Agreenco

NKOMATI JOINT VENTURE:
GEOTECHNICAL ASSESSMENT REPORT FOR
WATER TREATMENT PLANT AREA

Prepared for: Nkomati Joint Venture

Prepared by: Beal Africa

Date: May 2024

NKOMATI
We Care We Grow We Excel

BEAL
AFRICA

PROJECT INFORMATION

Project title	Geotechnical Assessment for Water Treatment Plant
Client	Nkomati Joint Venture
Contact person	Talent Nzuza Email address: Talent.Nzuza@nkomati.co.za Tswelopele Pida Email address: Tswelopele.Pida@Nkomati.co.za
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Document reviewed and approved by:	Willie du Plessis - PrEng
Submission date:	Final: May 2024

DECLARATION OF INPENDENCE AND QUALITY

This report is free from any external prejudice or influence and provides an accurate geotechnical assessment for the proposed water treatment plant. All the work herein has been conducted by Agreenco Environmental Projects (Pty) Ltd (Agreenco) and Beal Africa.

TERMS OF REFERENCE

Agreenco was requested to assist Nkomati Joint Venture with the geotechnical assessment for the water treatment plant in accordance with the relevant legislative requirements.

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LIST OF FIGURES

1 BACKGROUND INFROMATION

1.1 Introduction

This shallow surface geotechnical assessment report presents the findings and recommendations of the site investigation conducted on the designated area for the planned Water Treatment Plant area at Nkomati Nickel Mine in the Mpumalanga Province, South Africa.

1.2 Terms of reference

The purpose of this investigation was to assess the geological and geotechnical conditions to provide essential information for the planning and design of a proposed water treatment plant. This report outlines the scope of the investigation, methodology employed, and the key findings and recommendations.

1.3 Information sources

The investigation primarily relied on information from the following sources:

- Regional geological information:

  Council for Geoscience (CGS). 1986. 1:250 000 scale; 2530 Barberton geological map. (Map).

- Topographical map:

  1 :50 000 scale ; 2530DC Badplaas cadastral map (Digital image)

- Remote sensing information:

  Google Earth™ imagery (Digital images).

- Existing reports:

Detailed geotechnical investigation for the Nico Joint Venture at Slaaihoek for Anglovaal Limited, Report No 95/57/1, Part A and B, July 1994.

Excerpts of the draft geochemical model of the Waste Rock Dump of the Nkomati Mine expansion project, November 2013.

2 SITE DESCRIPTION

The project area is located south of the existing open pit.

The project area is mainly characterised by a very gentle slope mainly towards the south as a result of cut and / or fill operations.

Surface drainage is expected to be mainly by means of sheetwash, albeit with localised ponding expected during and for a short period after precipitation events if not drained adequately.

The Climatic N-value (Weinert, 1980) is less than 5, indicating semi-humid conditions where chemical alteration and breakdown of mineral constituents favouring soil formation, rather than mechanical disintegration that gives rise to mainly rock fragments occurring in a soil matrix, dominates.

The location of the project area is presented in Figure 1 below.

