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COJ BIOMETHANE PLANT
GEOTECHNICAL REPORT

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REVISION 2

Prepared for:

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SYNOPSIS

Report presenting the results of a geotechnical investigation undertaken for the new biomethane plant to be constructed at Robinson Deep Landfill site, Johannesburg, Gauteng Province

KEY WORDS:

Energidrop, biomethane plant, Robinson Deep Landfill, Johannesburg, Gauteng Province

QUALITY VERIFICATION

This report has been prepared under the controls established by a quality management system that meets the requirements of ISO9001: 2015 which has been independently certified by DEKRA Certification

Verification	Capacity	Name	Signature	Date
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COJ BIOMETHANE PLANT
GEOTECHNICAL REPORT

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1 INTRODUCTION

This report presents the results of a geotechnical site investigation undertaken for a proposed new biomethane plant, located within Pikitup's Robinson Deep Landfill Site, in southern Johannesburg, in the Gauteng Province.

JG Afrika were appointed to undertake a geotechnical investigation for a proposed biomethane plant, to be located in an area that is currently used for the sorting of recycling material. The proposed biomethane plant will incorporate the existing structures on site and the investigation includes an assessment of the existing concrete slabs within the workshop structures. The area around the existing structures were also investigated for the installation of large tanks, construction of roads, installation of a weigh bridge and the construction of a new office block.

The objectives of the investigation are to assess the suitability of the site from a geotechnical perspective, assess the founding conditions for structures, provide an overview of the subgrade conditions for the proposed new roads, identify the presence of problematic ground conditions and assess the excavation conditions for earthworks.

The field investigation was carried out on the 19th and 20th of March 2019 and entailed the following:

- The excavation of ten (10) test pits, designated TP1 to TP10. The test pits were excavated between or around the existing structures.
- The retrieval of selected and undisturbed disturbed soil samples for laboratory testing.
- The recovery of two (2) 100 mm diameter concrete cores through the existing concrete slabs within the workshop.
- Driving of seven (7) Dynamic Cone Penetration (DCP) tests adjacent to the test pit locations. Two of the DCP tests were driven through cored holes into the in-situ material below the existing concrete slabs.

This report is based therefore on extrapolation of point information, obtained from the test pits and DCP tests, using professional judgement. It is recommended that the excavations are inspected during construction, by a competent person, prior to casting any concrete or placing any backfill material, in order to verify the assumptions made in this report. Should conditions at variance from those described in this report be encountered, then the services of a geotechnical professional must be sought.

2 APPOINTMENT

The geotechnical investigation was undertaken as per the appointment by Energidrop, based on JG Afrika's proposal submitted on 19 September 2018. Order number PO0000002 was issued to JG Afrika by Energidrop on the 12th of March 2019.

2.1 Available Information

A Site Layout Plan, titled ED-0020100-A-M-001-01 Rev 0Bb was provided by Energidrop to illustrate the extent of the geotechnical investigation. This footprint plan was used to strategically position the test pits in order to get representative information about the site's subsurface characteristics. The 1:250 000 scale Geological Series Map 2628 East Rand was consulted prior to the investigation to determine the anticipated geology underlying the site. Google Earth imagery was consulted for planning purposes.

3 SITE LOCATION

The site can be accessed via the main entrance of the Robinson Deep Landfill Site. A Locality Map, Test Pit Location Plan and a Preliminary Site Layout Plan can be seen in Figure 1, through to Figure 3.

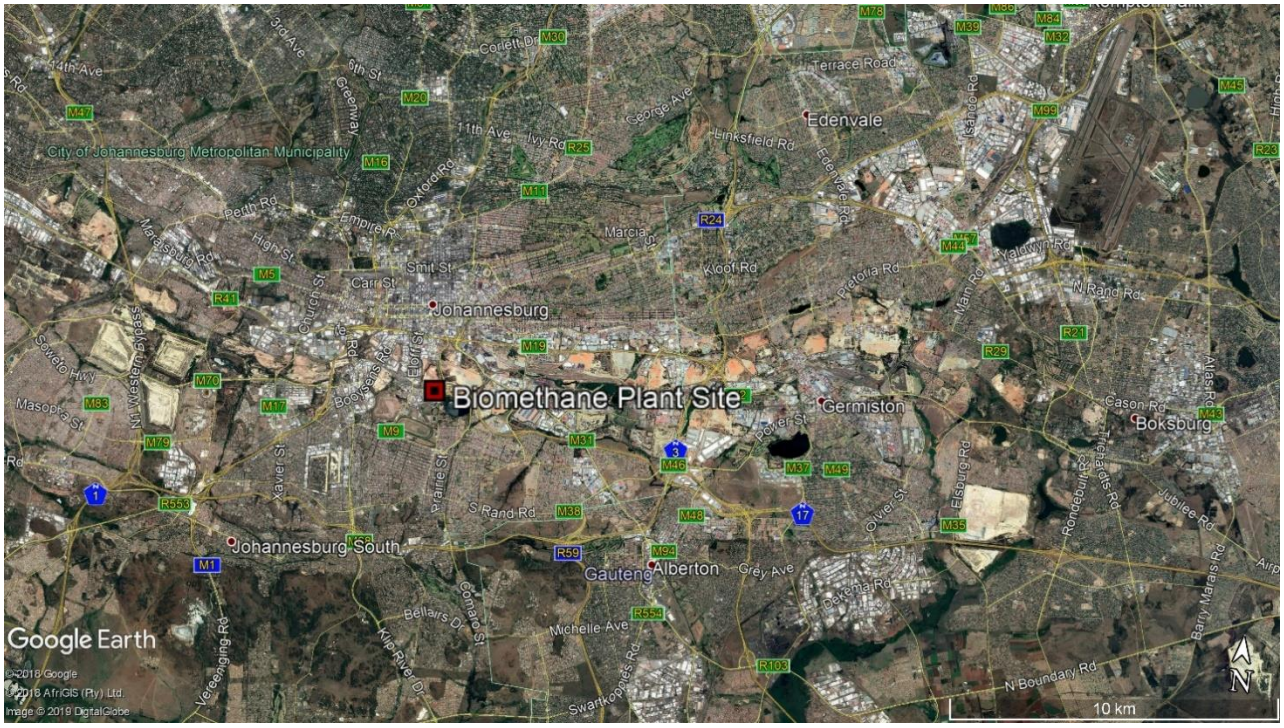


Figure 1: Locality Map

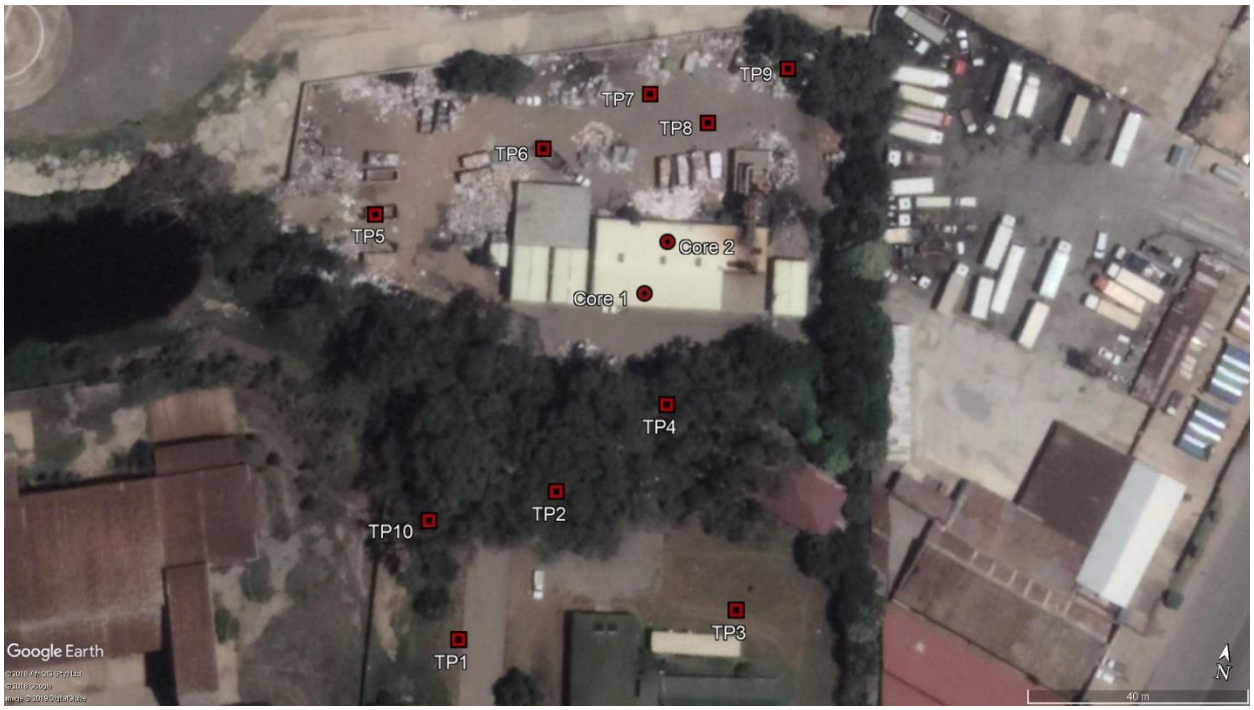


Figure 2: Test Pit Location Plan

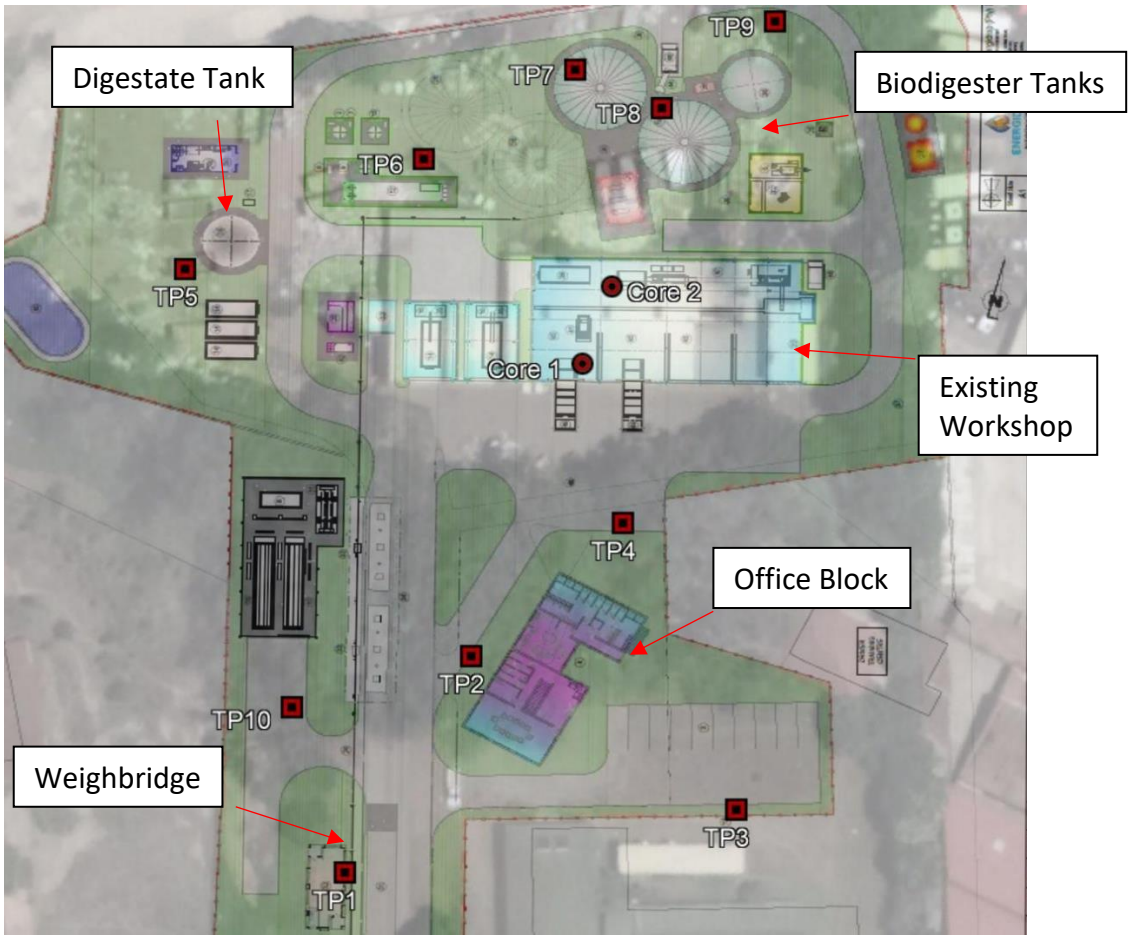


Figure 3: Preliminary Site Layout Plan

3.1 Topography and Drainage

The general topography of the area slopes gently towards the north west. While not immediately obvious from surface observations, the presence of thick layers of fill materials encountered in the test pits indicates that the topography of the site has been significantly affected by large scale earthworks. Fill and landscaping material has been placed to create a flat area on which the current structures stand.

Existing storm water drainage infrastructure was identified at the site, however, due to paving failure, standing water pools were noted on site.

3.2 Vegetation, Land Use and Existing Infrastructure

The natural vegetation of the area has been removed and the area is mostly covered with block paving. Large gum trees currently occupy the area in front of the existing workshop.

The site where the proposed biomethane plant will be constructed has been used for various activities. Historically, it was the site of an old brickworks before being converted to a heavy vehicle maintenance workshop. The existing paved surfacing and structures were constructed for the operation of the workshop and in later years the workshop was converted to house a medical waste incinerator. Currently, the site is used for the separation of recyclable materials by numerous vendors.

It is recommended that a manual service identification exercise is undertaken at the start of construction to confirm the presence of services beneath the site.

3.3 Access

The site is accessible through the main entrance of the Robinson Deep Landfill Site. The site is currently accessible to heavy and light vehicle via paved roads and loading areas. Access during construction, should the paving be removed, may be problematic due to poor quality soils and shallow groundwater conditions.

4 GEOLOGY

According to the 1:250 000 scale Geological Series Map 2628 East Rand, the site is underlain by the sedimentary rocks from the Vryheid Formation with the Dwyka Formation located in close proximity to the site. The Vryheid Formation is encompassed in the Ecca Group of the Karoo Supergroup and lithologies in the form of sandstone, shale and coal may be encountered. The Dwyka Formation is encompassed in the Karoo Supergroup and lithology in the form of diamictite and shale may be encountered

The geology of the site is depicted in Figure 4.

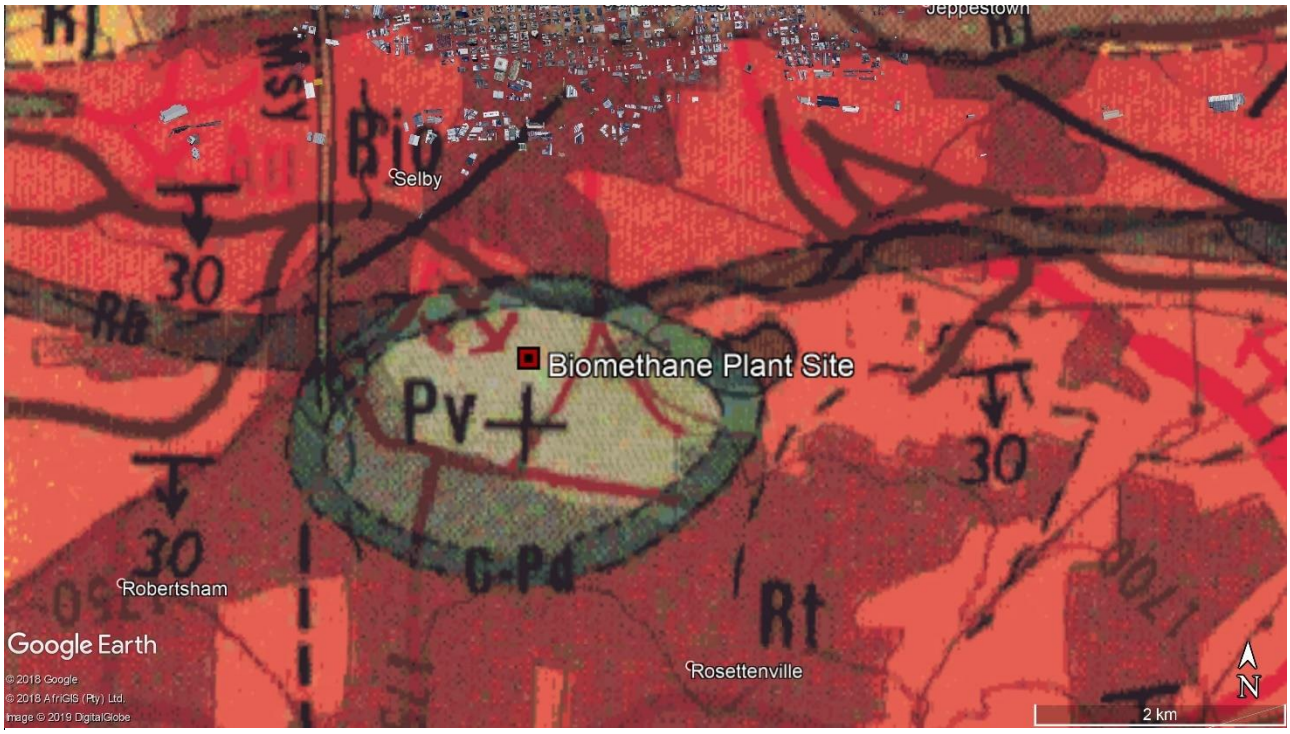


Figure 4: Geology Map

Extracted from the 1: 250 000 scale geology map titled: "2628 East Rand"
Council for Geoscience

Table 1: Geological Map Legend

Symbol	Stratigraphy	Lithology
Pv	Vryheid Formation, Ecca Group, Karoo Supergroup	Sandstone, shale, coal
C-Pd	Dwyka Formation, Karoo Supergroup	Diamictite, shale

5 CLIMATE

The climatic regime plays a fundamental role in the development of a soil profile. Weinert (1964) demonstrated that mechanical disintegration is the predominant mode of rock weathering in areas where his climatic "N-value" is greater than 5, while chemical decomposition predominates where the N-value is less than 5. Weinert's climatic N-value for the Johannesburg area is approximately 2.3. This implies that chemical decomposition is the dominant mode of weathering at the site.

6 FIELDWORK

The fieldwork was undertaken on the 19th and 20th of March 2019, towards the end of the wetter summer season.

6.1 Test Pits

Ten test pits, designated TP1 to TP10, were excavated by Tractor Loaded Backhoe (TLB) to depths of up to 3.10 m, below existing ground level (egl). The locations of the test pits are depicted in Figures 2 and 3, Test Pit Location Plan and Test pits with site plan overlay. The test pits were photographed and profiled immediately after excavation. The test pit logs can be found in Annexure A.

The test pits were loosely backfilled, once all necessary information and samples were retrieved.

6.2 Diamond Drill Coring

Two diamond drilled cores were extracted from the existing concrete slab within the workshop area. The two cores extracted were designated Core 1 and Core 2. Core 1 was extracted inside the workshop in front of the third retracting steel door, from the site entrance. Core 2 was extract from the slab within the middle office area. The drilling was undertaken by a specialist laboratory and the concrete cores were submitted for Uniaxial Compressive Strength (UCS) testing.

6.3 DCP Tests

Five Dynamic Cone Penetration (DCP) tests were performed adjacent to selected test pits, were suitable soil conditions were encountered. Two additional DCP tests were undertaken through the diamond cored holes to assess the ground conditions below the existing workshop concrete slab. The DCP tests undertaken adjacent to the test pits were typically undertaken from below existing ground level, due to the presence of paved surfacing and cemented fill soil horizons and refused at depths of between 2.40 and 3.15 m below existing ground level (egl). The DCP tests undertaken through the diamond cored holes refused at depths of between 3.10 and 3.40 m below the exiting concrete slab level.

The assessment of the Estimated Allowable Safe Bearing Pressures (EASBP's) is based on shear strengths, obtained using empirical methods, from the DCP test results and assuming a cohesive soils profile. The DCP tests were undertaken in separate areas and as such will be discussed per area in Section 9.

The interpretation of the DCP test results must take into account the moisture content of the soil, as a wet soil horizon will provide lower consistencies than a similar test undertaken under drier conditions, as percolating water softens the subsoils. Moisture content should thus always be noted and made mention of in any DCP investigation. The soil profile, to approximately 3.00 m depth, was described as "moist" to "wet", therefore significant loss of strength is not anticipated with increasing moisture content.

It should also be noted that the presence cobbles or gravels present in fill or residual soil horizons, if encountered by DCP apparatus, may produce abnormally high blow counts and result in inflated EASBP values.

Based on the above, it is recommended that the DCP test results are interpreted with caution and a conservative approach must be taken when utilising the DCP results for design purposes.

7 ASSESSMENT OF THE SITE

7.1 Ground Conditions

The ground conditions at the site are described from the observations made in the test pits. It must be noted that the investigation was undertaken during the summer season, which is characterised by significant rainfall.

7.1.1 Fill

Fill layers were encountered at all the test pit positions. The nature and composition of the fill varied greatly.

Deep fill layers were encountered at TP1, TP5 and TP10. These test pit positions are located along the western boundary of the site and the fill extended to depths of greater than 2.00 m to 3.00 m below egl (the lower extent of the fill material was not determined and extended to beyond the base of the test pits). Vast quantities of rubble, bricks and wire were noted within the loose fill layer at TP1 and TP10. The loose nature of the fill material at TP1, TP5 and TP10 combined with very strong groundwater ingress at these test positions, resulted in the severe sidewall collapse and required early termination of the test pits.

The fill material encountered at the remaining test pits was broadly similar and comprised of red brown to dark brown silty sand with abundant cobbles and varying boulder composition. Asphalt layers were noted between fill layers at TP2 and brick layers were noted within the fill layers at TP4.

The fill layers were encountered to depths of between 0.60 m and 1.00 m at TP2, TP3 and TP4 test pit positions. Deeper fill layers were noted at TP6, TP7, TP8 and TP9, to depths of between 1.10 m and 1.50 m, below egl.

The fill layer encountered at TP6, TP7, TP8 and TP9 is assumed to be poorly constructed layer works below the existing paved areas.

7.1.2 Hillwash

Hillwash soil horizons were encountered at all the test pit positions with the exception of TP1, TP5 and TP10 (where the test pits were terminated in fill).

The hillwash soil horizons at TP2, TP3 and TP4 were encountered at depths of between 0.60 m and 1.00 m, below egl, and terminated at depths of between 1.40 and 2.00 m, below egl. The hillwash soil horizons at these test pit positions were described as moist becoming wet with depth, orange mottled orange with depth, loose, voided and comprised of silty sandy clay.

The hillwash soil horizons at TP6, TP7, TP8 and TP9 were encountered from depths of between 1.10 and 1.50 m, below egl, and terminated at depths of between 1.50 m and 2.00 m, below egl. The hillwash at these test pit positions was quite variable in colour, ranging from dark brown beige to green grey becoming grey with depth, soft, voided in places and comprised of silty sandy clay.

7.2 Residual Sandstone

Residual sandstone was encountered at all the test pit positions with the exception of TP1, TP5 and TP10 (where the test pits were terminated in fill). The residual sandstone was encountered from

depths of between 1.40 m and 2.00 m, below egl, and persisted to depths in excess of 3.00 m, below egl. Two residual sandstone soil horizons were encountered at TP8.

The clayey residual sandstone soil horizons were encountered at TP2, TP3, TP4, TP6 and TP7. This residual sandstone soil horizon was encountered from depths of between 1.40 m and 2.00 m, below egl, and persisted to depths in excess of 3.00 m, below egl. This residual sandstone soil horizon was described as slightly moist, becoming wet in places, beige brown mottled orange, soft to firm, intact with slickensides and relict rock structure in places and comprised of sandy silty clay. Two residual sandstone horizons were identified at TP8 from depths of 1.50m and 2.60 m respectively. The residual sandstone persisted to depths beyond 3.00 m, below egl. The first residual sandstone horizon was described as moist, orange mottled beige, medium dense, intact with relict rock structure and comprised of gravelly silty sand. The second residual sandstone soil horizon was described as moist, beige mottled orange and grey, dense, intact with relict rock structure and comprised of gravelly silty sand with abundant cobbles of highly weathered sandstone. The residual sandstone horizon encountered at TP9 was described as moist, orange brown mottled orange and beige, medium dense, intact and comprised of silty sandy gravel.

7.3 Sandstone Bedrock

Sandstone bedrock was only encountered at TP4 from a depth of 2.90 m, below egl, and persisted to a depth in excess of 3.10 m, below egl. This bedrock horizon was described as beige brown stained orange on joints, completely weathered, fine grained, closely jointed and comprised of very soft rock sandstone.

7.4 Groundwater

Groundwater seepage was observed in TP1, TP5, TP6, TP7 and TP10. Very strong groundwater seepage was noted at TP1, TP5 and TP10 from depths between 1.50 m and 2.20 m, below egl. Slow ground water seepage was noted at TP6 and TP7 from a depth of 2.90 m, below egl. The stronger groundwater seepage along the western part of the site may be enhanced by the presence of high permeability and very loose soil horizons (predominantly fill material).

It is recommended that subsoil drainage is constructed along the western boundary of the site to lower the water table and prevent ingress of groundwater into the layer works and founding materials in this area.

7.5 Expansive, Collapsible and Dispersive Soils

Geotechnical constraints associated with collapsible soils may be expected in the areas underlain by fill layers and hillwash soil horizons. The fill may be poorly compacted while the hillwash soils were described as “voided” from visual inspection and is indicative of soils which may be susceptible to collapse settlement. The laboratory collapse potential testing indicated that a classification of “moderate trouble” may be expected at the site.

The hillwash and residual sandstone soil horizons were comprised predominantly of clay sized particles however, were assessed to have a “low” potential for expansiveness.

