NKHOPHELE HOLDINGS

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GEOTECHNICAL INVESTIGATION

Transnet Beaconsfield Refuelling Depot, Kimberley Final Report

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Executive Summary

Nkhophele Holdings conducted a geotechnical investigation in November 2021 for the construction of a proposed refueling depot situated in Beaconsfield, Kimberley, Northern Cape Province. The site investigation was aimed at evaluating engineering characteristics of near surface soils underlying the site.

Test pitting, DPSH and laboratory testing were used to conduct the investigation. Five (5) test pits were advanced on the site. The test pitting indicates the site to be underlain by homogeneous soils. The site is underlain by surficial soils comprising residual dolerite which is underlain by dolerite bedrock.

The investigation findings suggest that the soils encountered on the site may exhibit low to medium potential expansiveness with medium plasticity. The investigation findings further suggest that the site is underlain by soil material classifying as G7 and G9 according to TRH14 guidelines. The surficial soils underlying the site can be classified as: **2/H1/C1.**

Overall, the geotechnical investigation indicates that the site is developable albeit with precautionary measures.

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1. INTRODUCTION

Nkhophele Holdings has been appointed by IKAMVA Consulting to carry out a geotechnical investigation study for the construction of the proposed Refuelling Depot of a combined storage of 460 000L. The refueling depot` is a vertical cylindrical tank structure. This report presents the findings of the geotechnical investigation carried out on the site.

2. TERMS OF REFERENCE AND SCOPE OF WORK

The investigation was commissioned for the purpose of constructing a proposed Refuelling Depot. The project entails the establishment of the baseline conditions on the proposed site through a geotechnical study. The site investigation was carried out in accordance with SAIEG, GFSH-2 and TRH14 guidelines and included the following:

- Test pitting, in-situ soil profiling, and sampling;
- DPSH Testing
- Laboratory Testing;
- Site classification according to GFSH-2 and NHBRC Guidelines and;
- Material classification according to TRH13 and TRH14 Guidelines.

3. SITE DESCRIPTION

3.1. LOCATION

The site is located in Beaconsfield, Kimberley, Northern Cape Province near the National Road, N8 along Austen Street (Figure 1). The site is approximately 1.3 km southwest of Beaconsfield Central. The investigated area of the site is approximately 5070 m^2 and it is located within Transnet freight Rail. The centre coordinates of the site are 28°46'6.22"S; 24°46'15.57"E. The site is covered by low grass vegetation and there are existing railway structures on the site.

Figure 1. Site Locality

3.2. CLIMATE

The site is in the climatic region characterized by warm to hot rainy summers and cold dry winters. The annual average temperature in Kimberley is 18.6°C with midday temperatures ranging from 10.5°C in July to 24°C in January. The mean annual precipitation is approximately 500 mm, with the most rainfall occurring in January and least rainfall in July. The site is in a region with a Weinert N-value of greater than 5. This indicates that mechanical disintegration is the dominant form of weathering over chemical decomposition.

3.3. TOPOGRAPHY AND DRAINAGE

The site has a relatively flat surface with a 1.6% slope falling from 1217 masl (meters above sea level) on the southwestern end to 1216 masl on the northeastern end. Stormwater runoff is not anticipated on the site therefore the site must be shaped to improve stormwater drainage.

3.4. GEOLOGY

According to the geological map series 2824 Kimberley, the regional geology of the area comprises Jurassic aged Intrusive mafic rocks. These rocks intruded the Karoo Supergroup locally comprising carbonaceous shale of the Whitehill formation which forms part of the Ecca group. The site is immediately underlain by medium-grained Dolerite (Figure 2).

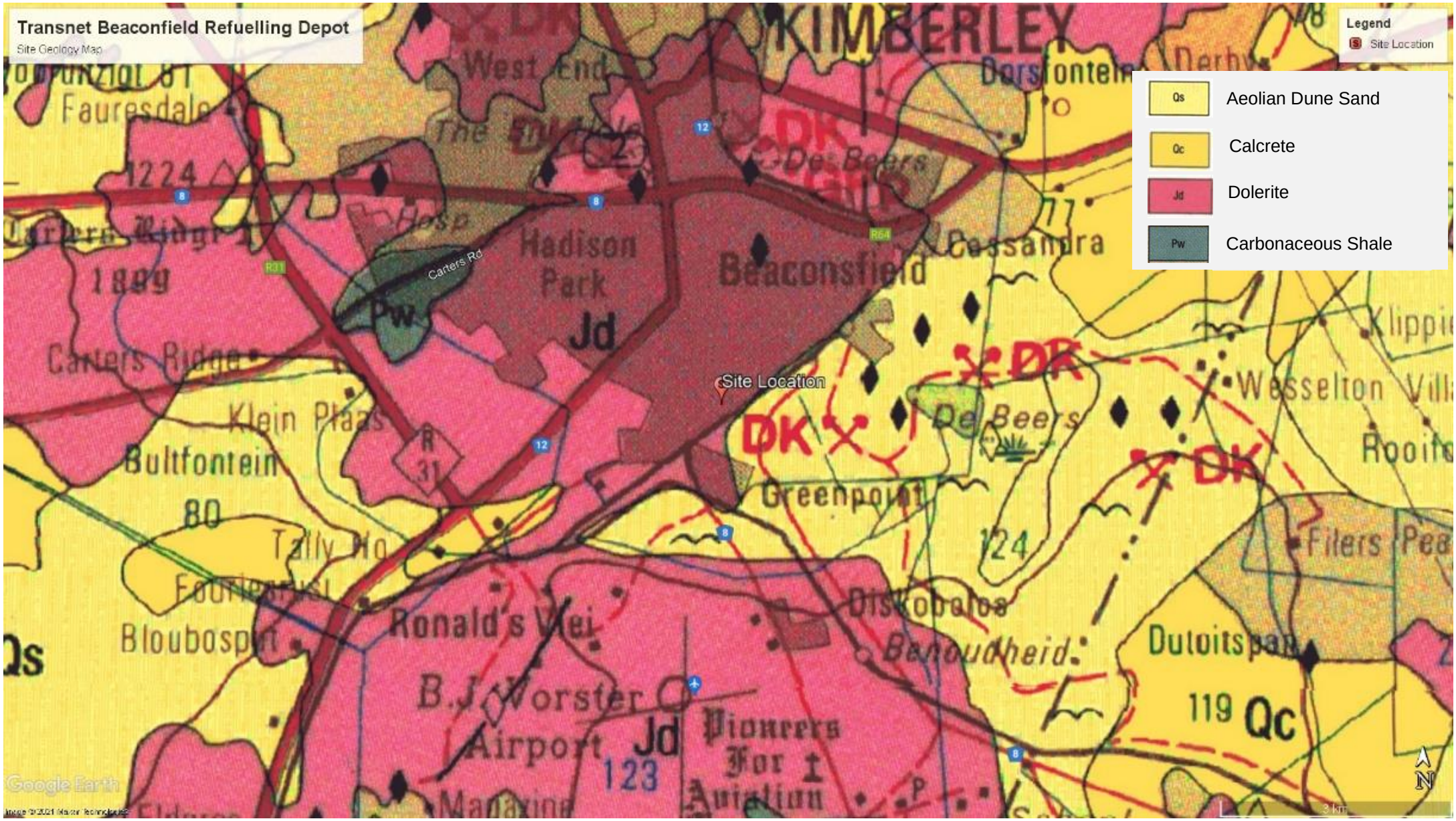

Figure 2. Site Geology

4. INVESTIGATION METHODOLOGY

The approach to this geotechnical investigation utilizes a combination of literature review (Desktop Study) and field investigation. The literature review was conducted to assess the current state of the environment according to available literature resources.

4.1. AVAILABLE INFORMATION

- Geological Map of the GSO: Scale 1: 250 000 Sheet – Geological series 2824 Kimberley;
- Expansive Roadbed Treatment for Southern Africa: D J Weston (1980) 4th Int. Conf. on Expansive Soils, Vol. 1, Denver pp 339-360
- National Home Builders Registration Council: Home Builders Manual: Parts 1 and 2, Revision 1, February 1999;
- Technical Recommendations for Highways – TRH14 Guidelines for Road Construction Materials by the National Institute for Transport and road research of the Council for Scientific and Industrial Research, (1985);
- Technical Recommendations for Highways – TRH13 Cementitious Stabilizers in Road Construction by the National Institute for Transport and road research of the Council for Scientific and Industrial Research, (1986);
- SAICE's Guidelines for Urban Engineering Geological Investigations;
- Schwartz, K. (1985). Collapsible soils. The Civil Engineer in South Africa, July, p379-393 and;
- New, M., Lister, D., Hulme, M. and Makin, I., 2002: A high-resolution data set of surface climate over global land areas. Climate Research 21:1-25.

4.2. FIELD INVESTIGATION

The following methodology was adopted for the field investigation:

4.2.1. Test Pitting and Soil Profiling

Test pits were excavated on the site using a Tractor Backhoe Loader (TLB) to maximum depths ranging from 1.02 mbgl to 1.85 mbgl. The test pits were logged by a registered engineering geologist according to MCCSSO method prescribed by Jennings et al. (1973). The test pits were loosely backfilled after profiling.

The locations of the test pits are indicated on the test pit locality plan available in Appendix B. Detailed soil profiles are attached in Appendix D.