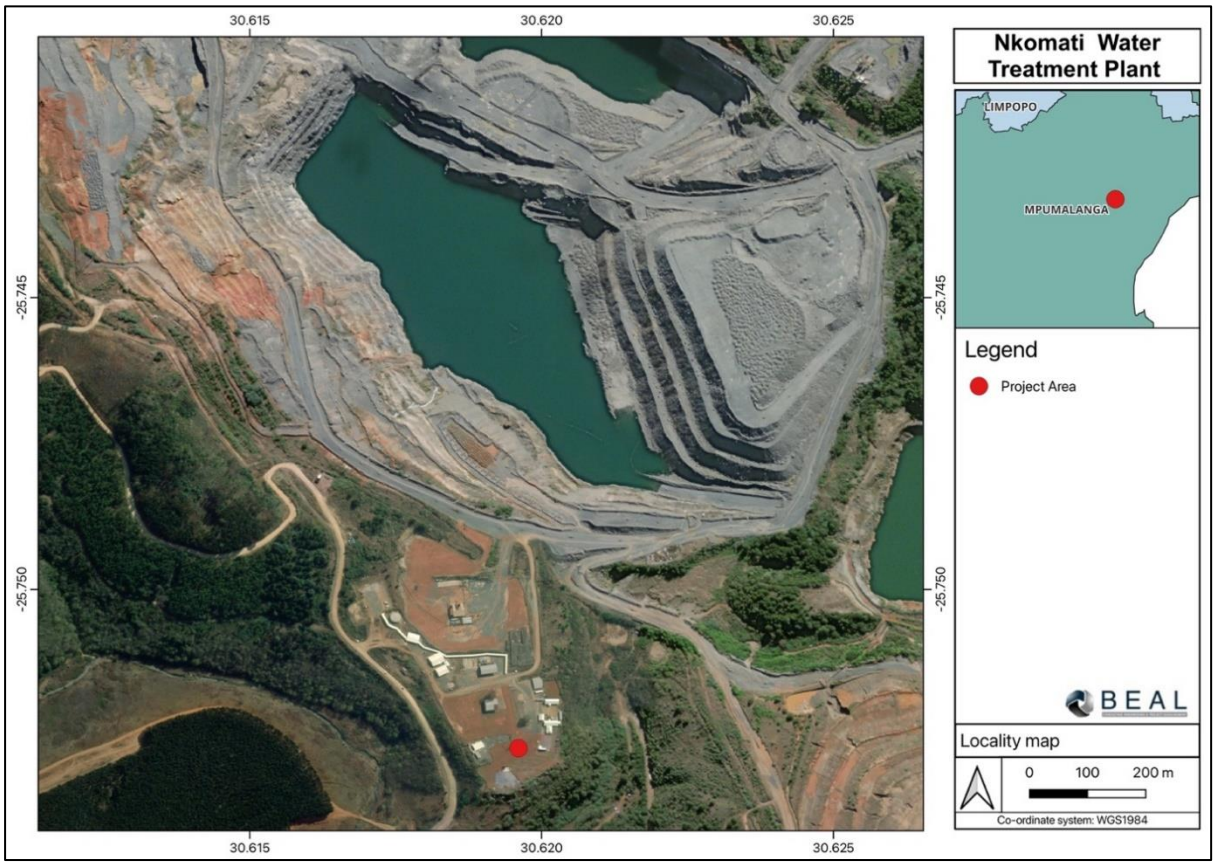


Figure 1: Map of WTP location

3 SITE GEOLOGY AND GEOHYDROLOGY

The general geological and soil conditions are discussed in this section of the report.

Stratigraphy

According to the published geological map, the project area is located on or near a geological contact.

The project area is typically underlaid by:

- Compact, poorly bedded dolomite and limestone with chert layers, transition zone of shale and thin interlayered quartzite and dolomite at base.
- Quartzite with pebble layers in places.
- Adjacent pyroxenite, chromitite, peridotite and gabbro to be noted.

The soil profiles in test pits confirmed complex and variable sub-surface geological conditions.

A map of the regional geological setting is presented in Figure 1: Map of WTP location.

Dolomite land

The WTF is underlaid by water-soluble strata as defined by SANS 1936 (2012) and, as such, classifies as dolomite land. Figure 3 is included as reference.

Structural geology

The available published information indicates the presence of several linear structures, deemed to represent dolerite dykes and sills.

Geohydrology

Perched groundwater conditions were not encountered. The deeper aquifer was not assessed as part of this phase of the investigation.

The potential acidic nature of the groundwater should be noted, especially in combination and interaction with dolomite, that may lead to dissolution, karstification and subsidence.

Mineral deposits and undermining

The project area is located in the direct vicinity of open pit and underground mining activities and may be at risk of adverse effects associated with mining and undermining.

Regional seismicity

With regards to the regional seismicity, the ground conditions are deemed to be classified as Ground Type 1 and 2. According to SANS 10160, the project area falls in Seismic Zone I with a potential for

only natural seismic activity. However, it is noted that the project area is also potentially at risk of mining-induced seismic events.

The proposed structure to be established is deemed to classify as Importance Class II with an Importance Factor of 1,0 but may also be classified as Class IV with an Importance Factor of 1,4.

Drainage

The project area drains mainly towards non-perennial and perennial streams towards the west, south and east.

