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Phase 1 Shallow Soil Engineering Geological Investigation Conducted on Portion 216 and Portion 36 of the Farm Zandfontein 317-JR, Tshwane Metropolitan Municipality, Gauteng Province, South Africa

Phase 1 Shallow Soil Engineering Geological Assessment

Client: GHDEVCO (Pty) Ltd.

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Phase 1 Shallow Soil Engineering Geological Investigation Conducted on Portion 216 and Portion 36 of the Farm Zandfontein 317-JR, Tshwane Metropolitan Municipality, Gauteng Province

1 Introduction

RockSoil Consult (Pty) Ltd. was appointed by ProPlan Technologies, representing GHDEVCO (Pty) Ltd., to conduct a Phase 1 shallow soil engineering geological assessment on Portion 216 and Portion 36 of the Farm Zandfontein 317-JR, Ward 55, Region 3, City of Tshwane Metropolitan Municipality, Gauteng Province, South Africa.

An initial fieldwork phase was conducted on 29 September 2021. A draft report, RS21041 V1.0, dated 15 December 2021 was provided to the client for commentary. The draft report stated that fill is present on-site and that infill work is recommended, including infill test pitting and waste classification. The client appointed and independent consultant to conduct the waste classification. The results are not available at the time of writing this report. The planners/developers should refer to the specialist input for planning and/or design purposes.

Infill test pitting was attempted by RockSoil Consult (Pty) Ltd. on 7 February 2022 to establish the vertical and lateral extent of the fill; however, the site was not trafficable due to excessive ongoing precipitation over the period, ponding water and saturated soft clay rendering the majority of the site inaccessible. The excavation equipment got stuck in the attempts and the infill test pitting was abandoned for time being. Re-establishment during a dryer period was suggested. The client requested formalisation of the report considering the available data obtained/available to date.

This report serves as a Phase 1 detailed shallow soil investigation considering the available data to date. The waste classification is addressed in a separate specialist report. This investigation is limited to a shallow soil engineering geological investigation with test pits positioned across the accessible areas of the site.

The objectives, investigation methodology, findings and recommendations are discussed/provided in the relevant report sections.

2 Objectives of the Assessment

The main objectives of a SANS634:2012 Phase 1 Detailed Geotechnical Site Investigation are to (SANS634, 2012):

- Identify any potential hazards that may affect the proposed development;
- Define the ground conditions, including detailed soil profile and groundwater occurrences within the zone of influence of foundation work;

- Broadly classify the land which is to be developed in accordance with the relevant site class designations for single-storey and double-storey type 1 masonry buildings;
- Provide the geotechnical basis for safe and appropriate land use planning, infrastructure design, housing unit design, and the formulation of precautionary measures and risk management procedures; and
- Gather factual data which has a bearing on the determination of housing subsidy variations and the installation of township services.

3 Information Used During the Study

The following available information were considered during this investigation:

1) Locality map with provided approximate site boundaries;
2) 1:250 000-scale regional geological sheet (2528 Pretoria);
3) 1:50 000-scale regional geological sheet (2528CA Pretoria);
4) 1:50 000-scale regional topographical sheet (2528CA);
1) Tshwane online GIS information;
2) GoogleEarth images;
3) Council for Geoscience Geohazard (CGS) database;
4) SANBI BGIS online database;
5) Climate-date.org database;
6) Local knowledge of the area.

The following available reports were considered during this investigation:

1) Report description "Report on a Phase 1 Geotechnical Site Investigation for Township Establishment on a Portion of the Farm Zandfontein 317-JR, Pretoria, Gauteng Province", dated September 2005, conducted by J. Louis van Rooy (JLvR, 2005).

The available information was supplemented with the information obtained during the fieldwork phase/s of this assessment, as discussed in the relevant report sections.

4 Investigation Methodology

The investigation comprises:

- Desk study of readily available information;
- Site visit and driveover/walkover survey (29 September 2021);
- Test excavation and material sampling in the accessible areas (29 September 2021);
- Attempt in infill test pit excavation and selected earth fill sampling (7 February 2022);

- In-situ soil profile logging by a suitably qualified and registered engineering geologists (29 September 2021 and 7 February 2022);
- Soil profile and material photography (29 September 2021 and 7 February 2022);
- Selective material sampling (29 September 2021 and 7 February 2022);
- Soil testing at an accredited commercial laboratory;
- Evaluation and reporting by a suitably qualified and professionally registered engineering geologist.

The number of trial pits, equipment and general investigation procedures/methods are provided in **Table 4-1**. The soil classification testing, relevant test methods and quantities are provided in **Table 4-2**. Additional information on the test procedures can be provided upon request.

Table 4-1: General Investigation Procedures and Information

Description	Information
Number of trial pits excavated	10 x Initial TP's on 29 September 2021 2 x Infill TP's on 07 February 2022
Placing Methodology	Site coverage limited to the accessibility at the time of conducting the investigations
Machine used for excavation	CAT422F TLB on 29 September 2021 CAT428E TLB on 07 February 2022
Profiling standards used for descriptions	SAICE 2009 and SANS633:2012
Profiles logged by	Qualified and registered engineering geologists
Test pit positioning	Hand-Held Garmin E-Trex GPS
Soil profile capturing and illustration	dotPLOT Version 3.22.0
Coordinate system	Decimal Degrees or WGS84 SA Grid

Table 4-2: Laboratory Tests and Tests Quantities

Laboratory Test	Laboratory	Test Standard	Number of Tests
Screen Analysis	Soil Tecnix (Pty) Ltd.	SANS 3001:GR1	7[a] + 2[b]
Hydrometer Analysis	Soil Tecnix (Pty) Ltd.	SANS 3001:GR3 & TMH1	7[a] + 2[b]
Atterberg Limits	Soil Tecnix (Pty) Ltd.	SANS 3001:GR10	7[a] + 2[b]
Relative Density	Soil Tecnix (Pty) Ltd.	SANS 5844	7[a] + 2[b]
pH	Soil Tecnix (Pty) Ltd.	Refer to lab report	4[a]
Electrical Conductivity	Soil Tecnix (Pty) Ltd.	Refer to lab report	4[a]
Density Moisture Relationship - Compaction Mod. AASHTO Energy	Soil Tecnix (Pty) Ltd.	Refer to lab report	2[b]
California Bearing Ratio on Mod. AASHTO compacted sample	Soil Tecnix (Pty) Ltd.	Refer to lab report	2[b]

Notes:

1. *[a] – Tests from samples retrieved during the initial test pitting phase.*
2. *[b] – Tests from samples retrieved during the infill test pitting phase.*

Refer to the laboratory test reports for investigation procedures/standards followed. More details on the investigation methodology and test standards can be provided upon request.

5 Basic Site Description

5.1 Location and Size

The erven of interest are Portion 216 and Portion 36 of the Farm Zandfontein 317-JR, Ward 55, Region 3, City of Tshwane Metropolitan Municipality, Gauteng Province, South Africa. The erven of interest are situated adjacent to the south of Van Der Hoff Road (R514), between Theo Slabbert and Richards Bay Streets, north of the east-west striking Witwatersberg range. The street addresses are known as 1311 and 1321 Van der Hoff Street as for Portion 216 and Portion 36, respectively.

The registered property sizes of PTN 216 and PTN 36 is 55 672 m^2 and 53 533 m^2, respectively. The combined size is 109 205m^2 (approximately 10.9205 Ha). The approximately centre site coordinates are (WGS84, Decimal Degrees): Latitude: -25.717182° Longitude: 28.116185°. The site locality is shown in **Figure 18-1** and **Figure 18-2**, **Appendix A**.

5.2 Land-Use, Topography and Vegetation

The area is seemingly zoned as Industrial 1 and mainly surrounded by Industrial 1 with Residential 1 and Industrial 2 towards the east and south-east and Residential 1, limited Residential 2, Special and Educational zonings in the immediate region. The planners should refer to registered and planned servitudes and/or planned routes that may bisect the site/s. Informal settlements are present towards the south and partially on the southern extent of the area of interest.

The site is situated towards the north of the Witwatersberg ridge, with a regional slope direction towards the north to north-east. The site is situated between approximately 1 295 and 1 290 mamsl. The site-specific drainage is towards the NNE. Localised high-spots of weathered shale fill is present towards the south-eastern portion of Erf 36. Relatively flat-lying areas are present that is expected to result in surface ponding immediately after heavy downpours. Water ponding were evident during the infill investigation attempt. The regional topography is shown in **Figure 18-3** and **Figure 18-4**, **Appendix A**.

The ground surface is mainly highly disturbed, and the presence of historic works, excavations, fill and foundations were identified, especially on the eastern erf, PTN 36. The 1:50 000-scale topographical sheet indicates historic excavations across the majority of PTN36. The 1:50 000-scale geological sheet indicates historic workings (mainly sand and clay pits) towards the south of the sites of interest. The 1:50 000-scale geological sheet indicates structures on PTN36 with notes on an historic brick works present on PTN36. The infrastructure was demolished; however, indications of the excavations/workings and foundation remains were identified during this assessment. Shallow concrete slabs were encountered on PTN36, indicating the presence of historic structures/foundations and relatively thick fill of mix origin were encountered across the site.

The vegetation is mainly invasive of nature with very little to no natural vegetation. The site is covered with domestic waste, construction rubble and localised areas with relatively thick brick, construction rubble and fly-ash and/or slag fill. Typical on-site conditions are depicted in **Photograph 5-1** to **Photograph 5-6** (as taken on 29 September 2021). Typical on-site conditions as encountered during the infill test pitting exercises are depicted in **Photograph 5-7** to **Photograph 5-10**. These photographs illustrate the un trafficable conditions during and for periods after precipitation events due to poor surface water drainage and soft clay under saturated conditions.

The planners should refer to the specialist reports for input on vegetation and waste classification.

Photograph 5-1: Typical On-site Conditions 1 (29 September 2021)

Photograph 5-2: Typical On-site Conditions 2 (29 September 2021)

Photograph 5-3: Typical On-site Conditions 3 (29 September 2021)

Photograph 5-4: Typical On-site Conditions 4 (29 September 2021)

Photograph 5-5: Typical On-site Conditions 5 (29 September 2021)

Photograph 5-6: Typical On-site Conditions 5 (29 September 2021)

Photograph 5-7: Typical On-site Conditions 6 – Inaccessible (7 February 2022)

Photograph 5-8: Typical On-site Conditions 7 – Inaccessible (7 February 2022)

Photograph 5-9: Typical On-site Conditions 8 – Inaccessible (7 February 2022)

Photograph 5-10: Typical On-site Conditions 9 – Inaccessible (7 February 2022)

5.3 Presence of Services and Access Roads

Identification of services and/or servitudes falls outside the scope of this assessment. The planners/designers should refer to the services report. A sewer line is present on the northern boundary of the site. An unknown service bisects PTN 216. An existing, seemingly drainage trench, bisects PTN 216 from the centre western boundary towards the north-eastern corner of PTN 216.

Informal unpaved roads are present on-site. The site can be accessed from the north-western corner of PTN 216, from Van der Hoff Road. Trafficability of the site is expected to be problematic, especially during the wet season, especially towards the northern centre portion of the site where the trench reaches the north-eastern corner of PTN 216. The site is accessible; however, surface preparation will be required to provide access for construction vehicles.

Trafficable conditions were confirmed during the infill investigation attempt conducted on 7 February 2022. Proper surface drainage will be required and temporarily roads may have to be considered for site access, especially for vehicles with high induced wheel loads.

On-site conditions and drainage are discussed in the relevant sections to follow.

6 Regional Climate

6.1 Climate Classification, Temperature and Precipitation

The regional climate is considered "Cwa" according to the Köppen-Geiger climate classification (Climate-Data, 2021).

The average annual temperature is ~18.4°C with an average annual rainfall of ~661 mm. The temperature is highest on average in January, at around an average of 22.3°C. The lowest average temperature in the year occurs in July, at around an average of 12.0°C.

The variation in the precipitation between the driest and wettest months is ~115 mm. The variation in annual temperature is around 10.3°C. Most of the precipitation occurs from November to March.

The regional average, minimum and maximum temperatures are presented in **Chart 6-1**. The regional average monthly rainfall and average amount of rainy days for each month is presented in **Chart 6-2**.

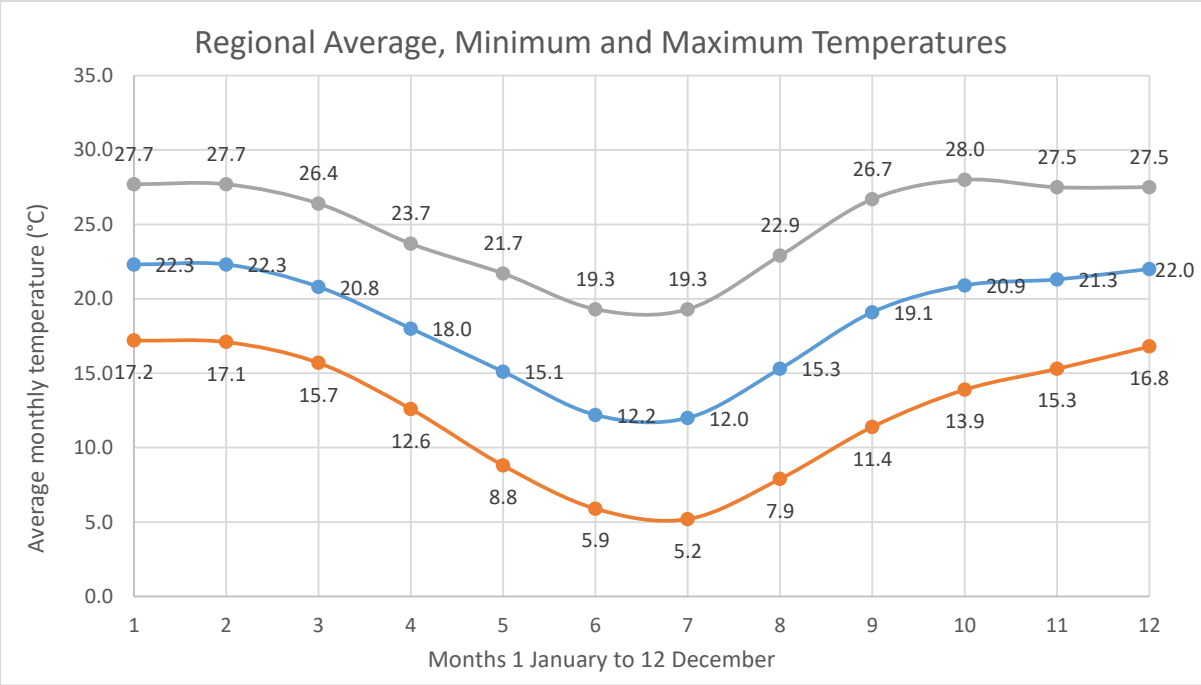

Chart 6-1: Regional average, minimum and maximum temperatures (Climate-Data, 2021)

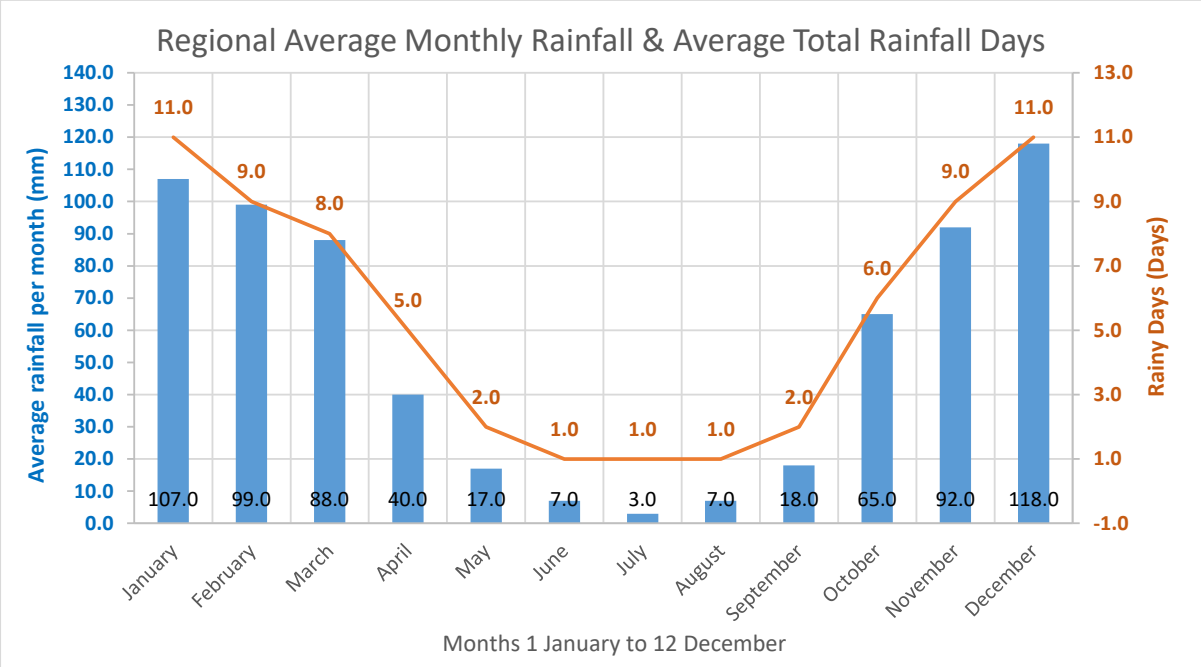

Chart 6-2: Regional average monthly rainfall & average total rainfall days (Climate-Data, 2021)

Planners and/or designers should refer to the site-specific data/records for design-level input.

6.2 Moisture Index - Weinert

This index is mainly for determination of the type of weathering profile that can be expected for a specific region and for input in road pavement evaluation and design. The index considers rainfall and evaporation with no direct relation to temperatures.

The index is calculated as follow (Weinert, 1980):

$$N = 12 \cdot \frac{Evaporation_{January}}{Mean\ Annual\ Precipitation}$$ **Equation 6.1**

The index ranges are:

- N <2 (Wet region);
- N 2 to 5 (Moderate region);
- N 5 to 10 (Dry region); and
- N >10 (Very arid region).

The broad macro-climatic regions of South Africa, as adapted from Weinert's N-value, are shown in **Figure 6-1**.

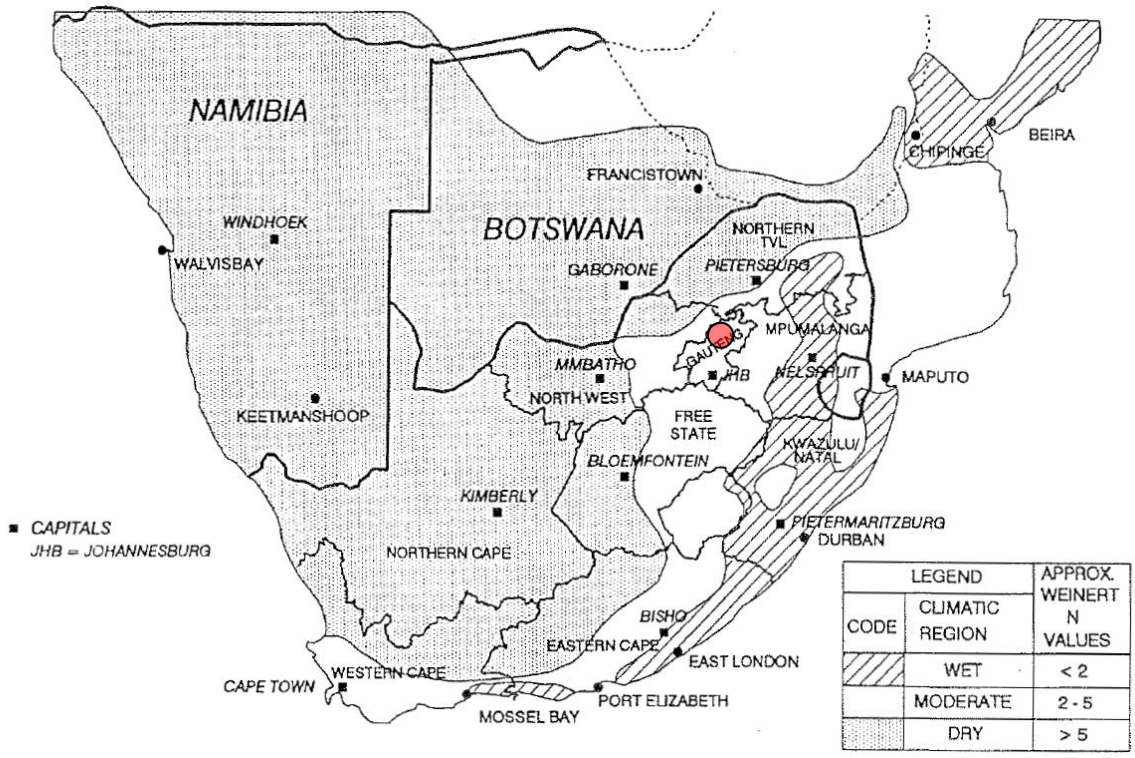

Figure 6-1: Macro climatic regions of Southern Arica (TRH4, 1996)

Chemical weathering (alteration) mainly prevails in N <5 regions and physical weathering (disintegration) in regions with N >5. The region is situated in a region with a N-value of between 2 and 5. The climate can be classified as "Moderate", and the weathering mode is expected to be a combination between physical and chemical weathering.

Relatively shallow profiles are expected regionally with upper chemically altered materials and localised areas of shallow rock with deeper soil formation in lower-lying regions.

6.3 Moisture Index – Thornthwaite

Thornthwaite's moisture index (Im) is used to classify climatic zones, also relevant to road pavement evaluation and design input. Im is a function of evapo-transpiration, which is dependent on vegetation and rainfall. Im provides a measure of the moisture surplus or moisture deficit (SAPEM, 2014).

Thornthwaite's Moisture Index is calculated as:

$$I_m = \frac{(100 \cdot Max\ Moisture\ Surplus) - (60 \cdot Moisture\ Deficit)}{Potential\ Evapotranspiration}$$ **Equation 6.2**

The Im classes are:

- Im > 100 (Peri-humid);
- Im 20 to 100 (Humid);
- Im 0 to 20 (Moist sub-humid);

- Im -20 to 0 (Dry sub-humid);
- Im -40 to -20 (Semi-arid); and
- Im <-40 (Arid).

The Im contour map of South Africa is shown in **Figure 6-2**.

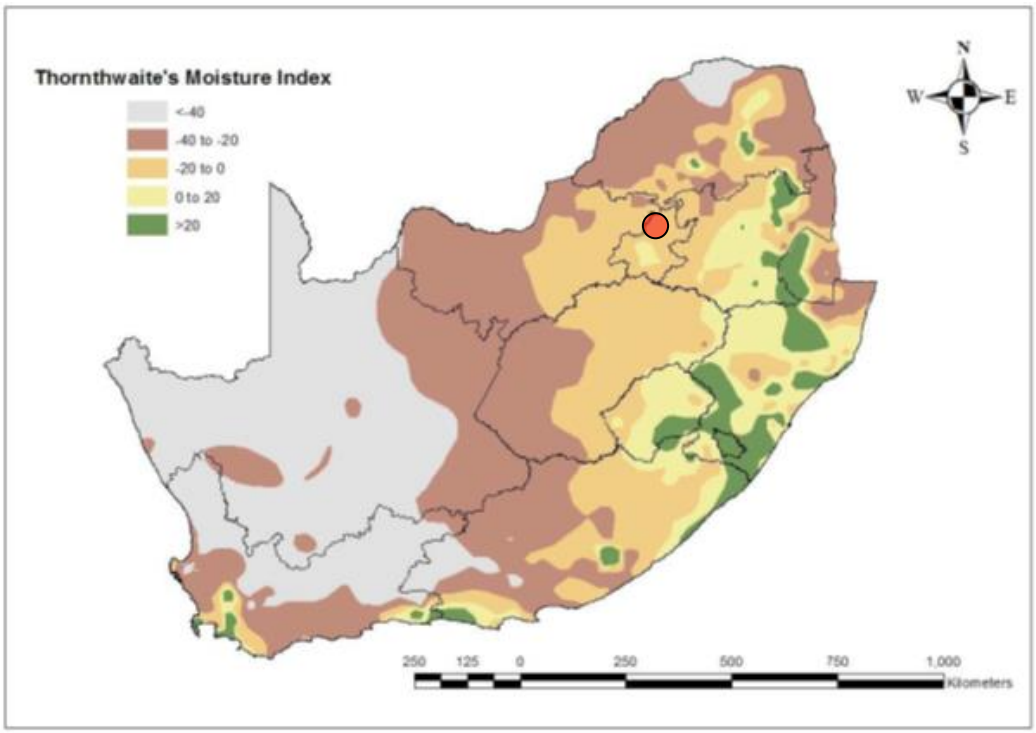

Figure 6-2: Contour map of Thornthwaite's Moisture Index (Im) (SAPEM, 2014)

Thornthwaite's Moisture index (Im) for this region is between -20 and 0, classifying as "Dry sub-humid".

7 Geology

7.1 General

According to the 1:50 000 geological sheet 2528CA Pretoria, the site is underlain by shale of the Silverton Formation (T3mS) with quartzite of the Daspoort Formation (T3dQ) of the Pretoria Group towards the far south of the site with two thick diabase intrusions striking east-west through the northern and southern parts of the erven with a 30° to 45° dip to the north.

A large sand deposit (SG) is indicated to the south of the erven with brick-clay and shale (CS) on and immediately south of the erven.

This site is not underlain by potentially soluble dolomite or limestone formations and a dolomite stability investigation is therefore not required.

According to the geological maps and accompanied explanation no specific mineral deposits, except the sand/clay deposits for fine aggregate/brick-clay, are present on the site, and from surface evidence most of this material has been mined out.

Two NNE to SSW striking faults are indicated on the 1:50 000-scale geological sheet towards the northeast of the site. These faults may cross the erven of interest.

The regional geology is shown in **Figure 18-5** and **Figure 18-6**, **Appendix A**.

7.2 Soil Profile and Assigned Material Groups

The detailed individual soil profile descriptions are attached as **Appendix B**. The soil profile and materials photographed at each of the test pit positions are attached as **Appendix C**. A summary table of the material types, horizon depths and general conditions on seepage and excavatability is provided in **Table 7-1**.

Table 7-1: Summary of Soil Horizons and General Conditions Encountered

TP No.	Un-engineered Fill	Reworked Topsoil and Colluvium	Alluvium	Residual Shale	Weathered Shale Rock	Residual Diabase	Weathered Diabase Rock	TP Depth	Seepage Encountered [a]	Excavation Conditions
TP01	0-1.50	1.50-1.70	1.70-3.00	-	-	-	-	3.00	None	Soft
TP02	0-2.70	-	-	-	-	-	-	2.70	None	Soft
TP03	0-0.60	0.60-0.80	0.80-2.20	2.20-2.70[b]	2.70-3.30[b]	-	-	3.30	None	Soft
TP04	0-0.70	-	0.70-2.40	2.40-2.70	-	-	-	2.70	None	Soft
TP05	0-0.70[c]	-	-	-	-	-	-	0.80	None	Hard[c]
TP06	0-1.10	-	1.10-2.70	2.70-3.20[b]	-	-	-	3.20	None	Soft
TP07	0-0.20	-	0.20-3.40	-	-	-	-	3.40	None	Soft
TP08	0-0.50	-	0.50-3.20	-	-	-	-	3.20	None	Soft
TP09	0-0.50	0.50-0.90	0.90-2.90	-	-	-	-	2.90	None	Soft
TP10	0-1.10	1.10-1.90	1.90-2.60	-	-	-	-	2.60	None	Soft
TP11	0-0.50	0.50-0.90	0.90-2.90	-	-	-	-	2.90	None	Soft
TP12	0-1.10	1.10-1.90	1.90-2.60	-	-	-	-	2.60	None	Soft

Notes:

1. *All depths are indicated as meters below ground level as on the date of inspection.*
2. *Excavation conditions classified as soft, intermediate and hard.*
3. *[a] Inspection date 29 September 2021 as for test pits TP01 to TP10 and 7 February 2022 as for test pits TP11 and TP12.*
4. *[b] Seemingly residual shale transgressing into shale, fair to low confidence level in assigned formation.*
5. *[c] Refusal on concrete slab/foundation.*

The different materials or soil horizons encountered on this site is grouped into 9 material groups, namely:

1. Un-engineered fill of mix origin;
2. Surficial fill of shale origin (localised stockpiled);
3. Surficial fill Ash/Slag mix origin (centre site portion backfill);
4. Topsoil and/or colluvium;
5. Alluvium;
6. Residual shale;
7. Shale rock;
8. Residual diabase; and
9. Diabase rock.

The materials encountered are discussed in the following sections.

7.2.1 Un-engineered Fill of Mix Origin

Un-engineered fill of mix origin was encountered in all of the test pits excavated. The thickness of the fill varies between 0.20 m (TP07) to >2.70 mbgl (TP02). The fill material varies between brick rubble to residual diabase, topsoil and shale to dolerite residuum. Vertical and lateral extent of the fill, as encountered in the test pits excavated in the accessible portions of the site, is significant. Detailed material descriptions of the fill are provided in the individual soil profile descriptions attached as **Appendix B**. The material is depicted in **Photograph 7-1**, **Photograph 7-2** and **Photograph 7-3**.

Photograph 7-1: Un-engineered Fill of Mix Origin (TP02)

Photograph 7-2: Un-engineered Fill of Mix Origin (TP02)

Photograph 7-3: Un-engineered Fill of Mix Origin (TP05)

7.2.2 Surficial Fill of Shale Origin (Localised Stockpile)

Two stockpiles (Roughly 1 900 to 2 000m^3 in total) of mainly weathered and residual shale origin is present on site, south of TP05 and west of TP10. The material contains a high percentage of highly to moderately weathered sub-angular to platy to slab-like shale gravel to small cobbles and scattered medium to large boulders. The material is depicted in **Photograph 7-4** and **Photograph 7-5.**

Photograph 7-4: Surficial Fill Shale Stockpile (Stockpile South of TP05)

Photograph 7-5: Surficial Fill Shale Stockpile (Stockpile South of TP05)

7.2.3 Surficial Fill Ash/Slag Mix Origin (Centre Site Portion Backfill)

Un-engineered and uncontrolled ash, slag and soil mixtures are present across the central site portion. The majority of the centre site portion were not accessible at the time of conducting this investigation due to extensive surface borrows of generally between ≈0.5 and ≈1.1 m in depth, where the slag is extracted by the local community. Infill investigation was attempted during early February and the site were inaccessible by the TLB due to wet/saturated/ponding water conditions and soft upper soils. The thickness of the fill in the centre site portion is unknown. Test pit TP02 was terminated in fill at 2.7 mbgl (practical reach of the TLB in the material type). Fill of mix origin was encountered from surface to 0.6 mbgl, some slag and mix origin fill from 0.6 to 1.8 mbgl from where construction rubble comprising mainly brick fill was encountered from 1.8 mbgl to termination depth of 2.7 mbgl. Typical surface exposures and borrows where the slag has been retrieved/sieved by the local community are depicted in **Photograph 7-6** and **Photograph 7-7**.

Photograph 7-6: Surficial and Backfill Ash/Slag (Borrows Centre Site Portion)

Photograph 7-7: Surficial and Backfill Ash/Slag (Borrows Centre Site Portion)

7.2.4 Topsoil and/or Colluvium

The natural topsoil and/or reworked colluvium horizon was encountered in test pits TP01 (0.50 to 1.70 mbgl), TP03 (0.60 to 0.80 mbgl), TP09 (0.50 to 0.90 mbgl), TP10 (1.10 to 1.90 mbgl), TP11 (0.50 to 0.90 mbgl) and TP12 (1.10 to 1.90 mbgl). The natural profile is generally identifiable by the lack of uncontrolled fill and material of mix origin and the upper slightly organic grey topsoil horizon that serves as a marker between the upper fill and lower natural soil profile. Detailed material descriptions of the topsoil and/or colluvium are provided in the individual soil profile descriptions attached as **Appendix B**. Typical horizon/material contacts and topsoil and/or colluvial materials are depicted in **Photograph 7-8** and **Photograph 7-9**.