4.2.1. Dynamic Probe Super Heavy Testing

Dynamic Probe Super Heavy (DPSH) testing is a method used to assess the consistency of underlying soils. A 63.5 kg hammer is repeatedly dropped onto a rod fitted with a cone at the bottom. The action of dropping the hammer onto the rod, drives the rod into the ground. The number of blows required to achieve successive 300 mm penetration are recorded. Refusal of DPSH testing is commonly associated with the presence of medium hard rock to hard rock. Dynamic Probe Super Heavy (DPSH) tests were carried out on the site at the proposed positions of the building support columns. The DPSH test positions are presented in Appendix B.

5. FIELD INVESTIGATION RESULTS

5.1. TEST PITTING AND PROFILING

The field investigation was carried out on the 15st of November 2021 and comprised of the excavation of 5 test pits strategically located across the site to give representative ground conditions. The test pits were excavated to depths ranging between 1.02 and 1.85 mbgl. The locations of the test pits are presented in Appendix B. The material encountered in the test pits is described below and detailed soil profiles are available in Appendix D.

The test pitting indicated that the site is underlain by fairly homogeneous ground conditions. The following soil horizons were encountered on the site:

Engineering Fill – Engineering fill material was encountered in all the test pits excavated on site. The engineering fill occurs as slightly moist, dark grey to black blotched white, loose to medium dense, sandy gravel. This horizon was encountered between ground level and 0.62 mbgl.

Residual Dolerite – The engineering fill is underlain by a horizon comprising of residual dolerite which was encountered in all the test pits excavated on the site. The horizon occurs as reddish brown blotched orange brown, medium dense, clayey silty sand. The residual dolerite horizon was encountered at depths between 0.37 mbgl and 1.50 mbgl.

Highly Weathered Dolerite – Residual dolerite soil horizon grades into a highly weathered dolerite bedrock. The horizon occurs as orange-grey blotched white, highly weathered soft rock. The highly weathered dolerite horizon was encountered at depths between 0.6 mbgl and 1.85 mbgl. The test pits encountered refused on highly weathered dolerite medium hard rock.

No groundwater or groundwater seepage was encountered in the test pits excavated across the site.

5.2. DYNAMIC CONE PENETROMETER TESTING

A total of five (5) DPSH tests were conducted on the proposed site on the 15th of November 2021. The DPSH tests were advanced from ground level and refused at depths ranging between 1.5 and 1.8 mbgl on weathered dolerite rock. The DPSH test positions are presented in Appendix C and the results are presented in Table 1. The DPSH logs are presented in Appendix C. The test indicates an allowable bearing capacity of greater than 200 kPa at depth greater than 0.9 mbgl.

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Table 1: DPSH Test Results

Depth (m)	Estimated Allowable Bearing Capacity (kPa)				
	DPSH01	DPSH02	DPSH03	DPSH04	DPSH05
0.00	0	0	0	0	0
0.30	32	48	40	40	48
0.60	104	160	104	104	120
0.90	200	224	208	248	320
1.20	344	232	960	592	600
1.50	256	456	808	>464	840
1.80	>800	>520	-	-	-

5.3. LABORATORY TESTING

Representative soil samples were taken at specific positions from material encountered in the test pits. A total of five (5) samples were collected and submitted to Civilab Civil Engineering Testing Laboratory for Foundation Indicator (FI) and California Bearing (CBR) testing to determine basic engineering characteristics including:

- Atterberg Limits (plastic limit, liquid limit, and plasticity index);
- Potential Expansiveness;
- Collapse Potential;
- Grading analysis and;
- MOD and CBR;

The laboratory tests were conducted to assist with the classification, description, and delineation of homogenous zones. The results of the foundation indicator, MOD and CBR tests are presented in Appendix E and are summarized in Table 2 and Table 3. The samples were taken from the test pit position denoted in the same manner.

Foundation Indicators

Three (3) Foundation indicators were collected and submitted to the laboratory for testing. The results are summarized in Table 2.

Residual Dolerite – One (1) sample collected from the site (TP03) indicate a Liquid Limit of 31% with the Linear Shrinkage of 7.5 %. The sample indicate medium plasticity with the Plasticity Index of 15%. Based on the clay content and plasticity, the soils underlying the site will exhibit medium potential expansiveness.

Highly Weathered Dolerite – Two (2) samples collected from the site (TP01 and TP04) indicate a Liquid of 33% and 36% with the Linear Shrinkage of 6.5% and 6.0%, respectively. The samples, TP03 and TP04, indicate medium plasticity with the Plasticity Index of 14% and 13%, respectively. Based on the clay content and plasticity, the soils underlying the site will exhibit low potential expansiveness.

MOD and CBR

Two (2) samples (TP01 and TP04) were collected and submitted for California Bearing Ratio (CBR) Testing. The results are summarized in Table 3.

Highly Weathered Dolerite - The grading modulus of the samples (TP01 and TP04) were 1.69 and 2.07, respectively, with a Plasticity Index ranging between 14% and 13%. The samples collected indicates CBR values of 23% for TP01 and 33% for TP04 at 95% MOD AASHTO. The samples indicate a maximum swell of between 0.3% and 0.1%. Based on the grading modulus, Atterberg limits and CBR, the soil underlying the site may be classified as ranging between G7 and G9.

Table 2: Foundation Indicator Test Results

Sample No.	Description	Depth (m)	Atterberg Limit			GM	Grading analysis (%)				USC	Potential expansiveness
			LL %	LS %	PI %		Clay	Silt	Sand	Gravel		
TP01	Highly Weathered Dolerite	0.60 - 1.60	33	6.5	14	1.69	1	17	54	27	SC	Low
TP03	Residual Dolerite	0.62-1.50	31	7.5	15	0.63	13	33	53	1	SC	Medium
TP04	Highly Weathered Dolerite	0.80 - 1.10	36	6.0	13	2.07	3	11	33	53	SC	Low

LL: **Liquid Limit** **PI**: Plasticity Index **LS:** Linear Shrinkage **GM**: Grading Modulus **NP**: Non-Plastic **SP**: Slightly Plastic **USC**: Unified Soil Classification

Table 3: CBR and MOD Test Results

Sample No.	Description	Depth (m)	CBR @					GM	PI (%)	Max. Swell (%)	OMC (%)	Max Dry Density (kg/m^3)	TRH14 Classification
			90%	93%	95%	98%	100%						
TP01	Highly Weathered Dolerite	0.60 - 1.60	9	16	23	39	57	1.69	14	0.3	8.60	2174	G9
TP04	Highly Weathered Dolerite	0.80 - 1.10	15	24	33	52	72	2.07	13	0.1	11.1	1999	G7

PI: Plasticity Index **GM**: Grading Modulus **OMC**: Optimum Moisture Content **CBR**: California Bearing Ratio **NP:** Non-Plastic

6. GEOTECHNICAL EVALUATION

The objective of the investigation was to assess geotechnical properties of the surficial soils. The following geotechnical characteristics relevant to the development were assessed:

- Expansive Potential
- Collapse Potential
- Compressibility
- Groundwater
- Drainage & Erodability
- Excavatability
- Slope Instability
- Subsidence
- Problematic soils

Table 4 gives the basis of the soil site classification that was applied during the investigation and table 5 gives the geotechnical classification for urban development.

Table 4: Soil Site Classification (NHBRC Building Manual)

Geotechnical category and site class designation	Geotechnical characteristics
Active soils (heave/shrink) - (H) H H1 H2 H3	Expected range of total movement at surface: < 5 mm 5 – 15 mm 15 – 30 mm > 30mm
Compressible soils (S) S S1 S2	Expected range of total movement at surface: < 5 mm 5 – 15 mm > 15 mm
Collapsible Soils (C) C C1 C2	Expected range of total movement at surface: < 5 mm 5 – 10 mm > 10 mm

Excavation – (R) r1 r2 r3	 sub outcrop scattered outcrop and sub-outcrop outcrop, scattered outcrop, and sub-outcrop
P – Problem soils	Dolomitic Areas, marshy areas, contaminated areas, abandoned borrow areas, land fill, mining subsidence and mine waste fill, shallow undermined areas, exploration pits or adits.
Inundation and seepage – (W)	Wet area, drainage line, seepage zone

Table 5: Geotechnical Classification for Urban Development (GFSH-2 Document)

Geotechnical Sub-Area	Definition
1	Areas recommended or favourable for development
2	Areas where development can be considered with certain precautionary measures.
3	Areas that are not recommended for development

6.1. EXPANSIVE SOILS

Active/expansive soils are defined as fine grained soils (generally with high clay content) that change in volume in response to the change in moisture content. These soils may increase in volume (heave/swell) upon wetting and decrease in volume (shrink) upon drying out. These soils are classified as (H) according to the SAICE site classes. Depending on the severity of the predicted movement, expansive soils can be classified as H, H1, H2 or H3 (Table 4).

The site is underlain by engineering fill which are in turn underlain by clayey silty sand. The laboratory results of all the samples analysed exhibit low to medium potential expansiveness. The site is therefore classified with the soil site class H1 according to the SAICE site classification system.

6.2. COLLAPSIBLE SOILS

Collapsible soils are defined as soils that have a potential for collapse and are commonly open-textured (e.g. honey comb and pinhole) with a high void ratio (Brink, 1985). These soils are typically silty sands, sands, sandy and gravelly soils commonly found in colluvial and aeolian sands.