8 LABORATORY TESTING

Selected representative disturbed and undisturbed soil samples were recovered in order to undertake the following laboratory tests:

- Grading Analyses (including Hydrometer analysis)
- Atterberg Limits
- California Bearing Ratio (CBR)
- Mod AASHTO moisture/density relationship
- Consolidation Testing
- Collapse potential testing

UCS testing was undertaken on concrete cores.

The laboratory test results are summarised in Tables 1 to 5 and the full results are attached in Annexure B.

Table 2: Summary of Foundation Indicator Test Results

POSITION	DEPTH (m)	DESCRIPTION	UNIFIED SOIL CLASSIFICATION SYSTEM	COMPOSITION				ATTERBERG LIMITS		POTENTIAL EXPANSIVENESS (van der Merwe Method)
				GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)	PLASTICITY INDEX	LINEAR SHRINKAGE	
TP2	1.00 – 2.00	Silty sandy CLAY Hillwash	CL	60	40	20	34	16	7.5	Low
	2.00 – 3.00	Sandy silty CLAY Residual Sandstone	CL	10	24	30	36	19	8.5	Low
TP3	0.60 – 2.00	Silty sandy CLAY Hillwash	CL	0	49	20	31	13	6.0	Low
TP6	2.00 – 2.90	Sandy silty CLAY Residual Sandstone	CL	14	22	27	37	20	9.0	Low
TP7	0.00 – 1.20	Silty gravelly SAND Fill	SC	24	44	23	9	11	5.0	Low
	1.50 – 3.00	Silty sandy CLAY Residual Sandstone	CL	14	31	29	26	13	6.0	Low
TP8	1.50 – 2.60	Clayey silty SAND Residual Sandstone	SC	14	48	25	13	18	7.5	Medium
TP9	1.50 – 2.90	Silty sandy GRAVEL	SC	48	32	13	7	13	5.5	Low

Table 3: Summary of CBR Test Results

POSITION	DEPTH (m)	DESCRIPTION	MAXIMUM DRY DENSITY	OPTIMUM MOISTURE CONTENT	CBR				COLTO CLASSIFICATION
					90 (%)	93 (%)	95 (%)	97 (%)	
TP2	1.00 – 2.00	Silty sandy CLAY Hillwash	1905	12.7	3	5	7	9	None
	2.00 – 3.00	Sandy silty CLAY Residual Sandstone	1841	15	1	1	2	2	None
TP6	2.00 – 2.90	Sandy silty CLAY Residual Sandstone	1838	14	2	2	2	2	None
TP7	0.00 – 1.20	Silty gravelly SAND. Fill	2170	8.7	8	8	9	10	G9
TP8	1.50 – 2.60	Clayey silty SAND Residual Sandstone	1895	13.3	6	8	10	12	None
TP9	1.50 – 2.90	Silty sandy GRAVEL Residual Sandstone	2121	8.2	4	5	6	7	None

Table 4: Summary of Collapse Potential Test

TRIAL PIT	DEPTH (m)	SOIL TYPE	SAMPLE TYPE	COLLAPSE POTENTIAL (%)
TP3	1.20 – 1.50	Silty sandy CLAY. Hillwash	Undisturbed sample soaked at 200 kPa	4.06

Table 5: Summary of Collapse Potential Classifications

CP	SEVERITY OF PROBLEM
0% - 1%	No problem
1% - 5%	Moderate trouble
5% - 10%	Trouble
10% - 20%	Severe trouble
>20%	Very severe trouble

Reference: Jennings J.E. and Knight K., (1975), A guide to construction on or with materials exhibiting additional settlement due to collapse of grain structure, Proceedings of the 6th Regional Conference for Africa on Soil Mechanics and Foundation Engineering.

Table 6: Summary of UCS testing undertaken

CORE SPECIMEN	DIAMETER (mm)	DENSITY (kg/m³)	FAILURE LOAD (KN)	COMPRESSIVE STRENGTH (MPa)	TOTAL CORE DRILLED (mm)
Core 1	100	2562	237	30.0	205
Core 2	100	2446	218	27.5	216

The potential for heave related movement of the soil samples was assessed according to the Van der Merwe method of predicting potential heave (Williams and Donaldson 1980). This estimates the expansiveness from the equivalent Plasticity Index of the whole sample and the clay content of the whole sample. The laboratory test results indicate that the hillwash and residual sandstone soil horizons have a "low" potential for expansiveness however, the residual sandstone encountered at TP8 was assessed to have a "medium" potential for expansiveness. Linear shrinkage values of greater than 7 are indicative of potentially expansive soils.

The hillwash and residual sandstone soils were found to have measured linear shrinkage values of between 7.5 and 9 %. This is indicative of soils susceptible to moisture induced volume changes. Minor heave and shrinkage movements may therefore occur within both soil types.

The hillwash and residual sandstone soils do not meet the requirements for G9 material in accordance with the COLTO materials classification system. Very low soaked CBR values of between 2% and 10 % were obtained 95 % Mod AASHTO density for the residual sandstone soil horizons. The fill material sampled at TP7 meets the requirements for G9 quality material, as per the COLTO materials classification system.

The collapse potential test indicates that the hillwash soil horizon encountered at TP3 classifies as "moderate trouble" as per the classification provided by Jennings and Knight (1975).

The UCS testing undertaken on the extracted cores yielded values of 30 MPa and 27.5 MPa for Core 1 and Core 2 respectively.

9 RECOMMENDATIONS

It is understood that the project involves the construction of a new biomethane plant in an area that was previously used as heavy vehicle workshop. The new biomethane plant requires new infrastructure in the form of an office block, biodigester tanks, a weighbridge and connecting roads and paved areas. The test pits were placed strategically on site to assess the founding conditions in the vicinity of the required infrastructure. Recommendations will be provided for each infrastructure type that will be required for the new biomethane plant.

9.1 Founding Conditions – Weighbridge

The weighbridge structure is expected to be highly sensitive to any potential differential settlement. Test pit TP1 was excavated immediately adjacent to the weighbridge footprint and TP10 was excavated slightly north of the footprint. Unconsolidated fill and rubble were noted to depths of between 2.50 m to beyond 3.00 m, below egl. Very strong groundwater ingress was also noted at both TP1 and TP10, resulting in the severe collapse of the test pits. The presence of thick fill and ground water ingress renders the founding conditions for the proposed weighbridge as *Poor*. It is understood that the weighbridge structure is very sensitive to settlement and is expected to cater

for heavy vehicles at the biomethane plant. The following founding options / solutions may be applicable.

9.1.1 Option 1 – Soil Raft

Based on the ground conditions it is recommended that the weighbridge be constructed on an engineered soil raft. It is recommended that all fill materials are removed to expose more competent residual soil horizons, which are expected to be encountered with depth. The following recommendations are provided for the engineered soil raft design:

Approximate depth:	Removal of fill until residual horizons are encountered. * .
Minimum dimensions:	1.00 m larger than footprint diameter
Material Specification:	G6 (According to TRH14 materials classification)
Minimum compaction:	95% of Modified AASHTO maximum dry density at Optimum Moisture Content

**To be re-evaluated should no residual horizons be encountered to depths in excess of 3.50 m, below egl.*

Strong groundwater ingress is anticipated during the excavations described above, particularly if construction takes place during or shortly after the wetter summer season. This must be considered and mitigated during the design and construction phases. Mitigation may comprise temporary dewatering during the construction period (via excavation of a sump and continuous pumping during construction). It is further recommended that a permanent subsoil drainage system is provided along the western section of the site. This will lower the groundwater levels in the area and prevent ingress into the layerworks and founding materials.

Due to the presence of groundwater, compaction of the in-situ soils and lower layers of the engineered soil raft may not be possible. It is therefore recommended that the design incorporates a pioneer layer of rockfill, encased in a geofabric separation layer. The pioneer layer should provide a stable platform for compaction of the overlying engineered fill and form a preferential drainage pathway for dewatering purposes.

9.1.2 Option 2 – Piled Foundation

A piled foundation solution may be considered. The depth to competent founding for end-bearing piles was however not determined during this investigation. Casing will be required if auger piles will be considered. Driven piles may refuse on boulders.

The presence of abundant rubble and concrete slabs may be problematic for the use of augered piles.

9.1.3 Option 3 – Relocation of Weighbridge Structure

The ground conditions improve substantially in an eastward direction from the current location proposed for the weighbridge structure. This is evident in the soil profile encountered at TP2 where clayey hillwash and clayey residual soil horizons were encountered to depths in excess of 3.00 m below egl. No groundwater seepage was encountered at TP2, however the presence of deep clayey soils with low bearing capacity and susceptibility to moisture induced strength loss will still require the construction of a soil raft.

The following recommendations are provided for the engineered soil raft design:

Approximate depth:	Removal of clayey horizons to 1.00 m below founding level .
Minimum dimensions:	1.00 m larger than footprint diameter
Material Specification:	G6 (According to TRH14 materials classification)
Minimum compaction:	95% of Modified AASHTO maximum dry density at Optimum Moisture Content

9.2 Founding Conditions – New Office Block

The new office structure is expected to be constructed in the area where TP2, TP3 and TP4 were excavated. The building will be a single-story conventional masonry structure constructed near the current ground level. The soil profile observed at these test pits was broadly similar and comprised of fill material underlain by a clayey hillwash soil horizon which was in turn underlain by a clayey residual sandstone horizon. Weathered sandstone bedrock was only encountered at TP4 from a depth of 2.90 m, below egl.

The office structure is expected to be founded within the clayey hillwash soil horizons. The clayey hillwash and residual sandstone horizons were classified as having a “low” potential expansiveness. However, measured linear shrinkages of between 6 % and 8.5 % indicate that these soil horizons may be susceptible to minor moisture induced volume changes. Laboratory testing also yielded low (7 %) to very low (2 %) CBR values at 95 % Mod AASHTO density.

The collapse potential test indicates that the hillwash soil horizon encountered at TP3 classifies as “moderate trouble” as per the classification provided by Jennings and Knight (1975).

DCP data indicates that the hillwash soil horizons have moderate to low EASBPs. Based on the results of DCP2 (near TP3) EASBP’s as low as 40 to 50 kPa were calculated at depths of between 0.75 to approximately 2.0 m. DCP2 was advanced away from the large gum trees and is interpreted to reflect the material properties without desiccation by the tree root systems. Based on the results of DCP2, assuming a 750 mm wide strip footing imposing 50 kPa bearing pressure, total settlement in the order of 25 mm were calculated beneath the footings.

In terms of the NHBRC Standards and Guidelines for single storey residential housing, the Site Class Designation of site of the proposed office block is interpreted as “S2” i.e. Fine grained soils (clayey silts and clayey sands of low plasticity) sands, sandy and gravelly soils with an expected range of total soil movements >15 mm. Foundation types and construction mitigation measures suitable for “S2” site classes may be considered for the new office block.

The NHBRC Standards and Guidelines mentioned above recommend that the following foundation types are considered for sites classified as “S2”:

- Stiffened strip footings
- Stiffened of cellular raft foundations
- Deep strip footings
- Piled or pier foundations
- Soil raft foundations
- Compaction of in-situ soils below individual footings

Taking into account the soil profile at this location it is recommended that stiffened strip footings or a stiffened raft foundation be used for the new office block. The stiffened strip footings or stiffened raft foundation will not require that the existing fill material or hillwash soil horizons be removed below the building footprint. The stiffened strip footings or stiffened raft foundations must include articulation joints or include solid lightly reinforced masonry. The NHBRC Standards and Guidelines also dictate that mesh reinforcement must be included in the floor slabs and that site drainage and plumbing precautions must be implemented with these founding solutions.

The site is currently occupied by large trees which will be removed for the construction of the new office block. The proper de-stumping and the removal of the major root systems must be undertaken. This will also require that any voids remaining be properly backfilled and compacted with suitable material, preventing voids from forming below the office block floor slabs.

9.3 Founding Conditions – Biodigester Tanks

The new biomethane plant will require two large biodigester tanks to be constructed in the area north of the existing workshop area. Test pits TP6, TP7, TP8 and TP9 were excavated in the area that would be occupied by the biodigester tanks.

The soil profiles observed at TP7, TP8 and TP9 were broadly similar and comprised of gravelly sand with cobbles and occasional boulders fill material underlain by clayey hillwash soils horizons that were in turn underlain by clayey residual sandstone soil horizons.

During the initial site visit Energidrop indicated that the biodigester tanks are expected to be founded at a depth of approximately 2.0 m, below egl, and foundation loads of 150 kPa are expected to be exerted. This information indicates that the biodigester tanks will be founded within the residual sandstone soil horizon.

The residual sandstone soil horizons were considered consistent across the site from a visual characterisation and the DCP test data.

The residual sandstone laboratory test results at TP7, TP8 and TP9 indicate that the soil horizon is of variable composition ranging between silty sandy clay (at TP7) to silty sandy gravel (at TP9) however, the gravelly nature of the soils at TP9 is attributed to minor cementation which occurred due to ferruginisation. The residual sandstone soils were assessed to have a “low” to “medium” potential for expansiveness, as per the van der Merwe Method. The residual sandstone soil horizons were assessed to have measured linear shrinkages of up to 9.0 % and thus are still considered susceptible to moderate moisture induced volume changes. CBR testing yielded soaked CBR values of between 2 % and 10 % at 95 % Mod AASHTO density and reflect a soil horizon very susceptible to decreasing strength under increasing soil moisture conditions.

DCP testing indicated inferred EASBPs values of between approximately 40 kPa and 300 kPa for the residual sandstone horizon. The inferred EASBPs at the expected founding depth of the biodigester tanks ranged between approximately 50 kPa and 120 kPa. The EASBPs were observed to increase substantially with depth (approaching 3 m below ground level) but some of this may be attributed to highly weathered cobbles being intercepted by the apparatus with depth. The DCP data should be interpreted with caution.

The “soft” residual sandstone soil horizons are not considered a suitable founding medium for the new biodigester. It is recommended that the residual sandstone soil horizons are removed and that the biodigester tanks are founded on an engineered soil raft, as detailed below.

Approximate depth:	1.00 m below founding level*
Minimum dimensions:	1.00 m larger than footprint diameter
Material Specification:	G6 (According to COLTO materials classification) Rockfill lower layer encased with separation geofabric
Minimum compaction:	G6 - 95% of Modified AASHTO maximum dry density at Optimum Moisture Content

* *The above recommendation would result in the engineered raft being constructed at approximately 3 m below e.g.l. Improved founding conditions are anticipated at this depth. The thickness of the raft will increase for shallower founding depths.*

Groundwater seepage was noted at TP6 and TP7 from a depth of 2.90 m, below existing ground level. This level is expected to be intersected during over excavation for the construction of the soil raft. Shoring and the construction of upslope cut-off drains should be implemented to ensure the stability of the deep excavations required. Construction of a basal rockfill layer, as described in Section 9.1.

9.4 Founding Conditions – Digestate Liquor Tank

Energidrop indicated that a new digestate liquor tank would be constructed in the area where TP5 was excavated. The new digestate tank would either be constructed above or below egl.

The soil profile observed at TP5 comprised of fill layers encountered to a depth of 2.00 m, below egl. The upper fill layer was described as dark brown red, loose, intact and comprised of silty sand with occasional cobbles. The lower fill layer comprised of clast supported sandy gravel. Very strong ground water seepage was encountered from a depth of 1.50 m, below egl, resulting in severe sidewall collapse and early termination of the test pit.

It is recommended that the digestate tank be founded above existing ground level. It is assumed that the area surrounding the digestate tank will be stripped and prepared for the construction of the access roads. It is recommended that the digestate tank is founded on a platform of G6 material above the expected layer works. These recommendations are provided with an assumption that the digestate tank is a light structure and that a total compacted layer thickness of at least 1.00 m is provided beneath the structure. Should there be any variance from these assumptions then the founding recommendations will need to be reassessed.

A below ground installation of the tank would require dewatering, to prevent the ingress of groundwater during construction. This option should be considered if founding the structure above ground level is not feasible.

9.5 Subgrade Conditions – Roads

The construction of the new biomethane plant will require new roads to be constructed across the site. The roads are expected to be constructed within the fill material or within the hillwash soil horizons.

The roads around the new office structure and weighbridge (TP2, TP3 and TP4) area are expected to be constructed within the hillwash soils, comprised of clayey material with very low soaked CBR values (<2 %) at 95 % mod AASHTO density. The hillwash soils are thus considered problematic subgrade material and will require that ground improvement measures are undertaken prior to the placement of any layer works. Over excavation of the hillwash soils should be undertaken and replacement with a pioneer layer to 0.50 m below subgrade layer is recommended.

The fill material encountered at TP6, TP7, TP8 and TP9 was broadly similar and comprised of gravelly sand with cobbles and small boulders. The fill material observed at TP7 was assessed to meet the requirements for G9 quality construction materials, as per the COLTO materials classification system. This classification is considered characteristic of the existing pavement layerworks surrounding the existing facilities. The fill material observed is considered a non-problematic subgrade material, provided that the material is compacted at optimum moisture content.

9.6 Ease of Excavation

According to the criteria published in SANS 1200D Earthworks, as specified for restricted excavation (shown in Table 6), soft excavation conditions are expected to minimum depths of 3.00 m below egl across the site.

Table 7: SANS 1200D excavation class descriptions – restricted excavation

Excavation Class	Description
Soft	*Excavation in material that can be efficiently removed by a back-acting excavator of flywheel power approximately 0.10 kW per millimetre of tined-bucket width, without the use of pneumatic tools such as paving breakers*
Intermediate	*Excavation in material that requires a back-acting excavator of flywheel power exceeding 0.10 kW per millimetre of tined-bucket width or the use of pneumatic tools before removal by equipment equivalent to that specified for soft excavation.*
Hard	*Hard rock excavation shall be excavation in material (excluding boulder excavation) that cannot be efficiently removed without blasting or wedging and splitting.*
Boulder (excavation class A)	*Excavation in material containing more than 40% by volume of boulders of size in the range of 0.03 - 20m³, in a matrix of soft or smaller boulders.*

9.7 Trench Stability

The contractor must appoint a competent excavation supervisor in terms of Section 14 of the Construction Regulations 2014 to inspect the excavations during construction.

Severe trench instability may be expected in the areas surrounding TP1, TP5 and TP10 due to the strong ingress of groundwater at these test pit positions. Shoring in conjunction with dewatering should be implemented at any excavations undertaken along the western site boundary or in any other areas with groundwater ingress.

9.8 Subsoil Drainage

Groundwater seepage was encountered in the following test pits:

Table 8 Test Pit location and Rate of seepage

Test Pit	Depth (m)	Rate of Seepage
TP1	2.20	Very strong
TP5	1.50	Very strong
TP6	2.90	Slow
TP7	2.90	Slow
TP10	2.00	Very strong

It is recommended that a permanent subsoil drainage system is provided along the western section of the site. This will lower the groundwater levels in the area and prevent ingress into the layerworks and founding materials. The minimum invert level of the drains should be below the base of the road pavement layerworks. Deeper drains would be beneficial, if feasible.

10 CONCLUSIONS

The geotechnical investigation undertaken indicates that the site investigated for the construction of the new biomethane plant is suitable, from a geotechnical perspective, provided that the recommendations given in this report are implemented in order to overcome geotechnical constraints identified.

- According to the 1:250 000 scale Geological Series Map 2628 East Rand, the site is underlain by the sedimentary rocks from the Vryheid Formation, with the Dwyka Formation located in close proximity to the site.
- Fill layers were encountered at all ten test pit positions across the site. The fill material varies in composition and thickness.
- Hillwash soil horizons were encountered at all the test pit positions with the exception of TP1, TP5 and TP10 (where the test pits were terminated in fill).
- Residual sandstone was encountered at all the test pit positions with the exception of TP1, TP5 and TP10 (where the test pits were terminated in fill).
- Sandstone bedrock was encountered in TP4 only, from a depth of 2.90 m, below egl.

- Laboratory testing indicates that the hillwash soils and residual sandstone soils have a high clay content and were assessed to have a “low” potential for expansiveness.
- The hillwash and residual sandstone soils were assessed to have measured linear shrinkage values of between 7.5 and 9 %. This is indicative of soils susceptible to moisture induced volume changes. Minor heave and shrinkage movements may therefore occur within both soil types.
- The results of the laboratory collapse potential test indicate that a classification of “moderate trouble”, as per Jennings and Knight (2015), may be expected for the hillwash soils across the site.
- Very strong ground water seepage was noted at TP1, TP5 and TP10 test pit positions. It is strongly recommended that sumps are constructed during construction for dewatering, and that subsoils drains are constructed to prevent groundwater ingress during the operational phase of the plant.
- The poor ground conditions encountered at the proposed location of the weighbridge structure will require substantial ground works for mitigation.
    - The first founding option would require the fill material be removed till until residual materials are encountered, and a soil raft is constructed with a pioneer layer of rockfill. This option assumes that the fill material does not persist to depths in excess of 3.50 m, below egl.
    - The second option would involve the use of a piled foundation for the weighbridge structure. The piling solution must take into account the presence of rubble and concrete slabs within the fill materials.
    - The third option would involve the relocation of the weighbridge to an area closer to TP2. Deep clayey horizons were encountered at TP2 and would require the weighbridge structure to be founded on an engineered soil raft as well, however, the improved ground conditions will require a shallower excavation than the first option.
- It is recommended that stiffened strip footings or a stiffened raft foundation be used for the new office block. The stiffed strip footings or stiffened raft foundation will not require that the existing fill material or hillwash soil horizons be removed below the building footprint. The full recommendations are included in Section 9.2 of this report.
- It is recommended that the new biodigester tanks are founded on an engineered soil raft as the residual sandstone soil horizons are expected to weaken significantly under increasing moisture conditions. The specifications and full recommendations are provided in Section 9.3 of this report.
- It is recommended that the new digestate liquor storage tank be constructed above existing ground level to limit the influence of the strong groundwater seepage. It is recommended that the digestate tank be founded on a platform above the expected road layer works, provided that no large loads are expected to be exerted by the digestate tank.
- Soft excavation conditions are expected across the site to depths of 3.00 m, below egl.

- Severe trench instability may be expected in the areas surrounding TP1, TP5 and TP10 due to the strong ingress of groundwater at these test pit positions. Shoring in conjunction with dewatering should be implemented at any excavations undertaken along the western site boundary, or in any other areas with groundwater ingress.
- It is recommended that a permanent subsoil drainage system is constructed along the western section of the site.

11 REFERENCES

1) Brink, A.B.A. (1985). *Engineering Geology of South Africa Volume 3*. Building Publications Pretoria.
2) Core Logging Committee of the South African Section of the Association of Engineering Geologists (1976). *A Guide to Core Logging for Rock Engineering.* Proceedings of the Symposium on Exploration for Rock Engineering, Johannesburg.
3) Jennings, J.E., Brink, A.B.A. and Williams, A.A.B. (1973). *Revised Guide to Soil Profiling for Civil Engineering Purposes in Southern Africa.* Transactions of the South African Institution of Civil Engineers, Vol. 15.
4) Johnson, M.R., Anhausser, C.R., Thomas, R.J. (1996). *The Geology of South Africa*. The Geological Society of South Africa and the Council for Geoscience.

Annexure A: TEST PIT LOGS

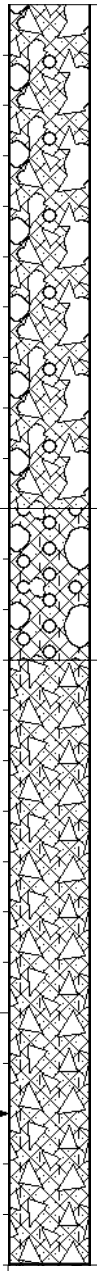
JG AFRIKA

ENERGiDROP
COJ BIOMETHANE PLANT

HOLE No: TP1
Sheet 1 of 1

JOB NUMBER: 5037

Scale 1:15



0.00 Slightly moist, dark brown, loose, cobbles and rubble in a gravelly sand matrix: Fill.

1.00 Slightly moist, light brown, medium dense, clast supported, silty sandy GRAVEL with abundant cobbles: Fill.

1.30 Moist becoming wet with depth, red brown mottled orange, very loose, silty sand with abundant rubble: Fill.

2.50

NOTES

1) Very strong groundwater seepage from 2.20m.
2) Major sidewall collapse above and below seepage.
3) Hole terminated due to collapse.
4) Abundant bricks and concrete slabs between 1.30m and 2.50m.
5) No sample.