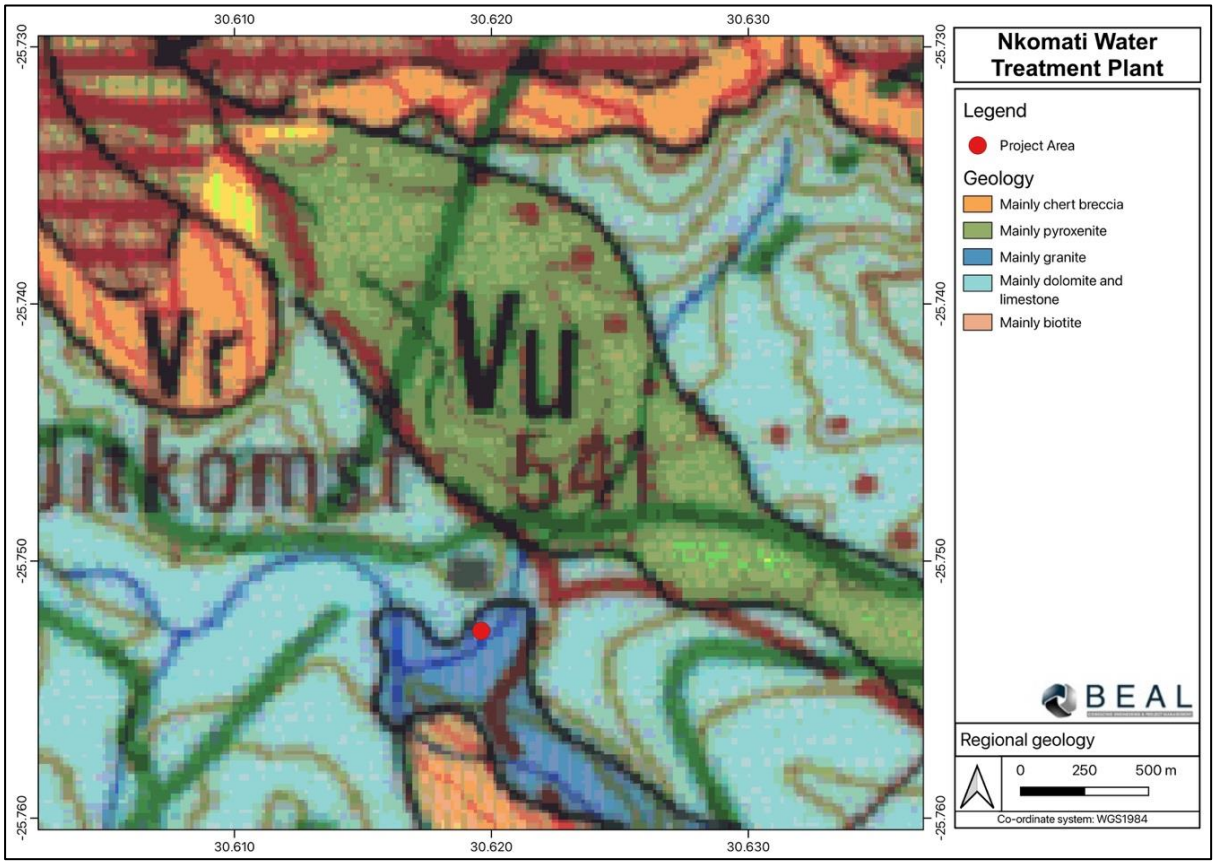


Figure 2: Regional geological.

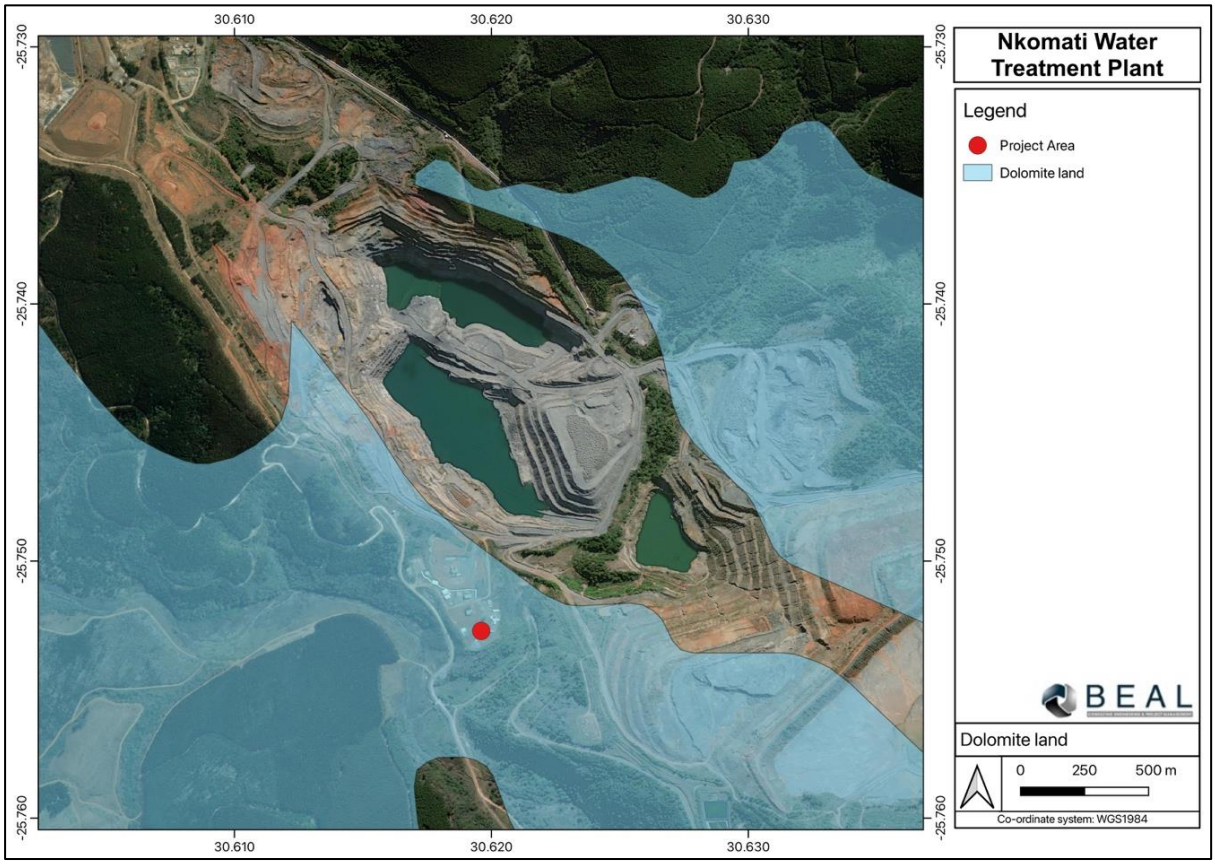


Figure 3: Dolomite land.

4 SITE INVESTIGATION

The site investigation comprises of the excavation of test pits.

4.1 Test pits

Six test pits were excavated and profiled within the proposed footprint of the WTF.

The location of test pits is presented in Figure 4, and detail profile logs are included as Appendix A, and test pit photos in Appendix B.