Soils which exhibit potentially collapsible characteristics are classified with the soil site class 'C' according to the SAICE site classification system (Table 4).

The site is underlain by Engineering fill which are in turn underlain by residual soils comprising clayey silty sand. The site is therefore classified with the soil site class C1 according to the SAICE site classification system

6.3. COMPRESSIBLE SOILS

Compressible soils are soils in which the bulk volume of the soil may gradually decrease with time when subjected to an applied load. These soils typically comprise fine-grained soils such as clay, clayey sand and clayey silt with low plasticity, gravelly and sandy soil. According to the SAICE soil site class (Table 4) these soils are denoted as class 'S' and may vary (S, S1, S2) depending on the severity of the bulk volume change.

The site is underlain by residual soils comprising clayey silty sand which is in turn underlain by highly weathered soft rock. The laboratory test results indicate all the samples to have medium plasticity.

6.4. GROUNDWATER

Groundwater may negatively affect structures founded on non-cohesive soil (sands and silt). When non-cohesive soils become saturated, the stiffness, vertical stress and effective confining stress are reduced resulting in lower bearing pressures of the soil. Furthermore, a shallow/perched groundwater table normally presents a problem of rising damp on structures. Therefore, appropriate remedial measures such as damp proofing needs to be incorporated in the construction of structures in areas where a shallow/ perched water table is anticipated. Various Pedogenic soils (ferricrete/calcrete and signs of ferruginisation/calcification) may indicate fluctuating or seasonally perched water table commonly caused by retarded vertical infiltration and percolation rates.

No groundwater seepage was encountered during the field investigation.

6.5. DRAINAGE AND ERODIBILITY

There are no major rivers, streams or major erosion channels that traverse the area and erosion is via sheetwash. The risk of erosion is significantly mitigated by the relatively flat slope of the site. The relatively

flat surface may promote the ponding of water. Therefore, the site must be shaped to improve stormwater runoff and extensive stormwater management must be considered. All drainage boundaries near wet areas or drainage lines and floodlines must be confirmed by the relevant Competent Person (floodline specialist).

6.6. EXCAVATABILITY

Excavatability may be defined as the degree of difficulty at which the ground can be excavated. The test pits were excavated to depths ranging between 1.02 mbgl and 1.85 mbgl with refusal in all test pits. Outcrops and sub-outcrops were not encountered on the site. Therefore, excavations for the proposed development are expected to utilise soft excavation techniques for the removal of the residual soils and medium hard techniques for the removal of the highly weathered dolerite underlying the site.

6.7. SLOPE INSTABILITY

The site has a relatively flat surface with a slight slope towards the north-eastern boundary of a gradient of less than 2%. Therefore, slope related instability is not anticipated on the site.

6.8. SUBSIDENCE

No subsidence related problems are anticipated on the site.

PROBLEMATIC SOILS

Problematic soils such as dolomitic land, marshes and thick horizons of uncontrolled fill were not encountered on the site.

7. RECOMMENDATIONS

7.1. SOIL SITE CLASSIFICATION

The investigation findings indicate that soils comprising of silty sand content, low potential expansiveness and medium plasticity underlie the site. Based on field observations (geological, hydrogeological, and geomorphological) and laboratory soil testing of the soil samples, the site can be classified as: **2/H1/C1**

7.2. FOUNDATION RECOMMENDATIONS

Based on the findings of the geotechnical investigations, conducted on the remaining portion of the site, the following foundation solutions may be adopted:

Deep Strip Footing

- Normal construction with precautions.
- Deep strip footings may be founded on the weathered dolorite bedrock. Safe, factored foundation bearing pressures to not exceed the allowable bearing pressure. Allowable bearing pressures of greater than 200 kPa were found at depth greater than 0.9 mbgl.
- Foundation should be in accordance with the SANS 10400 requirements.

Raft Foundation

Excavate in-situ material from at least 1.5m beyond the perimeter of the structure to a depth of at least 1.0m below natural ground level. Rip and compact 150mm of the bottom in-situ material. Competent material (at least G5) to be used and compacted to 95% MOD AASHTO MAXIMUM DENSITY in layers not exceeding 150mm.

7.3. PRECAUTIONS

The following precautions may be considered during construction on the site:

- The site is relatively flat therefore extensive site drainage and plumbing/service precautions must be considered.
- Structures to have damp proofing.
- The site must be graded to prevent ponding of storm water.
- 1.5 m apron around the structures to prevent water ingress under the immediate area or the foundation.
- Walkways and drive ways must be paved to allow easy access to the property during wet seasons.
- Planting of grass/lawn on the stands may be considered to prevent erosion.
- Roads must be paved or tarred. Specialist advice must be sought for the installation of the roads.
- Care must be taken with foundation designs where foundations straddle different soil mediums such as rock and soil.

7.4. PAVEMENT LAYERS

The weathered dolerite underlying the site exhibit fair to poor compaction characteristics for road building and pavement construction. According to the TRH14 guidelines, the laboratory test samples (TP01 and TP04) indicate the soils underlying the site between depths of 0.8 and 1.85 mbgl are classified as G9 and G7, respectively. The materials are suitable for selected layer construction (G7 and G9 material) and

subgrade layer construction (G9 material). Suitable material would need to be imported for subbase and base layer construction.

8. CONCLUSIONS

This report documents the findings of a near surface geotechnical investigation in Transnet, Beaconsfield, Kimberley, Northern Cape Province. The investigation was carried out by means of test pitting, DPSH testing as well as laboratory testing of collected samples. Based on the field investigation and laboratory testing the following conclusions can be drawn:

- The test pitting indicates the site to be uniform.
- The test pitting indicates that the site is underlain by engineering fill which is in turn underlain by residual soils comprising clayey silty sand material which are further underlain by highly weathered dolerite soft rock.
- Laboratory testing of the collected samples indicates that the underlying soil exhibits low potential expansiveness with medium plasticity. The results further indicated the soils to be G7 material at TP4 and G9 material at TP01.
- The test indicated an allowable bearing capacity of greater than 200 kPa at depth greater than 0.9 mbgl.
- No groundwater and groundwater seepage were encountered on the site.
- The investigated site is relatively flat which may lead to poor stormwater drainage. The site must be shaped to improve stormwater runoff and extensive management must be considered

Overall, the geotechnical investigation findings suggest that the site is developable albeit with precautionary measures.

Appendix A: Photolog

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>1. Existing refuelling depot structure</td><td>2. Typical soil profile in TP01</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>3. Typical soil profile at TP02.</td><td>4. Typical soil at TP03.</td></tr>
</table>

5. Typical soil profile in TP04

6. Typical soil from TP05

7. General Site layout

8. Existing railway structure on site

Appendix A: Test Pit and DPSH Location Map

Table 1: Test Pit and DPSH Coordinates

Test Pit and DPSH No.	Latitude	Longitude
TP01	28°46'6.68"S	24°46'14.83"E
TP02	28°46'6.20"S	24°46'14.76"E
TP03	28°46'6.20"S	24°46'15.40"E
TP04	28°46'5.84"S	24°46'15.78"E
TP05	28°46'5.68"S	24°46'16.28"E


Transnet Beaconfield Refuelling Depot
Site Geology Map
Legend
Test Pit + DPSH
Site Boundary
TP01
TP02
TP03
TP04
TP05
Google Earth
Image © 2021 Maxar Technologies
N
20 m

Appendix C: DPSH Logs

GEOSCIENCES

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DYNAMIC PROBE SUPER HEAVY TEST (DPSH)

Project Name:	**Client:** SALP
Area: Limhaby	
Test Number: 2	**Coordinates:**
Date: 15-11-2024	**Elevation:**
Operator: Jack	**Assistant:**

Rod Diameter:

Depth (m) 1650mm

Depth (mm)	Blows per 150 mm increment	Depth (mm)	Blows per 150 mm increment	Depth (mm)	Blows per 150 mm increment
0	0				
150	1	5100		10050	
300	3	5250		10200	
450	7	5400		10350	
600	6	5550		10500	
750	7	5700		10650	
900	18	5850		10800	
1050	21	6000		10950	
1200	22	6150		11100	
1350	15	6300		11250	
1500	17	6450		11400	
1650	100	6600		11550	
1800		6750		11700	
1950		6900		11850	
2100		7050		12000	
2250		7200		12150	
2400		7350		12300	
2550		7500		12450	
2700		7650		12600	
2850		7800		12750	
3000		7950		12900	
3150		8100		13050	
3300		8250		13200	
3450		8400		13350	
3600		8550		13500	
3750		8700		13650	
3900		8850		13800	
4050		9000		13950	
4200		9150		14100	
4350		9300		14250	
4500		9450		14400	
4650		9600		14550	
4800		9750		14700	
4950		9900		14850	

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DYNAMIC PROBE SUPER HEAVY TEST (DPSH)

Project Name: Beaconfield Refuelling Depot		**Client:** SALP Mhlophe Holding	
Area: Kimberley			
Test Number: 2	**Coordinates:**		
Date: 15-11-2024	**Elevation:**		**Rod Diameter:**
Operator: Jacob	**Assistant:**		**Depth (m)** 1650mm

