Consulting Engineering Geologists, Geotechnical Engineers, Geotechnicians & Geotechnical Quality Assurance Specialists

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- Geotechnical Engineering Services
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- Environmental and Groundwater
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- Earthworks/Materials Supervision & Control
- Geotechnical Monitoring Systems
- Road Pavement Materials and Design
- Project Management

# *Report to MPAMOT (Pty) Ltd on the Results of a Geotechnical Site Investigation for the Proposed Maritime Focus School of Excellence, Corner of Somtseu Road and Sylvester Ntuli Road, North Beach, eThekwini Municipality*

***Reference: 220-20.R01***

***Dated: 08 December 2020***

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# *Report to MPAMOT (Pty) Ltd on the Results of a Geotechnical Site Investigation for the Proposed Maritime Focus School of Excellence, Corner of Somtseu Road and Sylvester Ntuli Road, North Beach, eThekwini Municipality*

***Reference : 220-20.R01***

***Dated : 08 December 2020***


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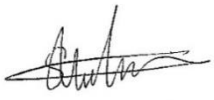
| **Author** |  | **Reviewer** | | **Reviewer** | |
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# *Report to MPAMOT (Pty) Ltd on the Results of a Geotechnical Site Investigation for the Proposed Maritime Focus School of Excellence, Corner of Somtseu Road and Sylvester Ntuli Road, North Beach, eThekwini Municipality*

**Reference: 220-20.R01 Revision 0** **Date: 08 December 2020**

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## Abbreviations and Expansions

| Abbreviation | Definition |
|---|---|
| **AASHTO** | American Association of State Highway and Transportation |
| **CBR** | California Bearing Ratio |
| **DBSA** | Development Bank of South Africa |
| **EGL** | existing ground level |
| **Geosure** | Geosure (Pty) Ltd |
| **GM** | grading modulus |
| **HBM** | Home Builder's Manual |
| **IP** | inspection pit |
| **km** | kilometre (s) |
| **$kN/m^2$** | kilonewtons per metre square |
| **LL** | liquid limit |
| **LS** | linear shrinkage |
| **m** | metre (s) |
| **MDD** | maximum dry density |
| **MH** | Inorganic silts of high plasticity |
| **ML** | inorganic silts of low plasticity |
| **mm** | millimetre (s) |
| **NHBRC** | National Home Builder's Registration Council |
| **No.** | number |
| **OH** | Orgnic silts / clays of high plasticity |
| **OL** | organic silts/clays of low plasticity |
| **OMC** | optimum moisture content |
| **PI** | plasticity index |
| **SANS** | South African National Standards |
| **TRH** | Technical Recommendations for Highways |
| **UCS** | Unconfined Compressive Strength |

# *Report to MPAMOT (Pty) Ltd on the Results of a Geotechnical Site Investigation for the Proposed Maritime Focus School of Excellence, Corner of Somtseu Road and Sylvester Ntuli Road, North Beach, eThekwini Municipality*

**Reference: 220-20.R01 Revision 0** **Date: 08 December 2020**

## 1. TERMS OF REFERENCE

The KwaZulu Natal Department of Education, under the Umlazi Education District, proposes to develop a Maritime School of Excellence on vacant land near North Beach in eThekwini Municipality with financial backing assistance by the Development Bank of South Africa.

Geosure was requested by MPAMOT (Pty) Ltd to provide a proposal and cost estimate to undertake a geotechnical investigation for the proposed Maritime Focus School of Excellence on the corner of Somtseu and Sylvester Ntuli Roads, North Beach, eThekwini Municipality.

Accordingly, Geosure provided a proposal and cost estimate in a letter referenced p007-20 (Maritime Focus School) - MPA/mb and dated 29 January 2020.

Subsequently, Geosure was authorised by MPAMOT (Pty) Ltd, hereafter referred to as the Client, to carry out the geotechnical investigation, as proposed, by return of the completed and signed Terms and Conditions accompanying the above fee proposal.

Geosure issued a report to the Client, while fieldwork was in progress, dated 09 November 2020 and titled *"Proposed Maritime Focus School of Excellence, Corner of Somtseu Road And Sylvester Ntuli Road, North Beach, eThekwini Municipality, Geotechnical Investigation, Interim Progress Report For Team Inception Report"* and reference 220-20.R01.

## 2. SCOPE OF REPORT

This report sets out the results of a geotechnical investigation carried out for the proposed Maritime Focus School of Excellence on the corner of Somtseu and Sylvester Ntuli Roads, North Beach, eThekwini Municipality, hereafter referred to as the site.

Conditions found on this site are evaluated against the requirements of the Codes of Practice and Standards as referred to in Section 3.

The fieldwork, soil and shallow groundwater conditions are described, and comment is made on the general stability of the site. Recommendations are provided for materials excavatability / rippability, earthworks, foundation solutions, drainage, materials usage and subgrade treatment for roads and parking areas.

## 3. GUIDELINES FOR INVESTIGATION

The fieldwork for the investigation was carried out according to guidelines relevant to geotechnical investigations of this nature.

The formation and weathering of geological materials are discontinuous processes and unexpected variations in soil, rock and groundwater regimes may occur even on sites where the conditions seem to be uniform or consistent. Variations in what is reported here may become evident during construction and it is thus imperative that an appropriately qualified and experienced Competent Person inspects all critical stages of development including, but not limited to, excavations to assess the conditions encountered and to assist in the interpretation of observations at variance with the information supplied in this report.

It is also possible that certain indications of ground stability, contamination or groundwater levels were latent or otherwise not visible. Our opinions can only be based on what was visible at the time the investigation was conducted.

This report was prepared for use by the Client and their professional team for the purpose stated and should not be relied upon for any other purpose.

## 4. INFORMATION SUPPLIED/UTILISED

The following information was referenced to assist with the investigation and subsequent reporting:

i. Power point presentation of the proposed development by DBSA, dated 27 October 2020 and titled *"DBSA - PSP Kickoff Meeting RFP 2772019 Agricultural School of Excellence and RFP 2782019 Maritime School of Excellence"*;

ii. Digital copy of report by MPAMOT (Pty) Ltd, dated 18 November 2020 and titled "*Maritime School of Excellence RFP 277 / 2019 Inception Report*" and reference 00;

iii. Electronic mail dated 04 December 2020 from the Client, indicating estimated column design loads for the architectural building designs proposed at the time of preparation of this report;

iv. Regional geological map sheet titled "*2930 Durban*" by the Council for Geoscience to scale 1:250 000 (1988) and

v. Low-resolution satellite imagery sourced from Google Earth (2019).

## 5. SITE DESCRIPTION

The site is located approximately 0.5km west of Durban's Marine Parade beachfront near North Beach.

The site is bound to the east by Sylvester Ntuli Road and Somtseu Road along its eastern and southern site boundaries, respectively.

Approximate latitude and longitude coordinates for the site plot as 29.0400° South and 31.03172° East, respectively.

Virtually level ground-slopes define the site which shows signs of levelling.

Current land-use is for sports / recreational purposes and floodlights are established in the central and western portions of the site

Plates 1 and 2 below show the regional and local contexts of the site.

**Plate 1:** Regional context of the site (Google Earth, 2020)

**Plate 2:** Local context of the site (Google Earth, 2020)

An indicative view of the site is presented below in Plate 3.

**Plate 3:** General northerly view of the site

# 6. FIELDWORK

Fieldwork commenced on 02 November 2020 and comprised shallow and deep investigations.

The aim and objective of the shallow subsurface investigation is to investigate the suitability of the near-surface subgrade materials for use in road / parking construction and inform aspects of the foundation recommendations.

The purpose of the deep subsurface investigation is to investigate the nature and variation in soils, groundwater levels, and inferred founding conditions to inform foundation recommendations for the proposed multi-storey building structures.

## 6.1 Shallow Investigation:

The following are the scope of works for the shallow investigation:

i. Inspection Pits; and
ii. Dynamic Penetrometer - Light (DPL) Tests.

## 6.2 Deep Investigation:

The deep stage of the investigation comprised rotary core drilling of boreholes.

## 6.3 Inspection Pits

Four inspection pits, designated IP1 through IP4, were excavated using hand tools at the approximate positions given in Figure 220-20.R01-001, attached.

Inspection pits were advanced to refusal / final depths in the range 1.37m (IP2 refers) to 2.42m (IP4 refers) below EGL.

The inspection pits were profiled using the South African Geoterminology Guidelines (2002)[1] and disturbed samples were retrieved. The inspection pits were sampled and backfilled on completion.

The detailed inspection pit profiles are given in Appendix A of this report.

## 6.4 Rotary Core Boreholes

Two (2 No.) rotary core geotechnical boreholes, designated BH1 and BH2, were drilled at the approximate positions shown in Figure 220-20.R01-001.

Positioning of the boreholes was confirmed by the Project Architect and drilling was carried out by TFI Drilling (Pty) Ltd.

The drilling of BH2 was completed on 09 November 2020. Inclement weather delayed the commencement of drilling at BH1 until 12 November 2020 which was completed on 19 November 2020.

Both boreholes were advanced by means of 1 No. rotary core drilling rig utilising a combination of NX and NWD4 core barrel. Standard Penetration Tests (SPTs) were carried out generally at "centre to centre" intervals of 1.5m, with reduced intervals in select materials.

The boreholes were advanced to final depths of 33.00m (BH1 refers) and 34.55m (BH2 refers) below EGL.

The materials recovered from both boreholes were profiled using the South African Geoterminology Guidelines (2002)[1].

Standpipe piezometers were installed in each of the boreholes to assist with the measurement of static groundwater levels.

The borehole profiles are given in Appendix B of this report.

Photographs of the borehole core are included as Appendix C of this report

[1] Geoterminology Workshop (2002) – Guidelines for Soil and Rock Logging – SAIEG – AEG – SAICE (Geotechnical Division) pp 47.

### 6.5 Dynamic Penetrometer - Light (DPL) tests

Six Dynamic Penetrometer - Light (DPL) tests, designated DPL1 to DPL6, were carried out at the approximate positions given in Figure 220-20.R01-001.

The DPL tests were advanced to refusal depths in the range 11.7m (DPL2 refers) to 13.5m (DPL1 and DPL4 refer) below EGL.

The results of the DPL tests comprising plots of blow counts versus depth are given in Appendix D of this report.

## 7. GEOLOGY AND INFERRED SUBSURFACE CONDITIONS

### 7.1 Overview

Inferring from the regional geological map series, sheet "*2930 Durban*" to scale 1:250 000 (1988), the site is underlain by unconsolidated Quaternary age sediments which belong to the Harbour Beds.

### 7.2 Inferred Subsurface Conditions on Site

Borehole drilling at BH1 and BH2 generally confirms the regional records.

Cretaceous age sandstone rock was encountered at depth in BH1 and BH2.

The rock was found to be overlain by residual sandstone clay (fully decomposed former sandstone rock) which in turn is overlain by extensive layers of Harbour Bed Deposits, Beach Deposits, and a relatively thin mantle of variable contaminated (uncontrolled) fill.

The presence of the fill would appear to relate to past earthworks' activities.

An excerpt of the above regional map is given below as Plate 4.

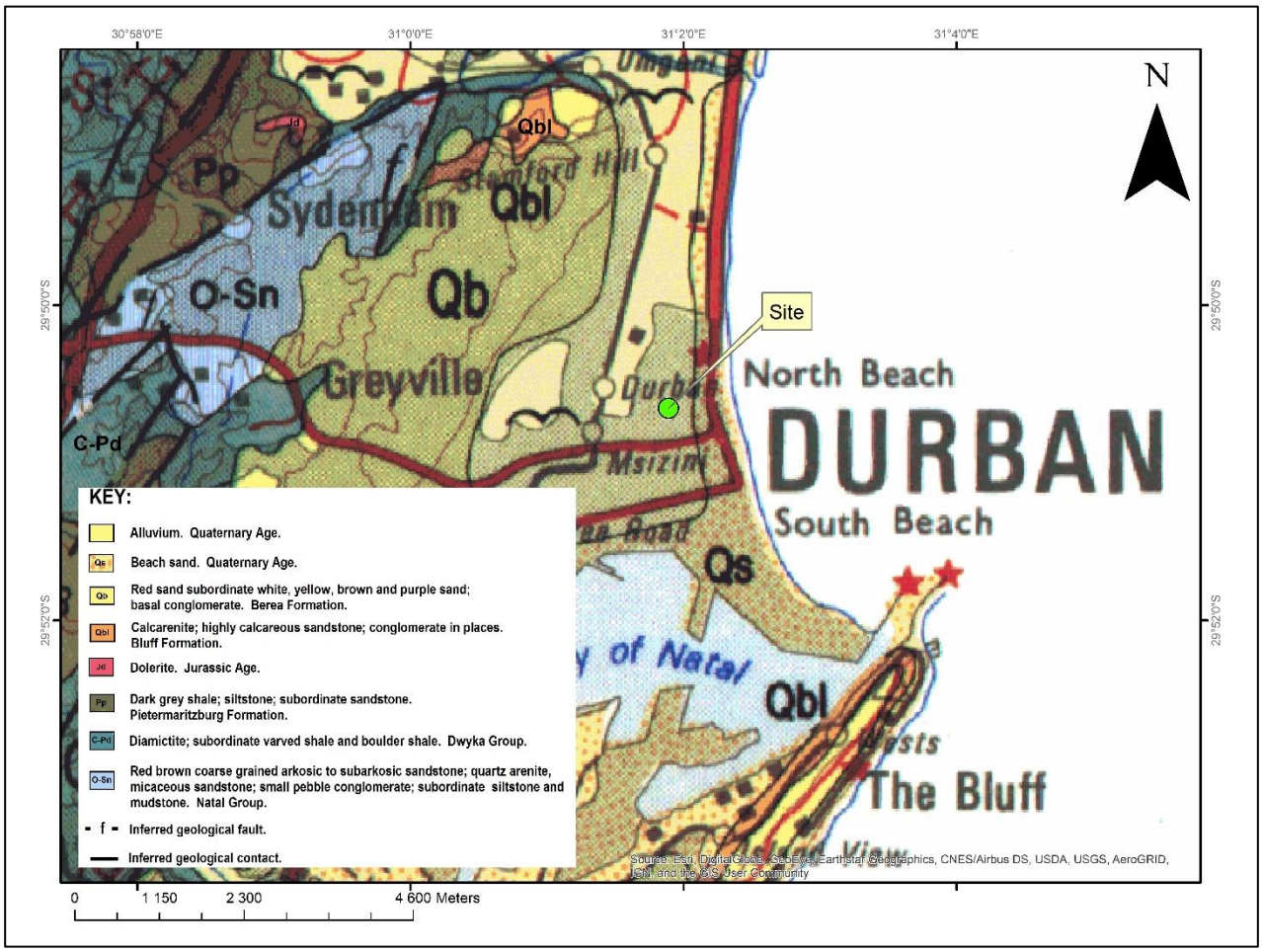


**Plate 4:** Excerpt from regional geological map sheet *"2930 Durban"* (Council for Geoscience, 1988)

General descriptions of the units encountered during the field investigation are given below in Table 1.

**<u>Table 1:</u> Proposed Maritime Focus School of Excellence - Geological Units Encountered, General Descriptions, Occurrence, and Depth Range Observed During Field Investigation**

| Unit | General Description | IP / BH | Observed / Inferred Depth Range (m below EGL)) |
|---|---|---|---|
| **Fill (Uncontrolled)** | Dark brown reddish brown and dark grey, loose, slightly clayey silty fine to coarse SAND, with abundant domestic waste broken glass bottles and builder's rubble / Dark grey, very soft, sandy CLAY | IP1 to IP4; potentially at BH1; BH2 | EGL to depths in the range 1.12m (IP4 refers) to 2.50m (BH2 refers) below EGL |
| **Beach Deposits** | Light grey and light to medium brown speckled light yellow, loose, slightly silty fine to coarse SAND/ Medium grey and dark grey, loose, silty medium grained SAND. | IP4; BH1; BH2 | From 1.12m (IP4 refers) to 4.0m (BH2 refers) below EGL |

| Unit | General Description | IP / BH | Observed / Inferred Depth Range (m below EGL)) |
|---|---|---|---|
| **Harbour Bed Deposits** | Light and medium brown speckled light grey / greyish brown / medium grey and dark grey, very loose to medium dense, fine to medium grained silty SAND and slightly clayey silty SAND, with limited dense lenses | BH1; BH2 | From 2.5 to 19.0m below EGL |
| **Harbour Bed Deposits** | Dark grey and light grey, stiff to very soft, silty CLAY to slightly sandy CLAY / Greyish brown, very stiff, medium sandy CLAY | BH1; BH2 | From 16.20m to 20.45m (BH2 refers) and 19.0 to 20.5m (BH1 refers) below EGL |
| **Harbour Bed Deposits** | Light brown / greyish brown, dense to very dense, slightly clayey, silty fine and medium grained SAND | BH1; BH2 | From 23.50 to 29.49m (BH1 refers) and 20.45m to 28.00m (BH2 refers) below EGL |
| **Harbour Bed Deposits** | Orange brown mottled medium brown, dense, sandy GRAVEL | BH2 | From 20.45 to 21.00m below EGL |
| **Residual Sandstone** | Dark grey, dense to very dense, slightly gravelly, clayey medium grained SAND and clayey SAND to very stiff sandy CLAY | BH1; BH2 | From 30.00m to 30.39m and 31.50m to 32.49 (BH1 refers) below EGL, and from 28.00m to 29.20m (BH2 refers) below EGL |
| **Weathered Sandstone Rock** | Dark grey stained dark olive grey, highly weathered, highly fractured, medium to coarse grained, very soft to soft rock, with completely weathered to highly friable very soft beds between 31.13m and 32.06m, and abundant fossils | BH2 | From 29.20m to 34.55m below EGL |
| **Weathered Sandstone Rock** | Dark grey to dark olive grey and greenish grey, highly weathered, highly fractured, medium to coarse grained, soft to medium hard rock, with abundant fossils | BH1 | From 29.49 to 30.00m, 30.39m to 31.50m and 32.49m to 33.00m below EGL |

## 8. GROUNDWATER

Groundwater seepage was encountered at shallow depths in each of the inspection pits profiled.

The installation of piezometers in BH1 and BH2 allowed the measurement of water levels in BH1 and BH2, on December 2020.

Table 2 below summarises depths of groundwater recorded in IP1 to IP4 and BH1 and BH2.

**Table 2: Proposed Maritime Focus School of Excellence - Depth of Groundwater in Inspection Pits and Boreholes**

| Inspection Pit Number | Depth of Groundwater (m below EGL) | Relative Intensity |
|---|---|---|
| IP1 | 1.34 | Moderate |
| IP2 | 0.91 | Moderate |
| IP3 | 1.10 | Slight |
| IP4 | 1.93 | Slight |
| BH1 | 0.98 | N/A |
| BH2 | 1.13 | N/A |

N/A: Not Applicable

The levels of the shallow groundwater condition encountered and the flow rates are likely to be influenced by the local and regional rainfall patterns.

Due cognisance of the shallow nature, intensity and potential fluctuations in the levels of the water table will therefore need to be taken into account for this project.

## 9. LABORATORY TESTS

The following laboratory tests on soil samples retrieved from the site were carried out:

i. Grading Analysis to 0,075mm sieve size, with Atterberg Limit Determinations;
ii. Natural Moisture-Density (Modified AASHTO) Tests;
iii. Natural California Bearing Ratio (CBR) Tests; and
iv. Insitu Moisture Contents.