Photograph 7-8: Topsoil and Colluvium (TP01)

Photograph 7-9: Topsoil and Colluvium (TP03)

7.2.5 Alluvium

Transported fine alluvial soils were encountered in test pits TP01, TP03, TP04, TP06, TP07, TP08, TP09, TP10, TP11 and TP12. Test pits TP02 and TP05 were terminated in fill and on an historic foundation/slab. The alluvium is generally identifiable by the grey colour and high fines content with scattered sub-angular to sub-rounded quartzite or quartz gravel and/or pebbles. Detailed material descriptions of the alluvium are provided in the individual soil profile descriptions attached as **Appendix B**. Typical alluvial soils are depicted in **Photograph 7-10**, **Photograph 7-11** and **Photograph 7-12**. **Photograph 7-11** shows a typical quartzite pebble indicating the transported nature of the material.

Photograph 7-10: Alluvium (TP06)

Photograph 7-11: Alluvium Quartzite Pebble (TP06)

Photograph 7-12: Alluvium Excavated (TP06)

7.2.6 Residual Shale

Residual shale was logged in test pits TP03, TP04 and TP06. The level of confidence in the material origin is generally fair to low due to the deeply weathered and reworked profiles. Detailed material descriptions of the residual shale are provided in the individual soil profile descriptions attached as **Appendix B**. The material logged as residual shale is shown in **Photograph 7-13** and **Photograph 7-14**. A localised patch of highly to completely weathered bedded backed shale were encountered in test pit TP03, as shown in **Photograph 7-13**.

Photograph 7-13: Residual and Highly to Completely Weathered Shale (TP03)

Photograph 7-14: Residual Shale (TP04)

7.2.7 Shale Rock

Shallow shale rock was not confirmed during this shallow soil investigation. It is expected that the majority of the site is underlain by shale of the Silverton Formation, at depth. A localised patch of highly to completely weathered shale was only logged in test pit TP03, at a depth of between 2.70 and 3.30 mbgl, as presented in **Photograph 7-13**.

7.2.8 Residual Diabase

Residual diabase was not encountered during this shallow soil investigation. Residual diabase may however be encountered with deeper or infill investigations, especially towards the southern boundary and northern boundary of the area of interest, as indicated by the 1:50 000-scale geological sheet.

7.2.9 Diabase Rock

Diabase rock was not confirmed during this shallow soil assessment; however, may be present towards the northern and southern site boundaries, as indicated on the 1:50 000-scale geological sheet.

8 Geohydrology

8.1 Groundwater Levels and Quality

Input on the groundwater levels and quality falls outside the scope of this shallow soil engineering geological investigation. The planners/designers should refer to the hydrogeological assessment/report where and if deemed necessary.

8.2 Seasonal Seepage Water or Perched Water Tables

No seepage water was encountered in any of the test pits excavated on 29 September 2021. The eastern and centre portions of the area of interest are disturbed and the natural seepage water and/or water tables are expected to be affected by the workings. Some staining and Fe and Mn nodules (pedocrete formation) were recorded in some of the profiles, indicating expected seasonal seepage water conditions. Seasonal seepage water may be experienced at depths of between, but not limited to ≈1.0 and 3.2 mbgl.

Infill test pitting was attempted on 7 February 2022. The site was mainly inaccessible due to excessive water ponding and soft non-trafficable upper soils. Only two test pits were excavated during this infill investigation attempt (test pits TP11 and TP12). No water seepage was recorded by the field personnel during the open inspection periods of the test pits (+/- 30minutes per test pit).

Infiltration of seepage water can be expected during and towards the end of the wet season.

9 Geotechnical Evaluation

The geotechnical evaluation is based on the desk study, conditions encountered in the test pits excavated in the accessible portions of the site, the laboratory test results and local knowledge of the area. The laboratory test results are attached as **Appendix D**. A summary table of the results and soil classifications is provided as **Table 9-1**.

Table 9-1: Basic Laboratory Test Result Summary Sheet

Test Pit No.	Sample Depth (m)	Material Description	Soil Composition				Atterberg Limits		GM (%)	LS (%)	Relative Density (SG)	Soil Class USCS [a]	Soil Class PRA [b]	Soil Heave Potential [c]
			Clay (%)	Silt (%)	Sand (%)	Gravel (%)	LL (%)	PI (%)						
TP03	1.3-1.6	Alluvium	41	17	34	8	51	21	0.67	15.0	2.706	CH	A-7-6	Medium to High
TP04	1.0-2.0	Ferruginised alluvium	12	19	34	35	33	15	1.53	7.5	2.650	SC	A-6	Low
TP04	2.5-2.7	Seemingly residual shale	17	38	30	15	46	24	0.83	11.5	2.650	CL	A-7-6	Medium
TP06	1.6-2.6	Seemingly alluvium	57	26	17	0	75	42	0.13	27.5	2.650	CH	A-7-5	Very High
TP06	2.7-3.2	Seemingly alluvium	13	59	28	0	53	21	0.14	12.0	2.749	MH	A-7-5	Medium
TP09	1.0-1.7	Ferruginised alluvium	25	19	33	23	45	24	1.13	12.5	2.650	SC	A-7-6	Medium
TP09	2.1-2.8	Alluvium	47	24	22	7	60	32	0.47	24.5	2.650	CH	A-7-6	High
SP1	--	Stockpile 1 (Centre North)	9	32	20	39	33	9	1.42	4.2	2.681	GM	A-4 (1)	Low
SP2	--	Stockpile 2 (South-East)	6	23	14	57	42	12	1.89	5.1	2.742	GM	A-2-7 (0)	Low

Notes:

1. [a] *Unified Soil Classification system.*
2. [b] *PRA or AASHTO Soil Classification System.*
3. [c] *Soil heave potential* (van der Merwe, 1964).

9.1 Material Grading and Atterberg Limits

The material grading and Atterberg Limits are summarised in **Table 9-1**. The soils in general have a fines content (clay and silt) in excess of 30% to as high as 83%.

Gravel is practically absent in the natural profile with only scattered quartzite gravel and pebbles, generally present in the transported alluvial soils only.

Fe and Mn nodules and concretions (pedocrete formation) are present in the ferruginised alluvial soils providing some gravel portion of between 20 to 35%. The majority of the soils are however fines (clay and silt) and the fines will dictate the material properties and behaviour.

The uncontrolled and un-engineered fill varies significantly with reference to material types and grading. Overall, the fill material contains less fines with the presence of sand, gravel, ash, slag and construction rubble (brick and concrete).

The Plasticity Index (PI) of the natural soils is generally between 20% and 40%, falling within the high plasticity range (see **Table 9-2**). The Liquid Limit (LL) of the natural soils varies 46% and 75%. The PI and LL of the ferruginised alluvium is slightly less; however, not considered significant due to the limited thickness of the ferruginised horizons.

The Grading Modulus (GM) of the natural soils are generally low, between 0.8 and 0.13, with only the ferruginised horizons with a GM of around 1.13 to 1.53.

The infill testing conducted on samples retrieved from Stockpile 1 (stockpile present towards the northern centre site boundary) and Stockpile 2 (stockpile present towards the south-eastern site boundary) indicate GM of between 1.42 and 1.89 with a PI of between 9 and 12%, LL of between 33 and 42% and LS of between 4.2 and 5.1%. The materials can be regarded as low to medium plasticity soils.

Table 9-2: Plasticity Classification

Plasticity Index	Description
0	Nonplastic
1 – 5	Slightly plastic
5 – 10	Low plasticity
10 – 20	Medium plasticity
20 – 40	High plasticity
> 40	Very high plasticity

Notes:

1. *Categories of plasticity after Burmister, 1949.*

9.2 Material Classification

9.2.1 Unified Soil Classification System

The materials tested classifies as the following soil classes (Unified Soil Classification System):

GM → Course-grained soils (more than 50% retained on the 0.075 mm sieve), gravels (50% or more of course fraction retained on the 4.75 mm sieve), gravel with fines, silty gravels, gravel-sand-silt mixtures.

SC → Course-grained soils (more than 50% retained on the 0.075 mm sieve), sands (50% or more of course fraction passes the 4.75 mm sieve), sands with fines, clayey sands, sand-clay mixtures.

CL → Fine-grained soils (more than 50% passes the 0.075 mm sieve), silts and clays with Liquid Limit of 50 % or less, inorganic clays of low to medium plasticity, gravelly/sandy/silty/lean clays.

MH → Fine-grained soils (more than 50% passes the 0.075 mm sieve), silts and clays with Liquid Limit greater than 50%, inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts.

CH → Fine-grained soils (more than 50% passes the 0.075 mm sieve), silts and clays with Liquid Limit greater than 50%, inorganic clays or high plasticity, fat clays.

9.2.2 AASHTO Classification System

The materials tested classifies as the following soil classes (AASHTO Classification System):

A-2 → Granular materials (35% or less passing the 0.075 mm sieve), different LL and PI for A-2 variances (refer to A-2-4, A-2-5 A-2-6 and A-2-7 sub-groups) with significant constituent: silty or clayey gravel sand.

A-4 → Silt-clay materials (>35% passing the 0.075 mm sieve), minimum of 36 % passing the 0.075 mm sieve, LL max of 40%, PI max of 10%, with significant constituent: silty soils.

A-6 → Silt-clay materials (>35% passing the 0.075 mm sieve), minimum of 36 % passing the 0.075 mm sieve, LL max of 40%, PI min of 11%, with significant constituent: clayey soils.

A-7 → Silt-clay materials (>35 % passing the 0.075 mm sieve), minimum of 36 % passing the 0.075 mm sieve, LL min of 41%, PI min of 11%, with significant constituent: clayey soils. Note: Plasticity Index of A-7-5 subgroup is equal to or less than the Liquid Limit – 30%. Plasticity Index of A-7-6 subgroup is greater than LL – 30%.

9.2.3 TRH or COLTO Classification System

Compaction tests were not performed on any of the samples retrieved during the initial test pitting phase. Considering the plasticity and soil heave potential, the materials are expected to classify as poorer than G10 material (thus unclassifiable in this system) due to the excessive >1.5% expected heave upon saturation after compaction.

Two compaction tests were performed from the stockpile material currently present on site. The results are attached as **Appendix D**. The results confirm the initial above expectation. The soils classify as poorer than G10 due to the have of >1.5% as well as borderline PI and CBR values.

The requirements for the various G-classes are (TRH or COLTO Classification Systems):

G1 → Graded crushed stone (Layered material). The material is unweathered with specific strength, durability and grading requirements. Nominal maximum size = 37.5 mm. LL (-0.425 mm) max. 25%, PI (-0.425 mm) max. 5%, PI (-0.075 mm) max. 12%, LS (-0.425 mm) max. 2%. Swell (100% Mod) max. 0.2%.

G2 → Graded crushed stone (Untreated) with a soaked CBR > 80% at 98% Mod. AASHTO density with swell <0.2% at 100% Mod. AASHTO density. Nominal maximum size = 37.5 mm. Nominal maximum size = 37.5 mm. LL (-0.425 mm) max. 25%, PI (-0.425 mm) max. 6%, PI (-0.075 mm) max. 12%, LS (-0.425 mm) max. 3%. Swell (100% Mod) max. 0.2%.

G3 → Graded crushed stone with a soaked CBR > 80% at 98 % Mod. AASHTO density with swell <0.2% at 100 % Mod. AASHTO density. Nominal maximum size = 37.5/26.5 mm. LL (-0.425 mm) max. 25%, PI (-0.425 mm) max. 6%, PI (-0.075 mm) max. 12%, LS (-0.425 mm) max. 3%. Swell (100% Mod) max. 0.2%.

G4 → Natural gravel with a soaked CBR > 80% at 98% Mod. AASHTO density with swell <0.2% at 100% Mod. AASHTO density. Nominal maximum size = 53 mm. LL (-0.425 mm) max. 25%, PI (-0.425 mm) max. 6%, LS (-0.425 mm) max. 3%. Swell (100% Mod) max. 0.2%.

G5 → Natural gravel with a soaked CBR > 45% at 95% Mod. AASHTO density with swell < 0.2% at 100% Mod. AASHTO density. Grading Modules (GM) 2.5 ≥ GM ≥ 1.5. Nominal maximum size 63 mm. LL (-0.425 mm) max. 30%, PI (-0.425 mm) max. 10% or 2 x GM +10, LS (-0.425 mm) max. 5%. Swell (100% Mod) max. 0.5%.

G6 → Natural gravel with a CBR > 25% at 93% Mod. AASHTO density with swell < 1.0% at 100% percent Mod. AASHTO density. Grading Modules (GM) 2.6 ≥ GM ≥ 1.2. Nominal maximum size 2/3 of the compacted layer. PI (-0.425 mm) max. 12% or 3 x GM +10, LS (-0.425 mm) max. 5%. Swell (100% Mod) max. 1.0%.

G7 → Gravel-soil with a CBR > 15% at 93% Mod. AASHTO density with swell < 1.5% at 100% percent Mod. AASHTO density. Grading Modules (GM) 2.7 ≥ GM ≥ 0.75. Nominal maximum size 2/3 of the compacted layer. PI (-0.425 mm) max. 12% or 3 x GM +10, LS (-0.425 mm) max. 7%. Swell (100% Mod) max. 1.5%.

G8 → Gravel-soil with CBR > 10% at in-situ density with swell < 1.5% at 100% percent Mod. AASHTO density. Grading Modules (GM) 2.7 ≥ GM ≥ 0.75. Nominal maximum size 2/3 of the compacted layer. PI (-0.425 mm) max. 12% or 3 x GM +10, LS (-0.425 mm) max. 7%. Swell (100% Mod) max. 1.5%.

G9 → Gravel-soil with a CBR > 7% at in-situ density with swell < 1.5% at 100% percent Mod. AASHTO density. Grading Modules (GM) 2.7 ≥ GM ≥ 0.75. Nominal maximum size 2/3 of the compacted layer. PI (-0.425 mm) max. 12% or 3 x GM +10, LS (-0.425 mm) max. 7%. Swell (100% Mod) max. 1.5%.

G10 → Gravel-soil with a CBR > 3% at in-situ density with **swell < 1.5%** at 100% percent Mod. AASHTO density. Nominal maximum size 2/3 of the compacted layer.

Refer to more detailed TRH14 and/or COLTO classification specifications.

9.3 Typical Material Properties and Performance Correlations

Typical material properties and performance correlations mainly based on the Unified Soil Classification System and assigned in-situ material consistencies are provided in **Table 18-1**, **Table 18-2**, **Table 18-3** and **Table 18-4**, **Appendix E**. The planners and designers can refer to the typical property ranges and expected performance of the soil classifications. Parameter selection will depend on the design philosophy followed. The designers should liaise with the engineering geologist during the design phase.

9.4 Collapse and Compressibility

The on-site soils are not considered collapsible due to the high percentage of fines and lack of a collapsible (voided) soil structure. Collapse severity classify as "No problem" (see **Table 9-3**).

The majority of the site is however covered will uncontrolled and uncompacted fill that will be compressible.

The natural soils are mainly high plasticity soils with high fines content (silt and clay size particles) that is generally considered compressible. The soils classify as SC, CL, CH and MH soils, as per the Unified Soil Classification System (USCS).

- **SC soils** will have a **low compressibility** once property compacted; however, only the ferruginised alluvium at depth classifies as SC.

- **CL soils** will have a **medium compressibility**, even if properly compacted. Only the seemingly residual shale encountered at depth (TP04) classifies as CL.
- **CH and MH soils** will have a **medium to high compressibility**, even if properly compacted. All the transported alluvial soils sampled and tested classify as CH and MH.

High compressibility, as for class "S2" (SAICE, 1995), is assigned to the site, with an estimated total expected settlement of >20 mm with assumed differential settlement of 50% of the total settlement. The actual settlement will be load specific; however, settlement is considered secondary to the expected heave. Earthwork and/or foundation precautionary measures will be essential to limit excessive differential movement under expected induced loading conditions. IN the regions not affected by thick fill, settlement will be secondary to the shrink-swell movements resulting from the swell potential of the soils (see **section 9.5**).

Table 9-3: Guiding Values of Collapse Potential (Schwartz, 1985)

Collapse Potential (CP) (%)	Severity of Problem
0 – 1	No problem
1 – 5	Moderate trouble
5 – 10	Trouble
10 – 20	Severe trouble
> 20	Very severe trouble

9.5 Potential Expansiveness

Expansive soil may result in surface movement mainly due to shrink and swell movements resulting from varying moisture conditions. Surface movement may result in unwanted damage of inappropriately designed buildings, services and general structures.

The amount of swell is directly dependent on the thickness of the active zone, type and percentage of the clay minerals and the swell pressure exerted by the soils.

The site is blanketed with soils with a high fines content (clay-size and silt-size particles). Desiccation cracks are present in the upper profile. Slickensided nature is present in some profiles. Significant surface cracks are present. The aforementioned are all indications of significant shrink-swell movement due to changes in moisture contents. Considering the regional geology (Silverton shales), diabase, associated secondary minerals and geomorphological setting (alluvial deposits), high swell potential is expected.

Based on the PI_{whole} and clay fraction (Van der Merwe, 1964) the on-site materials generally indicate a medium to high and occasionally very high heave potential (see **Chart 9-1**).

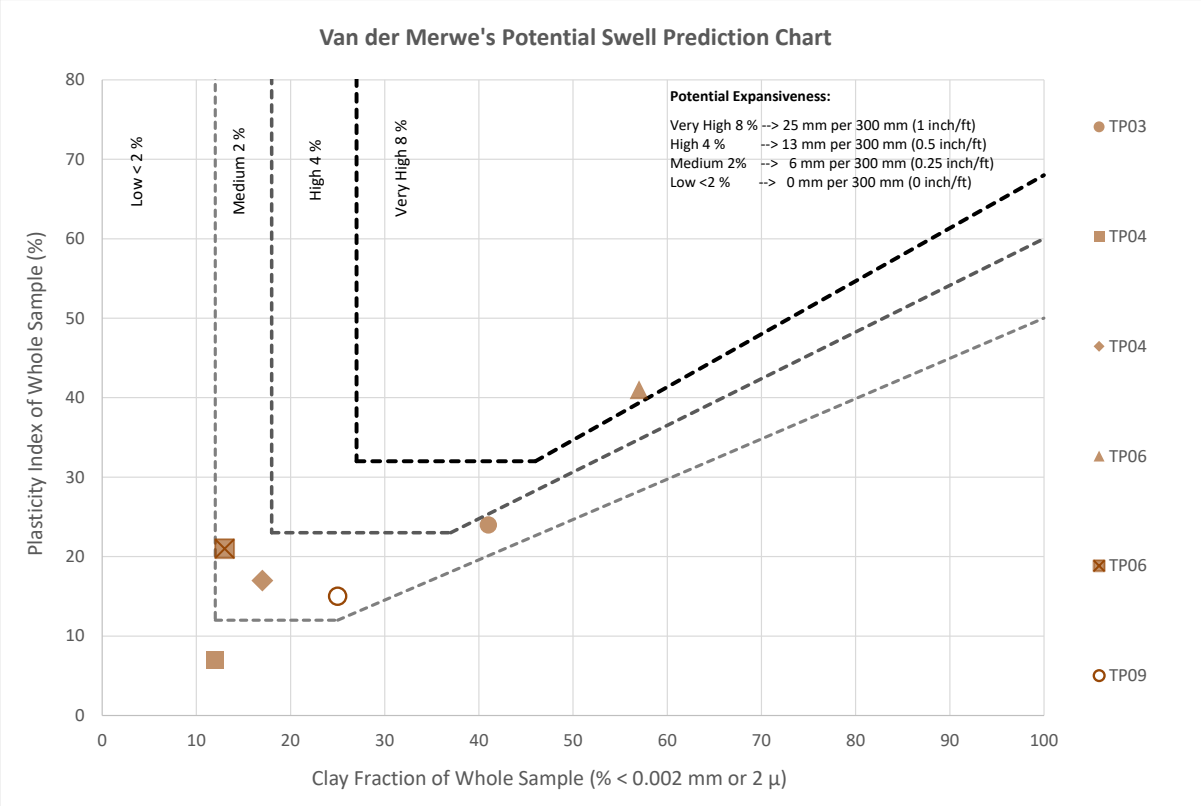

Chart 9-1: Potential Expansiveness Rating (Van der Merwe, 1964)

A potential heave as for class "H3" (SAICE, 1995) is assigned to the site with an estimated total heave of >30 mm (SAICE, 1995) with assumed differential movement of 50% of the total heave. Earthwork and/or foundation precautionary measures will be essential limit excessive differential movement due to the high heave potential.

9.6 Susceptibility to Erosion

It is important to differentiate between those soils that are merely erodible and those that are dispersive, as the mechanism and erosion control measures may differ for each of the types.

Erodible soils can be defined as soils in which the sum of the resisting forces (the cohesion or surface shear strength) is insufficient to resist the activating forces (impact force of rain or water flowing over the soil particles). A minimum entrainment velocity is required.

Dispersive soils are soils in which the fine component goes into suspension in standing water (thus no minimum entrainment velocity required to suspend the soil particles). Dispersion occurs when the repulsive forces between the individual clay particles exceeds the attractive (van der Waal's) forces so that when the soil is in contact with water the individual particles become detached and go into suspension. If flowing water is introduced, the already suspended particles are carried away, causing erosion.

Slaking soils are those that when dry or partially saturated have considerable soil suction which is totally lost on soaking, an extreme case of being erodible. If flowing water is introduced, the particles can be carried away, causing erosion. A minimum entrainment velocity is required.

The dispersiveness of the soils were not evaluated during this assessment due to the lack of excessive erosion features and typical dispersiveness indicators such as dribble patterns, rill erosion, eroded gullied slopes with indications of tunnels and piping, light-coloured profile outwash, calcrete nodules above clayey horizon etc. Based on the lack of dispersiveness indicators, the soils are considered to be non-dispersive, for the purposes of this shallow soil assessment focusing on the infrastructure of the area of interest only. The aforementioned statement cannot be considered in evaluation of the soils in construction of dam walls / embankments.

Soils classifying as "**SP**" (sand poorly graded), "**SM**" (silty sand), "**CL**" (inorganic clays of low to medium plasticity) or "**CH**" (inorganic clays of high plasticity) as per the Unified Soil Classification System is generally prone towards erosion.

The on-site soils classify as "SC", "**CL**", "MH" and "**CH**". The site slope is however generally flat-lying with no expected high flow velocities under normal rainfall events.

Erosion control measures should be considered. Basic control measures may include one or a combination of the following:

- Stormwater planning to reduce overland flow;
- Construction phasing to limit vast exposed areas that may result in high run-off and concentrated water flow;
- Surface water management to prevent high run-off rates and concentrated water flow;
- Direction of managed surface water away from structures;
- Temporary surface protection during and after construction till re-vegetated;
- Natural and/or permanent surface protection after construction for example grass establishment, paving and/or stone pitching;
- Physical improvement of the upper soils such as compaction in order to increase resistance to erosion;
- Subsurface drainage where pedogenic or expected seasonal perched water contacts are exposed by possible cuts/excavations.

Proper site water management will be recommended with surface protection measures (natural of artificial), in order to avoid concentrated water flow that may result in erosion of the upper soil horizons and potential undercutting of infrastructure, in the worst-case scenario.

9.7 Excavatability

The soils were easily excavatable down to 2.5 to 3.4 mbgl. Soft excavation conditions prevail. Localised areas of historic foundations are however present, especially towards the eastern portion of the area investigated which will result in excavation difficulty and will most probably require the use of pneumatic equipment to break down and excavated the concrete foundations/slabs.

Although not encountered, the presence of localised large-size boulders and/or floaters resulting from the weathering of diabase, as typically encountered in this geological/geomorphological setting, cannot be out ruled.

9.8 Soil Corrosiveness

The potential corrosiveness of the soil towards ferrous metals can be evaluated by means of pH and conductivity testing conducted on soil-water pastes. Corrosive soil load function of pH and resistivity according to EN 12501-2:2003 is provided is presented as Error! Reference source not found..

The pH of the soils varies between 6.8 and 7.4. The resistivity (Ω·cm) varies between 2 703 and 6 250 Ω·cm (or 0.037 and 0.016 S/m).

The corrosiveness rating assigned to the soils is “Medium” (EN 12501-2:2003).

Other soil characteristics that may influence corrosivity towards metals are soluble salt content, soil types, aeration, anaerobic conditions, and site drainage.

The index tests indicate that corrosion protection measures should be considered for underground ferrous services or ferrous services in potential contact with the soil and/or soil-water interface. More detailed assessments should be conducted for any critical services, as and if deemed necessary by the design engineer.

Table 9-4: Corrosive soil load function of pH and resistivity according to EN 12501-2:2003

pH	Resistivity (Ω.cm)	Corrosiveness Rating
<3.5	Any	High
3.5 to 4.5	<4 500	High
	>4 500	Medium-High
4.5 to 5.5	<4 500	High
	4 500 to 5 000	Medium-High
	>5 000	Medium
5.5 to 6.0	< 1 000	High
	1 000 to 5 000	Medium-High
	5 000 to 10 000	Medium
	> 10 000	Medium-Low
6.0 to 9.5	< 1 000	High
	1 000 to 3 000	Medium-High
	3 000 to 10 000	Medium
	10 000 to 20 000	Medium-Low
	> 20 000	Low

9.9 Undermined Ground

The ground surface is mainly highly disturbed, and the presence of historic works, excavations, fill and foundations were identified, especially on the eastern erf, PTN 36.

The 1:50 000-scale topographical sheet indicate historic excavations across the majority of PTN36.

The 1:50 000-scale geological sheet indicate historic workings (mainly sand and clay pits) towards the south of the sites of interest.

The 1:50 000-scale geological sheet indicates structures on PTN36 with notes on an historic brick works present on PTN36.

The infrastructure was demolished; however, indications of the excavations/workings and foundation remains were identified during this assessment. Shallow concrete slabs were encountered on PTN36, indicating the presence of historic structures/foundations and relatively thick fill of mix origin were encountered across the site.

Mining activities were limited to surface excavations and no surface instability due to undermining activities can occur. The excavation depths and thickness of backfill in the inaccessible centre portion of the area of interest could not be established during this shallow soil assessment that was limited to inspection depths of the TLB and current accessibility of the site.

9.10 Dolomite Stability

The site is not underlain by dolomitic formation and dolomite stability is not of concern.

9.11 Areas of Unstable Natural Slopes and Steep Slopes

No steep natural slopes are present and slope instability due to steep on-site and nearby natural slopes are not of concern.

Fill material was imported between 2017 and 2018 to provide for a raised bed for road construction for the road running parallel to the southern site boundary. Relatively steep embankment slopes are present towards the southern boundary of the site. The designers or road engineers should consider appropriate angles upon formalisation of the road.

9.12 Seismicity

Seismic hazard zones applicable to South Africa are depicted in **Figure 9-1**. The zones are determined from the seismic hazard map which presents the peak ground acceleration with a 10% probability of being exceeded in a 50-year period. It includes both natural and mining-induced seismicity (SANS10160-4, 2017).

The following zones are considered:

- Zone I: Natural seismic activity.
- Zone II: Regions of mining-induced and natural seismic activity.

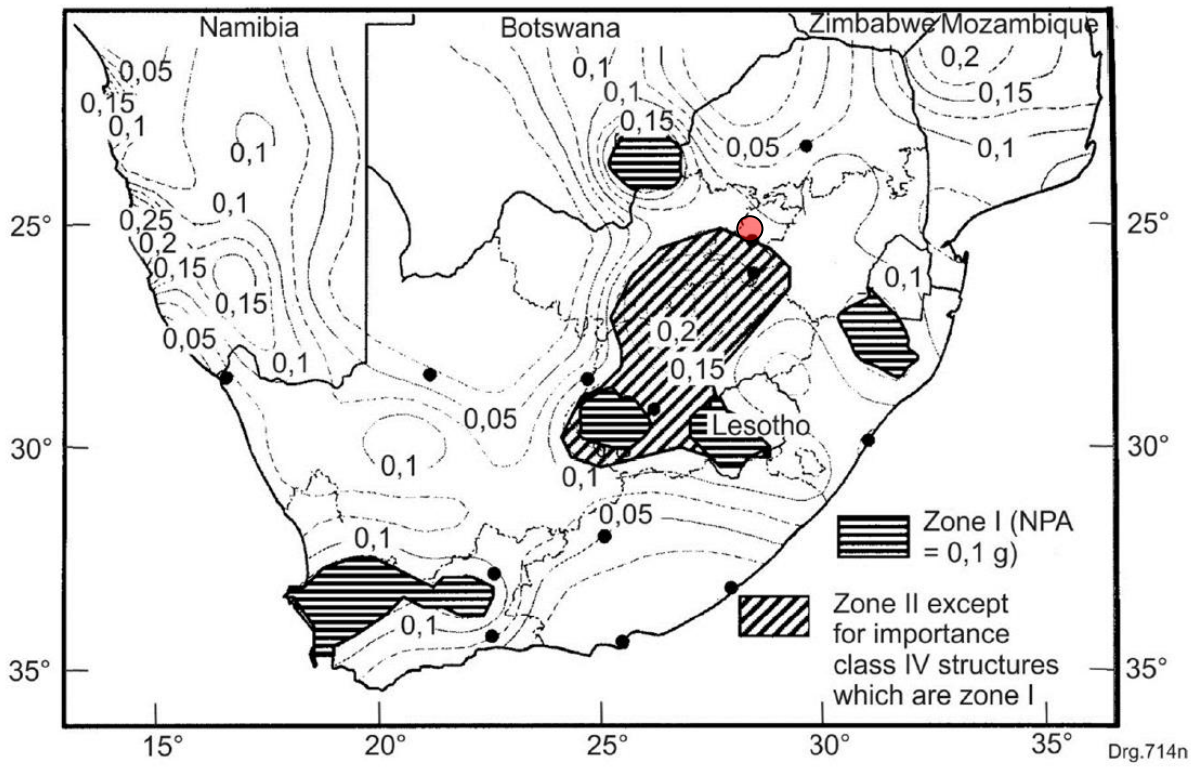

Figure 9-1: Seismic hazard zones of South Africa (SANS10160-4, 2017)

The site falls outside Zone I and Zone II. The structural engineers should however consider seismic activities and the necessary design requirements as outlined in the relevant standards (SANS10160-4, 2017).

9.13 Flooding

The natural drainage of the region is disturbed by the historic workings. A flood assessment falls outside the scope of this assessment. Indications of expected seasonal surface ponding water are present on site (severe surface water ponding was confirmed during the infill test pitting attempt on 7 February 2022), especially toward the lower centre northern portion of the site. The planners/designers should consider a site-specific survey, establish the nature of flow and allow for proper stormwater management to prevent water ponding and flooding.

9.14 Contaminated Land

Historic workings, structures and current excessive uncontrolled waste is present. Waste sampling, testing and classification was recommended. The client appointed an independent consultant to assess potential contamination. Planners/designers should refer to the relevant specialist reports.

10 Preliminary Assigned Geotechnical Zonation

The shallow soil conditions were assessed by means of 12 intrusive test pits excavated in the accessible site portions. The assigned geotechnical zonation considers the conditions encountered in the intrusive test pits as well as available regional information, laboratory test results, nearby reports and local knowledge of the area. The positions of the evaluation test pits are depicted in **Figure 18-7**, **Appendix A**. Selective historical GoogleEarth images are presented as **Figure 18-8**, **Figure 18-9** and **Figure 18-10**, **Appendix A**.

The site is preliminary assigned with 3 (three) broad preliminary residential site class designations (NHBRC, 2015) (refer to identified shortcomings, conclusions and proposed way forward, report **section 14**, **section 15** and **section 16**). The preliminary geotechnical zonation and assigned shallow soil designations are presented in **Figure 18-11**, **Appendix A**. The classification system assigned to the zones consider the site class designations as per the NHBRC 2015 home builders manual (or SAICE 1995 Code of Practice) as well as the typical constraints associated with urban development (SANS634, 2012).