Depth (mm)	Blows per 150 mm increment	Depth (mm)	Blows per 150 mm increment	Depth (mm)	Blows per 150 mm increment
0	0				
150	2	5100		10050	
300	4	5250		10200	
450	10	5400		10350	
600	10	5550		10500	
750	18	5700		10650	
900	10	5850		10800	
1050	8	6000		10950	
1200	13	6150		11100	
1350	22	6300		11250	
1500	35	6450		11400	
1650	65	6600		11550	
1800		6750		11700	
1950		6900		11850	
2100		7050		12000	
2250		7200		12150	
2400		7350		12300	
2550		7500		12450	
2700		7650		12600	
2850		7800		12750	
3000		7950		12900	
3150		8100		13050	
3300		8250		13200	
3450		8400		13350	
3600		8550		13500	
3750		8700		13650	
3900		8850		13800	
4050		9000		13950	
4200		9150		14100	
4350		9300		14250	
4500		9450		14400	
4650		9600		14550	
4800		9750		14700	
4950		9900		14850	

Head Office: 35 Woltemade Street, Culemborg Park, Randfontein, 1759. Postal Address: PO Box 1910, Silverton, 0127. Tel/Cell: +27 82 932 8465. Fax: +27 86 516 8663. e-mail: thokageo@gmail.com

DYNAMIC PROBE SUPER HEAVY TEST (DPSH)

Project Name: Beacon Refoeling Feld Depot
Client: SALP
Area: Kimberley
Test Number: 3
Coordinates:
Date: 15-11-2021
Elevation:
Rod Diameter:
Operator: Jack
Assistant:
Depth (m) 1500 mm

Depth (mm)	Blows per 150 mm increment	Depth (mm)	Blows per 150 mm increment	Depth (mm)	Blows per 150 mm increment
0	0				
150	2	5100		10050	
300	3	5250		10200	
450	7	5400		10350	
600	6	5550		10500	
750	8	5700		10650	
900	18	5850		10800	
1050	20	6000		10950	
1200	40	6150		11100	
1350	41	6300		11250	
1500	60	6450		11400	
1650		6600		11550	
1800		6750		11700	
1950		6900		11850	
2100		7050		12000	
2250		7200		12150	
2400		7350		12300	
2550		7500		12450	
2700		7650		12600	
2850		7800		12750	
3000		7950		12900	
3150		8100		13050	
3300		8250		13200	
3450		8400		13350	
3600		8550		13500	
3750		8700		13650	
3900		8850		13800	
4050		9000		13950	
4200		9150		14100	
4350		9300		14250	
4500		9450		14400	
4650		9600		14550	
4800		9750		14700	
4950		9900		14850	

GEOSCIENCES

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DYNAMIC PROBE SUPER HEAVY TEST (DPSH)

Project Name: Beacon Refocusing Depot	**Client:** SAWP	
Area: Kimberley		
Test Number: 4	**Coordinates:**	
Date: 15-11-2021	**Elevation:**	**Rod Diameter:**
Operator: Jacob	**Assistant:**	**Depth (m)** 1350mm

Depth (mm)	Blows per 150 mm increment	Depth (mm)	Blows per 150 mm increment	Depth (mm)	Blows per 150 mm increment
0	0				
150	2	5100		10050	
300	3	5250		10200	
450	5	5400		10350	
600	8	5550		10500	
750	13	5700		10650	
900	18	5850		10800	
1050	39	6000		10950	
1200	45	6150		11100	
1350	56	6300		11250	
1500		6450		11400	
1650		6600		11550	
1800		6750		11700	
1950		6900		11850	
2100		7050		12000	
2250		7200		12150	
2400		7350		12300	
2550		7500		12450	
2700		7650		12600	
2850		7800		12750	
3000		7950		12900	
3150		8100		13050	
3300		8250		13200	
3450		8400		13350	
3600		8550		13500	
3750		8700		13650	
3900		8850		13800	
4050		9000		13950	
4200		9150		14100	
4350		9300		14250	
4500		9450		14400	
4650		9600		14550	
4800		9750		14700	
4950		9900		14850	

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DYNAMIC PROBE SUPER HEAVY TEST (DPSH)

Project Name: Beacon Field Refuelling Depot	Client: SAAF
Area: Kimberley	
Test Number: 5	Coordinates:
Date: 15-11-2024	Elevation: / Rod Diameter:
Operator: Jacob	Assistant: / Depth (m) 1500 1500 mm

Depth (mm)	Blows per 150 mm increment	Depth (mm)	Blows per 150 mm increment	Depth (mm)	Blows per 150 mm increment
0	0				
150	2	5100		10050	
300	4	5250		10200	
450	5	5400		10350	
600	10	5550		10500	
750	18	5700		10650	
900	22	5850		10800	
1050	35	6000		10950	
1200	40	6150		11100	
1350	45	6300		11250	
1500	60	6450		11400	
1650		6600		11550	
1800		6750		11700	
1950		6900		11850	
2100		7050		12000	
2250		7200		12150	
2400		7350		12300	
2550		7500		12450	
2700		7650		12600	
2850		7800		12750	
3000		7950		12900	
3150		8100		13050	
3300		8250		13200	
3450		8400		13350	
3600		8550		13500	
3750		8700		13650	
3900		8850		13800	
4050		9000		13950	
4200		9150		14100	
4350		9300		14250	
4500		9450		14400	
4650		9600		14550	
4800		9750		14700	
4950		9900		14850	

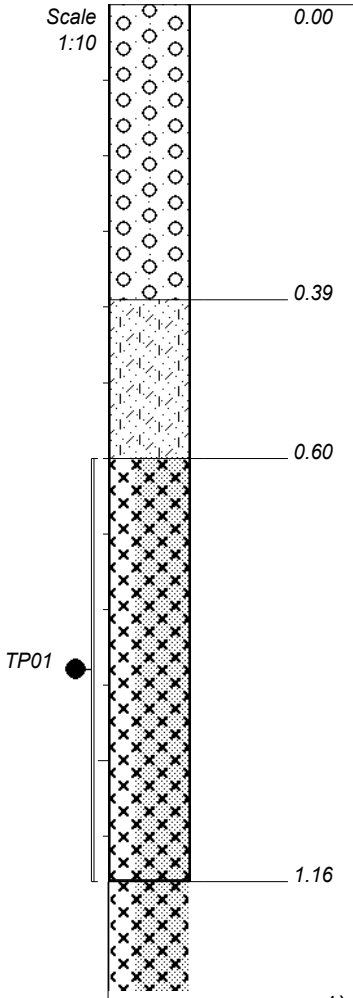
Appendix D: Soil Logs

NKHOPHELE HOLDINGS

IKAMVA Consulting
Transnet Beaconfields Refuelling Depot

HOLE No: TP01
Sheet 1 of 1

JOB NUMBER: NH30-21



0.00	"slightly moist, dark grey to black blotched orange white, loose -medium dense, matrix supported, sandy GRAVEL. ENGINEERING FILL. "
0.39	"slightly moist, reddish brown blotched orange brown , medium dense, intact, clayey silty SAND. RESIDUAL DOLERITE. "
0.60	"orange grey blotched white, HIGHLY WEATHERED DOLERITE SOFT ROCK."
1.16	End of hole with refusal on dolerite medium hard rock.

NOTES

1) No water seepage
2) "Bulk disturbed sample TP01 at 0,60--1.16 m"
3) Stable sidewalls.

CONTRACTOR :
MACHINE : CAT 425
DRILLED BY :
PROFILED BY : T. Mphahlele
TYPE SET BY : T. Mphahlele
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM : 0.7m trench
DATE : 15/11/2021
DATE : 15/11/2021
DATE : 13/12/2021 02:24
TEXT : ..TransnetBeaconfields.txt

ELEVATION :
X-COORD : -28.768522
Y-COORD : 24.770786

HOLE No: TP01

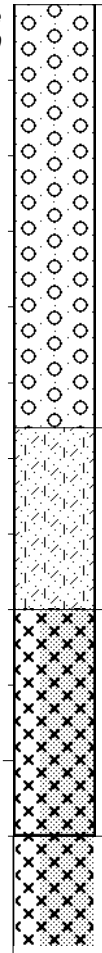
NKHOPHELE HOLDINGS

IKAMVA Consulting
Transnet Beaconfields Refuelling Depot

HOLE No: TP02
Sheet 1 of 1

JOB NUMBER: NH30-21

Scale 1:10



0.00	"slightly moist, dark grey to black blotched orange white, loose -medium dense, matrix supported, sandy GRAVEL. ENGINEERING FILL. "
0.56	"slightly moist, reddish brown blotched orange brown , medium dense, intact, clayey silty SAND. RESIDUAL DOLERITE. "
0.80	"orange grey blotched white, HIGHLY WEATHERED DOLERITE SOFT ROCK."
1.10	End of hole with refusal on dolerite medium hard rock.

NOTES

1) No water seepage.
2) No samples taken
3) Stable sidewalls.