Allowance was made at the outset of the investigation for Uniaxial Compressive Strength (UCS) tests on weathered rock, however, owing to the unsuitable quality of the rock encountered in BH1 and BH2, UCS determinations were not practically feasible.

The full set of laboratory test results is included in Appendix E of this report.

**Table 3: Summary of Results of Particle Size Distribution Analysis, Atterberg Limit Determinations, Grading Modulus, MOD AASHTO, California Bearing Ratio and Material Classifications**

| IP No. | Depth (m) | Description | Particle Size % | | | | Atterberg Limits % | | | OMC (%) | GM | MDD kg/m3 | CBR Values | | | Material Code & Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Clay | Silt | Sand | Gravel | LL | PI | LS | | | | Compaction MDD % | | | |
| | | | | | | | | | | | | | 90 | 93 | 95 | |
| **FILL** | | | | | | | | | | | | | | | | |
| IP1 | 0.0-0.37 | Dark brown slightly clayey silty SAND | 15 | 14 | 69 | 2 | 27 | 11 | 4 | - | 0,76 | - | - | - | - | A-2-6 (0)<br>SC |
| IP2 | 0.75-0.96 | Light greyish brown speckled dark grey slightly clayey silty SAND | 4 | | 71 | 25 | NP | NP | 0 | 9,2 | 1,52 | 1752 | 13,8 | 18,6 | 22,7 | A-3 (0)<br>SP<br>G7<br>G7 (#) |
| IP3 | 0.0-0.67 | Reddish orange slightly clayey silty SAND | 8 | 11 | 78 | 3 | SP | SP | 1 | - | 0,90 | - | - | - | - | A-2-4 (0)<br>SM |
| IP3 | 0.67-1.03 | Light greyish brown speckled dark grey slightly clayey silty SAND | 6 | | 67 | 27 | NP | NP | 0 | 9,4 | 1,53 | 1701 | 9,8 | 16,7 | 23,8 | A-3 (0)<br>SP-SM<br>G7<br>G7 (#) |
| IP4 | 0.0-0.55 | Reddish brown slightly clayey silty SAND | 12 | 8 | 78 | 2 | SP | SP | 1 | - | 0,86 | | | | | A-2-4 (0)<br>SM |
| **BEACH DEPOSITS** | | | | | | | | | | | | | | | | |
| IP4 | 1.12-2.3 | Light brown speckled light yellow slightly silty SAND | 2 | | 98 | 0 | NP | NP | 0 | 7,3 | 1,00 | 1681 | 12,1 | 16,4 | 20,2 | A-3 (0)<br>SP<br>G7<br>G7 (#) |
| IP4 | 2.3-2.4 | Light grey slightly silty SAND | 9 | 10 | 80 | 1 | SP | SP | 1 | - | 0,86 | - | - | - | - | A-2-4 (0)<br>SM |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| LL | - | Liquid Limit | A-2-4 (0) | - | Revised U.S Classification | PI | - | Plasticity Index |
| LS | - | Linear Shrinkage | GM | - | Grading Modulus | OMC | - | Optimum Moisture Content |
| SM | - | Unified Classification | G7 | - | Classification in terms of TRH14 | G7# | - | COLTO Classification |
| "-" | - | Not tested | NP | - | Non Plastic | | | |

# 10. DISCUSSION

## 10.1 Proposed Development

At the time of preparation of this report, architectural design was subject to finalisation and approval, however, the following general details regarding the proposed architectural scheme are understood from information received by the Client:

i. Three-storey building(s);
ii. Single and double storey buildings;
iii. Sports-field facilities including tennis court.

Details of structural design loads estimated by the Client are provided in Table 4 below

**Table 4: Maritime Focus School of Excellence - Estimated Structural Design Loads**

| Proposed Structures | Estimated Column Design Loads (kN) |
|---|---|
| Single Storey | 400 |
| Double Storey | 1150 |
| Triple Storey | 1750 |

## 10.2 General Stability and Suitability of the Site for Proposed Development

Signs of poor global stability were not identified at the positions and to the depths investigated on site.

There is, however, the potential for the development of rapidly unstable excavation conditions within the fill, Beach Deposits and Harbour Bed deposits profiled, exacerbated by the shallow groundwater condition identified. The above soils may also liquefy near and below the groundwater table.

Nonetheless, stable development of the site for the proposed development is considered feasible provided that the recommendations given in this report are adhered to. These measures amount to no more than sound development practices appropriate to the site conditions anticipated and the nature of proposed development confirmed with Geosure at the time of preparation of this report.

## 10.3 Geotechnical Factors Influencing Planning and Design of the Project

The investigation has identified the following factors which are assessed to have an impact on the design and implementation of the proposed development:

i. Relatively moderate groundwater at shallow depths;
ii. Poor soil conditions including fill with extensive particle contamination, and clays, within some 4m of EGL;
iii. Extensive sandy deposits of the Harbour Beds profiled down to depths in the range 28.0m (BH2 refers) and 29.29m (BH1 refers) below EGL, including highly compressible clays;
iv. Deep levels to weathered rock; and

v. Rapidly unstable / highly collapsible excavatability conditions associated with the fill materials, Beach Deposits and weakly cohesive sandy profiles of the Harbour Beds.

In view of the shallow nature of the groundwater table and generally unstable condition of the soil cover when excavated, ***it is considered that architectural design should exclude a basement to avoid the lowering of existing ground levels on site.*** Significant cost and time savings through the avoidance of bulk / deep excavations into the prevailing unstable and wet soils could be achieved, that would otherwise necessitate permanent dewatering and / or contiguous piling to achieve a stable and safe semi-basement or basement construction.

In the event, however, that the lowering of ground levels and / or allowance for basement structures is a requirement of the project, allowance should be made for the following ground improvement systems:

i. *Suitable permanent dewatering system* which is installed by a specialist to ensure a sufficient time for effect prior to commencing with excavations, to lower the water table to a depth which would enable stable battered excavations for semi-basement or basement structures. Design of the system should address a pressure head based on the difference in height / elevation between the basement floor and confirmed levels of groundwater. It is critical that dewatering is only attempted if a reliable dewatering system that does not clog and includes the provision of electrical backup to cater for power outages.

ii. Where time constraints do not permit a dewatering programme well prior to commencement of excavations to suitably dewater the ground to adequate depths to enable stable excavations for basement usage, then provision is to be made for the *installation of a contiguous pile curtain* to geotechnical specialist details, along the perimeter of basement walls. Under these circumstances, the dewatering is still considered necessary to permit construction of the basement floor and ramps, as well as to cater for any other deep construction such as service trenches elsewhere on the site.

## 10.4 Excavatability Assessment

The type of excavation plant and character of the underlying geology will determine actual excavation depths and classes.

It is considered that the fill materials, beach deposits and Harbour Bed deposits encountered will be excavatable in terms of density by light mechanical excavation plant down to depths corresponding to medium dense soil consistencies in the approximate depth range 2.4m (DPL2 refers) to 3.3m (DPL6 refers) below EGL. These materials classify as <u>SOFT</u> in terms of classifications set out in SANS 1200 DA, which can easily be removed by hand tools or a TLB of flywheel power approximately 0,10kW per millimetre of tined bucket width.

An allowance should be made for <u>INTERMEDIATE</u> excavation classes in dense to very dense sandy and very stiff clay soils inferred to occur from depths in the range 16.20m (BH2 refers) and 19.0m (BH1 refers) below EGL, and to cater for potential geological variations at shallower depths. Such materials can normally be efficiently ripped by a bulldozer of mass approximately 35 tonne, fitted with a single-tine ripper suitable for

heavy ripping, and of flywheel power approximately 220kW. In addition, consideration can also be given to use of a tracked excavator of flywheel power exceeding 0,10kW per millimetre of tined bucket width.

Excavations into weathered, highly fractured, very soft to medium hard rock sandstone are expected to classify in terms of SANS 1200 DA as INTERMEDIATE to HARD.

## 10.5 General Earthworks

Details of earthworks were not available at the time of reporting and should be discussed with Geosure prior to finalising tender documentation.

All earthworks should be carried out in a manner to promote stable development of the site. It is recommended that earthworks be carried out along the guidelines given in SANS 1200 (current version).

***The lowering of existing ground levels is to be avoided in light of the prevailing shallow groundwater condition discussed above in Sections 8 and 10.3 of this report.***

Excavations into the Fill, Beach Deposits, and Harbour Bed layers are likely to display rapid sidewall collapse / instability particularly near and below the groundwater table.

Workers should not enter any excavations that are not stabilised by a specialist. It remains the responsibility of the contractor / engineer on site to ensure excavations are safe and stabilised in line with the current requirements as set down in the Occupational Health and Safety Act.

All vegetation and topsoil with organic content should be removed from the areas over which fills are to be built.

Erosion control measures inclusive of suitable vegetation for exposed slopes should be prioritised, under the guidance of a horticulturalist, during the bulk earthworks stage of the site development.

## 10.6 Classification of Materials Encountered and Suitability for Usage

A general assessment of materials encountered on site for use in the construction of any fills for bulk earthworks and any road / parking infrastructure has been based on the visual assessment made on site and laboratory test results.

The characteristics of the materials and their suitability for use in construction are summarised below in Table 5.

**Table 5: Classification of Materials and Preliminary Recommendations for Usage**

| Material Description | AASHTO; USC TRH14; (COLTO) | Remarks on Usage |
|---|---|---|
| **FILL (UNCONTROLLED / CONTAMINATED)** | | |
| Light greyish brown speckled dark grey slightly clayey silty SAND, with abundant particle contamination | A-3 (0)<br>SP-SM<br>G7<br>(G7 (#)) | i. Considered unsuitable quality subgrade material due to particle contamination in terms of TRH14 (Commitee of State Road Authorities, 1985), after grubbing / removal of organic content.<br>ii. Accordingly, considered unsuitable for use as general fill and/or select fill.<br>iii. Will require undercutting and replacement with a suitable select granular soil where encountered at or below subgrade level. |
| **BEACH DEPOSITS** | | |
| light brown speckled light yellow, fine to medium grained, slightly silty SAND | A-3 (0)<br>SP<br>G7<br>(G7 (#)) | i. Considered good quality subgrade material in terms of TRH14.<br>ii. Will prove suitable for use as general fill and/or select fill subject to verification by laboratory testing during construction.<br>iii. If good quality material (G9 or better) is not confirmed by verification laboratory testing, materials will require undercutting and replacement with a suitable select granular soil where encountered at or below subgrade level |

(USC): Unified Soil Classification

The classification of materials on the site should be confirmed by laboratory testing to be undertaken during construction, as part of process and acceptance control monitoring, prior to the material being considered for use in construction.

## 10.7 Subgrade Treatment for Surface Bed floor and Paved/Surface Areas

The fill materials encountered are considered unsuitable subgrade material due to significant particle contamination. It is recommended that these materials be boxed out or undercut to the depth specified by the engineer. This material should then be replaced with a good quality granular material of at least G8 quality and compacted to at least 93% of Modified AASHTO maximum dry density to 1 to 2% (wet / dry) of OMC.

The sandy, almost cohesionless Beach deposits tested in the laboratory exceed the minimum subgrade requirements (G7) for the project. Where encountered at subgrade level and the material meets the minimum subgrade requirements, as verified by laboratory process and acceptance control testing, it is recommended that these materials

be ripped to the specified depth and re-compacted to at least 93% of Modified AASHTO maximum dry density to 1-2% (wet / dry) of OMC.

The pavement formation layer for any proposed roads should be designed taking into account the shallow groundwater condition, anticipated traffic loads, volumes and design life of the hard standing area(s).

## 10.8 Inferred Founding Conditions

Inferring from the results of the shallow investigation and BH1 and BH2, poor and deep founding conditions have been identified at the positions investigated, and comprise the following:

i. Relatively moderate groundwater at shallow depths in the range of approximately 0.9m (IP2 refers) and 1.9m (IP4 refers) of EGL;
ii. Poor soil conditions including fill with extensive particle contamination, and clays, within some 4m of EGL;
iii. Extensive sandy deposits of the Harbour Beds profiled down to depths in the range 28.0m (BH2 refers) and 29.29m (BH1 refers) below EGL;
iv. Highly compressible clays intercepted within the Harbour Beds at depths in the range 16.2m to 20.5m below EGL (BH2 refers);
v. Residual sandstone clayey sands / clays at depths in the range 30.00m to 30.39m and 31.50m to 32.49 (BH1 refers) below EGL, and 28.00m to 29.20m (BH2 refers) below EGL;
vi. Deep levels to weathered rock from depths in the range 29.49m (BH2 refers) and 29.2m (BH2 refers) below EGL; and
vii. Rapidly unstable / highly collapsible excavatability conditions associated with the fill materials, Beach Deposits and weakly cohesive sandy profiles of the Harbour Beds.

## 10.9 Foundations Recommendations

It is understood that multiple single storey buildings form part of the current requirements of the project.

The option of supporting design loads arising from the proposed single storey buildings on shallow (footing or raft) foundations has been assessed.

Taking into account the poor founding conditions anticipated which include contaminated fill of low bearing capacities and a shallow groundwater table from an observed minimum depth of 0.91m below EGL, it is considered that the employment of footing and raft foundations is not a practical option. In this regard, provision of permanent and costly dewatering well points and ground treatment / structural fill would be considered necessary.

Accordingly, under these circumstances, a piled foundation solution to engineer's detail is recommended for all building structures proposed.

In the employment of a piled foundation solution for the proposed building structure, consideration can be given to using the pressure grouted Continuous Flight Auger (CFA) pile system.

Driven Cast Insitu (DCI) pile types would also be suited to the subsurface conditions anticipated on site. Vibrations associated with the installation of the DCI pile type may result in damage to structures near the construction area. The risk of vibrations to existing building structures nearby can, however, be mitigated and measures in this regard should be discussed with the appointed piling contractor.

Typical working loads for the proposed pile diameters and indicative pile lengths are given in Table 6 below as a guideline for budgetary purposes only. A detailed pile design must be carried out by the piling contractor.

**Table 6: Typical Pile Working Loads and Indicative Pile Lengths (for Budgetary Purposes)**

| Pile Type | Pile Diameter (mm) | Allowable Pile Working Load (kN) | Approximate Pile Length Below EGL (metres) |
|---|---|---|---|
| *Pressure Grouted CFA Piles | 350 | 450 | 12.3-15.0 |
| | 400 | 600 | 13.5-20.5** |
| | 450 | 800 | 15.0-24.0* * |
| | 500 | 1000 | 19.5-27.0** |
| DCI Piles | 355 | 500 | 10.8-13.5 |
| | 410 | 750 | 11.7-15.0 |
| | 520 | 1200 | 13.5-20.5** |

* - Pile working loads are calculated using a shaft stress of 5 MPa. Consideration could be given to using a shaft stress of 6 MPa for piles founded on weathered rock.
**- Subject to founding below highly compressible clays anticipated between 16.2m - 20.5m below EGL.

The DPL tests conducted on the site were advanced to refusal depths in the range 11.7m (DP2 refers) to 13.5m (DP1 refers) below EGL. In view of highly compressible clays at depths in the approximate range 16.2m and 20.5m below EGL (BH2 refers), pile lengths should be designed either to found a minimum safe distance above the compressible clays or to extend beyond the clay horizon where this is not feasible.

The pile lengths given in Table 6 above have been calculated using DPL Test results supplemented by SPT N values, hence, the pile lengths given in Table 6 are deeper in many instances than the refusal depths of the DPL Tests.

Pile lengths will be dependent on the final platform level(s) and the detailed pile design must be provided by the piling contractor. Design should establish if the foundation loads are to be supported in shaft friction or end bearing or a combination of both shaft friction and end bearing.

Determination of the required diameter, depth and reinforcing of the piles will also be influenced by factors such as configuration and spacing of the piles in groups beneath the pile caps, depths of the bottom of the pile caps below ground level, and factors of safety or partial factors in accordance with the design code adopted by the structural engineer.

Final pile founding levels will need to be reviewed by the pile designer by observing the piles formed in the field.

Axial settlement of single isolated piles, excluding settlement that occurs during construction of the superstructure, should not exceed elastic shortening of the pile shaft plus 10mm. Additional settlement due to grouping of piles would depend on spacing, depth and number of piles in each group.

It is recommended that static load capacity tests be carried out on selected piles in order to confirm the pile working loads and pile design. The static load capacity tests should be carried out prior to the commencement of the piling contract. Geosure offers this specialist expertise and we would be pleased to assist with conducting and reviewing the results of static load capacity tests under an extension of our current authorisation.

It is also recommended that low energy Frequency Response dynamic pile integrity tests be carried out on all piles before they are covered by a pile cap. It should be specified in the tender document that these quality assurance tests be conducted by an independent specialist consultant to detect potential structural defects such as voids, honeycombing or cracks that would normally be detected by quality assurance procedures for reinforced concrete that was accessible after casting.

## 10.10 Layerworks to Infrastructure

It is critical that design of buried services and layerworks to the vehicular access routes maintains inverts at levels as shallow as possible and well above the groundwater table levels encountered at the time of construction. In this regard, a groundwater conditions was encountered at a minimum depth of 0.91m below EGL at the time of the fieldwork.

The levels and flow rates of the observed shallow groundwater condition may fluctuate in response to the local and regional rainfall patterns.

The option of reinforcement to limit thicknesses of layerworks to internal roads should be considered.

## 10.11 Drainage

One of the most important factors in the stable development of the site is the control and removal of both surface and groundwater from the site.

Earthworks and drainage measures should be designed in such a way as to prevent ponding of, or high concentrations of, stormwater or groundwater anywhere on the site, both during and after the development.

To address the risk of groundwater concentrations at the site, it is anticipated that suitable permanent subsoil drainage measures are necessary to assist with development of the infrastructure and pavement layerworks.

Stormwater from roofed, paved and lawned areas is to be collected, attenuated to engineer's design, and piped into the nearest municipal stormwater connection facility. The employment of a subsoil percolation system for on-site disposal of stormwater is to be avoided.

All construction areas should be shaped to a gradient to prevent water ponding on the surface and should be graded to direct water away from any fill edges and foundations

# 11. SUMMARY OF FINDINGS AND RECOMMENDATIONS

This report sets out the results of a geotechnical investigation carried out for the proposed Maritime Focus School of Excellence on the corner of Somtseu and Sylvester Ntuli Road, North Beach, eThekwini Municipality.

The results and recommendations of the above field investigations can generally be summarised as follows:

i. The site is considered stable and suitable for the proposed development, provided the recommendations given in Section 10 of this report are adhered to.

ii. It is considered that architectural design should exclude a basement to avoid costs of stabilisation and dewatering associated with the lowering of existing ground levels on site.

iii. At the positions and to the depths investigated, the site is underlain by poor quality and contaminated fill material which rests on sandy deposits of Beach Deposits, extensive thicknesses of Harbour Bed deposits, and weathered sandstone rock at depth. Highly compressible clays were encountered at depths in the range 16.2m to 22.5m below EGL. Further details in this regard are given in Section 7 of this report.

iv. A shallow groundwater table was observed at the positions investigated, commencing from 0.91m below EGL. Further details in this regard are set down in Section 8 of this report.

v. All earthworks should be carried out in a manner to promote stable development of the site. The lowering of existing ground levels is to be avoided in light of the prevailing shallow groundwater condition discussed in this report. It is recommended that earthworks be carried out along the guidelines given in SANS 1200 (current version). Where possible, earthworks should be carried out during the low rainfall months. Erosion control measures inclusive of suitable vegetation for exposed slopes should be prioritised, under the guidance of a horticulturalist, during the bulk earthworks stage of the proposed development.

vi. A piled foundation solution to engineer's detail is recommended for all building structures proposed to cater for the provisional design loads provided to Geosure, and the deep and wet founding character. Piling options and indicative piling depths are discussed in Section 10.9 of this report.