The broad residential site class designations are summarized as (NHBRC, 2015):

- **Zone I**: P(Fill raised road embankment) S2 // 2DEI
- **Zone II**: P(Uncontrolled backfill historical workings) H3-S2 // 3C 2BDE (2L)
- **Zone III**: H3-P(Surficial fill and historic foundations) // 3C 2BDE (2L)

The assigned designation/s before the "//" represent/s the following (NHBRC, 2015):

H → Expansive soils.

S → Compressible soils.

P → Variable constraint/s (refer to description in brackets).

The assigned designation/s after the "//" represent/s the following (SANS634, 2012):

B → Seepage.

C → Active soil.

D → Highly compressible soil.

E → Erodability of soil.

I → Steep slopes.

L → Areas subject to flooding.

The severity of the assigned residential designation (symbols before the "//") is presented in **Table 18-5**, **Appendix E**. The severity of the assigned constraints (symbols after the "//") is presented in **Table 18-9**, **Appendix E**.

Other localised areas of interest are shown in **Figure 18-11**, **Appendix A**.

It should be emphasised that the test pits were positioned in the accessible areas of the site in order to obtain maximum coverage; however, that the centre portion of the site were inaccessible at the time of conducting this shallow soil assessment. The extent of historic excavations/borrows and thickness of backfill in these excavations could not be established at the time of writing this report. The planners/designers should refer to identified shortcomings, conclusions and proposed way forward, as outlined in report **section 14**, **section 15** and **section 16**.

11 Foundation Options and Recommendations

Foundation design of type 1 masonry buildings (refer to list of definitions) shall be guided by the South African National Standards, Part H on Foundations (SANS10400-H, 2012), considering the assigned residential designation and estimated total and differential movements provided. Geotechnical and/or structural solutions can be considered. The selection of either a geotechnical or structural solution depends upon the practicality and economy of the solutions in question (SANS10400-H, 2012).

11.1 Geotechnical Solutions

Geotechnical solutions generally eliminate or reduce the total soil movements to within limits which can be tolerated by buildings without distress by means of one of the following (SANS10400-H, 2012):

a) Removal of the soil horizons that cause unacceptable differential movements and replacement of these horizons with inert material suitably compacted or the reuse of the excavated material as founding material in a compacted form;

b) Founding of the wall footings at a deeper level than is commonly associated with normal construction, i.e. a suitable founding horizon below the horizons within which relatively large movements might take place (where soil conditions allow); and

c) Densification of the soil horizons that cause unacceptable differential movement by means of surface compaction.

11.2 Structural Solutions

Structural solutions employ techniques to improve flexibility or stiffness and strength, which reduce the effects of differential soil movements to a level that can be tolerated by a building without significant damage (SANS10400-H, 2012).

11.3 Foundation Solutions

Foundation design, building procedures and precautionary measures for single-storey type 1 masonry buildings founded on highly expansive soils can be considered across the site, as typically considered for Site Class designation “H3 - >30 mm Heave”:

Site Class “H3”:

Stiffened or cellular raft:

- Stiffened or cellular raft of articulated lightly reinforced masonry.
- Site drainage and service and plumbing precautions.

Piled construction (Probably not feasible):

- Piled foundations with suspended floor slabs with or without ground beams.
- Site drainage and service and plumbing precautions.

Soil raft:

- Remove all or necessary parts of expansive horizon to 1.0 m beyond the perimeter of the building and replace with inert backfill compacted to at least 93 % MOD AASHTO density at -1% to +2% of optimum moisture content.
- Normal construction with lightly reinforced strip footings and light reinforcement in masonry if residual movements are < 7.5 mm, or construction type as appropriate to residual movements.
- Site drainage and service and plumbing precautions.

The boundaries, excavation depth and fill thickness and properties of the currently assigned Zone II should be refined/determined by means of infill investigation once the areas area accessible/trafficable. Once the zone boundaries, thickness of fill and properties of the fill is established, foundation options can be recommended. A hybrid approach including geotechnical and foundation solutions can be expected, most probably with a combination of soil mattress construction and cellular rafts as for Site Class H3 foundation solutions.

11.4 Larger Structures

Larger structures should be design by a competent engineer. Input can be provided upon request if load schedules and allowable structural tolerances are available.

Foundation options will probably include one or a combination of the following:

Stiffened strip footings, stiffened or cellular raft.

Soil raft.

Piled or pier foundations.

A combination of soil raft and stiffened strip footings, stiffened or cellular raft construction will probably be recommended, depending on the structural details, load schedules and sensitivity of the structures. The design engineer should ideally liaise with the engineering geologist to optimize foundation designs.

11.5 Foundations for Free-Standing Walls and Retaining Walls

Foundations for free-standing walls and retaining walls that comply with the requirements of SANS 10400-K shall be in accordance with the specifications provided in SANS10400-H. High soil heave, differential movements and overturning should be considered in the design. Earthwork and design input can be provided upon request, once conceptual designs are available.

11.6 High Bearing and/or Sensitive Structures

Bearing capacity input should be provided for all high-bearing or sensitive structures. The design engineer should liaise with the engineering geologist for input on all high bearing structures/foundations such as high bearing pad footings, shallow high bearing strip foundations, elevated reservoirs, ground based sensitive concrete dams etc.

12 Drainage Measures

A flood and stormwater assessment falls outside the scope of this shallow soil assessment. No site-specific contour data were available at the time of writing this report. Based on the historical GoogleEarth aerial images and visual surficial observations, areas of surface water ponding can be expected during and after heavy and/or continuous downpours. The natural drainage is highly disturbed due to fill and historic workings on site and in the surroundings. A detailed surface survey should be conducted in order to evaluate the drainage conditions. Areas of ponding water should be identified with practical gravitational drainage measures. Localised areas of earthwork modification and/or raised platforms may be required to allow for proper drainage. Seasonal seepage water conditions can be expected (refer to report **section 8.2**). Severe ponding was confirmed during the infill investigation attempt on 7 February 2022. Proper drainage measures and damp proofing will be highly recommended.

13 Special Precautionary Measures & Considerations

The vertical and lateral extent of historic workings and nature of the fill was not established in this shallow soil assessment that was limited to a practical excavation depth of between 2.8 and 3.2 mbgl. Special design precautionary and/or rehabilitation measures will be required in areas of significant fill.

The pH and resistivity measurements conducted on the soil-water pastes indicate that the soils can be considered corrosive and that corrosiveness measures should be considered for all ferrous metals/services in direct contact with the soil and/or soil-water interface.

Excessive workings/borrows are present on site, especially in the region of assigned Zone II. These areas will require clearance, rehabilitation and foundation precautionary measures.

Historic foundation/services can be expected towards the eastern portion of the investigated area. Historic platforms were constructed, and the presence of foundations (concrete slab) were confirmed in test pit TP05. Rehabilitation and foundation precautionary measures will be required in these areas.

Uncontrolled surficial fill is present across the site that will require relatively extensive clearance.

Two stockpiles of highly weathered shale are present towards the south of test pit TP05 and west of test pit TP10. The material may be utilised in the earthworks and/or mattresses.

Wet soil conditions can be expected towards the northern centre portion of the site for prolonged periods. The trafficability of the site in general is considered poor due to the state of the surface conditions and presence of high plasticity soils (where not covered with fill). Earthwork measures will be required to render the site accessible/trafficable during the wet season.

14 Identified Shortcomings

The identified shortcomings are:

a) The investigation is considered a **shallow soil investigation.**

b) The **depth of inspection was limited** to between approximately 2.8 to 3.2 mbgl that is the practical reach of the excavator.

c) The **centre portion of the site is not accessible** in the current state due to excessive fill, excessive shallow borrows and trafficability at the time of the conducting the fieldwork phases. Shallow borrows are mainly hand-excavated (shovel) where the local community extract slag for various uses.

d) The **depth of historic workings** (excavations), vertical and lateral extent and properties of the backfill was not established during this Phase 1 shallow soil assessment. Infill test pitting was attempted in early February 2022. The site was however not trafficable due to severe water ponding and soft surface soil.

e) Indications of historic platforms and structures are present towards the eastern portion of the area investigated. The exact **positions of the historic foundations and/or presence of historic underground services was not established** in this shallow soil assessment.

f) Assessment of potential soil contamination falls outside the scope of this assessment. Refer to the waste classification conducted by independent specialists.

g) The site is expected to be underlain by shale of the Silverton Formation with two diabase dykes towards the northern and southern site boundaries. The **contacts of the geological formations could not be established during this shallow soil assessment**. The soils overlying the formations are however mostly clayey soils with a medium to high potential expansiveness. Establishment of the exact contact of these formations are not deemed critical as from a shallow foundation perspective. Establishment of the contacts may be necessary where deep foundation options are considered, such as piling (feasibility and practicality will be final land-use dependant).

15 Conclusions

The following are concluded:

a) The region is non-dolomitic and a dolomite stability assessment is not required.

b) The region is underlain by shale of the Silverton Formation with the presence of W-E striking diabase dykes towards the norther and southern site boundaries.

c) The soil profiles are generally deep, and the geological contacts and formations could not be established during this shallow soil assessment.

d) Completely weathered shale was intersected at depth in test pit TP03. Shale and diabase were encountered in previous assessment, of which the fieldwork phase was conducted by the evaluator of this report, in the region towards the west and south of this site. The expected geology, as indicated by the 1:50 000-scale geological sheet, was confirmed during that assessment and the geological model as per the 1:50 000-scale geological sheet is expected.

e) The natural profile in the area of interest mainly comprises a relatively thick horizon >3m of transported alluvial and residual soils with a high fines content and medium to high soil heave potential.

f) Low soil collapse is expected; however, the soils can be considered as compressible, but secondary to the heave potential.

g) Indications of historic workings were noted during the fieldwork phase and desk study. The workings were mainly associated with an historic brick works with excavations towards the south of the site and potentially on the centre portion of the site. A number of historic buildings were founded on the eastern portion of the site. Remanence of the historic foundations was noted and encountered in test pit TP05.

h) Relatively thick, highly variable uncontrolled and un-engineered fill is present on site, especially in the region of assigned Zone II. The fill in general is expected to have better engineering properties than the in-situ soils; however, the fill is mainly in an uncompacted state, highly variable and with unconfirmed vertical and lateral extent. The thickness of the fill material encountered is summarised in **Table 7-1** with detailed descriptions and photograph of the material attached as **Appendix B** and **Appendix C**.

i) Depending on the final land-use consideration, the fill material should be evaluated; however, expected to be suitable for use as earth-mattress construction, provided that the materials are considered safe for use (refer to waste classification to be conducted by an independent specialist). The fill will have to be excavated (completely or partially, depending on the final land-use and design precautionary measures) mixed and backfilled in properly compacted layers to form mattresses of uniform properties to limit differential movement. Mattress design and precautionary measures can only be provided once infill investigation has been conducted to confirm the vertical and lateral extent of the fill.

j) The materials are easily excavated down to between 2.8 and 3.2 mbgl. TLB refusal was only experienced in test pit TP05 on an historic concrete slab/foundation. The presence of diabase corestones can however not be out ruled, especially during deep excavations towards the southern and northern boundaries of the investigated area.

k) pH and resistivity tests conducted on soil water pastes indicate that the soils are expected to be aggressive towards ferrous metals/services in direct contact with the soils and/or soil-water interface. Corrosion protection measures are recommended for ferrous services.

l) Historic mine workings (sand and brick clay) are present immediately towards the south of the area investigated. Historic excavations and backfill in excess of 3 m may be expected towards the centre portion of the investigated area. The aforementioned expectation is based on the fill material encountered in test pit TP02 of >2.70 mbgl and presence of excessive surface workings/borrows in the region of Zone II. The excavation and fill portion with excessive thickness may only be a localised area within assigned Zone II but it should be established once the area is accessible/trafficable.

m) The natural soils have a high Plasticity Index, generally excavate as clay lumps, has a medium to high heave potential, medium to high compressibility even if properly compacted and the workability of the soils are expected to be difficult. The natural on-site soils will not be suitable for use as soil mattresses below structures, pipe bedding, road pavement construction or use as fine and/or coarse aggregates. Suitable construction materials will have to be identified and imported. Various sources of fine to coarse aggregates are present regionally.

n) The material properties of the two stockpiles present on site is attached in **Appendix D**. The material is deemed not ideal for use in mattress construction due to the swell of >2.0% measured on saturation of the material compacted to 100% Mod. AASHTO density. The material can be considered if approved by the design engineer. A composite design approach between geotechnical and structural solutions will have to be considered.

o) No natural steep slopes are present and natural slope instability cannot occur.

p) Subgrade fill was imported and placed towards the southern boundary of the investigated area to form the base of seemingly structural pavement layer construction for a planned road in this region. The fill/embankment has relatively steep slopes, localised to the southern extent of the investigated area. The design engineer/pavement engineer should specify final slope angles in this region.

q) Seismicity is not of real concern. The structural engineer should however consider the information provided for structures in excess of 2 storeys, or as guided by the relevant national standards (SANS10160-4, 2017).

r) Indications of standing water and wet regions are present on site. Severe ponding was confirmed on 7 February 2022. A site-specific survey should be conducted for sufficient stormwater design. No natural flooding is expected; however, regions of severe ponding water will be present during and after heavy and/or continuous downpours.

s) Input on soil contamination falls outside the scope of this appointment/assessment. Planners/designers should refer to the findings/recommendations from the independent specialist. Indications of historic brick works are present with areas of excavations and uncontrolled backfill. There are indications that the site was historically utilised for storage of various materials, seemingly ranging from ash, slag construction rubble and soils/aggregates mainly from weathered shale and diabase origin. Significant surficial anthropogenic fill (surface dumping) is present across the majority of the site. Some degree of rehabilitation of the surface conditions and soils can be expected.

t) Three preliminary geotechnical zones are assigned to the site, namely (refer to **Figure 18-11**, **Appendix A**):

- **Zone I**: P(Fill raised road embankment) S2 // 2DEI
- **Zone II**: P(Uncontrolled backfill historical workings) H3-S2 // 3C 2BDE (2L)
- **Zone III**: H3-P(Surficial fill and historic foundations) // 3C 2BDE (2L)

u) **Foundation Solutions Zone III**: The natural soils are expansive and geotechnical and/or foundation precautionary measures assigned with shallow soil designation "H3" should be considered for assigned Zone III. Foundation solutions include:

- ***Stiffened or cellular raft.***
- ***Soil raft.***
- *Pile or deep founding options can be considered; however, most probably not feasible for residential land-use.*

v) **Foundation Solutions Zone II**: This zone should be confirmed and refined once the area is accessible. Foundation solutions should be provided once the infill investigation/s have been conducted. Foundation solutions expected for this region may comprise a combination of geotechnical and structural solutions (soil mattresses of improved material and stiffened or cellular rafts). Final rehabilitation and/or foundation solutions should be provided upon completion of the infill investigation.

w) **Foundation Solutions Zone I**: This assigned zone is the road embankment (formal or informal?) recently constructed towards the southern boundary of the site. The planners/designers should consider this region in the planning/layout of the proposed development. It is expected that no structures will be founded in this zone and foundation options are not provided. If construction is considered in this zone, the planners/designers should liaise with the engineering geologist for rehabilitation specifications and foundation options. The natural soils underlying the embankment will have a medium to probably high heave potential with an assigned "H3" site class designation.

x) The planners/designers should liaise with the engineering geologist for earthworks and/or foundation input for any large and/or sensitive structures planned for this site (if relevant).

y) Recommendation on the way forward is provided in the following section.

16 Way Forward

Considering the special site conditions with reference to 1) historic workings, 2) remanence of infrastructure and foundations, 3) presence of significant uncontrolled and un-engineered backfill and restricted accessibility, the following are recommended:

a) It will be in the best interest of the client and role-players to conduct an infill geotechnical investigation to establish the vertical and lateral extent of the expected and partially identified fill region towards the centre portion of the investigated area (currently assigned Zone II), once the site is accessible/trafficable.

17 Report Provisions

While every effort was made during this basic shallow soil engineering geological investigation to identify the different geological materials, areas subject to a perched water tables, hydrogeological conditions, areas of poor drainage and to estimate their distribution, it is impossible to guarantee that isolated zones of significantly different conditions have not been missed.

For this reason, this investigation has sought to highlight the significant issues regarding the influence of the proposed development on the geological environment to provide prior warning to the developer.

Investigation limitations/shortcomings and recommendations regarding the way forward are provided in the relevant report section/s. The authorities/planners/designers are urged to consider the recommendations regarding the way forward as it is within the best interest of all parties.

The report may only be distributed in its full context. RockSoil Consult (Pty) Ltd. and/or any of its employees or sub-contractors will not be held liable for any damages caused due to miss-interpretation of the findings and/or recommendations due to selective data presentation or distribution.

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Appendix A: Figures

Figure 18-1: Locality Map 1

Figure 18-2: Locality Map 2

Figure 18-3: Topographical Map 1 (1:50 000-scale – © Government Printer)

Figure 18-4: Topographical Map 2 (City of Tswhane online GIS)

Figure 18-5: Regional Geological Map (1:250 000-scale)

Figure 18-6: Regional Geological Map (1:50 000-scale)

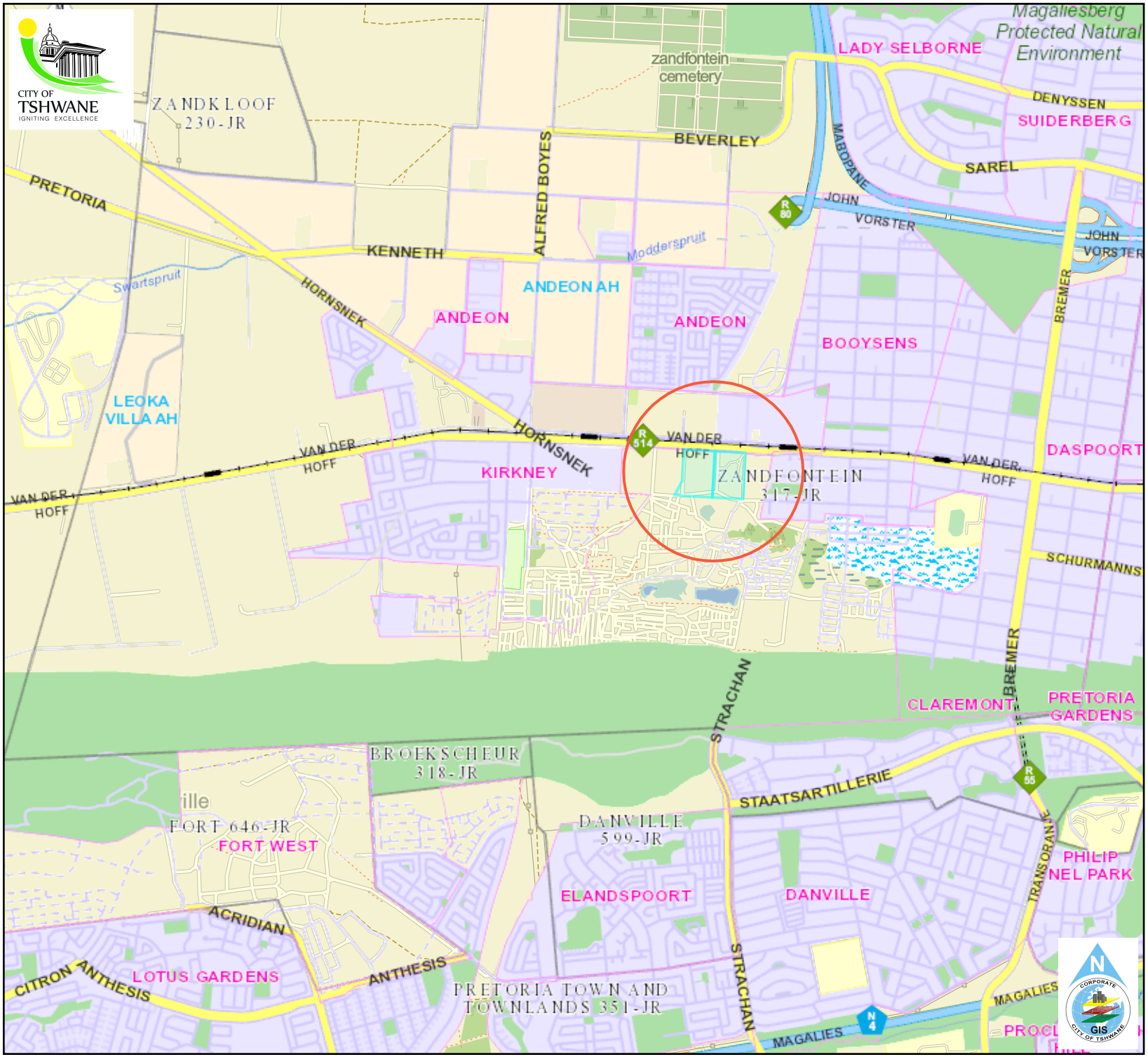
Figure 18-7: Test Pit Positions

Figure 18-8: Historic Aerial Images (GoogleEarth Image Dated April 2009)

Figure 18-9: Historic Aerial Images (GoogleEarth Image Dated July 2014)

Figure 18-10: Historic Aerial Images (GoogleEarth Image Dated February 2021)

Figure 18-11: Preliminary Assigned Geotechnical Zonation Map



Locality Map 1

Legend

Points of Interest

- Shopping Centre
- Social Service
- Hotel & Lodges
- Police Station
- Emergency Services
- Clinic
- Hospital
- Primary School
- Secondary School
- Tertiary Education
- Post Office
- Library
- Animal Welfare
- Places of Interest
- Court
- Tourism Information
- Municipal
- Government Department
- Foreign Representation
- Societies, Institutes
- Theatre
- Cinema
- Casino
- Museum
- Art Gallery
- Park
- Nature Conservation
- Resort
- Caravan Park
- Swimming Pool
- Ice Rink
- Cemetery
- Place of Worship
- Refuse Site
- Sport
- Stadium
- Toll Gate
- E-Toll
- Airport

Base map

- Tshwane Regions
- Wards
- Municipal Boundary
- Suburb Boundary
- Farm Boundary
- Open Space
- Dam
- River
- Freeway
- Main Road
- Street
- Main Railway
- Gautrain

Figure 18-1: Locality Map 1

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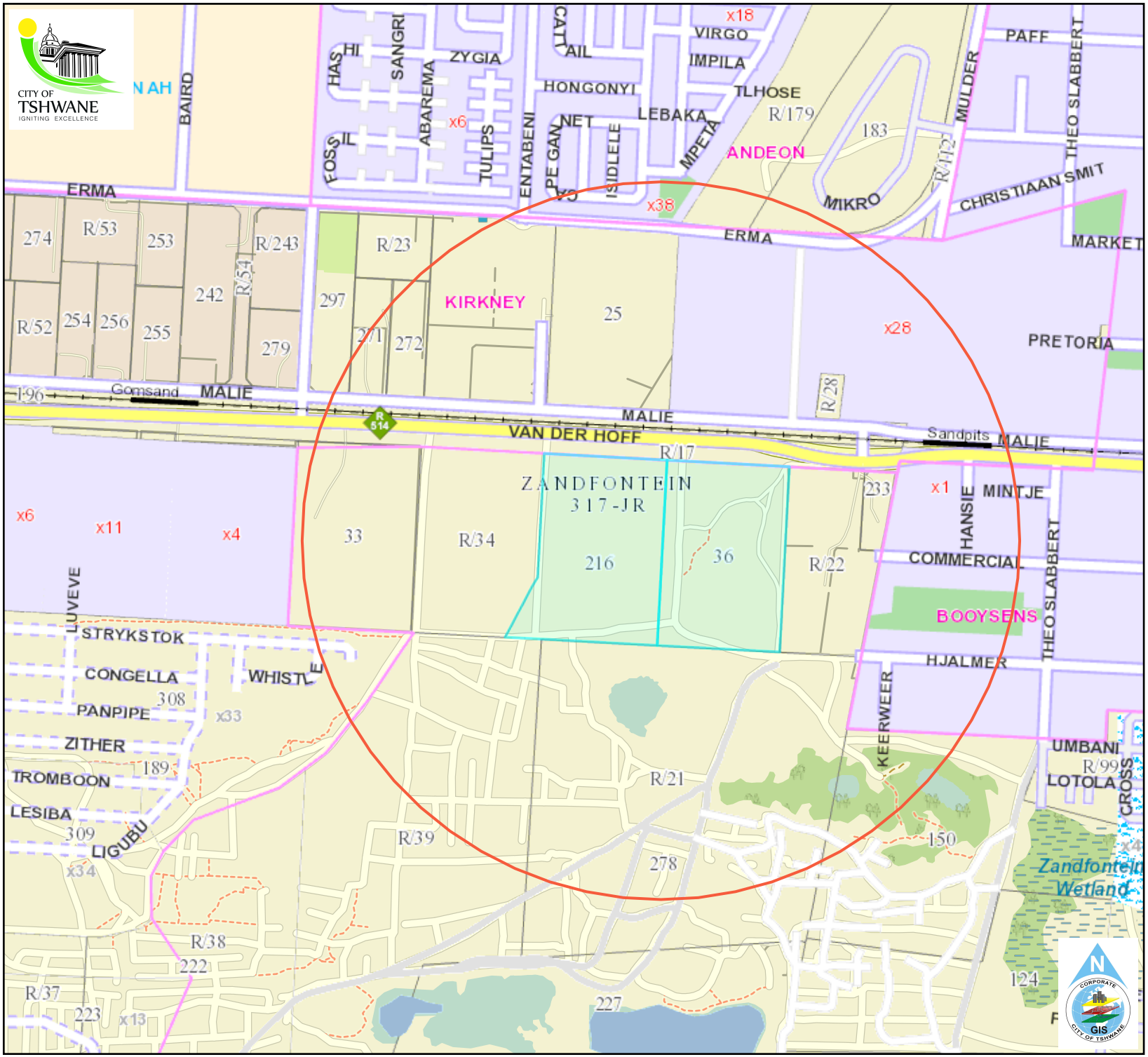

Locality Map 2

Legend

Points of Interest

- Shopping Centre
- Social Service
- Hotel & Lodges
- Police Station
- Emergency Services
- Clinic
- Hospital
- Primary School
- Secondary School
- Tertiary Education
- Post Office
- Library
- Animal Welfare
- Places of Interest
- Court
- Tourism Information
- Municipal
- Government Department
- Foreign Representation
- Societies, Institutes
- Theatre
- Cinema
- Casino
- Museum
- Art Gallery
- Park
- Nature Conservation
- Resort
- Caravan Park
- Swimming Pool
- Ice Rink
- Cemetery
- Place of Worship
- Refuse Site
- Sport
- Stadium
- Toll Gate
- E-Toll
- Airport

Base map

- Tshwane Regions
- Wards
- Municipal Boundary
- Suburb Boundary
- Farm Boundary
- Open Space
- Dam
- River
- Freeway
- Main Road
- Street
- Main Railway
- Gautrain

Figure 18-2: Locality Map 2

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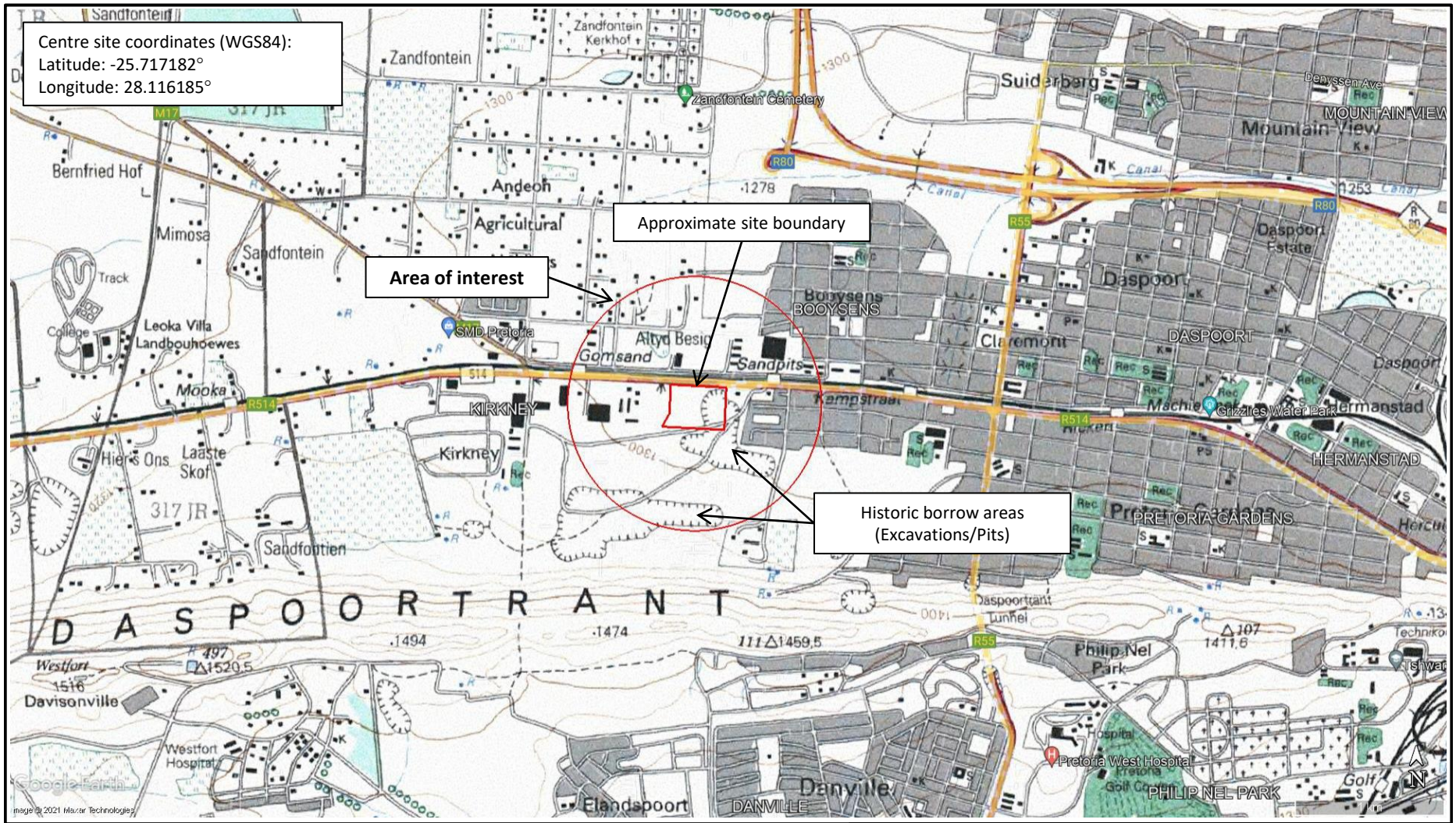

Project Description: Portion 216 and Portion 36 of the Farm Zandfontein 317-JR
Investigation Type: Phase 1 Shallow Soil Investigation
Figure 18-3: Topographical Map 1 (1:50 000-scale Government Printer)