CONTRACTOR :
MACHINE : CAT 425
DRILLED BY :
PROFILED BY : T. Mphahlele
TYPE SET BY : T. Mphahlele
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM : 0.7m trench
DATE : 15/11/2021
DATE : 15/11/2021
DATE : 13/12/2021 02:24
TEXT : ..TransnetBeaconfields.txt

ELEVATION :
X-COORD : -28.768389
Y-COORD : 24.770767

HOLE No: TP02

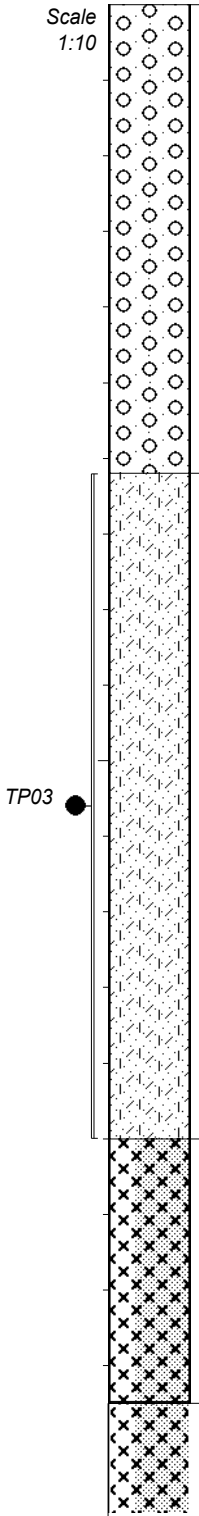
NKHOPHELE HOLDINGS

IKAMVA Consulting
Transnet Beaconfields Refuelling Depot

HOLE No: TP03
Sheet 1 of 1

JOB NUMBER: NH30-21

Scale 1:10



0.00 "slightly moist, dark grey to black blotched orange white, loose -medium dense, matrix supported, sandy GRAVEL. ENGINEERING FILL. "

0.62 "slightly moist, reddish brown blotched orange brown , medium dense, intact, clayey silty SAND. RESIDUAL DOLERITE. "

1.50 "orange grey blotched white, HIGHLY WEATHERED DOLERITE SOFT ROCK."

1.85 End of hole with refusal on dolerite medium hard rock.

NOTES

1) No water seepage.
2) "Disturbed sample TP03 at 0,62--1,5 m"
3) Stable sidewalls.

CONTRACTOR :
MACHINE : CAT 425
DRILLED BY :
PROFILED BY : T. Mphahlele
TYPE SET BY : T. Mphahlele
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM : 0.7m trench
DATE : 15/11/2021
DATE : 15/11/2021
DATE : 13/12/2021 02:24
TEXT : ..TransnetBeaconfields.txt

ELEVATION :
X-COORD : -28.768389
Y-COORD : 24.770944

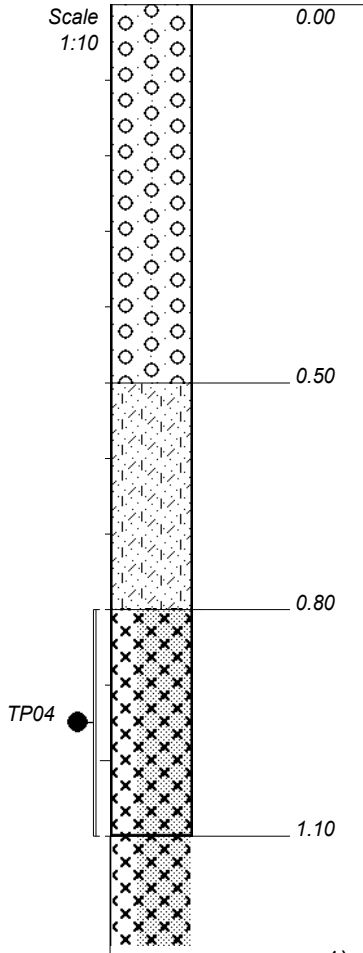
HOLE No: TP03

NKHOPHELE HOLDINGS

IKAMVA Consulting
Transnet Beaconfields Refuelling Depot

HOLE No: TP04
Sheet 1 of 1

JOB NUMBER: NH30-21



0.00	"slightly moist, dark grey to black blotched orange white, loose -medium dense, matrix supported, sandy GRAVEL. ENGINEERING FILL. "
0.50	"slightly moist, reddish brown blotched orange brown , medium dense, intact, clayey silty SAND. RESIDUAL DOLERITE. "
0.80	"orange grey blotched white, HIGHLY WEATHERED DOLERITE SOFT ROCK."
1.10	End of hole with refusal on dolerite medium hard rock.

NOTES

1) No water seepage.
2) "Bulk disturbed sample TP04 at 0,8--1,10 m"
3) Stable sidewalls.

CONTRACTOR :
MACHINE : CAT 425
DRILLED BY :
PROFILED BY : T. Mphahlele

TYPE SET BY : *T. Mphahlele*
SETUP FILE : *STANDARD.SET*

INCLINATION :
DIAM : 0.7m trench
DATE : 15/11/2021
DATE : 15/11/2021

DATE : *13/12/2021 02:24*
TEXT : *..TransnetBeaconfields.txt*

ELEVATION :
X-COORD : -28.768289
Y-COORD : 24.771050

HOLE No: TP04

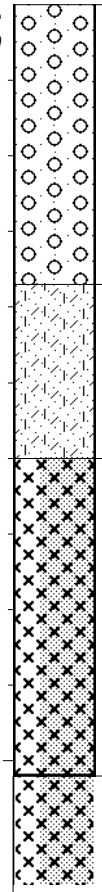
NKHOPHELE HOLDINGS

IKAMVA Consulting
Transnet Beaconfields Refuelling Depot

HOLE No: TP05
Sheet 1 of 1

JOB NUMBER: NH30-21

Scale 1:10



0.00	"slightly moist, dark grey to black blotched orange white, loose -medium dense, matrix supported, sandy GRAVEL. ENGINEERING FILL. "
0.37	"slightly moist, reddish brown blotched orange brown , medium dense, intact, clayey silty SAND. RESIDUAL DOLERITE. "
0.60	"orange grey blotched white, HIGHLY WEATHERED DOLERITE SOFT ROCK."
1.02	End of hole with refusal on dolerite medium hard rock.

NOTES

1) No water seepage.
2) No sample taken
3) Stable sidewalls.

CONTRACTOR :
MACHINE : CAT 425
DRILLED BY :
PROFILED BY : T. Mphahlele

TYPE SET BY : T. Mphahlele
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM : 0.7m trench
DATE : 15/11/2021
DATE : 15/11/2021

DATE : 13/12/2021 02:24
TEXT : ..TransnetBeaconfields.txt

ELEVATION :
X-COORD : -28.768244
Y-COORD : 24.771189

HOLE No: TP05

NKHOPHELE HOLDINGS

IKAMVA Consulting
Transnet Beaconfields Refuelling Depot

LEGEND
Sheet 1 of 1

JOB NUMBER: NH30-21

	GRAVEL	{SA02}
	SAND	{SA04}
	SANDY	{SA05}
	SILTY	{SA07}
	CLAYEY	{SA09}
	DOLERITE	{SA18}{SA42}
	DISTURBED SAMPLE	{SA38}

Name

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY :

INCLINATION :
DIAM :
DATE :
DATE :

ELEVATION :
X-COORD :
Y-COORD :

TYPE SET BY : T. Mphahlele
SETUP FILE : STANDARD.SET

DATE : 13/12/2021 02:24
TEXT : ..TransnetBeaconfields.txt

LEGEND
SUMMARY OF SYMBOLS

Appendix E: Laboratory Test Results

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E-mail: jhb@civilab.co.za•Website: www.civilab.co.za

sanas Testing Laboratory T0062

Civilab

Civil Engineering Testing Laboratories

Client	:	NKHOPHELE HOLDINGS (C)			
Address	:	UNIT 3, OXFORD OFFICE PARK	**Client Reference**	:	
	:	3 BAUHINIA STREET	**Order No.**	:	Ndivhuwo
	:	HIGHVELD TECHNO PARK			
Attention	:		**Date Received**	:	16/11/2021
Facsimile	:	086 565 5359	**Date Tested**	:	17/11/2021-03/12/2021
E-mail	:	ndivhuwo@nkhopheleh.co.za	**Date Reported**	:	09/12/2021
Project	:	Transnet			
Project No.	:	2021-B-1461	**Report Status**	:	Final
			Page	:	1 of 7

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)
Atterberg Limits <0.425mm	3,000	SANS 3001 GR10	S Pullen	2-3; 6-7
Sieve Analysis 0.075mm	3,000	SANS 3001 GR1	B Mvubu	2-3; 6-7
Hydrometer Analysis	3,000	SANS 3001 GR3	B Mvubu	2-3
MDD & OMC	2,000	SANS 3001 GR30	S Pullen	4-5
California Bearing Ratio (CBR)	2,000	SANS 3001 GR40	S Pullen	6-7

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, unless agreed upon in writing or made publicly available by the client or required to make available by law.