The ground conditions given in this report refer specifically to the field tests carried out on site. It is therefore, quite possible that conditions at variance with those given in this report can be encountered elsewhere on site during construction. It is therefore important that Geosure be appointed to carry out periodic inspections during construction of the proposed development. Any change from the anticipated ground conditions can also be taken into account to avoid unnecessary expense.

There is merit in affording Geosure the opportunity to review the recommendations in this report, under an extension of the current appointment, once detailed information regarding foundation design loads and bulk earthworks are confirmed.

## 12. BIBLIOGRAPHY

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# APPENDIX A

# INSPECTION PIT PROFILES

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MPAMOT (Pty) Ltd
Proposed Maritime Focus School,
North Beach,
Durban, KwaZulu Natal

HOLE No: IP1
Sheet 1 of 1

JOB NUMBER: 220-20

Scale 1:25

0.01--0.37

0.37--0.52

1.34m

| | |
|---|---|
| 0.00 | Slightly moist, dark brown, loose, fine to medium grained, slightly clayey silty SAND with building stone and grass roots. FILL. |
| 0.37 | Slightly moist, reddish brown, loose, fine to medium grained, slightly clayey silty SAND with pieces of concrete up to 0,3m in size. FILL. |
| 0.52 | Wet, dark grey speckled white, loose, fine to medium grained, slightly gravelly SAND containing ash, broken bottles and crusher stone. FILL. |
| 1.54 | |

NOTES

1) Moderate groundwater seepage observed at 1,34m.

2) Samples taken at:
S1 0,01--0,37 (1 x Ind)
S2 0,37--0,52 (1 x Ind)

3) Final depth at 1,54m.

CONTRACTOR :
MACHINE : By hand
DRILLED BY :
PROFILED BY : K.Gavu
TYPE SET BY : K.Kistasamy
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE : 09 November 2020
DATE : 09 November 2020
DATE : 12/11/20 15:01
TEXT : ..C:\LOGS\PITS.TXT

ELEVATION : -
X-COORD : 31.03172 E
Y-COORD : 29.04400 S

HOLE No: IP1

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HOLE No: IP2
Sheet 1 of 1

JOB NUMBER: 220-20

Scale 1:25

0.75--0.96
0.91m

0.96--1.37

| | |
|---|---|
| 0.00 | Slightly moist, dark brown, loose, fine to medium grained, slightly clayey silty SAND with glass bottle fragments and building stone. FILL. |
| 0.50 | Slightly moist, reddish brown, loose, fine to medium grained, slightly clayey silty SAND with builder's rubble, pieces of steel and biulding stone. FILL. |
| 0.75 | Slightly moist to wet, light greyish brown speckled dark grey, loose, fine to medium grained, slightly gravelly silty SAND with glass bottle fragments and crusher stone. FILL. |
| 0.96 | Wet, dark grey speckled white, loose, fine to medium grained, slightly gravelly SAND containing ash, broken bottles and crusher stone. FILL. |
| 1.37 | |

NOTES

1) Moderate groundwater seepage observed at 0,91m.

2) Samples taken at:
S1 0,75--0,96 (2 x Bulk)
S2 0,96--1,37 (1 x Ind)

3) Final depth at 1,37m due to seepage.

CONTRACTOR :
MACHINE : By hand
DRILLED BY :
PROFILED BY : K.Gavu
TYPE SET BY : K.Kistasamy
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE : 09 November 2020
DATE : 09 November 2020
DATE : 12/11/20 15:01
TEXT : ..C:\LOGS\PITS.TXT

ELEVATION : -
X-COORD : 31.03115 E
Y-COORD : 29.84404 S

HOLE No: IP2

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HOLE No: IP3
Sheet 1 of 1

JOB NUMBER: 220-20

Scale 1:25

0.01--0.67
0.67--1.05
1.10m
1.05--1.62

| | |
|---|---|
| 0.00 | Slightly moist, reddish orange, loose, fine to medium grained, slightly clayey silty SAND with broken glass bottles and builder's rubble. FILL. |
| 0.67 | Slightly moist, light grey speckled dark grey, loose, fine to medium grained, silty SAND with builder's rubble. FILL. |
| 1.05 | Moist to wet, dark grey speckled orange, loose, fine to medium grained, slightly gravelly silty SAND with pieces of steel and builder's rubble. FILL. |
| 1.62 | |

NOTES

1) Slight groundwater seepage observed at 1,10m.

2) Samples taken at:
S1 0,01--0,67 (1 x Ind)
S2 0,67--1,05 (2 x Bulk)
S3 1,05--1,62 (1 x Ind)

3) Final depth at 1,62m.

CONTRACTOR :
MACHINE : By hand
DRILLED BY :
PROFILED BY : K.Gavu
TYPE SET BY : K.Kistasamy
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE : 09 November 2020
DATE : 09 November 2020
DATE : 12/11/20 15:01
TEXT : ..C:\LOGS\PITS.TXT

ELEVATION : -
X-COORD : 31.03123 E
Y-COORD : 29.84463 S

HOLE No: IP3

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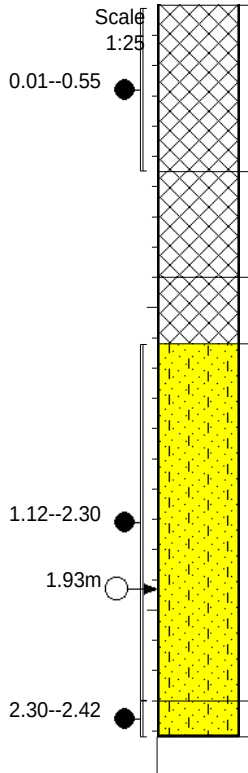
HOLE No: IP4
Sheet 1 of 1

JOB NUMBER: 220-20




| | |
|---|---|
| 0.00 | Slightly moist, reddish brown, loose, fine to medium grained, slightly clayey silty SAND with builder's rubble, pieces of steel and biulding stone. FILL. |
| 0.55 | Slightly moist, light grey speckled dark grey, loose, fine to medium grained, silty SAND with pieces of steel and broken glass bottles. FILL. |
| 0.90 | Slightly moist, reddish orange speckled dark grey, loose, fine to medium grained, silty SAND with grass, pieces of steel and broken glass bottles. FILL. |
| 1.12 | Slightly moist to wet, light brown speckled light yellow, fine to medium grained, slightly silty SAND. Beach Deposits. |
| 2.30 | Wet, light grey, fine to medium grained, slightly silty SAND. Beach Deposits. |
| 2.42 | |

NOTES

1) Slight groundwater seepage observed at 1,93m.

2) Samples taken at:
S1 0,01--0,55 (1 x Ind)
S2 1,12--2,30 (2 x Bulk)
S3 2,30--2,42 (1 x Ind)

3) Final depth at 2,42m.

CONTRACTOR :
MACHINE : By hand
DRILLED BY :
PROFILED BY : K.Gavu
TYPE SET BY : K.Kistasamy
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE : 09 November 2020
DATE : 09 November 2020
DATE : 12/11/20 15:01
TEXT : ..C:\LOGS\PITS.TXT

ELEVATION : -
X-COORD : 31.03193 E
Y-COORD : 29.84442 S

HOLE No: IP4

# APPENDIX B

# BOREHOLE PROFILES

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HOLE No: BH1
Sheet 1 of 4

JOB NUMBER: 220-20

Scale 1:50

| DEPTH Scale 1:50 | Drill Method and Size | Core Recovery (%) | R.Q.D (%) | Fracture Frequency | SPT Blow Count | | |
|---|---|---|---|---|---|---|---|
| | | | | | | 0.00 | No recovery. |
| | | | | | | 1.50 | |
| | | | | | N=11 | | Medium brown, medium dense, fine to medium grained, silty SAND. Beach Deposits. |
| | | | | | | 2.50 | |
| | | | | | N=12 | | Dark grey, medium dense, fine to medium grained, SAND. Harbour Beds. |
| | | | | | | 4.00 | |
| | | | | | N=7 | | Medium grey and dark grey, loose, silty medium grained SAND. Harbour Beds. |
| | | | | | | 5.50 | |
| | | | | | N=3 | | Medium grey to dark grey, very loose, slightly clayey silty medium grained SAND. Harbour Beds. |
| | | | | | | 7.00 | |
| | | | | | N=8 | | Light brown to light greyish brown, loose, fine to medium grained, silty SAND. Harbour Beds. |
| | | | | | | 8.50 | |
| | | | | | N=35 | | Light brown to light greyish brown, medium dense to dense, fine to medium grained, silty SAND. Harbour Beds. |
| | | | | | N=25 | | |

1 2 3 4 5 6 7 8 9 10 11

-1 -2 -3 -4 -5 -6 -7 -8 -9 -10 -11

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HOLE No: BH1
Sheet 2 of 4

JOB NUMBER: 220-20

| DEPTH Scale 1:50 | Drill Method and Size | Core Recovery (%) | R.Q.D (%) | Fracture Frequency | SPT Blow Count | | | |
|---|---|---|---|---|---|---|---|---|
| 12 | | | | | N=30 | -12 | | |
| 13 | | | | | N=50 | -13 | 13.00 | Light brown speckled light grey, dense, slightly clayey coarse SAND. Harbour Beds. |
| 14 | | | | | N=63 | -14 | 14.50 | Light brown, medium dense to dense, fine to medium grained, silty SAND. Harbour Beds |
| 15 | | | | | N= 10 | -15 | 17.50 | Medium grey, loose, clayey medium grained SAND. Harbour Beds. |
| 16 | | | | | N=10 | -16 | 19.00 | Greyish brown, very stiff, medium sandy CLAY. Harbour Beds. |
| 17 | | | | | N=25 | -17 | 20.50 | Medium brown to greyish brown, medium dense, clayey medium grained SAND. Harbour Beds. |
| 18 | | | | | N=26 | -18 | 22.00 | |
| 19 | | | | | | -19 | | |
| 20 | | | | | | -20 | | |
| 21 | | | | | | -21 | | |
| 22 | | | | | | -22 | | |

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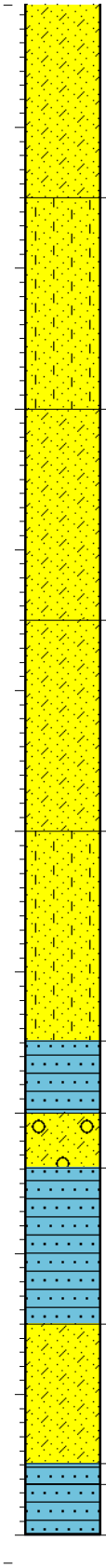
HOLE No: BH1
Sheet 3 of 4

JOB NUMBER: 220-20

| DEPTH Scale 1:50 | Drill Method and Size | Core Recovery (%) | R.Q.D (%) | Fracture Frequency | SPT Blow Count |
|---|---|---|---|---|---|
| 23 | | | | | N=40 |
| 24 | | | | | N=55 |
| 25 | | | | | |
| 26 | | | | | N=32 |
| 27 | | | | | N=51 |
| 28 | | | | | |
| 29 | | | | | N=80 |
| 30 | | 69 | 31 | 10 | |
| 31 | | 86 | | 5 | |
| 32 | | 19 | | 4 | |
| 33 | | 43 | | >50 | |
| | | 15 | | 0 | |
| | | 88 | | 6 | |



| | |
|---|---|
| | Greyish brown, dense, slightly clayey medium grained SAND. Harbour Beds. |
| 23.50 | |
| | Light brown very dense, fine to medium grained, silty SAND. Harbour Beds. |
| 25.00 | |
| | Orange brown, dense, fine grained, clayey SAND. Harbour Beds. |
| 26.50 | |
| | Medium brown and orange brown, very dense, fine to medium grained, clayey SAND. Harbour Beds. |
| 28.00 | |
| | Medium brown and greyish brown, very dense, fine grained, silty SAND. Harbour Beds. |
| 29.49 | |
| | Dark olive grey to dark grey, highly weathered, medium to coarse grained, highly fractured, soft to medium hard rock with abundant fossils. SANDSTONE. Cretaceous. |
| 30.00 | |
| | Dark grey, apparently dense to very dense, slightly gravelly clayey medium grained SAND to very stiff sandy CLAY. Residual Sandstone. |
| 30.39 | |
| | Dark olive grey to dark grey, highly weathered, medium to coarse grained, highly to very highly fractured, soft to medium hard rock with and abundant fossils. SANDSTONE. Cretaceous. |
| 31.50 | |

GEOSURE (Pty) Ltd
Geotechnical, Environmental & Groundwater Engineering
Pile Integrity Testing & Civil Engineering Laboratory
P O Box 1461, Westville, 3630, South Africa
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email: geosure@ iafrica.com
Fax: 086 689-5506
www.geosure.co.za

MPAMOT (Pty) Ltd
Proposed Maritime Focus School,
North Beach,
Durban, KwaZulu Natal

HOLE No: BH1
Sheet 4 of 4

JOB NUMBER: 220-20

| DEPTH Scale 1:50 | Drill Method and Size | Core Recovery (%) | R.Q.D (%) | Fracture Frequency | SPT Blow Count | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | Dark grey, apparently very dense, fine to medium grained, clayey SAND to very stiff sandy CLAY. Residual Sandstone. |
| | | | | | | 32.49 | Dark grey to dark olive grey, highly weathered, medium to coarse grained, highly fractured, soft to medium hard rock. SANDSTONE. Cretaceous. |
| | | | | | | 32.64 | Dark grey to dark olive greenish grey, highly weathered, medium to coarse grained, highly fractured, soft rock with abundant fossils. SANDSTONE. Cretaceous. |
| | | | | | | 33.00 | |

NOTES

1) Water level (standpipe piezometer): 0,98m.

2) Borehole terminated at 33,0m below EGL.

CONTRACTOR : TFI (Pty) Ltd
MACHINE : TONE-170
DRILLED BY :
PROFILED BY : S.Maharaj/F.Smith (Pr.Sci.Nat)
TYPE SET BY : K.Kistasamy
SETUP FILE : STANDARG.SET

INCLINATION : -
DIAM : NWD4
DATE : 11 November 2020
DATE : 19 November 2020
DATE : 10/12/20 16:13
TEXT : ..C:\LOGS\BH1.TXT

ELEVATION : m
X-COORD : E
Y-COORD : S

HOLE No: BH1
-

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MPAMOT (Pty) Ltd
Proposed Maritime Focus School,
North Beach,
Durban, KwaZulu Natal

HOLE No: BH2
Sheet 1 of 4

JOB NUMBER: 220-20

| DEPTH Scale 1:50 | Drill Method and Size | Core Recovery (%) | SPT Blow Count | Scale 1:50 | | |
|---|---|---|---|---|---|---|
| | | | | | 0.00 | Dark grey mottled medium brown, very soft, fine to medium grained, sandy CLAY. FILL. |
| 1 | | | | -1 | | |
| | | | N=1 | | | |
| 2 | | | | -2 | | |
| | | | | | 2.50 | Light grey, loose, fine to coarse grained, silty SAND. Beach Deposits. |
| 3 | | | | -3 | | |
| | | | N=10 | | | |
| 4 | | | | -4 | 4.00 | Dark grey, loose, fine grained, clayey SAND. Harbour Beds. |
| | | | N=4 | | | |
| 5 | | | | -5 | 5.50 | Dark grey, very loose to loose, fine to medium grained, silty SAND. Harbour Beds. |
| 6 | | | | -6 | | |
| | | | N=0 | | | |
| | | | N=2 | | | |
| 7 | | | N=3 | -7 | | |
| | | | N=8 | | | |
| 8 | | | | -8 | 8.20 | Medium brown, very loose, fine to medium grained, silty SAND. Harbour Beds. |
| | | | N=1 | | | |
| 9 | | | | -9 | 9.20 | Greyish brown to medium brown, loose fine to medium grained, silty SAND. Harbour Beds. |
| | | | N=8 | | | |
| 10 | | | N=8 | -10 | 9.95 | |
| 11 | | | | -11 | | |

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Proposed Maritime Focus School,
North Beach,
Durban, KwaZulu Natal

HOLE No: BH2
Sheet 2 of 4

JOB NUMBER: 220-20

| DEPTH Scale 1:50 | Drill Method and Size | Core Recovery (%) | SPT Blow Count | | |
|---|---|---|---|---|---|
| | | | N=21 | | Medium brown and greyish brown stained dark grey, medium dense to dense, silty SAND with occasional shell fragments. Harbour Beds. |
| 12 | | | N=24 | -12 | |
| | | | N=22 | | |
| 13 | | | | -13 | |
| | | | N=29 | | |
| 14 | | | | -14 | |
| | | | N=40 | | |
| | NXC | 27 | | | |
| 15 | | | | -15 | |
| | | | N=46 | | |
| 16 | | | | -16 | |
| | | | | | 16.20 |
| | | | | | Light grey and dark grey, stiff to very soft, silty CLAY to slightly sandy CLAY. Harbour Beds. |
| | | | N=10 | | |
| 17 | | | | -17 | |
| 18 | | | | -18 | |
| | | | N=1 | | |
| | | | N=2 | | |
| 19 | | | | -19 | |
| | | | N=0 | | |
| 20 | | | N=9 | -20 | |
| | | | | | 20.45 |
| | | | N=33 | | Orange brown mottled medium brown, dense, fine to coarse grained, sandy GRAVEL. Harbour Beds. |
| 21 | | | | -21 | |
| | | | N=31 | | 21.00 |
| | | | N=12 | | |
| 22 | | | | -22 | |

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HOLE No: BH2
Sheet 3 of 4

JOB NUMBER: 220-20

| DEPTH Scale 1:50 | Drill Method and Size | Core Recovery (%) | SPT Blow Count | Depth | Description |
|---|---|---|---|---|---|
| 23 | | | N=16 | -23 | Medium brown mottled orange brown, dense, fine grained, clayey SAND. Harbour Beds. |
| | | | | 21.45 | |
| | | | | | Medium brown blotched orange brown, soft to firm, sandy CLAY. Harbour Beds. |
| | | | | 22.25 | |
| 24 | | | N=19 | -24 | Medium brown blotched greyish brown stained orange brown, medium dense, clayey SAND. Harbour Beds. |
| 25 | | | | -25 | |
| 26 | | | N=20 | -26 | |
| 27 | | | N=31 | -27 | |
| 28 | | | | -28 | |
| | | | | 28.00 | |
| | | | | | Dark grey, very dense, slightly gravelly clayey SAND to very stiff sandy CLAY with gravel sized sandstone fragments. Residual Sandstone. |
| 29 | | | N=48 | -29 | |
| | | | | 29.20 | |
| 30 | | | | -30 | Dark grey stained dark olive grey, highly weathered, medium to coarse grained, highly fractured, very soft to soft rock with very soft highly friable rock zones between 31.13m and 32.06m with abundant fossils. SANDSTONE. (Cretaceous). |
| 31 | | 52 | | -31 | |
| 32 | NWD4 | | | -32 | |
| 33 | | 2 | | -33 | |

