |
| Position: | TP6 - Layer 3 | Liquid Limit | 16 | Linear Shrinkage | 1 |
| Depth: | 1500-2500 | Plasticity Index | 2 | Insitu M/C% | 18.9 |

| Sieve Size(mm) | % Passing |
|---|---|
| 75.0 | 100 |
| 63.0 | 100 |
| 53.0 | 100 |
| 37.5 | 100 |
| 26.5 | 100 |
| 19.0 | 100 |
| 13.2 | 100 |
| 9.5 | 100 |
| 6.7 | 100 |
| 4.75 | 100 |
| 2.36 | 100 |
| 1.18 | 100 |
| 0.600 | 99 |
| 0.425 | 92 |
| 0.075 | 17 |
| 0.0704 | 16 |
| 0.0505 | 14 |
| 0.0226 | 14 |
| 0.0065 | 14 |
| 0.0046 | 14 |
| 0.0033 | 14 |
| 0.0023 | 13 |
| 0.0013 | 13 |




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| % Clay | 13 | % Silt | 4 | % Sand | 83 | % Gravel | 0 |
| Unified Soil Classification | | SM | | PRA Soil Classification | | A-2-4 | |




**Notes:**

- **Specimens sampled by Outeniqua Lab according to sampling Plan TMH 5 Methods MB1 & MC1**
- **All specimen sampled by : 0**
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For Outeniqua Lab (Pty) Ltd.

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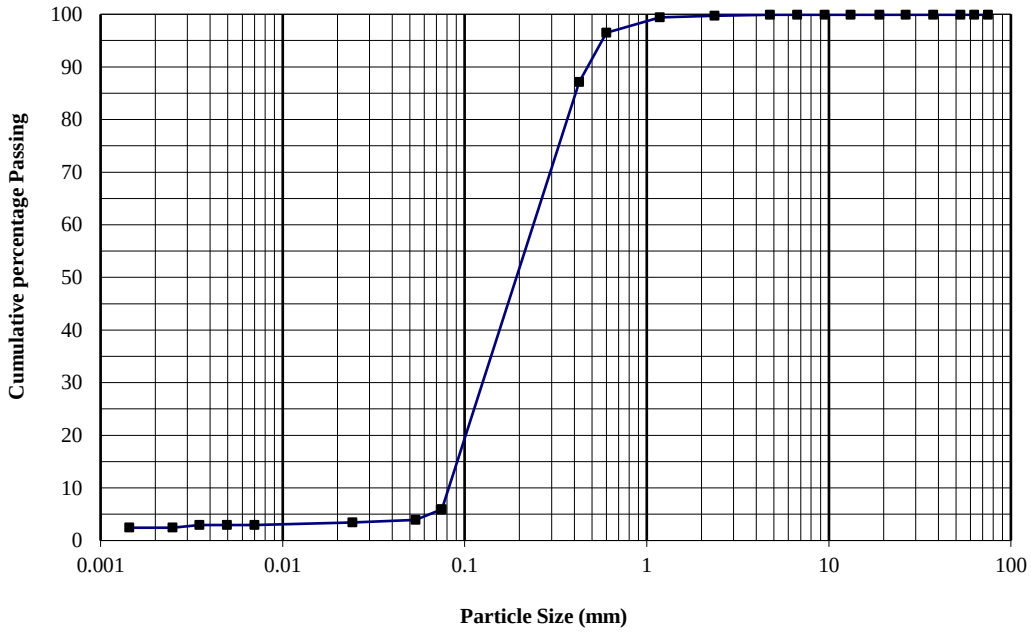
| Attention : | David Douglas | No. of Pages : | 6/12 |

## TEST REPORT
## FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

| | | | | | |
|---|---|---|---|---|---|
| Material Description: | Dark Reddish Brown Sand | Sample Number: | 68648 | | |
| Position: | TP7 - Layer 1 | Liquid Limit | NP | Linear Shrinkage | 0 |
| Depth: | 0-400 | Plasticity Index | NP | Insitu M/C% | 6.9 |

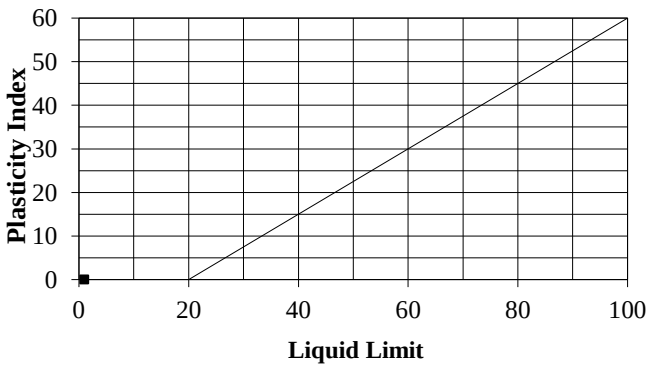
| Sieve Size(mm) | % Passing |
|---|---|
| 75.0 | 100 |
| 63.0 | 100 |
| 53.0 | 100 |
| 37.5 | 100 |
| 26.5 | 100 |
| 19.0 | 100 |
| 13.2 | 100 |
| 9.5 | 100 |
| 6.7 | 100 |
| 4.75 | 100 |
| 2.36 | 100 |
| 1.18 | 99 |
| 0.600 | 97 |
| 0.425 | 87 |
| 0.075 | 6 |
| 0.0741 | 6 |
| 0.0537 | 4 |
| 0.0242 | 3 |
| 0.0070 | 3 |
| 0.0049 | 3 |
| 0.0035 | 3 |
| 0.0025 | 2 |
| 0.0014 | 2 |

### Particle Size Distribution

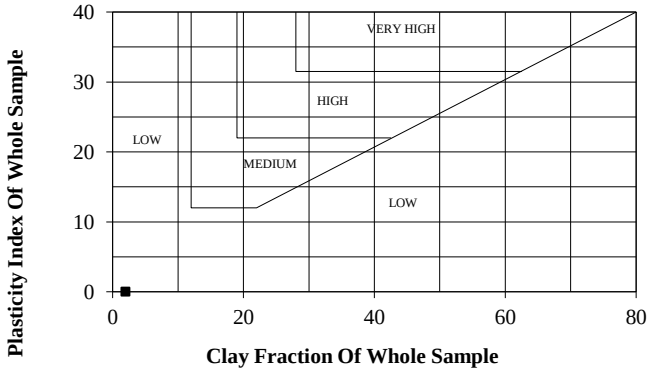



| | | | | | | | |
|---|---|---|---|---|---|---|---|
| % Clay | 2 | % Silt | 4 | % Sand | 94 | % Gravel | 0 |
| Unified Soil Classification | | SP-SM | | PRA Soil Classification | | A-3 / A-2-4 | |

### Plasticity Chart
**A Line**




### Potential Expansiveness




**Notes:**

- **Specimens sampled by Outeniqua Lab according to sampling Plan TMH 5 Methods MB1 & MC1**
- **All specimen sampled by : 0**
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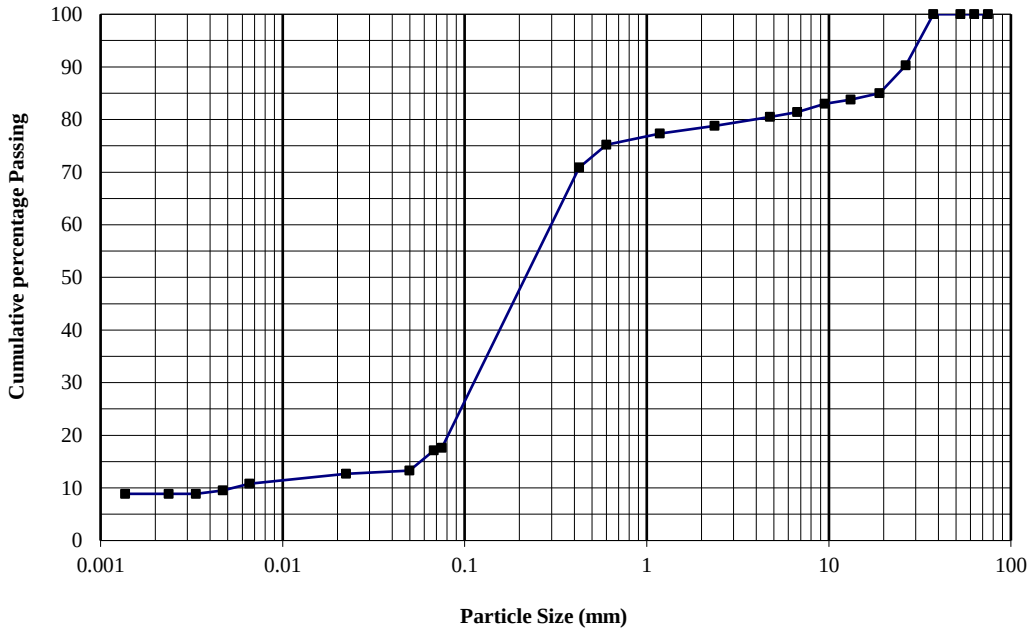
| | 7151 | Req. Number : | 4026/17 |
| Attention : | David Douglas | No. of Pages : | 7/12 |

## TEST REPORT
## FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

| | | | | | |
|---|---|---|---|---|---|
| Material Description: | Dark Reddish Brown Gravelly Sand | Sample Number: | 68649 | | |
| Position: | TP12 - Layer 1 | Liquid Limit | 21 | Linear Shrinkage | 1 |
| Depth: | 0-300 | Plasticity Index | 2 | Insitu M/C% | 15.6 |

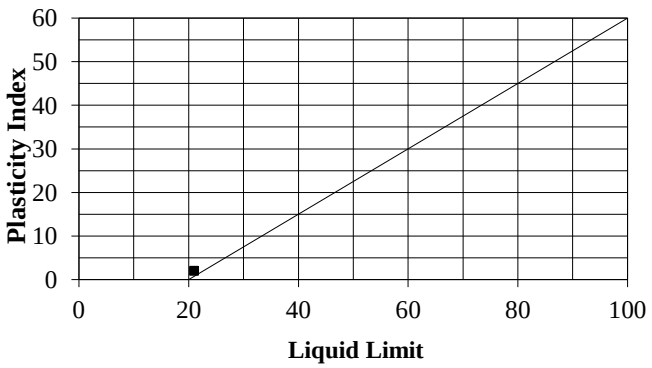
| Sieve Size(mm) | % Passing |
|---|---|
| 75.0 | 100 |
| 63.0 | 100 |
| 53.0 | 100 |
| 37.5 | 100 |
| 26.5 | 90 |
| 19.0 | 85 |
| 13.2 | 84 |
| 9.5 | 83 |
| 6.7 | 81 |
| 4.75 | 81 |
| 2.36 | 79 |
| 1.18 | 77 |
| 0.600 | 75 |
| 0.425 | 71 |
| 0.075 | 18 |
| 0.0676 | 17 |
| 0.0498 | 13 |
| 0.0223 | 13 |
| 0.0066 | 11 |
| 0.0047 | 10 |
| 0.0033 | 9 |
| 0.0024 | 9 |
| 0.0014 | 9 |

### Particle Size Distribution

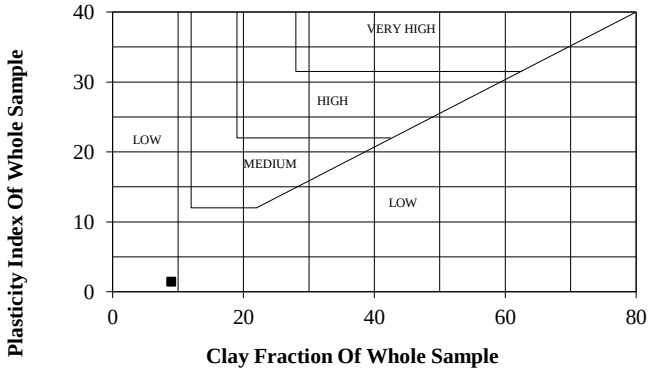



| | | | | | | | |
|---|---|---|---|---|---|---|---|
| % Clay | 9 | % Silt | 9 | % Sand | 60 | % Gravel | 22 |
| Unified Soil Classification | | SM | | PRA Soil Classification | | A-2-4 | |

### Plasticity Chart
**A Line**




### Potential Expansiveness




**Notes:**

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- **All specimen sampled by : 0**
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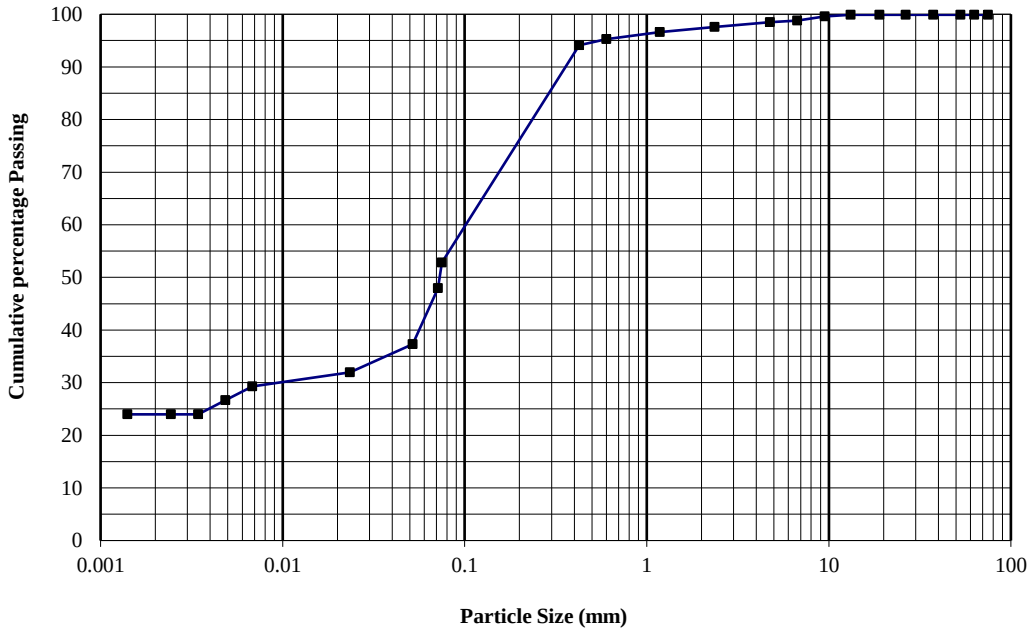
## TEST REPORT
## FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

| | | | | | |
|---|---|---|---|---|---|
| Material Description: | Light Yellowish Orange Clayey Silty Sand | Sample Number: | 68651 | | |
| Position: | TP12 - Layer 3 | Liquid Limit | NP | Linear Shrinkage | 0 |
| Depth: | 700-1600 | Plasticity Index | NP | Insitu M/C% | 6.5 |