Deviations in Test Methods:

Technical Signatory:	
Signature:	

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

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E-mail: jhb@civilab.co.za•Website: www.civilab.co.za

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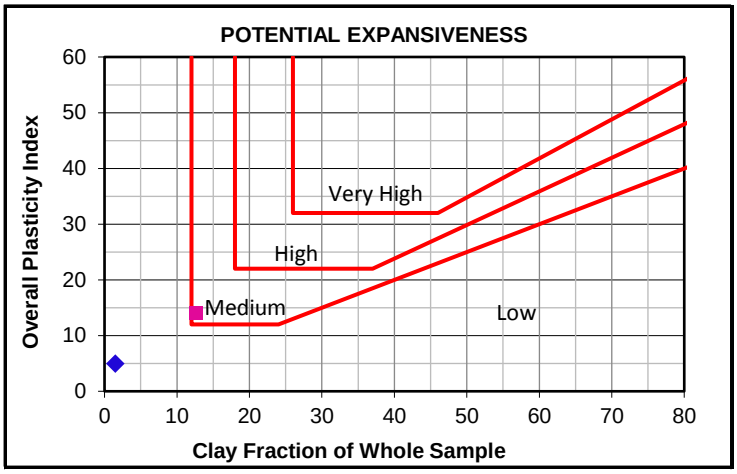
Civil Engineering Testing Laboratories

Client	:	NKHOPHELE HOLDINGS (C)	Date Received:	16/11/2021
Project	:	Transnet	Date Reported:	09/12/2021
Project No	:	2021-B-1461	Page No. :	2 of 7

FOUNDATION INDICATOR

Laboratory Number		S-6051 ◆	S-6052 ■
Field Number		TP1	TP3
Client Reference			
Depth (m)		0,6-1,6	0,62-1,50
Position			
Coordinates	X		
	Y		
Description			
Aditional Information			
Calcrete / Crushed Stabilizing Agent			

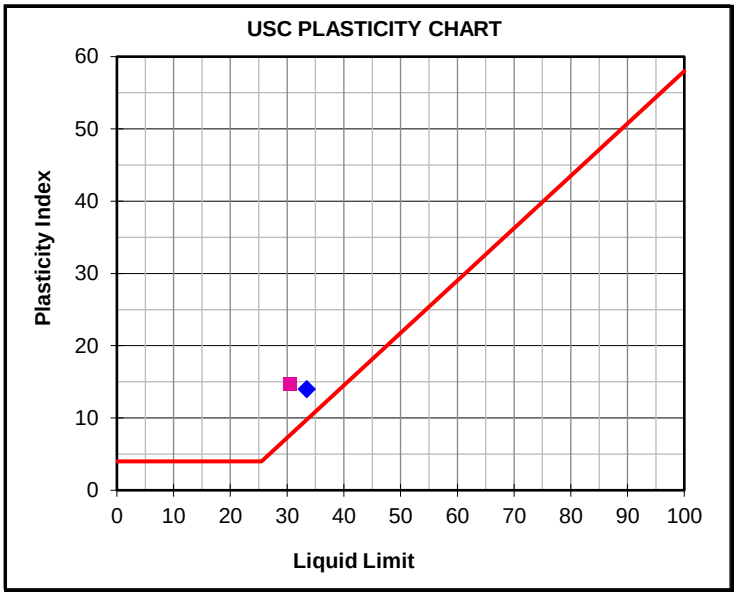


Moisture Content & Relative Density

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

Sieve Analysis (Wet Prep)

Percentage Passing	100 mm	100	100
	75 mm	100	100
	63 mm	100	100
	50 mm	100	100
	37.5 mm	98	100
	28 mm	98	100
	20 mm	98	100
	14 mm	98	100
	5 mm	95	100
	2 mm	73	99
	1 mm	53	97
	0.425 mm	39	93
	0.250 mm	34	87
	0.150 mm	27	71
	0.075 mm	20	46
Grading Modulus		1,69	0,63



Hydrometer Analysis

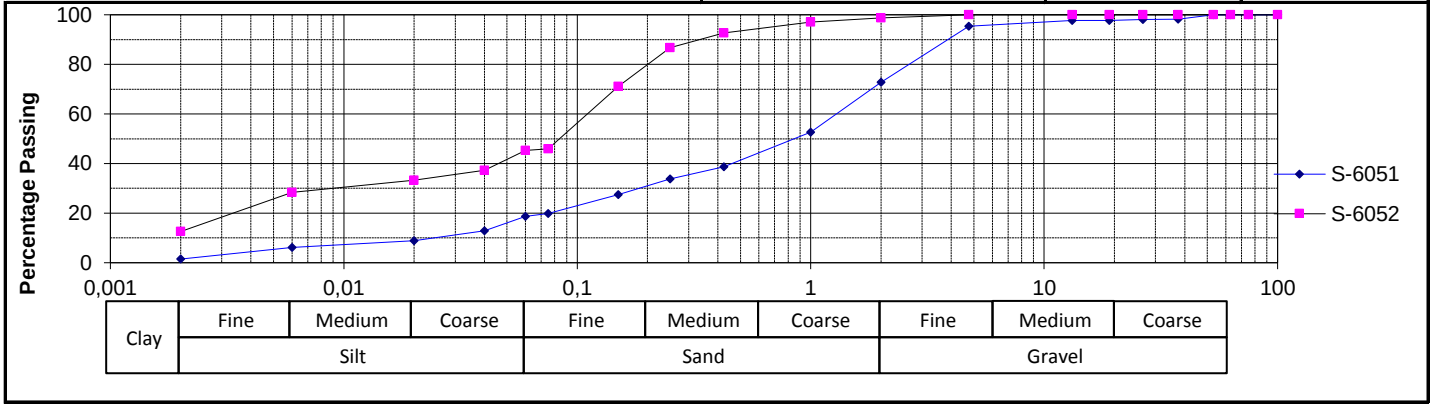
Percentage Passing	0.060 mm	19	45
	0.040 mm	13	37
	0.020 mm	9	33
	0.006 mm	6	28
	0.002 mm	1	13
Gravel	%	27	1
Sand	%	54	53
Silt	%	17	33
Clay	%	1	13

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

Laboratory Number		S-6051 ◆	S-6052 ■
Atterberg Limits -425µ			
Liquid Limit	%	33	31
Plasticity Index	%	14	15
Linear Shrinkage	%	6,5	7,5
Overall PI	%	5	14

Classifications

HRB (AASHTO)	A-2-6(0)	A-6(3)
Unified (ASTM D2487)	SC	SC
Weston Swell @ 1 kPa		



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E-mail: jhb@civilab.co.za•Website: www.civilab.co.za

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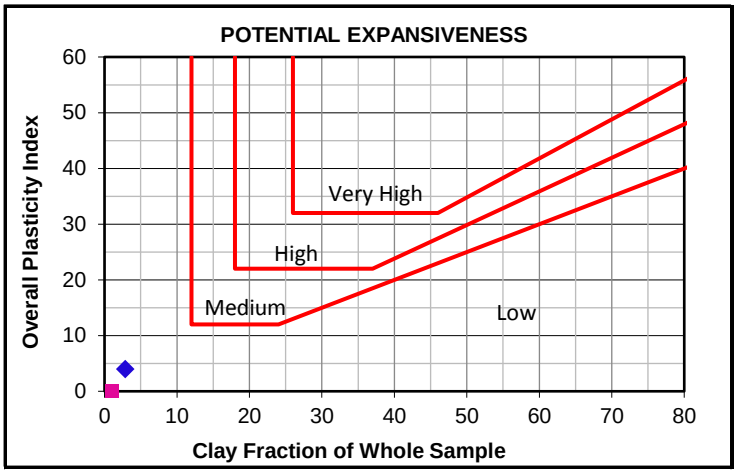
Civil Engineering Testing Laboratories

Client	:	NKHOPHELE HOLDINGS (C)	Date Received:	16/11/2021
Project	:	Transnet	Date Reported:	09/12/2021
Project No	:	2021-B-1461	Page No. :	3 of 7

FOUNDATION INDICATOR

Laboratory Number		S-6053 ◆	■
Field Number		TP4	
Client Reference			
Depth (m)		0,8-1,1	
Position			
Coordinates	X		
	Y		
Description			
Aditional Information			
Calcrete / Crushed			
Stabilizing Agent			

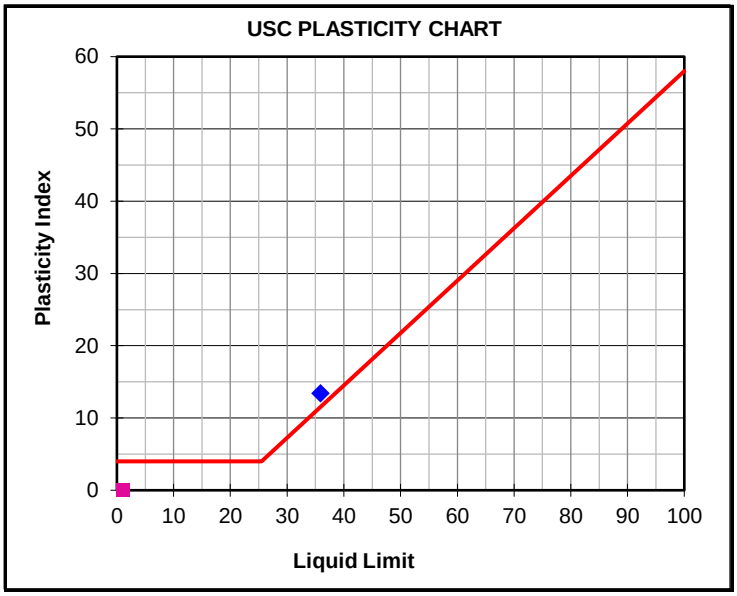


Moisture Content & Relative Density

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

Sieve Analysis (Wet Prep)

Percentage Passing	100 mm	100
	75 mm	94
	63 mm	84
	50 mm	79
	37.5 mm	78
	28 mm	76
	20 mm	73
	14 mm	72
	5 mm	60
	2 mm	47
	1 mm	39
	0.425 mm	31
	0.250 mm	26
	0.150 mm	21
	0.075 mm	15
Grading Modulus		2,07