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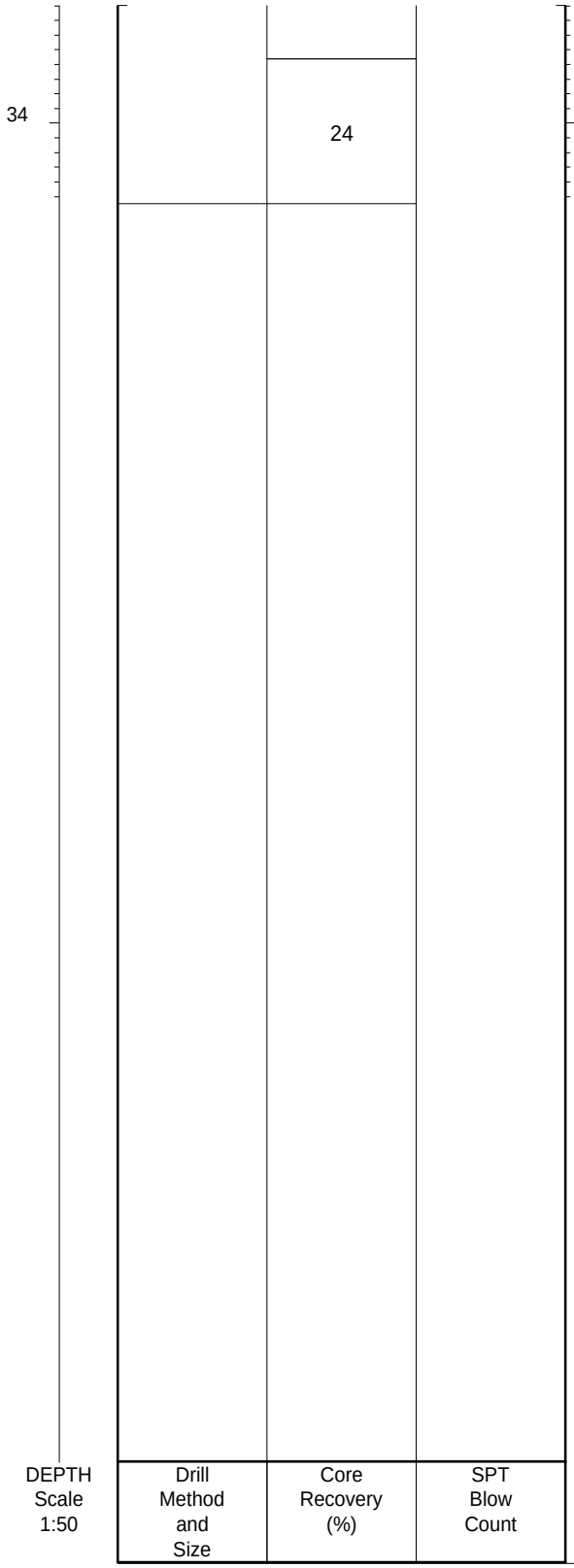
HOLE No: BH2
Sheet 4 of 4

JOB NUMBER: 220-20




NOTES

1) Water level (standpipe piezometer): 1,13m.

2) Borehole terminated at 34,55m below EGL.

CONTRACTOR : TFI (Pty) Ltd
MACHINE : TONE-170
DRILLED BY :
PROFILED BY : S.Maharaj/F.Smith (Pr.Sci.Nat)

INCLINATION : -
DIAM : NWD4
DATE : 03 November 2020
DATE : 09 November 2020

ELEVATION : m
X-COORD : 31.031925E
Y-COORD : 29.843992S

TYPE SET BY : K.Kistasamy
SETUP FILE : STANDARG.SET

DATE : 10/12/20 16:13
TEXT : ..C:\LOGS\BH2.TXT

HOLE No: BH2
-

# APPENDIX C

# BOREHOLE CORE PHOTOGRAPHY

Consulting Engineering Geologists, Geotechnical Engineers, Geotechnicians & Geotechnical Quality Assurance Specialists

GEOSURE (Pty) Ltd

| | |
|---|---|
| **Client:** | MPAMOT (Pty) Ltd |
| **Project:** | Proposed Maritime Focus School, North Beach, Durban, KZN |
| **Reference No.:** | 220-20 |
| **Borehole No:** | BH1 |
| **Depth:** | 0.0m - 33,0m |
| **Box No:** | 1 of 1 |

Consulting Engineering Geologists, Geotechnical Engineers, Geotechnicians & Geotechnical Quality Assurance Specialists

GEOSURE (Pty) Ltd

| | |
|---|---|
| **Client:** | MPAMOT (Pty) Ltd |
| **Project:** | Proposed Maritime Focus School, North Beach, Durban, KZN |
| **Reference No.:** | 220-20 |
| **Borehole No:** | BH2 |
| **Depth:** | 0.0m - 34,55m |
| **Box No:** | 1 of 1 |

# APPENDIX D

# RESULTS OF DYNAMIC CONE PENETROMETER LIGHT (DPL) TESTS

# GEOSURE (PTY) LTD.

Geotechnical Engineering Consultants

Tel: (031) 266 0458 Fax: 086 689 5506 Email: info@geosure.co.za


**Client:** MPAMOT (Pty) Ltd **Ref.No.** 220-20

**Project:** Proposed Maritime Focus School **Date:** 09.11.2020

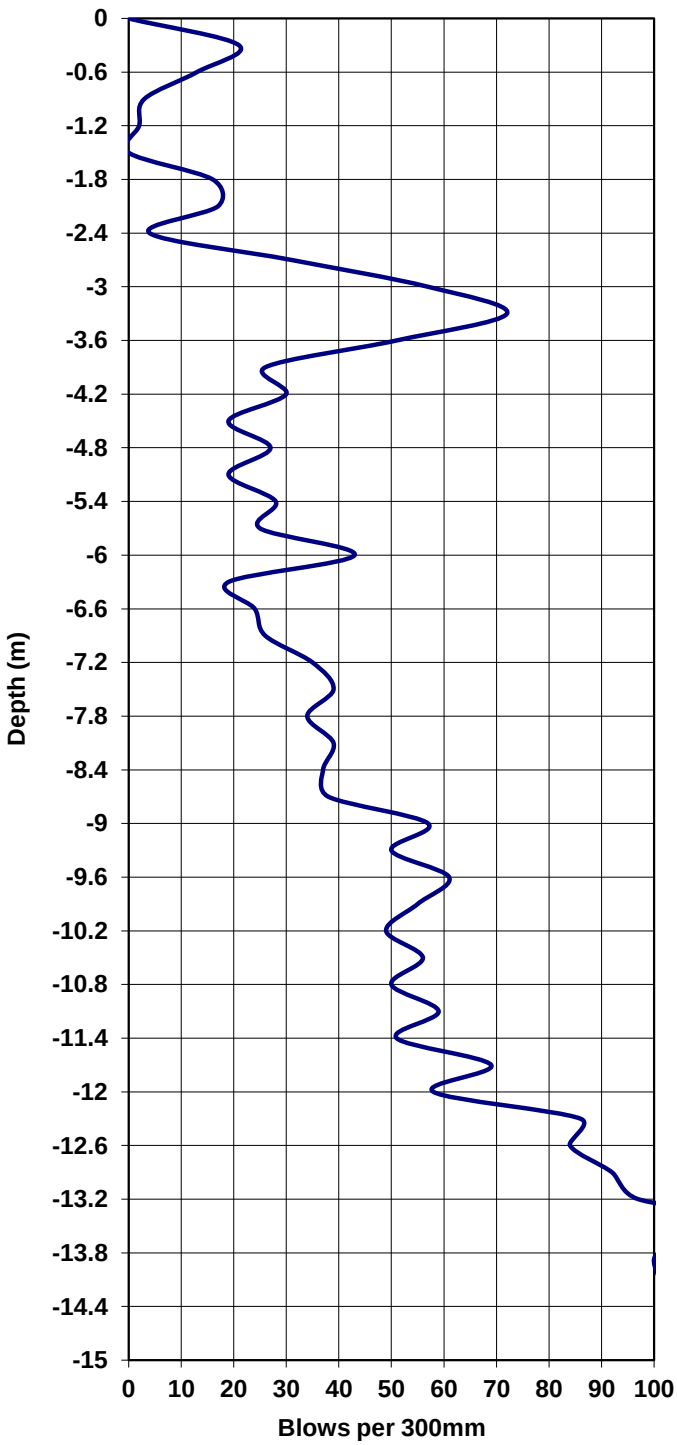
**Section:** North Beach, Durban, KwaZulu Natal **Operator:** K.Gavu

## *Light Dynamic Penetrometer Probe* ---------- ***Test No. DPL 1***

THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angel
Rods: 16mm diameter, 22mm diameter couplings

| Depth metres | Blows per 300mm | Inferred Consistency | Insitu Shear Strength |
|---|---|---|---|
| 0 | | | |
| 0.3 | 21 | Med.Dense | 32 deg |
| 0.6 | 13 | Loose | <30 deg |
| 0.9 | 3 | Very Loose | <29 deg |
| 1.2 | 2 | Very Loose | <29 deg |
| 1.5 | 0 | V.V.Loose | <28 deg |
| 1.8 | 16 | Med.Dense | 30 deg |
| 2.1 | 17 | Med.Dense | 31 deg |
| 2.4 | 4 | Very Loose | <29 deg |
| 2.7 | 31 | Med.Dense | 35 deg |
| 3 | 57 | Dense | 37 deg |
| 3.3 | 72 | Dense | 37 deg |
| 3.6 | 51 | Dense | 36 deg |
| 3.9 | 26 | Med.Dense | 34 deg |
| 4.2 | 30 | Med.Dense | 34 deg |
| 4.5 | 19 | Med.Dense | 32 deg |
| 4.8 | 27 | Med.Dense | 34 deg |
| 5.1 | 19 | Med.Dense | 32 deg |
| 5.4 | 28 | Med.Dense | 34 deg |
| 5.7 | 25 | Med.Dense | 33 deg |
| 6 | 43 | Dense | 36 deg |
| 6.3 | 19 | Med.Dense | 32 deg |
| 6.6 | 24 | Med.Dense | 33 deg |
| 6.9 | 26 | Med.Dense | 34 deg |
| 7.2 | 35 | Med.Dense | 35 deg |
| 7.5 | 39 | Med.Dense | 36 deg |
| 7.8 | 34 | Med.Dense | 35 deg |
| 8.1 | 39 | Med.Dense | 36 deg |
| 8.4 | 37 | Med.Dense | 35 deg |
| 8.7 | 38 | Med.Dense | 36 deg |
| 9 | 57 | Dense | 37 deg |
| 9.3 | 50 | Dense | 36 deg |
| 9.6 | 61 | Dense | 37 deg |
| 9.9 | 55 | Dense | 37 deg |
| 10.2 | 49 | Dense | 36 deg |
| 10.5 | 56 | Dense | 37 deg |
| 10.8 | 50 | Dense | 36 deg |
| 11.1 | 59 | Dense | 37 deg |
| 11.4 | 51 | Dense | 36 deg |
| 11.7 | 69 | Dense | 37 deg |
| 12 | 58 | Dense | 37 deg |
| 12.3 | 86 | Dense | 38 deg |
| 12.6 | 84 | Dense | 38 deg |
| 12.9 | 92 | Dense | 38 deg |
| 13.2 | 97 | Dense | 38 deg |
| 13.5 | 124 | Very Dense | >38 deg |
| | Refusal | | |



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**Client:** MPAMOT (Pty) Ltd **Ref.No.** 220-20

**Project:** Proposed Maritime Focus School **Date:** 09.11.2020

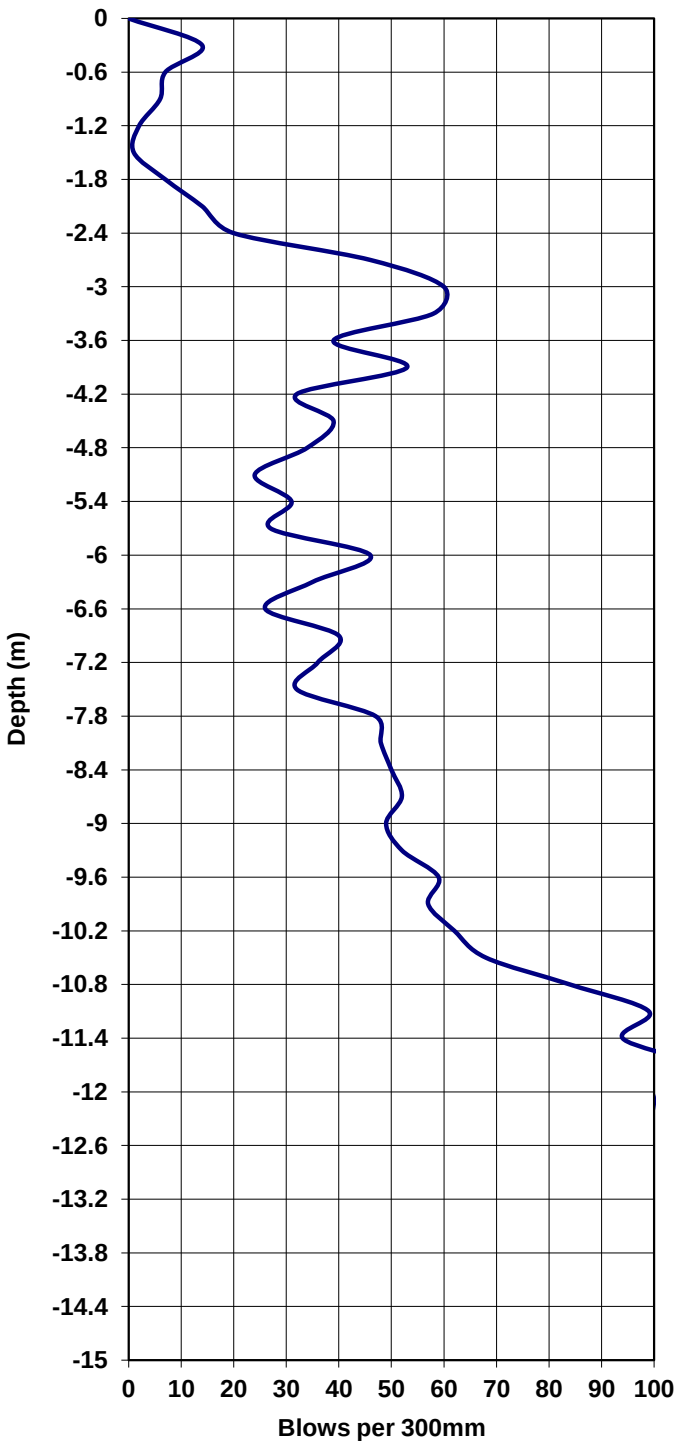
**Section:** North Beach, Durban, KwaZulu Natal **Operator:** K.Gavu

## *Light Dynamic Penetrometer Probe* ---------- ***Test No. DPL 2***

THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angel
Rods: 16mm diameter, 22mm diameter couplings

| Depth metres | Blows per 300mm | Inferred Consistency | Insitu Shear Strength |
|---|---|---|---|
| 0 | | | |
| 0.3 | 14 | Loose | <30 deg |
| 0.6 | 7 | Loose | <30 deg |
| 0.9 | 6 | Very Loose | <29 deg |
| 1.2 | 2 | Very Loose | <29 deg |
| 1.5 | 1 | Very Loose | <29 deg |
| 1.8 | 7 | Loose | <30 deg |
| 2.1 | 14 | Loose | <30 deg |
| 2.4 | 20 | Med.Dense | 32 deg |
| 2.7 | 46 | Dense | 36 deg |
| 3 | 60 | Dense | 37 deg |
| 3.3 | 58 | Dense | 37 deg |
| 3.6 | 39 | Med.Dense | 36 deg |
| 3.9 | 53 | Dense | 37 deg |
| 4.2 | 32 | Med.Dense | 35 deg |
| 4.5 | 39 | Med.Dense | 36 deg |
| 4.8 | 34 | Med.Dense | 35 deg |
| 5.1 | 24 | Med.Dense | 33 deg |
| 5.4 | 31 | Med.Dense | 35 deg |
| 5.7 | 27 | Med.Dense | 34 deg |
| 6 | 46 | Dense | 36 deg |
| 6.3 | 35 | Med.Dense | 35 deg |
| 6.6 | 26 | Med.Dense | 34 deg |
| 6.9 | 40 | Med.Dense | 36 deg |
| 7.2 | 36 | Med.Dense | 35 deg |
| 7.5 | 32 | Med.Dense | 35 deg |
| 7.8 | 47 | Dense | 36 deg |
| 8.1 | 48 | Dense | 36 deg |
| 8.4 | 50 | Dense | 36 deg |
| 8.7 | 52 | Dense | 37 deg |
| 9 | 49 | Dense | 36 deg |
| 9.3 | 52 | Dense | 37 deg |
| 9.6 | 59 | Dense | 37 deg |
| 9.9 | 57 | Dense | 37 deg |
| 10.2 | 62 | Dense | 37 deg |
| 10.5 | 68 | Dense | 37 deg |
| 10.8 | 84 | Dense | 38 deg |
| 11.1 | 99 | Very Dense | >38 deg |
| 11.4 | 94 | Dense | 38 deg |
| 11.7 | 107 | Very Dense | >38 deg |
| | Refusal | | |



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Tel: (031) 266 0458 Fax: 086 689 5506 Email: info@geosure.co.za


**Client:** MPAMOT (Pty) Ltd **Ref.No.** 220-20

**Project:** Proposed Maritime Focus School **Date:** 09.11.2020

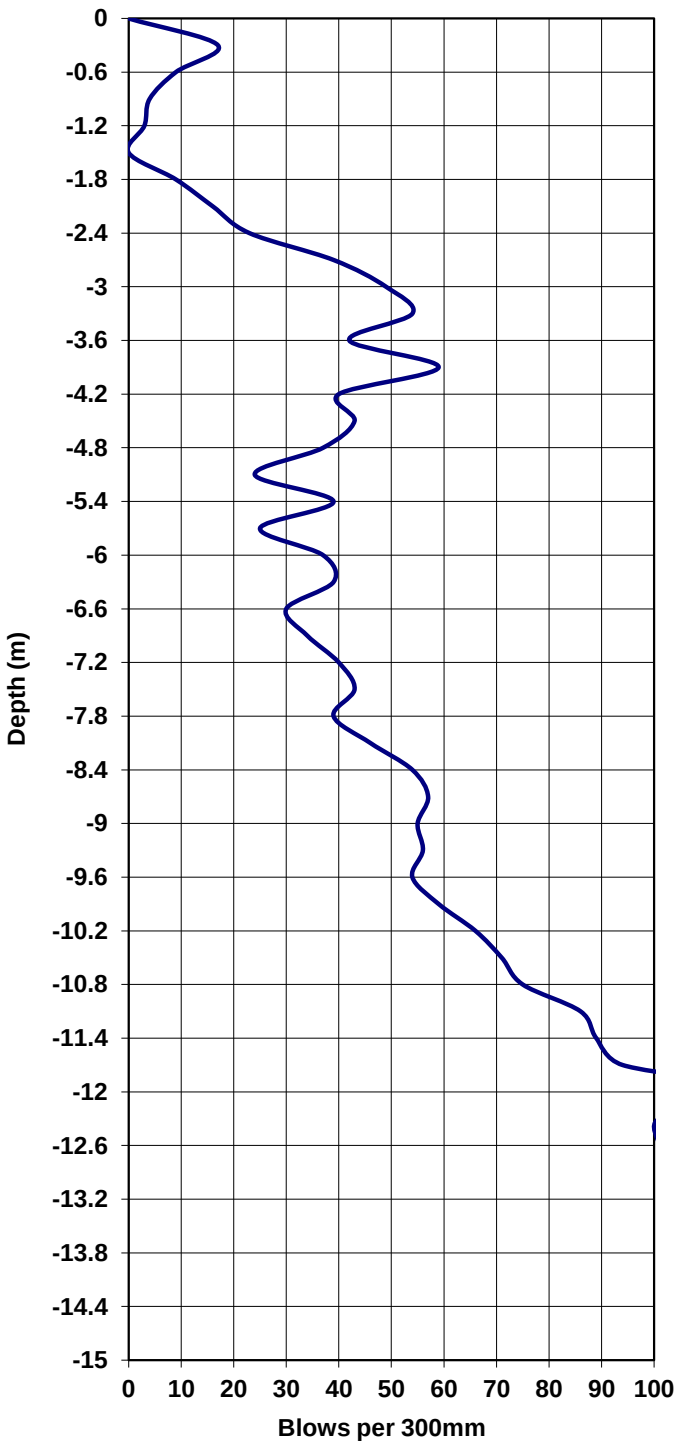
**Section:** North Beach, Durban, KwaZulu Natal **Operator:** K.Gavu