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Project no: RS21041

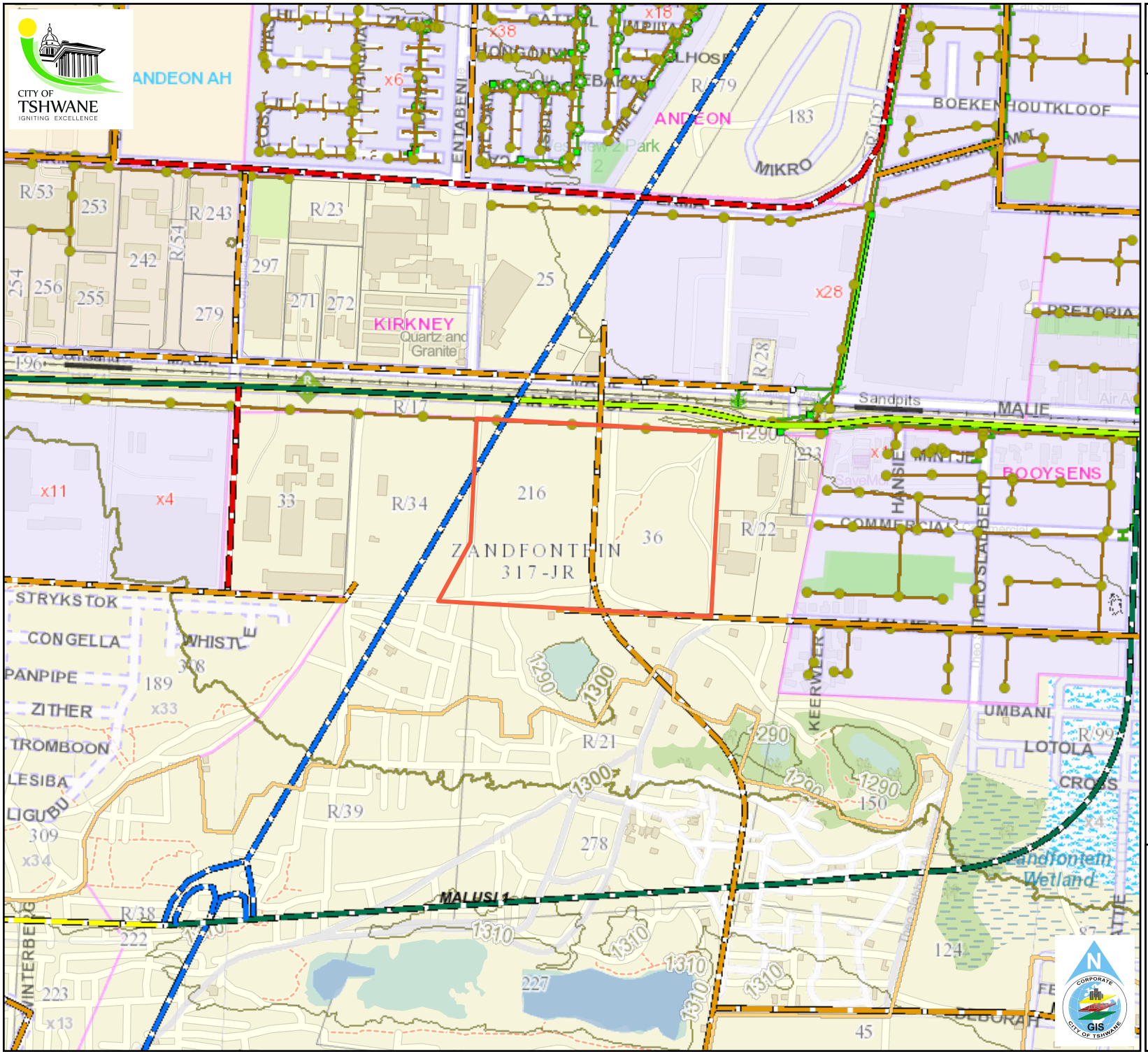

Figure: Contour Map

Zoning Map

Legend

Zoning

- Residential 1
- Residential 2
- Residential 3
- Residential 4
- Residential 5
- Business 1
- Business 2
- Business 3
- Business 4
- Industrial 1
- Industrial 2
- Commercial
- Educational
- Institutional
- Municipal
- Government
- Agricultural
- Public Garage
- Undetermined
- Public Open Space
- Private Open Space
- Existing Streets
- Proposed Streets
- Aerodrome
- S.A.R.
- Cemetery
- Infrastructure Works
- Special

Base map

- Tshwane Regions
- Wards
- Municipal Boundary
- Suburb Boundary
- Farm Boundary
- Open Space
- Dam
- River
- Freeway
- Main Road
- Street
- Main Railway
- Gautrain

Figure 18-4: Topographical Map COT

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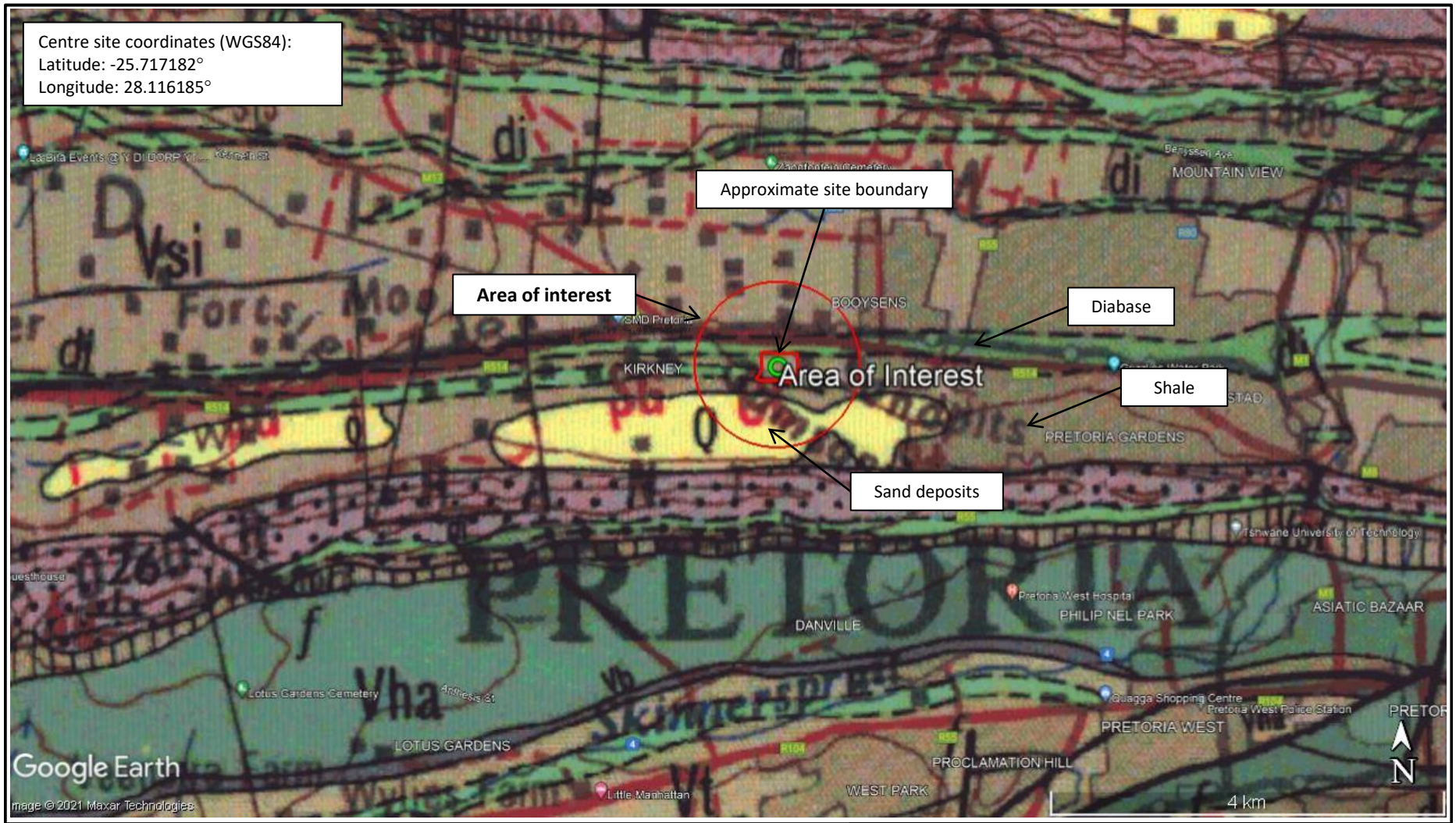

Project Description: Portion 216 and Portion 36 of the Farm Zandfontein 317-JR
Investigation Type: Phase 1 Shallow Soil Investigation
Figure 18-5: Regional Geological Map (1:250 00-scale)

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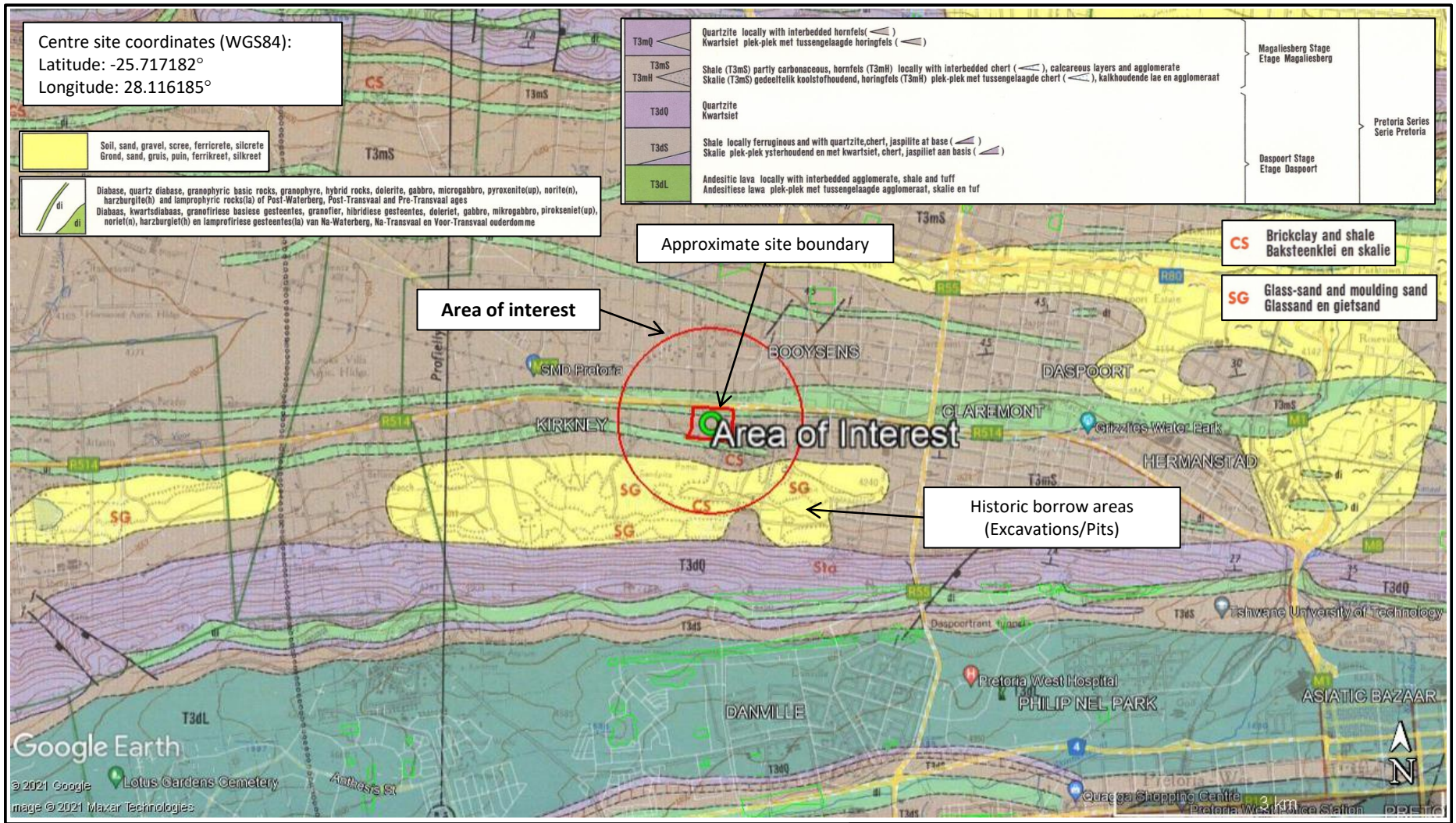
Project no: RS21041



Project Description: Portion 216 and Portion 36 of the Farm Zandfontein 317-JR
Investigation Type: Phase 1 Shallow Soil Investigation
Figure 18-6: Regional Geological Map (1:50 00-scale)

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Test Pit No.	Latitude	Longitude
TP01	-25.716407	28.117712
TP02	-25.716929	28.117005
TP03	-25.717607	28.116501
TP04	-25.718323	28.117424
TP05	-25.717646	28.117725
TP06	-25.717960	28.115273
TP07	-25.717505	28.114826
TP08	-25.716836	28.115303
TP09	-25.716203	28.114901
TP10	-25.716284	28.116627
TP11	-25.718042	28.114462
TP12	-25.717967	28.115957

Notes:

1) System: WGS84, Decimal Degrees, Lat/Lon.

2) Hand-held Garmin E-Trex GPS.

Project Description: Portion 216 and Portion 36 of the Farm Zandfontein 317-JR
Investigation Type: Phase 1 Shallow Soil Investigation (Version V1.2)
Figure 18-7: Regional Geological Map (1:50 00-scale)

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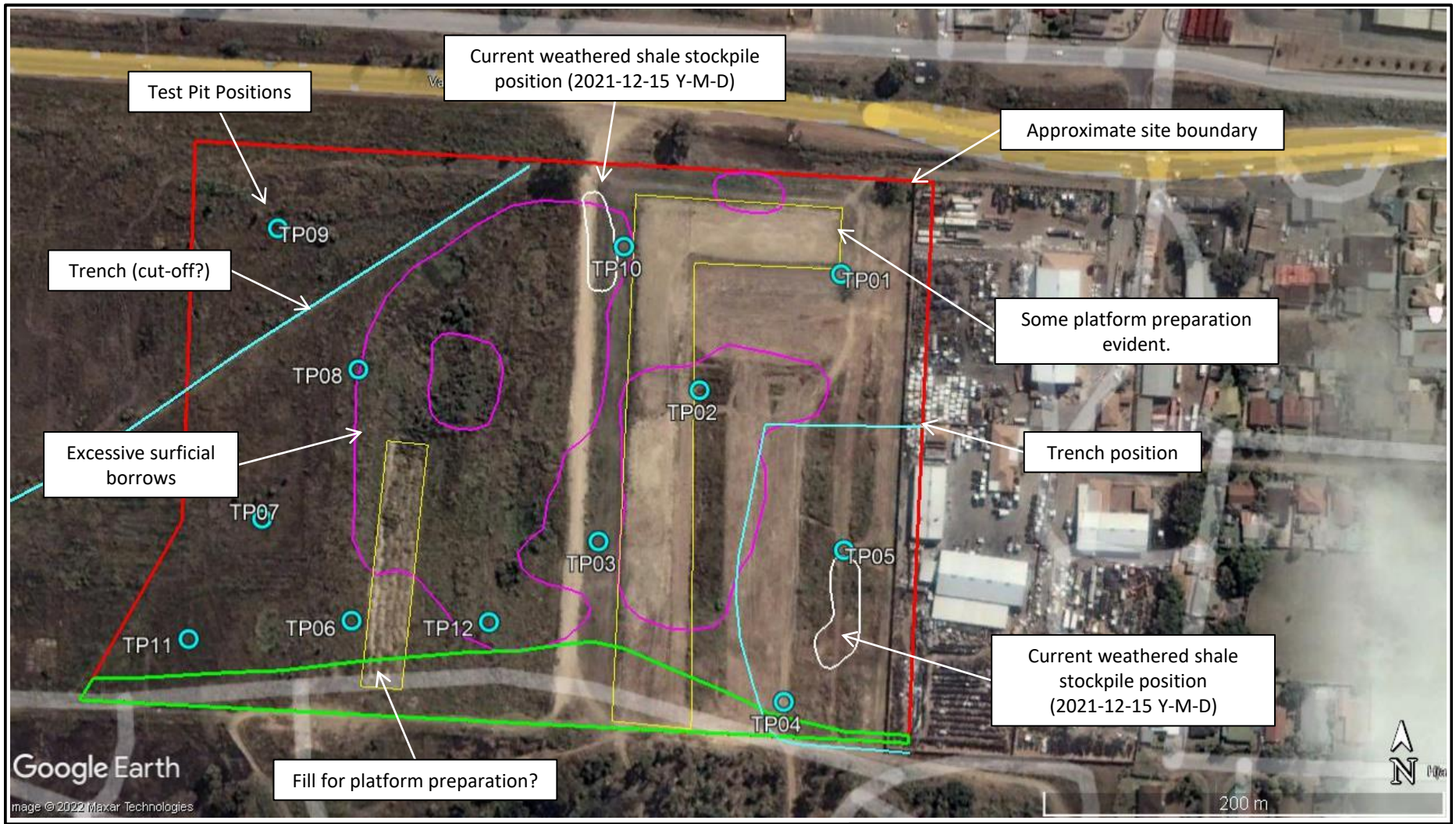
Project no: RS21041



Project Description: Portion 216 and Portion 36 of the Farm Zandfontein 317-JR
Investigation Type: Phase 1 Shallow Soil Investigation (Version V1.2)
Figure 18-8: Historic Aerial Images (GoogleEarth Image Dated April 2009)

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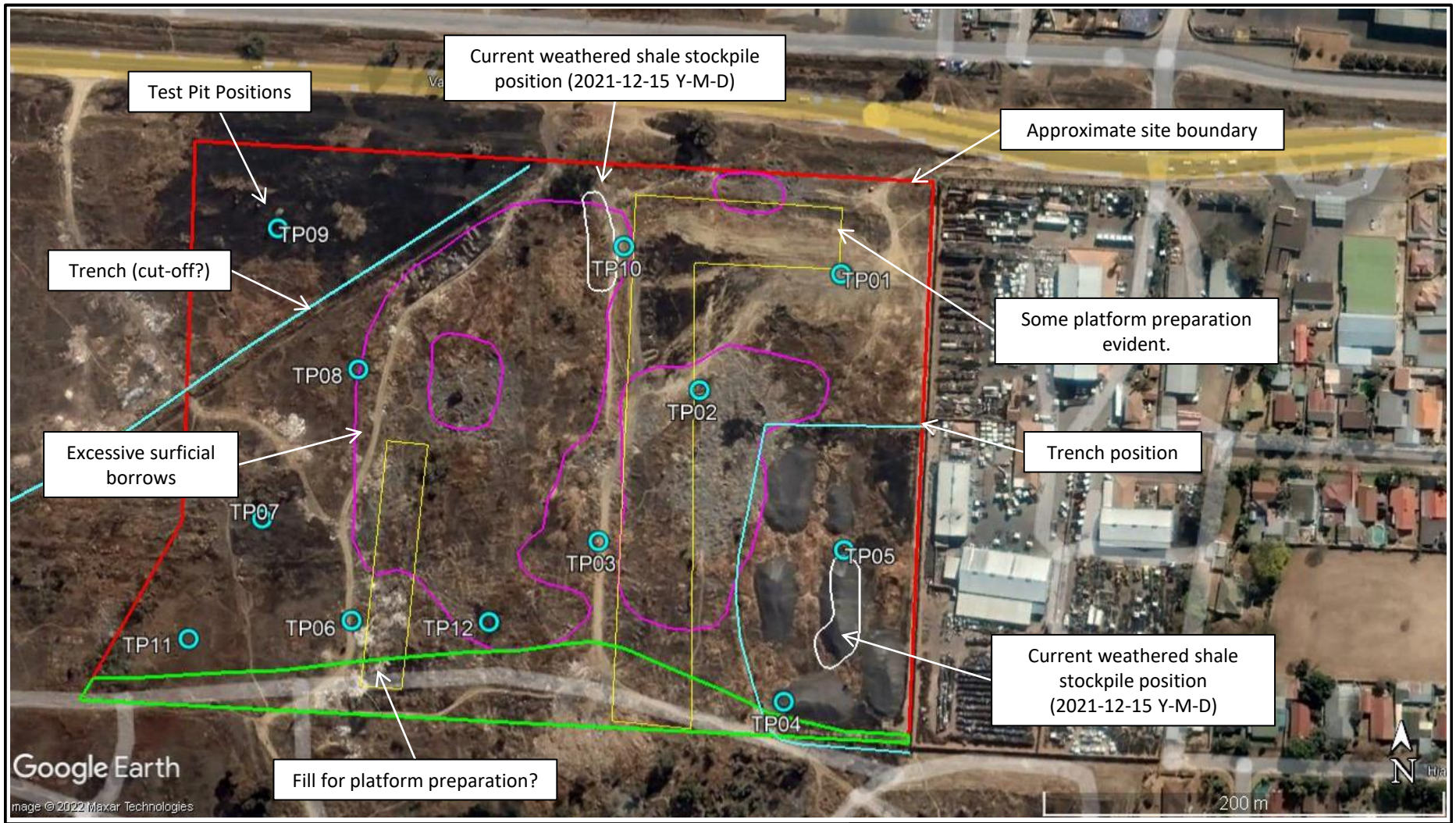

Project Description: Portion 216 and Portion 36 of the Farm Zandfontein 317-JR
Investigation Type: Phase 1 Shallow Soil Investigation (Version V1.2)
Figure 18-9: Historic Aerial Images (GoogleEarth Image Dated July 2014)

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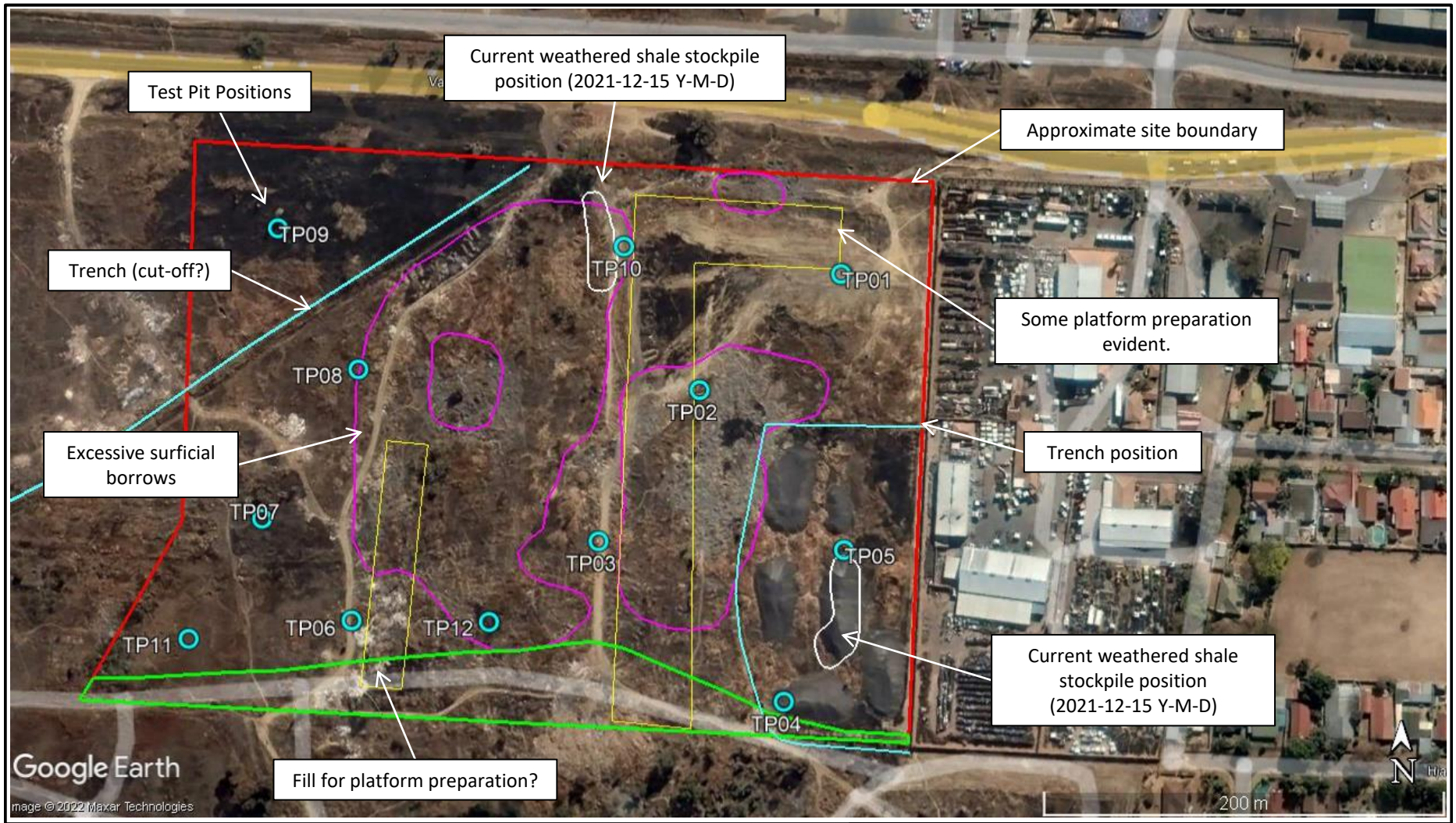

Project Description: Portion 216 and Portion 36 of the Farm Zandfontein 317-JR
Investigation Type: Phase 1 Shallow Soil Investigation (Version V1.2)
Figure 18-10: Historic Aerial Images (GoogleEarth Image Dated February 2021)

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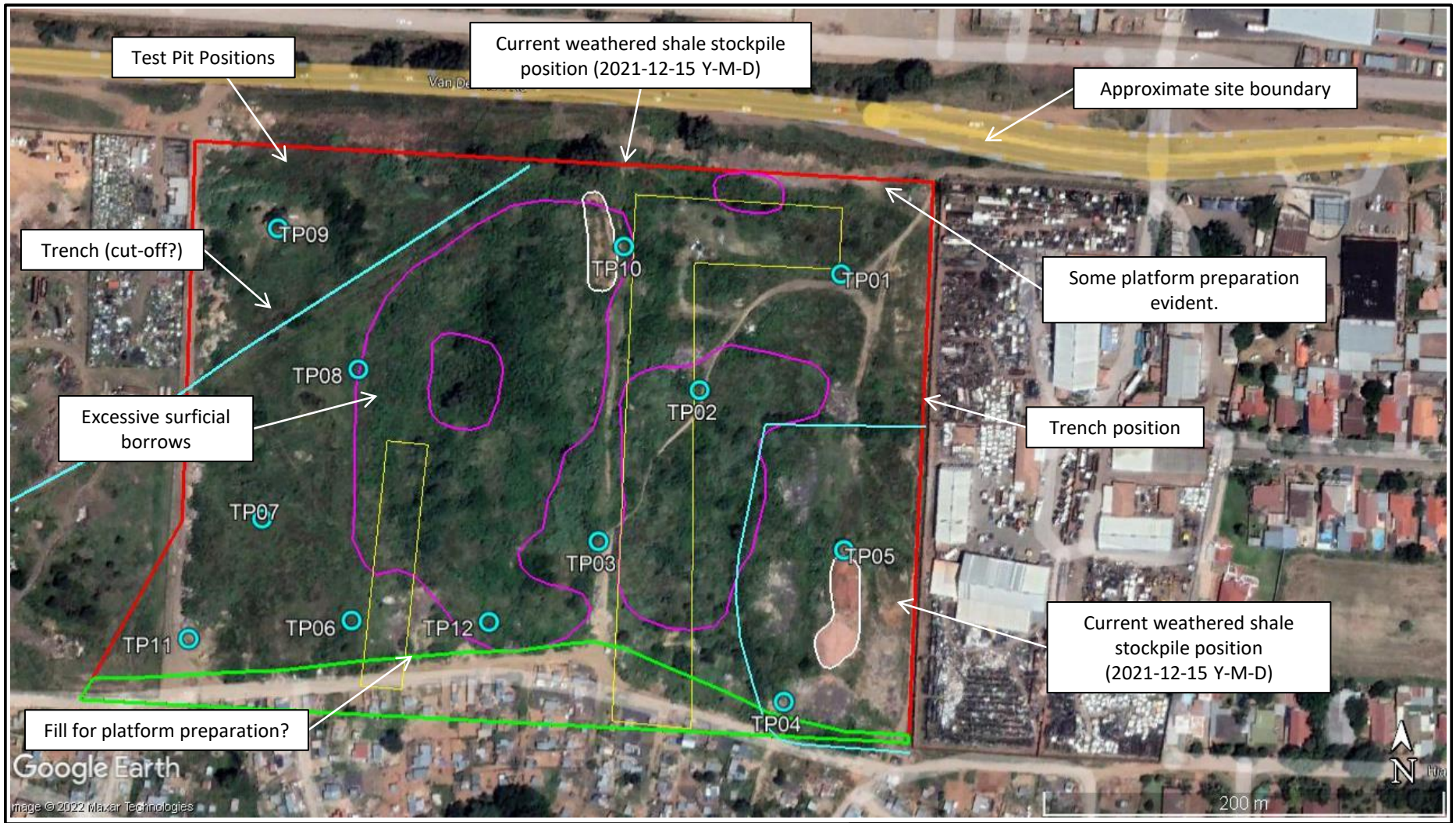

Project Description: Portion 216 and Portion 36 of the Farm Zandfontein 317-JR
Investigation Type: Phase 1 Shallow Soil Investigation (Version V1.2)
Figure 18-10: Historic Aerial Images (GoogleEarth Image Dated February 2021)

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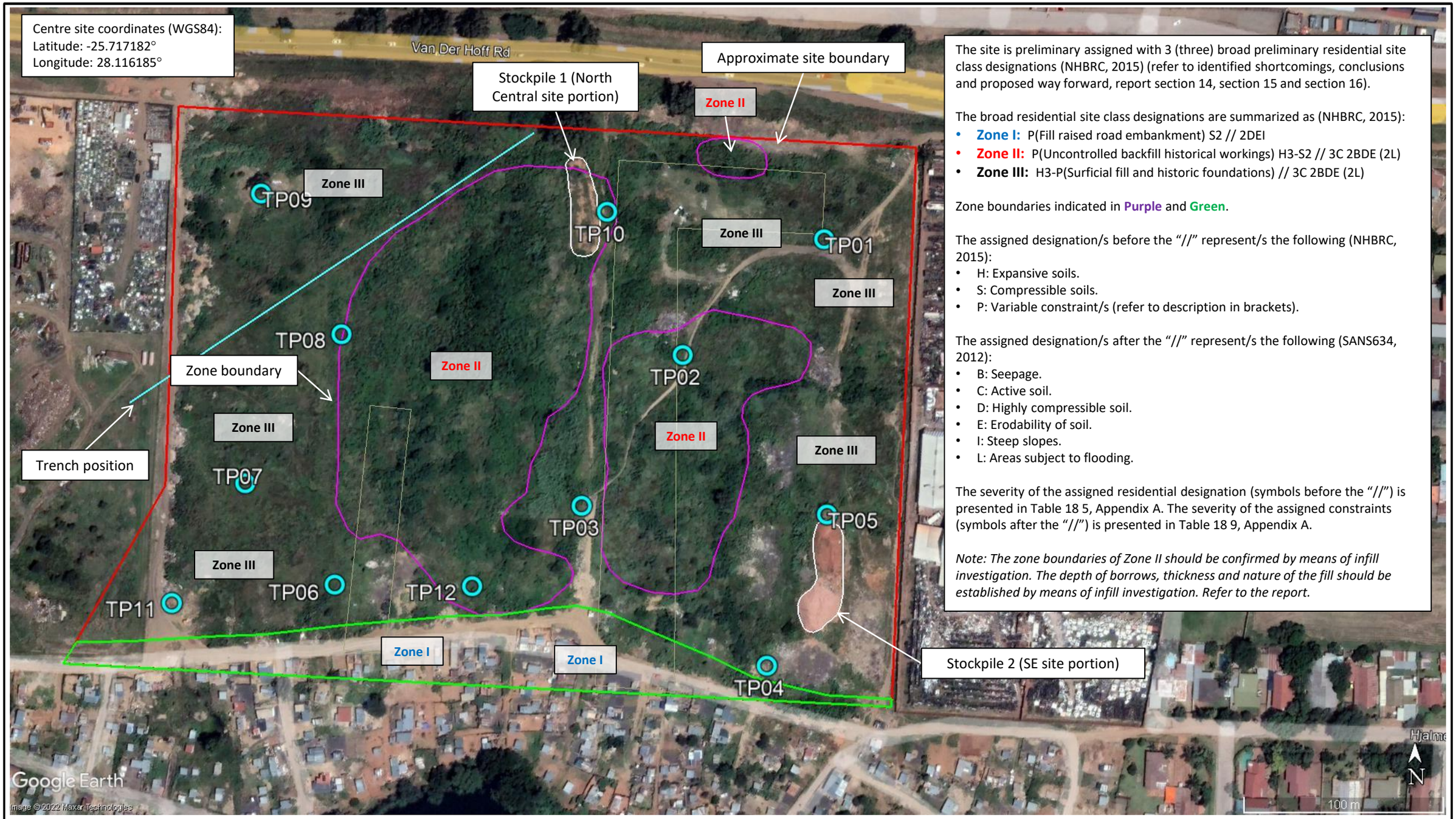
Project no: RS21041



The site is preliminary assigned with 3 (three) broad preliminary residential site class designations (NHBRC, 2015) (refer to identified shortcomings, conclusions and proposed way forward, report section 14, section 15 and section 16).