CONTRACTOR :
MACHINE : JCB 3CX TLB
DRILLED BY :
PROFILED BY : K.NAIDOO

INCLINATION :
DIAM :
DATE :
DATE : 27/03/2019

ELEVATION :
X-COORD : E 28.04209
Y-COORD : S 26.23062

HOLE No: TP1

TYPE SET BY : K.NAIDOO
SETUP FILE : TP-JGA-A4.SET

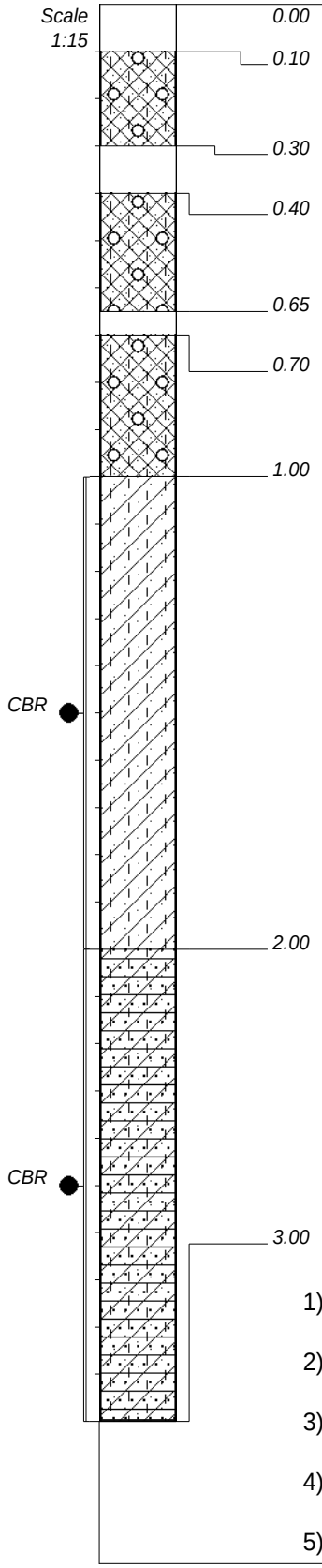
DATE : 31/05/2019 14:12
TEXT : ..JBIOMETHANEPLANTLOGS.TXT

JG AFRIKA

ENERGiDROP
COJ BIOMETHANE PLANT

HOLE No: TP2
Sheet 1 of 1

JOB NUMBER: 5037



0.00	Paved surfacing.
0.10	Slightly moist, red brown, medium dense, clast supported, gravelly silty SAND: Fill.
0.30	Black cemented ASPHALT
0.40	Slightly moist, dark brown, dense, intact, silty gravelly SAND: Fill.
0.65	Black cemented ASPHALT
0.70	Slightly moist, dark brown, loose, intact, gravelly silty SAND: Fill.
1.00	Moist, orange brown becoming mottled orange with depth, loose, voided, silty sandy CLAY: Hillwash.
2.00	Slightly moist, beige brown mottled orange, firm, intact with slickensides, sandy silty CLAY: Residual sandstone.
3.00	

NOTES

1) No groundwater seepage.
2) No sidewall collapse.
3) N0 refusal.
4) CBR sample taken 1.00--2.00m.
5) CBR sample taken 2.00--3.00m.

CONTRACTOR :
MACHINE : JCB 3CX TLB
DRILLED BY :
PROFILED BY : K.NAIDOO

TYPE SET BY : K.NAIDOO
SETUP FILE : TP-JGA-A4.SET

INCLINATION :
DIAM :
DATE :
DATE : 27/03/2019

DATE : 31/05/2019 14:12
TEXT : ..JBIOMETHANEPLANTLOGS.TXT

ELEVATION :
X-COORD : E 28.04221
Y-COORD : S 26.23035

HOLE No: TP2

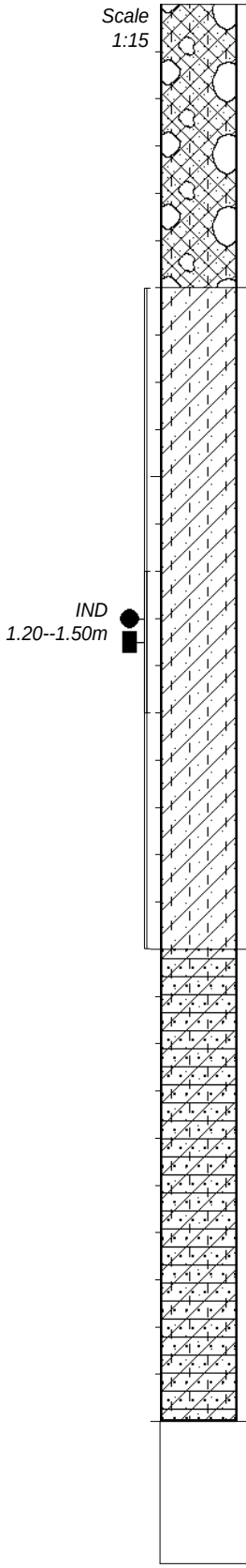
JG AFRIKA

ENERGiDROP
COJ BIOMETHANE PLANT

HOLE No: TP3
Sheet 1 of 1

JOB NUMBER: 5037

Scale 1:15



0.00 Moist, dark brown red, loose, intact, silty fine sand with occasional cobbles: Fill.

0.60 Moist becoming wet with depth, orange brown becoming mottled orange with depth, loose, voided, silty sandy CLAY: Hillwash.

2.00 Wet, orange mottled beige and red, soft, intact with relict rock structure, sandy silty CLAY: Residual Sandstone.

Possible transition to highly weathered sandstone at test pit base.

3.00

NOTES

1) No groundwater seepage.
2) No sidewall collapse.
3) Slow advance from 2.90m.
4) IND sample taken 0.60--2.00m.
5) Undisturbed block sample taken 1.20--1.50m.

CONTRACTOR :
MACHINE : JCB 3CX TLB
DRILLED BY :
PROFILED BY : K.NAIDOO

INCLINATION :
DIAM :
DATE :
DATE : 27/03/2019

ELEVATION :
X-COORD : E 28.04258
Y-COORD : S 26.23048

HOLE No: TP3

TYPE SET BY : K.NAIDOO
SETUP FILE : TP-JGA-A4.SET

DATE : 31/05/2019 14:12
TEXT : ..JBIOMETHANEPLANTLOGS.TXT

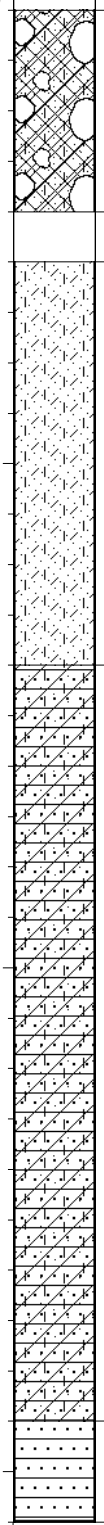
JG AFRIKA

ENERGiDROP
COJ BIOMETHANE PLANT

HOLE No: TP4
Sheet 1 of 1

JOB NUMBER: 5037

Scale 1:15



0.00	Paved surfacing.
0.10	Moist, red brown, soft, intact, silty clayey SAND to sandy CLAY with abundant cobbles: Fill.
0.50	Paved surfacing.
0.60	Moist, orange brown becoming mottled orange with depth, loose, voided, clayey silty SAND: Hillwash.
1.40	Moist, orange mottled beige and red, soft, intact with relict rock structure, sandy silty CLAY: Residual sandstone.
2.90	Beige brown stained orange on joints, completely weathered, fine grained, closely jointed, very soft rock, SANDSTONE: Vryheid Formation.
3.10	

NOTES

1) No groundwater seepage.
2) No sidewall collapse.
3) No refusal.

CONTRACTOR :
MACHINE : JCB 3CX TLB
DRILLED BY :
PROFILED BY : K.NAIDOO

INCLINATION :
DIAM :
DATE :
DATE : 27/03/2019

ELEVATION :
X-COORD : E 28.04238
Y-COORD : S 26.23017

HOLE No: TP4

TYPE SET BY : K.NAIDOO
SETUP FILE : TP-JGA-A4.SET

DATE : 31/05/2019 14:12
TEXT : ..JBIOMETHANEPLANTLOGS.TXT

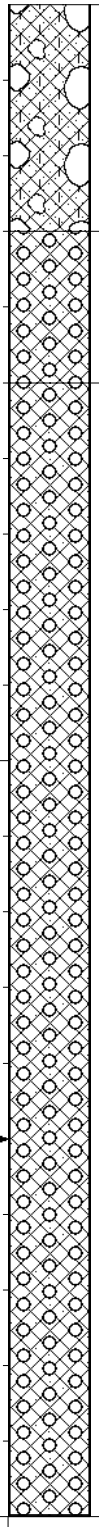
JG AFRIKA

ENERGiDROP
COJ BIOMETHANE PLANT

HOLE No: TP5
Sheet 1 of 1

JOB NUMBER: 5037

Scale 1:10



0.00 Moist, dark brown red, loose, intact, silty fine sand with occasional cobbles: Fill.

0.30 Moist, black, medium dense, clast supported, sandy GRAVEL: Fill.

0.50 Wet, red brown, medium dense, clast supported, sandy GRAVEL: Fill.

2.00

NOTES

1) Very strong groundwater seepage from 1.50m.
2) Major sidewall collapse above and below seepage.
3) Hole terminated due to collapse.
4) No sample.

CONTRACTOR :
MACHINE : JCB 3CX TLB
DRILLED BY :
PROFILED BY : K.NAIDOO

INCLINATION :
DIAM :
DATE :
DATE : 27/03/2019

ELEVATION :
X-COORD : E 28.04176
Y-COORD : S 26.22995

HOLE No: TP5

TYPE SET BY : K.NAIDOO
SETUP FILE : TP-JGA-A4.SET

DATE : 31/05/2019 14:12
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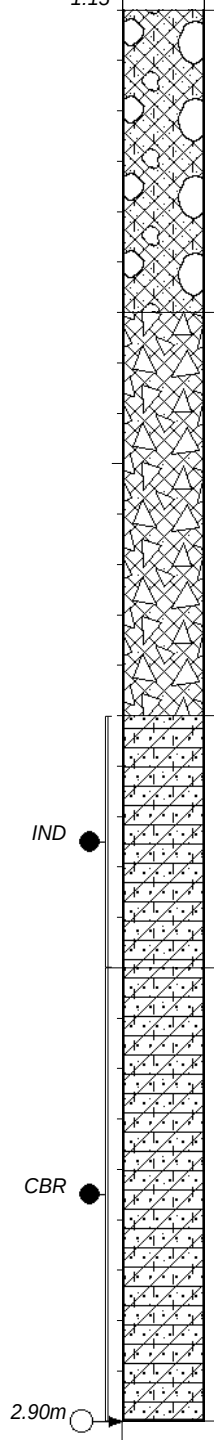
JG AFRIKA

ENERGiDROP
COJ BIOMETHANE PLANT

HOLE No: TP6
Sheet 1 of 1

JOB NUMBER: 5037

Scale 1:15



0.00 Paved surfacing.

0.10 Moist, dark brown red, loose, intact, silty fine sand with occasional cobbles: Fill.

0.70 Slightly moist, black, medium dense, clast supported, rubble in sandy matrix with abundant bricks: Fill.

1.50 Moist, green grey becoming brown grey with depth, soft, intact with relict rock structure, sandy silty CLAY: Residual sandstone.

2.00 Moist, brown mottled orange and beige becoming beige mottled orange with depth, soft, intact with relict rock structure, sandy silty CLAY: Residual sandstone.

2.90

NOTES

1) Groundwater seepage from 2.90m.
2) No sidewall collapse.
3) Slow advance from 2.70m.
4) IND sample taken 1.50--2.00m.
5) CBR sample taken 2.00--2.90m.

CONTRACTOR :
MACHINE : JCB 3CX TLB
DRILLED BY :
PROFILED BY : K.NAIDOO

INCLINATION :
DIAM :
DATE :
DATE : 27/03/2019

ELEVATION :
X-COORD : E 28.04205
Y-COORD : S 26.22978

HOLE No: TP6

TYPE SET BY : K.NAIDOO
SETUP FILE : TP-JGA-A4.SET

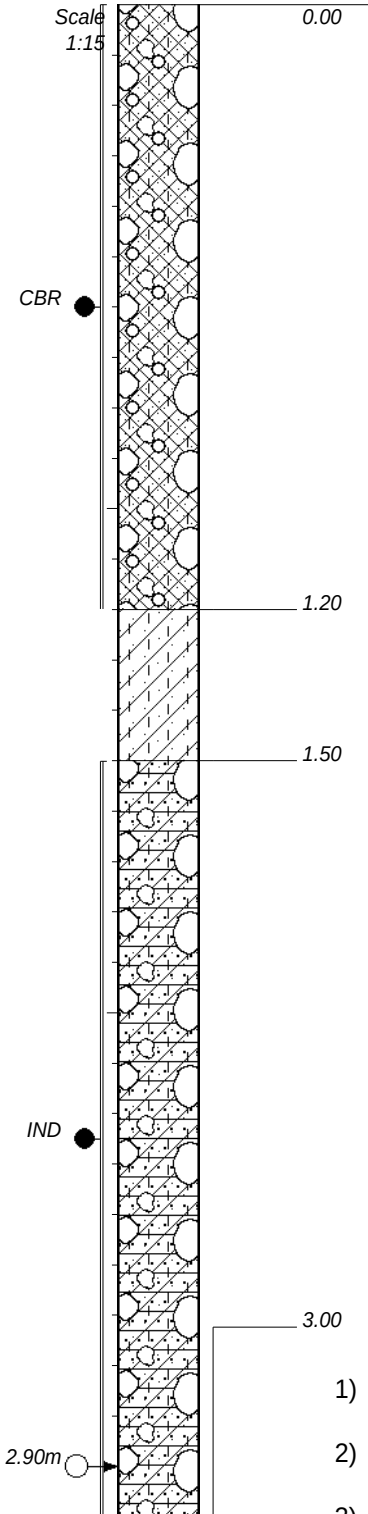
DATE : 31/05/2019 14:12
TEXT : ..JBIOMETHANEPLANTLOGS.TXT

JG AFRIKA

ENERGiDROP
COJ BIOMETHANE PLANT

HOLE No: TP7
Sheet 1 of 1

JOB NUMBER: 5037



0.00

Moist, dark brown red, loose, intact, silty gravelly SAND with abundant cobbles: Fill.

1.20

Moist, dark brown beige, loose, intact but voided in places, silty sandy CLAY: Hillwash.

1.50

Moist becoming wet with depth, orange brown mottled orange and beige becoming beige mottled orange with depth, soft, intact with relict rock structure, silty sandy CLAY with abundant highly weathered cobbles of fine grained sandstone: Residual sandstone.

Possible transition to highly weathered fine grained sandstone at test pit base.

3.00

NOTES

1) Groundwater seepage from 2.90m.
2) Minor sidewall collapse at depth.
3) No refusal.
4) CBR sample taken 0.00--1.20m.
5) IND sample taken 1.50--3.00m.

CONTRACTOR :
MACHINE : JCB 3CX TLB
DRILLED BY :
PROFILED BY : K.NAIDOO

INCLINATION :
DIAM :
DATE :
DATE : 27/03/2019

ELEVATION :
X-COORD : E 28.04223
Y-COORD : S 26.22965

HOLE No: TP7

TYPE SET BY : K.NAIDOO
SETUP FILE : TP-JGA-A4.SET

DATE : 31/05/2019 14:12
TEXT : ..JBIOMETHANEPLANTLOGS.TXT

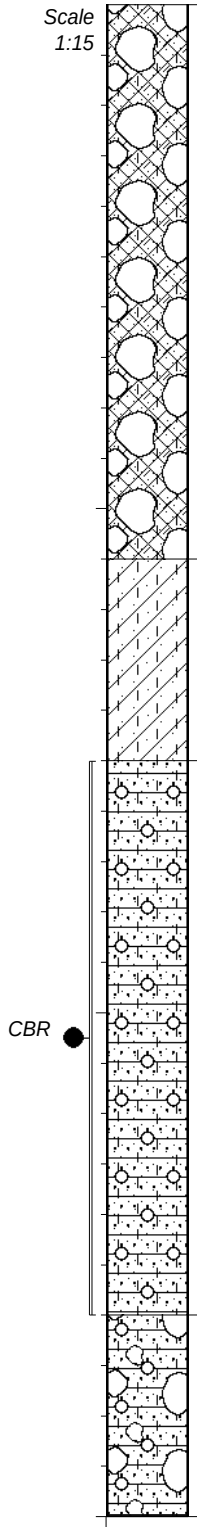
JG AFRIKA

ENERGiDROP
COJ BIOMETHANE PLANT

HOLE No: TP8
Sheet 1 of 1

JOB NUMBER: 5037

Scale 1:15



0.00 Moist, red brown, loose, intact, clayey silty SAND with abundant cobbles and small boulders: Fill.

1.10 Moist, orange brown, loose, intact but voided in places, silty sandy CLAY: Hillwash.

1.50 Moist, orange brown mottled orange and beige, medium dense, relict rock structure, gravelly silty SAND: Residual sandstone.

2.60 Moist, beige mottled orange and grey, dense, intact with relict rock structure, gravelly silty SAND with cobbles of highly weathered sandstone: Residual sandstone.

3.00

NOTES

1) No groundwater seepage.
2) No sidewall collapse.
3) N0 refusal.
4) CBR sample taken 1.50--2.60m.

CONTRACTOR :
MACHINE : JCB 3CX TLB
DRILLED BY :
PROFILED BY : K.NAIDOO

TYPE SET BY : K.NAIDOO
SETUP FILE : TP-JGA-A4.SET

INCLINATION :
DIAM :
DATE :
DATE : 27/03/2019

DATE : 31/05/2019 14:12
TEXT : ..JBIOMETHANEPLANTLOGS.TXT

ELEVATION :
X-COORD : E 28.04235
Y-COORD : S 26.22968

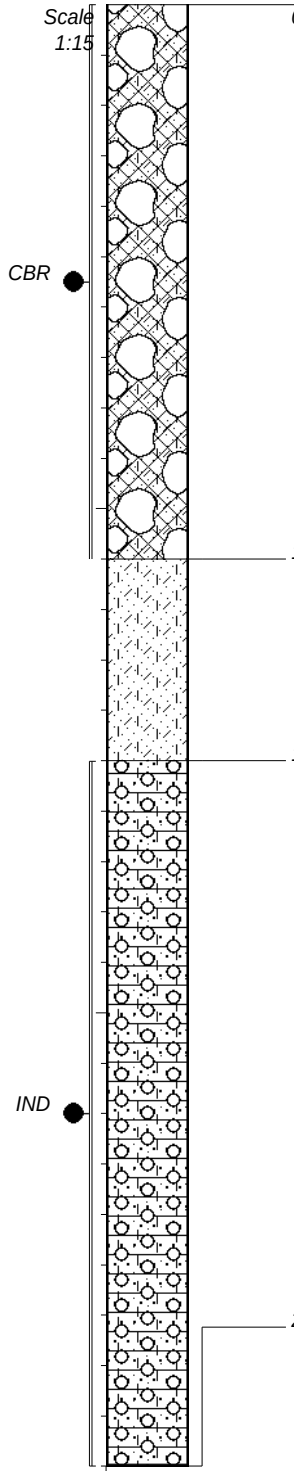
HOLE No: TP8

JG AFRIKA

ENERGiDROP
COJ BIOMETHANE PLANT

HOLE No: TP9
Sheet 1 of 1

JOB NUMBER: 5037



0.00

Moist, red brown, loose, intact, clayey silty SAND with abundant cobbles and small boulders: Fill.

1.10

Moist, orange brown, loose, intact but voided in places, clayey silty SAND: Hillwash.

1.50

Moist, orange brown mottled orange and beige, medium dense, intact, silty sandy GRAVEL: Residual sandstone.

2.90

NOTES

1) No groundwater seepage.
2) No sidewall collapse.
3) Slow advance from 2.90m.
4) CBR sample taken 0.00--1.10m.
5) IND sample taken 1.50--2.90m.

CONTRACTOR :
MACHINE : JCB 3CX TLB
DRILLED BY :
PROFILED BY : K.NAIDOO

TYPE SET BY : K.NAIDOO
SETUP FILE : TP-JGA-A4.SET

INCLINATION :
DIAM :
DATE :
DATE : 27/03/2019

DATE : 31/05/2019 14:12
TEXT : ..JBIOMETHANEPLANTLOGS.TXT

ELEVATION :
X-COORD : E 28.04248
Y-COORD : S 26.22956

HOLE No: TP9

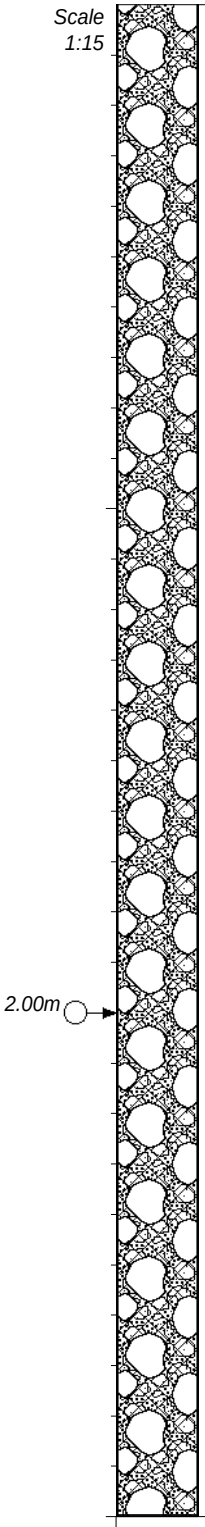
JG AFRIKA

ENERGiDROP
COJ BIOMETHANE PLANT

HOLE No: TP10
Sheet 1 of 1

JOB NUMBER: 5037

Scale 1:15



0.00 Moist becoming wet, brown red, loose, clast supported, silty sand with bricks, wire, boulders and concrete slabs: Fill.

3.00

NOTES

1) Very strong groundwater seepage from 2.00m.
2) Major sidewall collapse from surface.
3) Hole terminated due to collapse.
4) No sample.

CONTRACTOR :
MACHINE : JCB 3CX TLB
DRILLED BY :
PROFILED BY : K.NAIDOO

INCLINATION :
DIAM :
DATE :
DATE : 27/03/2019

ELEVATION :
X-COORD : E 28.04199
Y-COORD : S 26.23044

HOLE No: TP10

TYPE SET BY : K.NAIDOO
SETUP FILE : TP-JGA-A4.SET

DATE : 31/05/2019 14:12
TEXT : ..JBIOMETHANEPLANTLOGS.TXT

TP1 Profile

TP1 Spoil

TP2 Profile

TP2 Spoil

TP3 Profile

TP3 Spoil

TP4 Profile

TP4 Spoil

TP5 Profile

TP5 Spoil

TP6 Profile

TP6 Spoil

TP7 Profile

TP7 Spoil

TP8 Profile

TP8 Spoil

TP9 Profile

TP9 Spoil

TP10 Profile

TP10 Spoil

Annexure B: LABORATORY TEST RESULTS

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Client	:	J G AFRIKA			
Address	:	P O BOX 1109	**Client Reference**	:	
	:	SUNNINGHILL	**Order No.**	:	Keshan
	:	2157			
Attention	:		**Date Received**	:	26/03/2019
Facsimile	:	011 807 1607	**Date Tested**	:	26/03/2019 - 18/04/2019
E-mail	:	chettyn@jgafrika.com	**Date Reported**	:	18/04/2019
Project	:	COJ Biomethane			
Project No.	:	2019-B-425	**Report Status**	:	Final
			Page	:	1 of 10

Herewith please find the test report(s) pertaining to the above project. All tests were conducted in accordance with prescribed test method(s). Information herein consists of the following:

Test(s) conducted / Item(s) measured	Qty.	Test Method(s)	Authorized By**	Page(s)
Moisture Density Relationship	4.000	SANS3001: GR30	S Pullen	5-8
Relative density of soil (SG)	1.000	SANS3001: AG23		2-4
Atterberg Limits <0.425mm	5.000	SANS3001: GR10	S Pullen/C Petersen	2-4, 9-10
Sieve Analysis 0.075mm	5.000	SANS3001: GR1	C Petersen/S Pullen	2-4, 9-10
California Bearing Ratio (CBR)	4.000	SANS3001: GR40	S Pullen	9-10
Hydrometer Analysis	5.000	SANS3001: GR3	S Pullen	2-4

Any test results contained in this report and marked with * in the table above are "not SANAS accredited" and are not included in the schedule of accreditation for this laboratory.

Any information contained in this test report pertain only to the areas and/or samples tested. Documents may only be reproduced or published in their full context.

While every care is taken to ensure that all tests are carried out in accordance with recognised standards, neither Civilab (Proprietary) Limited nor its employess shall be liable in any way whatsoever for any error made in the execution or reporting of tests or any erroneous conclusions drawn therefrom or for any consequences thereof.

All interpretations, Interpolations, Opinions and/or Classifications contained in this report falls outside our scope of accreditation.

The following parameters, where applicable, were excluded from the classification procedure: Chemical modifications, Additional fines, Fractured Faces, Soluble Salts, pH, Conductivity, Coarse Sand Ratio, Durability (COLTO: G4-G9).

The following parameters, where applicable, were assumed: Rock types were assumed to be of an Arenaceous nature with Siliceous cementing material.

Unless otherwise requested or stated, all samples will be discarded after a period of 3 months.

This report is completely confidential between the parties (Civilab and Civilab's client) and shall not be disclosed to anybody else. Any disclosure in violation shall be deemed a breach of this agreement.

Deviations in Test Methods:

**All results are authorized electronically by approved managers and/or technical signatories.

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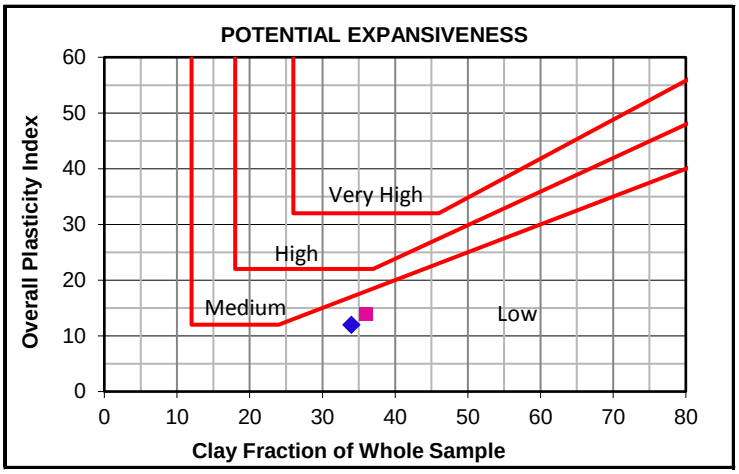
Client	:	J G AFRIKA	Date Received:	26/03/2019
Project	:	COJ Biomethane	Date Reported:	18/04/2019
Project No	:	2019-B-425	Page No. :	2 of 10

FOUNDATION INDICATOR

Laboratory Number		1 ◆	2 ■
Field Number		TP2	TP2
Client Reference			
Depth (m)		1.00-2.00	2.00-3.00
Position			
Coordinates	X		
	Y		
Description			
Aditional Information			
Calcrete / Crushed			
Stabilizing Agent			

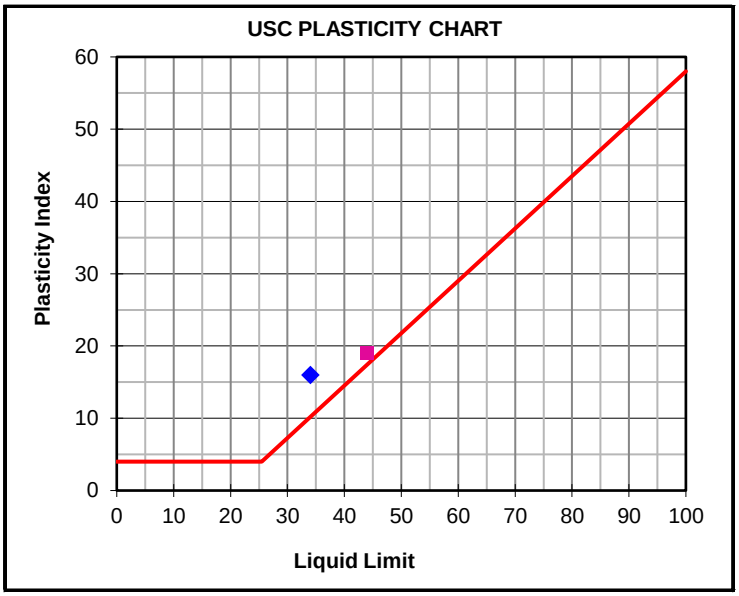


Moisture Content & Relative Density — **SANS3001: GR30**

Moisture Content (%)		
Relative Density (S.G.)		