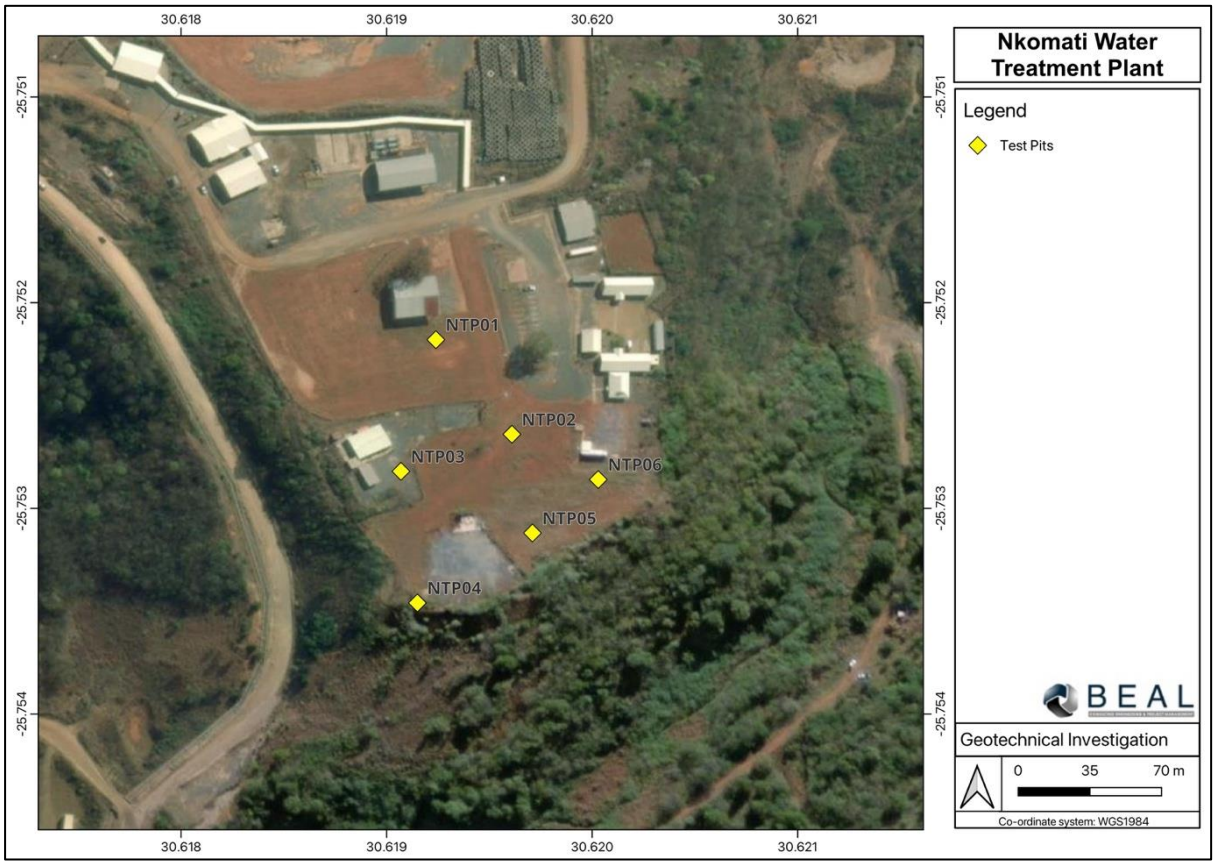


Figure 4: Geotechnical investigation.

4.2 Material sampling

A selection of disturbed and bulk disturbed samples was retrieved from test pits and are submitted to Stratalab in Klerksdorp for testing and identification.

The following tests were undertaken:

- Foundation Indicators.
- Mod AASHTO & CBR, and
- Basson's Index.

Test results are included in Appendix C.

5 ENGINEERING AND MATERIAL CHARACTERISTICS

Generalised soil profile

The entire proposed plant area is characterized by significant historical earthworks. These include cut and fill as well as end-tipping and bulldozing. No evidence of an engineered or suitably compacted fill was observed. The source of fill material is unknown but may be inclusive of mining related rock dump or waste. The fill material typically extends to a depth of between 0,3 and 2,0 m, except for NTP 04 on the southern perimeter, where it is expected to be more than 3,3 m.

The residual soil profile below the fill material is variable. The excavation of trenches was mostly terminated near refusal on highly weathered rock (i.e., dolomite and chert, dolerite, or gabbro at a depth of between 1,3 and 2,9 m. No refusal on rock was encountered in NTP 04 and 05 on the southern perimeter of the project area.

Expansiveness

The completely weathered shale is deemed to be moderately expansive and the residual dolerite moderately to highly expansive. This results in an expected soil movement of between 15 and in excess of 25 mm for the relevant soil horizons within the project area, depending on the thickness of the horizon and depth below surface.

Collapsibility

The material tested is not deemed to be potentially collapsible.

Compressibility

The entire soil-like overburden is deemed to be slightly to moderately compressible. The result is an expected range of total soil movement of between 15 and in excess of 150 mm, depending on the foundation load and extent.

Slope stability

Due to the near level terrain, instability of natural slopes is not expected. Slumping and/or toppling may occur within trenches, especially during or after rainfall events. The potential fill area along the perimeter of the project area is deemed to be susceptible to slope failure.

Dispersivity

No evidence of potentially dispersive material (e.g., a weakly to strongly developed prismatic soil structure), considered highly prone to erosion especially under the influence of gully or sheetwash, was observed in the test pits or at surface.