The broad residential site class designations are summarized as (NHBRC, 2015):

- **Zone I:** P(Fill raised road embankment) S2 // 2DEI
- **Zone II:** P(Uncontrolled backfill historical workings) H3-S2 // 3C 2BDE (2L)
- **Zone III:** H3-P(Surficial fill and historic foundations) // 3C 2BDE (2L)

Zone boundaries indicated in **Purple** and **Green**.

The assigned designation/s before the "//" represent/s the following (NHBRC, 2015):

- H: Expansive soils.
- S: Compressible soils.
- P: Variable constraint/s (refer to description in brackets).

The assigned designation/s after the "//" represent/s the following (SANS634, 2012):

- B: Seepage.
- C: Active soil.
- D: Highly compressible soil.
- E: Erodability of soil.
- I: Steep slopes.
- L: Areas subject to flooding.

The severity of the assigned residential designation (symbols before the "//") is presented in Table 18 5, Appendix A. The severity of the assigned constraints (symbols after the "//") is presented in Table 18 9, Appendix A.

Note: The zone boundaries of Zone II should be confirmed by means of infill investigation. The depth of borrows, thickness and nature of the fill should be established by means of infill investigation. Refer to the report.

Project Description: Portion 216 and Portion 36 of the Farm Zandfontein 317-JR Gauteng
Investigation Type: Phase 1 Shallow Soil Assessment
Figure 18-11: Preliminary Assigned Geotechnical Zonation Map (Shallow Soil Designation)

Notes:
1) The figure is for informational purposes only, refer to the report and report data.
2) Refer to limitations, identified shortcomings and recommendations on the way forward, as outlined in the relevant report sections.

Figure compiled by: DHW
Profession: Engineering Geologist
Registration: SACNASP
Date complied: 2021/12/15
Figure version: V1.0

© 2021 GoogleEarth

Project no: RS21041

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Appendix B: Soil Profile Descriptions

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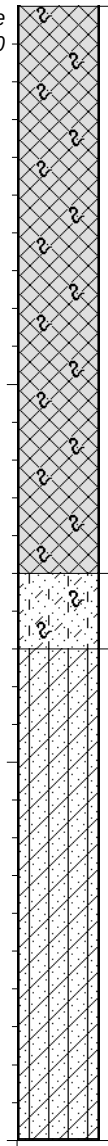
HOLE No: TP01
Sheet 1 of 1

JOB NUMBER: RS21041

Scale 1:20



0.00

Slightly moist, layered light grey-brown and light brown to light orange-brown, medium dense, **intact**, clayey silty SAND. **UNENGINEERED FILL OF MIX ORIGIN**. Few roots.

Note: Upper horizon desiccation cracks, very dark grey lens towards bottom of the horizon, all indications of uncontrolled fill material.

1.50

Slightly moist to moist, light greyish-brown, medium dense, **intact**, clayey silty fine SAND. **SLIGHTLY ORGANIC SEEMINGLY TOPSOIL HORIZON INDICATING POSSIBLE ORIGINAL GROUND LEVEL**. Very few roots.

1.70

Moist, grey becoming light brown, stained and mottled orange, soft to firm, **intact**, approximate equal amounts of clay silt sand with scattered very light grey highly to completely weathered quartzite sub rounded gravel. **SEEMINGLY SLIGHLTY FERRUGINISED ALLUVIUM**. No roots.

3.00

NOTES

1) Hole stopped at practical reach of the excavator.
2) No water seepage noted during approximately 15min inspection period.
3) No indications of sidewall instability during approximately 15min inspection period.
4) No sample taken.
5) Coordinate captured with hand-held Garmin E-Trex GPS.

CONTRACTOR :	RockSoil Consult (Pty) Ltd.	INCLINATION :	Vertical	ELEVATION :	
MACHINE :	CAT 422F TLB	DIAM :	600 mm wide trench	X-COORD :	
DRILLED BY :	RockSoil Consult (Pty) Ltd.	DATE :	2021-09-29	Y-COORD :	
PROFILED BY :	DH Wessels (Eng. Geo. Pr.Sci.Nat)	DATE :	2021-09-29		
TYPE SET BY :	DH Wessels	DATE :	08/03/2022 12:06		
SETUP FILE :	RSC.SET	TEXT :	..APPBSP\RS21041SPV1.2.txt		

HOLE No: TP01

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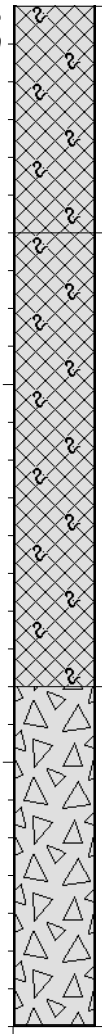
GHDEVCO (Pty) Ltd.
PTN 36 and 216 Zandfontein

HOLE No: TP02
Sheet 1 of 1

JOB NUMBER: RS21041

Scale 1:20



0.00

Slightly moist, light grey-brown, medium dense, **intact**, gravelly silty fine SAND to fine sandy silt with minor to abundant gravel and cobbles of mix origin. **UNENGINEERED FILL OF MIX ORIGIN**. Roots.

0.60

Slightly moist, banded brown-grey, light grey, grey and orange-yellow, medium dense, **layered**, silty fine sandy gravel to gravelly fine sandy silt, fly-ash, slag and completely weathered diabase. **UNENGINEERED FILL OF MIX ORIGIN**. Few roots.

Note: Significant variation in grading and consistency in the horizon. Consistency varies from loose to dense with overall medium dense consistency assigned.

1.80

Abundant orange to brown clay brick, **clast supported** in a matrix of brown silty fine sand to fine sandy silt. Overall consistency medium dense. **UNENGINEERED FILL OF MIX ORIGIN MAINLY COMPRISING BRICK FILL RUBBLE**. Few roots.

2.70

NOTES

1) Hole stopped at practical reach of the excavator.
2) No water seepage noted during approximately 15min inspection period.
3) No indications of sidewall instability during approximately 15min inspection period.
4) No sample taken.
5) Coordinate captured with hand-held Garmin E-Trex GPS.

CONTRACTOR :	RockSoil Consult (Pty) Ltd.	INCLINATION :	ELEVATION :
MACHINE :	CAT 422F TLB	DIAM : 600 mm wide trench	X-COORD :
DRILLED BY :	RockSoil Consult (Pty) Ltd.	DATE : 2021-09-29	Y-COORD :
PROFILED BY :	DH Wessels (Eng. Geo. Pr.Sci.Nat)	DATE : 2021-09-29	
TYPE SET BY :	DH Wessels	DATE : 08/03/2022 12:06	
SETUP FILE :	RSC.SET	TEXT : ..APPBSP\RS21041SPV1.2.txt	

HOLE No: TP02

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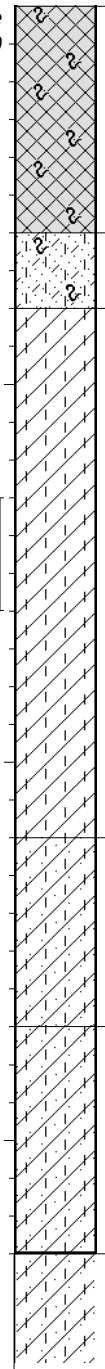
HOLE No: TP03
Sheet 1 of 1

JOB NUMBER: RS21041

Scale 1:20



0.00

Slightly moist, banded grey, yellow, red-orange to grey and yellow-green, medium dense, **layered**, silty sandy gravel to gravelly sandy silt with scattered sub-angular cobbles. **UNENGINEERED FILL OF MIX ORIGIN**. Few roots.

Note: Fill mix mainly of diabase, fly-ash, slag and residual shale.

0.60

Moist, brownish-grey becoming olive-green, firm, **intact**, clayey silty SAND to sandy silty clay. **SLIGHTLY ORGANIC SEEMINGLY NATURAL TOPSOIL AND COLLUVIUM**. Few roots.

0.80

Moist to very moist, slightly yellowish-grey to greenish-grey, minor mottled dark purple-black, stained orange, soft, **intact**, fine sandy silty CLAY with scattered sub-rounded to sub-angular quartzite pebbles mainly towards lower part of horizon. **ALLUVIUM WITH SEEMINGLY VAGUE PEBBLE MARKER TOWARDS BOTTOM OF HORIZON**. Very few becoming no roots.

Material properties tested:
% Mortar = 92%, Gravel: 8%, Sand: 34%, Silt: 17% Clay: 41%, LL = 51%, PImortar = 21%, GM: 0.67, Unified Soil class: **CH**, HRB class: **A-7-6**, Van Der Merwe heave potential: **Medium to High**.

2.20

Moist to very moist, yellow-green, stained orange, firm, **intact**, fine sandy silty CLAY. **SLIGHTLY FERRUGINISED SEEMINGLY REWORKED RESIDUAL SHALE**. No roots.

2.70

Moist to very moist, yellow-green, stained orange, firm, **intact**, fine sandy silty CLAY with a patch of highly fractured, bedded, stained dark purple-black on joint surfaces, highly to completely weathered shale. **REWORKED RESIDUAL TO SEEMINGLY COMPLETELY WEATHERED SHALE**.

3.30

As above.

NOTES

1) Hole stopped at practical reach of the excavator.
2) No water seepage noted during approximately 15min inspection period.
3) No indications of sidewall instability during approximately 15min inspection period.
4) Disturbed small sample retrieved at 1.30--1.60m.
5) Coordinate captured with hand-held Garmin E-Trex GPS.

CONTRACTOR : RockSoil Consult (Pty) Ltd.	*INCLINATION :*		*ELEVATION :*
MACHINE : CAT 422F TLB	*DIAM :* 600 mm wide trench		*X-COORD :*
DRILLED BY : RockSoil Consult (Pty) Ltd.	*DATE :* 2021-09-29		*Y-COORD :*
PROFILED BY : DH Wessels (Eng. Geo. Pr.Sci.Nat)	*DATE :* 2021-09-29		
TYPE SET BY : DH Wessels	*DATE :* 08/03/2022 12:06		
SETUP FILE : RSC.SET	*TEXT :* ..APPBSP\RS21041SPV1.2.txt		

HOLE No: TP03

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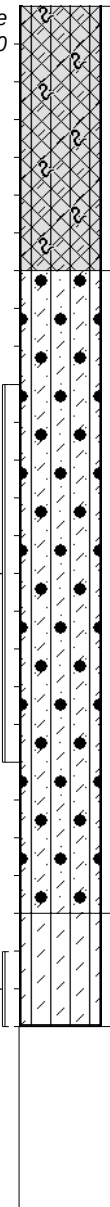
PTN 36 and 216 Zandfontein

HOLE No: TP04
Sheet 1 of 1

JOB NUMBER: RS21041

Scale 1:20



0.00

Slightly moist, light pinkish light brown, highly weathered shale and diabase gravel and small cobbles, clast supported in a matrix of very light pinkish-brown, clayey SILT. Overall consistency medium dense to dense. **UNENGINEERED FILL OF MIX ORIGIN, MAINLY SHALE AND DIABASE**. Few roots.

0.70

Slightly moist to moist, light grey to greyish-orange, abundant mottled dark purple-black and orange, abundant stained orange, dense, **slightly open structured**, fine sandy clayey SILT with abundant Fe and Mn nodules and concretions and scattered sub-rounded to sub-angular quartzite pebbles. **FERRUGINISED TRANSPORTED MATERIAL**. Few grass roots.

Material properties tested:
% Mortar = 65%, Gravel: 35%, Sand: 34%, Silt: 19% Clay: 12%, LL = 33%, PImortar = 15%, GM: 1.53, Unified Soil class: **SC**, HRB class: **A-6**, Van Der Merwe heave potential: **Low**.

2.40

Slightly moist, yellow-orange, blotched pink-orange and greyish to very light grey, soft, **intact**, clayey SILT. **SLIGHTLY FERRUGINISED SEEMINGLY REWORKED RESIDUAL SHALE?**. No roots.

Material properties tested:
% Mortar = 85%, Gravel: 15%, Sand: 30%, Silt: 38% Clay: 17%, LL = 46%, PImortar = 24%, GM: 0.83, Unified Soil class: **CL**, HRB class: **A-7-6**, Van Der Merwe heave potential: **Medium**.

2.70

NOTES

1) Hole stopped at practical reach of the excavator.
2) No water seepage noted during approximately 15min inspection period.
3) No indications of sidewall instability during approximately 15min inspection period.
4) Disturbed small sample retrieved at 1.00--2.00m and 2.50--2.70m.
5) Coordinate captured with hand-held Garmin E-Trex GPS.

CONTRACTOR :	RockSoil Consult (Pty) Ltd.	*INCLINATION :*		*ELEVATION :*	
MACHINE :	CAT 422F TLB	*DIAM :*	600 mm wide trench	*X-COORD :*	
DRILLED BY :	RockSoil Consult (Pty) Ltd.	*DATE :*	2021-09-29	*Y-COORD :*	
PROFILED BY :	DH Wessels (Eng. Geo. Pr.Sci.Nat)	*DATE :*	2021-09-29		
TYPE SET BY :	*DH Wessels*	*DATE :*	*08/03/2022 12:06*		
SETUP FILE :	*RSC.SET*	*TEXT :*	*..APPBSP\RS21041SPV1.2.txt*		

HOLE No: TP04

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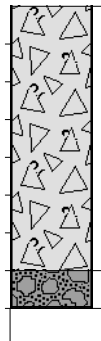
PTN 36 and 216 Zandfontein

HOLE No: TP05
Sheet 1 of 1

JOB NUMBER: RS21041

Scale 1:20



0.00

Abundant brick and concrete gravel to cobble size fragments, clast supported in a matrix of slightly moist, light brown to light grey-brown, fine sandy silt. Overall consistency medium dense to dense. **UNENGINEERED FILL OF MIX ORIGIN, MAINLY BRICK AND CONCRETE RUBBLE**. Few roots.

0.70

Light grey concrete slab, probably old foundation or pad.

0.80

NOTES

1) TLB refusal experienced on concrete slab expectedly an old foundation.
2) No water seepage noted during approximately 15min inspection period.
3) No indications of sidewall instability during approximately 15min inspection period.
4) No sample taken.
5) Coordinate captured with hand-held Garmin E-Trex GPS.

CONTRACTOR :	RockSoil Consult (Pty) Ltd.	INCLINATION :		ELEVATION :	
MACHINE :	CAT 422F TLB	DIAM :	600 mm wide trench	X-COORD :	
DRILLED BY :	RockSoil Consult (Pty) Ltd.	DATE :	2021-09-29	Y-COORD :	
PROFILED BY :	DH Wessels (Eng. Geo. Pr.Sci.Nat)	DATE :	2021-09-29		
TYPE SET BY :	DH Wessels	DATE :	08/03/2022 12:06		
SETUP FILE :	RSC.SET	TEXT :	..APPBSP\RS21041SPV1.2.txt		

HOLE No: TP05

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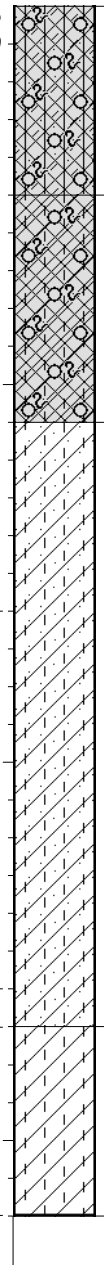
PTN 36 and 216 Zandfontein

HOLE No: TP06
Sheet 1 of 1

JOB NUMBER: RS21041

Scale 1:20



0.00 – **0.50**

Slightly moist, light brown-grey, medium dense, **minor desiccation cracks**, gravelly sandy clayey SILT with minor to abundant shale, diabase and brick gravel and rubble. **UNENGINEERED FILL OF MIX ORIGIN**. Grass roots.

0.50 – **1.10**

Moist, very dark grey to black, mottled and stained orange, shattered, gravelly silty CLAY with minor shale, diabase and brick gravel and rubble. Few grass roots. **REWORKED FILL AND EXPECTEDLY NATURAL TOPSOIL**.

1.10 – **2.70**

Moist, light grey to greenish-grey, stained orange, soft to very soft, **intact**, fine sandy silty CLAY with scattered sub-angular quartzite pebbles and scattered small cobbles. **SEEMINGLY NATURAL ALLUVIAL SOIL**.

Note: Five to fifteen cm blocky shattered crack pattern upon excavation and exposure indicating shrinkage and heave potential.

Material properties tested:
% Mortar = 100%, Gravel: 0%, Sand: 17%, Silt: 26% Clay: 57%, LL = 75%, PImortar = 33%, GM: 0.13, Unified Soil class: **CH**, HRB class: **A-7-5**, Van Der Merwe heave potential: **Very High**.

2.70 – **3.20**

Moist, light grey to yellow-orange, stained orange-red and orange, soft, **intact**, (fine sandy) silty CLAY to clayey silt. **SEEMINGLY TRANSPORTED ALLUVIUM BUT POSSIBLY REWORKED RESIDUAL SHALE OR DIABASE?**.

Material properties tested:
% Mortar = 100%, Gravel: 0%, Sand: 28%, Silt: 59% Clay: 13%, LL = 53%, PImortar = 32%, GM: 0.14, Unified Soil class: **MH**, HRB class: **A-7-5**, Van Der Merwe heave potential: **Medium**.

3.20

NOTES

1) Hole stopped at practical reach of the excavator.
2) No water seepage noted during approximately 15min inspection period.
3) No indications of sidewall instability during approximately 15min inspection period.
4) Disturbed small samples retrieved at 1.60--2.60m and 2.70--3.20m.
5) Coordinate captured with hand-held Garmin E-Trex GPS.

CONTRACTOR : RockSoil Consult (Pty) Ltd.
MACHINE : CAT 422F TLB
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : DH Wessels (Eng. Geo. Pr.Sci.Nat)

INCLINATION :
DIAM : 600 mm wide trench
DATE : 2021-09-29
DATE : 2021-09-29

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP06

TYPE SET BY : DH Wessels
SETUP FILE : RSC.SET

DATE : 08/03/2022 12:06
TEXT : ..APPBSP\RS21041SPV1.2.txt

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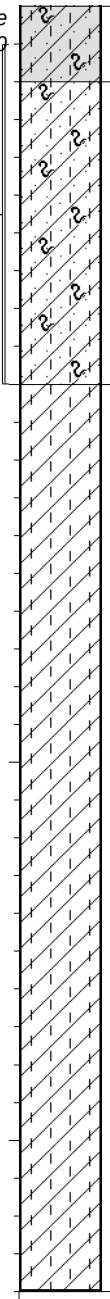
PTN 36 and 216 Zandfontein

HOLE No: TP07
Sheet 1 of 1

JOB NUMBER: RS21041

Scale 1:20



0.00	Slightly moist, dark grey becoming grey, stiff, **shattered**, fine sandy silty CLAY with scattered brick fragments at or near surface. **SLIGHLTY ORGANIC TOPSOIL WITH UPPER REWORK MATERIAL**. Abundant grass roots.
0.20	Slightly moist, grey becoming light grey, firm, shattered with prominent desiccation cracks, fine sandy silty CLAY. **ALLUVIUM**. Few grass roots.
1.00	Moist to very moist, light grey, stained orange, soft, **intact**, silty CLAY with scattered sub-angular to sub-rounded medium to coarse gravel quartzite. **ALLUVIUM**. No roots.
3.40	

NOTES

1) Hole stopped at practical reach of the excavator.
2) No water seepage noted during approximately 15min inspection period.
3) No indications of sidewall instability during approximately 15min inspection period.
4) Disturbed large sample retrieved at 0.10--1.00m.
5) Coordinate captured with hand-held Garmin E-Trex GPS.

CONTRACTOR :	RockSoil Consult (Pty) Ltd.	INCLINATION :	ELEVATION :
MACHINE :	CAT 422F TLB	DIAM : 600 mm wide trench	X-COORD :
DRILLED BY :	RockSoil Consult (Pty) Ltd.	DATE : 2021-09-29	Y-COORD :
PROFILED BY :	DH Wessels (Eng. Geo. Pr.Sci.Nat)	DATE : 2021-09-29	
TYPE SET BY :	DH Wessels	DATE : 08/03/2022 12:06	
SETUP FILE :	RSC.SET	TEXT : ..APPBSP\RS21041SPV1.2.txt	

HOLE No: TP07

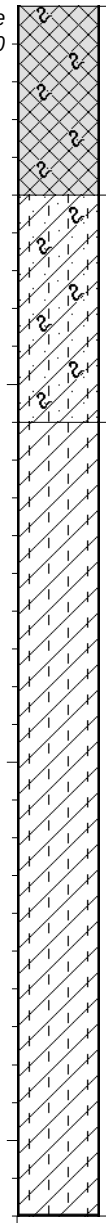
ROCKSOIL CONSULT

GHDEVCO (Pty) Ltd.
PTN 36 and 216 Zandfontein

HOLE No: TP08
Sheet 1 of 1

JOB NUMBER: RS21041

Scale 1:20



0.00	Slightly moist, grey and layered light orange brown and grey, mottled dark purple-black, medium dense to dense, **layered**, (clayey) fine sandy silty gravel to (clayey) silty gravelly fine sand. **UNENGINEERED FILL OF MIX ORIGIN MAINLY DIABASE, FLY-ASH, SLAG AND TOPSOIL**. Grass roots.
0.50	Slightly moist, dark grey becoming grey, firm, shattered with prominent desiccation cracks, fine sandy silty CLAY. **ALLUVIUM**. Few grass roots.
1.10	Moist to very moist, light grey, stained orange, soft, **intact**, silty CLAY with scattered sub-angular to sub-rounded medium to coarse gravel quartzite. **ALLUVIUM**. No roots.
3.20	

NOTES

1) Hole stopped at practical reach of the excavator.
2) No water seepage noted during approximately 15min inspection period.
3) No indications of sidewall instability during approximately 15min inspection period.
4) No sample taken.
5) Coordinate captured with hand-held Garmin E-Trex GPS.

CONTRACTOR :	RockSoil Consult (Pty) Ltd.	INCLINATION :	ELEVATION :
MACHINE :	CAT 422F TLB	DIAM : 600 mm wide trench	X-COORD :
DRILLED BY :	RockSoil Consult (Pty) Ltd.	DATE : 2021-09-29	Y-COORD :
PROFILED BY :	DH Wessels (Eng. Geo. Pr.Sci.Nat)	DATE : 2021-09-29	
TYPE SET BY :	DH Wessels	DATE : 08/03/2022 12:06	
SETUP FILE :	RSC.SET	TEXT : ..APPBSP\RS21041SPV1.2.txt	

HOLE No: TP08

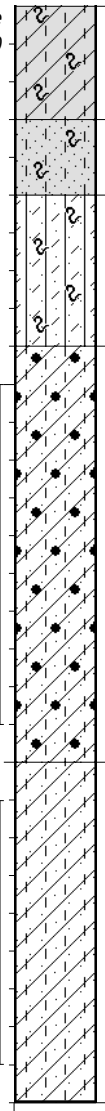
ROCKSOIL CONSULT

GHDEVCO (Pty) Ltd.
PTN 36 and 216 Zandfontein

HOLE No: TP09
Sheet 1 of 1

JOB NUMBER: RS21041

Scale 1:20



0.00	Slightly moist, dark brown-grey, firm, **slightly shattered**, fine sandy silty CLAY with minor to scattered brick and concrete rubble fragments. **UNENGINEERED FILL OF MIX ORIGIN, MAINLY CLAYEY TOPSOIL AND MINOR CONSTRUCTION RUBBLE**. Abundant grass roots.
0.30	Slightly moist, light slightly greenish-brown to yellowish-brown, silty fine SAND to fine sandy silt. **COMPLETELY WEATHERED AND RESIDUAL DIABASE UNENGINEERED FILL HORIZON**. Few grass roots.
0.50	Slightly moist, light greyish-brow to brownish-grey, slightly stained orange, firm to stiff, **slight desiccation cracks**, fine sandy clayey SILT to fine sandy silty clay with scattered Fe and Mn nodules and concretions. **REWORKED SEEMINGLY NATURAL TOPSOIL AND COLLUVIUM**. Few grass roots.
0.90	Slightly brown-orange, minor mottled dark purple-black, stained orange, firm to stiff, **intact**, fine sandy silty CLAY to fine sandy clayey silt with scattered Mn nodules and concretions. **FERRUGINISED ALLUVIUM**. No roots. **Material properties tested**: % Mortar = 77%, Gravel: 23%, Sand: 33%, Silt: 19% Clay: 25%, LL = 45%, PImortar = 24%, GM: 1.13, Unified Soil class: **SC**, HRB class: **A-7-6**, Van Der Merwe heave potential: **Medium**.
2.00	Slightly moist, greenish-grey, stained orange, scattered mottled dark purple-black, firm to stiff, **slickensided**, fine sandy silty CLAY. **SLIGHTLY FERRUGINISED ALLUVIUM**. No roots. **Material properties tested**: % Mortar = 93%, Gravel: 7%, Sand: 22%, Silt: 24% Clay: 47%, LL = 60%, PImortar = 32%, GM: 0.47, Unified Soil class: **CH**, HRB class: **A-7-6**, Van Der Merwe heave potential: **High**.
2.90	

NOTES

1) Hole stopped at practical reach of the excavator.
2) No water seepage noted during approximately 15min inspection period.
3) No indications of sidewall instability during approximately 15min inspection period.
4) Disturbed small samples retrieved at 1.00--1.90m and 2.10--2.80m.
5) Coordinate captured with hand-held Garmin E-Trex GPS.

CONTRACTOR : RockSoil Consult (Pty) Ltd.	*INCLINATION :*		*ELEVATION :*
MACHINE : CAT 422F TLB	*DIAM :* 600 mm wide trench		*X-COORD :*
DRILLED BY : RockSoil Consult (Pty) Ltd.	*DATE :* 2021-09-29		*Y-COORD :*
PROFILED BY : DH Wessels (Eng. Geo. Pr.Sci.Nat)	*DATE :* 2021-09-29		
TYPE SET BY : DH Wessels	*DATE :* 08/03/2022 12:06		
SETUP FILE : RSC.SET	*TEXT :* ..APPBSP\RS21041SPV1.2.txt		

HOLE No: TP09

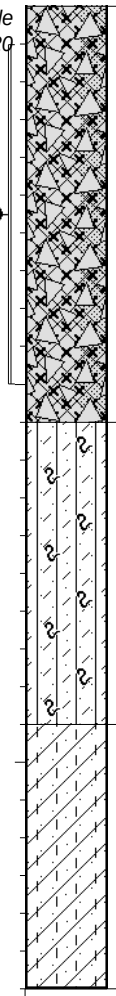
ROCKSOIL CONSULT

GHDEVCO (Pty) Ltd.
PTN 36 and 216 Zandfontein

HOLE No: TP10
Sheet 1 of 1

JOB NUMBER: RS21041

Scale 1:20



0.00

Layered grey, brown, greenish-yellow to yellow, and orange-brown brick rubble, completely weathered to residual diabase, fly-ash and slag and soil of mix origin. **FILL OF MIX ORIGIN MAINLY CONSTRUCITON RUBBLE, DIABSE, SLAG AND ASH**.

1.10

Slightly moist, light greyish-brow to brownish-grey, slightly stained orange, firm to stiff, **slight desiccation cracks**, fine sandy clayey SILT to fine sandy silty clay with scattered Fe and Mn nodules and concretions. **REWORKED SEEMINGLY NATURAL TOPSOIL AND COLLUVIUM**. Few grass roots.

1.90

Slightly moist, greenish-grey, stained orange, scattered mottled dark purple-black, firm to stiff, **slickensided**, fine sandy silty CLAY. **SLIGHTLY FERRUGINISED ALLUVIUM**. No roots.

2.60

NOTES

1) Hole stopped at practical reach of the excavator.
2) No water seepage noted during approximately 15min inspection period.
3) No indications of sidewall instability during approximately 15min inspection period.
4) Disturbed large sample retrieved at 0.10--1.00m.
5) Coordinate captured with hand-held Garmin E-Trex GPS.

CONTRACTOR : RockSoil Consult (Pty) Ltd.	*INCLINATION :*		*ELEVATION :*
MACHINE : CAT 422F TLB	*DIAM :* 600 mm wide trench		*X-COORD :*
DRILLED BY : RockSoil Consult (Pty) Ltd.	*DATE :* 2021-09-29		*Y-COORD :*
PROFILED BY : DH Wessels (Eng. Geo. Pr.Sci.Nat)	*DATE :* 2021-09-29		
TYPE SET BY : DH Wessels	*DATE :* 08/03/2022 12:06		
SETUP FILE : RSC.SET	*TEXT :* ..APPBSP\RS21041SPV1.2.txt		

HOLE No: TP10

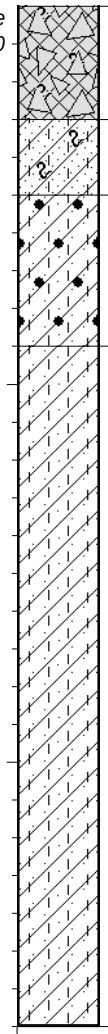
ROCKSOIL CONSULT

GHDEVCO (Pty) Ltd.
PTN 36 and 216 Zandfontein

HOLE No: TP11
Sheet 1 of 1

JOB NUMBER: RS21041

Scale 1:20



Depth	Description
0.00 – 0.30	Moist to very moist, layered orange, black and brown, soft to loose, **intact to voided**, gravelly sandy silty clay to clayey sandy gravel with abundant gravel, domestic waste and rubble. **FILL OF MIX ORIGIN**. Grass roots present.
0.30 – 0.50	Moist to very moist, dark brown to black, soft, **shattered to slightly open structured**, silty clay sand with trace amounts of sub-rounded gravel of mixed origin. Few grass roots. **SEEMINGLY NATURAL TOPSOIL**.
0.50 – 0.90	Moist, light grey to dark brown mottled orange, soft, **shattered to slightly open structured**, fine silty sandy CLAY with scattered sub-rounded quartzite gravel and ferricrete concretions. **SLIGHTLY FERRUGINISED ALLUVIAL SOIL**.
0.90 – 2.70	Moist, grey mottled orange, soft, **shattered to slickensided**, sandy silty CLAY with scattered trace amounts of sub-rounded quartzite gravel cobbles and occasional weakly cemented Fe concretions. **ALLUVIAL SOIL**.

NOTES

1) Hole terminated near practical reach of the TLB.
2) Soft excavation conditions at termination depth.
3) No water seepage noted during approximately 15min inspection period.
4) No indications of sidewall instability during approximately 15min inspection period.
5) No sample retrieved.
6) Abundant anthropogenic fill material in the vicinity of the test pit.