## *Light Dynamic Penetrometer Probe* ---------- ***Test No. DPL 3***

THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angel
Rods: 16mm diameter, 22mm diameter couplings

| Depth metres | Blows per 300mm | Inferred Consistency | Insitu Shear Strength |
|---|---|---|---|
| 0 | | | |
| 0.3 | 17 | Med.Dense | 31 deg |
| 0.6 | 9 | Loose | <30 deg |
| 0.9 | 4 | Very Loose | <29 deg |
| 1.2 | 3 | Very Loose | <29 deg |
| 1.5 | 0 | V.V.Loose | <28 deg |
| 1.8 | 9 | Loose | <30 deg |
| 2.1 | 16 | Med.Dense | 30 deg |
| 2.4 | 23 | Med.Dense | 33 deg |
| 2.7 | 39 | Med.Dense | 36 deg |
| 3 | 49 | Dense | 36 deg |
| 3.3 | 54 | Dense | 37 deg |
| 3.6 | 42 | Dense | 36 deg |
| 3.9 | 59 | Dense | 37 deg |
| 4.2 | 40 | Med.Dense | 36 deg |
| 4.5 | 43 | Dense | 36 deg |
| 4.8 | 37 | Med.Dense | 35 deg |
| 5.1 | 24 | Med.Dense | 33 deg |
| 5.4 | 39 | Med.Dense | 36 deg |
| 5.7 | 25 | Med.Dense | 33 deg |
| 6 | 37 | Med.Dense | 35 deg |
| 6.3 | 39 | Med.Dense | 36 deg |
| 6.6 | 30 | Med.Dense | 34 deg |
| 6.9 | 34 | Med.Dense | 35 deg |
| 7.2 | 40 | Med.Dense | 36 deg |
| 7.5 | 43 | Dense | 36 deg |
| 7.8 | 39 | Med.Dense | 36 deg |
| 8.1 | 46 | Dense | 36 deg |
| 8.4 | 54 | Dense | 37 deg |
| 8.7 | 57 | Dense | 37 deg |
| 9 | 55 | Dense | 37 deg |
| 9.3 | 56 | Dense | 37 deg |
| 9.6 | 54 | Dense | 37 deg |
| 9.9 | 59 | Dense | 37 deg |
| 10.2 | 66 | Dense | 37 deg |
| 10.5 | 71 | Dense | 37 deg |
| 10.8 | 75 | Dense | 37 deg |
| 11.1 | 86 | Dense | 38 deg |
| 11.4 | 89 | Dense | 38 deg |
| 11.7 | 94 | Dense | 38 deg |
| 12 | 121 | Very Dense | >38 deg |
| | Refusal | | |



# GEOSURE (PTY) LTD.

Geotechnical Engineering Consultants

Tel: (031) 266 0458 Fax: 086 689 5506 Email: info@geosure.co.za


**Client:** MPAMOT (Pty) Ltd **Ref.No.** 220-20

**Project:** Proposed Maritime Focus School **Date:** 09.11.2020

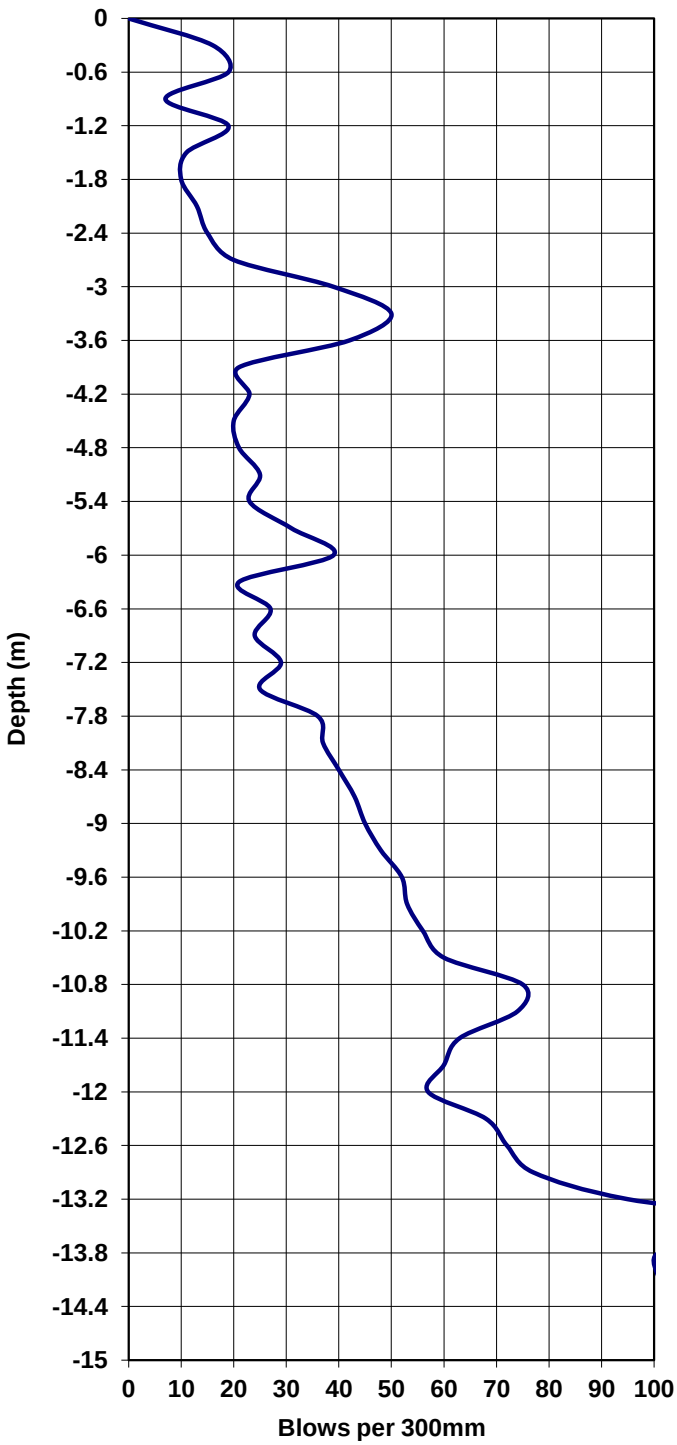
**Section:** North Beach, Durban, KwaZulu Natal **Operator:** K.Gavu

## *Light Dynamic Penetrometer Probe* ---------- ***Test No. DPL 4***

THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angel
Rods: 16mm diameter, 22mm diameter couplings

| Depth metres | Blows per 300mm | Inferred Consistency | Insitu Shear Strength |
|---|---|---|---|
| 0 | | | |
| 0.3 | 16 | Med.Dense | 30 deg |
| 0.6 | 19 | Med.Dense | 32 deg |
| 0.9 | 7 | Loose | <30 deg |
| 1.2 | 19 | Med.Dense | 32 deg |
| 1.5 | 11 | Loose | <30 deg |
| 1.8 | 10 | Loose | <30 deg |
| 2.1 | 13 | Loose | <30 deg |
| 2.4 | 15 | Loose | <30 deg |
| 2.7 | 20 | Med.Dense | 32 deg |
| 3 | 39 | Med.Dense | 36 deg |
| 3.3 | 50 | Dense | 36 deg |
| 3.6 | 42 | Dense | 36 deg |
| 3.9 | 21 | Med.Dense | 32 deg |
| 4.2 | 23 | Med.Dense | 33 deg |
| 4.5 | 20 | Med.Dense | 32 deg |
| 4.8 | 21 | Med.Dense | 32 deg |
| 5.1 | 25 | Med.Dense | 33 deg |
| 5.4 | 23 | Med.Dense | 33 deg |
| 5.7 | 31 | Med.Dense | 35 deg |
| 6 | 39 | Med.Dense | 36 deg |
| 6.3 | 21 | Med.Dense | 32 deg |
| 6.6 | 27 | Med.Dense | 34 deg |
| 6.9 | 24 | Med.Dense | 33 deg |
| 7.2 | 29 | Med.Dense | 34 deg |
| 7.5 | 25 | Med.Dense | 33 deg |
| 7.8 | 36 | Med.Dense | 35 deg |
| 8.1 | 37 | Med.Dense | 35 deg |
| 8.4 | 40 | Med.Dense | 36 deg |
| 8.7 | 43 | Dense | 36 deg |
| 9 | 45 | Dense | 36 deg |
| 9.3 | 48 | Dense | 36 deg |
| 9.6 | 52 | Dense | 37 deg |
| 9.9 | 53 | Dense | 37 deg |
| 10.2 | 56 | Dense | 37 deg |
| 10.5 | 60 | Dense | 37 deg |
| 10.8 | 75 | Dense | 37 deg |
| 11.1 | 74 | Dense | 37 deg |
| 11.4 | 63 | Dense | 37 deg |
| 11.7 | 60 | Dense | 37 deg |
| 12 | 57 | Dense | 37 deg |
| 12.3 | 68 | Dense | 37 deg |
| 12.6 | 72 | Dense | 37 deg |
| 12.9 | 77 | Dense | 37 deg |
| 13.2 | 95 | Dense | 38 deg |
| 13.5 | 131 | Very Dense | >38 deg |
| | Refusal | | |



# GEOSURE (PTY) LTD.

Geotechnical Engineering Consultants

Tel: (031) 266 0458 Fax: 086 689 5506 Email: info@geosure.co.za


**Client:** MPAMOT (Pty) Ltd **Ref.No.** 220-20

**Project:** Proposed Maritime Focus School **Date:** 09.11.2020

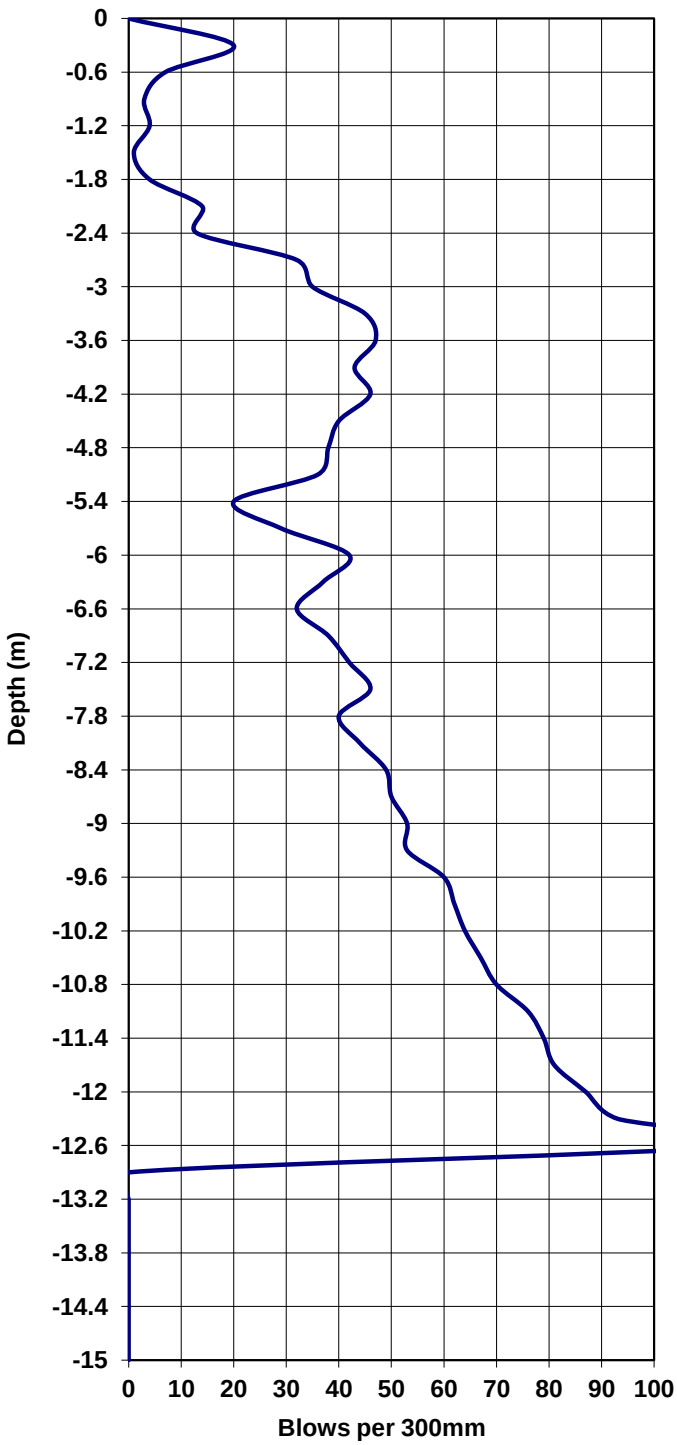
**Section:** North Beach, Durban, KwaZulu Natal **Operator:** K.Gavu

## *Light Dynamic Penetrometer Probe* ---------- ***Test No. DPL 5***

THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angel
Rods: 16mm diameter, 22mm diameter couplings

| Depth metres | Blows per 300mm | Inferred Consistency | Insitu Shear Strength |
|---|---|---|---|
| 0 | | | |
| 0.3 | 20 | Med.Dense | 32 deg |
| 0.6 | 7 | Loose | <30 deg |
| 0.9 | 3 | Very Loose | <29 deg |
| 1.2 | 4 | Very Loose | <29 deg |
| 1.5 | 1 | Very Loose | <29 deg |
| 1.8 | 4 | Very Loose | <29 deg |
| 2.1 | 14 | Loose | <30 deg |
| 2.4 | 13 | Loose | <30 deg |
| 2.7 | 32 | Med.Dense | 35 deg |
| 3 | 35 | Med.Dense | 35 deg |
| 3.3 | 45 | Dense | 36 deg |
| 3.6 | 47 | Dense | 36 deg |
| 3.9 | 43 | Dense | 36 deg |
| 4.2 | 46 | Dense | 36 deg |
| 4.5 | 40 | Med.Dense | 36 deg |
| 4.8 | 38 | Med.Dense | 36 deg |
| 5.1 | 36 | Med.Dense | 35 deg |
| 5.4 | 20 | Med.Dense | 32 deg |
| 5.7 | 29 | Med.Dense | 34 deg |
| 6 | 42 | Dense | 36 deg |
| 6.3 | 37 | Med.Dense | 35 deg |
| 6.6 | 32 | Med.Dense | 35 deg |
| 6.9 | 38 | Med.Dense | 36 deg |
| 7.2 | 42 | Dense | 36 deg |
| 7.5 | 46 | Dense | 36 deg |
| 7.8 | 40 | Med.Dense | 36 deg |
| 8.1 | 44 | Dense | 36 deg |
| 8.4 | 49 | Dense | 36 deg |
| 8.7 | 50 | Dense | 36 deg |
| 9 | 53 | Dense | 37 deg |
| 9.3 | 53 | Dense | 37 deg |
| 9.6 | 60 | Dense | 37 deg |
| 9.9 | 62 | Dense | 37 deg |
| 10.2 | 64 | Dense | 37 deg |
| 10.5 | 67 | Dense | 37 deg |
| 10.8 | 70 | Dense | 37 deg |
| 11.1 | 76 | Dense | 37 deg |
| 11.4 | 79 | Dense | 38 deg |
| 11.7 | 81 | Dense | 38 deg |
| 12 | 87 | Dense | 38 deg |
| 12.3 | 93 | Dense | 38 deg |
| 12.6 | 117 | Very Dense | >38 deg |



# GEOSURE (PTY) LTD.

Geotechnical Engineering Consultants

Tel: (031) 266 0458 Fax: 086 689 5506 Email: info@geosure.co.za


**Client:** MPAMOT (Pty) Ltd **Ref.No.** 220-20

**Project:** Proposed Maritime Focus School **Date:** 09.11.2020

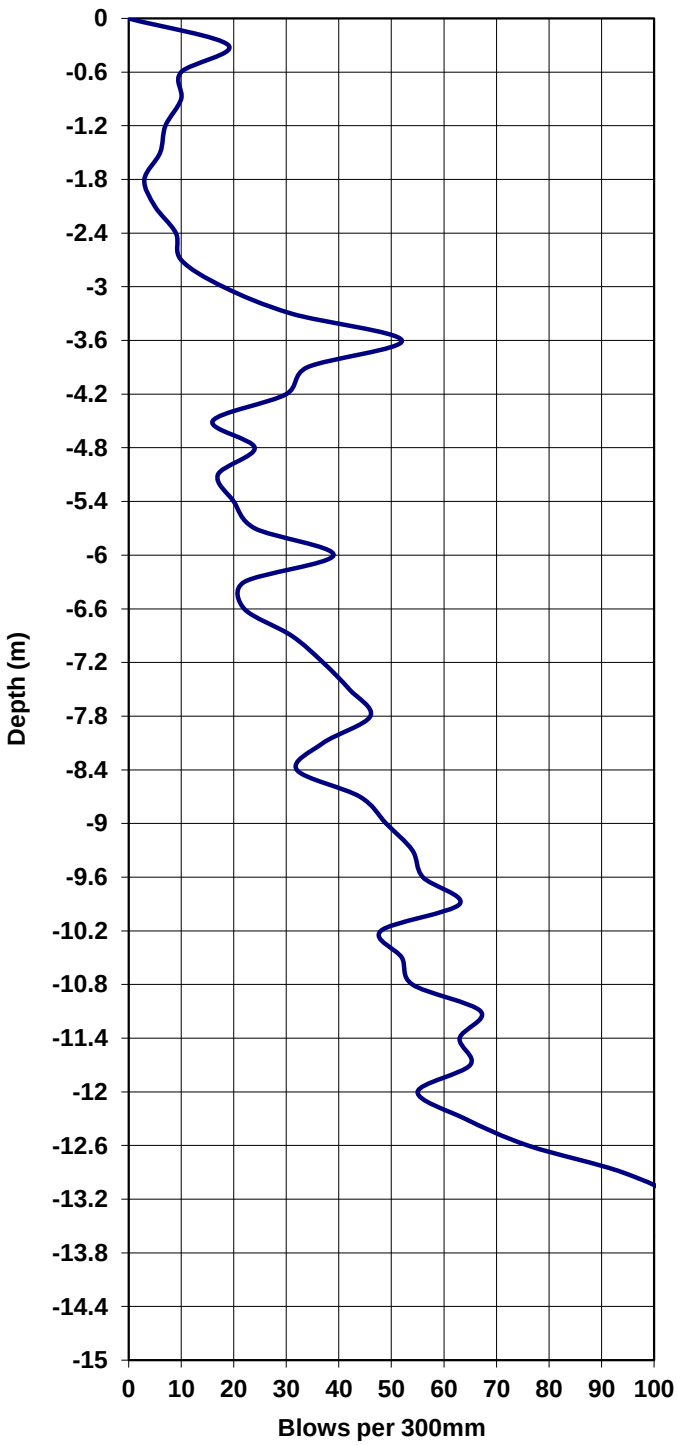
**Section:** North Beach, Durban, KwaZulu Natal **Operator:** K.Gavu