Erodibility

The near level slope in the area is not conducive to erosion. The far outer perimeter of the project area along the steep slope of the fill embankment is susceptible to erosion.

Excavatability

Excavatability is in general not deemed to be a problem with soft excavation possible to a depth of between 1,3 and 3,3 m with an average of 2,4 m. The fill material of the embankment on the outer perimeter of the project area did not show signs of refusal within 3,3 m.

Groundwater seepage

No groundwater seepage was encountered.

Corrosiveness

The material tested proved to be potentially highly corrosive and aggressive.

Bearing capacity

The typical bearing capacity of the soil-like overburden can vary depending on several factors, including the specific properties of the soil or rock, degree of weathering, the presence of any structural defects or discontinuities, level of the groundwater, etc. With the varying soil profile encountered within the project area, bearing capacity assumptions cannot be made to any degree of accuracy.

Conclusion

In summary, the subsurface materials are inferred to exhibit the following main adverse geotechnical characteristics:

- Dolomite land.
- Mining induced seismicity.
- Slope instability.
- Slightly to highly expansive.
- Slightly to moderately compressible.
- Highly corrosive.
- Varying bearing capacity.
- Potentially complicated groundwater-surface water interaction with dolomite and subsequent dissolution, karstification and overburden subsidence or instability.

6 GEOTECHNICAL SITE CLASSIFICATION

The results of the investigation revealed the following geotechnical constraints.

The primary constraints are:

- Dolomite land.
- Slope instability.
- Slightly to highly expansive (movement between 15 and in excess of 25 mm).
- Slightly to moderately compressible (movement of between 15 and in excess of 150 mm).
- Variable unknown bearing capacity.

The secondary constraints are:

- Mining induced seismicity.
- Highly corrosive and aggressive.
- Unknown source of fill material.
- Potentially complicated groundwater-surface water interaction with dolomite and subsequent dissolution, karstification and overburden subsidence or instability.

7 CONSTRUCTION SOLUTIONS

7.1 Foundations

Founding of intricate or heavy load bearing structures is not recommended within the soil-like overburden without a carefully designed solution.

Provision should be made in the design and construction for the variable and potentially limited bearing capacity of the entire soil-like overburden.

Structures should take cognisance of the heave and settlement characteristics of the soil-like overburden material, especially differential movement, and the varying nature of the different soil horizons.

Inferred high corrosivity and aggressivity of the soil moisture within the soil-like overburden with regard to steel and concrete should be considered during design and construction.

The design of structures should take cognizance of the potential loss of support due to the formation of subsidences and/or sinkholes in dolomite.

The extent and stability of the fill embankment on the outer perimeter of the project area should inform the design of foundations.

Structural designs should take cognizance of the potential mining induced seismicity within the project area.

7.2 Earth works

The soil-like overburden is deemed unsuitable for use as fill in its natural state. Although the material tested as G7 and G8 (TRH 14), the corrosiveness and aggressiveness of the material tested high to very high. The extent of the different fill material horizons is variable. The in-situ soil-like material is not deemed suitable as founding or construction material in its natural state.

Material should be sourced commercially.

7.3 Drainage

Proper site drainage is essential to prevent seasonal ponding of surface water and large-scale changes in soil moisture beneath and near the structure.

Incorporation of suitable damp-proofing measures within the foundation is essential to protect against the effects of rising damp.

8 GENERAL CONCLUSIONS AND RECOMMENDATIONS

Although the project area exhibits geotechnical characteristics deemed to have an adverse effect on the proposed development, these characteristics do not disqualify the site from being used, but rather require the strict implementation of site-specific precautionary measures with regard to design and construction.

The following recommendations are given below:

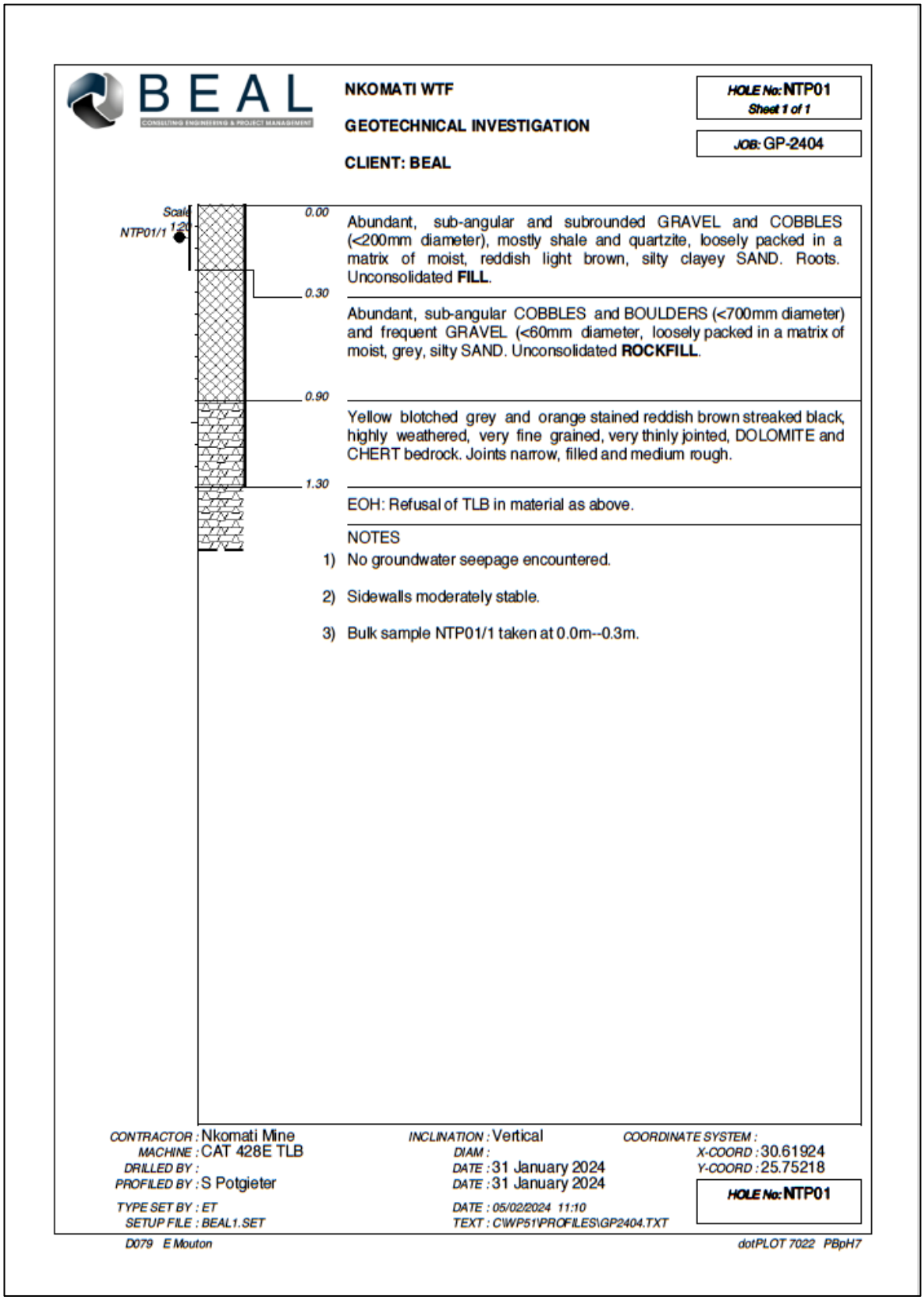
- The extent of and depth to competent bedrock should be determined. A MASW geophysical survey should be considered.
- The extent of the fill embankment and slope stability along the perimeter of the project area should be confirmed or defined, depending on the layout and load of the proposed WTP.
- The source and extent of fill material should be confirmed, especially with regards to waste and potentially hazardous waste products and legislation.
- A dolomite stability investigation should be conducted in order to determine the inherent hazard of the dolomite and subsequent potential loss of support, especially due to the acid groundwater-surface water-dolomite interaction over time. This study should include a micro-gravity survey and the drilling of at least 3 to 4 boreholes as a first phase.
- Detailed relevant geotechnical footprint investigations beneath proposed structures should be conducted as and where deemed necessary.

The observations and recommendations contained in this report are based on the assumption that geological conditions will not vary drastically from those encountered during the investigation. Although every effort has been made to ensure the accuracy of the information contained in this report, the results of the investigation are based upon field work and laboratory testing only. Localized soil conditions at variance to those described in the report is expected and will most likely be encountered.

A competent person should inspect excavations and/or operations during construction in order to verify that the materials exposed are not at variance with those described in the report.

9 APPENDIXES

APPENDIX A: DRAFT TEST PIT LOGS



BEAL
CONSULTING ENGINEERING & PROJECT MANAGEMENT

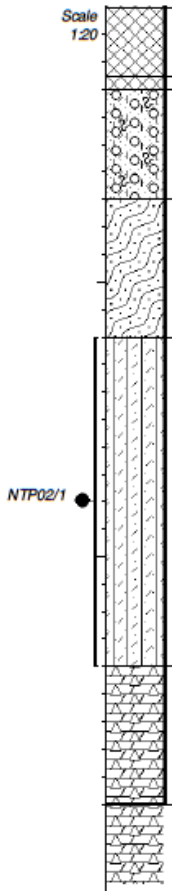
NKOMATI WTF

GEOTECHNICAL INVESTIGATION

CLIENT: BEAL

HOLE No: **NTP02**
Sheet 1 of 1

JOB: GP-2404



0.00 — Abundant, sub-angular and subrounded GRAVEL and COBBLES (<200mm diameter), mostly shale and quartzite, loosely packed in a matrix of moist, reddish light brown, silty clayey SAND. Roots. Unconsolidated **FILL**.

0.25 — Abundant, subrounded dolomite GRAVEL (<30mm diameter), densely packed in a matrix of moist, grey, silty SAND. Crushed stone **FILL**.

0.30 — Moist, reddish brown, firm, intact, clayey silty SAND, with frequent sub-angular GRAVEL (<60mm diameter) with depth. Roots. **COLLUVIUM**.

0.70 — Grey reddish brown, black and yellow bands, highly weathered, medium grained, moderately jointed, very soft QUARTZITE bedrock. Joints wide, filled and rough.

1.20 — Very moist, yellow blotched orange speckled black, firm, intact, sandy clayey SILT. Completely weathered **SHALE**, interlayered with below.