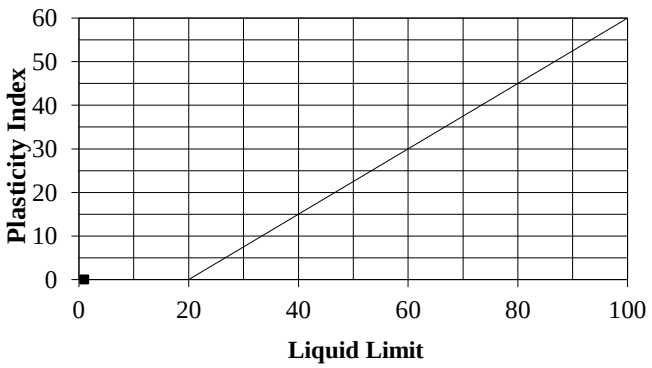
| Sieve Size(mm) | % Passing |
|---|---|
| 75.0 | 100 |
| 63.0 | 100 |
| 53.0 | 100 |
| 37.5 | 100 |
| 26.5 | 100 |
| 19.0 | 100 |
| 13.2 | 100 |
| 9.5 | 100 |
| 6.7 | 99 |
| 4.75 | 99 |
| 2.36 | 98 |
| 1.18 | 97 |
| 0.600 | 95 |
| 0.425 | 94 |
| 0.075 | 53 |
| 0.0715 | 48 |
| 0.0519 | 37 |
| 0.0234 | 32 |
| 0.0068 | 29 |
| 0.0049 | 27 |
| 0.0034 | 24 |
| 0.0024 | 24 |
| 0.0014 | 24 |

### Particle Size Distribution

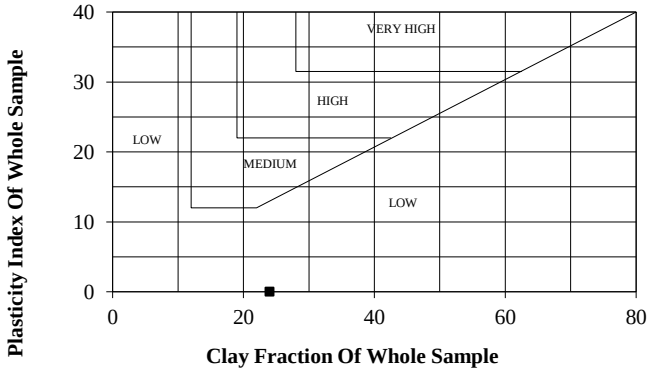



| | | | | | | | |
|---|---|---|---|---|---|---|---|
| % Clay | 24 | % Silt | 25 | % Sand | 48 | % Gravel | 3 |
| Unified Soil Classification | | ML | | PRA Soil Classification | | A-4 | |

### Plasticity Chart
**A Line**




### Potential Expansiveness




**Notes:**

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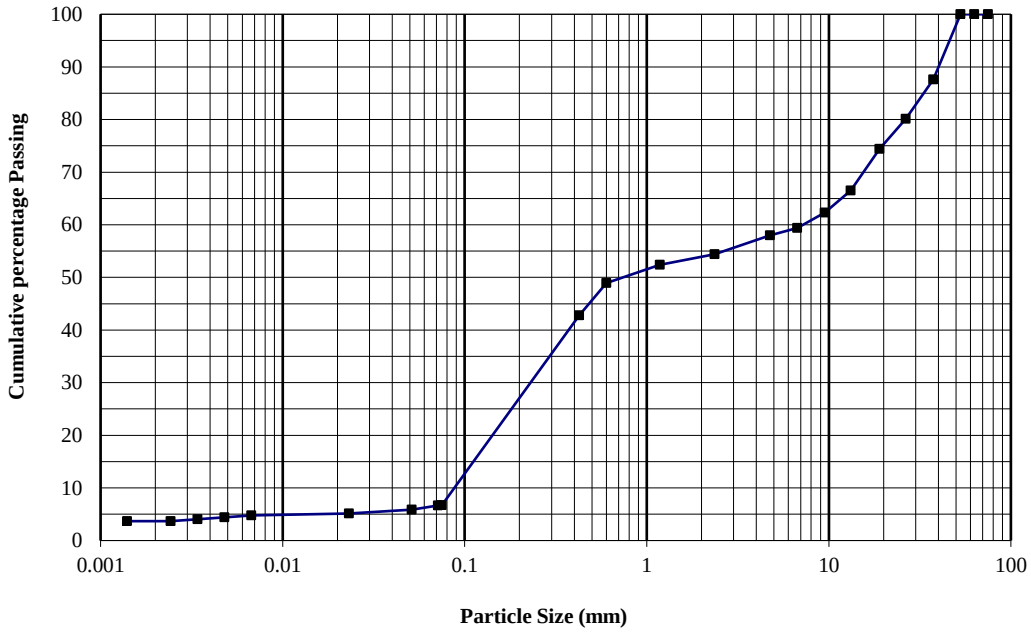
## TEST REPORT
## FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

| | | | | | |
|---|---|---|---|---|---|
| Material Description: | Light Yellowish Orange Gravelly Sand | Sample Number: | 68652 | | |
| Position: | TP14 - Layer 2 | Liquid Limit | NP | Linear Shrinkage | 0 |
| Depth: | 300-2200 | Plasticity Index | NP | Insitu M/C% | 8.3 |

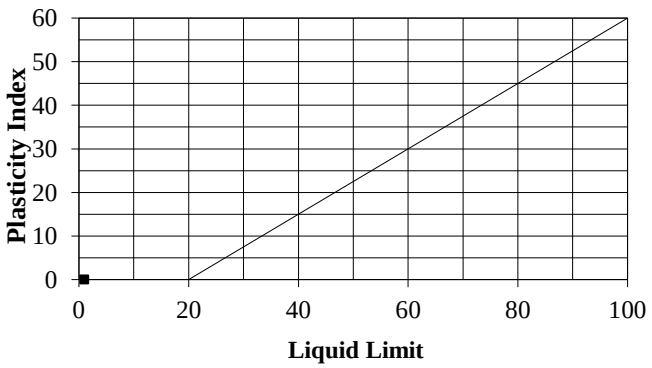
| Sieve Size(mm) | % Passing |
|---|---|
| 75.0 | 100 |
| 63.0 | 100 |
| 53.0 | 100 |
| 37.5 | 88 |
| 26.5 | 80 |
| 19.0 | 74 |
| 13.2 | 67 |
| 9.5 | 62 |
| 6.7 | 59 |
| 4.75 | 58 |
| 2.36 | 54 |
| 1.18 | 52 |
| 0.600 | 49 |
| 0.425 | 43 |
| 0.075 | 7 |
| 0.0715 | 7 |
| 0.0513 | 6 |
| 0.0232 | 5 |
| 0.0067 | 5 |
| 0.0048 | 4 |
| 0.0034 | 4 |
| 0.0024 | 4 |
| 0.0014 | 4 |

### Particle Size Distribution

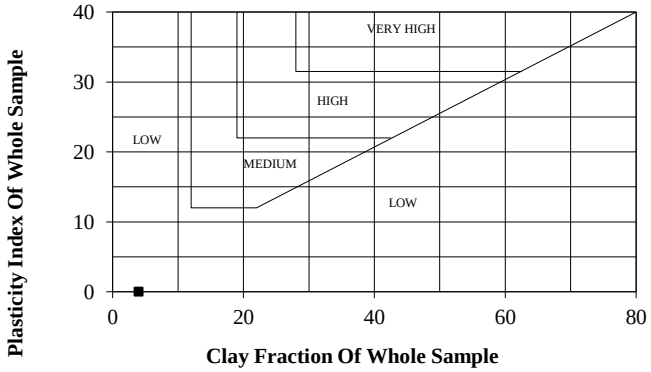



| | | | | | | | |
|---|---|---|---|---|---|---|---|
| % Clay | 4 | % Silt | 3 | % Sand | 47 | % Gravel | 46 |
| Unified Soil Classification | | SP-SM | | PRA Soil Classification | | A-1-b / A-2-4 | |

### Plasticity Chart
**A Line**




### Potential Expansiveness




**Notes:**

- **Specimens sampled by Outeniqua Lab according to sampling Plan TMH 5 Methods MB1 & MC1**
- **All specimen sampled by : 0**
- **The weather conditions are such that there is no detrimental effect on the sample taken.**

L Heathcote (Director)
For Outeniqua Lab (Pty) Ltd.

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2. The test results are reported with an approximate 95% level of confidence.
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# OUTENIQUA LAB (Pty) Ltd
Materials Testing Laboratory
Registration No. 95/07742/07
6 Mirrorball Street, George : PO Box 3186, George Industria, 6536
Tel: 044 8743274 : Fax: 044 8745779 : e-mail: llewelyn@outeniqualab.co.za

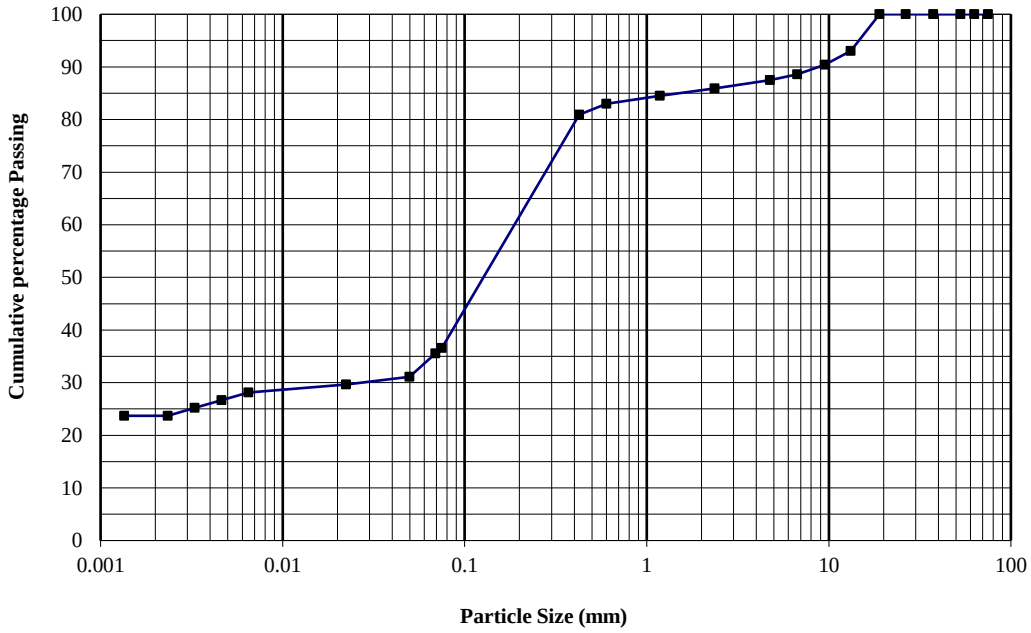

| | | | |
|---|---|---|---|
| Customer : | Asla Devco | Project : | Subsidy Housing Projects on Portion 111 of Melkhoutfontein 480 - Still Bay |
| | P O Box 118 | Date Received : | 05/12/17 |
| | Gordons Bay | Date Reported : | 25/01/18 |
| | 7151 | Req. Number : | 4026/17 |
| Attention : | David Douglas | No. of Pages : | 10/12 |

## TEST REPORT
## FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

| | | | | | |
|---|---|---|---|---|---|
| Material Description: | Light Greyish Yellow Silty Gravelly Clayey Sand | Sample Number: | 68654 | | |
| Position: | TP17 - Layer 2 | Liquid Limit | 16 | Linear Shrinkage | 1 |
| Depth: | 300-700 | Plasticity Index | 3 | Insitu M/C% | 14.4 |

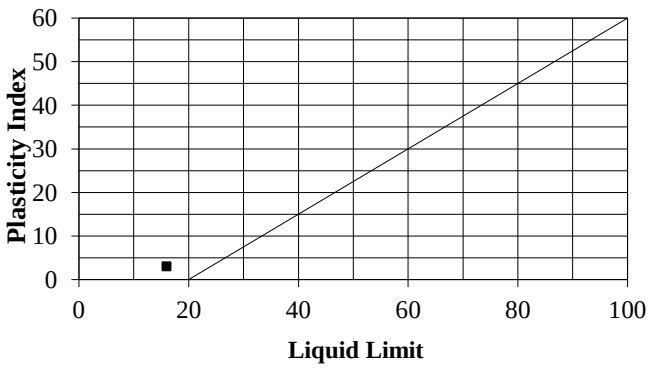
| Sieve Size(mm) | % Passing |
|---|---|
| 75.0 | 100 |
| 63.0 | 100 |
| 53.0 | 100 |
| 37.5 | 100 |
| 26.5 | 100 |
| 19.0 | 100 |
| 13.2 | 93 |
| 9.5 | 90 |
| 6.7 | 89 |
| 4.75 | 88 |
| 2.36 | 86 |
| 1.18 | 85 |
| 0.600 | 83 |
| 0.425 | 81 |
| 0.075 | 37 |
| 0.0690 | 36 |
| 0.0498 | 31 |
| 0.0223 | 30 |
| 0.0065 | 28 |
| 0.0046 | 27 |
| 0.0033 | 25 |
| 0.0023 | 24 |
| 0.0014 | 24 |

### Particle Size Distribution

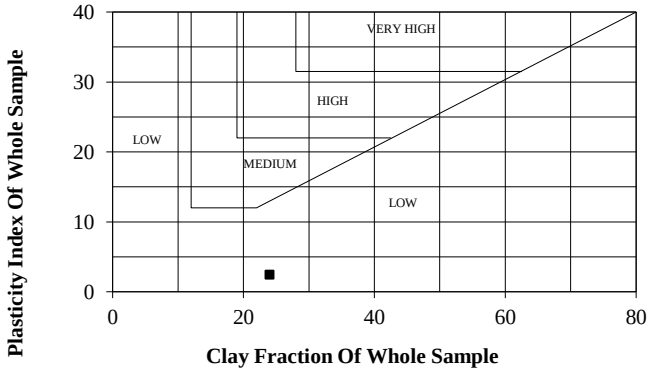



| | | | | | | | |
|---|---|---|---|---|---|---|---|
| % Clay | 24 | % Silt | 13 | % Sand | 48 | % Gravel | 15 |
| Unified Soil Classification | | SM | | PRA Soil Classification | | A-4 | |

### Plasticity Chart
**A Line**




### Potential Expansiveness




**Notes:**

- **Specimens sampled by Outeniqua Lab according to sampling Plan TMH 5 Methods MB1 & MC1**
- **All specimen sampled by : 0**
- **The weather conditions are such that there is no detrimental effect on the sample taken.**

L Heathcote (Director)
For Outeniqua Lab (Pty) Ltd.