Sieve Analysis (Wet Prep) — **SANS3001: GR1**

Percentage Passing	100 mm	100	100
	75 mm	100	100
	63 mm	100	100
	50 mm	100	100
	37.5 mm	100	100
	28 mm	100	100
	20 mm	100	100
	14 mm	100	100
	5 mm	97	96
	2 mm	94	90
	1 mm	89	85
	0.425 mm	77	76
	0.250 mm	72	74
	0.150 mm	66	72
	0.075 mm	58	69
Grading Modulus		0.71	0.65



Hydrometer Analysis — **SANS3001: GR3**

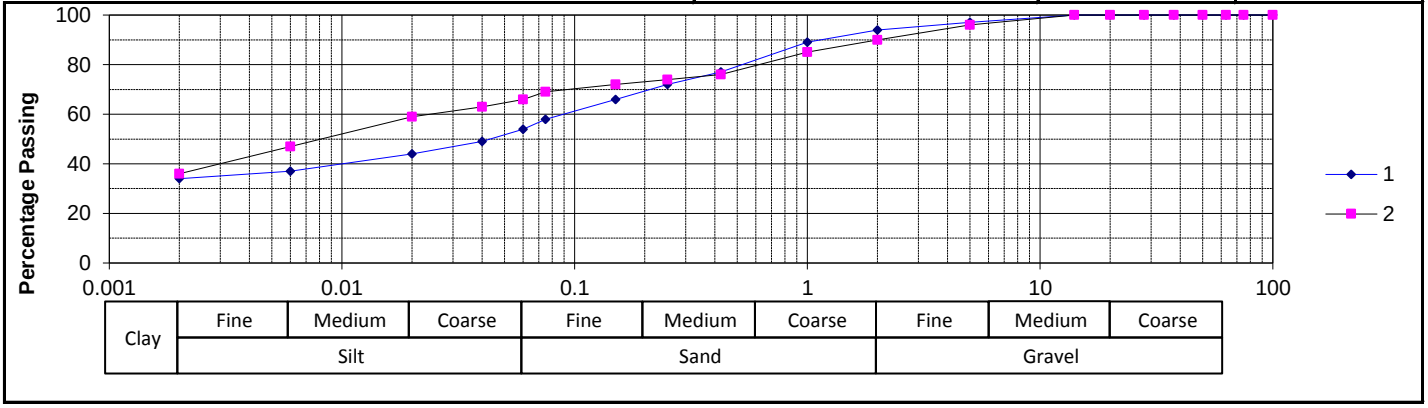
Percentage Passing	0.060 mm	54	66
	0.040 mm	49	63
	0.020 mm	44	59
	0.006 mm	37	47
	0.002 mm	34	36
Gravel	%	6	10
Sand	%	40	24
Silt	%	20	30
Clay	%	34	36

Note: An assumed S.G. may be used in Hydrometer Analysis calculations

Laboratory Number		1 ◆	2 ■
Atterberg Limits -425µ		**SANS3001: GR10**	
Liquid Limit	%	34	44
Plasticity Index	%	16	19
Linear Shrinkage	%	7.5	8.5
Overall PI	%	12	14

Classifications

HRB (AASHTO)	A-6(6)	A-7-6(12)
Unified (ASTM D2487)	CL	CL
Weston Swell @ 1 kPa		



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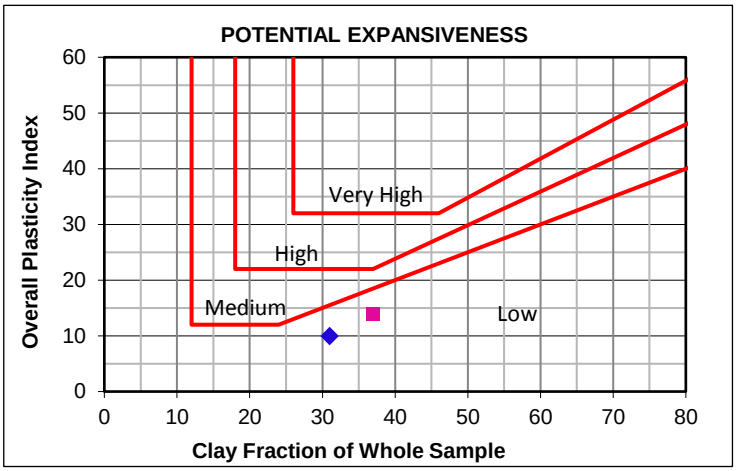
Client	:	J G AFRIKA	Date Received:	26/03/2019
Project	:	COJ Biomethane	Date Reported:	18/04/2019
Project No	:	2019-B-425	Page No. :	3 of 10

FOUNDATION INDICATOR

Laboratory Number		4 ◆	5 ■
Field Number		TP3	TP6
Client Reference			
Depth (m)		0.60-2.00	2.00-2.90
Position			
Coordinates	X		
	Y		
Description			
Aditional Information			
Calcrete / Crushed			
Stabilizing Agent			

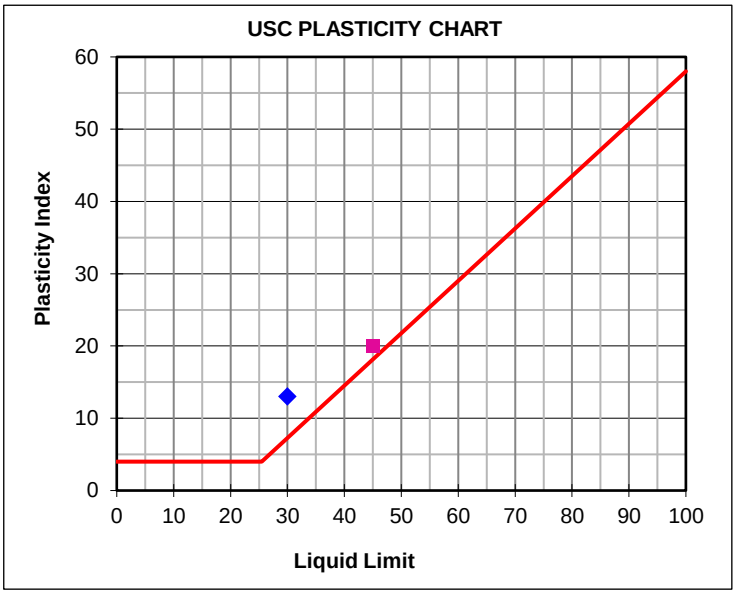


Moisture Content & Relative Density

Moisture Content (%)		
Relative Density (S.G.)		

Sieve Analysis (Wet Prep) — **SANS3001: GR1**

Percentage Passing	100 mm	100	100
	75 mm	100	100
	63 mm	100	100
	50 mm	100	100
	37.5 mm	100	100
	28 mm	100	100
	20 mm	100	100
	14 mm	100	99
	5 mm	100	93
	2 mm	100	86
	1 mm	94	80
	0.425 mm	77	72
	0.250 mm	72	69
	0.150 mm	65	67
	0.075 mm	56	64
Grading Modulus		0.67	0.78



Hydrometer Analysis — **SANS3001: GR3**

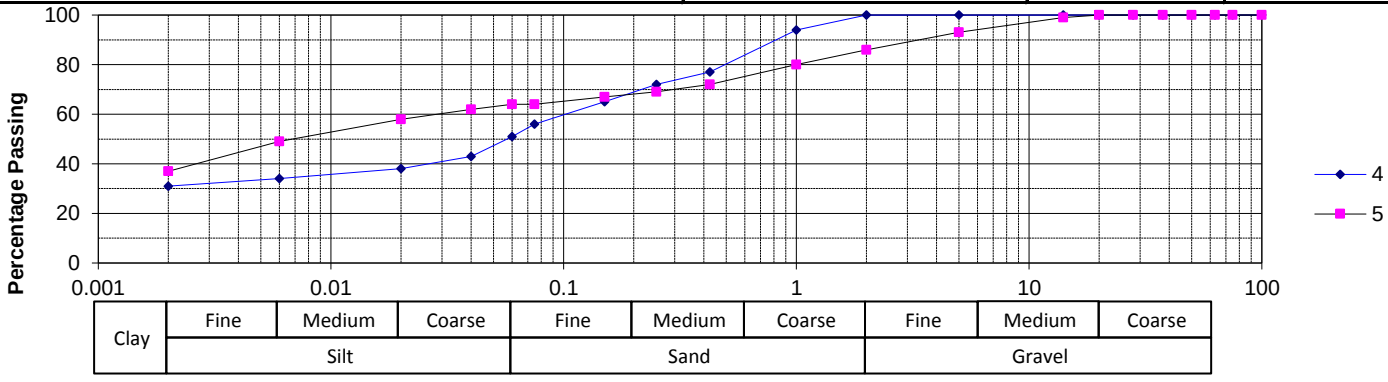
Percentage Passing	0.060 mm	51	64
	0.040 mm	43	62
	0.020 mm	38	58
	0.006 mm	34	49
	0.002 mm	31	37
Gravel	%		14
Sand	%	49	22
Silt	%	20	27
Clay	%	31	37

Note: An assumed S.G. may be used in Hydrometer Analysis calculations

Laboratory Number		4 ◆	5 ■
Atterberg Limits -425µ		**SANS3001: GR10**	
Liquid Limit	%	30	45
Plasticity Index	%	13	20
Linear Shrinkage	%	6.0	9.0
Overall PI	%	10	14

Classifications

HRB (AASHTO)	A-6(4)	A-7-6(11)
Unified (ASTM D2487)	CL	CL
Weston Swell @ 1 kPa		



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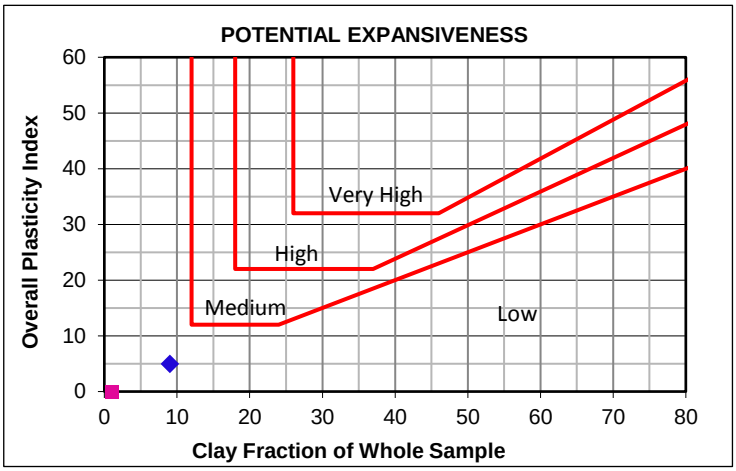
Project	:	COJ Biomethane	Date Reported:	18/04/2019
Project No	:	2019-B-425	Page No. :	4 of 10

FOUNDATION INDICATOR

Laboratory Number		6 ◆	■
Field Number		TP7	
Client Reference			
Depth (m)		0.00-1.20	
Position			
Coordinates	X		
	Y		
Description			
Aditional Information			
Calcrete / Crushed			
Stabilizing Agent			

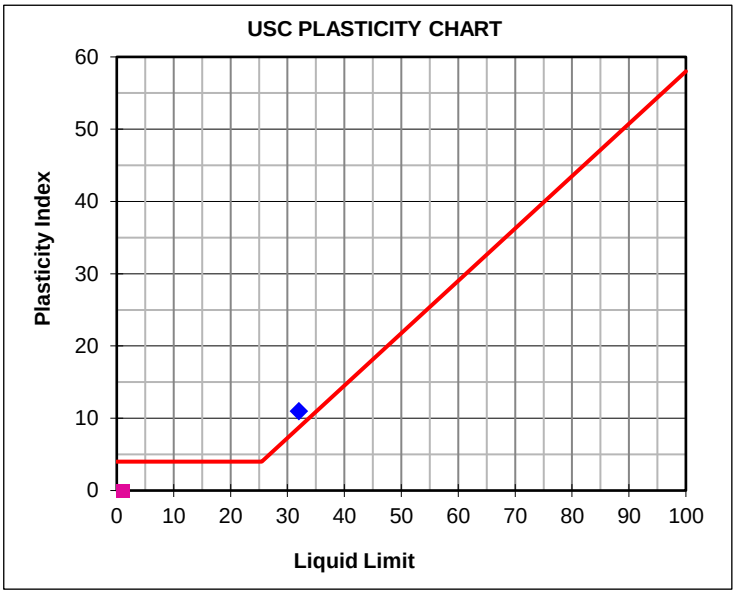


Moisture Content & Relative Density — **SANS3001: GR30**

Moisture Content (%)	
Relative Density (S.G.)	

Sieve Analysis (Wet Prep) — **SANS3001: GR1**

Percentage Passing	100 mm	100
	75 mm	100
	63 mm	100
	50 mm	100
	37.5 mm	100
	28 mm	100
	20 mm	100
	14 mm	99
	5 mm	85
	2 mm	76
	1 mm	68
	0.425 mm	49
	0.250 mm	43
	0.150 mm	38
	0.075 mm	34
Grading Modulus		1.41



Hydrometer Analysis — **SANS3001: GR3**

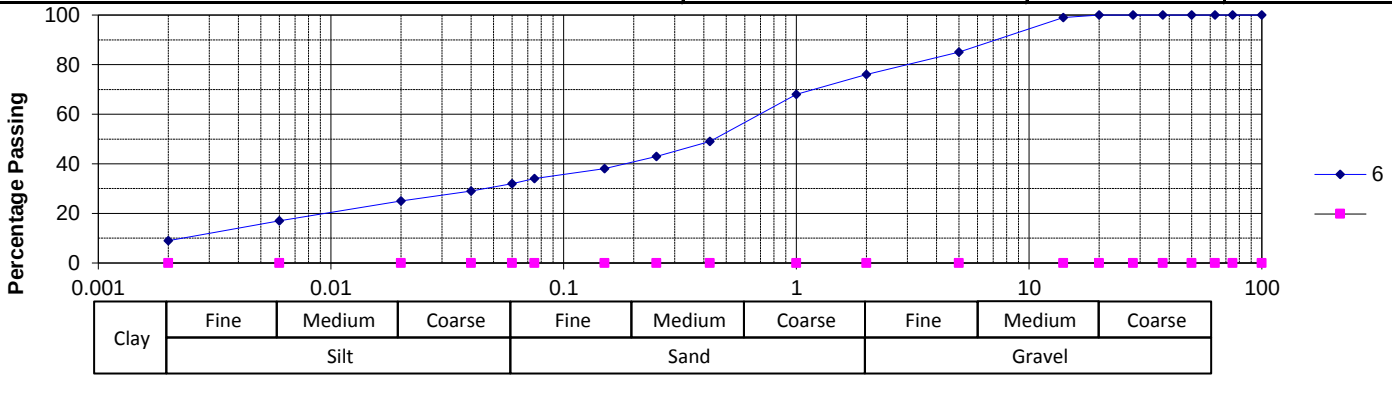
Percentage Passing	0.060 mm	32
	0.040 mm	29
	0.020 mm	25
	0.006 mm	17
	0.002 mm	9
Gravel	%	24
Sand	%	44
Silt	%	23
Clay	%	9

Note: An assumed S.G. may be used in Hydrometer Analysis calculations

Laboratory Number		6 ◆	■
Atterberg Limits -425µ		**SANS3001: GR10**	
Liquid Limit	%	32	
Plasticity Index	%	11	
Linear Shrinkage	%	5.0	
Overall PI	%	5	

Classifications

HRB (AASHTO)	A-2-6(0)	
Unified (ASTM D2487)	SC	
Weston Swell @ 1 kPa		



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Project	:	COJ Biomethane	Date Reported: 18/04/2019
Project No:		2019-B-425	Page No. : 5 of 10

MOISTURE DENSITY RELATIONSHIP

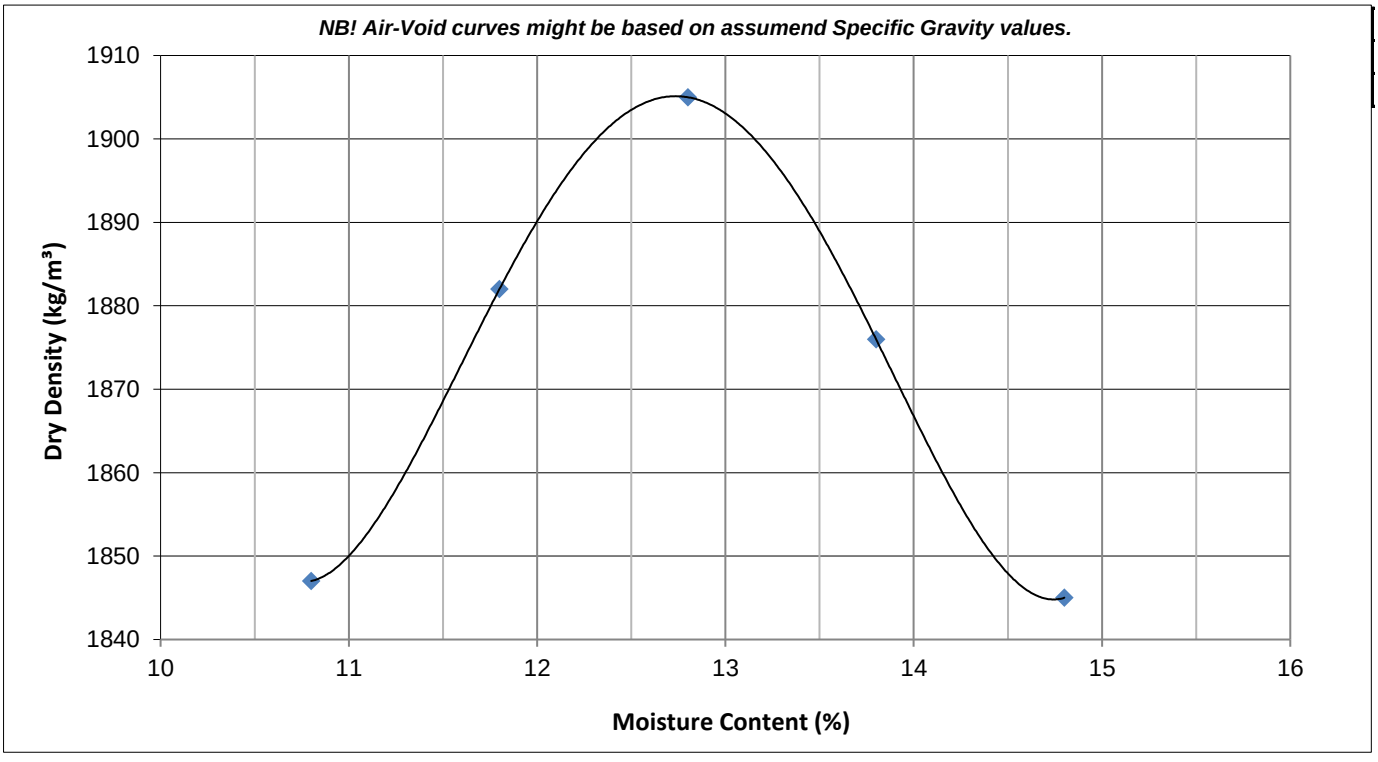
Laboratory Number		1
Field Number		TP2
Client Reference		
Depth (m)		1.00-2.00
Position		
Coordinates	X	
	Y	
Description		
Additional Information		
Calcrete / Crushed Stabilizing Agent		

Maximum Dry Density & Optimum Moisture Content - SANS3001: GR30

Compactive Effort:	Modified AASHTO

Dry Density	kg/m³	1847	1882	1905	1876	1845	
Moisture Content	%	10.8	11.8	12.8	13.8	14.8	

Max. Dry Density	kg/m³	1905
Optimum Moisture	%	12.7



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Project	:	COJ Biomethane	Date Reported: 18/04/2019
Project No:		2019-B-425	Page No. : 6 of 10

MOISTURE DENSITY RELATIONSHIP

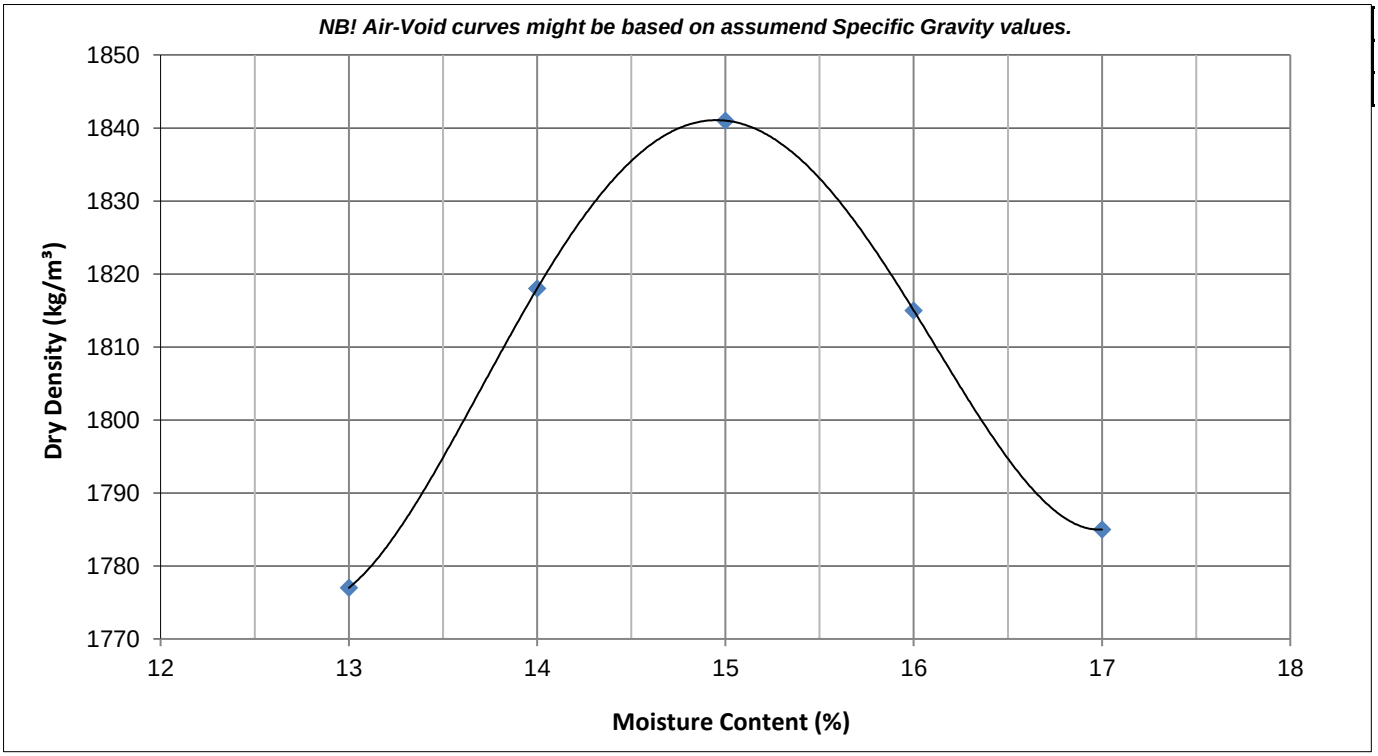
Laboratory Number		2
Field Number		TP2
Client Reference		
Depth (m)		2.00-3.00
Position		
Coordinates	X	
	Y	
Description		
Additional Information		
Calcrete / Crushed		
Stabilizing Agent		

Maximum Dry Density & Optimum Moisture Content - SANS3001: GR30

Compactive Effort:	Modified AASHTO

Dry Density	kg/m³	1777	1818	1841	1815	1785	
Moisture Content	%	13	14	15	16	17	

Max. Dry Density	kg/m³	1841
Optimum Moisture	%	15



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Client	:	J G AFRIKA	Date Received: 26/03/2019
Project	:	COJ Biomethane	Date Reported: 18/04/2019
Project No:		2019-B-425	Page No. : 7 of 10