2.40 — Light and dark grey bands stained yellow and red, highly weathered, very fine grained, thinly jointed, very soft to soft DOLOMITE and CHERT bedrock. Joints wide, filled and rough.

2.90 — EOH: Refusal of TLB in material as above.

NOTES

1) No groundwater seepage encountered.
2) Sidewalls moderately stable.
3) Disturbed sample NTP02/1 taken at 1.2m--2.4m.

CONTRACTOR : Nkomati Mine
MACHINE : CAT 428E TLB
DRILLED BY :
PROFILED BY : S Potgieter
TYPE SET BY : ET
SETUP FILE : BEAL1.SET

INCLINATION : Vertical
DIAM :
DATE : 31 January 2024
DATE : 31 January 2024
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X-COORD : 30.61061
Y-COORD : 25.75264

HOLE No: **NTP02**

D079 E Mouton

dotPLOT 7022 PBpH7

BEAL
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NKOMATI WTF

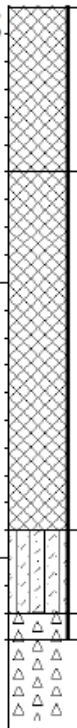
GEOTECHNICAL INVESTIGATION

CLIENT: BEAL

HOLE No: NTP03
Sheet 1 of 1

JOB: GP-2404

Scale 1:20



0.00	Abundant, subrounded dolomite GRAVEL (<30mm diameter), densely packed in a matrix of moist, grey, silty SAND. Crushed stone **FILL**.
0.60	Frequent, sub-angular and subrounded GRAVEL and COBBLES (<200mm diameter), interlayered with clayey silty SAND. Roots. Unconsolidated **FILL**.
1.90	Very moist, yellow blotched orange speckled black, firm, intact, sandy clayey SILT. Completely weathered **SHALE**, interlayered with below.
2.20	Yellow blotched grey and orange stained reddish brown streaked black, highly weathered, very fine grained, very thinly jointed, DOLOMITED and CHERT bedrock. Joints narrow, filled and medium rough.
2.30	EOH: Refusal of TLB in material as above.

NOTES

1) No groundwater seepage encountered.

2) Sidewalls moderately stable.

CONTRACTOR : Nkomati Mine
MACHINE : CAT 428E TLB
DRILLED BY :
PROFILED BY : S Potgieter
TYPE SET BY : ET
SETUP FILE : BEAL1.SET

INCLINATION : Vertical
DIAM :
DATE : 31 January 2024
DATE : 31 January 2024
DATE : 05/02/2024 11:10
TEXT : C\WP51\PROFILES\GP2404.TXT

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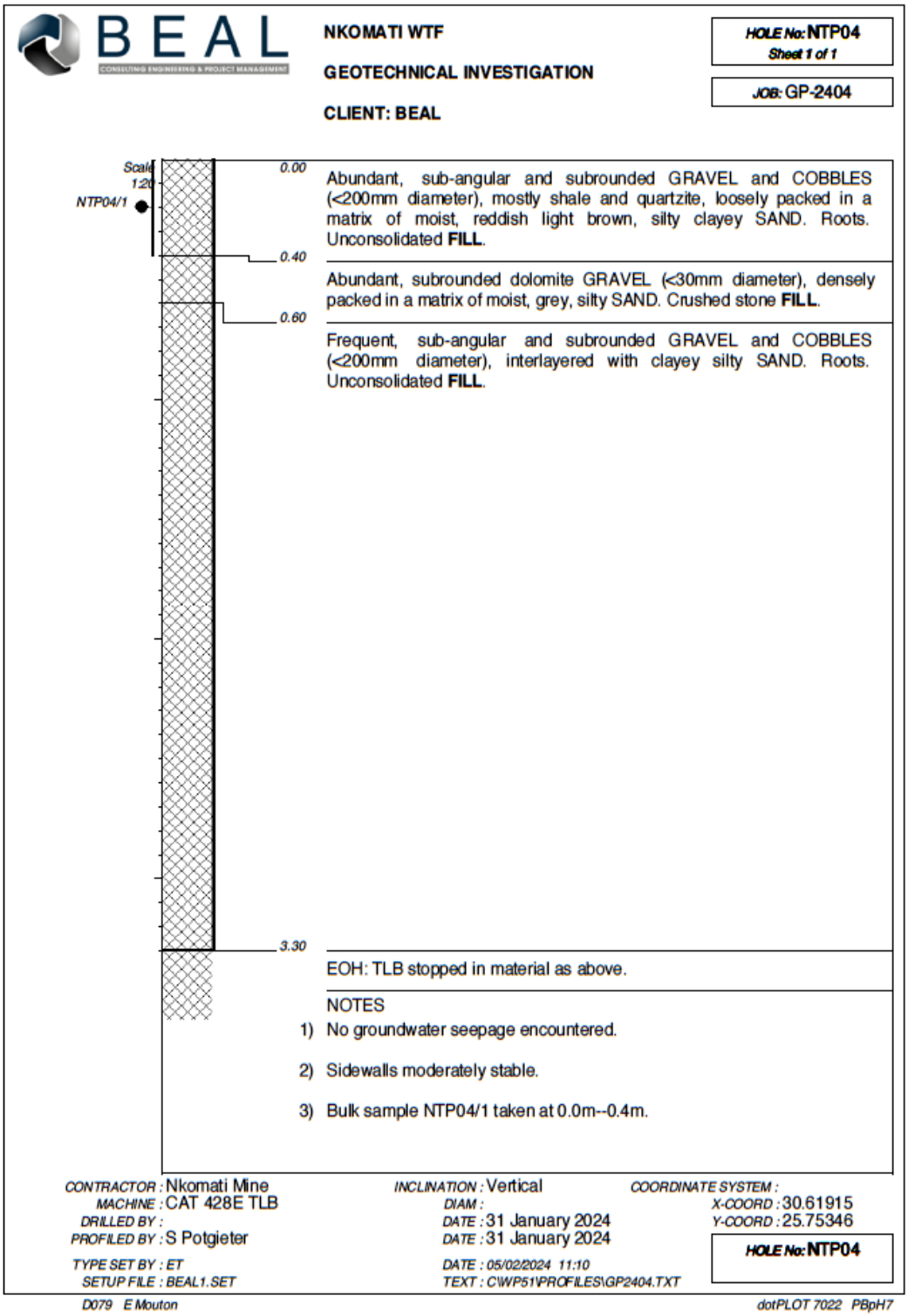
Y-COORD : 25.75282