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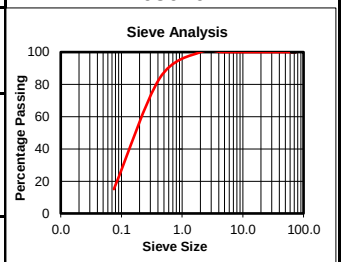
| | | | |
|---|---|---|---|
| Customer : | Asla Devco | Project : | Subsidy Housing Projects on Portion 111 of Melkhoutfontein 480 - Still Bay |
| | PO Box 118 | Date Received : | 05/12/17 |
| | Gordons Bay | Date Reported : | 01/02/18 |
| | 7151 | Req. Number : | 4026/17 |
| Attention : | David Douglas | No. of Pages : | 11/12 |

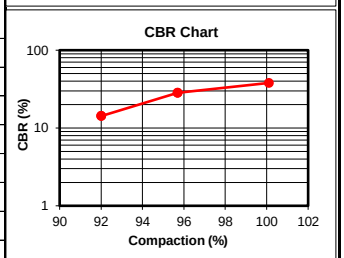
## TEST REPORT

## CALIFORNIA BEARING RATIO - (TMH 1 Method A1(a),A2,A3,A4,A5,A7,A8)

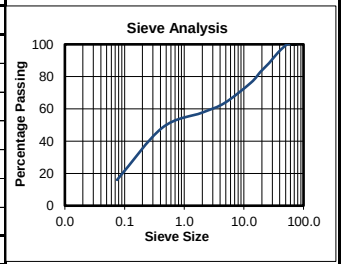
| Material Indicators | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sample Position (SV) | | TP 5 - Layer 1 | TRH 14: | | TP 12 - Layer 2 | TRH 14: | |
| Depth (mm) | | 0-900 | G7 SSG | | 300-700 | G6 Subbase | |
| Sample No | | 68646 | | | 68650 | | |
| Materials Description | Source | In-Situ | | | In-Situ | | |
| | Colour | Dark Reddish Brown | | | Light Brown | | |
| | Soil Type | SILTY Sand | | | Silty Sandy Gravel with Cobbles | | |
| | Classification | Existing | | | Exisiting | | |
| Max. Stone size in hole (mm) | | | | Opinion | | | Opinion |
| Percentage Passing | 75.0mm | 100 | | | 100 | | |
| | 63.0mm | 100 | | | 100 | | |
| | 53.0mm | 100 | | | 100 | | |
| | 37.5mm | 100 | | | 95 | | |
| | 26.5mm | 100 | | | 88 | | |
| | 19.0mm | 100 | | | 83 | | |
| | 13.2mm | 100 | | | 76 | | |
| | 4.75mm | 100 | | | 64 | | |
| | 2.00mm | 100 | | | 58 | | |
| | 0.425mm | 84 | | | 48 | | |
| | 0.075mm | 15.1 | | | 16.0 | | |
| **Soil Mortar & Constants** | | | | | | | |
| Grading Modulus | | 1.01 | 0.75 - 2.70 | ✓ | 1.78 | 1.20 - 2.60 | ✓ |
| Coarse Sand (%) | | 16 | | | 17 | | |
| Fine Sand (%) | | 69 | | | 56 | | |
| Silt & Clay (%) | | 15 | | | 28 | | |
| Liquid Limit (%) | | NP | | | 27 | | |
| Plasticity Index (%) | | NP | ≤ 12 | ✓ | 3 | ≤ 12 | ✓ |
| Linear Shrinkage (%) | | 0.0 | | | 2.0 | | |
| **CBR / Density Relationship** | | | | | | | |
| MOD | Max Dry Density (kg/m$^3$) | 1842 | | | 1775 | | |
| | Opt Moisture Content (%) | 9.7 | | | 15.3 | | |
| | Mould Moisture Con. (%) | 9.7 | | | 15.2 | | |
| | @100% Mod AASHTO | 100.1 | | | 100.8 | | |
| | Swell (%) | 0.00 | ≤ 1.5 | ✓ | 0.00 | ≤ 1.0 | ✓ |
| Proc NRB | 100% NRB | 95.7 | | | 95.6 | | |
| | Swell (%) | 0.00 | | | 0.00 | | |
| Proc | 100% Proctor | 92.0 | | | 92.2 | | |
| | Swell (%) | 0.00 | | | 0.00 | | |
| CBR | @ 100% Mod AASHTO | 38 | | | 68 | | |
| | @ 98% Mod AASHTO | 33 | | | 56 | | |
| | @ 95% Mod AASHTO | 25 | | | 43 | | |
| | @ 93% Mod AASHTO | 17 | ≥ 15 | ✳ | 28 | ≥ 25 | ✳ |
| | @ 90% Mod AASHTO | 10 | | | 14 | | |
| Insitu Moisture Content (%) | | | | | | | |
| **Soil Classification Achieved By The Material** | | | | | | | |
| TRH 14: | | G7 SSG | | | G6 Subbase | | |
| AASTHO System | | A-2-4 | | | A-1-b / A-2-4 | | |
| Unified System | | SM | | | GM | | |

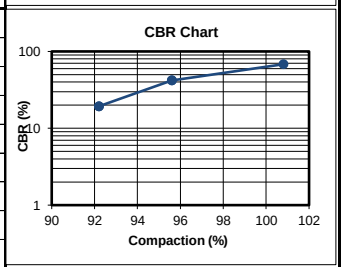
68646



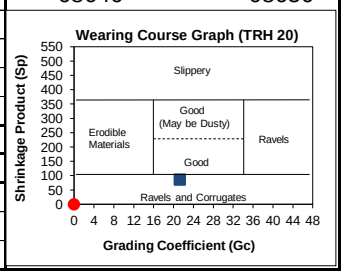




68650




● 68646 ■ 68650




- **Specimens delivered to Outeniqua Lab in good order.**

Llewelyn Heathcote
Technical Signatory
For Outeniqua Lab (Pty) Ltd.



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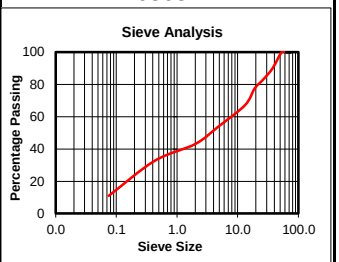
|---|---|---|---|
| Customer : | Asla Devco | Project : | Subsidy Housing Projects on Portion 111 of Melkhoutfontein 480 - Still Bay |
| | PO Box 118 | Date Received : | 05/12/17 |
| | Gordons Bay | Date Reported : | 30/01/18 |
| | 7151 | Req. Number : | 4026/17 |
| Attention : | David Douglas | No. of Pages : | 12/12 |

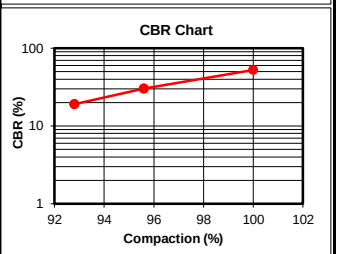
## TEST REPORT

## CALIFORNIA BEARING RATIO - (TMH 1 Method A1(a),A2,A3,A4,A5,A7,A8)

| Material Indicators | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sample Position (SV) | | TP 14 - Layer 2 | TRH 14: G7 SSG | | TP 15 - Layer 2 | TRH 14: G7 SSG | | |
| Depth (mm) | | 300-2200 | | | 250-800 | | | |
| Sample No | | 68652 | | | 68653 | | | |
| Materials Description | Source | In-Situ | | | In-Situ | | | |
| | Colour | Light Yellowish Orange | | | Light Yellowish Orange - White | | | |
| | Soil Type | Gravely Sand | | | Sandy Gravel with Gabbles + Boulders | | | |
| | Classification | Existing | | | Existing | | | |
| Max. Stone size in hole (mm) | | | | Opinion | | | Opinion | |
| Percentage Passing | 75.0mm | 100 | | | 100 | | | |
| | 63.0mm | 100 | | | 100 | | | |
| | 53.0mm | 100 | | | 100 | | | |
| | 37.5mm | 90 | | | 90 | | | |
| | 26.5mm | 83 | | | 82 | | | |
| | 19.0mm | 77 | | | 73 | | | |
| | 13.2mm | 67 | | | 63 | | | |
| | 4.75mm | 54 | | | 50 | | | |
| | 2.00mm | 43 | | | 39 | | | |
| | 0.425mm | 33 | | | 27 | | | |
| | 0.075mm | 11.0 | | | 8.5 | | | |
| **Soil Mortar & Constants** | | | | | | | | |
| Grading Modulus | | 2.13 | 0.75 - 2.70 | ✓ | 2.25 | 0.75 - 2.70 | ✓ | |
| Coarse Sand (%) | | 24 | | | 30 | | | |
| Fine Sand (%) | | 50 | | | 48 | | | |
| Silt & Clay (%) | | 26 | | | 22 | | | |
| Liquid Limit (%) | | NP | | | NP | | | |
| Plasticity Index (%) | | NP | ≤ 12 | ✓ | NP | ≤ 12 | ✓ | |
| Linear Shrinkage (%) | | 0.0 | | | 0.0 | | | |
| **CBR / Density Relationship** | | | | | | | | |
| MOD | Max Dry Density (kg/m$^3$) | 1858 | | | 1812 | | | |
| | Opt Moisture Content (%) | 11.6 | | | 15.4 | | | |
| | Mould Moisture Con. (%) | 11.6 | | | 15.1 | | | |
| | @100% Mod AASHTO | 100.0 | | | 100.0 | | | |
| | Swell (%) | 0.00 | ≤ 1.5 | ✓ | 0.00 | ≤ 1.5 | ✓ | |
| Proc NRB | 100% NRB | 95.6 | | | 95.8 | | | |
| | Swell (%) | 0.00 | | | 0.00 | | | |
| | 100% Proctor | 92.8 | | | 91.6 | | | |
| | Swell (%) | 0.00 | | | 0.00 | | | |
| CBR | @ 100% Mod AASHTO | 52 | | | 65 | | | |
| | @ 98% Mod AASHTO | 41 | | | 50 | | | |
| | @ 95% Mod AASHTO | 27 | | | 31 | | | |
| | @ 93% Mod AASHTO | 20 | ≥ 15 | ✓ | 20 | ≥ 15 | ✓ | |
| | @ 90% Mod AASHTO | 12 | | | 11 | | | |
| Insitu Moisture Content (%) | | | | | | | | |
| **Soil Classification Achieved By The Material** | | | | | | | | |
| TRH 14: | | G7 SSG | | | G7 SSG | | | |
| AASTHO System | | A-1-b / A-2-4 | | | A-1-a / A-1-b / A-2-4 | | | |
| Unified System | | GP-GM | | | GP-GM | | | |

68652

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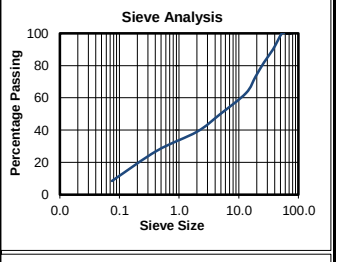
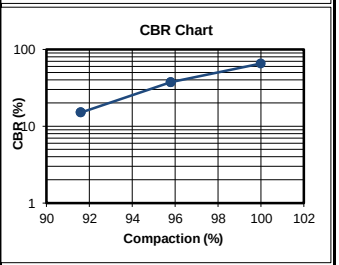
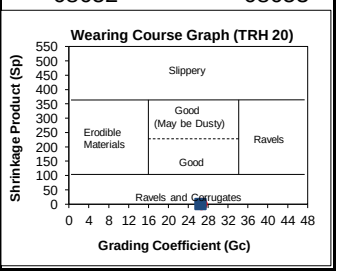



● 68652 ■ 68653




- **Specimens delivered to Outeniqua Lab in good order.**

Llewelyn Heathcote
Technical Signatory
For Outeniqua Lab (Pty) Ltd.



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# ControLab South Africa (Pty) Ltd

CIVIL ENGINEERING MATERIAL AND GEOTECHNICAL LABORATORY,
GEOTECHNICAL AND ENVIRONMENTAL SERVICES

201000582907

www.controlab.co.za

**HEAD OFFICE:** 1 Alfred Road, Vincent 5247, Tel: 043 726 7859, Fax: 043 726 7426
**CENTRAL LABORATORY :** 10 St Pauls Road, East London, 5201, Tel: 043 722 5420 / 722 8565, Fax: 043 743 9942, P O Box 346, East London, 5200
**OTHER BRANCH OFFICES:** Cape Town, Kokstad, Johannesburg, Mithatha, Queenstown, Lusaka - Zambia


## CONSOLIDATION TEST — SUMMARY OF READINGS

**CLIENT:** Outeniqua Geotechnical Services
**PROJECT :** MELKHOUTFONTEIN, STILBAAI, WC

**PROJECT NO :** 88293
**SAMPLE NO :** 8179
**POSITION:** TP4
**DEPTH:** 2000mm

**INITIAL DIAL READING =** 5.268 mm
**RING DIAMETER =** 71 mm

**H1 =** 19.7 mm
**$H_s$ =** 12.0579 mm
**Dial Gauge Div =** 1

**OEDOMETER NO :** 5
**BEAM RATIO :** 11

| BEAM LOAD | COMMENTS | PRESSURE | DIAL READING | UNCORRECTED DEFLECTION | MACHINE CORRECTION | CORRECTED DEFLECTION | HEIGHT CHANGE | VOID RATIO |
|---|---|---|---|---|---|---|---|---|
| (kg) | | (Kpa) | (mm) | (mm) | (mm) | (mm) | (mm) | |
| 0.1 | | 2.73 | 5.268 | 0.000 | 0.000 | 0 | 19.700 | 0.6338 |
| 1.1 | | 29.98 | 5.872 | -0.604 | 0.000 | 0.604 | 19.096 | 0.5837 |
| 2.1 | | 57.24 | 6.048 | -0.780 | 0.000 | 0.780 | 18.920 | 0.5691 |
| 2.1 | sat | 57.24 | 6.056 | -0.788 | 0.000 | 0.788 | 18.912 | 0.5684 |
| 4.1 | | 111.75 | 6.312 | -1.044 | 0.000 | 1.044 | 18.656 | 0.5472 |
| 8.1 | | 220.77 | 8.330 | -3.062 | 0.000 | 3.062 | 16.638 | 0.3798 |
| 16.1 | | 438.81 | 9.148 | -3.880 | 0.000 | 3.880 | 15.820 | 0.3120 |
| 32.1 | | 874.90 | 9.688 | -4.420 | 0.000 | 4.420 | 15.280 | 0.2672 |
| 16.1 | | 438.81 | 9.620 | -4.352 | 0.000 | 4.352 | 15.348 | 0.2729 |
| 8.1 | | 220.77 | 9.564 | -4.296 | 0.000 | 4.296 | 15.404 | 0.2775 |
| 4.1 | | 111.75 | 9.522 | -4.254 | 0.000 | 4.254 | 15.446 | 0.2810 |
| 2.1 | | 57.24 | 9.476 | -4.208 | 0.000 | 4.208 | 15.492 | 0.2848 |
| 1.1 | | 29.98 | 9.430 | -4.162 | 0.000 | 4.162 | 15.538 | 0.2886 |
| 0.1 | | 2.73 | 9.056 | -3.788 | 0.000 | 3.788 | 15.912 | 0.3196 |
| 1.1 | | 29.98 | 9.146 | -3.878 | 0.000 | 3.878 | 15.822 | 0.3122 |
| 2.1 | | 57.24 | 9.218 | -3.950 | 0.000 | 3.950 | 15.750 | 0.3062 |
| 4.1 | | 111.75 | 9.350 | -4.082 | 0.000 | 4.082 | 15.618 | 0.2952 |
| 8.1 | | 220.77 | 9.466 | -4.198 | 0.000 | 4.198 | 15.502 | 0.2856 |
| 16.1 | | 438.81 | 9.574 | -4.306 | 0.000 | 4.306 | 15.394 | 0.2767 |
| 32.1 | | 874.90 | 9.756 | -4.488 | 0.000 | 4.488 | 15.212 | 0.2616 |
| 16.1 | | 438.81 | 9.718 | -4.450 | 0.000 | 4.450 | 15.250 | 0.2647 |
| 8.1 | | 220.77 | 9.688 | -4.420 | 0.000 | 4.420 | 15.280 | 0.2672 |
| 4.1 | | 111.75 | 9.652 | -4.384 | 0.000 | 4.384 | 15.316 | 0.2702 |
| 2.1 | | 57.24 | 9.620 | -4.352 | 0.000 | 4.352 | 15.348 | 0.2729 |
| 1.1 | | 29.98 | 9.578 | -4.310 | 0.000 | 4.310 | 15.390 | 0.2763 |
| 0.1 | | 2.73 | 9.128 | -3.860 | 0.000 | 3.860 | 15.840 | 0.3137 |