MOISTURE DENSITY RELATIONSHIP

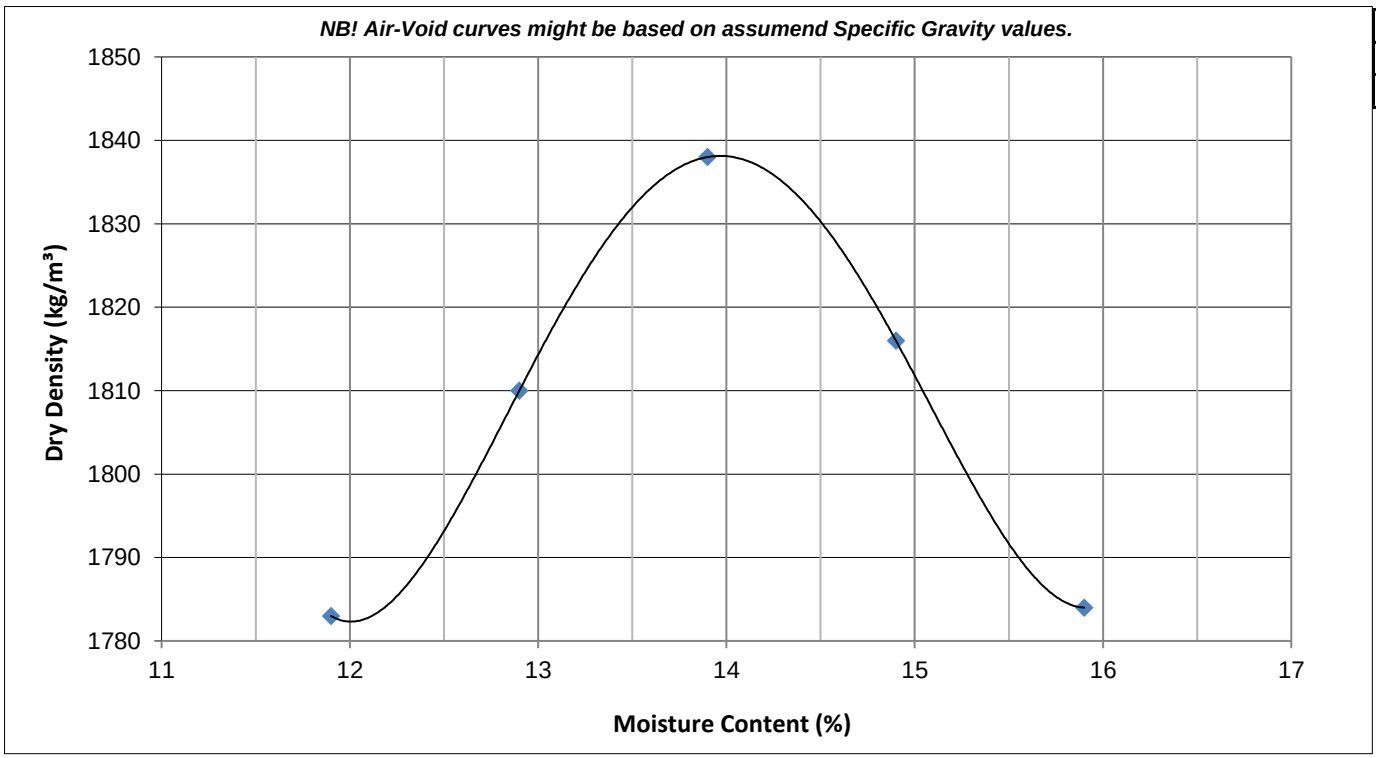
Laboratory Number		5
Field Number		TP6
Client Reference		
Depth (m)		2.00-2.90
Position		
Coordinates	X	
	Y	
Description		
Additional Information		
Calcrete / Crushed		
Stabilizing Agent		

Maximum Dry Density & Optimum Moisture Content - SANS3001: GR30

Compactive Effort:	Modified AASHTO

Dry Density	kg/m³	1783	1810	1838	1816	1784	
Moisture Content	%	11.9	12.9	13.9	14.9	15.9	

Max. Dry Density	kg/m³	1838
Optimum Moisture	%	14



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Client	:	J G AFRIKA	Date Received: 26/03/2019
Project	:	COJ Biomethane	Date Reported: 18/04/2019
Project No:		2019-B-425	Page No. : 8 of 10

MOISTURE DENSITY RELATIONSHIP

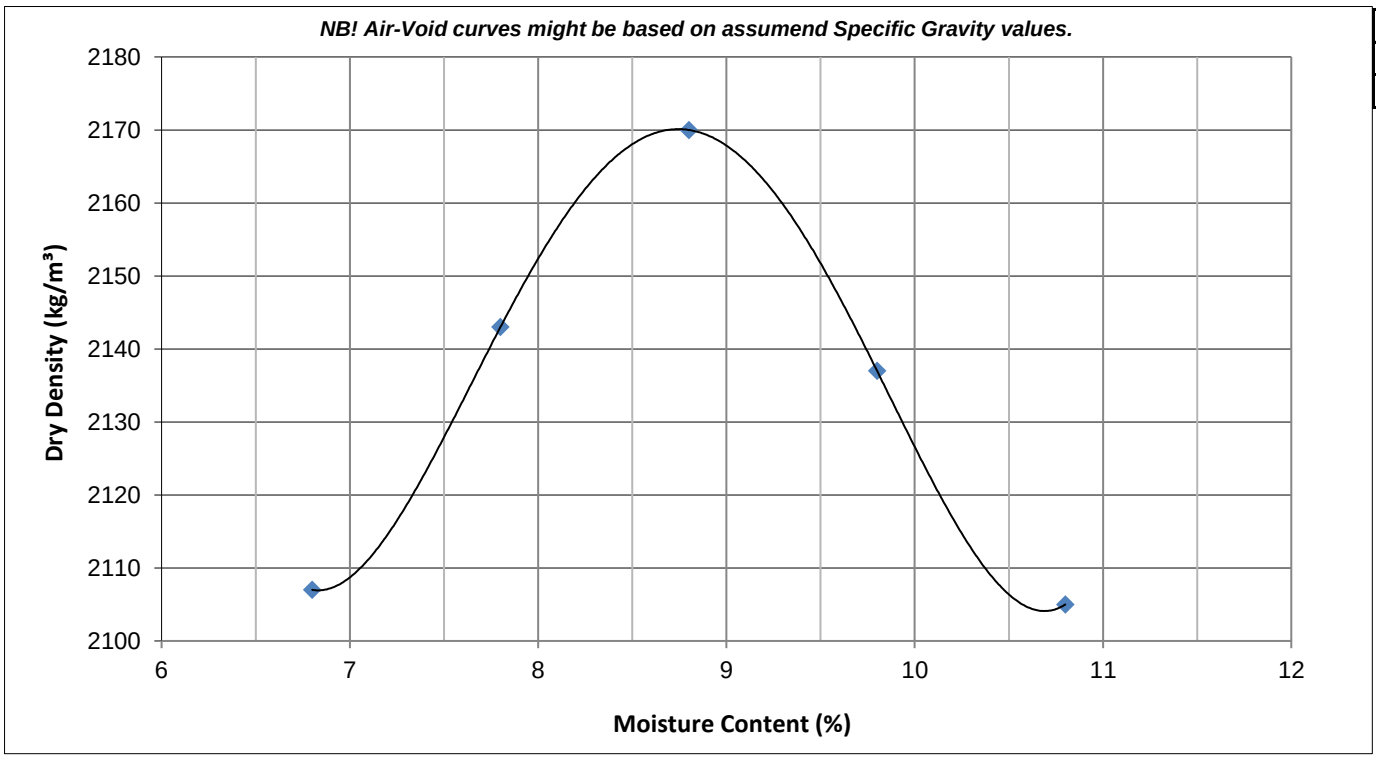
Laboratory Number		6
Field Number		TP7
Client Reference		
Depth (m)		0.00-1.20
Position		
Coordinates	X	
	Y	
Description		
Additional Information		
Calcrete / Crushed		
Stabilizing Agent		

Maximum Dry Density & Optimum Moisture Content - SANS3001: GR30

Compactive Effort:	Modified AASHTO

Dry Density	kg/m³	2107	2143	2170	2137	2105	
Moisture Content	%	6.8	7.8	8.8	9.8	10.8	

Max. Dry Density	kg/m³	2170
Optimum Moisture	%	8.7



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Project	:	COJ Biomethane	Date Reported	:	18/04/2019
Project No.	:	2019-B-425	Page No.	:	9 of 10

CALIFORNIA BEARING RATIO (CBR) & ROAD INDICATOR REPORT

Laboratory No.		1	2
Field Number		TP2	TP2
Client Reference			
Depth (m)		1.00-2.00	2.00-3.00
Position			
Coordinates	X		
	Y		
Description			
Additional information			
Calcrete/Crushed			
Stabilizing Agent			

Sieve Analysis (Wet preparation) — SANS3001: GR1

Percentage Passing	100 mm	100	100
	75 mm	100	100
	63 mm	100	100
	50 mm	100	100
	37.5 mm	100	100
	28 mm	100	100
	20 mm	100	100
	14 mm	100	100
	5 mm	97	96
	2 mm	94	90
	1 mm	89	85
	0.425 mm	77	76
	0.250 mm	72	74
	0.150 mm	66	72
	0.075 mm	58	69
Grading Modulus		0.7	0.7

Soil Mortar Analysis

Coarse Sand	18	16
Coarse Fine Sand	5	2
Medium Fine Sand	7	3
Fine Fine Sand	9	3
Silt and Clay	62	76

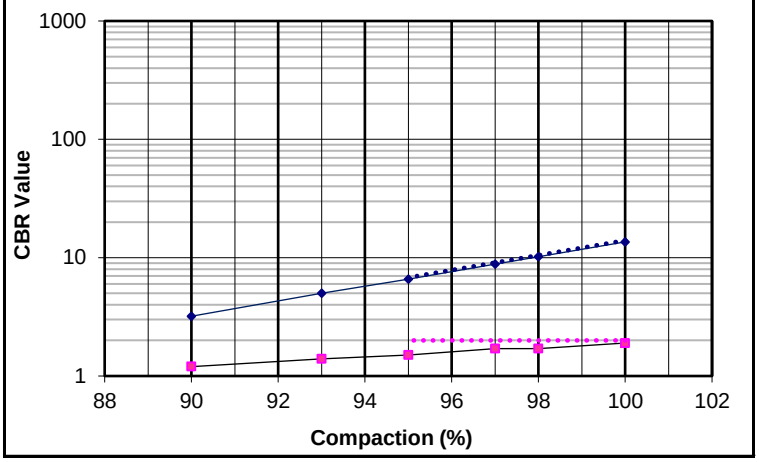
Atterberg Limits — SANS3001: GR10

Liquid Limit (%)	34	44
Plasticity Index (%)	16	19
Linear Shrinkage (%)	7.5	8.5

Laboratory No.		1	2
Maximum Dry Density & Optimum Moisture Content			**SANS3001: GR30**
MDD	kg/m³	1905	1841
OMC	%	12.7	15

California Bearing Ratio — SANS3001: GR40

Compaction Data							
Moisture	%	12.7			15		
Dry Density	kg/m³	1910	1818	1720	1853	1763	1670
Compaction	%	100.0	95.2	90.1	100.0	95.1	90.1
Penetration Data							
CBR at	2.50 mm	14	7	3	2	2	1
	5.00 mm	11	6	3	2	2	1
	7.50 mm	10	5	3	2	2	1
Swell	%	0.4	0.5	0.5	2.2	5.2	6.1
Final Moisture (%)		15.8	18.2	19	22.7	23.1	26

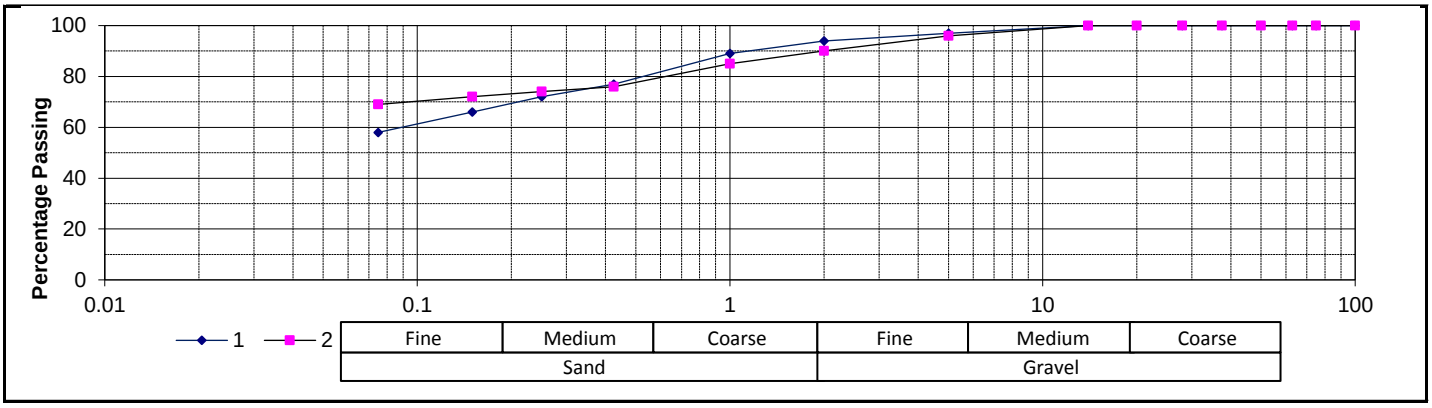


Interpolated CBR Data

CBR	@ 100%	Mod. AASHTO	14	2
	@ 98%		10	2
	@ 97%		9	2
	@ 95%		7	2
	@ 93%		5	1
	@ 90%		3	1
	@ SANS3001 Midpoint		10	2

Classifications

HRB (AASHTO)	A-6(6)	A-7-6(12)
COLTO	None	None
TRH14	G10	None



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Client	:	J G AFRIKA	Date Received	:	26/03/2019
Project	:	COJ Biomethane	Date Reported	:	18/04/2019
Project No.	:	2019-B-425	Page No.	:	10 of 10

CALIFORNIA BEARING RATIO (CBR) & ROAD INDICATOR REPORT

Laboratory No.		5 ◆	6 ■
Field Number		TP6	TP7
Client Reference			
Depth (m)		2.00-2.90	0.00-1.20
Position			
Coordinates	X		
	Y		
Description			
Additional information			
Calcrete/Crushed			
Stabilizing Agent			

Sieve Analysis (Wet preparation) — SANS3001: GR1

Percentage Passing	100 mm	100	100
	75 mm	100	100
	63 mm	100	100
	50 mm	100	100
	37.5 mm	100	100
	28 mm	100	100
	20 mm	100	100
	14 mm	99	99
	5 mm	93	85
	2 mm	86	76
	1 mm	80	68
	0.425 mm	72	49
	0.250 mm	69	43
	0.150 mm	67	38
	0.075 mm	64	34
Grading Modulus		0.8	1.4

Soil Mortar Analysis

Coarse Sand	16	36
Coarse Fine Sand	3	8
Medium Fine Sand	3	7
Fine Fine Sand	4	5
Silt and Clay	74	45

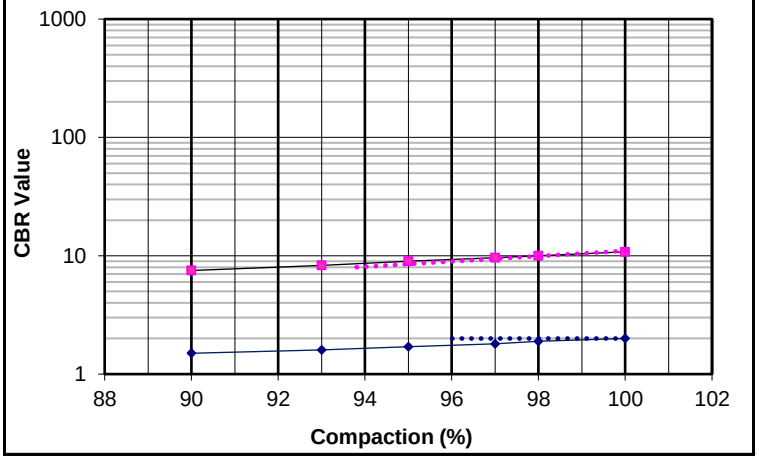
Atterberg Limits — SANS3001: GR10

Liquid Limit (%)	45	32
Plasticity Index (%)	20	11
Linear Shrinkage (%)	9.0	5.0

Laboratory No.		5 ◆	6 ■
Maximum Dry Density & Optimum Moisture Content			**SANS3001: GR30**
MDD	kg/m³	1838	2170
OMC	%	14	8.7

California Bearing Ratio — SANS3001: GR40

Compaction Data							
Moisture	%	14.1			8.8		
Dry Density	kg/m³	1834	1760	1658	2200	2064	1980
Compaction	%	100.0	96.0	90.4	100.0	93.8	90.0
Penetration Data							
CBR at	2.50 mm	2	2	1	11	8	7
	5.00 mm	2	2	1	14	11	10
	7.50 mm	3	2	2	15	13	12
Swell	%	5.9	6.7	7.5	1.3	1.8	3.4
Final Moisture (%)		21.9	23.9	26.6	12.9	14.8	19

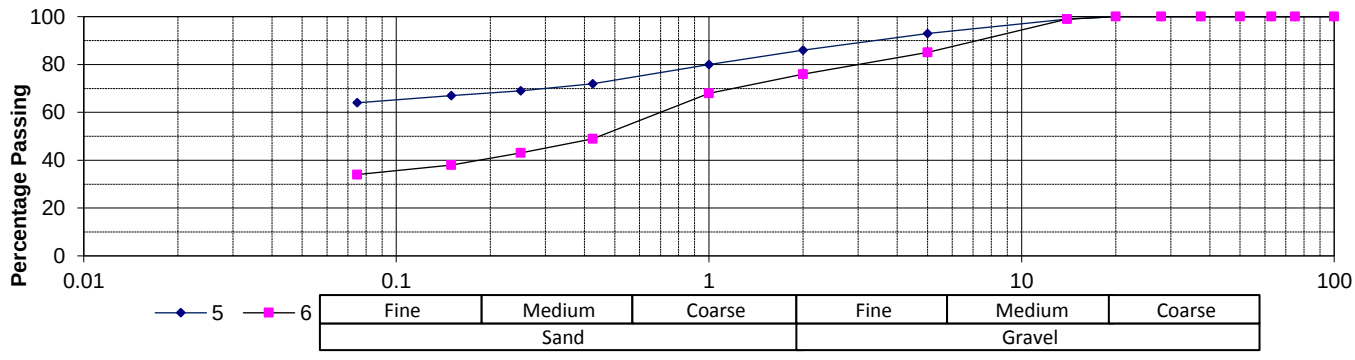


Interpolated CBR Data

CBR	@ 100%	Mod. AASHTO	2	11
	@ 98%		2	10
	@ 97%		2	10
	@ 95%		2	9
	@ 93%		2	8
	@ 90%		2	8
	@ SANS3001 Midpoint		2	10

Classifications

HRB (AASHTO)	A-7-6(11)	A-2-6(0)
COLTO	None	G9
TRH14	None	G9



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Client	:	J G AFRIKA			
Address	:	P O BOX 1109	**Client Reference**	:	
	:	SUNNINGHILL	**Order No.**	:	Keshan
	:	2157			
Attention	:		**Date Received**	:	29/04/2019
Facsimile	:	011 807 1607	**Date Tested**	:	29/04/2019 - 10/05/2019
E-mail	:	chettyn@jgafrika.com	**Date Reported**	:	13/05/2019
Project	:	COJ Biomethane			
Project No.	:	2019-B-617	**Report Status**	:	Final
			Page	:	1 of 6

Herewith please find the test report(s) pertaining to the above project. All tests were conducted in accordance with prescribed test method(s). Information herein consists of the following:

Test(s) conducted / Item(s) measured	Qty.	Test Method(s)	Authorized By**	Page(s)
Moisture Density Relationship	2.000	SANS3001: G30	S Pullen	4-5
Atterberg Limits <0.425mm	3.000	SANS3001: G10	S Pullen	2-3, 6
Sieve Analysis 0.075mm	3.000	SANS3001: GR1	S Pullen	2-3, 6
California Bearing Ratio (CBR)	2.000	SANS3001: GR40	S Pullen	6
Hydrometer Analysis	3.000	SANS3001: G3	S Pullen	2-3

Any test results contained in this report and marked with * in the table above are "not SANAS accredited" and are not included in the schedule of accreditation for this laboratory.

Any information contained in this test report pertain only to the areas and/or samples tested. Documents may only be reproduced or published in their full context.

While every care is taken to ensure that all tests are carried out in accordance with recognised standards, neither Civilab (Proprietary) Limited nor its employess shall be liable in any way whatsoever for any error made in the execution or reporting of tests or any erroneous conclusions drawn therefrom or for any consequences thereof.

All interpretations, Interpolations, Opinions and/or Classifications contained in this report falls outside our scope of accreditation.

The following parameters, where applicable, were excluded from the classification procedure: Chemical modifications, Additional fines, Fractured Faces, Soluble Salts, pH, Conductivity, Coarse Sand Ratio, Durability (COLTO: G4-G9).

The following parameters, where applicable, were assumed: Rock types were assumed to be of an Arenaceous nature with Siliceous cementing material.

Unless otherwise requested or stated, all samples will be discarded after a period of 3 months.

This report is completely confidential between the parties (Civilab and Civilab's client) and shall not be disclosed to anybody else. Any disclosure in violation shall be deemed a breach of this agreement.

Deviations in Test Methods:

**All results are authorized electronically by approved managers and/or technical signatories.

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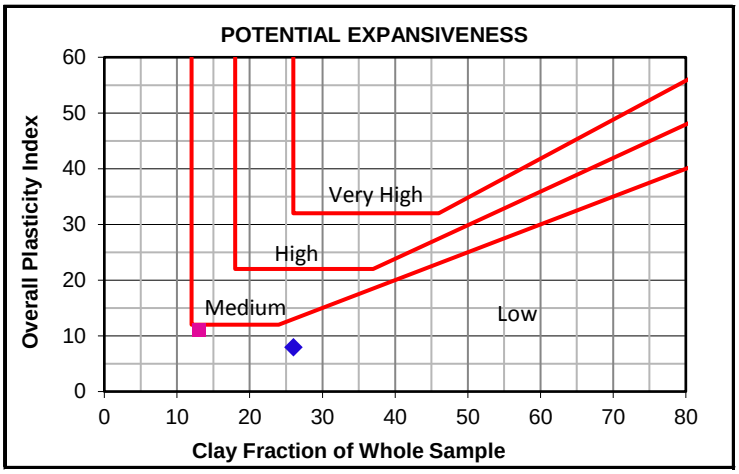
Client	:	J G AFRIKA	Date Received:	29/04/2019
Project	:	COJ Biomethane	Date Reported:	13/05/2019
Project No	:	2019-B-617	Page No. :	2 of 6

FOUNDATION INDICATOR

Laboratory Number		1 ◆	2 ■
Field Number		TP7	TP8
Client Reference			
Depth (m)		1.50-3.00	1.50-2.60
Position			
Coordinates	X		
	Y		
Description			
Aditional Information			
Calcrete / Crushed			
Stabilizing Agent			

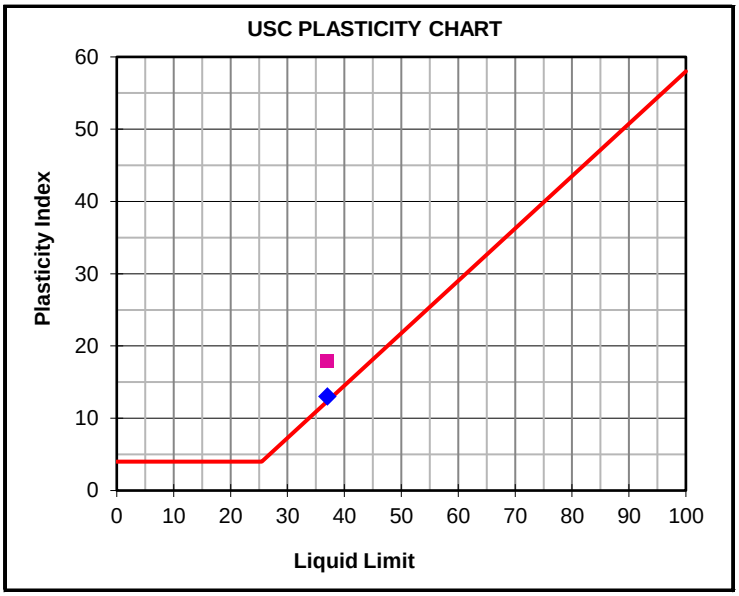


Moisture Content & Relative Density

Moisture Content (%)		
Relative Density (S.G.)		