CONTRACTOR :	RockSoil Consult (Pty) Ltd.	INCLINATION :	ELEVATION :
MACHINE :	CAT 428E TLB	DIAM : 600 mm wide trench	X-COORD :
DRILLED BY :	RockSoil Consult (Pty) Ltd.	DATE : 2022-02-07	Y-COORD :
PROFILED BY :	JI Roux (Eng. Geo. Pr.Sci.Nat)	DATE : 2022-02-07	
TYPE SET BY :	JI Roux	DATE : 08/03/2022 12:06	
SETUP FILE :	RSC.SET	TEXT : ..APPBSP\RS21041SPV1.2.txt	

HOLE No: TP11

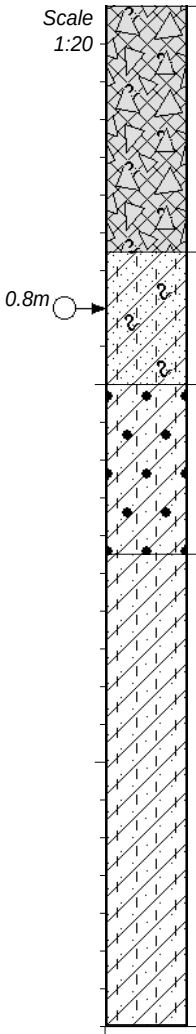
ROCKSOIL CONSULT

GHDEVCO (Pty) Ltd.
PTN 36 and 216 Zandfontein

HOLE No: TP12
Sheet 1 of 1

JOB NUMBER: RS21041

Scale 1:20



Depth	Description
0.00 – 0.65	Moist to wet, dark brown to black and orange, soft to loose, **intact to voided**, gravelly sandy silty clay to clayey sandy gravel with abundant gravel, domestic waste and rubble. **FILL OF MIX ORIGIN**. Grass roots present.
0.65 – 1.00	Moist to very moist, dark brown to black, soft, **shattered to slightly open structured**, silty clay sand with trace amounts of sub-rounded gravel of mixed origin. Few grass roots. **SEEMINGLY NATURAL TOPSOIL**.
1.00 – 1.45	Moist, light grey to dark brown mottled orange, soft, **shattered to slightly open structured**, fine silty sandy CLAY with scattered sub-rounded quartzite gravel and ferricrete concretions. **SLIGHTLY FERRUGINISED ALLUVIAL SOIL**.
1.45 – 2.70	Moist, grey mottled orange, soft, **shattered to slickensided**, sandy silty CLAY with scattered trace amounts of sub-rounded quartzite gravel cobbles and occasional weakly cemented Fe concretions. **ALLUVIAL SOIL**.

NOTES

1) Hole terminated near practical reach of the TLB.
2) Soft excavation conditions at termination depth.
3) Slow water seepage recorded from 0.8m during approximately 30min inspection period.
4) Some indications of sidewall instability during approximately 30min inspection period.
5) No sample retrieved.
6) Abundant anthropogenic fill material in the vicinity of the test pit.

CONTRACTOR :	RockSoil Consult (Pty) Ltd.	INCLINATION :	ELEVATION :
MACHINE :	CAT 428E TLB	DIAM : 600 mm wide trench	X-COORD :
DRILLED BY :	RockSoil Consult (Pty) Ltd.	DATE : 2022-02-07	Y-COORD :
PROFILED BY :	JI Roux (Eng. Geo. Pr.Sci.Nat)	DATE : 2022-02-07	
TYPE SET BY :	JI Roux	DATE : 08/03/2022 12:06	
SETUP FILE :	RSC.SET	TEXT : ..APPBSP\RS21041SPV1.2.txt	

HOLE No: TP12

ROCKSOIL CONSULT

GHDEVCO (Pty) Ltd.
PTN 36 and 216 Zandfontein

LEGEND
Sheet 1 of 1

JOB NUMBER: RS21041

	GRAVELLY	{SA03}
	SAND	{SA04}
	SANDY	{SA05}
	SILT	{SA06}
	SILTY	{SA07}
	CLAY	{SA08}
	CLAYEY	{SA09}
	DIABASE	{SA18}{SA41}
	NODULAR FERRICRETE/ferricrete nodules/honeycomb ferric....	{SA24}
	SPARSE FERRICRETE NODULES/occasional ferricrete nodu....	{SA25}
	RUBBLE	{SA31}
	FILL	{SA32}
	CONCRETE	{SA34}
Name	DISTURBED SAMPLE	{SA38}
	ROOTS	{SA40}
15.5	WATER SEEPAGE/water strike	{CH50}

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY :

INCLINATION :
DIAM :
DATE :
DATE :

ELEVATION :
X-COORD :
Y-COORD :

TYPE SET BY : JI Roux
SETUP FILE : RSC.SET

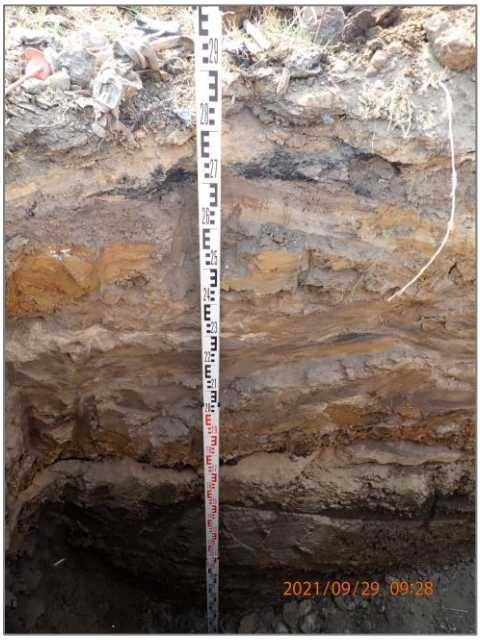
DATE : 08/03/2022 12:06
TEXT : ..APPBSP\RS21041SPV1.2.txt

LEGEND
SUMMARY OF SYMBOLS

Appendix C: Soil Profile Photographs

Project reference number: RS21041
Project name: PTN36 and 216 Zandfontein 317-JR

Test Pit no: TP01



Note: Freshly exposed soil profile.

Test Pit no: TP01

Note: Upper profile fill material.

Test Pit no: TP01

Note: Fill material.

Test Pit no: TP01

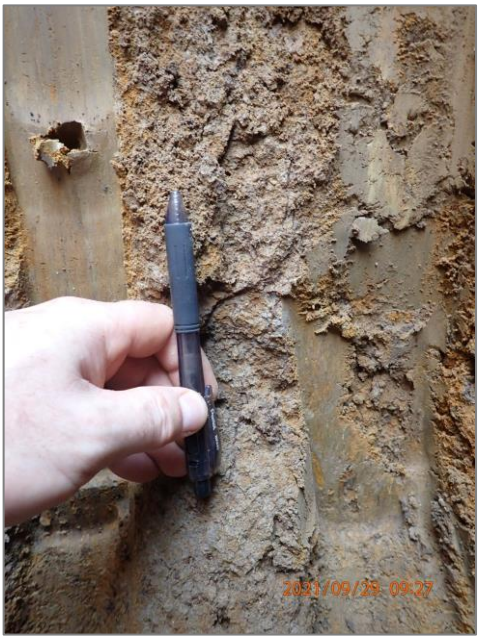
Note: Fill material dark grey lense and sand underlying.

Project reference number: RS21041
Project name: PTN36 and 216 Zandfontein 317-JR

Test Pit no: TP01

Note: Possibly slightly organic topsoil horizon of possible natural ground level.

Test Pit no: TP01

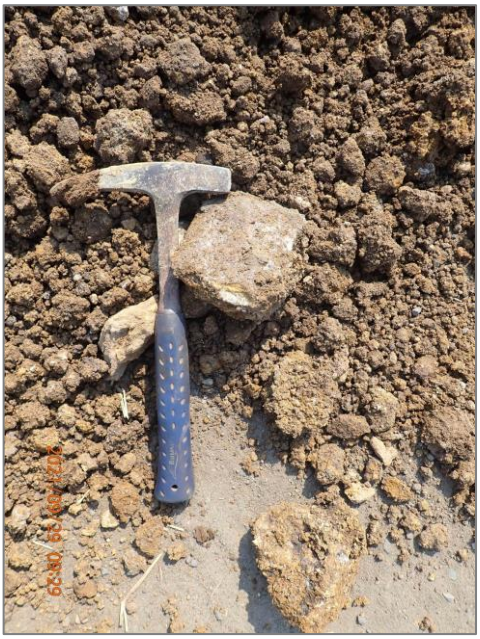


Note: Lower seemingly alluvium.

Test Pit no: TP01

Note: Excavated material with hammer as scale, hammer 32cm bottom to top center.

Test Pit no: TP01



Note: Sub angular sandstone cobble.

Project reference number: RS21041
Project name: PTN36 and 216 Zandfontein 317-JR

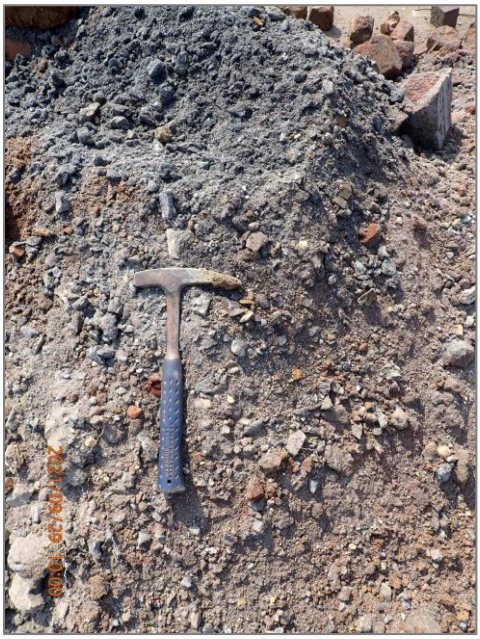
Test Pit no: TP02

Note: Freshly exposed soil profile.

Test Pit no: TP02

Note: Freshly exposed soil profile.

Test Pit no: TP02



Note: Excavated material with hammer as scale, hammer 32cm bottom to top center.

Test Pit no: TP02

Note: Excavated material with hammer as scale, hammer 32cm bottom to top center.

Project reference number: RS21041
Project name: PTN36 and 216 Zandfontein 317-JR

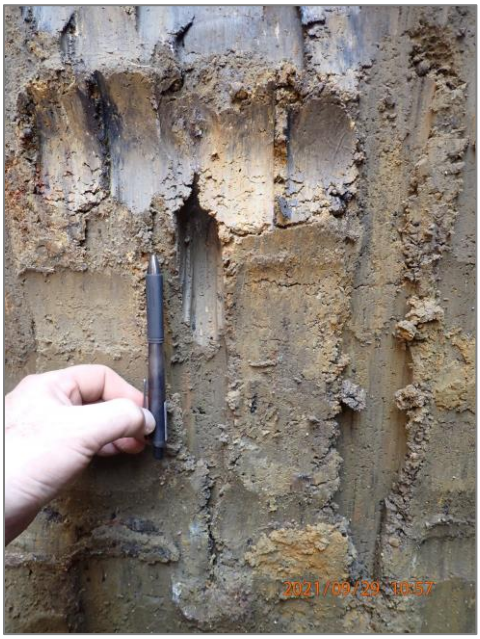
Test Pit no: TP03

Note: Freshly exposed soil profile.

Test Pit no: TP03

Note: Upper profile fill.

Test Pit no: TP03



Note: Lower profile exposed.

Test Pit no: TP03

Note: Lower profile exposed.

Project reference number: RS21041
Project name: PTN36 and 216 Zandfontein 317-JR

Test Pit no: TP03

Note: Lower profile exposed.

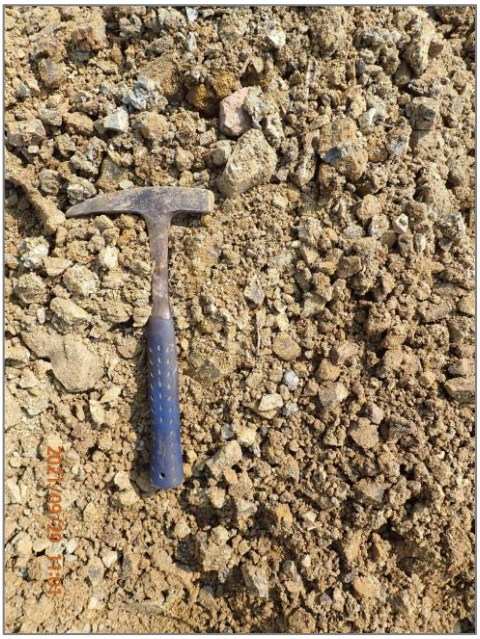
Test Pit no: TP03

Note: Lower profile exposed.

Test Pit no: TP03

Note: Excavated material.

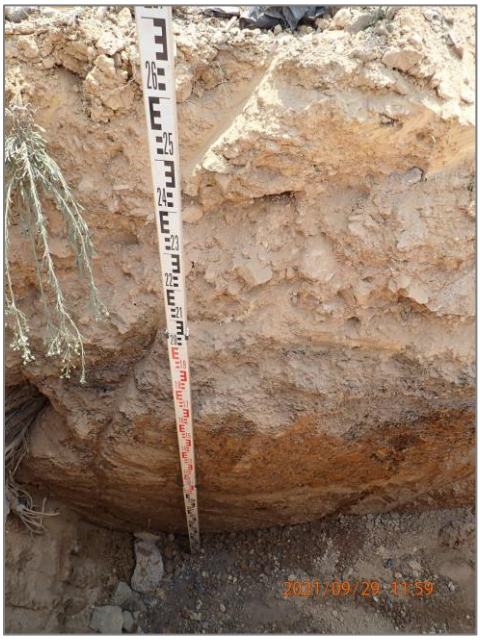
Test Pit no: TP03



Note: Excavated material with hammer as scale, hammer 32cm bottom to top center.

Project reference number: RS21041
Project name: PTN36 and 216 Zandfontein 317-JR

Test Pit no: TP04



Note: Freshly exposed soil profile.

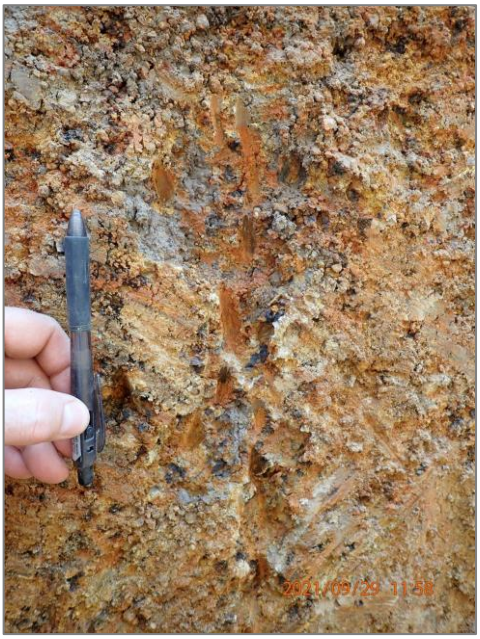
Test Pit no: TP04

Note: Exposed profile.

Test Pit no: TP04

Note: Exposed profile.

Test Pit no: TP04



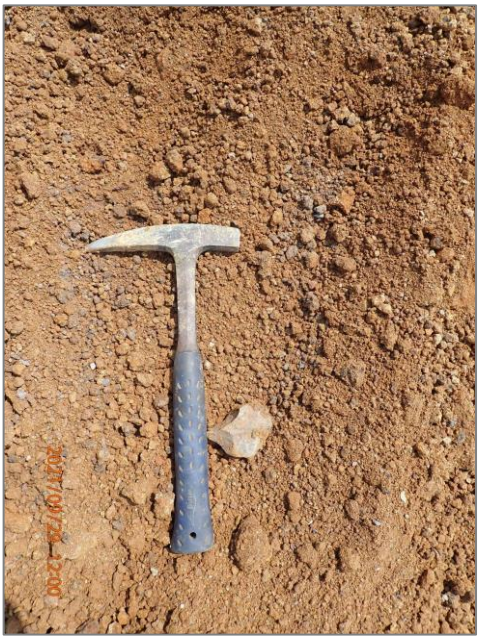
Note: Exposed profile.

Project reference number: RS21041
Project name: PTN36 and 216 Zandfontein 317-JR

Test Pit no: TP04

Note: Lower exposed profile.

Test Pit no: TP04

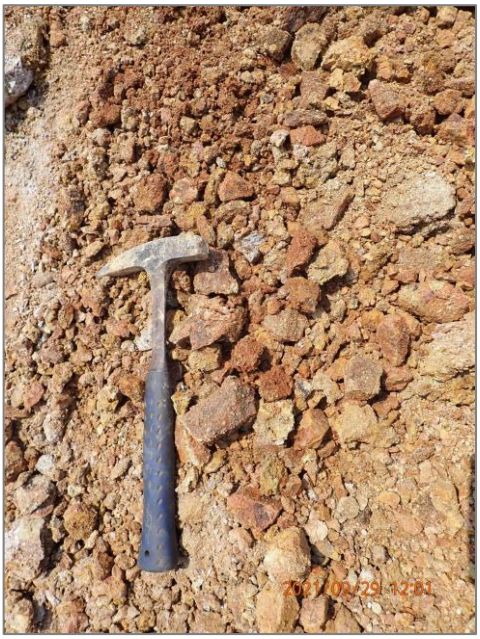


Note: Excavated material with hammer as scale, hammer 32cm bottom to top center.

Test Pit no: TP04

Note: Excavated material.

Test Pit no: TP04



Note: Excavated material with hammer as scale, hammer 32cm bottom to top center.

Project reference number: RS21041
Project name: PTN36 and 216 Zandfontein 317-JR

Test Pit no: TP05

Note: Freshly exposed soil profile.

Test Pit no: TP05

Note: Trench excavated refusal on concrete slab/foundation.

Test Pit no: TP05

Note: Excavated material with hammer as scale, hammer 32cm bottom to top center.

Test Pit no: TP05

Note: Sidewall of test pit, fill with refusal on concrete slab/foundation at depth.

Project reference number: RS21041
Project name: PTN36 and 216 Zandfontein 317-JR

Test Pit no: TP06

Note: Freshly exposed soil profile.

Test Pit no: TP06

Note: Exposed soil profile, fill.

Test Pit no: TP06

Note: Exposed soil profile, fill.

Test Pit no: TP06

Note: Sub-angular sandstone pebble.

Project reference number: RS21041
Project name: PTN36 and 216 Zandfontein 317-JR

Test Pit no: TP06

Note: Excavated material.

Test Pit no: TP06 Region

Note: Surface desiccation cracks.

Test Pit no: TP07

Note: Freshly exposed soil profile.

Test Pit no: TP07

Note: Upper exposed profile, desiccation cracks.

Project reference number: RS21041
Project name: PTN36 and 216 Zandfontein 317-JR

Test Pit no: TP07

Note: Exposed material.

Test Pit no: TP08

Note: Freshly exposed soil profile.

Test Pit no: TP08

Note: Excavated material with hammer as scale, hammer 32cm bottom to top center.

Test Pit no: TP08

Note: Lump excavated.

Project reference number: RS21041
Project name: PTN36 and 216 Zandfontein 317-JR

Test Pit no: TP09

Note: Freshly exposed soil profile.

Test Pit no: TP09

Note: Excavated material with hammer as scale, hammer 32cm bottom to top center.

Test Pit no: TP09

Note: Excavated material with hammer as scale, hammer 32cm bottom to top center.

Test Pit no: TP09

Note: Clod/lump, slight ferruginisation.

Project reference number: RS21041
Project name: PTN36 and 216 Zandfontein 317-JR

Test Pit no: TP09

Note: Excavated material with hammer as scale, hammer 32cm bottom to top center.

Test Pit no: TP09

Note: Lump excavated.

Test Pit no: TP09

Note: Lump excavated.

Test Pit no: TP10

Note: Freshly exposed soil profile.

Project reference number: RS21041
Project name: PTN36 and 216 Zandfontein 317-JR

Test Pit no: TP10

Note: Freshly exposed soil profile.

Test Pit no: TP10

Note: Exposed material.

Test Pit no: TP10

Note: Lump cohesive soil.

Test Pit no: TP10

Note: Exposed material cohesive soil.

Project reference number: RS21041
Project name: PTN36 and 216 Zandfontein 317-JR

CAT 422F TLB with soil bucket used for excavation of test pits.

Note: TLB used for excavation of test pits.

Specification plate – CAT 422F TLB

Note: TLB used – CAT422F TLB.

Project reference number: RS21041 (Infill Test Pitting)
Project name: PTN36 and 216 Zandfontein 317-JR

Test Pit no: TP11

Note: Freshly exposed soil profile.

Test Pit no: TP11

Note: Exposed soil profile, topsoil.

Test Pit no: TP11

Note: Exposed soil profile, slightly ferruginised alluvial soil.

Test Pit no: TP11

Note: Excavated clay lumps.

Project reference number: RS21041 (Infill Test Pitting)
Project name: PTN36 and 216 Zandfontein 317-JR

Test Pit no: TP12

Note: Freshly exposed soil profile.

Test Pit no: TP12

Note: Exposed soil profile, fill.

Test Pit no: TP12

Note: Exposed soil profile, fill.

Test Pit no: TP12

Note: Topsoil material.

Project reference number: RS21041 (Infill Test Pitting)
Project name: PTN36 and 216 Zandfontein 317-JR

CAT 428E TLB with soil bucket used during infill test pitting attempt.

Note: TLB used during infill test pitting attempt (7 February 2022).

CAT 428E TLB with soil bucket used during infill test pitting attempt.

Note: TLB used during infill test pitting attempt (7 February 2022).

Appendix D: Laboratory Test Results

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Client Name: RockSoil Consult (Pty) Ltd
Project Name: RS21041: Zandfontein
Job Number: RSC-48
Date: 2021-11-16
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

Sheet Reference: R-STL-011 Rev02

Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				**Atterberg Limits & Classification**			
Sample	TP03	TP04	TP04	Sample	TP03	TP04	TP04
Depth (m)	1.3 - 1.6	1.0 - 2.0	2.5 - 2.7	Depth (m)	1.3 - 1.6	1.0 - 2.0	2.5 - 2.7
Lab No	RSC-48-563	RSC-48-563A	RSC-48-564	Lab No	RSC-48-563	RSC-48-563A	RSC-48-564
53.0	**100**	**100**	**100**	Liquid Limit (%)	**51**	**33**	**46**
37.5	**100**	**100**	**100**	Plastic Limit (%)	**21**	**18**	**22**
26.5	**100**	**100**	**100**	Plasticity Index (%)	**30**	**15**	**24**
19.0	**100**	**100**	**100**	Linear Shrinkage (%)	**15.0**	**7.5**	**11.5**
13.2	**100**	**100**	**100**	PI of whole sample	**24**	**7**	**17**
9.5	**100**	**98**	**100**				
6.7	**99**	**93**	**98**	% Gravel	**8**	**35**	**15**
4.75	**98**	**88**	**95**	% Sand	**34**	**34**	**30**
2.00	**92**	**65**	**85**	% Silt	**17**	**19**	**38**
1.00	**87**	**54**	**78**	% Clay	**41**	**12**	**17**
0.425	**80**	**46**	**71**	Activity	**0.7**	**1.3**	**1.4**
0.250	**71**	**42**	**68**				
0.150	**66**	**39**	**65**	% Soil Mortar	**92**	**65**	**85**
0.075	**61**	**36**	**61**				
0.060	**58**	**31**	**55**	Grading Modulus	**0.67**	**1.53**	**0.83**
0.050	**56**	**29**	**52**	Moisture Content (%)	**N / T**	**N / T**	**N / T**
0.035	**53**	**26**	**47**	Relative Density (SG)*	**2.706**	**2.65**	**2.65**
0.020	**50**	**23**	**41**				
0.006	**46**	**16**	**26**	Unified (ASTM D2487)	**CH**	**SC**	**CL**
0.002	**41**	**12**	**17**	AASHTO (M145-91)	**A - 7 - 6**	**A - 6**	**A - 7 - 6**

Remarks: *: 2.706 Determined, 2.65 Assumed
N / T: Not Tested

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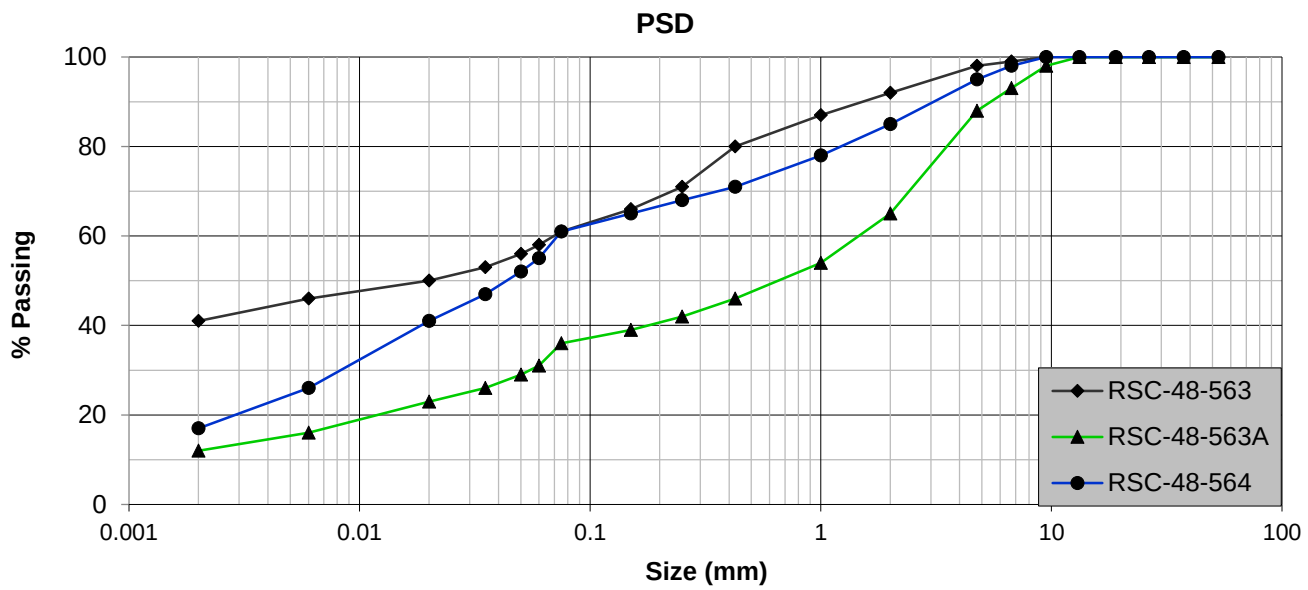
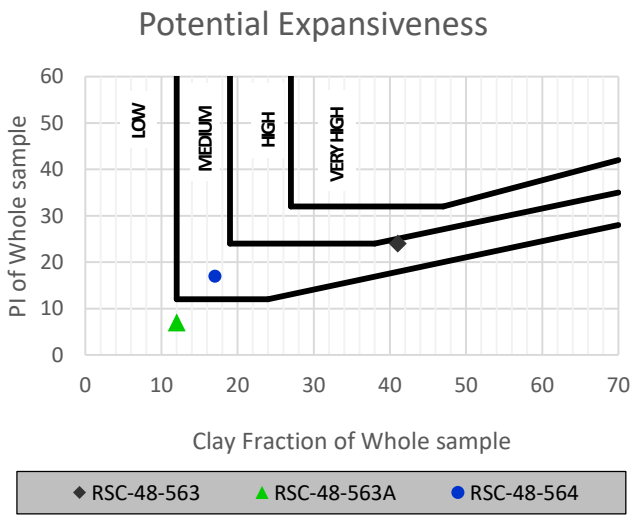
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

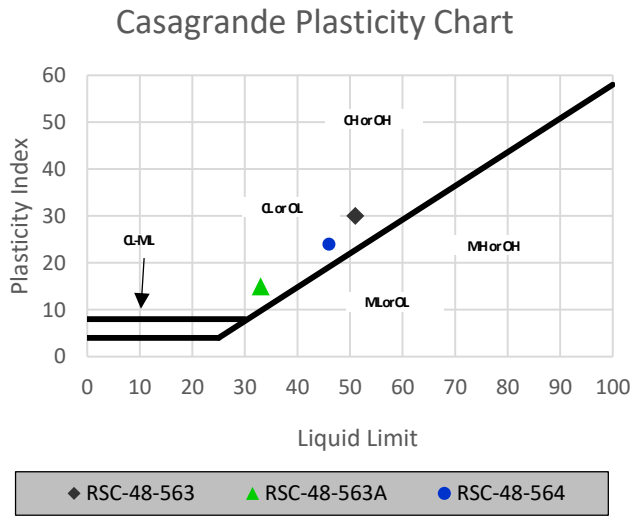
Client Name: RockSoil Consult (Pty) Ltd
Project Name: RS21041: Zandfontein
Job Number: RSC-48
Date: 2021-11-16
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

Sheet Reference: R-STL-011 Rev02







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Job Number: RSC-48
Date: 2021-11-16
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

Sheet Reference: R-STL-011 Rev02

Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				**Atterberg Limits & Classification**			
Sample	TP06	TP06	TP09	Sample	TP06	TP06	TP09
Depth (m)	1.6 - 2.6	2.7 - 3.2	1.0 - 1.9	Depth (m)	1.6 - 2.6	2.7 - 3.2	1.0 - 1.9
Lab No	RSC-48-565	RSC-48-566	RSC-48-567	Lab No	RSC-48-565	RSC-48-566	RSC-48-567
53.0	**100**	**100**	**100**	Liquid Limit (%)	**75**	**53**	**45**
37.5	**100**	**100**	**100**	Plastic Limit (%)	**33**	**32**	**21**
26.5	**100**	**100**	**100**	Plasticity Index (%)	**42**	**21**	**24**
19.0	**100**	**100**	**100**	Linear Shrinkage (%)	**27.5**	**12.0**	**12.5**
13.2	**100**	**100**	**100**	PI of whole sample	**41**	**21**	**15**
9.5	**100**	**100**	**100**				
6.7	**100**	**100**	**98**	% Gravel	**0**	**0**	**23**
4.75	**100**	**100**	**94**	% Sand	**17**	**28**	**33**
2.00	**100**	**100**	**77**	% Silt	**26**	**59**	**19**
1.00	**99**	**100**	**70**	% Clay	**57**	**13**	**25**
0.425	**98**	**99**	**63**	Activity	**0.7**	**1.6**	**1.0**
0.250	**95**	**99**	**56**				
0.150	**93**	**95**	**52**	% Soil Mortar	**100**	**100**	**77**
0.075	**89**	**87**	**47**				
0.060	**83**	**72**	**44**	Grading Modulus	**0.13**	**0.14**	**1.13**
0.050	**82**	**65**	**43**	Moisture Content (%)	**N / T**	**N / T**	**N / T**
0.035	**79**	**51**	**40**	Relative Density (SG)*	**2.65**	**2.749**	**2.65**
0.020	**75**	**41**	**37**				
0.006	**67**	**25**	**30**	Unified (ASTM D2487)	**CH**	**MH**	**SC**
0.002	**57**	**13**	**25**	AASHTO (M145-91)	**A - 7 - 5**	**A - 7 - 5**	**A - 7 - 6**