## *Light Dynamic Penetrometer Probe* ---------- ***Test No. DPL 6***

THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angel
Rods: 16mm diameter, 22mm diameter couplings

| Depth metres | Blows per 300mm | Inferred Consistency | Insitu Shear Strength |
|---|---|---|---|
| 0 | | | |
| 0.3 | 19 | Med.Dense | 32 deg |
| 0.6 | 10 | Loose | <30 deg |
| 0.9 | 10 | Loose | <30 deg |
| 1.2 | 7 | Loose | <30 deg |
| 1.5 | 6 | Very Loose | <29 deg |
| 1.8 | 3 | Very Loose | <29 deg |
| 2.1 | 5 | Very Loose | <29 deg |
| 2.4 | 9 | Loose | <30 deg |
| 2.7 | 10 | Loose | <30 deg |
| 3 | 18 | Med.Dense | 31 deg |
| 3.3 | 31 | Med.Dense | 35 deg |
| 3.6 | 52 | Dense | 37 deg |
| 3.9 | 34 | Med.Dense | 35 deg |
| 4.2 | 30 | Med.Dense | 34 deg |
| 4.5 | 16 | Med.Dense | 30 deg |
| 4.8 | 24 | Med.Dense | 33 deg |
| 5.1 | 17 | Med.Dense | 31 deg |
| 5.4 | 20 | Med.Dense | 32 deg |
| 5.7 | 24 | Med.Dense | 33 deg |
| 6 | 39 | Med.Dense | 36 deg |
| 6.3 | 22 | Med.Dense | 33 deg |
| 6.6 | 22 | Med.Dense | 33 deg |
| 6.9 | 31 | Med.Dense | 35 deg |
| 7.2 | 37 | Med.Dense | 35 deg |
| 7.5 | 42 | Dense | 36 deg |
| 7.8 | 46 | Dense | 36 deg |
| 8.1 | 37 | Med.Dense | 35 deg |
| 8.4 | 32 | Med.Dense | 35 deg |
| 8.7 | 44 | Dense | 36 deg |
| 9 | 49 | Dense | 36 deg |
| 9.3 | 54 | Dense | 37 deg |
| 9.6 | 56 | Dense | 37 deg |
| 9.9 | 63 | Dense | 37 deg |
| 10.2 | 48 | Dense | 36 deg |
| 10.5 | 52 | Dense | 37 deg |
| 10.8 | 54 | Dense | 37 deg |
| 11.1 | 67 | Dense | 37 deg |
| 11.4 | 63 | Dense | 37 deg |
| 11.7 | 65 | Dense | 37 deg |
| 12 | 55 | Dense | 37 deg |
| 12.3 | 64 | Dense | 37 deg |
| 12.6 | 76 | Dense | 37 deg |
| 12.9 | 94 | Dense | 38 deg |
| 13.2 | 104 | Very Dense | >38 deg |
| | Refusal | | |



# APPENDIX E

# LABORATORY TEST RESULTS

Consulting Engineering Geologists, Geotechnical Engineers, Geotechnicians & Geotechnical Quality Assurance Specialists

GEOSURE (Pty) Ltd

sanas Testing Laboratory T0483

CLIENT : Geosure (Pty) Ltd
PHYSICAL ADDRESS : 122 Intersite Avenue, Springfield Park, Umgeni Durban, 4001
ATTENTION : Mr D. Naidoo
PROJECT : Maritime Focus School

**TEST REPORT REFERENCE NUMBER: 51406**

**Dear Sir/Madam,**
Enclosed herewith, please find the original reports pertaining to the above-mentioned project.

| | |
|---|---|
| Date Received | **11.11.2020** |
| Date Tested | 12.11.2020 to 21.11.2020 |
| Sample Location | Refer to Report |
| Sampling Method | N/A |
| Sample Condition | Moist |
| Sampling Environmental Condition | N/A |
| Sampler(s) Name | Client |
| Total Number of Pages | 13 |

| **Test Carried Out** | | | |
|---|---|---|---|
| SANS3001 GR1 | ✓ | TMH1 Method C3 | |
| SANS3001 GR10, GR12 | ✓ | TMH1 Method C4a | |
| SANS3001 GR30 | ✓ | TMH1 Method B6 | |
| SANS3001 GR40 | ✓ | Hydrometer Analysis - ASTM D422 | ✓ |
| TMH1 Method A10(b) | | SABS1200 (Compactibility Factor)# | |
| TMH1 Method A13T + A14app | | SANS 5862-1 | |
| TMH1 Method A15d | | SANS 5860, 5861-1, 5861-2, 5861-3 | |
| TMH1 Method A13T + A16T | | TMH1 Method B9 | |

✓ - Tick denotes tests that were carried out. #Denotes non accredited tests

**We would like to take this opportunity of thanking you for your continued support.**
**Should you have any queries please do not hesitate to contact me.**

**Yours faithfully**

**Technical Signatory,**
**Dheeran Ramcharan for Geosure (Pty) Ltd.**

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| ***Head Office*** | ***Civil Engineering Laboratory*** | *Gauteng Branch* |
|---|---|---|
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| Mobile: +27 (0)82 784 0544 | Mobile: 072 870 2621 | Mobile: 083 377 6559 |
| E-mail: geosure@iafrica.com | E-mail: lab@geosure.co.za | Email: gauteng@geosure.co.za |

Consulting Engineering Geologists, Geotechnical Engineers, Geotechnicians & Geotechnical Quality Assurance Specialists
GEOSURE (Pty) Ltd

sanas T0483

Reg.No.: 92/03145/07

LABORATORY AND HEAD OFFICE ADDRESS: 122 Intersite Avenue, Umgeni Business Park, Durban, 4091

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Mobile: +27(0) 82 784 0544 e-mail:geosure@iafrica.com

WEBSITE: www.geosure.co.za

**Client** : **Geosure (Pty) Ltd** **Our Ref.** : **51406**

**Project** : **Maritime Focus School** **Your Ref.** : **220-20**

**Date Tested** : **12.11.2020 to 19.11.2020**

**Attention** : **Mr D. Naidoo** **Date Reported** : **25.11.2020**

| **Sample No.** | | | T29319 | T29321 | T29323 | T29325 | |
|---|---|---|---|---|---|---|---|
| **Field No.** | | | IP1 | IP3 | IP4 | IP4 | |
| **Position in Field** | | | Layer 1 | Layer 1 | Layer 1 | Layer 5 | |
| **Depth (m)** | | | 0.0-0.37 | 0.0-0.67 | 0.0-0.55 | 2.3-2.4 | |
| **Material Description** | | | Dark brown slightly clayey silty SAND. Fill | Reddish orange slightly clayey silty SAND. Fill | Reddish brown slightly clayey silty SAND. Fill | Light grey slightly silty SAND. Beach Deposits | |
| **Sieve Analysis ( Wet Preparation ) - SANS3001 GR 1 - Percent Passing Sieve Size** | | | | | | | |
| **% Passing** | **100.0** | **mm** | 100 | 100 | 100 | 100 | |
| | **75.0** | **mm** | 100 | 100 | 100 | 100 | |
| | **63.0** | **mm** | 100 | 100 | 100 | 100 | |
| | **50.0** | **mm** | 100 | 100 | 100 | 100 | |
| | **37.5** | **mm** | 100 | 100 | 100 | 100 | |
| | **28.0** | **mm** | 100 | 100 | 100 | 100 | |
| | **20.0** | **mm** | 100 | 100 | 100 | 100 | |
| | **14.0** | **mm** | 100 | 100 | 100 | 100 | |
| | **5.00** | **mm** | 99 | 99 | 99 | 100 | |
| | **2.00** | **mm** | 99 | 98 | 98 | 100 | |
| | **0.425** | **mm** | 94 | 92 | 94 | 91 | |
| | **0.250** | **mm** | 77 | 70 | 78 | 58 | |
| | **0.150** | **mm** | 41 | 30 | 31 | 33 | |
| | **0.075** | **mm** | 32 | 21 | 21 | 24 | |
| **Hydrometer Analysis - ASTM - D422 - Percent Passing Particle Diameter (<0.425mm)** | | | | | | | |
| **% Passing** | **0.060** | **mm** | 30 | 20 | 20 | 21 | |
| | **0.050** | **mm** | 29 | 20 | 20 | 19 | |
| | **0.040** | **mm** | 28 | 19 | 19 | 18 | |
| | **0.026** | **mm** | 27 | 19 | 18 | 15 | |
| | **0.015** | **mm** | 27 | 17 | 16 | 13 | |
| | **0.010** | **mm** | 25 | 15 | 16 | 12 | |
| | **0.0074** | **mm** | 23 | 14 | 15 | 12 | |
| | **0.0036** | **mm** | 20 | 11 | 12 | 10 | |
| | **0.0020** | **mm** | 15 | 8 | 12 | 9 | |
| | **0.0015** | **mm** | 14 | 7 | 11 | 9 | |
| **Mechanical analysis - SANS3001 GR1 - Percent of Soil Mortar (<2 mm) for Grain Size range** | | | | | | | |
| **Coarse Sand** | | **%** | 5 | 6 | 4 | 9 | |
| **Coarse Fine Sand** | | **%** | 17 | 22 | 16 | 33 | |
| **Medium Fine Sand** | | **%** | 36 | 41 | 48 | 24 | |
| **Fine Fine Sand** | | **%** | 10 | 9 | 10 | 10 | |
| **Silt & Clay** | | **%** | 32 | 21 | 22 | 24 | |
| **Grading Modulus** | | | 0.76 | 0.90 | 0.86 | 0.86 | |
| **Atterberg Limits - SANS3001 GR10, GR12 (<0.425mm)** | | | | | | | |
| **Liquid Limit** | | **%** | 27 | SP | SP | SP | |
| **Plasticity Index** | | **%** | 11 | SP | SP | SP | |
| **Linear Shrinkage** | | **%** | 3.5 | 1.0 | 0.5 | 0.5 | |
| **AASHTO Classification (Group Index)*** | | | A-2-6 (0) | A-2-4 (0) | A-2-4 (0) | A-2-4 (0) | |
| **Unified Classification*** | | | SC | SM | SM | SM | |
| **Moisture Content** | | **%** | 17.7 | 13.3 | 9.9 | 23.8 | |

**Remarks:** Date Received: 11.11.2020
Sampled by Client.
*Opinions expressed herein fall outside the scope of SANAS accreditation.

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Consulting Engineering Geologists, Geotechnical Engineers, Geotechnicians & Geotechnical Quality Assurance Specialists
GEOSURE (Pty) Ltd

Reg.No.: 92/03145/07

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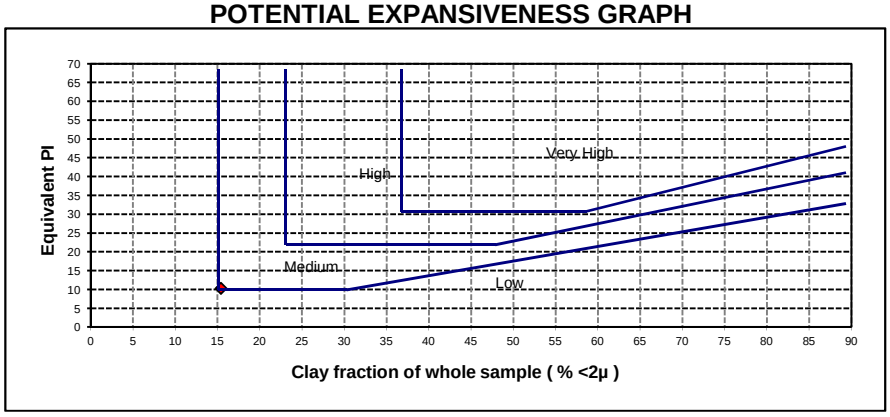
WEBSITE: www.geosure.co.za

**Client** : Geosure (Pty) Ltd
**Project** : Maritime Focus School
**Attention** : Mr D. Naidoo

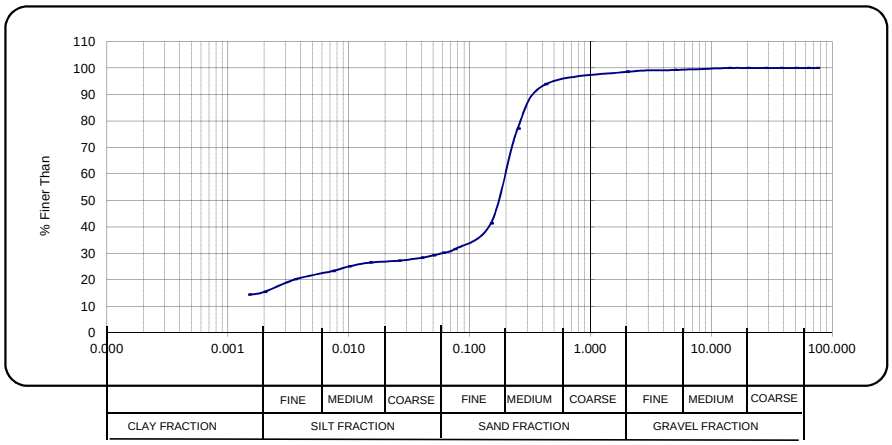
**Job No.** : 51406
**Your Ref.No.** : 220-20
**Date Tested** : 12.11.2020 to 19.11.2020
**Date Reported** : 25.11.2020

**Sample Number** : T29319
**Field No.** : IP1
**Sample Description** : Dark brown slightly clayey silty SAND. Fill
**Equivalent PI** : 10 **Clay fraction of whole sample (% <2μ)** : 15

## POTENTIAL EXPANSIVENESS GRAPH




## PARTICLE SIZE DISTRIBUTION CHART

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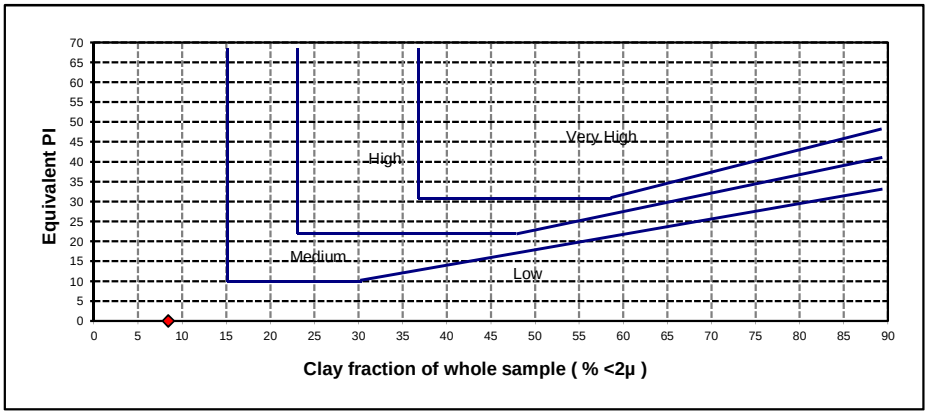
**Project** : Maritime Focus School
**Attention** : Mr D. Naidoo

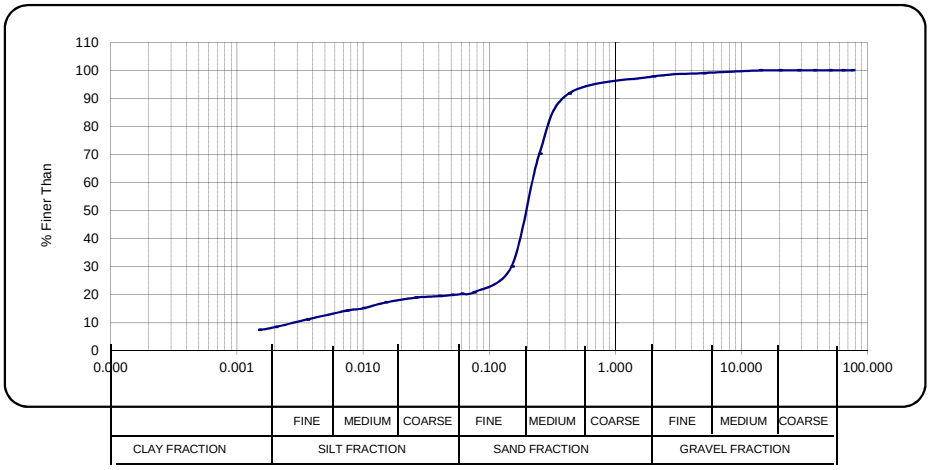
**Job No.** : 51406
**Your Ref.No.** : 220-20
**Date Tested** : 12.11.2020 to 19.11.2020
**Date Reported** : 25.11.2020

**Sample Number** : T29321
**Field No.** : IP3
**Sample Description** : Reddish orange slightly clayey silty SAND. Fill
**Equivalent PI** : **Clay fraction of whole sample (% <2μ)** : **8**

## POTENTIAL EXPANSIVENESS GRAPH




## PARTICLE SIZE DISTRIBUTION CHART

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WEBSITE: www.geosure.co.za

| | | | |
|---|---|---|---|
| **Client** | : Geosure (Pty) Ltd | **Job No.** | : 51406 |
| **Project** | : Maritime Focus School | **Your Ref.No.** | : 220-20 |
| | | **Date Tested** | : 12.11.2020 to 19.11.2020 |
| **Attention** | : Mr D. Naidoo | **Date Reported** | : 25.11.2020 |