Sieve Analysis (Wet Prep) — **SANS3001: GR1**

Percentage Passing	100 mm	100	100
	75 mm	100	100
	63 mm	100	100
	50 mm	100	100
	37.5 mm	100	100
	28 mm	100	100
	20 mm	100	100
	14 mm	100	100
	5 mm	100	93
	2 mm	86	86
	1 mm	77	78
	0.425 mm	65	60
	0.250 mm	63	56
	0.150 mm	60	51
	0.075 mm	56	46
Grading Modulus		0.93	1.08



Hydrometer Analysis — **SANS3001: G3**

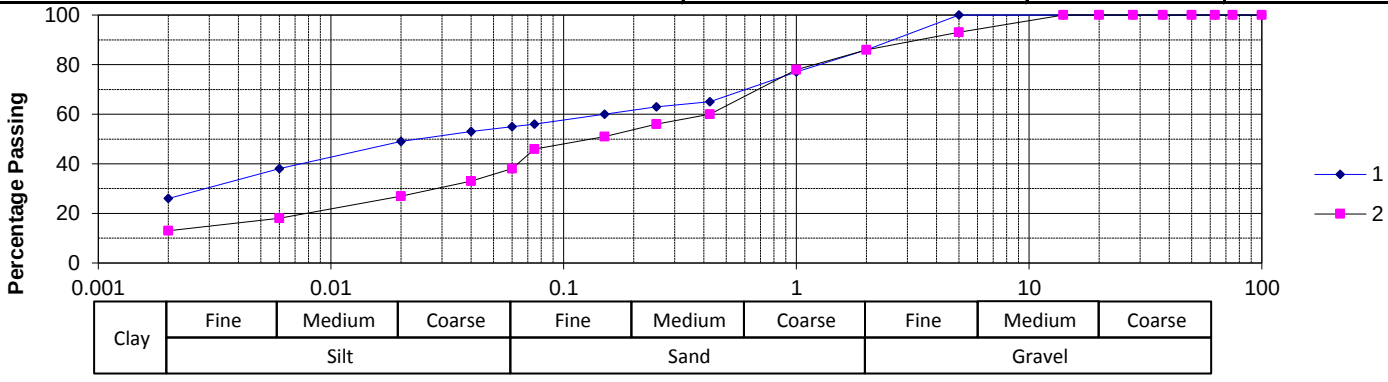
Percentage Passing	0.060 mm	55	38
	0.040 mm	53	33
	0.020 mm	49	27
	0.006 mm	38	18
	0.002 mm	26	13
Gravel	%	14	14
Sand	%	31	48
Silt	%	29	25
Clay	%	26	13

Note: An assumed S.G. may be used in Hydrometer Analysis calculations

Laboratory Number		1 ◆	2 ■
Atterberg Limits -425µ		**SANS3001: G10**	
Liquid Limit	%	37	37
Plasticity Index	%	13	18
Linear Shrinkage	%	6.0	7.5
Overall PI	%	8	11

Classifications

HRB (AASHTO)	A-6(5)	A-6(5)
Unified (ASTM D2487)	CL	SC
Weston Swell @ 1 kPa		



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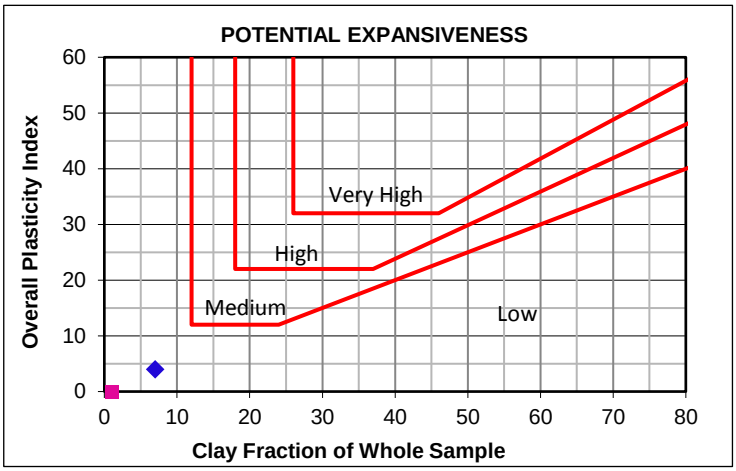
Project	:	COJ Biomethane	Date Reported:	13/05/2019
Project No	:	2019-B-617	Page No. :	3 of 6

FOUNDATION INDICATOR

Laboratory Number		3 ◆	■
Field Number		TP9	
Client Reference			
Depth (m)		1.50-2.90	
Position			
Coordinates	X		
	Y		
Description			
Aditional Information			
Calcrete / Crushed			
Stabilizing Agent			

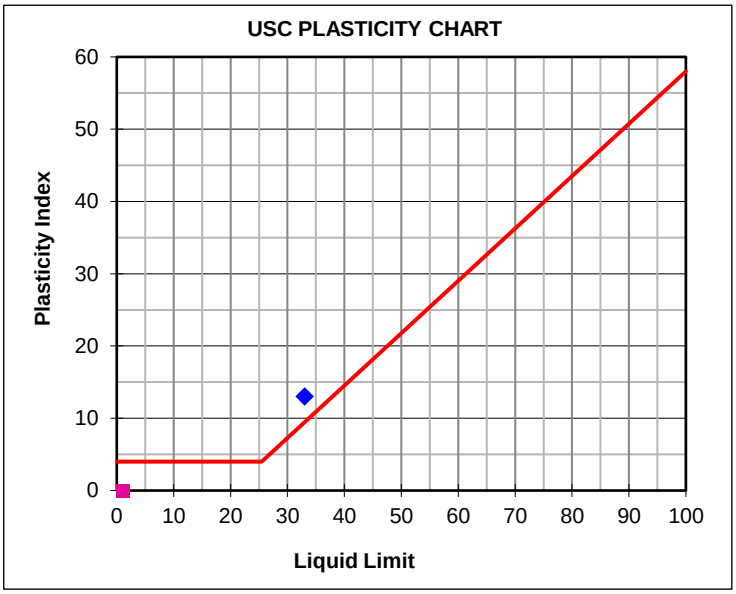


Moisture Content & Relative Density — **SANS3001: G30**

Moisture Content (%)		
Relative Density (S.G.)		

Sieve Analysis (Wet Prep) — **SANS3001: GR1**

Percentage Passing	100 mm	100	
	75 mm	100	
	63 mm	100	
	50 mm	100	
	37.5 mm	100	
	28 mm	100	
	20 mm	100	
	14 mm	89	
	5 mm	61	
	2 mm	52	
	1 mm	46	
	0.425 mm	33	
	0.250 mm	29	
	0.150 mm	25	
	0.075 mm	21	
Grading Modulus		1.94	



Hydrometer Analysis — **SANS3001: G3**

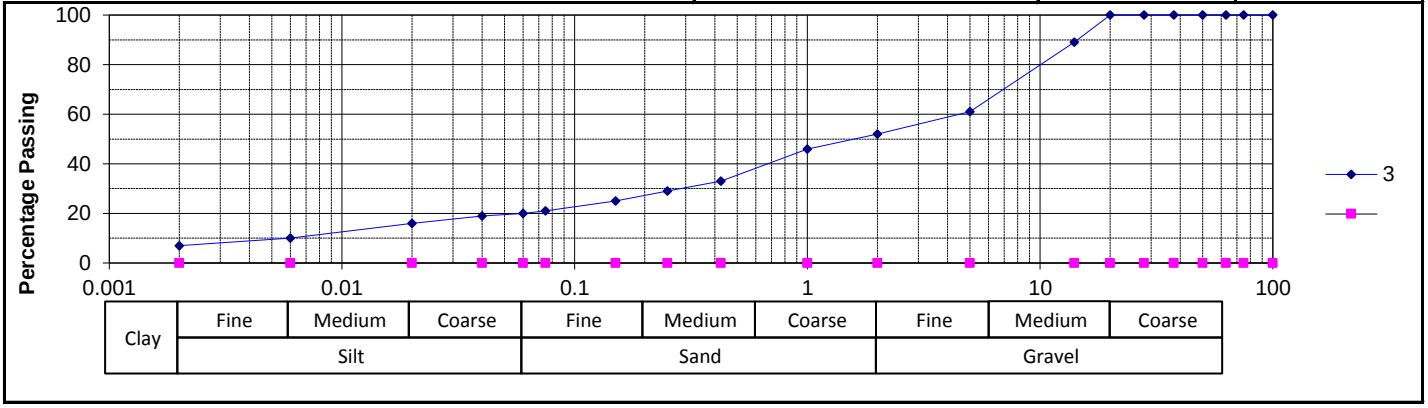
Percentage Passing	0.060 mm	20	
	0.040 mm	19	
	0.020 mm	16	
	0.006 mm	10	
	0.002 mm	7	
Gravel	%	48	
Sand	%	32	
Silt	%	13	
Clay	%	7	

Note: An assumed S.G. may be used in Hydrometer Analysis calculations

Laboratory Number		3 ◆	■
Atterberg Limits -425µ		**SANS3001: G10**	
Liquid Limit	%	33	
Plasticity Index	%	13	
Linear Shrinkage	%	5.5	
Overall PI	%	4	

Classifications

HRB (AASHTO)	A-2-6(0)	
Unified (ASTM D2487)	SC	
Weston Swell @ 1 kPa		



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Client	:	J G AFRIKA	Date Received: 29/04/2019
Project	:	COJ Biomethane	Date Reported: 13/05/2019
Project No:		2019-B-617	Page No. : 4 of 6

MOISTURE DENSITY RELATIONSHIP

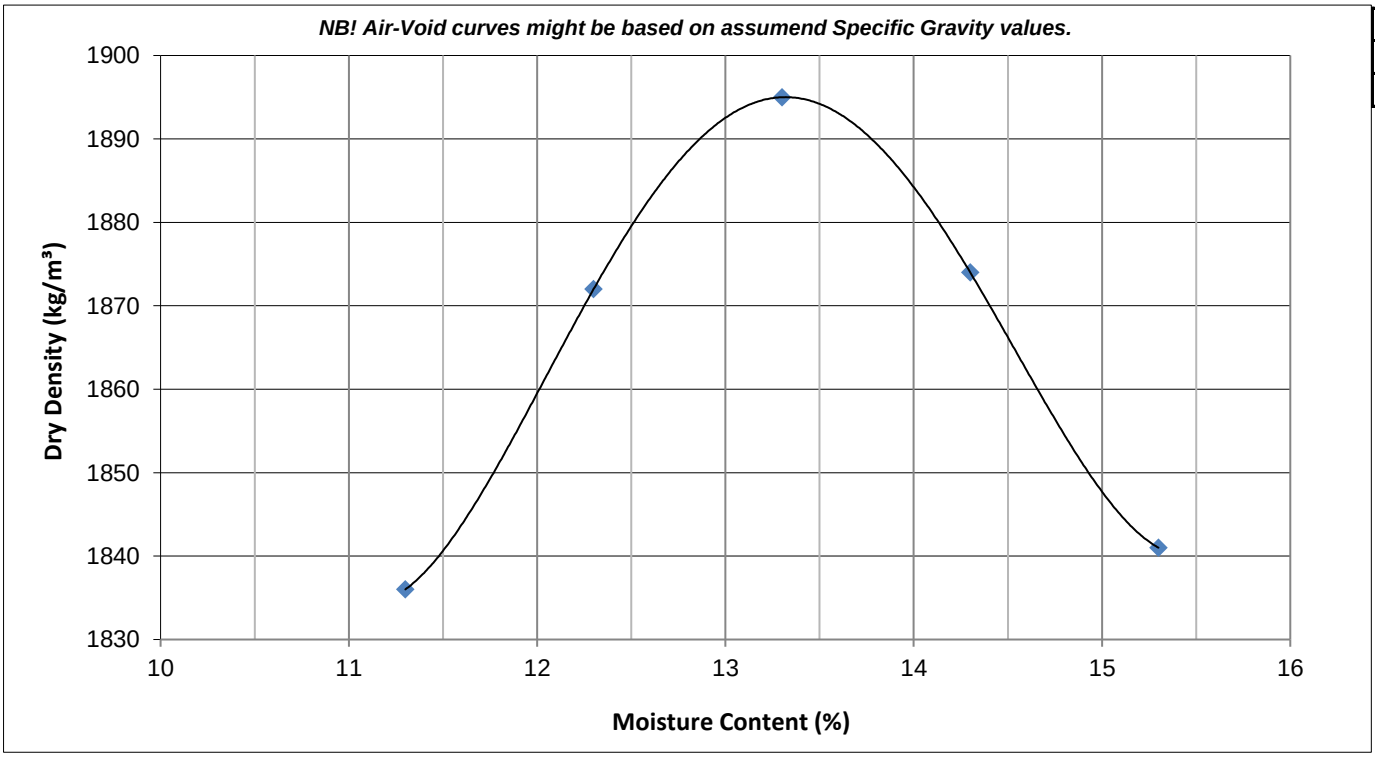
Laboratory Number		2
Field Number		TP8
Client Reference		
Depth (m)		1.50-2.60
Position		
Coordinates	X	
	Y	
Description		
Additional Information		
Calcrete / Crushed Stabilizing Agent		

Maximum Dry Density & Optimum Moisture Content - SANS3001: G30

Compactive Effort:	Modified AASHTO

Dry Density	kg/m³	1836	1872	1895	1874	1841	
Moisture Content	%	11.3	12.3	13.3	14.3	15.3	

Max. Dry Density	kg/m³	1895
Optimum Moisture	%	13.3



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Project	:	COJ Biomethane	Date Reported: 13/05/2019
Project No:		2019-B-617	Page No. : 5 of 6

MOISTURE DENSITY RELATIONSHIP

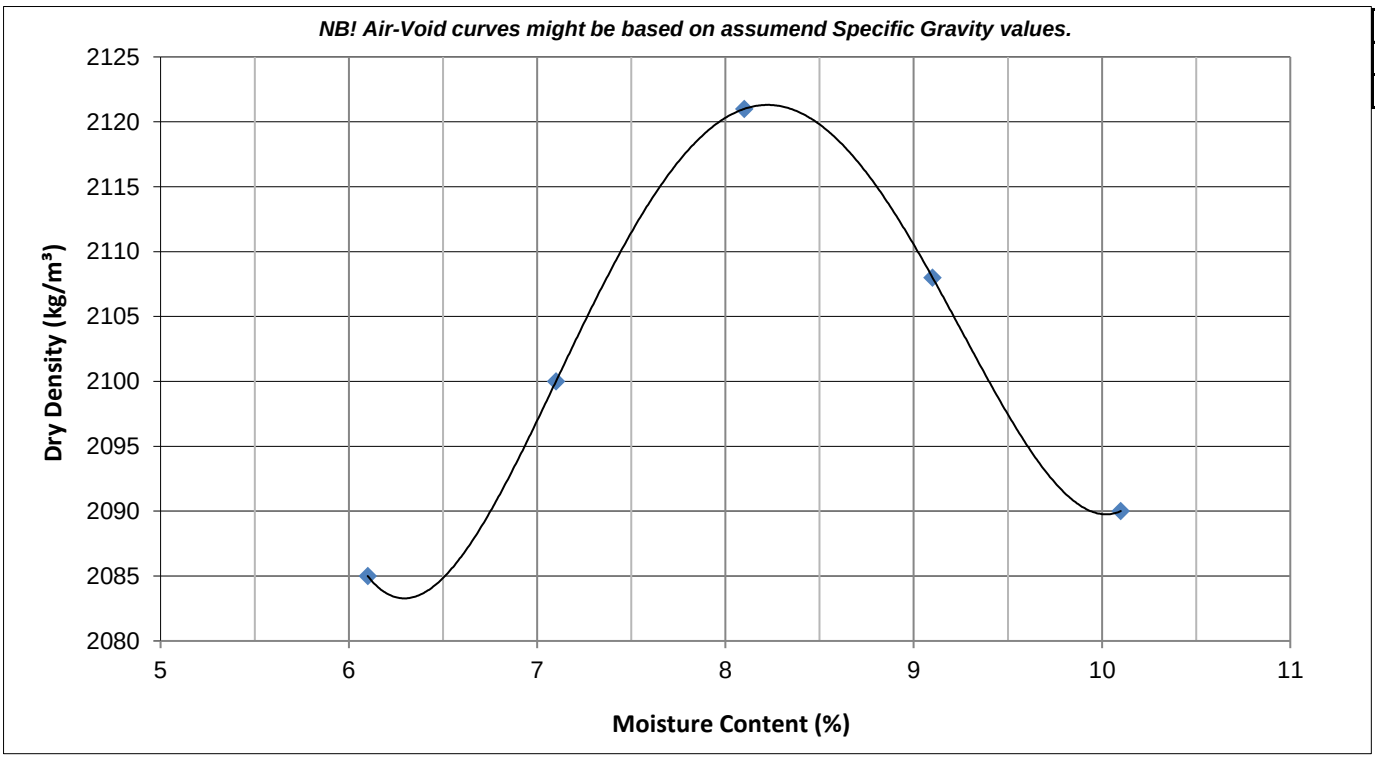
Laboratory Number		3
Field Number		TP9
Client Reference		
Depth (m)		1.50-2.90
Position		
Coordinates	X	
	Y	
Description		
Additional Information		
Calcrete / Crushed		
Stabilizing Agent		

Maximum Dry Density & Optimum Moisture Content - SANS3001: G30

Compactive Effort:	Modified AASHTO

Dry Density	kg/m³	2085	2100	2121	2108	2090	
Moisture Content	%	6.1	7.1	8.1	9.1	10.1	

Max. Dry Density	kg/m³	2121
Optimum Moisture	%	8.2



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Client	:	J G AFRIKA	Date Received	:	29/04/2019
Project	:	COJ Biomethane	Date Reported	:	13/05/2019
Project No.	:	2019-B-617	Page No.	:	6 of 6

CALIFORNIA BEARING RATIO (CBR) & ROAD INDICATOR REPORT

Laboratory No.		2 ◆	3 ■
Field Number		TP8	TP9
Client Reference			
Depth (m)		1.50-2.60	1.50-2.90
Position			
Coordinates	X		
	Y		
Description			
Additional information			
Calcrete/Crushed			
Stabilizing Agent			

Sieve Analysis (Wet preparation) — SANS3001: GR1

Percentage Passing	100 mm	100	100
	75 mm	100	100
	63 mm	100	100
	50 mm	100	100
	37.5 mm	100	100
	28 mm	100	100
	20 mm	100	100
	14 mm	100	89
	5 mm	93	61
	2 mm	86	52
	1 mm	78	46
	0.425 mm	60	33
	0.250 mm	56	29
	0.150 mm	51	25
	0.075 mm	46	21
Grading Modulus		1.1	1.9

Soil Mortar Analysis

Coarse Sand	30	37
Coarse Fine Sand	5	7
Medium Fine Sand	5	8
Fine Fine Sand	7	7
Silt and Clay	53	41

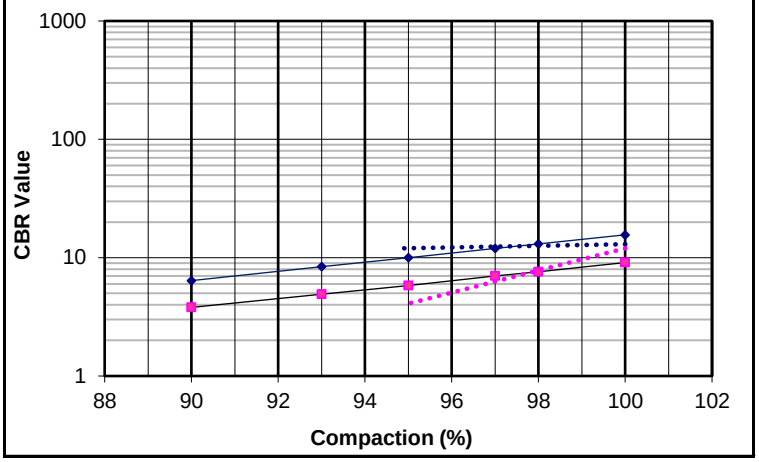
Atterberg Limits — SANS3001: G10

Liquid Limit (%)	37	33
Plasticity Index (%)	18	13
Linear Shrinkage (%)	7.5	5.5

Laboratory No.		2 ◆	3 ■
Maximum Dry Density & Optimum Moisture Content			**SANS3001: G30**
MDD	kg/m^3	1895	2121
OMC	%	13.3	8.2

California Bearing Ratio — SANS3001: GR40

Compaction Data							
Moisture	%	13.3			8.2		
Dry Density	kg/m^3	1918	1821	1725	2144	2034	1932
Compaction	%	100.0	94.9	89.9	100.0	94.9	90.1
Penetration Data							
CBR at	2.50 mm	13	12	6	12	4	4
	5.00 mm	11	11	6	15	5	5
	7.50 mm	10	10	5	17	6	6
Swell	%	0.6	0.7	1	2.1	2.3	2.5
Final Moisture (%)		16.3	19.3	22.3	13.7	15.4	18.7

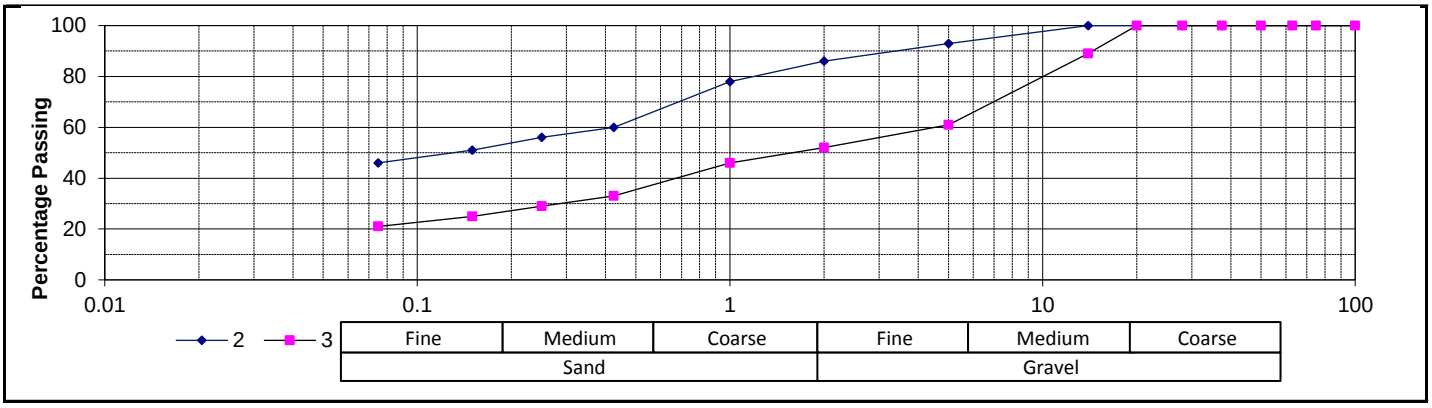


Interpolated CBR Data

CBR Mod. AASHTO	@ 100%		16	9
	@ 98%		13	8
	@ 97%		12	7
	@ 95%		10	6
	@ 93%		8	5
	@ 90%		6	4
	@	SANS3001 Midpoint	13	7

Classifications

HRB (AASHTO)	A-6(5)	A-2-6(0)
COLTO	None	None
TRH14	G10	None



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CONSOLIDATION TEST RESULTS - BS 1377: Part 5

Project	COJ BIOMETHANE	Date Tested:	27/3/2019
Project No.	2019-B-425	Laboratory Number:	3
Field Sample Reference	TP 3	Depth (m):	1.2 - 1.5

Test No.	1	
Test Type	Collapse Potential	
Remarks	Collapse Potential: 4.06%	

Specimen-, Preparation- & Test Conditions

Specimen Type	Undisturbed	
Moulding Dry Density		
Moulding Moisture		
Testing Moisture	Soaked @ 200kPa	

Equipment Detail

Machiene No.		OED17	
Ring	No.	15	
	Mass (g)	84.5	
	Height (mm)	19.15	
	Diameter (mm)	69.84	

Specimen Parameters

Stage	Initial	Final (Unloaded)	Initial	Final (Unloaded)
Relative density (S.G.)	2.650			
Moisture Content (%)	20.5	21.9		
Dry Density (kg/m^3)	1299	1589		
Void Ratio, e	1.041	0.668		
Degree of Saturation (%)	52	87		

Test Data

Test 1

Cycle	No.	1	2	3	4	5	6	7	8								
Total time	min	1067	1368	428.5	3881	108.2	146.4	108.2	1069								
Stress	kPa	10	51	100	198	198	398	100	10								
Strain	%	0.18	1.19	3.57	9.57	13.63	19.27	19.08	18.27								
Void Ratio	e	1.037	1.017	0.968	0.845	0.763	0.648	0.651	0.668								
Mv (1/MPa)		0.000	0.246	0.486	0.613		0.282	0.006	0.090								
t90	min																
Cv	m^2/year																

Test 2

Cycle	No.																
Total time	min																
Stress	kPa																
Strain	%																
Void Ratio	e																
Mv (1/MPa)																	
t90	min																
Cv	m^2/year																

The t90 values reported, if any, which are used to calculate the coefficient of consolidation at different loads are selected by the operator conducting the test and checked by the appropriate technical signatories. They may however not reflect an engineer's interpretation of the time settlement graphs and are by no means final.