**COLLAPSE 0.0**



Technical Signatory: C Becker

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CIVIL ENGINEERING MATERIAL AND GEOTECHNICAL LABORATORY,
GEOTECHNICAL AND ENVIRONMENTAL SERVICES

201000582907

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HEAD OFFICE: 1 Alfred Road, Vincent 5247, Tel: 043 726 7859, Fax: 043 726 7426
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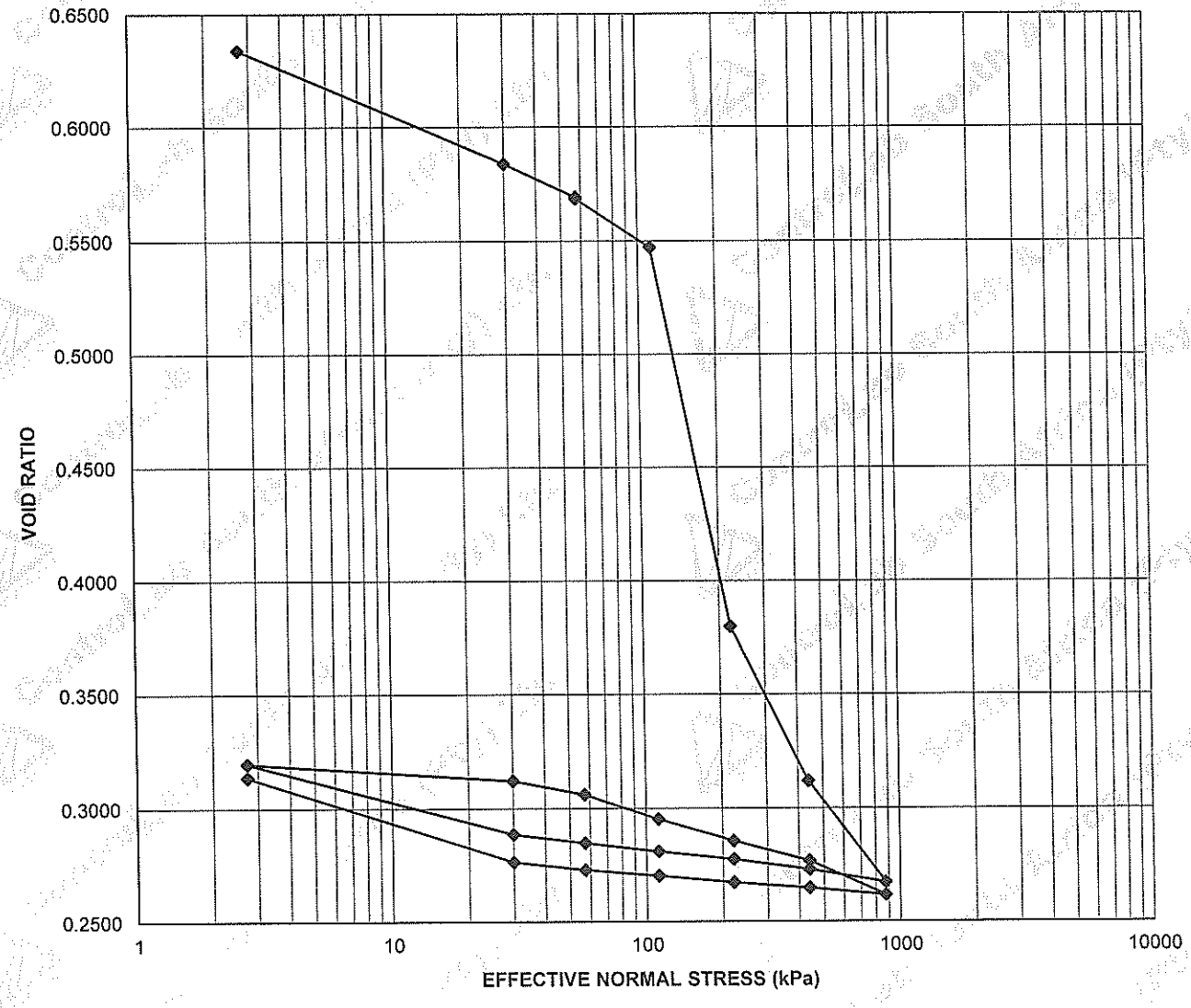
OTHER BRANCH OFFICES: Cape Town, Kokstad, Johannesburg, Mthatha, Queenstown, Lusaka - Zambia

# CONSOLIDATION TEST

**CLIENT:** Outeniqua Geotechnical Services
**PROJECT :** MELKHOUTFONTEIN, STILBAAI, WC

**PROJECT NO :** 88293
**SAMPLE NO :** 8179
**POSITION :** TP4
**DEPTH :** 2000mm

| | | | | | |
|---|---|---|---|---|---|
| CLIENT SAMPLE DESCRIPTION | : | dk Y cly s | | | |
| STATE OF SAMPLE | : | Undisturbed | SPECIFIC GRAVITY est. | = | 2.69 |
| BULK DENSITY | = | 2040 | VOL VOIDS | = | 0.38792227 |
| DRY DENSITY | = | 1646 Kg/m3 | VOL SOILDS | = | 0.61207773 |
| INITIAL SATURATION | = | 1.01 | FINAL SATURATION | = | 1.03 |
| INITIAL MOISTURE CONTENT | = | 23.90 % | FINAL MOISTURE CONTENT | = | 24.2 |
| INITIAL VOID RATIO | = | 0.6338 | FINAL VOID RATIO | = | 0.2848 |
| | | COLLAPSE 0.0 | | | |



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TR0014

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201000682907
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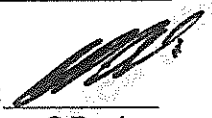
| | | | |
|---|---|---|---|
| **CLIENT:** | Outeniqua Geotechnical Services | **PROJECT:** | Melkhoutfontein Stilbaai |
| | P O Box 964 | | Western Cape |
| | KNYSNA | | |
| | 6570 | **DATE:** | 2017-12-15 |
| | | | |
| | | | |
| **ATT:** | Mr I Paton | **REF:** | 88293 |

## *pH & CONDUCTIVITY*

| SAMPLE NO. | SAMPLE NO. & TEST POSITION | DEPTH mm | pH | Conductivity (mS/m) |
|---|---|---|---|---|
| 8180 | TP4PH TP 4 | 800-1400 | 7.57 | 1843 |
| 8181 | TP7PH TP 7 | 0-400 | 6.66 | 1441 |
| 8182 | TP17PH TP 17 | 300-700 | 8.20 | N/A |

Technical Signatory: 

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# Appendix 4

# DCP test data

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18 Clyde Street, Knysna : PO Box 964, Knysna, 6570

Tel: 044 3820502 : Fax: 044 3820503 : e-mail: iain@outeniqualab.co.za


| | | | |
|---|---|---|---|
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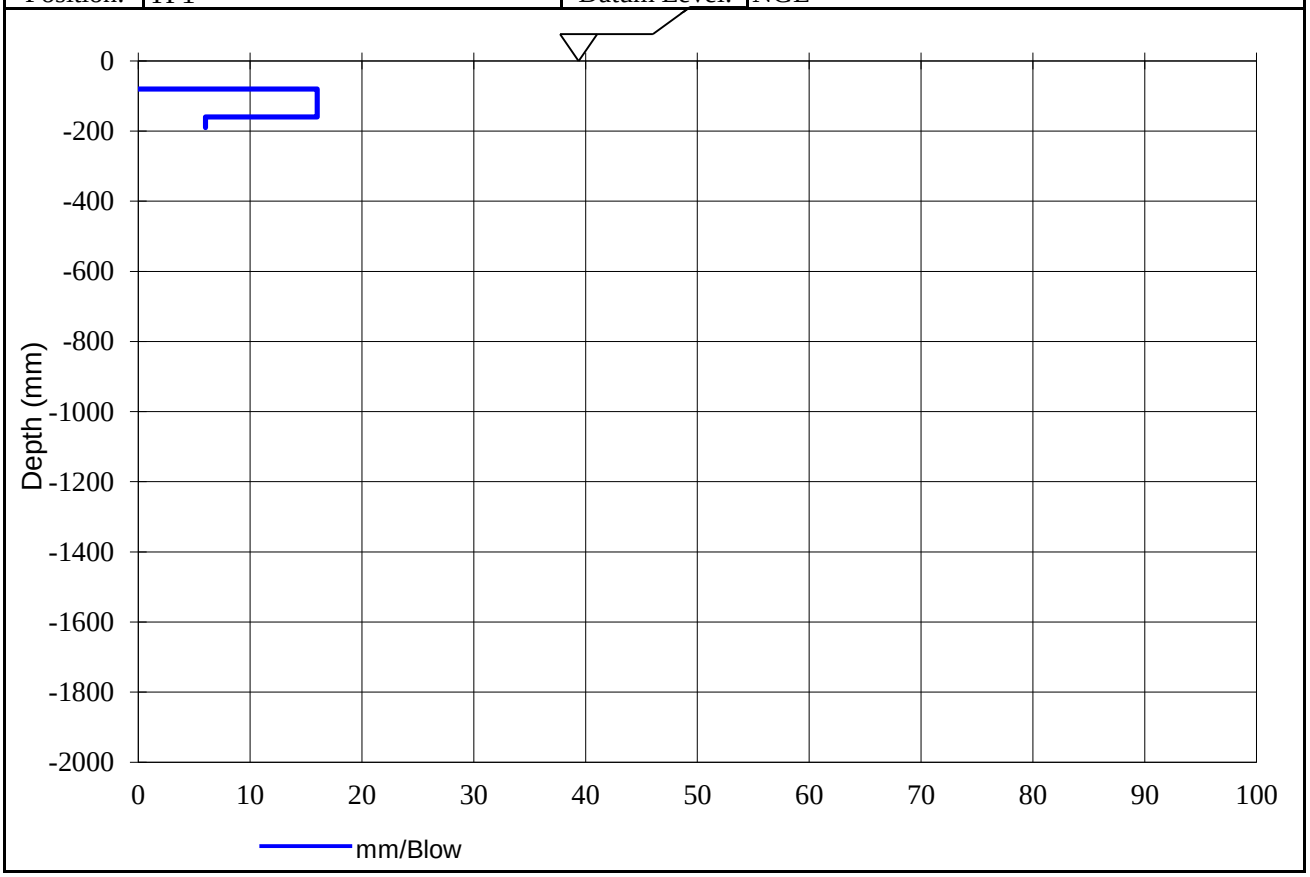
| | | Date Reported : | 29.11.17 |
| | | Req. Number : | |
| Attention : | David Douglas | No. of Pages : | 1 of 19 |

## TEST REPORT

## Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

| Position: | TP1 | Datum Level: | NGL |
|---|---|---|---|

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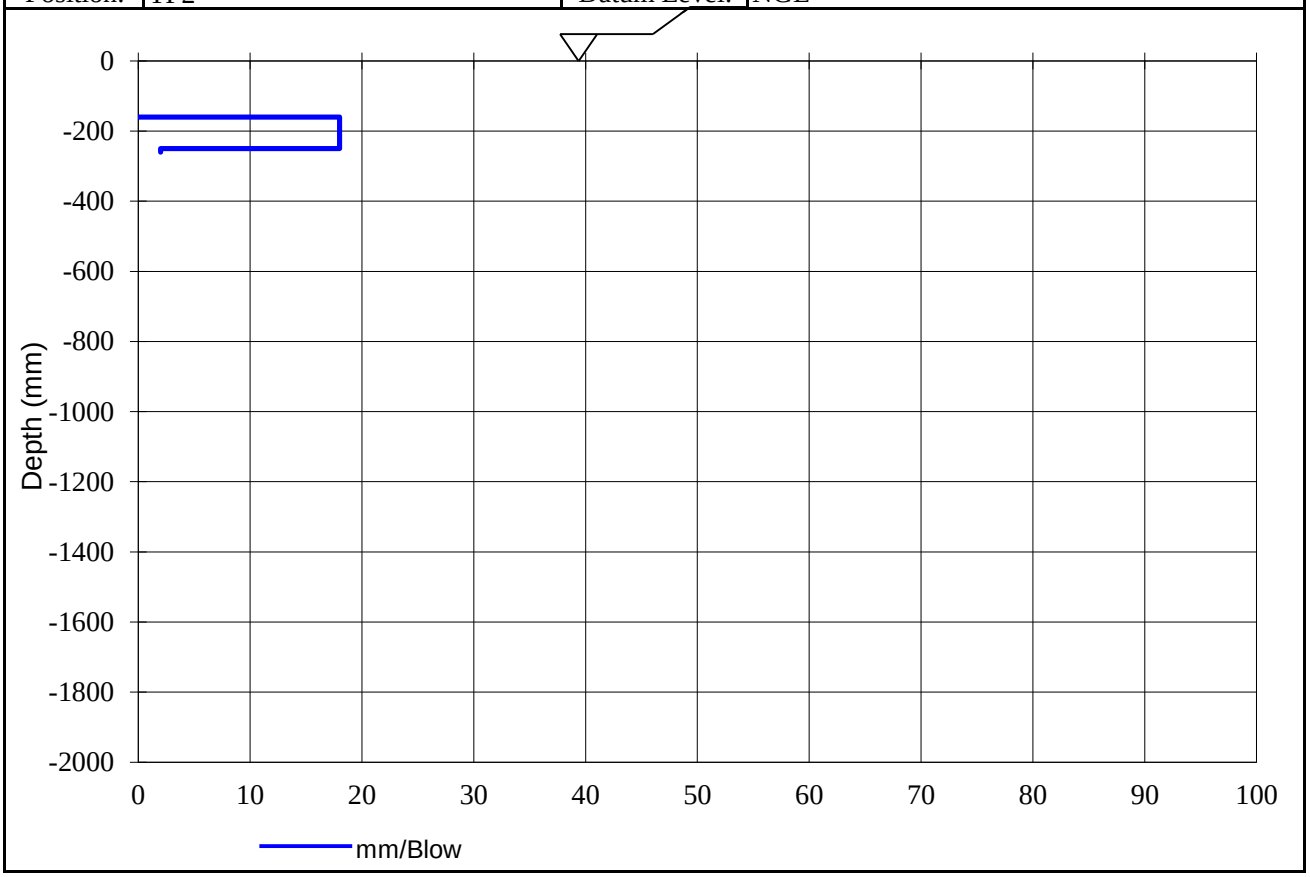
## TEST REPORT

## Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

| Position: | TP2 | Datum Level: | NGL |
|---|---|---|---|

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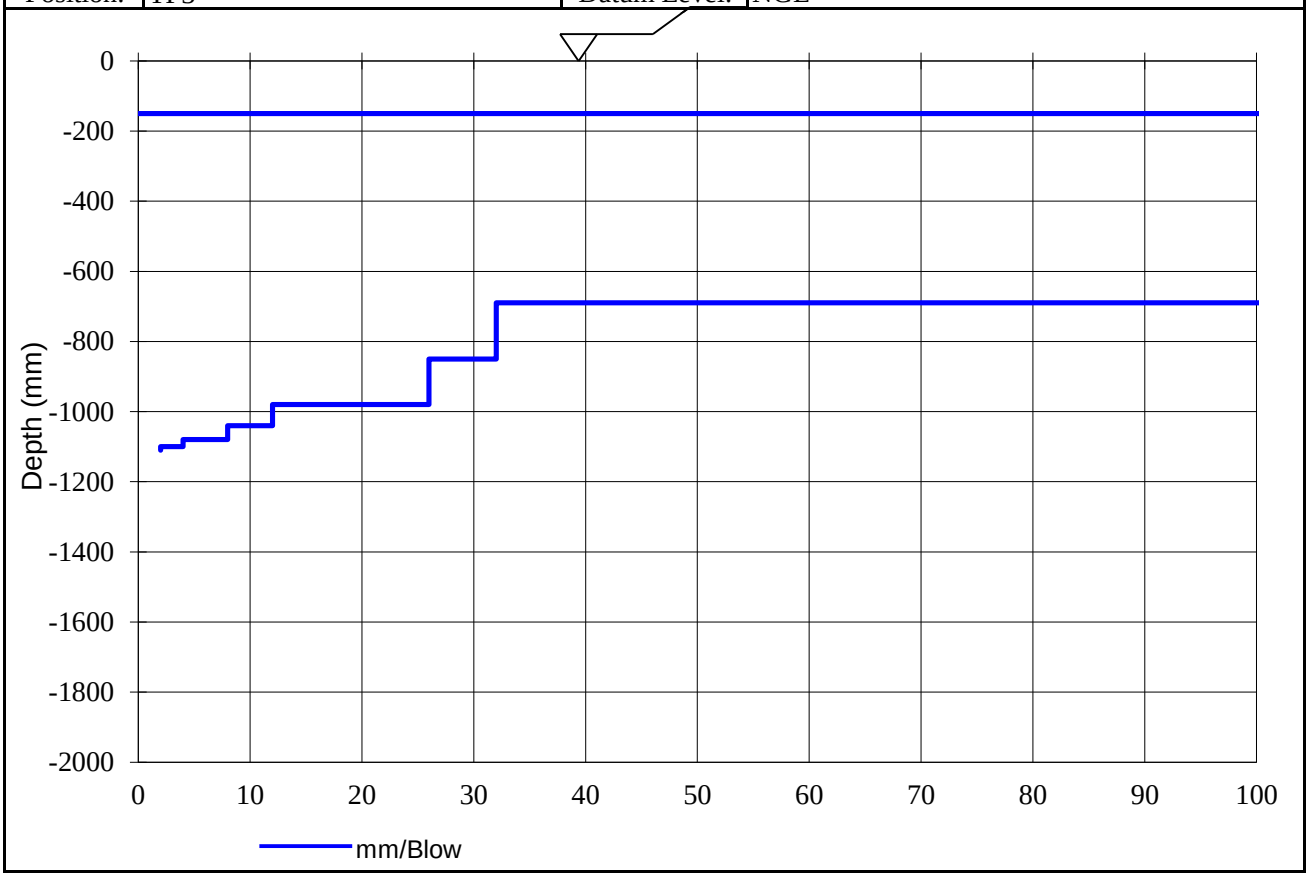
## TEST REPORT

## Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

| Position: | TP3 | Datum Level: | NGL |
|---|---|---|---|

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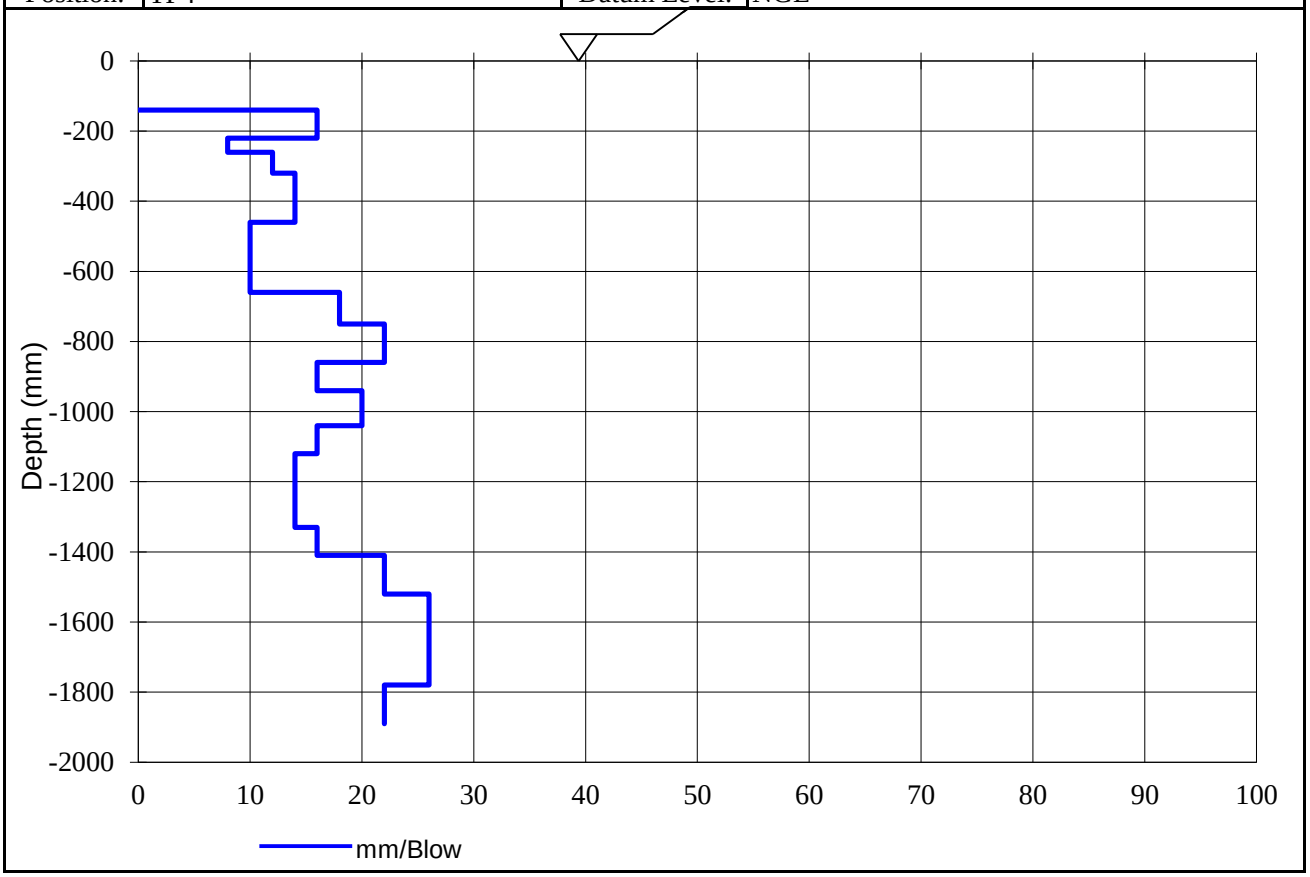
## TEST REPORT

## Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

| Position: | TP4 | Datum Level: | NGL |
|---|---|---|---|

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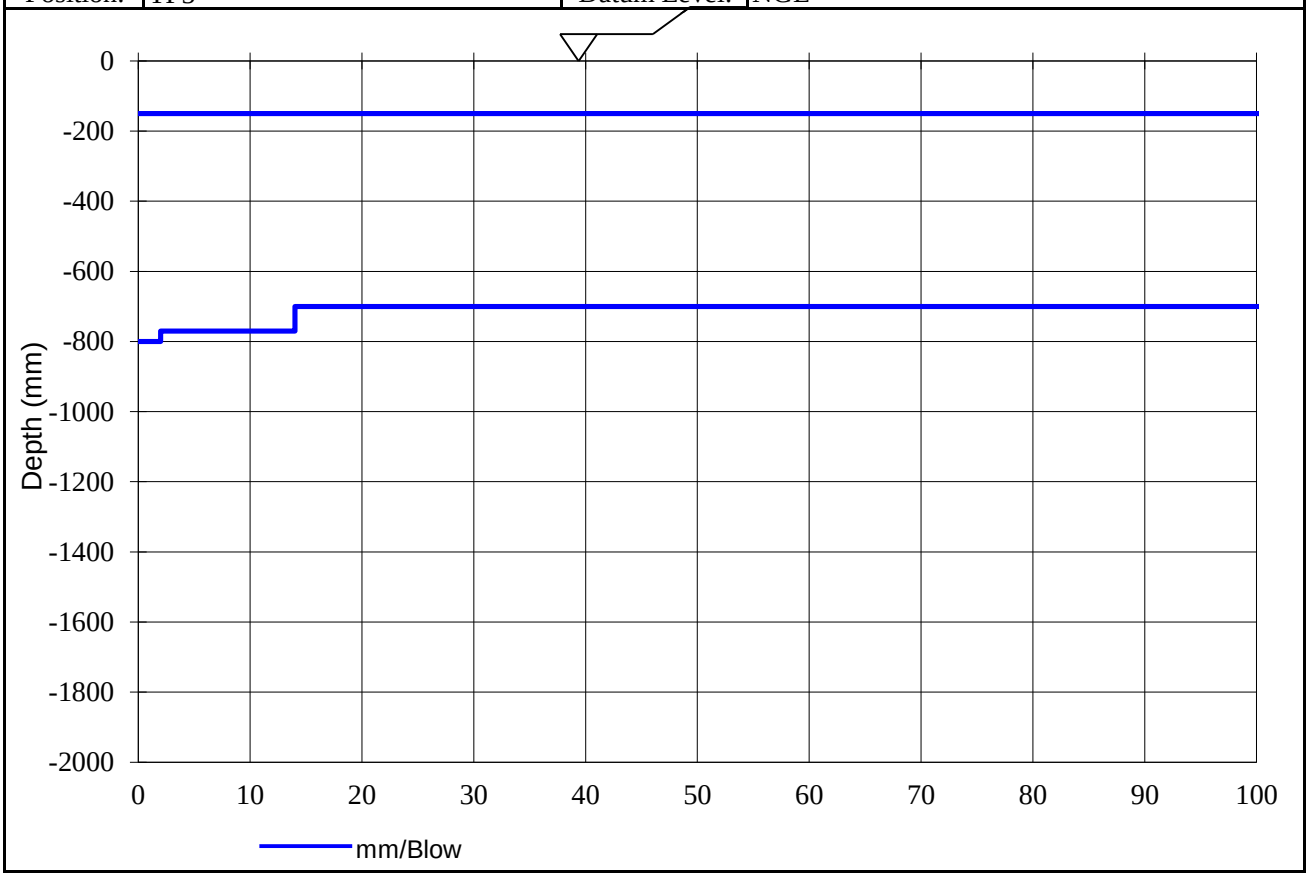
## TEST REPORT

## Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

| Position: | TP5 | Datum Level: | NGL |
|---|---|---|---|

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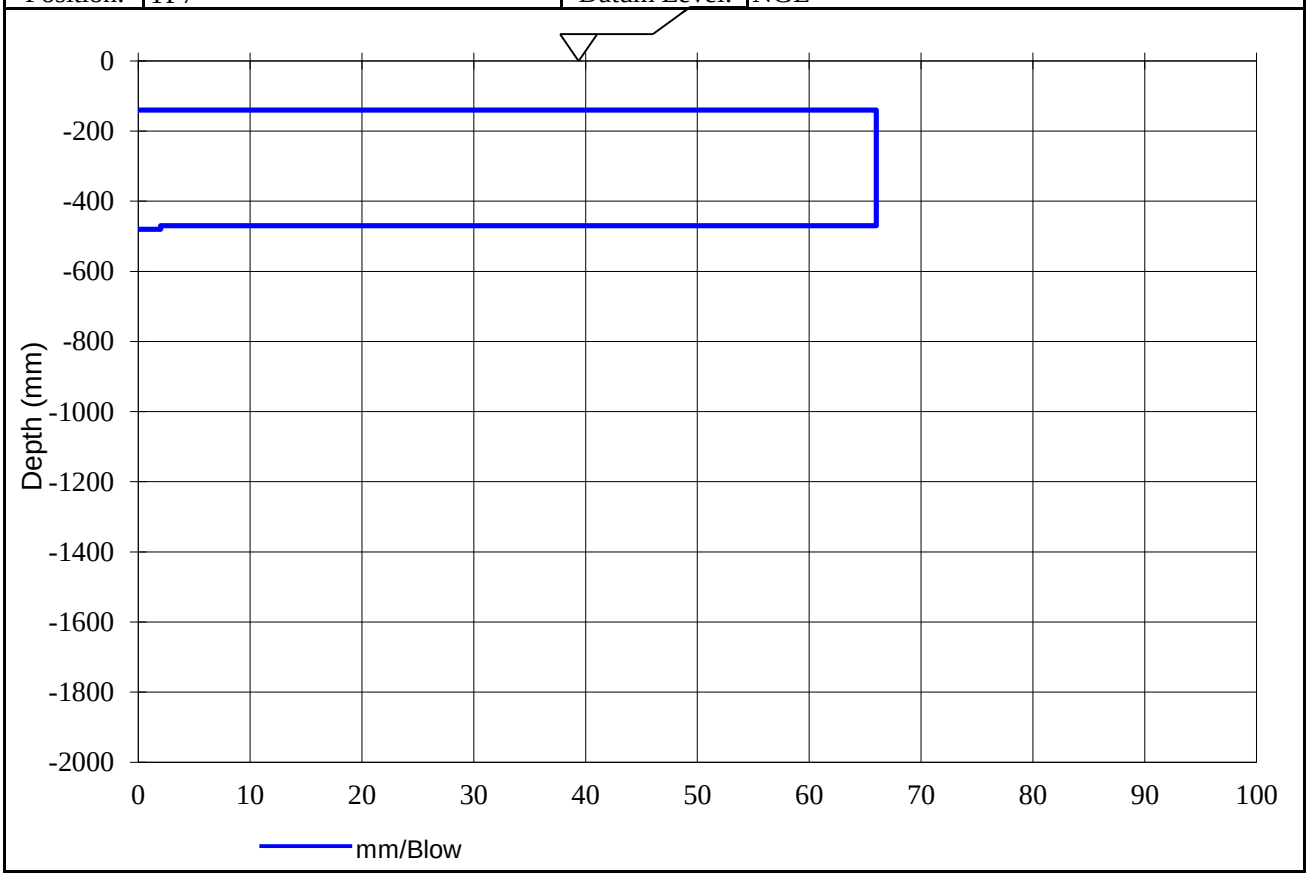
## TEST REPORT

## Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

| Position: | TP7 | Datum Level: | NGL |
|---|---|---|---|

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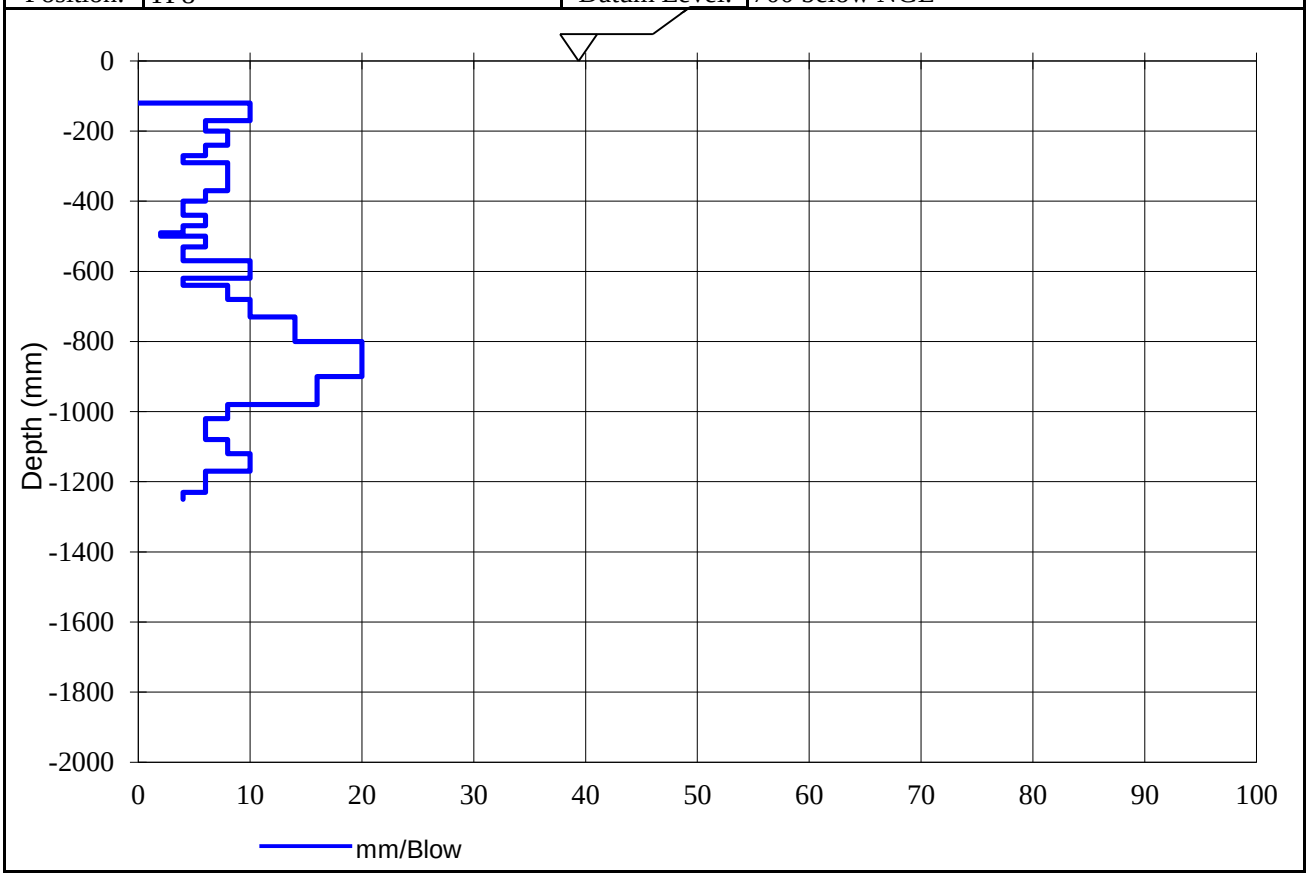
## TEST REPORT

## Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

| Position: | TP8 | Datum Level: | 700 below NGL |
|---|---|---|---|

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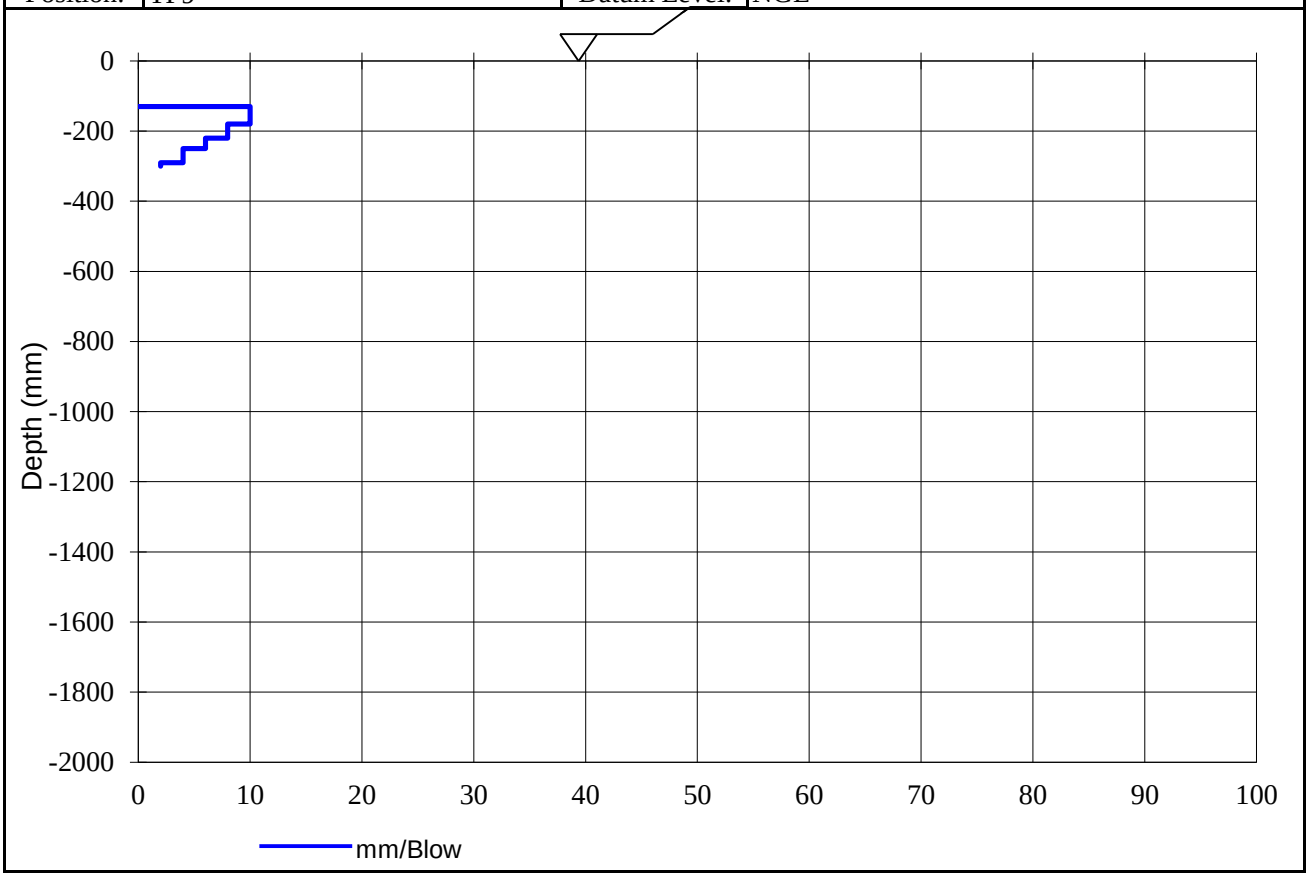
| Attention : | David Douglas | No. of Pages : | 9 of 19 |

## TEST REPORT

## Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

| Position: | TP9 | Datum Level: | NGL |
|---|---|---|---|

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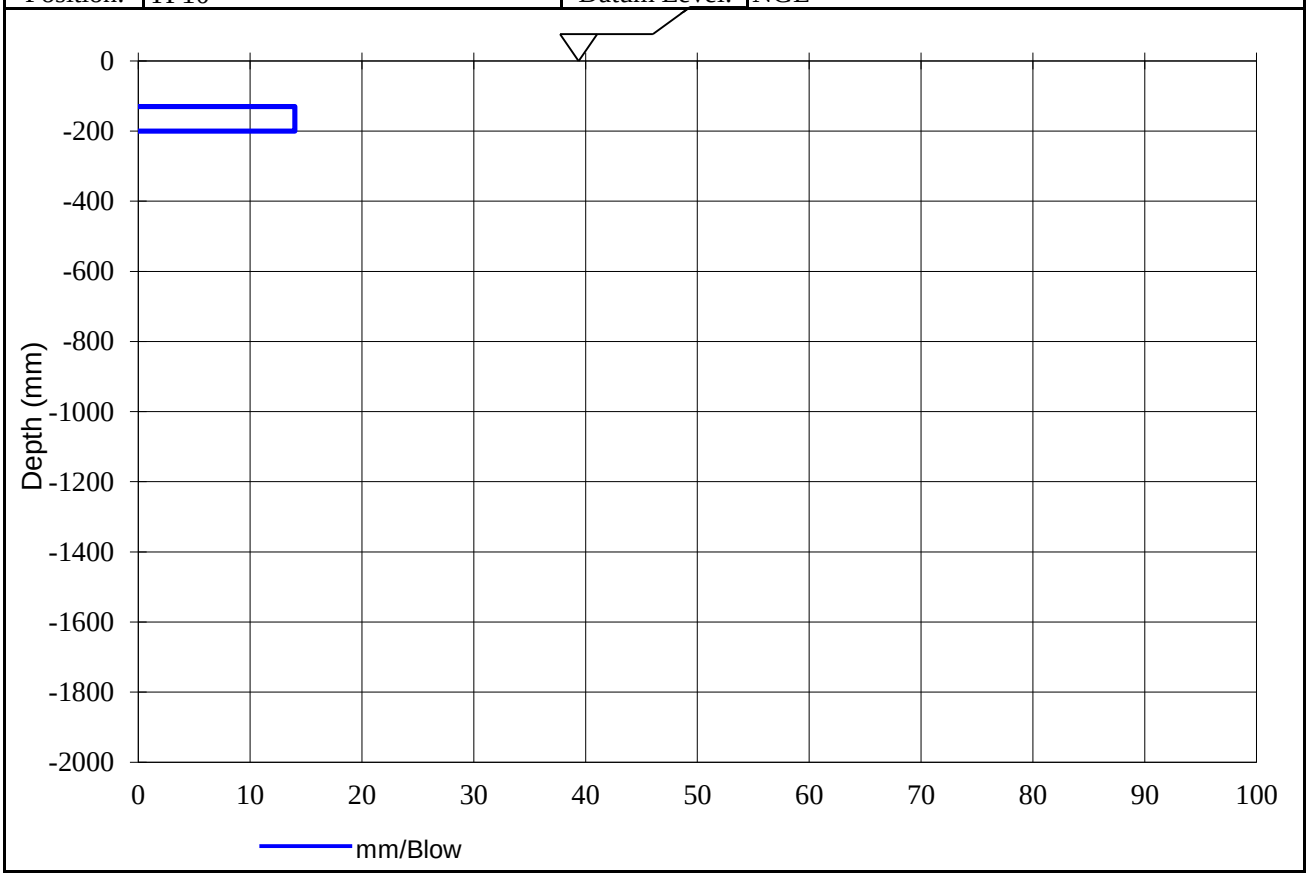
## TEST REPORT

## Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

| Position: | TP10 | Datum Level: | NGL |
|---|---|---|---|

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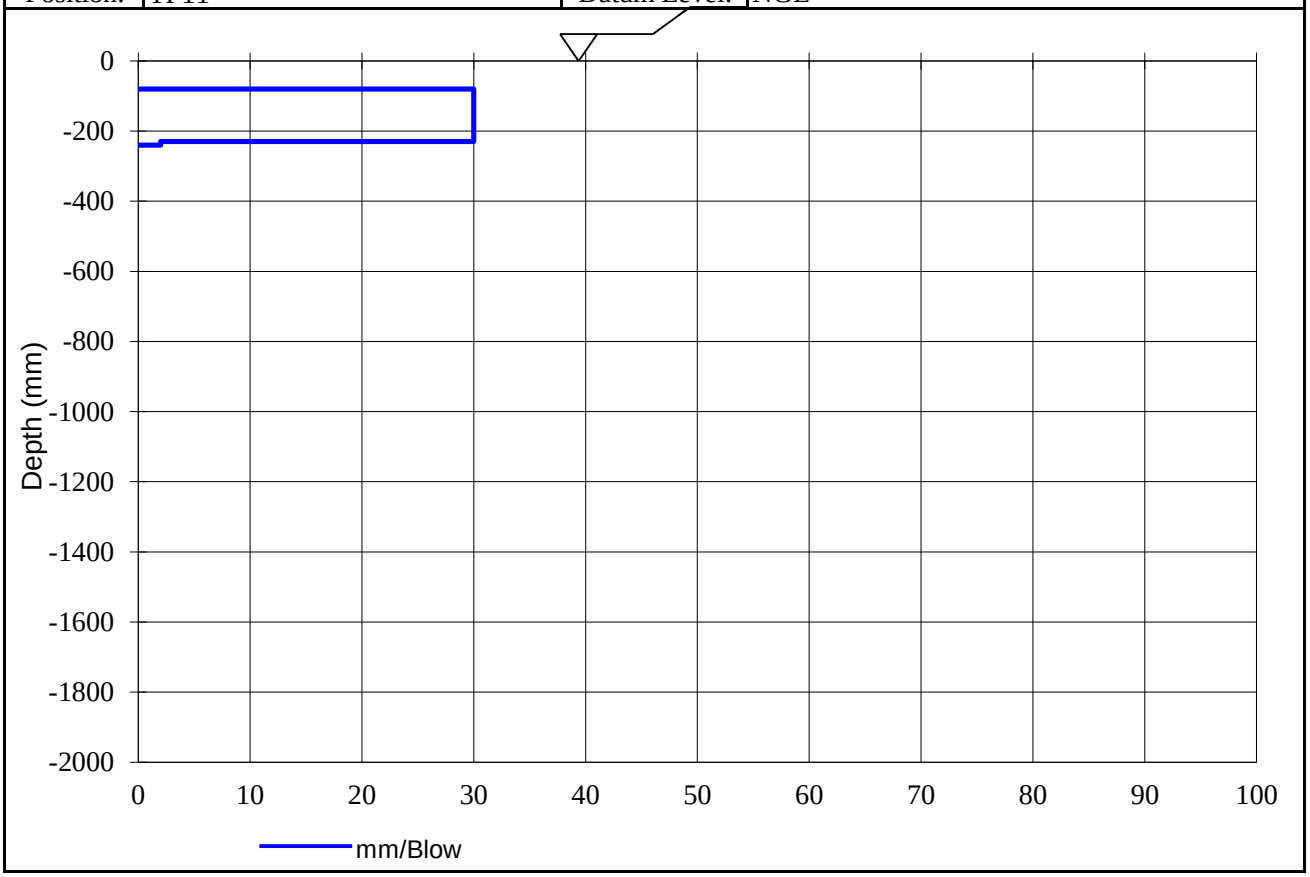
## TEST REPORT

## Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

| Position: | TP11 | Datum Level: | NGL |
|---|---|---|---|

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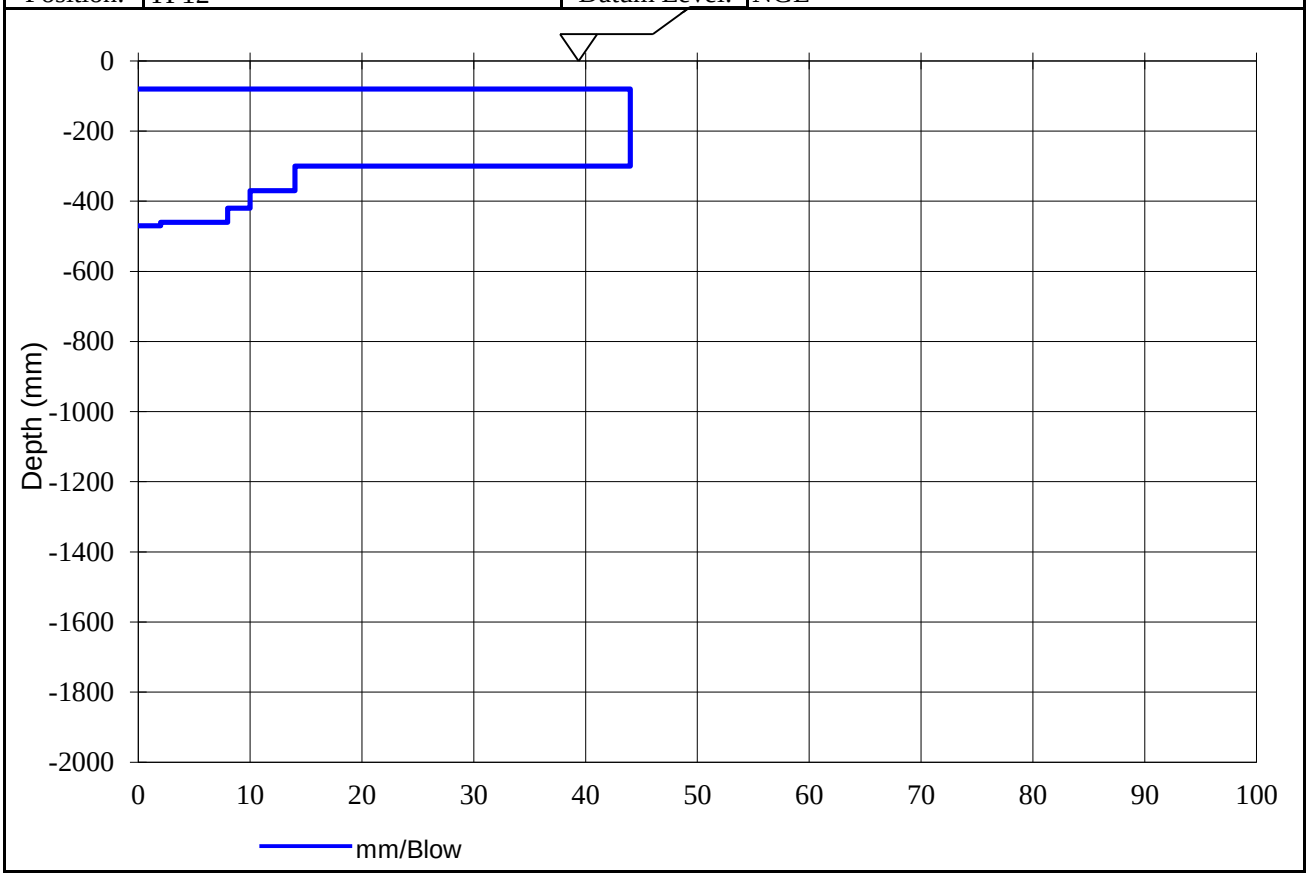
## TEST REPORT

## Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

| Position: | TP12 | Datum Level: | NGL |
|---|---|---|---|

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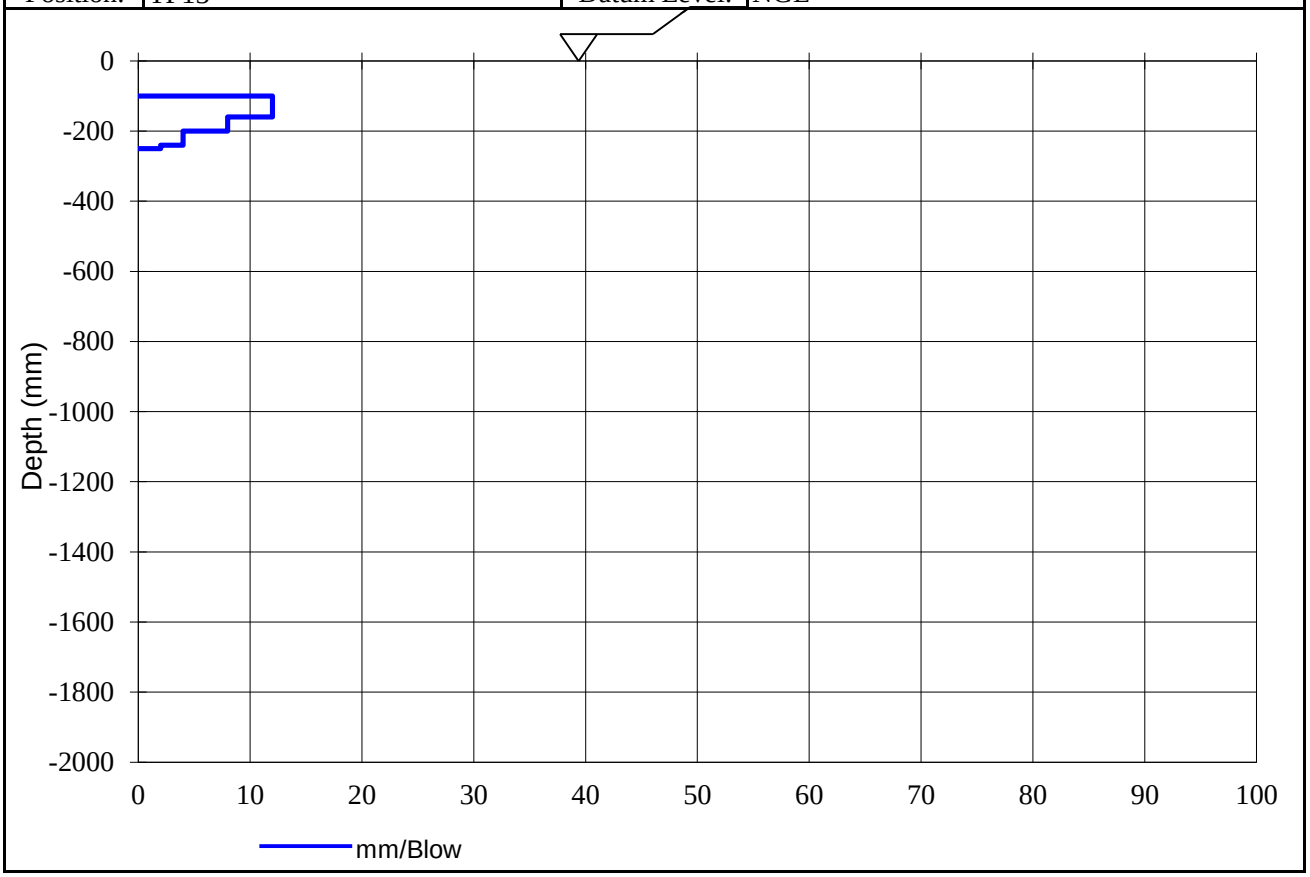
## TEST REPORT

## Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

| Position: | TP13 | Datum Level: | NGL |
|---|---|---|---|




I Paton (Member)
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Technical Signatory

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Geotechnical Engineering Consultants

Registration No. 1999/062743/23

18 Clyde Street, Knysna : PO Box 964, Knysna, 6570

Tel: 044 3820502 : Fax: 044 3820503 : e-mail: iain@outeniqualab.co.za


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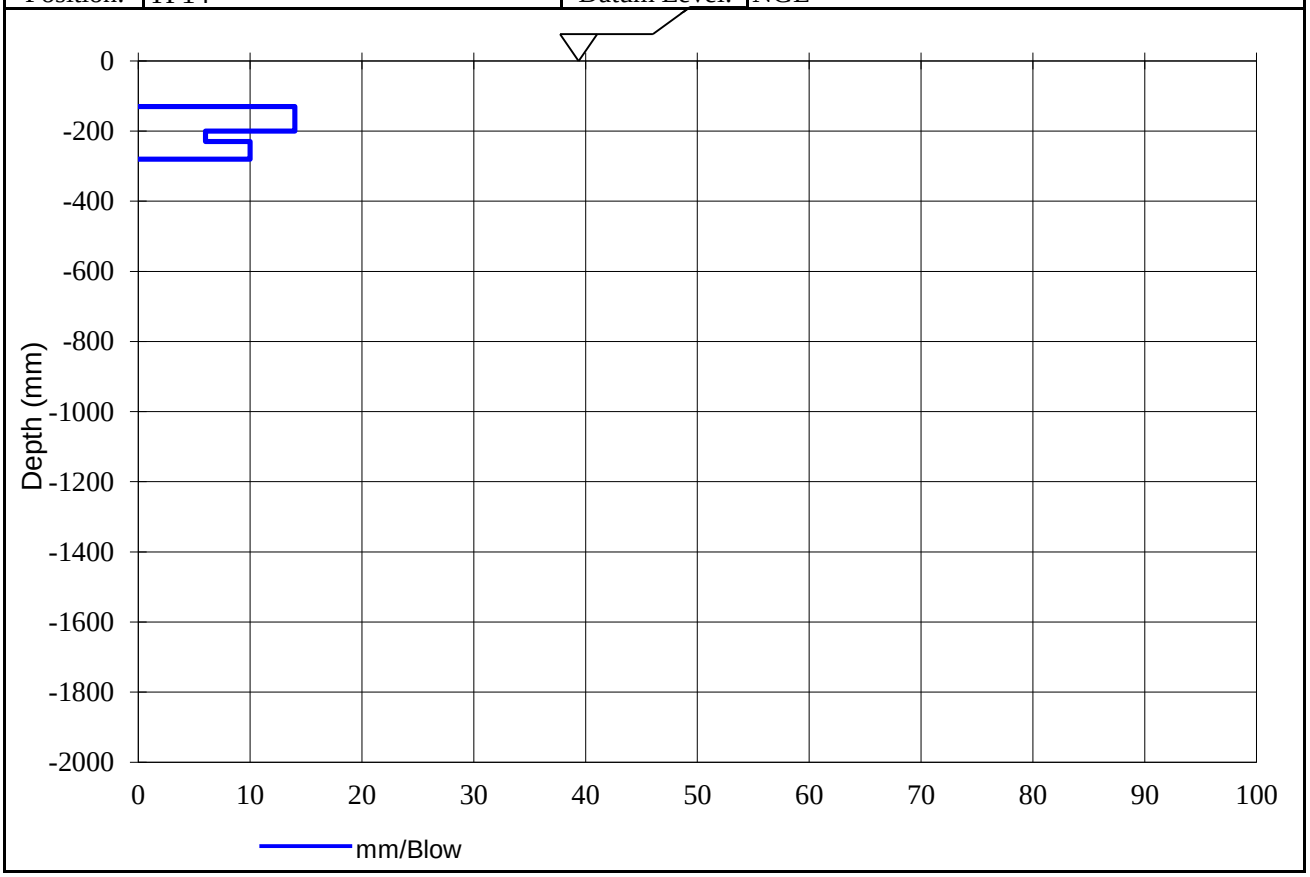
|---|---|---|---|
| Customer : | Asla Devco<br>P.O. Box 118<br>Gordons Bay<br>7151 | Project : | Subsidy Housing Project on Portion 111 of Melkhoutfontein 480, Still Bay |
| | | Date Received : | 20.11.17 |
| | | Date Reported : | 29.11.17 |
| | | Req. Number : | |
| Attention : | David Douglas | No. of Pages : | 14 of 19 |

## TEST REPORT

## Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

| Position: | TP14 | Datum Level: | NGL |
|---|---|---|---|

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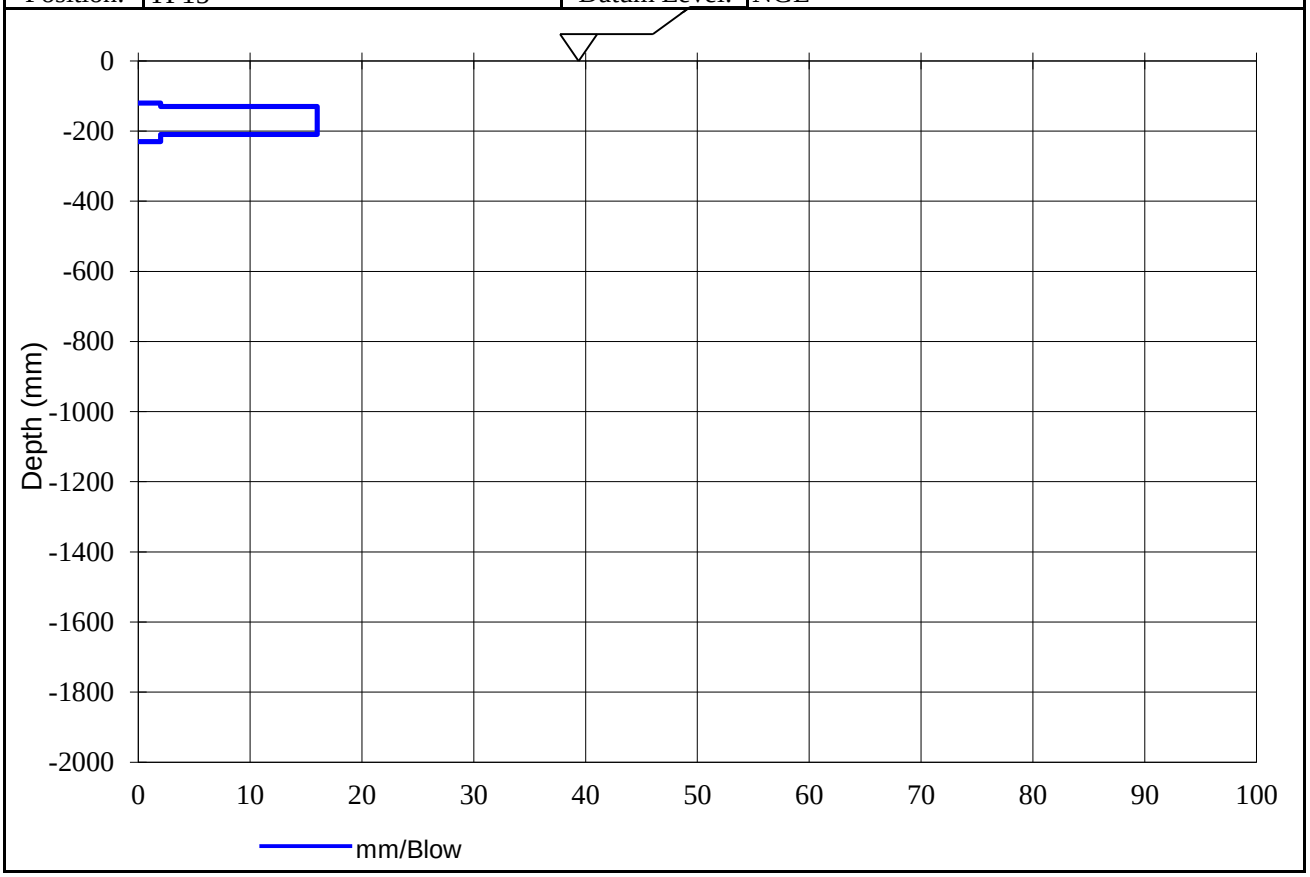
## TEST REPORT

## Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

| Position: | TP15 | Datum Level: | NGL |
|---|---|---|---|

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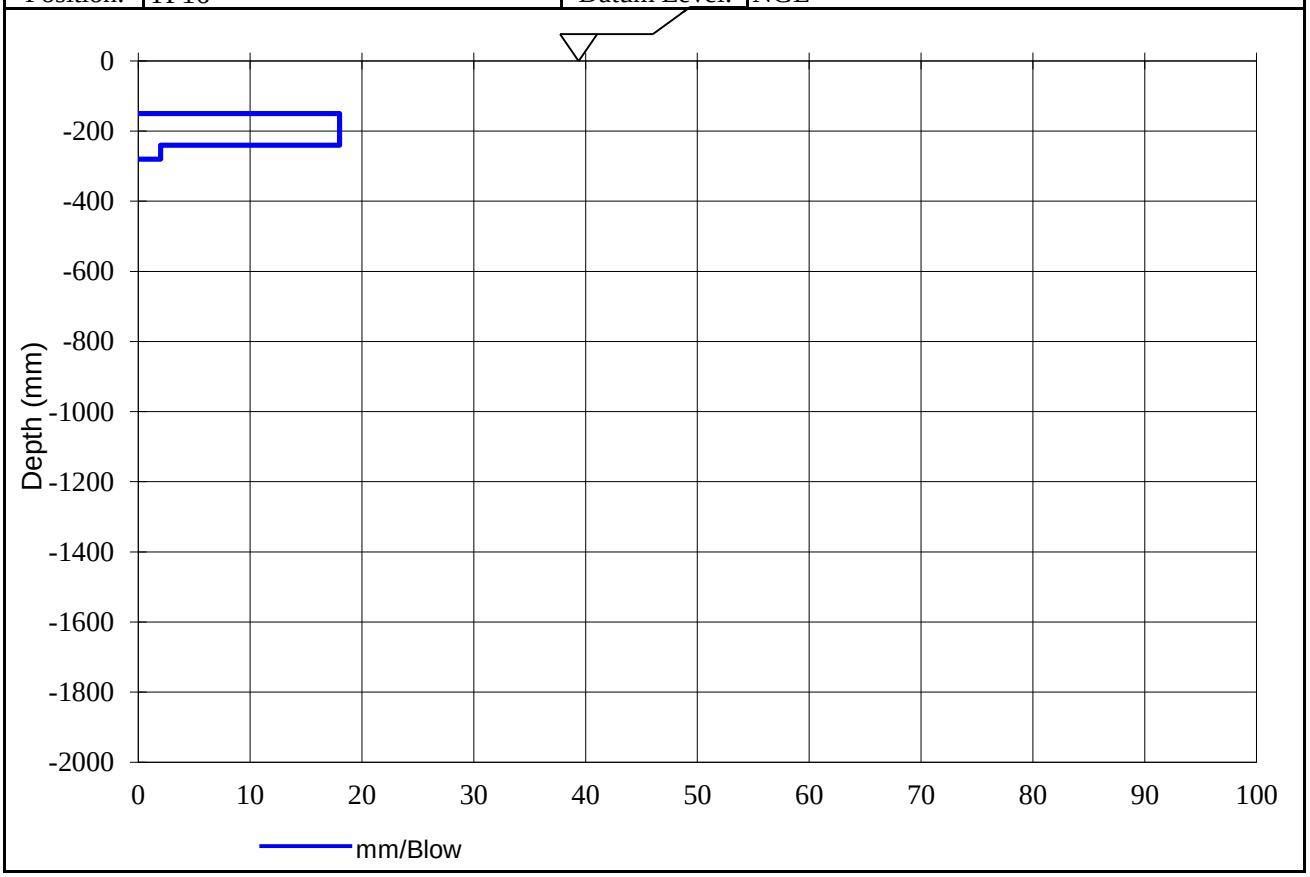
## TEST REPORT

## Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

| Position: | TP16 | Datum Level: | NGL |
|---|---|---|---|

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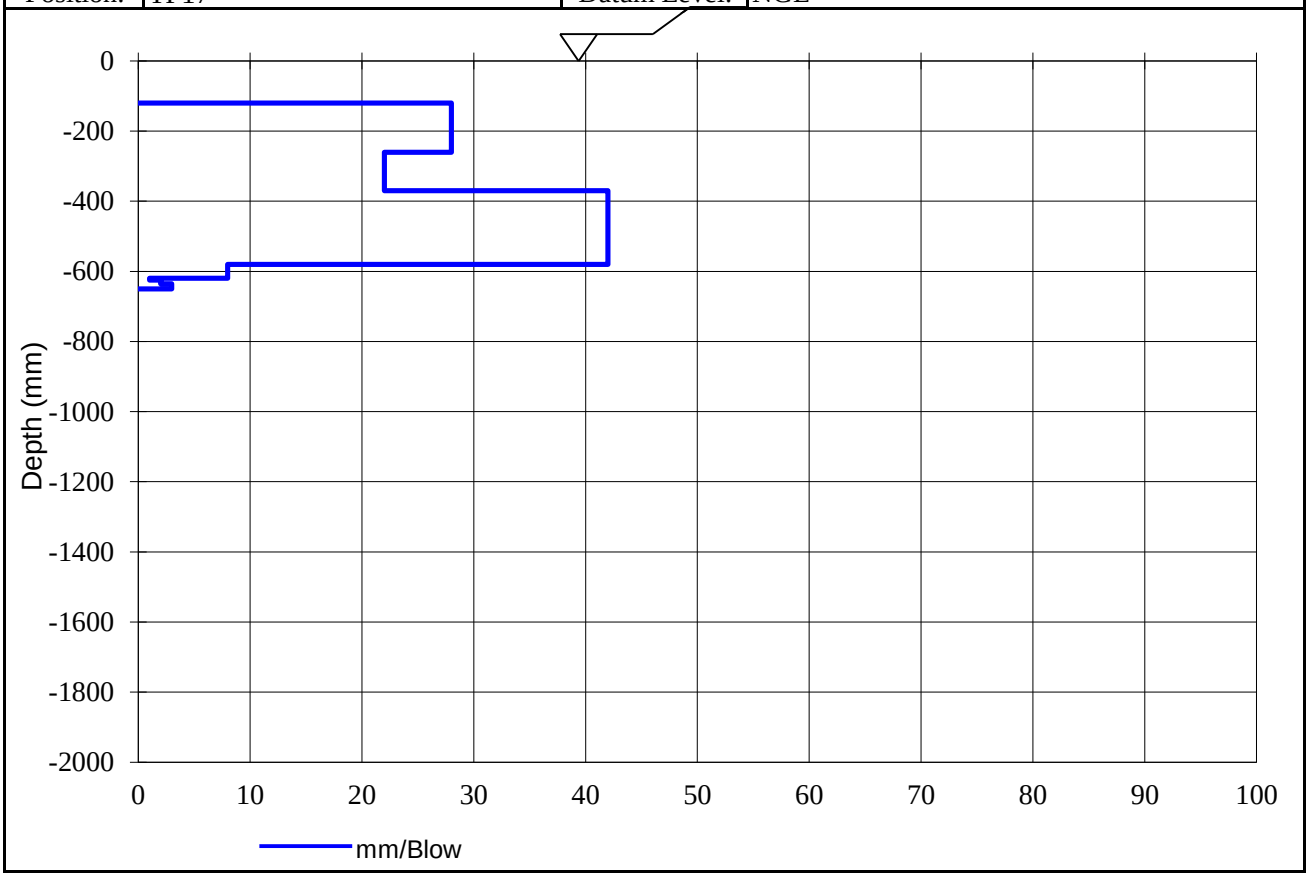
## TEST REPORT

## Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

| Position: | TP17 | Datum Level: | NGL |
|---|---|---|---|

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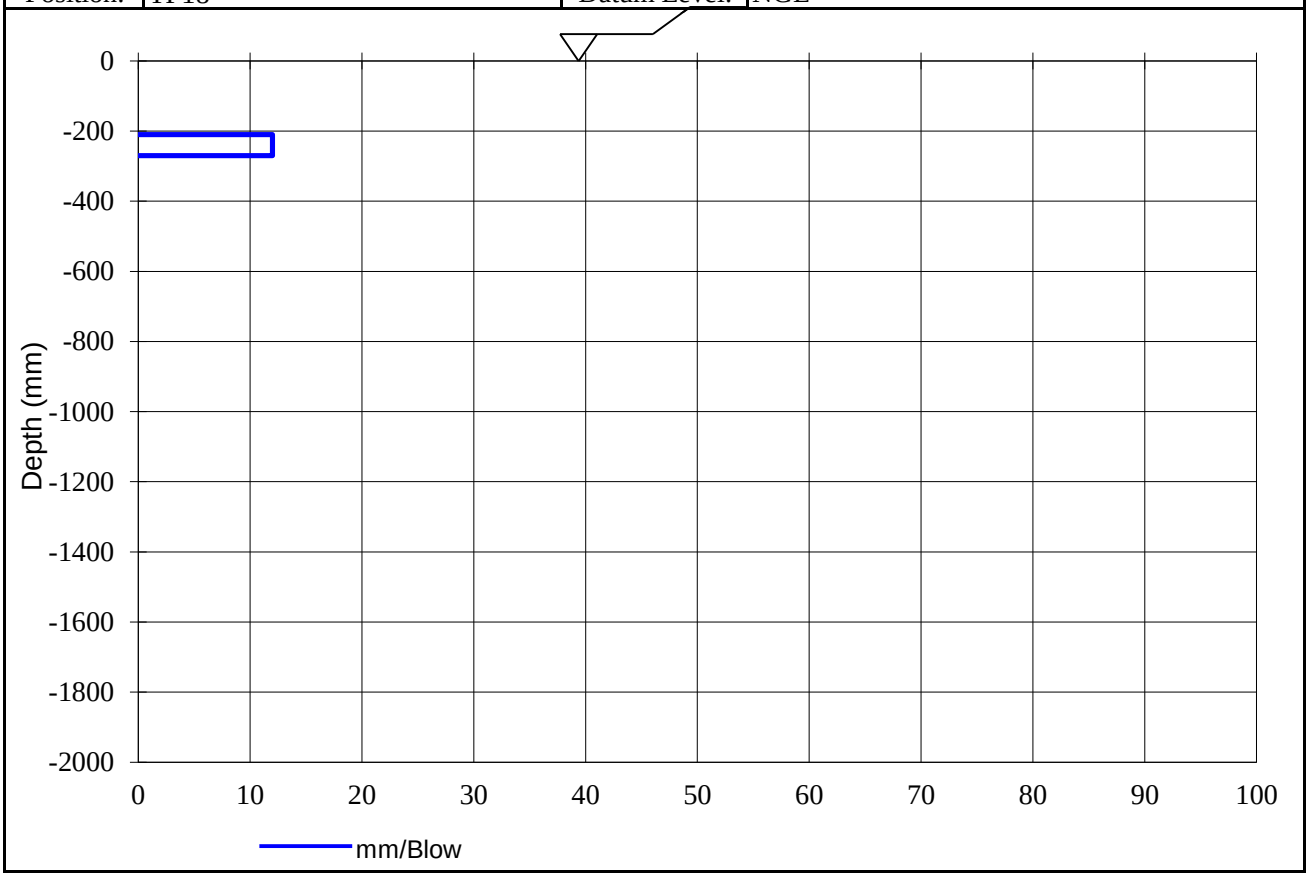
## TEST REPORT

## Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

| Position: | TP18 | Datum Level: | NGL |
|---|---|---|---|

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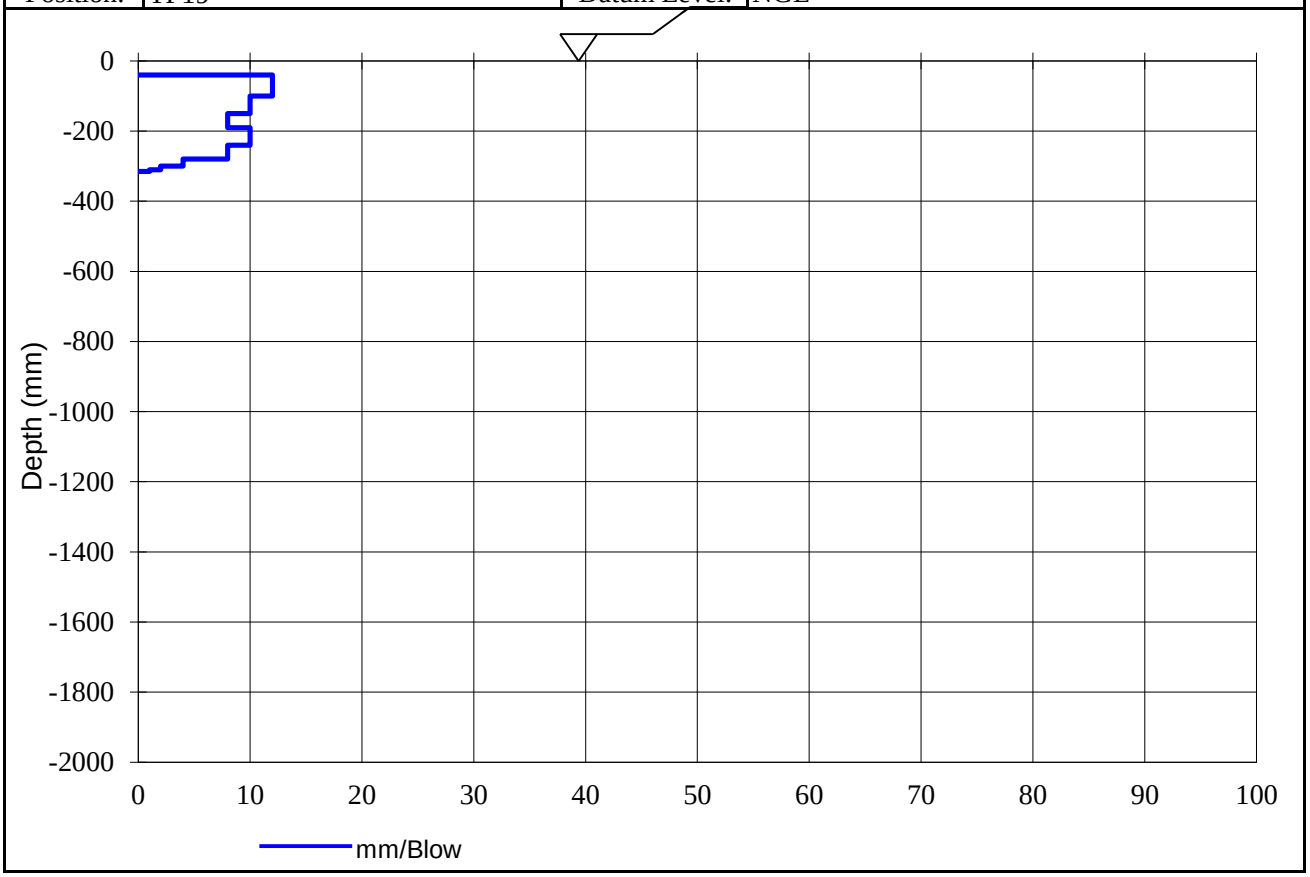
## TEST REPORT

## Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

| Position: | TP19 | Datum Level: | NGL |
|---|---|---|---|

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