Remarks: *: 2.749 Determined, 2.65 Assumed
N / T: Not Tested

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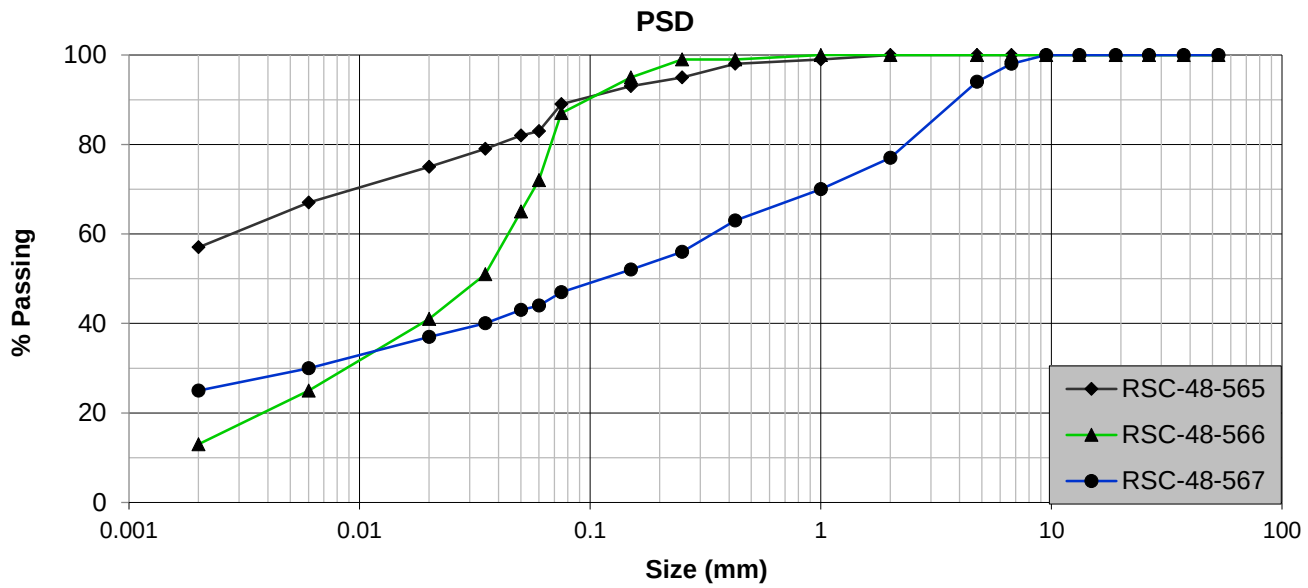
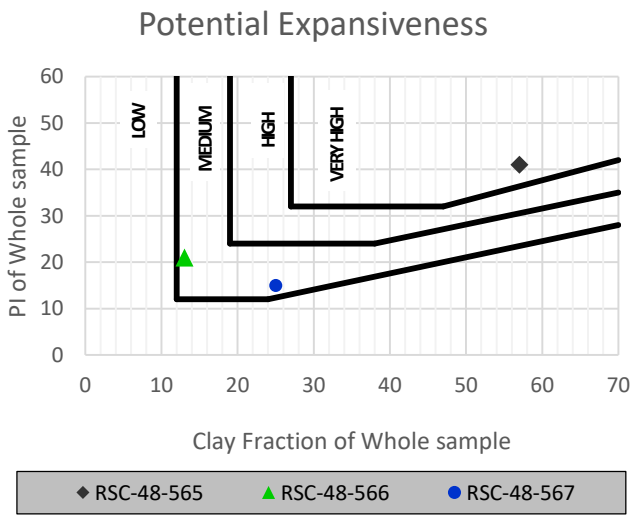
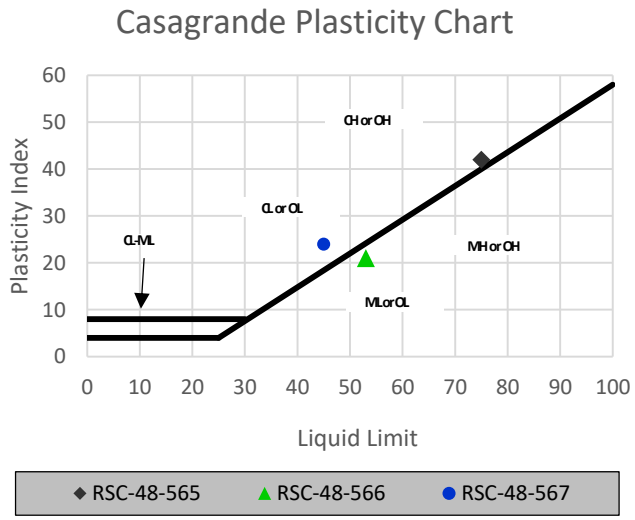
Client Name: RockSoil Consult (Pty) Ltd
Project Name: RS21041: Zandfontein
Job Number: RSC-48
Date: 2021-11-16
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

Sheet Reference: R-STL-011 Rev02







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Job Number: RSC-48
Date: 2021-11-16
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

Sheet Reference: R-STL-011 Rev02

Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				**Atterberg Limits & Classification**			
Sample	TP09			Sample	TP09		
Depth (m)	2.1 - 2.8			Depth (m)	2.1 - 2.8		
Lab No	RSC-48-568			Lab No	RSC-48-568		
53.0	**100**			Liquid Limit (%)	**60**		
37.5	**100**			Plastic Limit (%)	**28**		
26.5	**100**			Plasticity Index (%)	**32**		
19.0	**100**			Linear Shrinkage (%)	**24.5**		
13.2	**100**			PI of whole sample	**28**		
9.5	**100**						
6.7	**100**			% Gravel	**7**		
4.75	**99**			% Sand	**22**		
2.00	**93**			% Silt	**24**		
1.00	**89**			% Clay	**47**		
0.425	**86**			Activity	**0.7**		
0.250	**81**						
0.150	**78**			% Soil Mortar	**93**		
0.075	**74**						
0.060	**71**			Grading Modulus	**0.47**		
0.050	**69**			Moisture Content (%)	**N / T**		
0.035	**65**			Relative Density (SG)*	**2.65**		
0.020	**61**						
0.006	**54**			Unified (ASTM D2487)	**CH**		
0.002	**47**			AASHTO (M145-91)	**A - 7 - 6**		

Remarks: *: Assumed
N / T: Not Tested

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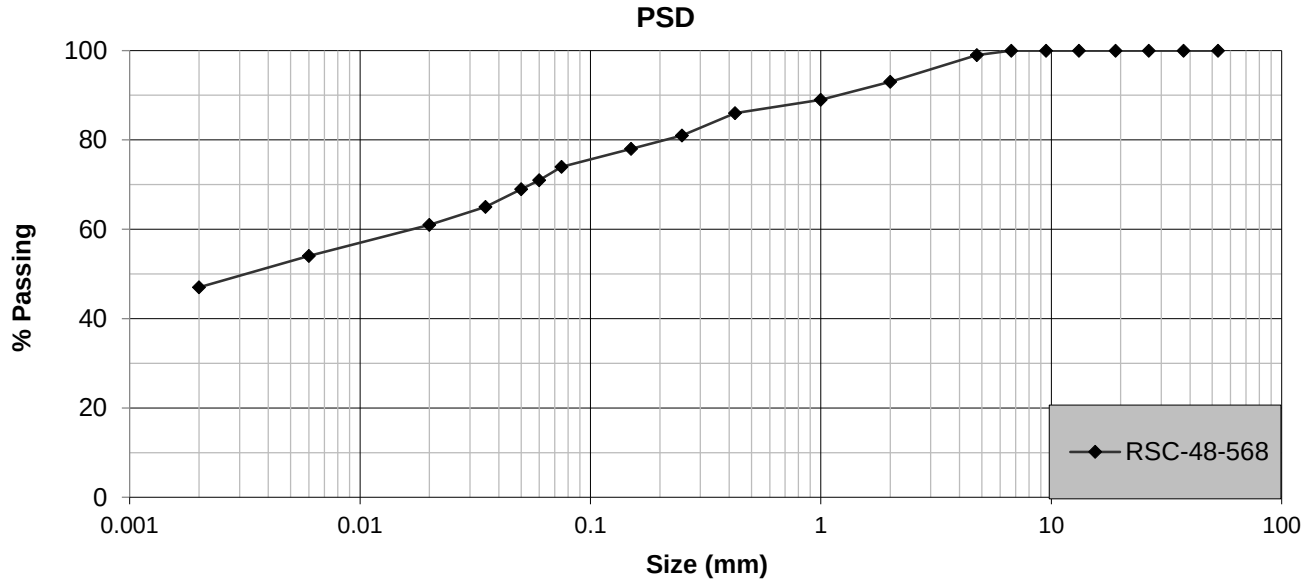
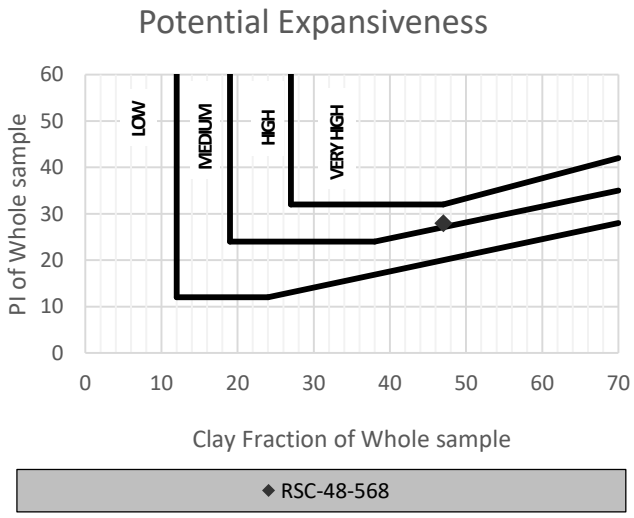
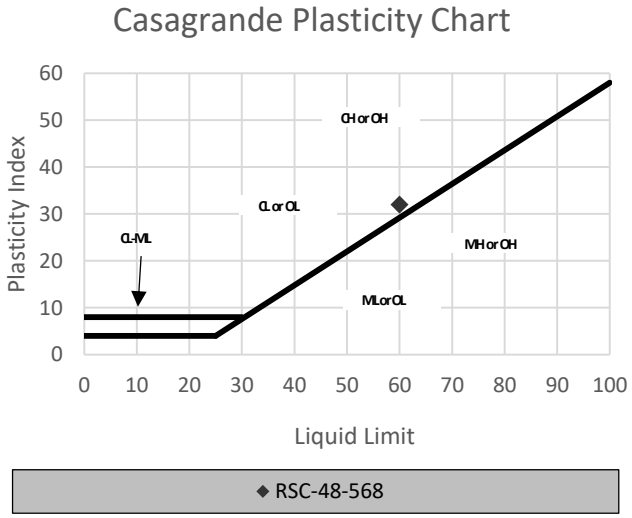
Project Name: RS21041: Zandfontein
Job Number: RSC-48
Date: 2021-11-16
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

Sheet Reference: R-STL-011 Rev02







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Client Name: RockSoil Consult (Pty) Ltd
Project Name: RS21041: Zandfontein
Job Number: RSC-48
Date: 16-Nov-21
Method: SANS 3001 GR1, GR3, GR10, GR12 GR20, GR30, GR31, GR40, GR50, GR53, GR54 & BS 1377 (where applicable)

SUMMARY OF TEST DATA

Grading & Hydrometer Analysis (% Passing)

Sample	TP03	TP04	TP04	TP06	TP06	TP09	TP09	
Depth (m)	1.3 - 1.6	1.0 - 2.0	2.5 - 2.7	1.6 - 2.6	2.7 - 3.2	1.0 - 1.9	2.1 - 2.8	
Lab No	RSC-48-563	RSC-48-563A	RSC-48-564	RSC-48-565	RSC-48-566	RSC-48-567	RSC-48-568	
53.0	**100**	**100**	**100**	**100**	**100**	**100**	**100**	
37.5	**100**	**100**	**100**	**100**	**100**	**100**	**100**	
26.5	**100**	**100**	**100**	**100**	**100**	**100**	**100**	
19.0	**100**	**100**	**100**	**100**	**100**	**100**	**100**	
13.2	**100**	**100**	**100**	**100**	**100**	**100**	**100**	
9.5	**100**	**98**	**100**	**100**	**100**	**100**	**100**	
6.7	**99**	**93**	**98**	**100**	**100**	**98**	**100**	
4.75	**98**	**88**	**95**	**100**	**100**	**94**	**99**	
2.00	**92**	**65**	**85**	**100**	**100**	**77**	**93**	
1.00	**87**	**54**	**78**	**99**	**100**	**70**	**89**	
0.425	**80**	**46**	**71**	**98**	**99**	**63**	**86**	
0.250	**71**	**42**	**68**	**95**	**99**	**56**	**81**	
0.150	**66**	**39**	**65**	**93**	**95**	**52**	**78**	
0.075	**61**	**36**	**61**	**89**	**87**	**47**	**74**	
0.060	**58**	**31**	**55**	**83**	**72**	**44**	**71**	
0.050	**56**	**29**	**52**	**82**	**65**	**43**	**69**	
0.035	**53**	**26**	**47**	**79**	**51**	**40**	**65**	
0.020	**50**	**23**	**41**	**75**	**41**	**37**	**61**	
0.006	**46**	**16**	**26**	**67**	**25**	**30**	**54**	
0.002	**41**	**12**	**17**	**57**	**13**	**25**	**47**	
GM	**0.67**	**1.53**	**0.83**	**0.13**	**0.14**	**1.13**	**0.47**	

Atterberg Limits

LL (%)	**51**	**33**	**46**	**75**	**53**	**45**	**60**	
PI (%)	**30**	**15**	**24**	**42**	**21**	**24**	**32**	
LS (%)	**15.0**	**7.5**	**11.5**	**27.5**	**12.0**	**12.5**	**24.5**	

pH & Conductivity

pH		**7.0**	**6.9**			**6.8**	**7.4**	
EC (S/m)		**0.016**	**0.028**			**0.027**	**0.037**	

MDD / OMC

MDD (kg/m^3)								
OMC (%)								

CBR

100%								
98%								
97%								
95%								
93%								
90%								
Swell (%)								

UCS (MPa)

100%								
97%								
90%								

COLTO Classification

Remarks:

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Client: **Rocksoil Consult**

Project: PTN 36 & Zandfontein 317-JR

Attention: Mr. K Roux

Your Ref. No: RS21041

Date Reported Thursday, 10 March 2022

TEST REPORT REFERENCE NUMBER / JOB NUMBER : ST00247

Dear Sir / Madam

Herewith please find the original reports pertaining to the above mentioned project.

Test Requested

2	*x*	*MDD / CBR*
2	*x*	*FOUNDATION INDICATOR*
2	*x*	*SPECIFIC GRAVITY*

Site Sampling and Materials Information

Sampling Method	*Sampled by Client*
Environmental Condition	*Sunny*
Deviation from the prescribed test method	*No deviation from prescribed Test Methods*
Responsibility of information disclaimer	*The sample information was received from the customer. Results apply to the sample as received from the Customer.*

FINAL REPORT

We would like to take this opportunity to thank you for your valued support.
Should you have any further enquiries please don't hesitate to contact me.

Yours Faithfully
SOILTECNIX (PTY) LTD

Mr. A.Barnard
Technical Signatory

Remarks:

1. Information contained herein is confidential to SOILTECNIX (PTY) LTD and the addressee
2. Opinions & Interpretations are not included in our schedule of Accreditation.
3. The samples where subjected and analysed according to ASTM.
4. The results reported relate only to the sample tested, Further use of the attached information is not the responsibility or liability of SOILTECNIX (PTY) LTD.
5. This document is the correct record of all measurements made, and may not be reproduced other than with full written approval from a director of SOILTECNIX (PTY) LTD.
6. Measuring equipment is traceable to national standards (Where applicable).
7. Should there be any deviation from the prescribed test method comments will be made thereof, pertaining to the test on the relevant materials report.
8. Uncertainty of measurement is calculated and corresponds to a coverage probability of approximately 95%. Available on request.
9. The decision rule states that the measurement of uncertainty can be applied by the customer to the test results, on request. It is not the responsibility or liability of SOILTECNIX (PTY) LTD.

DIRECTORS: **Mr. A Barnard B-Tech Civil (Managing) | Mr. J. Steyn ND-Civil | Mr. R. Wilson B-Tech Civil**

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Fax: 017 647 3622
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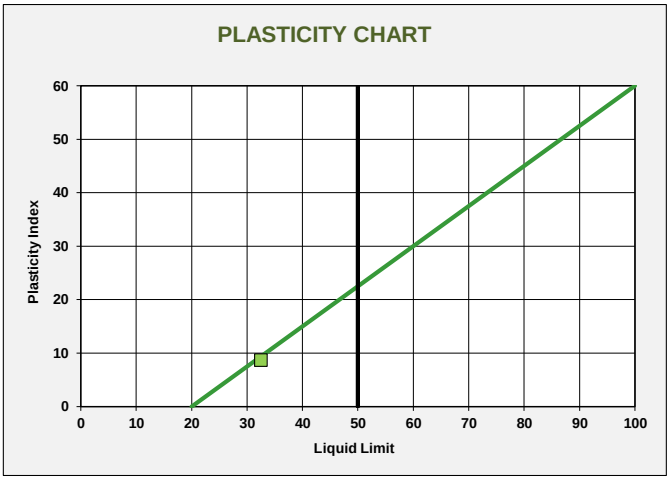
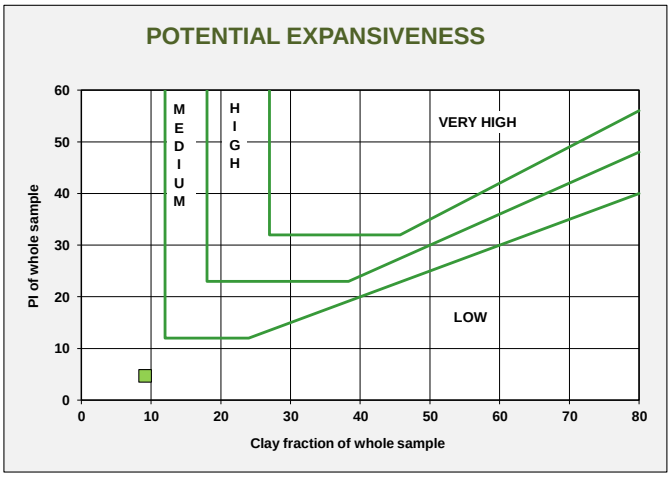
Customer :	Rocksoil Consult	Project :	PTN 36 & Zandfontein 317-JR
	Floor 5, Block B, Menlyn Corporate Park	Date Received :	Tuesday, 08 February 2022
	Waterkloof Glen, Pretoria	Date Reported :	Thursday, 10 March 2022
	0081	Req. Number :	RS21041
Attention :	Mr. K Roux	Date Sampled:	Tuesday, 08 February 2022

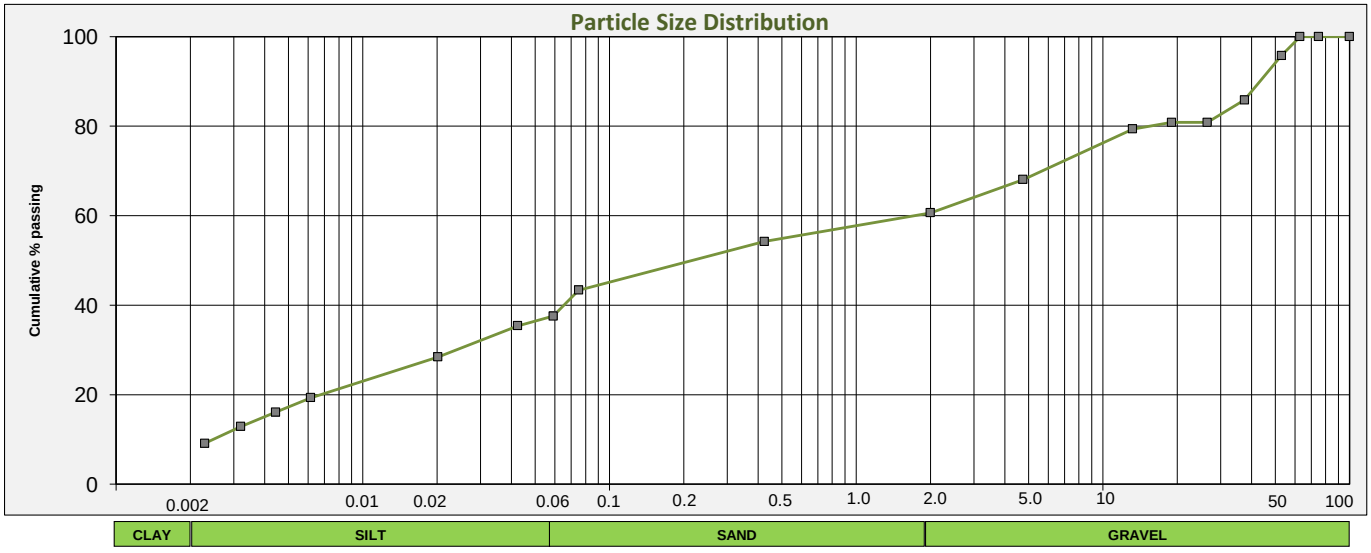
FOUNDATION INDICATOR

Job No.:	ST00247	**Sample No.**	STS603
Depth (m)	N/A	**Client Reference:**	1
Position	Stockpile1	**Material Description**	Light Red Orange SILTY GRAVEL
Organic Material	No		
Moisture (%)	N/A		

SIEVE ANALYSIS (mm) SANS 3001 GR1	100.0 mm	100
	75.0mm	100
	63.0 mm	100
	50.0 mm	96
	37.5 mm	86
	28.0 mm	81
	20.0 mm	81
	14.0 mm	79
	5.0 mm	68
	2.00 mm	61
	0.425 mm	54
	0.075 mm	43
HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3 2012)	59 µm	38
	42 µm	35
	20 µm	28
	6 µm	19
	4 µm	16
	3 µm	13
	2,2 µm	9
	% Clay	9
	% Silt	32
	% Sand	20
	% Gravel	39
ATTERBERG LIMITS (SANS 3001:GR10, GR12)	Liquid Limit	32,5
	Plasticity Index	8,6
	Linear Shrinkage (%)	4,2
SANS 3001: PR5	Grading Modulus	1,42
TRH 14	Classification	A-4 (1)
Unified ASSTHO	Unified Classification	GM
TMH1 A21T	Conductivity(s.m^{-1})	-
TMH1 A20	pH	-
TMH1 A12T	Specific Gravity (SG)	2,681
MOD AASHTO SANS 3001 GR30	OMC%	12,1
	MDD(Kg/m^3)	1925
C.B.R. SANS 3001 GR40	COMP MC%	12,1
	% SWELL	2,3
	100%	12,9
	98%	10,1
	97%	9,0
	95%	7,0
	93%	5,5
	90%	3,8
COLTO Classification		**None**







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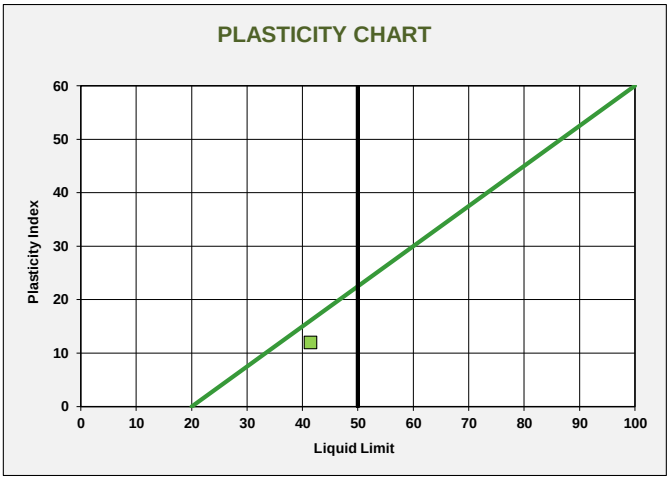
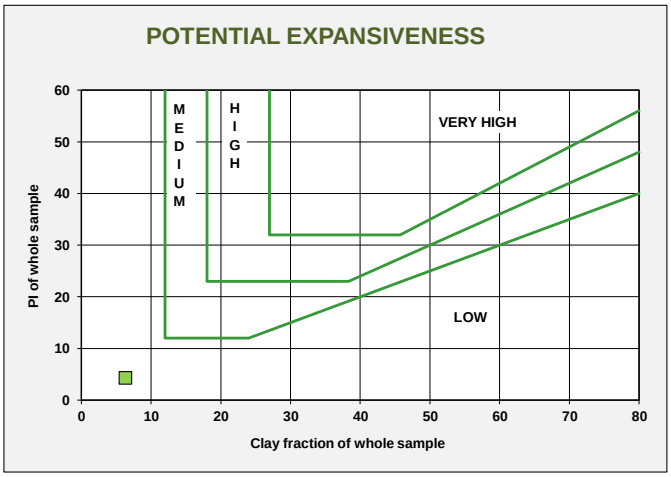
Customer :	Rocksoil Consult	Project :	PTN 36 & Zandfontein 317-JR
	Floor 5, Block B, Menlyn Corporate Park	Date Received :	Tuesday, 08 February 2022
	Waterkloof Glen, Pretoria	Date Reported :	Thursday, 10 March 2022
	0081	Req. Number :	RS21041
Attention :	Mr. K Roux	Date Sampled:	Tuesday, 08 February 2022

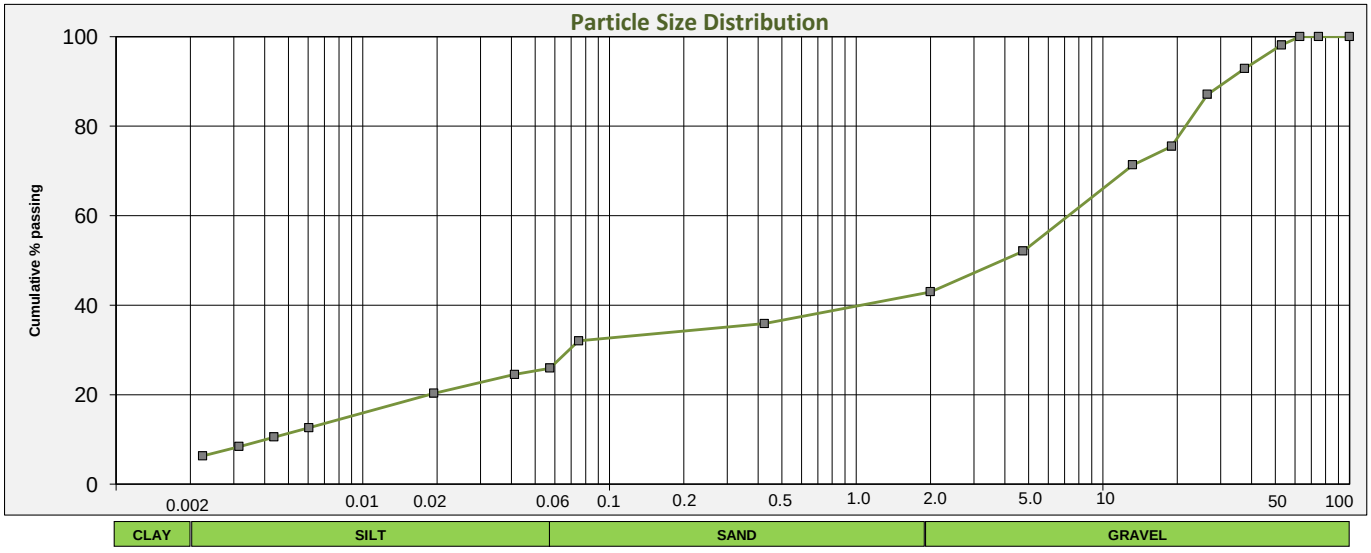
FOUNDATION INDICATOR

Job No.:	ST00247	**Sample No.**	STS604
Depth (m)	N/A	**Client Reference:**	2
Position	Stockpile 2	**Material Description**	Pale Red SILTY GRAVEL
Organic Material	No		
Moisture (%)	N/A		

SIEVE ANALYSIS (mm) SANS 3001 GR1	100.0 mm	100
	75.0mm	100
	63.0 mm	100
	50.0 mm	98
	37.5 mm	93
	28.0 mm	87
	20.0 mm	75
	14.0 mm	71
	5.0 mm	52
	2.00 mm	43
	0.425 mm	36
	0.075 mm	32
HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3 2012)	57 µm	26
	41 µm	24
	19 µm	20
	6 µm	13
	4 µm	10
	3 µm	8
	2,2 µm	6
	% Clay	6
	% Silt	23
	% Sand	14
	% Gravel	57
ATTERBERG LIMITS (SANS 3001:GR10, GR12)	Liquid Limit	41,5
	Plasticity Index	12,0
	Linear Shrinkage (%)	5,1
SANS 3001: PR5	Grading Modulus	1,89
TRH 14	Classification	A-2-7 (0)
Unified ASSTHO	Unified Classification	GM
TMH1 A21T	Conductivity(s.m^{-1})	-
TMH1 A20	pH	-
TMH1 A12T	Specific Gravity (SG)	2,742
MOD AASHTO SANS 3001 GR30	OMC%	14,8
	MDD(Kg/m^3)	1820
C.B.R. SANS 3001 GR40	COMP MC%	14,6
	% SWELL	1,8
	100%	10,9
	98%	9,9
	97%	9,4
	95%	8,6
	93%	7,8
	90%	6,7
COLTO Classification		**None**







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Client:	**Rocksoil Consult**
Project:	PTN 36 & 216 Zandfontein 317-JR
Attention:	Mr. K Roux
Your Ref. No:	-
Date Reported	Monday, 14 March 2022

TEST REPORT REFERENCE NUMBER / JOB NUMBER : ST00247

Dear Sir / Madam

Herewith please find the original reports pertaining to the above mentioned project.

Test Requested

2 x MDD

Site Sampling and Materials Information

Sampling Method	Sampled by Client
Environmental Condition	Sunny
Deviation from the prescribed test method	No deviation from prescribed Test Methods
Responsibility of information disclaimer	The sample information was received from the customer. Results apply to the sample as received from the Customer.

FINAL REPORT

We would like to take this opportunity to thank you for your valued support.
Should you have any further enquiries please don't hesitate to contact me.

Yours Faithfully
SOILTECNIX (PTY) LTD

Mr. A Barnard
Technical Signatory

Remarks:

1. Information contained herein is confidential to SOILTECNIX (PTY) LTD and the addressee
2. Opinions & Interpretations are not included in our schedule of Accreditation.
3. The samples where subjected and analysed according to SANS 3001.
4. The results reported relate only to the sample tested, Further use of the attached information is not the responsibility or liability of SOILTECNIX (PTY) LTD.
5. This document is the correct record of all measurements made, and may not be reproduced other than with full written approval from a director of SOILTECNIX (PTY) LTD.
6. Measuring equipment is traceable to SI Units (Where applicable).
7. Should there be any deviation from the prescribed test method comments will be made thereof, pertaining to the test on the relevant materials report.
8. Uncertainty of measurement is calculated and corresponds to a coverage probability of approximately 95%. Available on request.
9. The decision rule states that the measurement of uncertainty can be applied by the customer to the test results, on request. It is not the responsibility or liability of SOILTECNIX (PTY) LTD.