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CONSOLIDATION TEST RESULTS - BS 1377: Part 5

Project	COJ BIOMETHANE	Date Tested	27/3/2019
Project No.	2019-B-425	Laboratory Number	3
Field Sample Reference	TP 3	Depth (m)	1.2 - 1.5

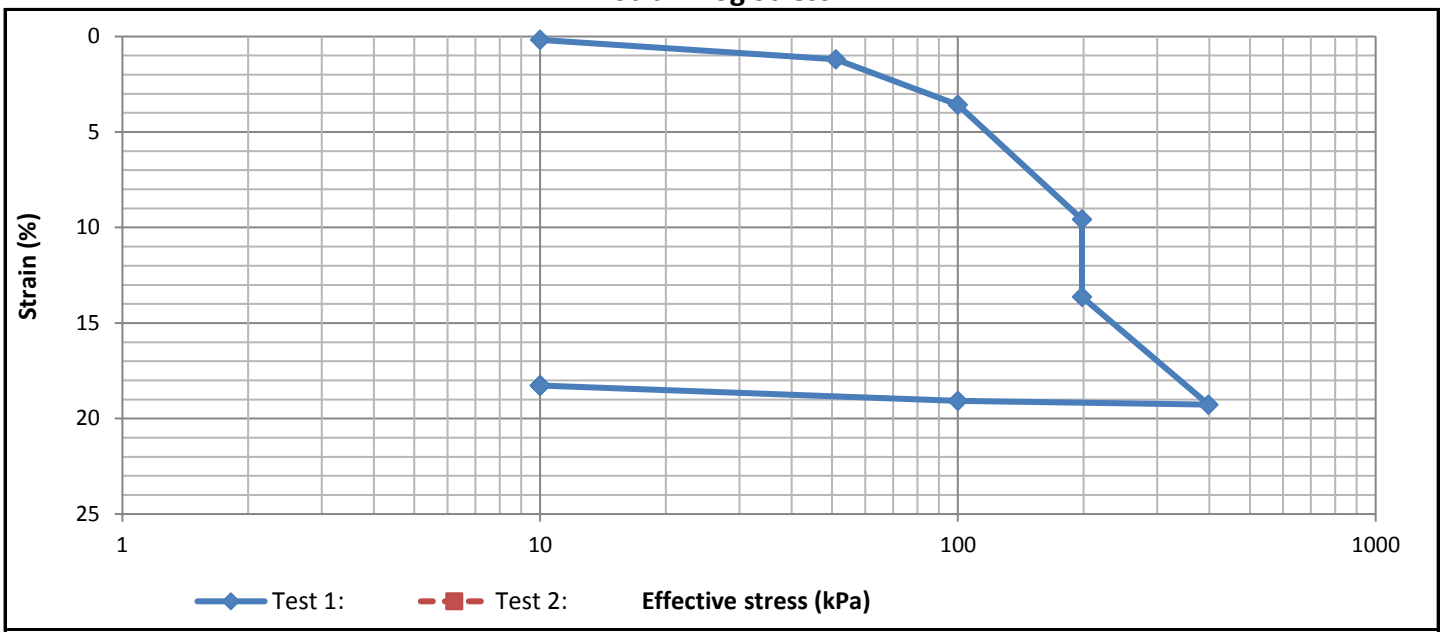
Test 1: **Specimen: Undisturbed , Testing Moisture: Soaked @ 200kPa**

Cycle	1	2	3	4	5	6	7	8								
Stress (kPa)	10	51	100	198	198	398	100	10								
Strain (%)	0.18	1.19	3.57	9.57	13.63	19.27	19.08	18.27								
Void Ratio, e	1.037	1.017	0.968	0.845	0.763	0.648	0.651	0.668								

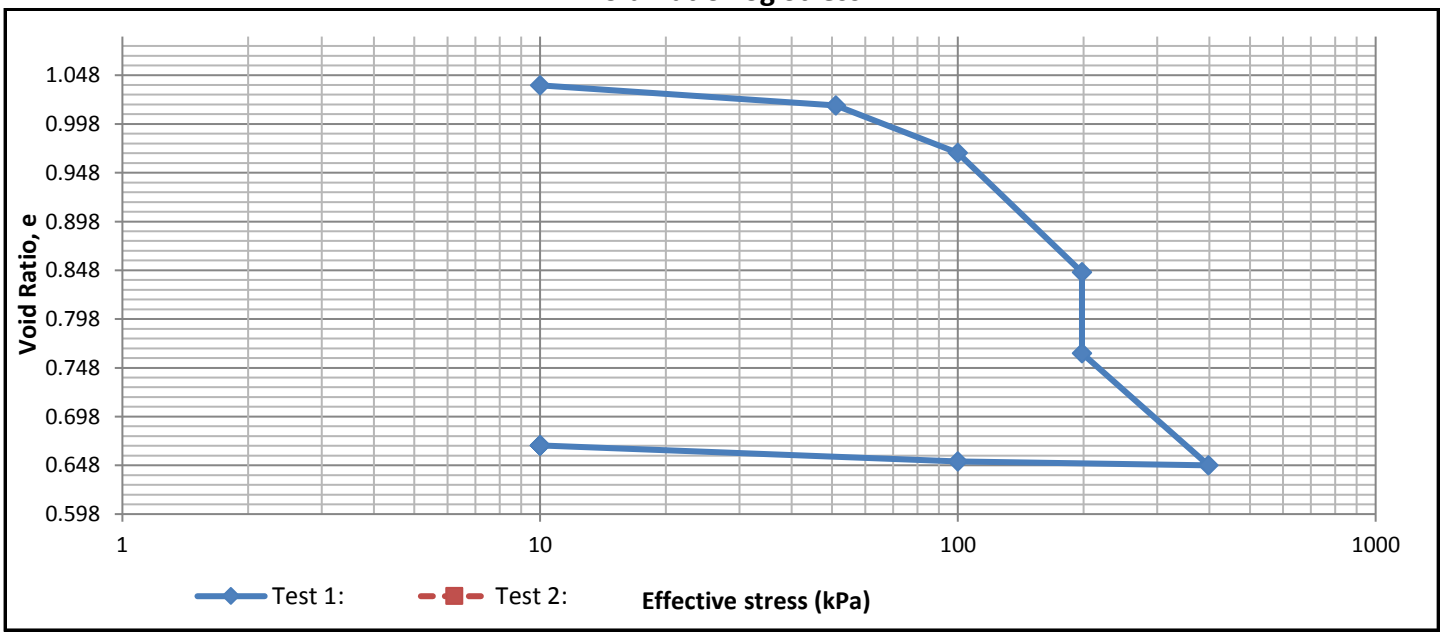
Test 2:

Cycle																
Stress (kPa)																
Strain (%)																
Void Ratio, e																

Strain Log Stress



Void Ratio Log Stress



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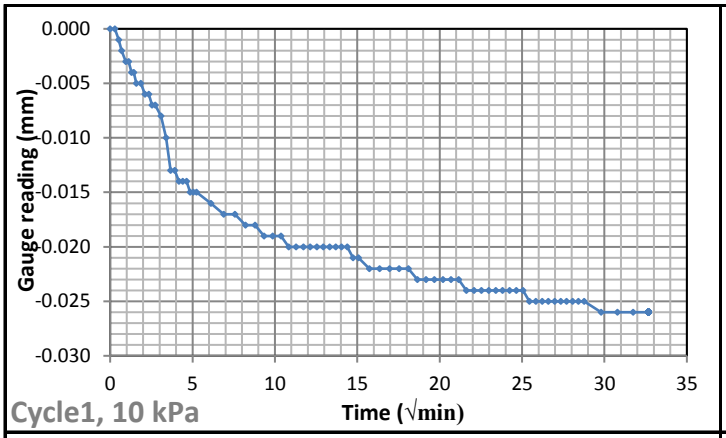
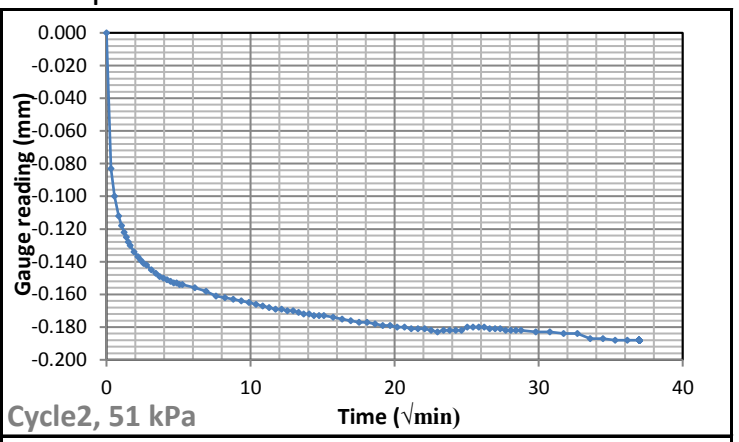
CONSOLIDATION TEST RESULTS - BS 1377: Part 5

Project	COJ BIOMETHANE	Date Tested:	27/3/2019
Project No.	2019-B-425	Laboratory Number:	3
Field Sample Reference	TP 3	Depth (m):	1.2 - 1.5

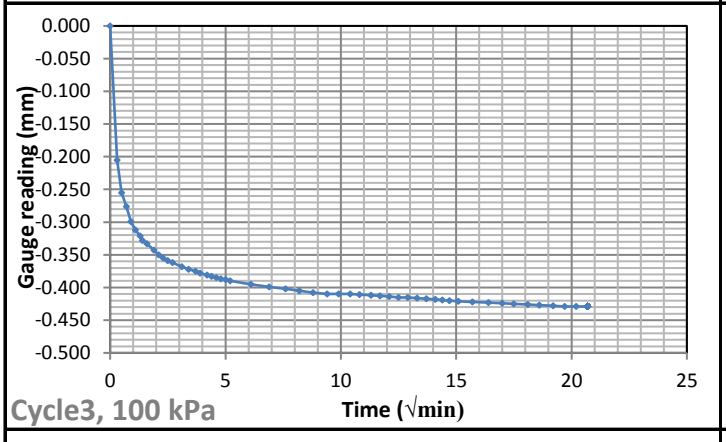
Test 1 - Consolidation vs Square Root Time



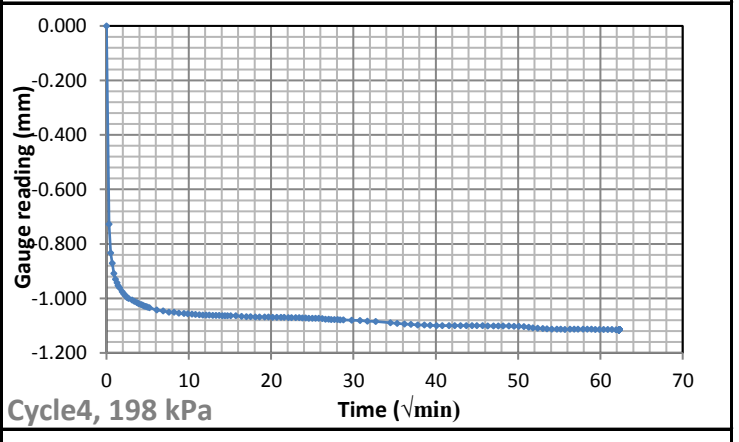
Cycle1, 10 kPa



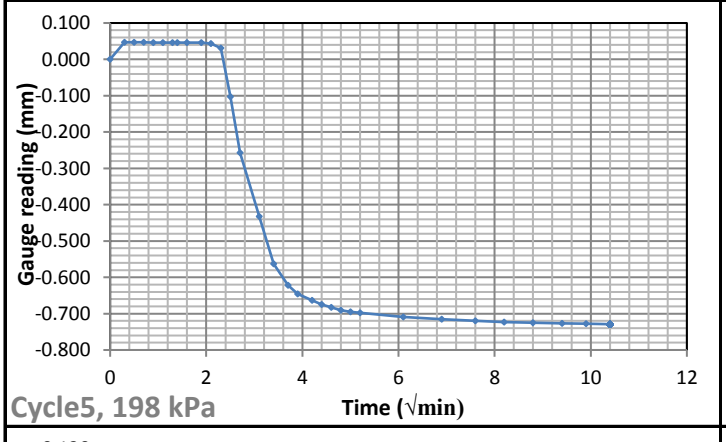
Cycle2, 51 kPa



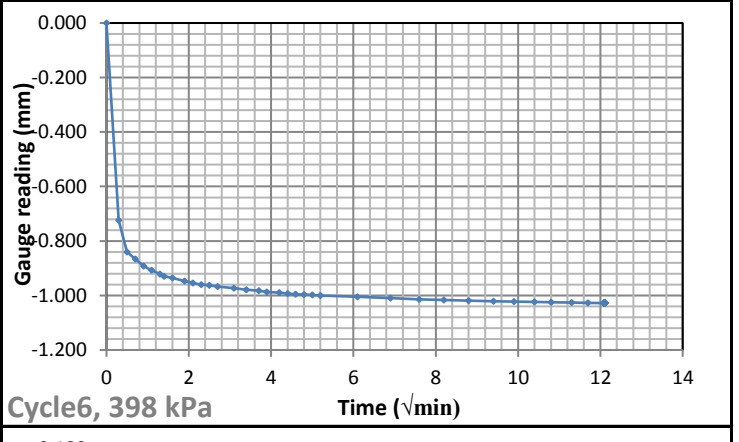
Cycle3, 100 kPa



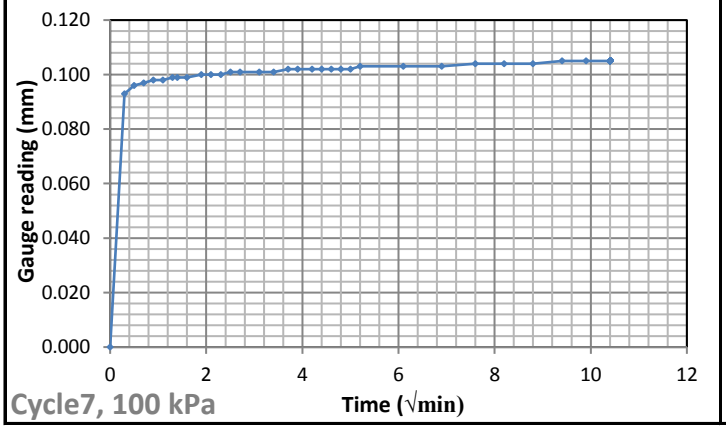
Cycle4, 198 kPa



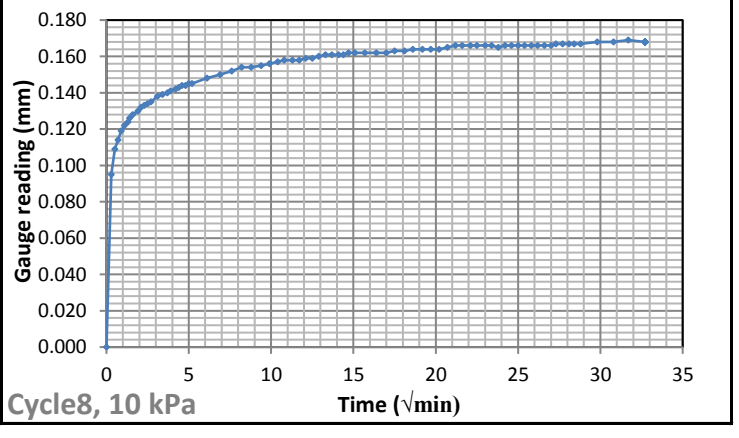
Cycle5, 198 kPa



Cycle6, 398 kPa



Cycle7, 100 kPa



Cycle8, 10 kPa

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CONSOLIDATION TEST RESULTS - BS 1377: Part 5

Project	COJ BIOMETHANE	Date Tested:	28/3/2019
Project No.	2019-B-425	Laboratory Number:	3
Field Sample Reference	TP 3	Depth (m):	1.2 - 1.5

Test No.	1	
Test Type	Standard Consolidation	
Remarks		

Specimen-, Preparation- & Test Conditions

Specimen Type	Undisturbed	
Moulding Dry Density		
Moulding Moisture		
Testing Moisture	Soaked @ 10kPa	

Equipment Detail

Machiene No.		OED1	
Ring	No.	31	
	Mass (g)	82.5	
	Height (mm)	19.51	
	Diameter (mm)	76.08	

Specimen Parameters

Stage	Initial	Final (Unloaded)	Initial	Final (Unloaded)
Relative density (S.G.)	2.650			
Moisture Content (%)	21.4	17.4		
Dry Density (kg/m^3)	1186	1605		
Void Ratio, e	1.234	0.652		
Degree of Saturation (%)	46	71		

Test Data

Test 1

Cycle	No.	1	2	3	4	5	6	7	8	9	10						
Total time	min	947.4	327.6	4007	116.6	146.4	98.01	108.2	948.6	428.5	948.6						
Stress	kPa	10	50	100	200	400	800	1600	400	100	10						
Strain	%	0.26	6.47	12.37	16.46	20.75	24.63	27.86	27.67	27.26	26.07						
Void Ratio	e	1.228	1.089	0.958	0.866	0.770	0.684	0.612	0.616	0.625	0.652						
Mv (1/MPa)		0.000	1.553	1.180	0.409	0.214	0.097	0.040	0.002	0.014	0.133						
t90	min																
Cv	m^2/year																

Test 2

Cycle	No.																
Total time	min																
Stress	kPa																
Strain	%																
Void Ratio	e																
Mv (1/MPa)																	
t90	min																
Cv	m^2/year																

The t90 values reported, if any, which are used to calculate the coefficient of consolidation at different loads are selected by the operator conducting the test and checked by the appropriate technical signatories. They may however not reflect an engineer's interpretation of the time settlement graphs and are by no means final.

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CONSOLIDATION TEST RESULTS - BS 1377: Part 5

Project	COJ BIOMETHANE	Date Tested	28/3/2019
Project No.	2019-B-425	Laboratory Number	3
Field Sample Reference	TP 3	Depth (m)	1.2 - 1.5

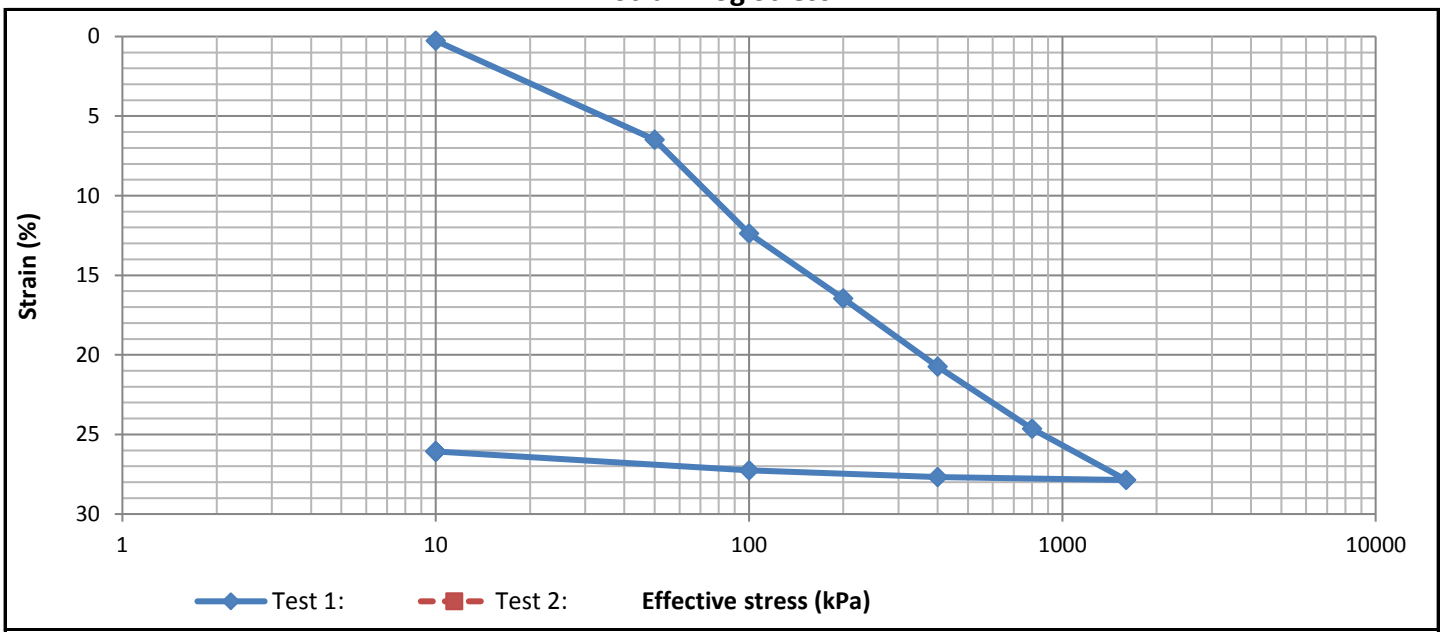
Test 1: **Specimen: Undisturbed , Testing Moisture: Soaked @ 10kPa**

Cycle	1	2	3	4	5	6	7	8	9	10						
Stress (kPa)	10	50	100	200	400	800	1600	400	100	10						
Strain (%)	0.26	6.47	12.37	16.46	20.75	24.63	27.86	27.67	27.26	26.07						
Void Ratio, e	1.228	1.089	0.958	0.866	0.770	0.684	0.612	0.616	0.625	0.652						

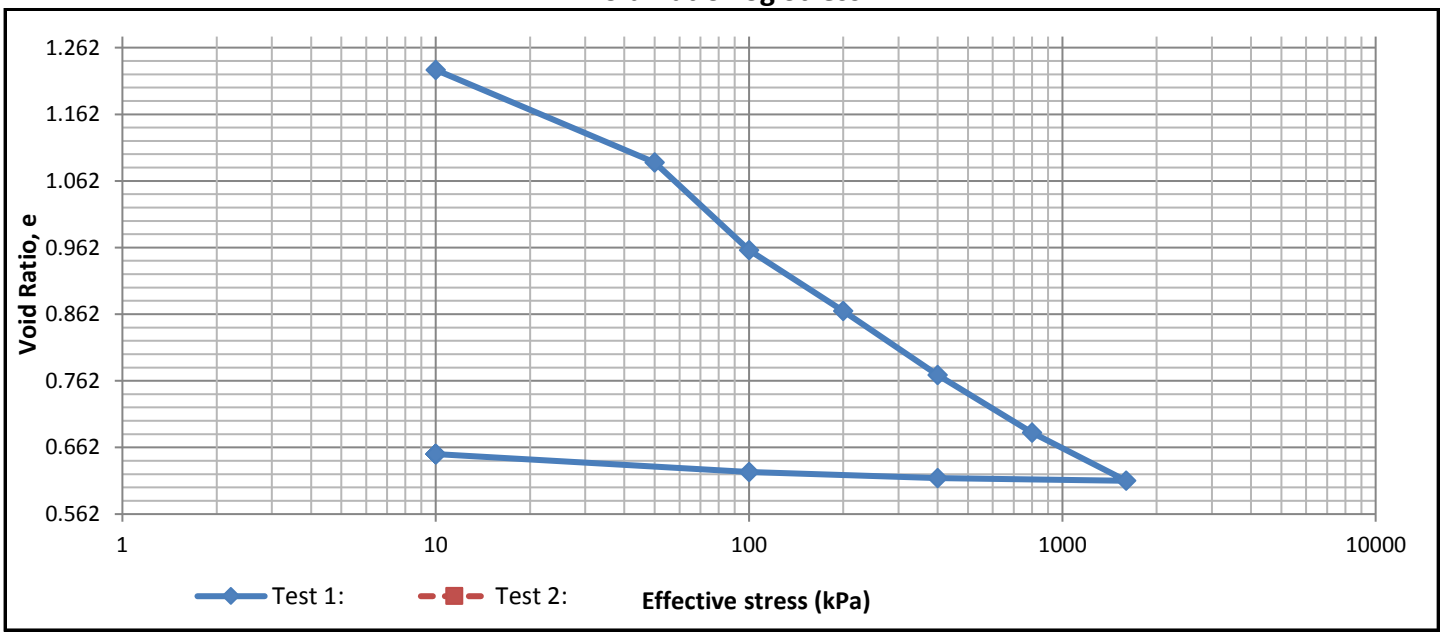
Test 2:

Cycle																
Stress (kPa)																
Strain (%)																
Void Ratio, e																

Strain Log Stress



Void Ratio Log Stress



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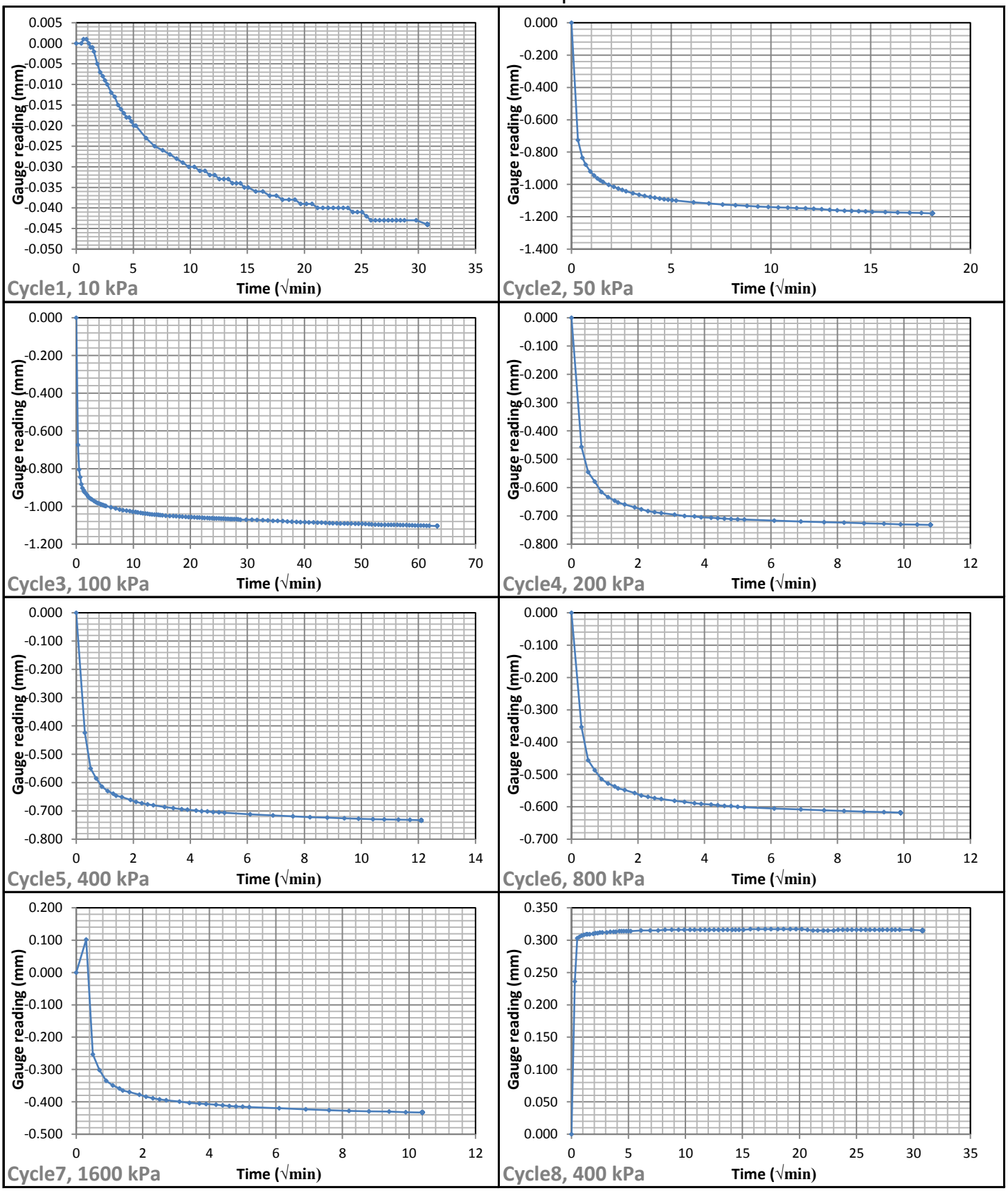
CONSOLIDATION TEST RESULTS - BS 1377: Part 5