Hydrometer Analysis

Percentage Passing	0.060 mm	14
	0.040 mm	10
	0.020 mm	7
	0.006 mm	5
	0.002 mm	3
Gravel	%	53
Sand	%	33
Silt	%	11
Clay	%	3

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

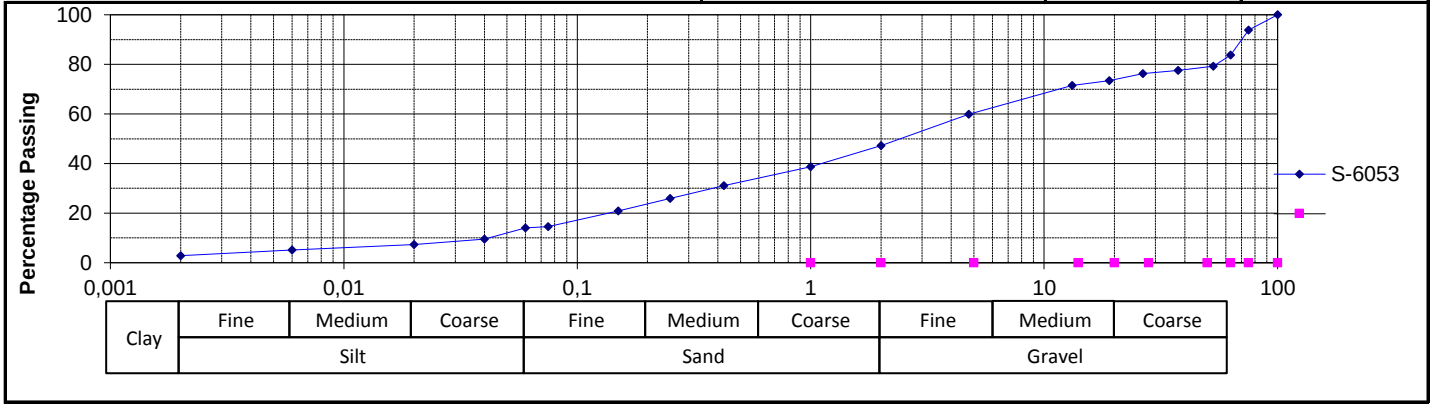
Laboratory Number		S-6053 ◆	■

Atterberg Limits -425µ

Liquid Limit	%	36	
Plasticity Index	%	13	
Linear Shrinkage	%	6,0	
Overall PI	%	4	

Classifications

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



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E-mail: jhb@civilab.co.za•Website: www.civilab.co.za

sanas Testing Laboratory T0062

Civilab
Civil Engineering Testing Laboratories

Client	: NKHOPHELE HOLDINGS (C)	Date Received:	16/11/2021
Project	: Transnet	Date Reported:	09/12/2021
Project No:	2021-B-1461	Page No. :	4 of 7

MOISTURE DENSITY RELATIONSHIP

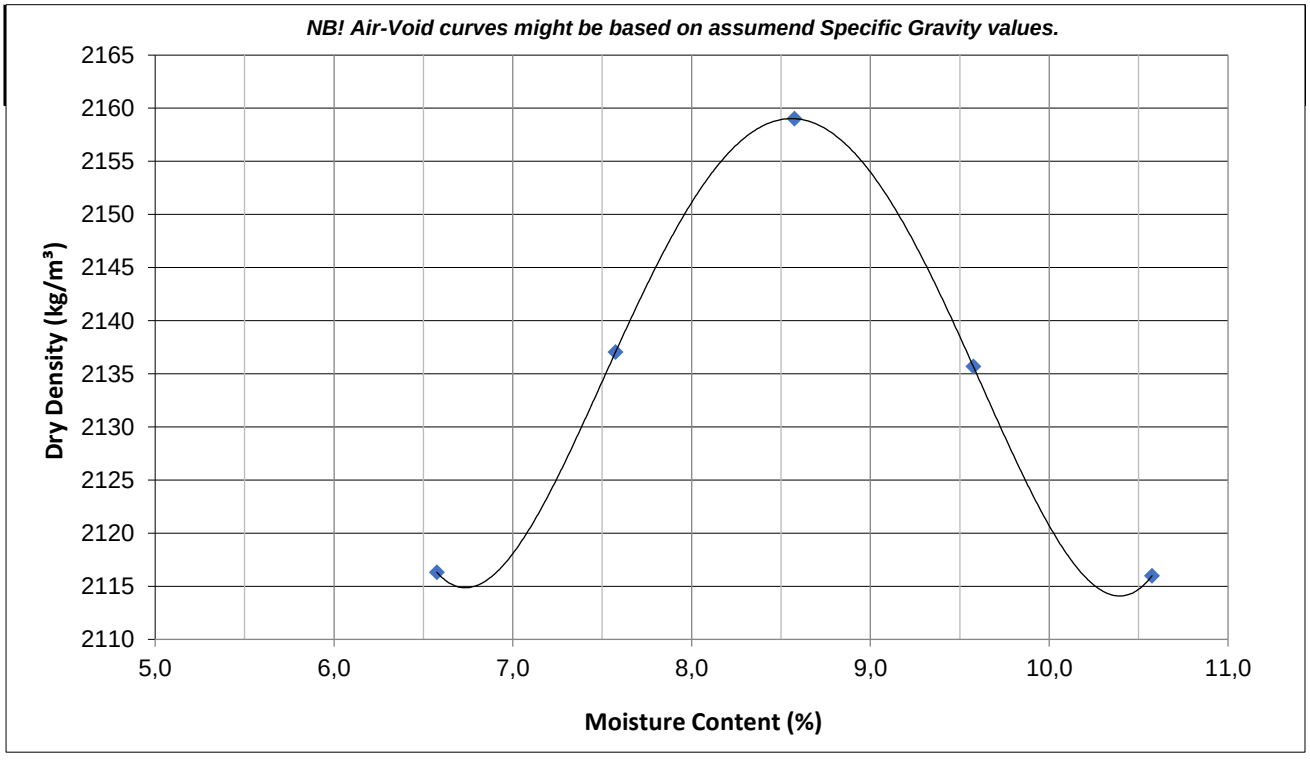
Laboratory Number		S-6051
Field Number		TP1
Client Reference		
Depth (m)		0,6-1,6
Position		
Coordinates	X	
	Y	
Description		
Additional Information		
% of Sample Scalped		
Stabilizing Agent		

Maximum Dry Density & Optimum Moisture Content - SANS 3001 GR30

Compactive Effort:	Modified AASHTO

Dry Density	kg/m³	2116	2137	2159	2136	2116	
Moisture Content	%	6,6	7,6	8,6	9,6	10,6	

Max. Dry Density	kg/m³	2159
Optimum Moisture	%	8,6



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Client	: NKHOPHELE HOLDINGS (C)	Date Received:	16/11/2021
Project	: Transnet	Date Reported:	09/12/2021
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MOISTURE DENSITY RELATIONSHIP

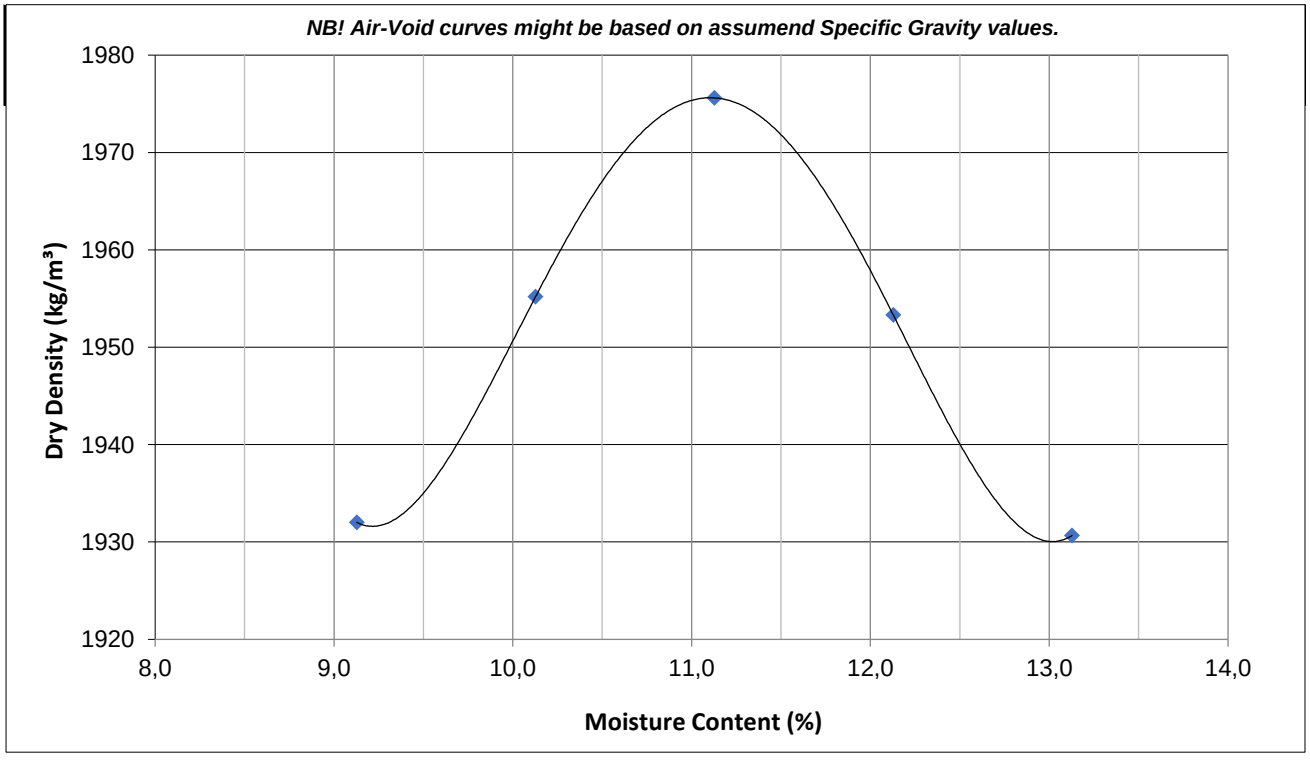
Laboratory Number		S-6053
Field Number		TP4
Client Reference		
Depth (m)		0,8-1,1
Position		
Coordinates	X	
	Y	
Description		
Additional Information		
% of Sample Scalped		
Stabilizing Agent		