DIRECTORS: **Mr. A Barnard B-Tech Civil (Managing) | Mr. J. Steyn ND-Civil | Mr. R. Wilson B-Tech Civil**

Soil Tecnix
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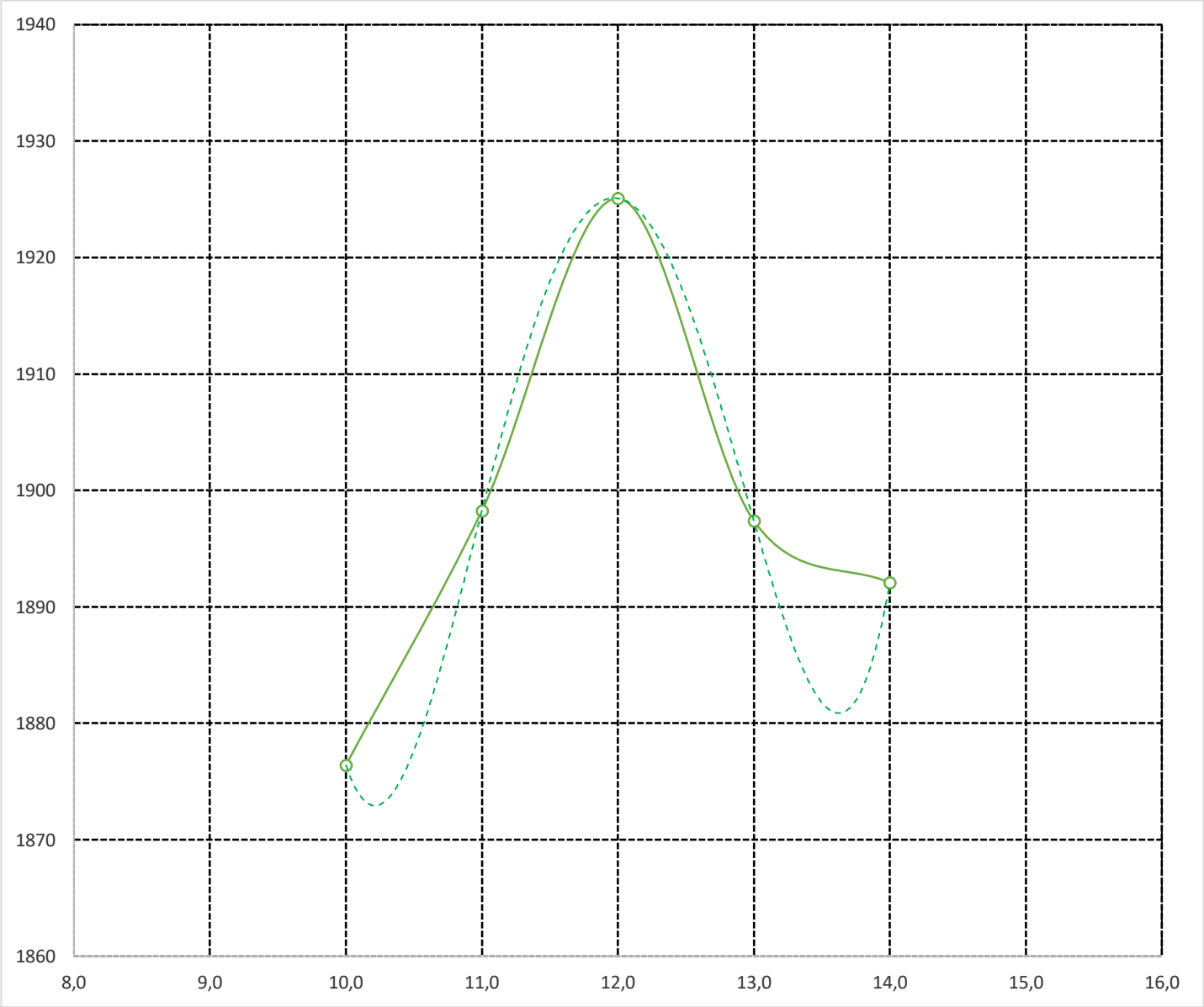
JOB NO:	ST00247	REFERENCE NO:	-	DATE:	2022/03/14
CLIENT	Rocksoil Consult		PROJECT	PTN 36 & 216 Zandfontein 317-JR	
	Floor 5, Block B, Menlyn Corporate Park		POSITION / LAYER	Stockpile 1	
	Waterkloof Glen, Pretoria		KM / SV	-	
	0081		SAMPLE NUMBER	STS603	
ATTENTION	Mr. K Roux		MATERIAL DISCRIPTION	Light Red & Shale	
			ENVIROMENTAL CONDITIONS	Sunny	
SAMPLED BY	As per Client		LABORATORY TESTER	M.Nenzhelele	
TEMP.'C INSIDE LABORATORY		23'C	SAMPLE METHOD *	Sampled by Client	

MAXIMUM DRY DENSITY / OPTIMUM MOISTURE CONTENT SANS GR30 / GR31 / GR20



Maximum Dry Density Kg/m3	**1925**
Optimum Moisture Content %	**12,1**

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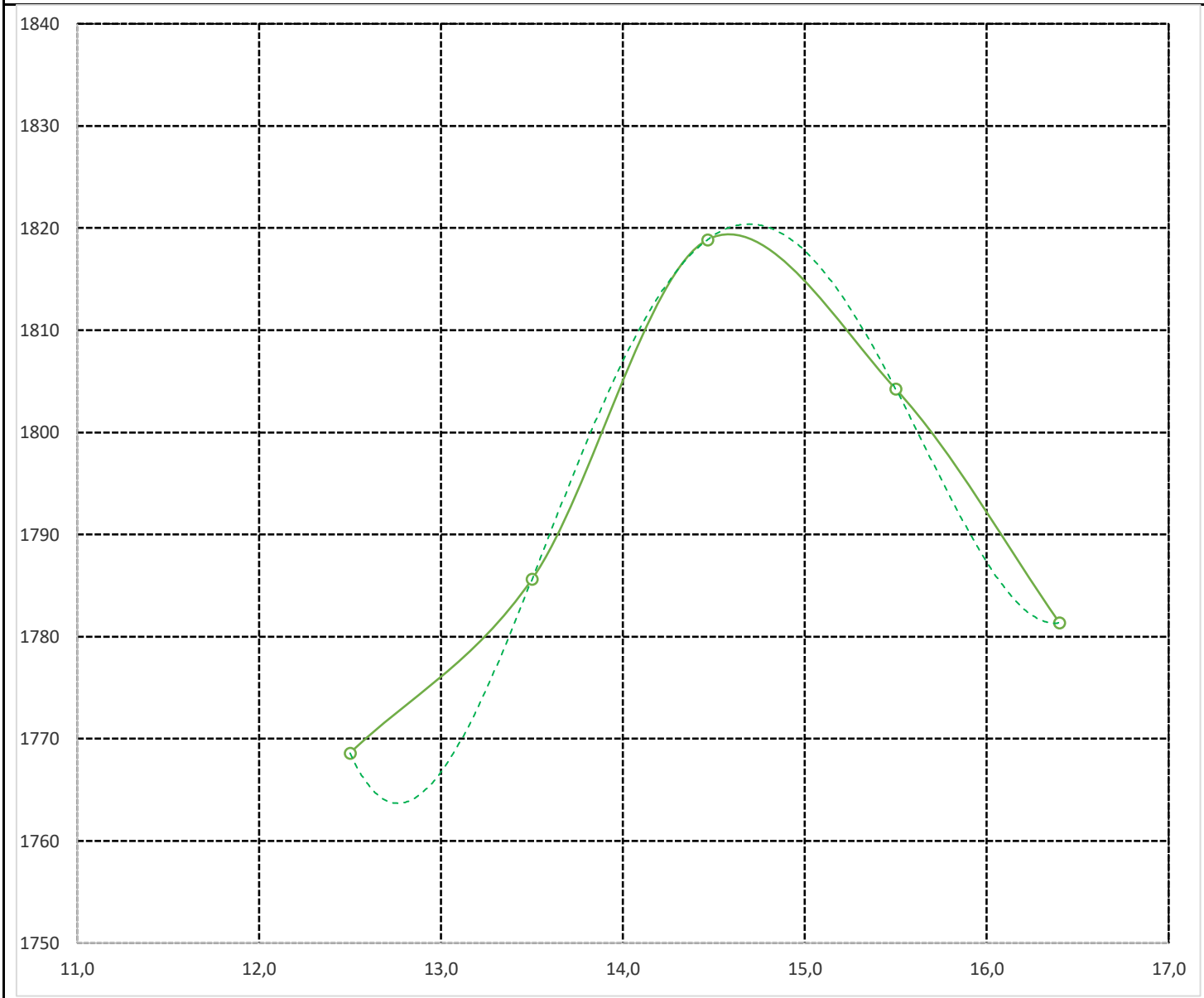
JOB NO:	ST00247	REFERENCE NO:	-	DATE:	2022/03/14
CLIENT	Rocksoil Consult		PROJECT	PTN 36 & 216 Zandfontein 317-JR	
	Floor 5, Block B, Menlyn Corporate Park		POSITION / LAYER	Stockpile 2	
	Waterkloof Glen, Pretoria		KM / SV	-	
	0081		SAMPLE NUMBER	STS604	
ATTENTION	Mr. K Roux		MATERIAL DISCRIPTION	Pale Red & Shale	
			ENVIROMENTAL CONDITIONS	Sunny	
SAMPLED BY	As per Client		LABORATORY TESTER	M.Nenzhelele	
TEMP.'C INSIDE LABORATORY		23'C	SAMPLE METHOD *	Sampled by Client	

MAXIMUM DRY DENSITY / OPTIMUM MOISTURE CONTENT SANS GR30 / GR31 / GR20



Maximum Dry Density Kg/m3	**1820**
Optimum Moisture Content %	**14,8**

Appendix E: Reference Tables

Table 18-1: Typical Properties of Compacted Soils (NAFVAC, 1986)

Group Symbol	Soil Type	Range of Maximum Dry Density (kg/m³)	Range of Optimum Moisture Content (%)	Typical Cohesion (Compacted State)	Typical Cohesion (Saturated)	Typical Effective Stress Envelope (°)	Range of CBR Value (%)
GW	Well graded clean gravels, gravel-sand mixtures.	2002 – 2162	8 – 11	0	0	>38	40 – 80
GP	Poorly graded clean gravels, gravel-sand mix.	1842 – 2002	11 – 14	0	0	>37	30 – 60
GM	Silty gravels, poorly graded gravel-sand-silt.	1922 – 2612	8 – 12	….	….	>34	20 – 60
GC	Clayey gravels, poorly graded gravel-sand-clay.	1842 – 2082	9 – 14	….	….	>31	20 – 40
SW	Well graded clean sands, gravelly sands.	1762 – 2082	9 – 16	0	0	38	20 – 40
SP	Poorly graded clean sands, sand-gravel mix.	1602 – 1922	12 – 21	0	0	37	10 – 40
SM	Silty sands, poorly graded sand-silt mix.	1762 – 2002	11 – 16	50	20	34	10 – 40
SM-SC	Sand-silt clay mix with slightly plastic fines.	1762 – 2082	11 – 15	50	14	33	5 – 30
SC	Clayey sands, poorly graded sand-clay mix.	1682 – 2002	11 – 19	74	11	31	5 – 20
ML	Inorganic silts and clayey silts.	1522 – 1922	12 – 24	67	9	32	≤ 15
ML-CL	Mixture of inorganic silt and clay.	1602 – 1922	12 – 22	65	22	32	….
CL	Inorganic clays of low to medium plasticity.	1522 – 1922	12 – 24	86	13	28	≤ 15
OL	Organic silts and silt-clays, low plasticity.	1281 – 1602	21 – 35	….	….	….	≤ 5
MH	Inorganic clayey silts, elastic silts.	1121 – 1522	24 – 40	72	20	25	≤ 10
CH	Inorganic clays of high plasticity.	1201 – 1682	19 – 36	103	11	19	≤ 15
OH	Organic clays and silty clays.	1041 – 1602	21 – 45	….	….	….	≤ 5

Notes:

1. All properties are for condition of "Standard Proctor" maximum density, except values of k and CBR which are for "modified Proctor" maximum density.
2. Typical strength characteristics are for effective strength envelopes and are obtained from USBR data.
3. Compression values are for vertical loading with complete lateral confinement.
4. (>) indicates that typical property is greater than the value shown.
5. "…." Indicates insufficient data available for an estimate.

Table 18-2: Typical Construction Performance based on Unified Soil Classification System

Class	Material description	Subgrade	Subbase	Base	Drainage when compacted	Compaction characteristics	Embankment material	Compressibility when compacted
GW	Well-graded gravel	Good to Excellent	Good	Fair to good	Excellent	Good	Reasonably stable	Low
GP	Poorly grade gravel (<5% fines)	Good to Excellent	Good	Fair to good	Excellent	Good	Reasonably stable	Low
GC	Clayey gravel (>12% fines)	Good	Fair	Poor to not suitable	Poor to practically impervious	Good to fair	Reasonably stable	Low
SP	Poorly graded sand (<5% fines)	Fair to good	Fair	Poor to not suitable	Excellent	Good	Reasonably stable	Low
SM	Silty sand (sand with fines PI<4)	Fair to good	Fair to good	Poor to not suitable	Fair to practically impervious to impervious	Good	Reasonably stable	Low
SC	Clayey sand (>12% fines PI>7)	Fair	Poor	Not suitable	Poor, impervious when compacted	Good to fair	Reasonably stable	Low
CL	Silts and clays (LL<50 & PI>7)	Fair to poor	Not suitable	Not suitable	Practically impervious	Good to fair	Good stability	Medium
ML	Silts and clays (LL<50 & PI<4)	Fair to poor	Not suitable	Not suitable	Semi-pervious to impervious	Good to poor	Poor stability	Medium
CH	Silts and clays (LL>50)	Poor to fair	Not suitable	Not suitable	Practically impervious	Fair to poor	Fair stability	Medium to high
MH	Silts and clays (LL>50)	Poor	Not suitable	Not suitable	Fair to poor, semi-pervious to pervious	Fair to poor	Poor stability	Medium to high
GW	Well-graded gravel	Good to Excellent	Good	Fair to good	Excellent	Good	Reasonably stable	Low
GP	Poorly grade gravel (<5% fines)	Good to Excellent	Good	Fair to good	Excellent	Good	Reasonably stable	Low

** To be used for planning and guideline purposes only. Refer to design-level reports for design input.*

Table 18-3: Shear Strength Parameters for Slow Draining Cohesive Materials (SAICE, 2010)

Consistency	Rule of thumb Field identification	Unconfined Compressive Strength (kN/m²)	UCS (kPa) (COP4)	UCS (kPa) (Terz & Peck)	Approximate SPT (N)
Very soft	Easily moulded by fingers. Full pick penetration.	< 40	< 35	<25	<2
Soft	Easily penetrated by with thumb. Moulded with strong pressure. 30 to 40mm penetration.	40 to 80	35 to 75	25 to 50	2 to 4
Firm	Indent by thumb with effort. Very difficult to mould with fingers. 10mm penetration.	80 to 160	75 to 150	50 to 100	4 to 8
Stiff	Penetration by thumb nail. Cannot be moulded with fingers. Geologist pick (sharp end) makes slight indentation when pushed.	160 to 320	150 to 300	100 to 200	8 to 15
Very stiff	Indentation by thumb nail difficult. Slight indentation with blow of geologist pick. Power tools required for excavation.	320 to 1000	> 300	200 to 400	15 to 50

Notes:
1. For guideline purposes only.

Table 18-4: Shear Strength Parameters for Quick Draining Non-Cohesive Materials (SAICE, 2010)

Consistency	Rule of thumb Field identification	Approximate CPT (MPa)	Approximate SPT (N)	Approximate ϕ`	Typical Dry Density (kg/m³)
Very loose	Crumbles very easily when scraped with geological pick.	0 to 2	0 to 5	26 to 28	< 1450
Loose	Small resistance to penetration by sharp end of geological pick.	2 to 4	5 to 10	28 to 30	1 450 to 1 600
Medium dense	Considerable resistance to penetration by sharp end of geological pick.	4 to 9	10 to 30	30 to 35	1 600 to 1 750
Dense	Very high resistance to penetration of sharp end of geological pick. Requires many blows of pick for excavation.	9 to 12.5	30 to 50	35 to 40	1 750 to 1 950
Very dense	High resistance to repeated blows of geological pick. Requires power tools for excavation.	< 12.5	> 50	40 to 50	> 1 950

Notes:
1. For guideline purposes only.

Table 18-5: Residential Site Class Designations (SAICE, 1995)

Typical Founding Material	Character of Founding Material	Expected Range of Total Soil Movements (mm)	Assumed Differential Movement (% of total)	Site Class
Rock (excluding mud rocks which exhibit swelling to some depth)	Stable	NEGLIGIBLE	-	R
Fine-grained soils with moderate to very high plasticity (clays, silty clays, clayey silts and sandy clays)	Expansive Soils	< 7,5 7,5 – 15 15 – 30 > 30	50% 50% 50% 50%	H H1 H2 H3
Silty sands, sands, sandy and gravelly soils	Compressible and Potentially Collapsible Soils	< 5,0 5,0 – 10 > 10	75% 75% 75%	C C1 C2
Fine-grained soils (clayey silts and clayey sands of low plasticity), sands, sandy and gravelly soils	Compressible Soils	< 10 10 – 20 > 20	50% 50% 50%	S S1 S2
Contaminated soils Controlled fill Dolomitic areas Land fill Marshy areas Mine waste fill Mining subsidence Reclaimed areas Very soft silt/silty clays Uncontrolled fill	Variable	Variable		P

Notes:

1. The classifications C, H, R and S are not intended for dolomitic area sites unless specific investigations are carried out to assess the stability (risk of sinkholes and doline formation) of the dolomites. Where this risk is found to be acceptable, the site shall be designated as Class P (dolomitic areas).
2. Site classes are based on the assumption that differential movements, experienced by single-storey residential buildings, expressed as a percentage of the total movements are equal to about 50% for soils that exhibit expansive or compressive characteristics and 75% for soils that exhibit both compressible and collapse characteristics. Where this assumption is incorrect or inappropriate, the total soil movements must be adjusted so that the resultant different movements implied by the table are equal to that which is expected in the field.
3. In some instances, it may be more appropriate to use a composite description to describe a site mote fully e.g. C1/H2 or S1 and/or H2. Composite Site Classes may lead to higher differential movements and result in design solutions appropriate to a higher range of differential movement e.g. a Class R/C1 site. Alternatively, a further site investigation may be necessary since the final design solution may depend on the location of the building on a particular site.
4. Where it is not possible to provide a single site designation and a composite description is inappropriate, sites may be given multiple descriptions to indicate the range of possible conditions e.g. H-H1-H2 or C1-C2.
5. Soft silts and clays usually exhibit high consolidation and low bearing characteristics. Structures founded on these horizons may experience high settlements and such sites should be designated as being Class S1 or S2 as relevant and appropriate.
6. Sites containing contaminated soils include those associated with reclaimed mine land, land down-slope of mine tailings and old land fills.
7. Where a site is designated as Class P, full particulars relating to the founding conditions on the site must be provided.
8. Where sites are designated as being Class P, the reason for such classification shall be placed in brackets immediately after the suffix – i.e. P(contaminated soils). Under certain circumstances, composite description may be more appropriate – e.g. P(dolomite areas)-C1.
9. Certain fills may contain contaminates which present a health risk. The nature of such fill should be evaluated and should be clearly demarcated as such.

Table 18-6: Foundation design, building procedures and precautionary measures for single-storey residential buildings founded on expansive soil horizons (SAICE, 1995)

Site Class	Estimated Total Heave	Construction Type	Foundation Design and Building Procedures
H	<7,5 mm	Normal	- Normal construction (strip footing or slab-on-the-ground foundations) - Good site drainage and service/plumbing precautions recommended.
H1	7,5 – 15 mm	Modified normal	- Lightly reinforced strip footings - Articulation joints at all internal/external doors - Light reinforcement in masonry - Site drainage and service/plumbing precautions
		Soil raft	- Remove in situ material to 1,0m beyond perimeter of the structure and replace with inert backfill, compacted to 93% MOD AASHTO density at –1% to +2% of optimum moisture content. - Normal construction with lightly reinforced strip footings and light reinforcement in masonry if residual movements are <7,5mm, or construction type appropriate to residual movements. - Site drainage and plumbing/service precautions.
H2	15-30 mm	Stiffened or cellular raft	- Stiffened or cellular raft with articulation joints or lightly reinforced masonry. - Site drainage and plumbing/service precautions.
		Piled construction	- Piled foundations with suspended floor slabs with or without ground beams. - Site drainage and plumbing/service precautions.
		Split construction	- Combination of reinforced brickwork/block work and full movement joints. - Suspended floors of fabric-reinforced ground slabs acting independently from the structure. - Site drainage and plumbing/service precautions.
		Soil raft	- As for H1.
H3	>30 mm	Stiffened or cellular raft	- As for H2.
		Piled construction	- As for H2.
		Soil raft	- As for H1.

Notes:

1. Differential movement assumed to equal 50% of total heave.
2. The relaxation of some of these requirements, e.g. the reduction or omission of steel or articulation joints, may result in a Category 2 level of expected damage.

Table 18-7: Foundation design, building procedures and precautionary measures for single-storey residential buildings founded on horizons subject to both consolidation and collapse settlement (SAICE, 1995)

Site Class	Estimated Total Settlement	Construction Type	Foundation Design and Building Procedures
C	<5 mm	Normal	- Normal construction (strip footing or slab-on-the-ground foundations) - Good site drainage
C1	5 – 10 mm	Modified normal	- Reinforced strip footings - Articulation joints at some internal and all external doors - Light reinforcement in masonry - Site drainage and service/plumbing precautions - Foundation pressure not to exceed 50 kPa
		Compaction of in situ soils below individual footings	- Remove in situ material below foundations to a depth and width of 1,5 times the foundation width or to a competent horizon and replace with material compacted to 93% MOD AASHTO density at –1% to +2% of optimum moisture content. - Normal construction with lightly reinforced strip foundations and light reinforcement in masonry.
		Deep strip foundations	- Normal construction with drainage requirements. - Founding on a competent horizon below the problem horizon
		Soil raft	- Remove in situ material to 1,0m beyond perimeter of building to a depth and width of 1,5 times the widest foundation or to a competent horizon and replace with material compacted to 93% MOD AASHTO density at –1% to +2% of optimum moisture content. - Normal construction with lightly reinforced strip footings and light reinforcement in masonry.
C2	>10 mm	Stiffened strip footings, stiffened or cellular raft	- Stiffened strip footing or stiffened or cellular raft with articulation joints or solid lightly reinforced masonry. - Bearing pressure not to exceed 50kPa. - Fabric reinforcement in floor slabs. - Site drainage and service/plumbing precautions.
		Deep strip foundations	- As for C1 but with fabric reinforcement in floor slabs
		Compaction of in situ soils below individual footings	- As for C1.
		Piled or pier foundations	- Reinforced concrete ground beams or solid slabs on piled or pier foundations. - Ground slabs with fabric reinforcement. - Good site drainage.
		Soil raft	- As for C1.

Notes:

1. Differential settlement assumed to equal 75% of total settlement
2. The relaxation of some of these requirements, e.g. the reduction or omission of steel or articulation joints, may result in a Category 2 level of expected damage.

Table 18-8: Foundation design, building procedures and precautionary measures for single-storey residential buildings founded on horizons subject to consolidation settlement (SAICE, 1995).

Site Class	Estimated Total Settlement	Construction Type	Foundation Design and Building Procedures
S	<10 mm	Normal	- Normal construction (strip footing or slab-on-the-ground foundations) - Good site drainage
S1	10-20 mm	Modified normal	- Reinforced strip footings - Articulation joints at some internal and all external doors - Light reinforcement in masonry - Site drainage and service/plumbing precautions - Foundation pressure not to exceed 50 kPa
		Compaction of in situ soils below individual footings	- Remove in situ material below foundations to a depth and width of 1,5 times the foundation width or to a competent horizon and replace with material compacted to 93% MOD AASHTO density at –1% to +2% of optimum moisture content. - Normal construction with lightly reinforced strip foundations and light reinforcement in masonry.
		Deep strip foundations	- Normal construction with drainage requirements. - Founding on a competent horizon below the problem horizon
		Soil raft	- Remove in situ material to 1,0m beyond perimeter of building to a depth and width of 1,5 times the widest foundation or to a competent horizon and replace with material compacted to 93% MOD AASHTO density at –1% to +2% of optimum moisture content. - Normal construction with lightly reinforced strip footings and light reinforcement in masonry.
S2	>20 mm	Stiffened strip footings, stiffened or cellular raft	- Stiffened strip footing or stiffened or cellular raft with articulation joints or solid lightly reinforced masonry. - Bearing pressure not to exceed 50kPa. - Fabric reinforcement in floor slabs. - Site drainage and service/plumbing precautions.
		Deep strip foundations	- As for S1 but with fabric reinforcement in floor slabs
		Compaction of in-situ soils below individual footings	- As for S1.
		Piled or pier foundations	- Reinforced concrete ground beams or solid slabs on piled or pier foundations. - Ground slabs with fabric reinforcement. - Good site drainage.
		Soil raft	- As for S1.

Notes:

1. Differential settlement assumed to equal 50% of total settlement.
2. The relaxation of some of these requirements, e.g. the reduction or omission of steel or articulation joints, may result in a Category 2 level of expected damage.
3. Account must be taken on sloping site since differential fill heights may lead to greater differential settlements.
4. Settlements induced by loads imposed by deep filling beneath surface beds may necessitate the adoption of a construction type appropriate to a more severe site class.

Table 18-9: Geotechnical Constraints in Urban Development (SANS634, 2012)

Constraint		Descriptor		
Letter	**Description**	**1 (most favourable)**	**2 (intermediate)**	**3 (least favourable)**
A	Collapsible soil	Any collapsible horizon or consecutive horizons totalling a depth of less than 750 mm in thickness[a]	Any collapsible horizon or consecutive horizons with a depth of more than 750 mm in thickness	A least favourable situation for this constraint does not occur
B	Seepage	Permanent or perched water table more than 1,5 m below ground below	Permanent or perched water table less than 1,5 m ground surface	Swamps and marshes
C	Active soil	Low soil-heave potential anticipated[a]	Moderate soil-heave potential anticipated	High soil-heave potential anticipated
D	Highly compressible soil	Low soil compressibility anticipated[a]	Moderate soil compressibility anticipated	High soil compressibility anticipated
E	Erodability of soil	Low	Intermediate	High
F	Difficulty of excavation to 1,5 m depth	Scattered or occasional boulders less than 10 % of the total volume[a]	Rock or hardpan pedocretes between 10 % and 40 % of the total volume	Rock or hardpan pedocretes more than 40 % of the total volume
G	Undermined ground	Undermining at a depth greater than 200 m below surface (except where total extraction mining has not occurred)	Old undermined areas to a depth of 200 m below surface where stope closure has ceased	Mining within less than 200 m of surface or where total extraction mining has taken place
H	Stability (dolomite land)	Possibly stable. Areas of dolomite overlain by Karoo rocks or intruded by sills. Areas of Black Reef rocks. Anticipated inherent hazard class 1 (see SANS 1936-2)	Potentially characterized by instability. Anticipated inherent classes 2 to 5 (see SANS 1936-2)	Known sinkholes and dolines. Anticipated inherent hazard classes 6 to 8 (see SANS 1936-2)
I	Steep slopes	Between 2° and 6° (all regions)	Slopes between 6° and 18° and less than 2° (Natal and Western Cape) Slopes between 6° and 12°and less than 2° (all other regions)	More than 18° (Natal and Western Cape) More than 12° (all other regions)
J	Areas of unstable natural slopes	Low risk	Intermediate risk	High risk (especially in areas subject to seismic activity)
K	Areas subject to seismic activity	10 % probability of an event less than 100 cm/s² within 50 years	Mining-induced seismic activity more than 100 cm/s²	Natural seismic activity more than 100 cm/s²
L	Areas subject to flooding	A "most favourable" situation for this constraint does not occur	Areas adjacent to a known drainage channel or floodplain with slope less than 1 %	Areas within a known drainage channel or floodplain

Note 1: Areas should be designated by the numeral associated with the most appropriate descriptor in columns 3 to 5 followed by the letter associated with the constraint. For example, an area designated as Zone 2BF would be an intermediate class with anticipated seepage and excavation problems while an area designated as Zone 3B would be least favourable and not recommended for development due to surface water inundation.

Note 2: More detailed information on undermined land can be obtained from Stacey, T.R. and Bakker, D. The erection or construction of buildings and other structures on undermined ground. NOTE 3 Undermining assessments should be carried out by persons with expert knowledge of such conditions.

[a] *These areas are designated as 1A, 1C, 1D, or 1F where localized occurrences of the constraint might arise.*

Table 18-10: Classification of Rock and Soil Strengths (ISRM, 1981b)

Grade	Description	Field identification	Approx. range of uniaxial compressive strength (MPa)
R6	Extremely strong rock	Specimen can only be chipped with geological hammer. UCS testing required.	>250
R5	Very strong rock	Specimen requires many blows of geological hammer to fracture it. UCS testing required.	100-250
R4	Strong rock	Specimen requires more than one blow of geological hammer to fracture it. UCS testing required.	50-100
R3	Medium strong rock	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer.	25-50
R2	Weak rock	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer.	5.0-25
R1	Very weak rock	Crumbles under firm blows with point of geological hammer and can be peeled by a pocket knife.	1.0-5.0
R0	Extremely weak rock	Indented by thumbnail.	0.25-1.0
S6	Hard clay	Indented with difficulty by thumbnail.	>0.5
S5	Very stiff clay	Readily indented by thumbnail.	0.25-0.50
S4	Stiff clay	Readily indented by thumb nail but penetrated only with great difficulty.	0.1-0.25
S3	Firm clay	Can be penetrated several inches by thumb with moderate effort.	0.05-0.1
S2	Soft clay	Easily penetrated several inches by thumb.	0.025-0.05
S1	Very soft clay	Easily penetrated several inches by fist.	<0.025

Notes:

2. Discontinuity wall strength will generally be characterized by grades R0-R6 (rock). Some rounding of strength values has been made when converting to SI units (ISRM, 1981b).

Table 18-11: Presumed Safe Bearing Capacity on Supporting Ground for Central Vertical Static Loads* on the Foundation (SABS0161-1980-(Amdt.1986))

Supporting Ground		Description of Rocks, Soils and Fills	Presumed Safe Bearing Capacity+ (kN/m²)	
Type	Class		Dry ‡	Submerged‡
Rocks	1	Fresh rock, massively bedded, intact (igneous, metamorphic, or sedimentary) and requiring blasting for excavation.	5 000	5 000
	2	Fresh rock, fractured or jointed, which can be excavated with difficulty by pneumatic picks, but which normally requires light blasting.	1 000	1 000
	§//3	Shale, of hard rock consistency.	200 – 400	200 – 400
	4	Decomposed rock, to be assessed as a soil as below.	--	--
Non-Cohesive Soils	5	Compact, well graded gravels, very dense silty sand, sands, gravel-sand mixtures.	400 – 600	200 – 300
	6	Compact but poorly graded gravels, gravel-sand, dense sands, silty sands, sandy silt, silt mixtures.	200 – 400	100 – 200
	**)7	Medium dense sands, silty sands, sandy silts, and silts, clayey sands, clayey silts.	100 – 150	50 – 75
	**)8	Loose and very loose sand, silty sands, sandy silts, clayey sands, clayey silts.	By test only	By test only
Cemented Soils	++9	Cemented gravel, hard "ouklip" (ferricrete), hard calcrete, and hard silcrete.	400 – 600	400 – 600
	**10	Weakly cemented soils of medium and low (loose) density.	100 – 150	By test only
Cohesive Soils	//11	Very stiff sandy or silty clays.	400 – 500	300 – 400
	//12	Stiff clays, sandy clays, silty clays.	200 – 400	150 – 200
	//)13	Firm clays, sandy clays, silty clays.	100 – 200	75 – 150
	)14	Soft clays, sandy clays, silty clays.	50 – 100	50 – 100
	)15	Very soft sandy or silty clays.	0 – 50	0 – 50
Compacted Selected Fill	16	Compacted fill or selected material.	By test only	By test only
Random Fill	17	Made-up ground, waste dumps, and other uncompacted fills.	By test only	--

Notes:

* Most foundation loads in buildings are applied vertically to the centre of the foundation. However, where the load is applied eccentrically or inclined from the vertical or both, the safe bearing capacity will require modification.

** The presumed safe bearing capacities should be taken at a depth of not less than 600 mm below the top of natural supporting ground.

‡

a) The bearing capacity of non-cohesive soils in particular, is greatly influenced by the effective density of the soil. Thus, when a soil occurs above the water-table, the full density will act, but when the soil occurs below the water-table, only the submerged density will be effective.

b) The soil zone that provides the bearing capacity extends to a depth of twice the least dimension (breadth) of the foundation below the base of the footing and, therefore, if the water-table is at a level at least twice the least dimension of the footing below the base of the footing, the value of safe bearing capacity given under the heading "Dry" in Column 4 may be used.

c) The fully submerged case occurs when the water-table is at the base of the footing or above, in which case the value of safe bearing capacity given under the heading "Submerged" in Column 5 may be used.

d) When the water-table is between the base of the footing and twice the least dimension of the footing below the base of the footing, the foundation is partially submerged and an intermediate value of the safe bearing capacity between those appearing under the headings "Dry" and "Submerged" in Columns 4 and 5 may be used.

§ Bedding planes can affect the stability of excavations in shales of this class.

// **Heaving may be a problem with shales or clays of this class.**

** Beware of collapse settlement on inundation of soils of this class.

) Appreciable settlement may be expected on soils of this class.

++ If not underlain by any softer layer.