Project	COJ BIOMETHANE	Date Tested:	28/3/2019
Project No.	2019-B-425	Laboratory Number:	3
Field Sample Reference	TP 3	Depth (m):	1.2 - 1.5

Test 1 - Consolidation vs Square Root Time



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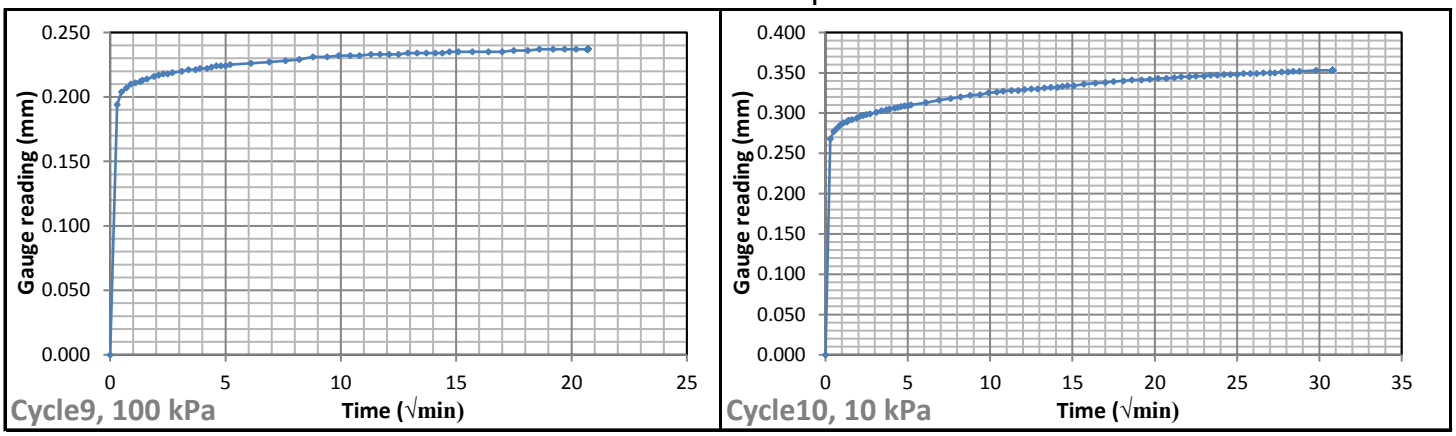
CONSOLIDATION TEST RESULTS - BS 1377: Part 5

Project	COJ BIOMETHANE	Date Tested:	28/3/2019
Project No.	2019-B-425	Laboratory Number:	3
Field Sample Reference	TP 3	Depth (m):	1.2 - 1.5

Test 1 - Consolidation vs Square Root Time



Annexure C: DCP RESULTS

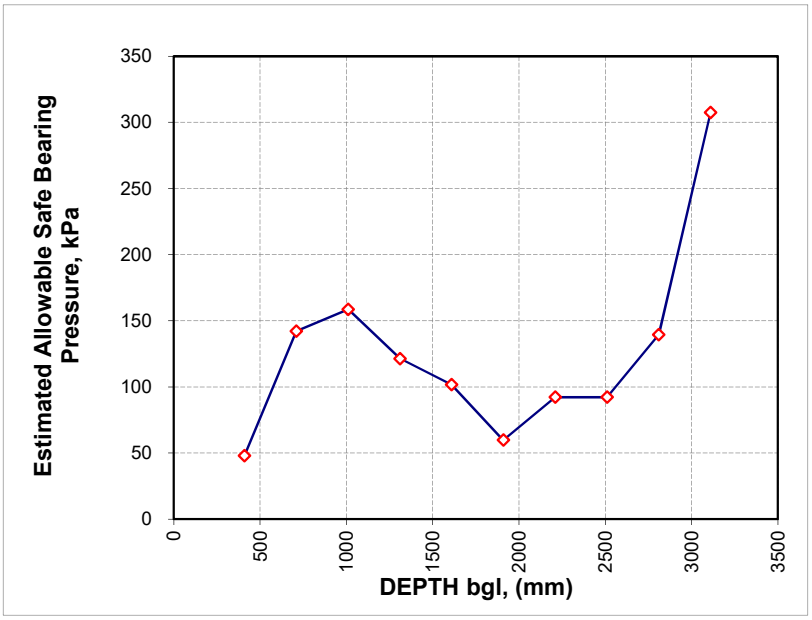
EASBP FROM DCP, clay

Job Name COJ Biomethane Plant

File No: Job No: 5037 Date of Test: 20/03/2019

DCP No: Location: Core 1

note: EASBP= SuxNc/FOS Su from N via T3 of Geotermin ology



Penetration Guide

SPT N mm/blow	DCP DN	consistency
< 5	132-210	Very Dense
5 - 10	78-132	Dense
10 - 30	25-78	Med Dense
30 - 75	10 25	Loose
75 -100	<10	Very Loose

NOTE :
Stated consistencies do not apply to cohesive materials. Describe using "stiff or firm or soft".

SPT N	Descr	DN
5	V soft	13
10	Soft	26
25	Firm	66
50	Stiff	132
80	V stiff	211

Geoterminology Table 3

Depth of hole in which DCP was taken : 260 mm below NGL

Nc 5 FOS 3

Remarks : Test terminated at 2.40m (>100 blows/300mm recorded)

Reading No.	Layer From	Layer To	Average Layer Depth	DCP DN Blows/layer	Level Below NGL mm	DCP penetration mm/blow	Equiv. SPT N Value	Approx Su kPa	Approx EASBP kPa
1	0	300	150	7	410	43	3	29	48
2	300	600	450	48	710	6	18	85	142
3	600	900	750	54	1010	6	21	95	159
4	900	1200	1050	40	1310	8	15	73	121
5	1200	1500	1350	32	1610	9	12	61	102
6	1500	1800	1650	13	1910	23	5	36	60
7	1800	2100	1950	28	2210	11	11	55	92
8	2100	2400	2250	28	2510	11	11	55	92
9	2400	2700	2550	47	2810	6	18	84	140
10	2700	3000	2850	100	3110	3	38	185	308

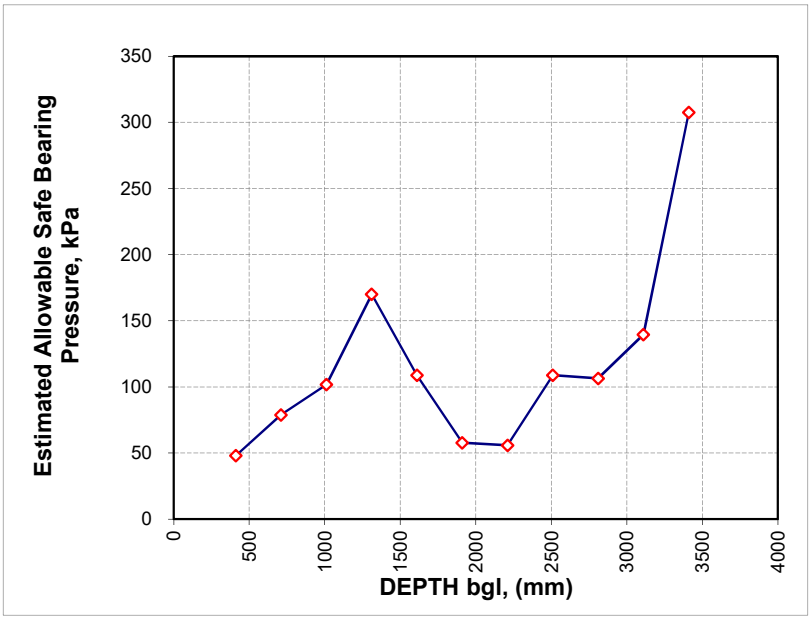
EASBP FROM DCP, clay

Job Name COJ Biomethane Plant

File No: Job No: 5037 Date of Test: 20/03/2019

DCP No: Location: Core 2

note: EASBP= SuxNc/FOS Su from N via T3 of Geotermin ology



Penetration Guide

SPT N mm/blow	DCP DN	consistency
< 5	132-210	Very Dense
5 - 10	78-132	Dense
10 - 30	25-78	Med Dense
30 - 75	10 25	Loose
75 -100	<10	Very Loose

NOTE :
Stated consistencies do not apply to cohesive materials. Describe using "stiff or firm or soft".

SPT N	Descr	DN
5	V soft	13
10	Soft	26
25	Firm	66
50	Stiff	132
80	V stiff	211

Geoterminology Table 3

Depth of hole in which DCP was taken : 260 mm below NGL

Nc 5 FOS 3

Remarks : Test terminated at 2.40m (>100 blows/300mm recorded)

Reading No.	Layer From	Layer To	Average Layer Depth	DCP DN Blows/layer	Level Below NGL mm	DCP penetration mm/blow	Equiv. SPT N Value	Approx Su kPa	Approx EASBP kPa
1	0	300	150	7	410	43	3	29	48
2	300	600	450	22	710	14	8	47	79
3	600	900	750	32	1010	9	12	61	102
4	900	1200	1050	58	1310	5	22	102	170
5	1200	1500	1350	35	1610	9	13	65	109
6	1500	1800	1650	12	1910	25	5	35	58
7	1800	2100	1950	11	2210	27	4	33	56
8	2100	2400	2250	35	2510	9	13	65	109
9	2400	2700	2550	34	2810	9	13	64	106
10	2700	3000	2850	47	3110	6	18	84	140
11	3000	3300	3150	100	3410	3	38	185	308

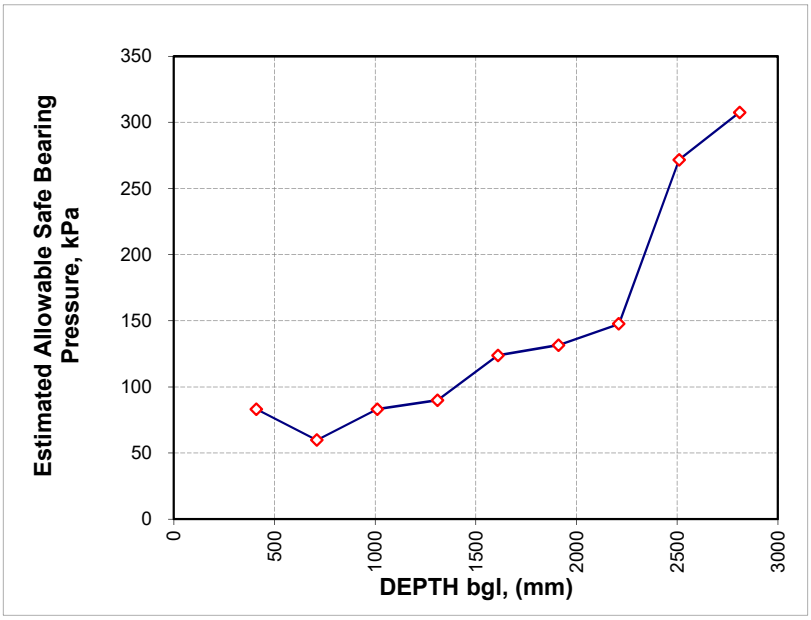
EASBP FROM DCP, clay

Job Name COJ Biomethane Plant

File No: Job No: 5037 Date of Test: 20/03/2019

DCP No: 1 Location: TP2

note: EASBP= SuxNc/FOS Su from N via T3 of Geotermin ology



Penetration Guide

SPT N mm/blow	DCP DN	consistency
< 5	132-210	Very Dense
5 - 10	78-132	Dense
10 - 30	25-78	Med Dense
30 - 75	10 25	Loose
75 -100	<10	Very Loose

NOTE :
Stated consistencies do not apply to cohesive materials. Describe using "stiff or firm or soft".

SPT N	Descr	DN
5	V soft	13
10	Soft	26
25	Firm	66
50	Stiff	132
80	V stiff	211

Geoterminology Table 3

Depth of hole in which DCP was taken : 260 mm below NGL

Nc 5 FOS 3

Remarks : Test terminated at 2.40m (>100 blows/300mm recorded)

Reading No.	Layer From	Layer To	Average Layer Depth	DCP DN Blows/layer	Level Below NGL mm	DCP penetration mm/blow	Equiv. SPT N Value	Approx Su kPa	Approx EASBP kPa
1	0	300	150	24	410	13	9	50	83
2	300	600	450	13	710	23	5	36	60
3	600	900	750	24	1010	13	9	50	83
4	900	1200	1050	27	1310	11	10	54	90
5	1200	1500	1350	41	1610	7	16	74	124
6	1500	1800	1650	44	1910	7	17	79	132
7	1800	2100	1950	50	2210	6	19	89	148
8	2100	2400	2250	90	2510	3	34	163	272
9	2400	2700	2550	100	2810	3	38	185	308

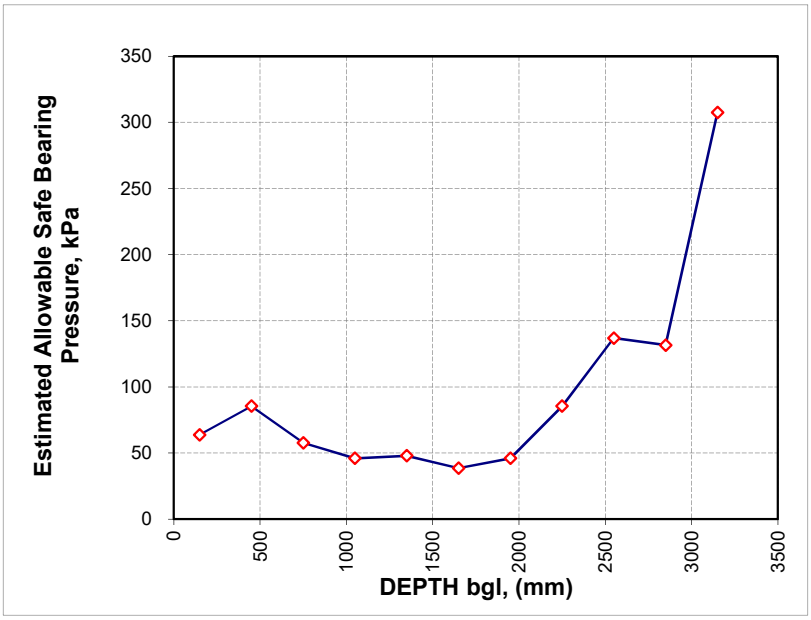
EASBP FROM DCP, clay

Job Name COJ Biomethane Plant

File No: Job No: 5037 Date of Test: 20/03/2019

DCP No: 2 Location: TP3

note: EASBP= SuxNc/FOS Su from N via T3 of Geotermin ology



Penetration Guide

SPT N mm/blow	DCP DN	consistency
< 5	132-210	Very Dense
5 - 10	78-132	Dense
10 - 30	25-78	Med Dense
30 - 75	10 25	Loose
75 -100	<10	Very Loose

NOTE :
Stated consistencies do not apply to cohesive materials. Describe using "stiff or firm or soft".

SPT N	Descr	DN
5	V soft	13
10	Soft	26
25	Firm	66
50	Stiff	132
80	V stiff	211

Geoterminology Table 3

Depth of hole in which DCP was taken : 0 mm below NGL

Nc 5 FOS 3

Remarks : Test terminated at 2.40m (>100 blows/300mm recorded)

Reading No.	Layer From	Layer To	Average Layer Depth	DCP DN Blows/layer	Level Below NGL mm	DCP penetration mm/blow	Equiv. SPT N Value	Approx Su kPa	Approx EASBP kPa
1	0	300	150	15	150	20	6	38	64
2	300	600	450	25	450	12	10	51	85
3	600	900	750	12	750	25	5	35	58
4	900	1200	1050	6	1050	50	2	28	46
5	1200	1500	1350	7	1350	43	3	29	48
6	1500	1800	1650	2	1650	150	1	23	39
7	1800	2100	1950	6	1950	50	2	28	46
8	2100	2400	2250	25	2250	12	10	51	85
9	2400	2700	2550	46	2550	7	17	82	137
10	2700	3000	2850	44	2850	7	17	79	132
11	3000	3300	3150	100	3150	3	38	185	308

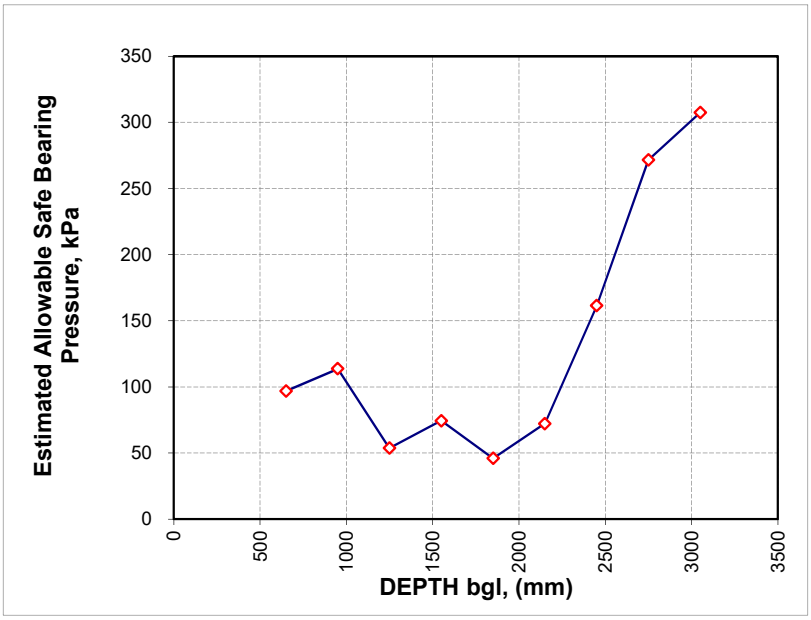
EASBP FROM DCP, clay

Job Name COJ Biomethane Plant

File No: Job No: 5037 Date of Test: 20/03/2019

DCP No: 3 Location: TP7

note: EASBP= SuxNc/FOS Su from N via T3 of Geotermin ology



Penetration Guide

SPT N mm/blow	DCP DN	consistency
< 5	132-210	Very Dense
5 - 10	78-132	Dense
10 - 30	25-78	Med Dense
30 - 75	10 25	Loose
75 -100	<10	Very Loose

NOTE :
Stated consistencies do not apply to cohesive materials. Describe using "stiff or firm or soft".

SPT N	Descr	DN
5	V soft	13
10	Soft	26
25	Firm	66
50	Stiff	132
80	V stiff	211
Geoterminology		Table 3

Depth of hole in which DCP was taken : 500 mm below NGL

Nc 5 FOS 3

Remarks : Test terminated at 2.40m (>100 blows/300mm recorded)

Reading No.	Layer From	Layer To	Average Layer Depth	DCP DN Blows/layer	Level Below NGL mm	DCP penetration mm/blow	Equiv. SPT N Value	Approx Su kPa	Approx EASBP kPa
1	0	300	150	30	650	10	11	58	97
2	300	600	450	37	950	8	14	68	114
3	600	900	750	10	1250	30	4	32	54
4	900	1200	1050	20	1550	15	8	45	74
5	1200	1500	1350	6	1850	50	2	28	46
6	1500	1800	1650	19	2150	16	7	43	72
7	1800	2100	1950	55	2450	5	21	97	161
8	2100	2400	2250	90	2750	3	34	163	272
9	2400	2700	2550	100	3050	3	38	185	308

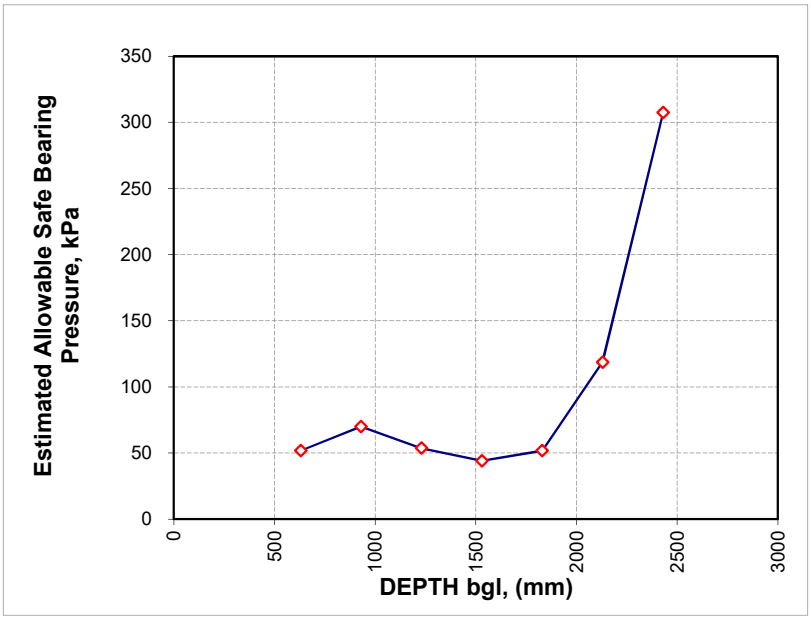
EASBP FROM DCP, clay

Job Name COJ Biomethane Plant

File No: Job No: 5037 Date of Test: 20/03/2019

DCP No: 4 Location: TP8

note: EASBP= SuxNc/FOS Su from N via T3 of Geotermin ology



Penetration Guide

SPT N mm/blow	DCP DN	consistency
< 5	132-210	Very Dense
5 - 10	78-132	Dense
10 - 30	25-78	Med Dense
30 - 75	10 25	Loose
75 -100	<10	Very Loose

NOTE :
Stated consistencies do not apply to cohesive materials. Describe using "stiff or firm or soft".

SPT N	Descr	DN
5	V soft	13
10	Soft	26
25	Firm	66
50	Stiff	132
80	V stiff	211

Geoterminology Table 3

Depth of hole in which DCP was taken : 480 mm below NGL

Nc 5 FOS 3

Remarks : Test terminated at 2.40m (>100 blows/300mm recorded)

Reading No.	Layer From	Layer To	Average Layer Depth	DCP DN Blows/layer	Level Below NGL mm	DCP penetration mm/blow	Equiv. SPT N Value	Approx Su kPa	Approx EASBP kPa
1	0	300	150	9	630	33	3	31	52
2	300	600	450	18	930	17	7	42	70
3	600	900	750	10	1230	30	4	32	54
4	900	1200	1050	5	1530	60	2	26	44
5	1200	1500	1350	9	1830	33	3	31	52
6	1500	1800	1650	39	2130	8	15	71	119
7	1800	2100	1950	100	2430	3	38	185	308

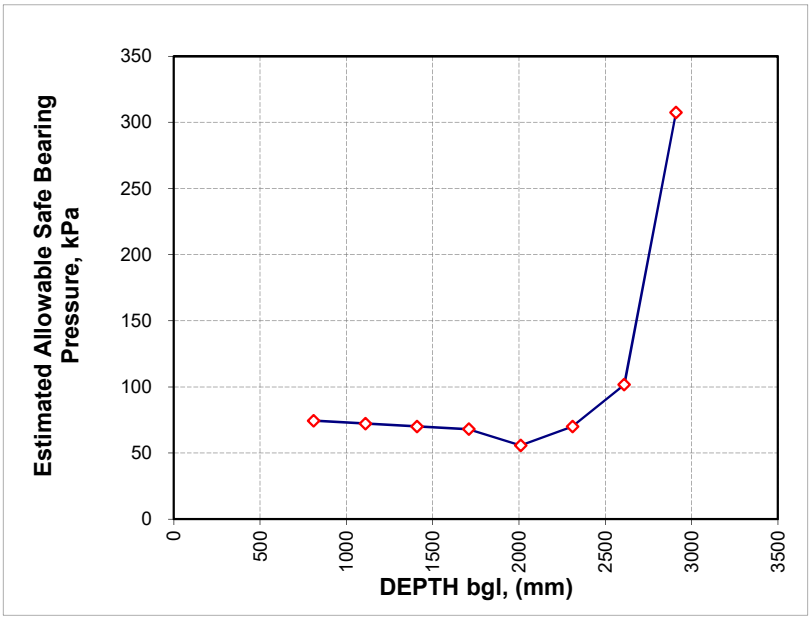
EASBP FROM DCP, clay

Job Name COJ Biomethane Plant

File No: Job No: 5037 Date of Test: 20/03/2019

DCP No: 5 Location: TP9

note: EASBP= SuxNc/FOS Su from N via T3 of Geotermin ology



Penetration Guide

SPT N mm/blow	DCP DN	consistency
< 5	132-210	Very Dense
5 - 10	78-132	Dense
10 - 30	25-78	Med Dense
30 - 75	10 25	Loose
75 -100	<10	Very Loose

NOTE :
Stated consistencies do not apply to cohesive materials. Describe using "stiff or firm or soft".

SPT N	Descr	DN
5	V soft	13
10	Soft	26
25	Firm	66
50	Stiff	132
80	V stiff	211

Geoterminology Table 3

Depth of hole in which DCP was taken : 660 mm below NGL

Nc 5 FOS 3

Remarks : Test terminated at 2.40m (>100 blows/300mm recorded)

Reading No.	Layer From	Layer To	Average Layer Depth	DCP DN Blows/layer	Level Below NGL mm	DCP penetration mm/blow	Equiv. SPT N Value	Approx Su kPa	Approx EASBP kPa
1	0	300	150	20	810	15	8	45	74
2	300	600	450	19	1110	16	7	43	72
3	600	900	750	18	1410	17	7	42	70
4	900	1200	1050	17	1710	18	6	41	68
5	1200	1500	1350	11	2010	27	4	33	56
6	1500	1800	1650	18	2310	17	7	42	70
7	1800	2100	1950	32	2610	9	12	61	102
8	2100	2400	2250	100	2910	3	38	185	308