Maximum Dry Density & Optimum Moisture Content - SANS 3001 GR30

Compactive Effort:	Modified AASHTO

Dry Density	kg/m³	1953	1931	1976	1955	1932	
Moisture Content	%	12,1	13,1	11,1	10,1	9,1	

Max. Dry Density	kg/m³	1976
Optimum Moisture	%	11,1



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Client	:	NKHOPHELE HOLDINGS (C)	Date Received	:	16/11/2021
Project	:	Transnet	Date Reported	:	09/12/2021
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CALIFORNIA BEARING RATIO (CBR) & ROAD INDICATOR REPORT

Laboratory No.		S-6051 ◆	S-6052 ■
Field Number		TP1	TP3
Client Reference			
Depth (m)		0,6-1,6	0,62-1,50
Position			
Coordinates	X		
	Y		
Description			
Additional information			
Calcrete/Crushed			
Stabilizing Agent			

Sieve Analysis (Wet preparation)

		S-6051 ◆	S-6052 ■
Percentage Passing		100	100
		100	100
		100	100
		100	100
		98	100
		98	100
		98	100
		98	100
		95	100
		73	99
		53	97
	0.425 mm	39	93
	0.250 mm	34	87
	0.150 mm	27	71
	0.075 mm	20	46
Grading Modulus		1,69	0,63

Soil Mortar Analysis

	S-6051 ◆	S-6052 ■
Coarse Sand	47	6
Coarse Fine Sand	7	6
Medium Fine Sand	9	16
Fine Fine Sand	10	26
Silt and Clay	27	47

Atterberg Limits

	S-6051 ◆	S-6052 ■
Liquid Limit (%)	33	31
Plasticity Index (%)	14	15
Linear Shrinkage (%)	6,5	7,5

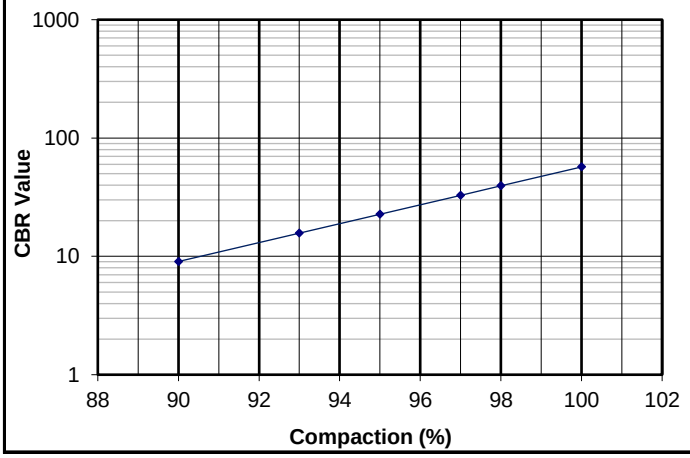
Laboratory No.		S-6051 ◆	S-6052 ■

Maximum Dry Density & Optimum Moisture Content

MDD	kg/m^3	2159	
OMC	%	8,6	

California Bearing Ratio

Compaction Data							
Moisture	%	8,7					
Dry Density	kg/m^3	2174	2073	1959			
Compaction	%	100,0	95,3	90,1			
Penetration Data							
CBR at	2.54 mm	43	30	9			
	5.08 mm	50	42	9			
	7.62 mm	47	44	9			
Swell	%	0,3	0,3	0,2			
Final Moisture (%)		10,7	11,5	12,0			

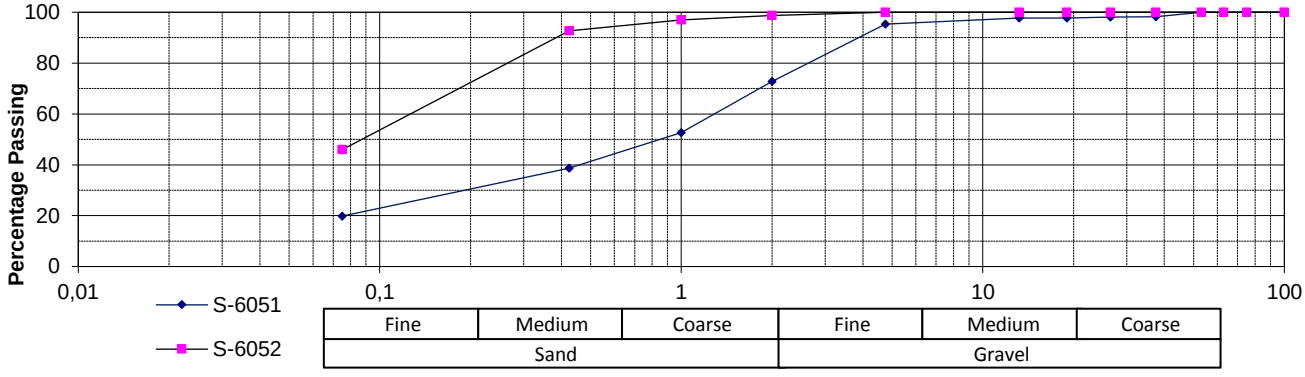


Interpolated CBR Data

CBR Mod. AASHTO	@ 100%		57
	@ 98%		39
	@ 97%		33
	@ 95%		23
	@ 93%		16
	@ 90%		9
	@ SANS3001 Midpoint		36

Classifications

HRB (AASHTO)	A-2-6(0)	
COLTO	G7	
TRH14	G9	



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Project	:	Transnet	Date Reported	:	09/12/2021
Project No.	:	2021-B-1461	Page No.	:	7 of 7

CALIFORNIA BEARING RATIO (CBR) & ROAD INDICATOR REPORT

Laboratory No.		S-6053
Field Number		TP4
Client Reference		
Depth (m)		0,8-1,1
Position		
Coordinates	X	
	Y	
Description		
Additional information		
Calcrete/Crushed		
Stabilizing Agent		

Sieve Analysis (Wet preparation)

Percentage Passing		100
		94
		84
		79
		78
		76
		73
		72
		60
		47
		39
	0.425 mm	31
	0.250 mm	26
	0.150 mm	21
	0.075 mm	15
Grading Modulus		2,07

Soil Mortar Analysis

Coarse Sand	34
Coarse Fine Sand	11
Medium Fine Sand	11
Fine Fine Sand	13
Silt and Clay	31

Atterberg Limits

Liquid Limit (%)	36
Plasticity Index (%)	13
Linear Shrinkage (%)	6,0

Laboratory No.		S-6053

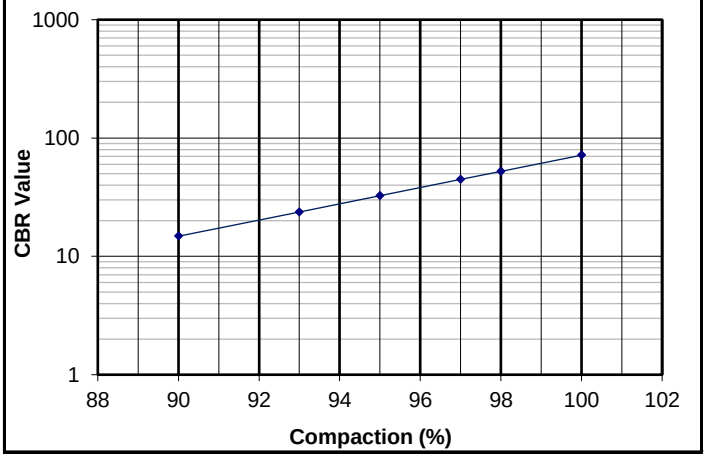
Maximum Dry Density & Optimum Moisture Content

MDD	kg/m^3	1976
OMC	%	11,1

California Bearing Ratio

Compaction Data				
Moisture	%	11,0		
Dry Density	kg/m^3	1999	1893	1793
Compaction	%	100,0	94,7	89,7

Penetration Data				
CBR at	2.54 mm	91	26	15
	5.08 mm	90	34	15
	7.62 mm	75	34	15
Swell	%	0,1	0,1	0,1
Final Moisture (%)		14,8	15,5	17,7



Interpolated CBR Data

CBR	@ 100%	Mod. AASHTO	72
	@ 98%		52
	@ 97%		45
	@ 95%		33
	@ 93%		24
	@ 90%		15
	@ SANS3001 Midpoint		48

Classifications

HRB (AASHTO)	A-2-6(0)
COLTO	G7
TRH14	G7