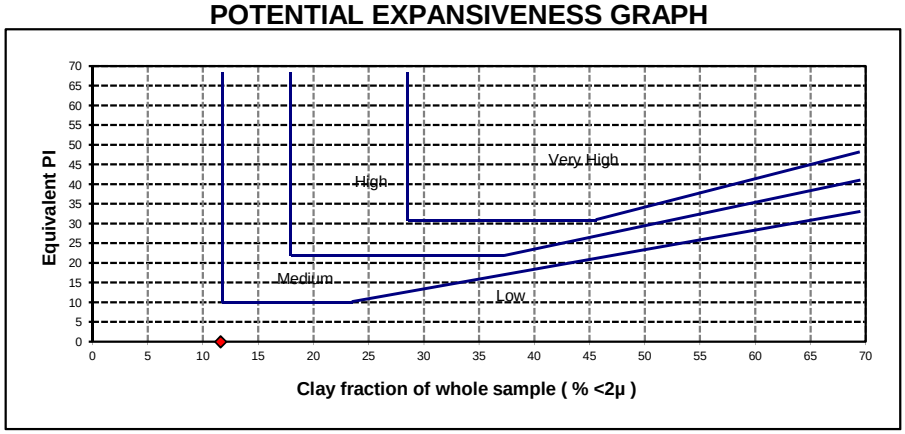
**Sample Number** : T29323

**Field No.** : IP4

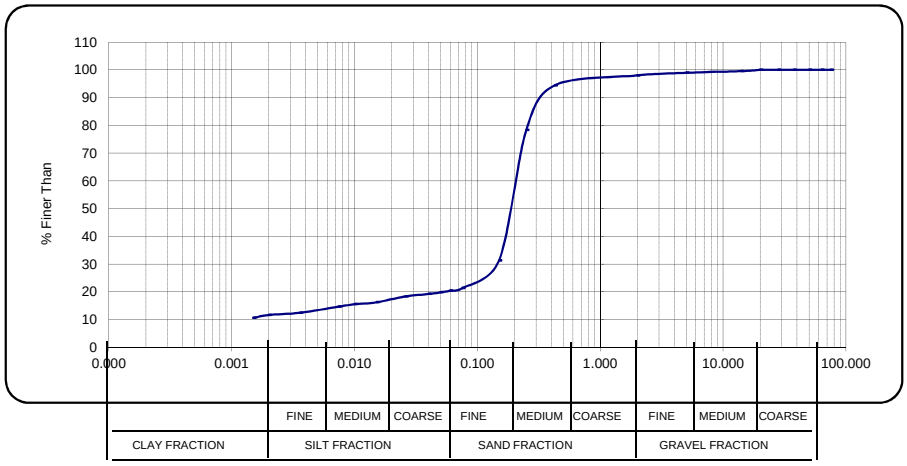
**Sample Description** : Reddish brown slightly clayey silty SAND. Fill

**Equivalent PI** : **Clay fraction of whole sample (% <2μ)** : **12**

## POTENTIAL EXPANSIVENESS GRAPH




## PARTICLE SIZE DISTRIBUTION CHART

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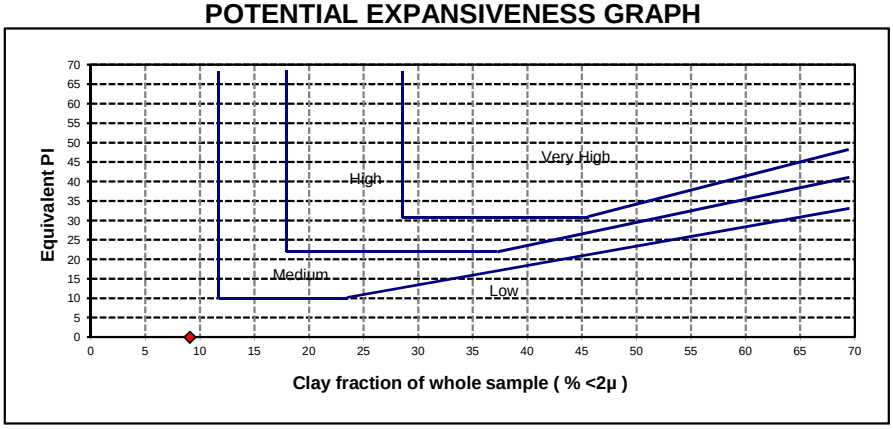
WEBSITE: www.geosure.co.za

**Client** : Geosure (Pty) Ltd
**Project** : Maritime Focus School
**Attention** : Mr D. Naidoo

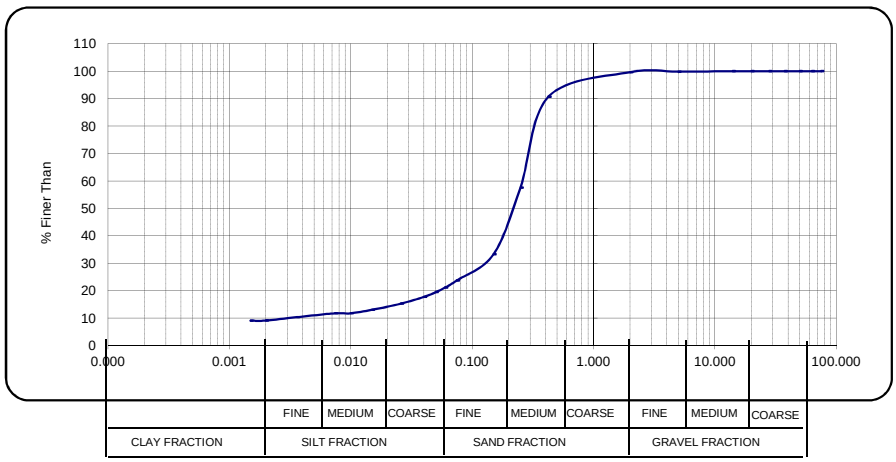
**Job No.** : 51406
**Your Ref.No.** : 220-20
**Date Tested** : 12.11.2020 to 19.11.2020
**Date Reported** : 25.11.2020

**Sample Number** : T29325
**Field No.** : IP4
**Sample Description** : Light grey slightly silty SAND. Beach Deposits
**Equivalent PI** : **Clay fraction of whole sample (% <2μ)** : **9**

## POTENTIAL EXPANSIVENESS GRAPH




## PARTICLE SIZE DISTRIBUTION CHART

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Consulting Engineering Geologists, Geotechnical Engineers, Geotechnicians & Geotechnical Quality Assurance Specialists
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Tel: +27 (0)31 266 0458 Fax: 086 689 5506
email: geosure@iafrica.com www.geosure.co.za

**Client** : **Geosure (Pty) Ltd** **Your Ref No. : 220-20**
**Project** : **Maritime Focus School** **Our Ref No. : 51406**
**Attention** : **Mr D. Naidoo** **Date Reported : 23/11/2020**

# Test Report - SANS 3001

| | | | | | | |
|---|---|---|---|---|---|---|
| **Sample No.** | | T29320 | T29322 | T29324 | | |
| **Field No.** | | IP2 | IP3 | IP4 | | |
| **Position** | | Layer 3 | Layer 2 | Layer 4 | | |
| **Depth ( m )** | | 0.75-0.96 | 0.67-1.03 | 1.12-2.3 | | |
| **Method of Preparation** | | Scalped | Scalped | N/A | | |
| | | | | | | |
| **Material Description** | | Light greyish brown speckled dark grey slightly clayey silty SAND. Fill | Light greyish brown speckled dark grey slightly clayey silty SAND. Fill | Light brown speckled light yellow slightly silty SAND. Beach Deposits | | |
| **Sieve Analysis - Percent Passing Sieve Size** | | | | | | |
| **Sieve Aperture (mm)** | **100.00** | | | | | |
| | **75.00** | 100 | 100 | | | |
| | **63.00** | 95 | 99 | | | |
| | **53.00** | 95 | 99 | | | |
| | **50.00** | 92 | 95 | | | |
| | **37.50** | 87 | 93 | | | |
| | **28.00** | 85 | 92 | | | |
| | **26.50** | 85 | 92 | | | |
| | **20.00** | 83 | 90 | | | |
| | **19.00** | 83 | 90 | | | |
| | **14.00** | 82 | 85 | | | |
| | **13.20** | 82 | 85 | | | |
| | **5.00** | 77 | 76 | | | |
| | **4.750** | 77 | 76 | | | |
| | **2.000** | 75 | 73 | 100 | | |
| | **0.425** | 70 | 68 | 98 | | |
| | **0.075** | 4 | 6 | 2 | | |
| **Grading Modulus** | | 1.52 | 1.53 | 1.00 | | |
| **Mechanical analysis - Percent of Soil Mortar (<2 mm) for Grain Size range** | | | | | | |
| Coarse Sand | **2.000 - 0.425** | 6 | 7 | 2 | | |
| Coarse-Fine Sand | **0.425 - 0.250** | 27 | 26 | 33 | | |
| Medium-Fine Sand | **0.250 - 0.150** | 55 | 52 | 59 | | |
| Fine-Fine Sand | **0.150 - 0.075** | 7 | 7 | 4 | | |
| Silt and Clay | **< 0.075** | 5 | 8 | 2 | | |
| **Atterberg Limits SANS 3001 on <0.425 mm fraction** | | | | | | |
| Liquid Limit | % or symbol | NP | NP | NP | | |
| Plasticity Index | % or symbol | NP | NP | NP | | |
| Linear Shrinkage | % | 0.0 | 0.0 | 0.0 | | |
| **Maximum Dry Density and Optimum Moisture Content** | | | | | | |
| **Maximum Dry Density (kg/m³)** | | 1752 | 1701 | 1681 | | |
| **Optimum moisture content (%)** | | 9.2 | 9.4 | 7.3 | | |
| **California Bearing Ratio** | | | | | | |
| CBR @100% Compaction | % | 38 | 58 | 34 | | |
| CBR @ 98% Compaction | % | 31 | 41 | 27 | | |
| CBR @ 97% Compaction | % | 28 | 34 | 25 | | |
| CBR @ 95% Compaction | % | 23 | 24 | 20 | | |
| CBR @ 93% Compaction | % | 19 | 17 | 16 | | |
| CBR @ 90% Compaction | % | 14 | 9.8 | 12 | | |
| Swell @100% Compaction | % | 0.0 | 0.0 | 0.0 | | |
| **COLTO Classification (1998)†**** | | G7 (#) | G7 (#) | G7 (#) | | |
| **TRH 14 Classification (1985)**** | | G7 | G7 | G7 | | |
| **AASHTO Classification (Group Index)**** | | A-3 (0) | A-3 (0) | A-3 (0) | | |
| **Unified Classification **** | | SP | SP-SM | SP | | |

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**Remarks:** ***Subject to further testing as required by TRH14.**

† Subject to further testing as required by COLTO. COLTO above uses only: Atterberg Limits (<0.425 mm fraction; not arithmetic mean), Nominal Max Size, Grading Curve, Coarse Sand Ratio, Grading Modulus, Strength (CBR), and Swell.

# *Check that Max Size <= 2/3 of compacted layer thickness.*

** Opinions and interpretations expressed herein are outside the scope of SANAS accreditation

Version 5.05 - 14 February 2018

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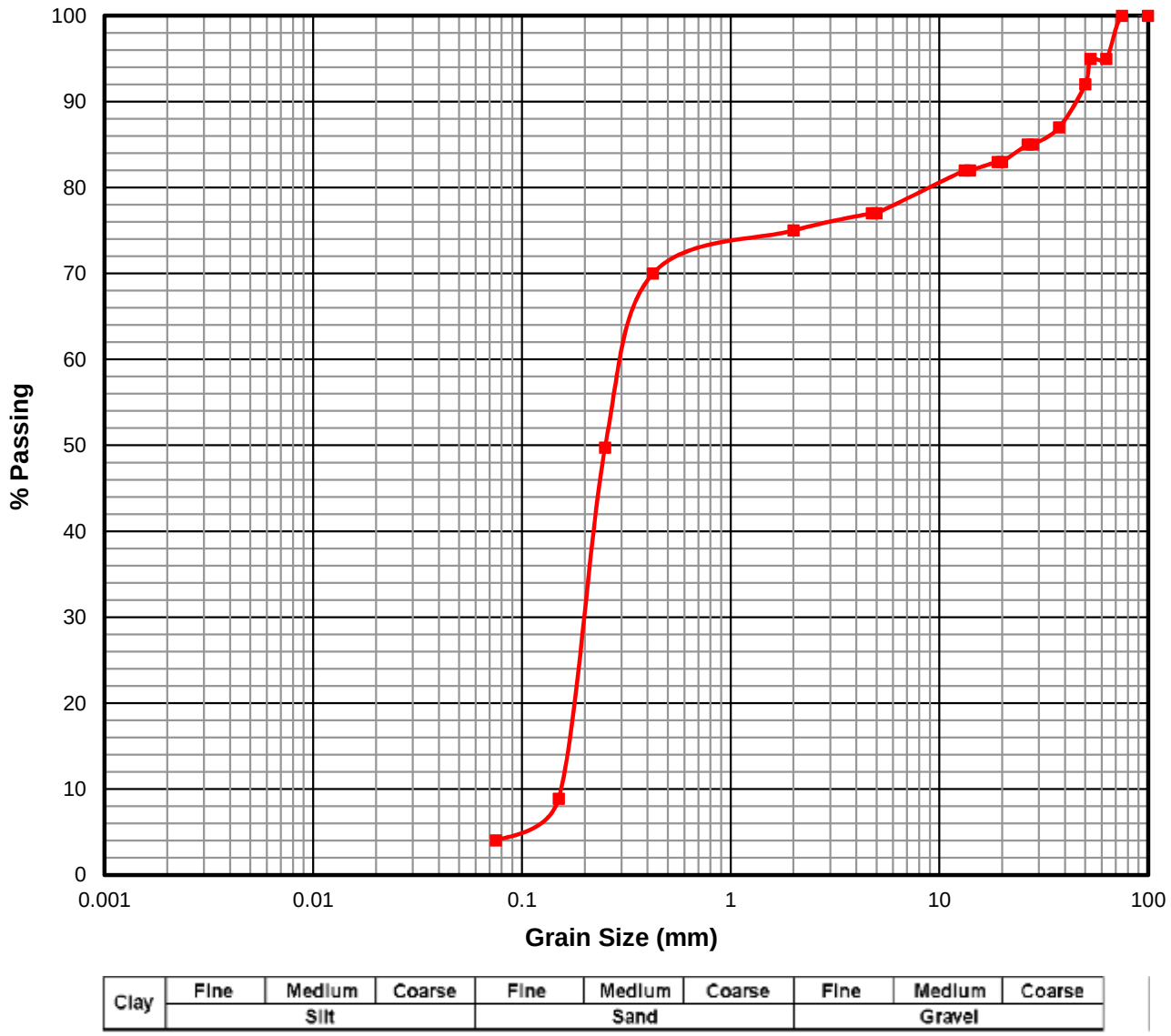
**Client** : **Geosure (Pty) Ltd**
**Project** : **Maritime Focus School**
**Attention** : **Mr D. Naidoo**

**Your Ref No.: 220-20**
**Our Ref No. : 51406**
**Date Reported : 23/11/2020**

# Grading Curve for Sample T29320 – SANS 3001




**Thick Red Line is the Grading Curve (COLTO Classification = G7 (#)) (TRH 14 Classification = G7)**

| Sieve Aperture Size | 0.075 | 0.150 | 0.250 | 0.425 | 2.00 | 4.75 | 5.00 | 13.20 | 14.00 | 19.00 | 20.00 | 26.50 | 28.0 | 37.5 | 50.0 | 53.0 | 63 | 75 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Percentage Passing | 4% | 9% | 50% | 70% | 75% | 77% | 77% | 82% | 82% | 83% | 83% | 85% | 85% | 87% | 92% | 95% | 95% | 100% | 100% |

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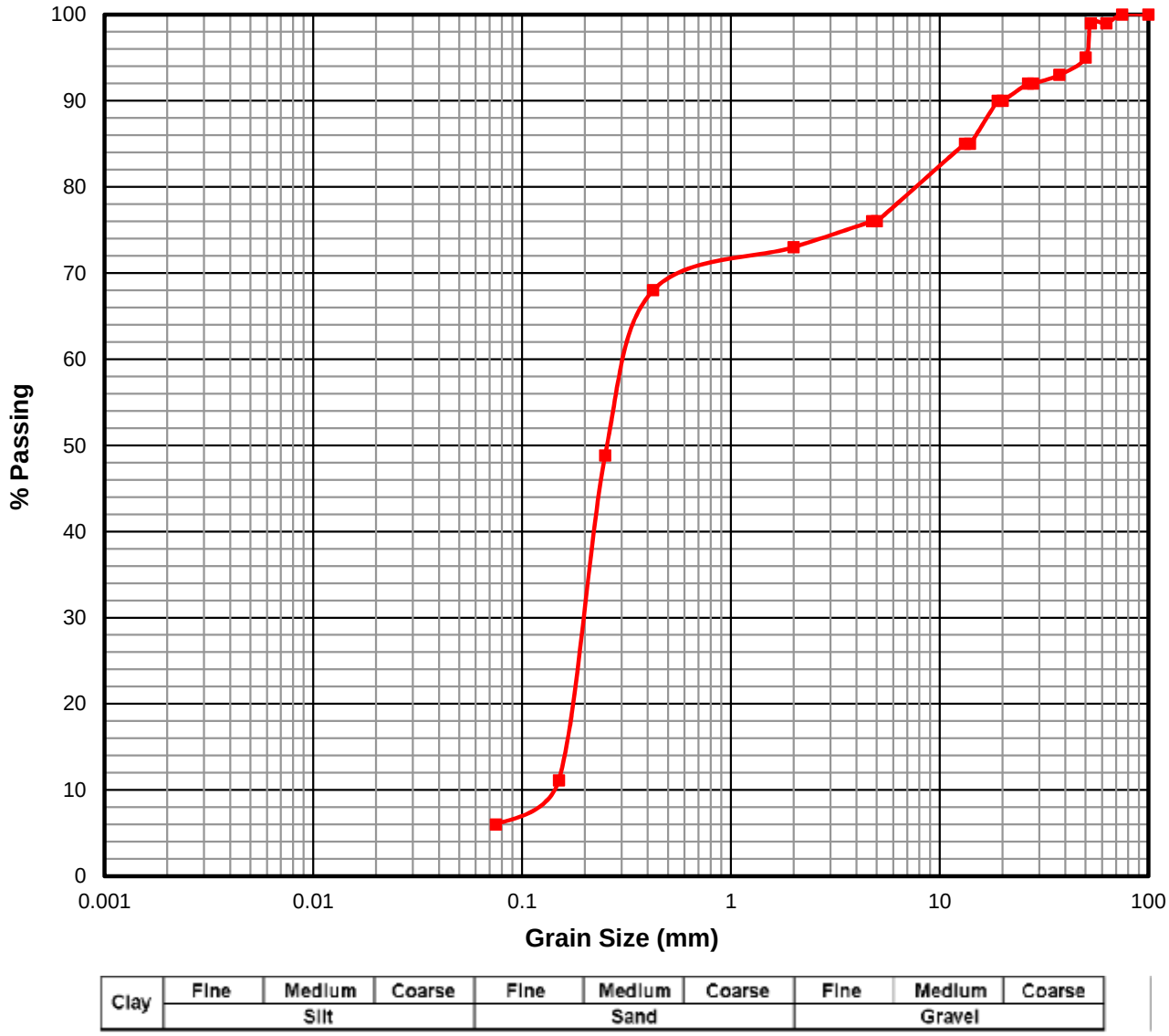
**Our Ref No. :** **51406**
**Date Reported :** **23/11/2020**

# Grading Curve for Sample T29322 – SANS 3001




**Thick Red Line is the Grading Curve (COLTO Classification = G7 (#)) (TRH 14 Classification = G7)**

| Sieve Aperture Size | 0.075 | 0.150 | 0.015 | 0.026 | 0.05 | 0.06 | 5.00 | 13.20 | 14.00 | 19.00 | 20.00 | 26.50 | 28.0 | 37.5 | 50.0 | 53.0 | 63 | 75 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Percentage Passing | 6% | 11% | 49% | 68% | 73% | 76% | 76% | 85% | 85% | 90% | 90% | 92% | 92% | 93% | 95% | 99% | 99% | 100% | 100% |

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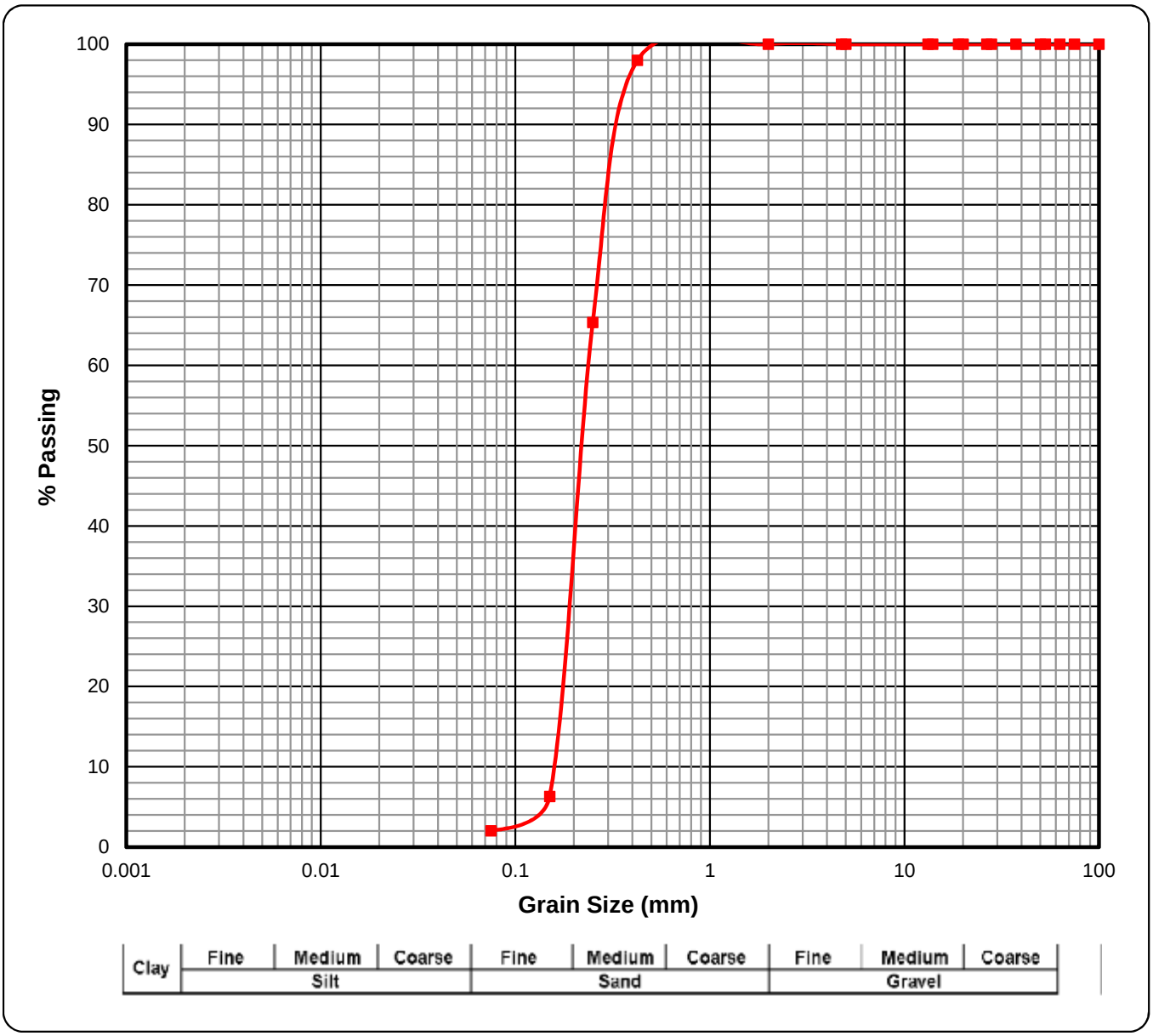
**Date Reported :** **23/11/2020**

# Grading Curve for Sample T29324 – SANS 3001




**Thick Red Line is the Grading Curve (COLTO Classification = G7 (#)) (TRH 14 Classification = G7)**

| Sieve Aperture Size | 0.075 | 0.150 | 0.250 | 0.425 | 2.00 | 4.75 | 5.00 | 13.20 | 14.00 | 19.00 | 20.00 | 26.50 | 28.0 | 37.5 | 50.0 | 53.0 | 63 | 75 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Percentage Passing | 2% | 6% | 65% | 98% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

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**Your Ref No.** : **220-20**
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**Date Reported** : **23.11.2020**

# SANS 3001 Moisture/Density Relationship

Sample No. : T29320
Method of preparation : Scalped
Natural/Stabilised : Natural
Material Description : Lt.Gr.Br.Spec.Dk.gr.Sl.clayey silty SAND. Fill

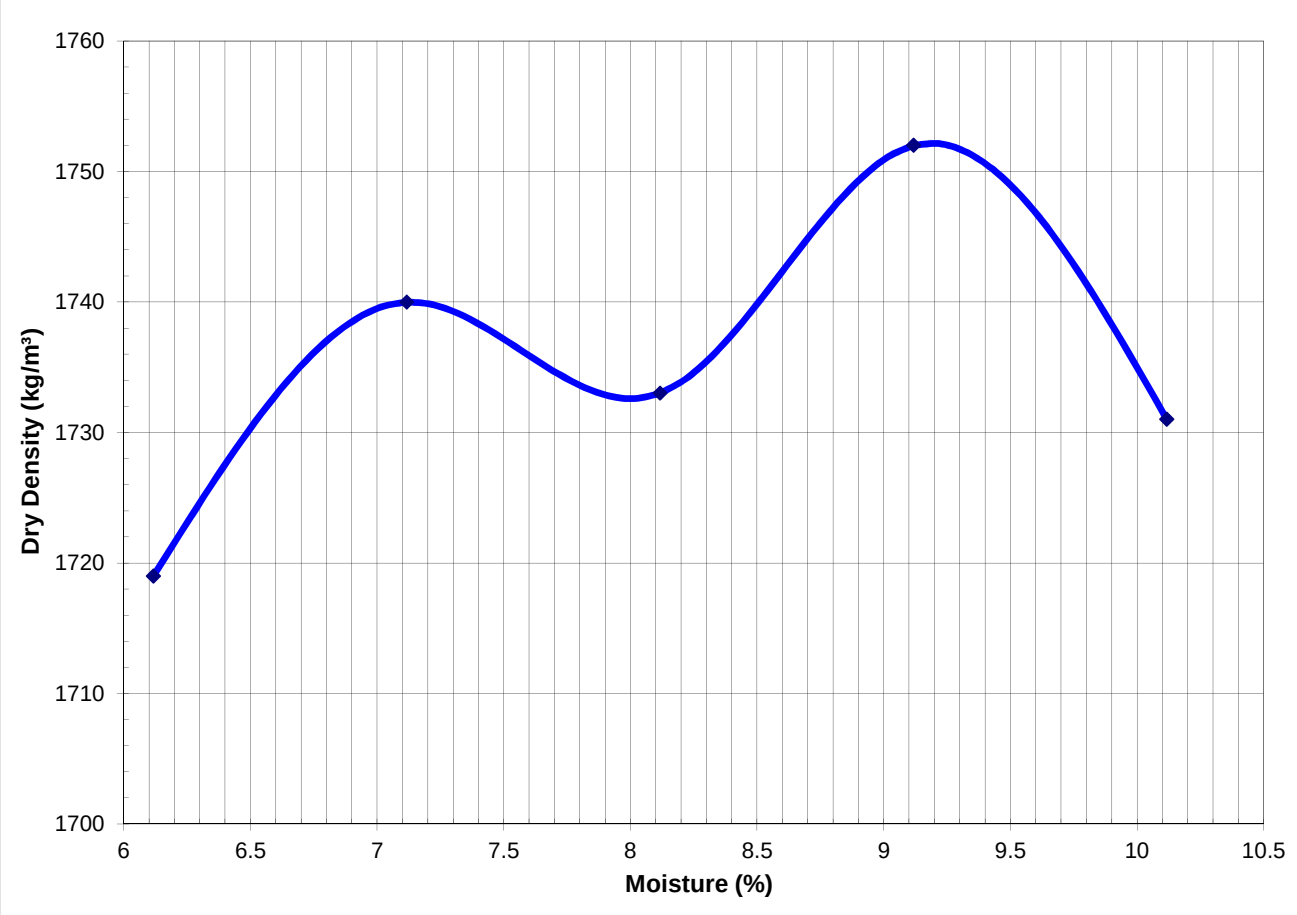
Field No. : IP2
Depth (m) : 0.75-0.96
Origin : Layer 3
Compaction Effort : Mod AASHTO

**Maximum Dry Density (kg/m³)** **1752**

**Optimum Moisture Content (%)** **9.2**

Plotted Values:

| | | | | | |
|---|---|---|---|---|---|
| Moisture (%) | 6.1 | 7.1 | 8.1 | 9.1 | 10.1 |
| Dry Density (kg/m³) | 1719 | 1740 | 1733 | 1752 | 1731 |

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**Date Reported** : **23.11.2020**

# SANS 3001 Moisture/Density Relationship

Sample No. : T29322
Method of preparation : Scalped
Natural/Stabilised : Natural
Material Description : Lt.Gr.Br.Spec.Dk.Gr.Sl.clayey silty SAND. Fill

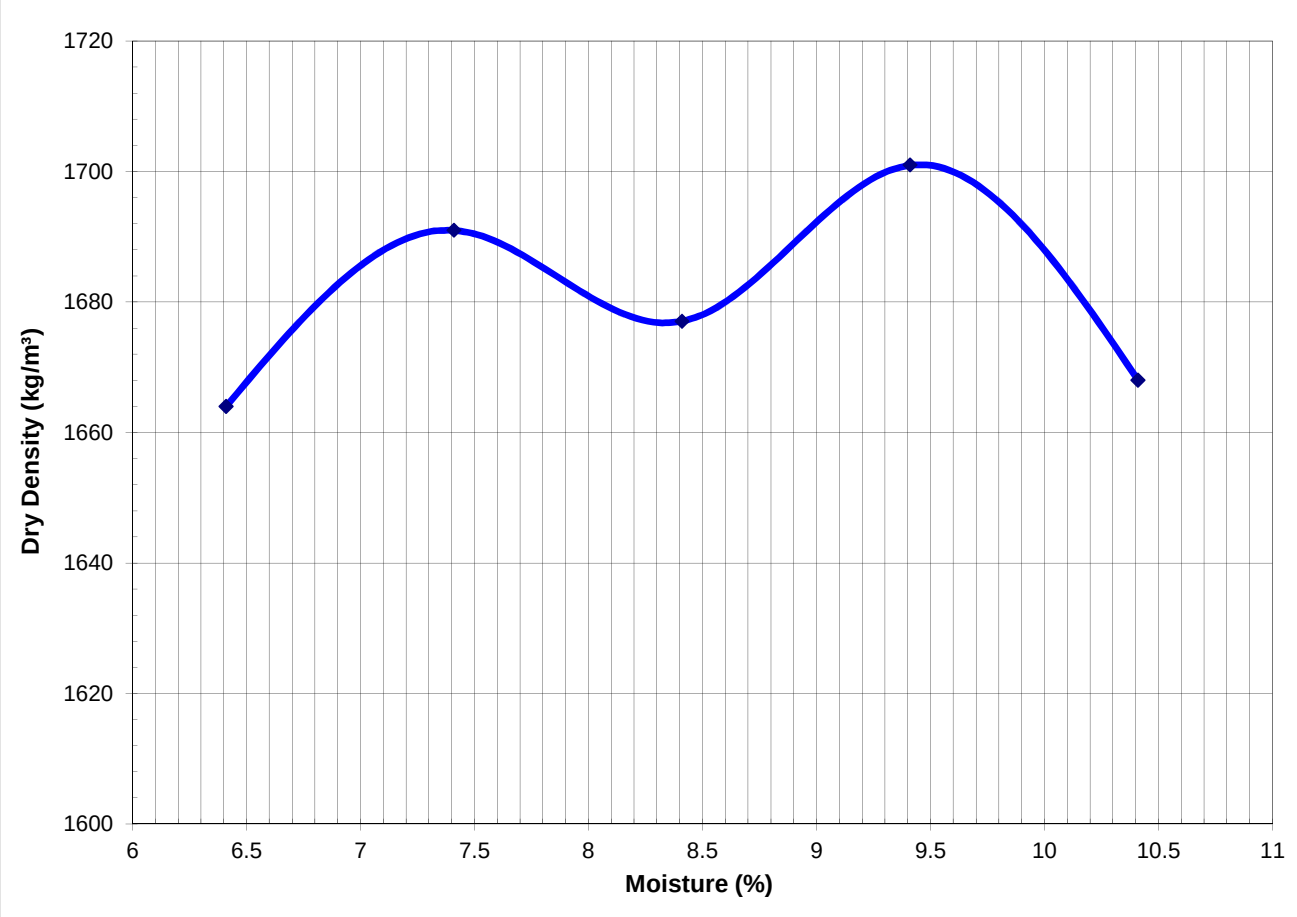
Field No. : IP3
Depth (m) : 0.67-1.03
Origin : Layer 2
Compaction Effort : Mod AASHTO

**Maximum Dry Density (kg/m³)** **1701**

**Optimum Moisture Content (%)** **9.4**

Plotted Values:

| | | | | | |
|---|---|---|---|---|---|
| Moisture (%) | 6.4 | 7.4 | 8.4 | 9.4 | 10.4 |
| Dry Density (kg/m³) | 1664 | 1691 | 1677 | 1701 | 1668 |

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**Date Reported** : **23.11.2020**

# SANS 3001 Moisture/Density Relationship

Sample No. : T29324
Method of preparation : N/A
Natural/Stabilised : Natural
Material Description : Lt.Br.Spec.Lt.Yell.Sl.silty SAND. Beach Dep.

Field No. : IP4
Depth (m) : 1.12-2.3
Origin : Layer 4
Compaction Effort : Mod AASHTO

**Maximum Dry Density (kg/m³)** **1681**

**Optimum Moisture Content (%)** **7.3**

Plotted Values:

| | | | | | |
|---|---|---|---|---|---|
| Moisture (%) | 4.1 | 5.1 | 6.1 | 7.1 | 8.1 |
| Dry Density (kg/m³) | 1644 | 1669 | 1661 | 1680 | 1671 |

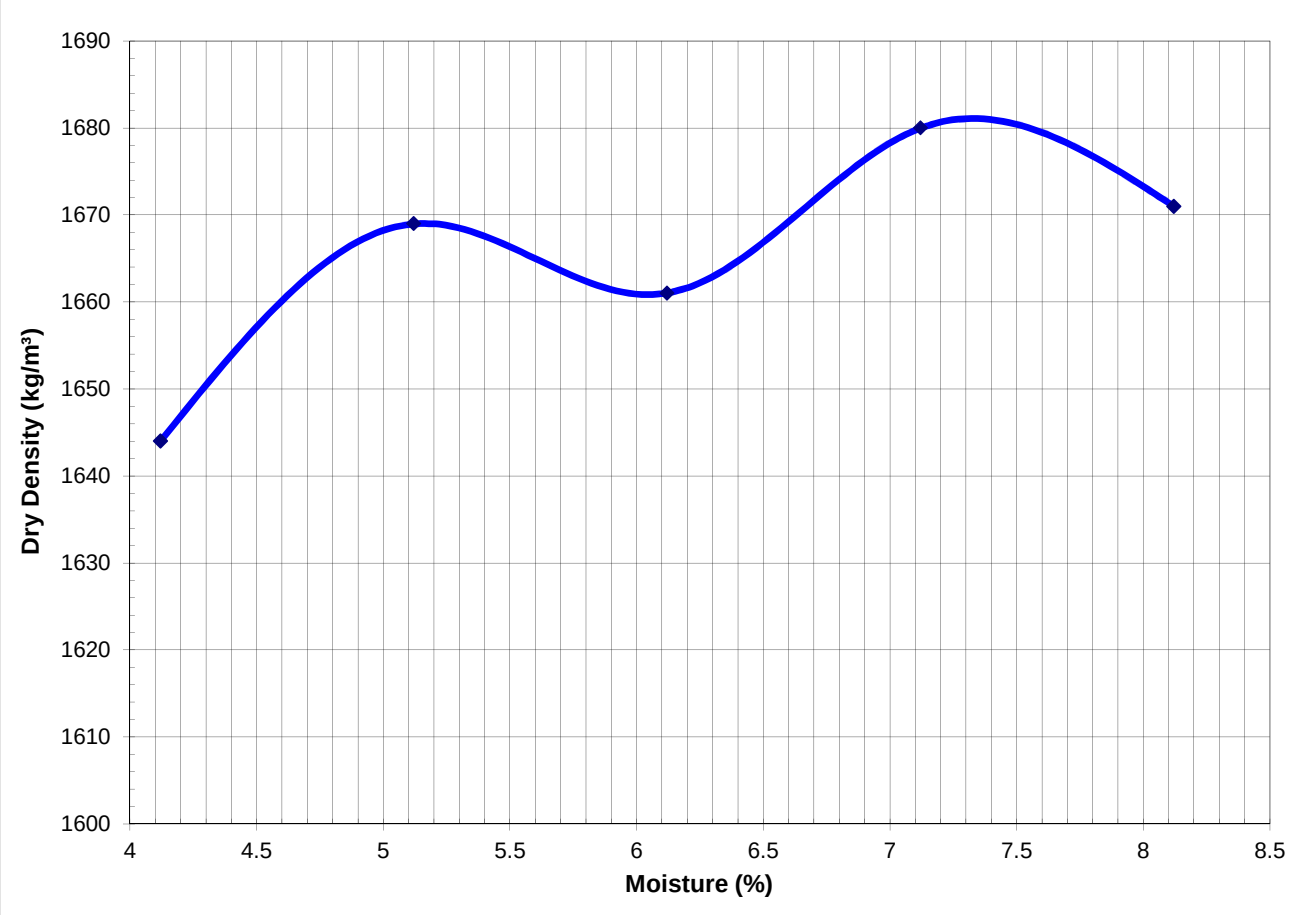


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**FIGURE 220-20.R01-001:**

# SITE PLAN

## KEY:

Approximate boundary of site.

**BH1** — Approximate position of Borehole.

**IP1** (>1.54) >1.54 — Approximate position of Inspection Pit showing depth to rock () and depth to refusal in metres below existing ground level.

**DPL1** 13.5 — Approximate position of Dynamic Penetrometer Light (DPL) Test showing depth to refusal in metres below existing ground level.

**WT:1.1** — Denotes depth to ground water seepage in metres below existing ground level.

Site plan for Inception Report showing approximate positions of:

Boreholes;
Inspection Pits; and
Dynamic Penetrometer Light (DPL) Tests.

SCALE 1:1000 — 0 10 20 Metres

MPAMOT (Pty) Ltd

Proposed Maritime Focus School of Excellence
Geotechnical Investigation

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| | |
|---|---|
| DATE: | 07-12-2020 |
| DRAWN BY: | V.G |
| CHECKED BY: | F.S |
| REFERENCE NO. | 220-20 |
| DRAWING NO. | 220-20.R01-001 |
| REV. NO. | 1 |