HOLE No: NTP03

D079 E Mouton

dotPLOT 7022 PBpH7


BEAL
CONSULTING ENGINEERING & PROJECT MANAGEMENT
NKOMATI WTF
GEOTECHNICAL INVESTIGATION
CLIENT: BEAL
HOLE No: NTP04
Sheet 1 of 1
JOB: GP-2404
Scale 1:20
NTP04/1
0.00
Abundant, sub-angular and subrounded GRAVEL and COBBLES (<200mm diameter), mostly shale and quartzite, loosely packed in a matrix of moist, reddish light brown, silty clayey SAND. Roots. Unconsolidated FILL.
0.40
Abundant, subrounded dolomite GRAVEL (<30mm diameter), densely packed in a matrix of moist, grey, silty SAND. Crushed stone FILL.
0.60
Frequent, sub-angular and subrounded GRAVEL and COBBLES (<200mm diameter), interlayered with clayey silty SAND. Roots. Unconsolidated FILL.
3.30
EOH: TLB stopped in material as above.
NOTES
1) No groundwater seepage encountered.
2) Sidewalls moderately stable.
3) Bulk sample NTP04/1 taken at 0.0m--0.4m.
CONTRACTOR : Nkomati Mine
MACHINE : CAT 428E TLB
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PROFILED BY : S Potgieter
TYPE SET BY : ET
SETUP FILE : BEAL1.SET
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Y-COORD : 25.75346
HOLE No: NTP04
D079 E Mouton
dotPLOT 7022 PBpH7

BEAL
CONSULTING ENGINEERING & PROJECT MANAGEMENT

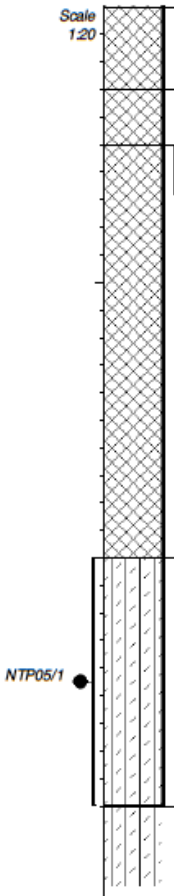
NKOMATI WTF

GEOTECHNICAL INVESTIGATION

CLIENT: BEAL

HOLE No: NTP05
Sheet 1 of 1

JOB: GP-2404



0.00 – 0.30: Abundant, sub-angular and subrounded GRAVEL and COBBLES (<200mm diameter), mostly shale and quartzite, loosely packed in a matrix of moist, reddish light brown, silty clayey SAND. Roots. Unconsolidated **FILL**.

0.30 – 0.50: Abundant, subrounded dolomite GRAVEL (<30mm diameter), densely packed in a matrix of moist, grey, silty SAND. Crushed stone **FILL**.

0.50 – 2.00: Frequent, sub-angular and subrounded GRAVEL and COBBLES (<200mm diameter), interlayered with clayey silty SAND. Roots. Unconsolidated **FILL**.

2.00 – 2.90: Moist, reddish brown, soft, intact, clayey SILT, with occasional sub-angular gravel and cobbles (<200mm diameter). RESIDUAL DOLERITE.

NTP05/1

2.90: EOH: TLB stopped in material as above.

NOTES

1) No groundwater seepage encountered.
2) Sidewalls moderately stable.
3) Disturbed sample NTP05/1 taken at 2.0m--2.9m.

CONTRACTOR : Nkomati Mine
MACHINE : CAT 428E TLB
DRILLED BY :
PROFILED BY : S Potgieter
TYPE SET BY : ET
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INCLINATION : Vertical
DIAM :
DATE : 31 January 2024
DATE : 31 January 2024
DATE : 05/02/2024 11:10
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COORDINATE SYSTEM :
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Y-COORD : 25.75312

HOLE No: NTP05

D079 E Mouton

dotPLOT 7022 PBpH7

BEAL
CONSULTING ENGINEERING & PROJECT MANAGEMENT

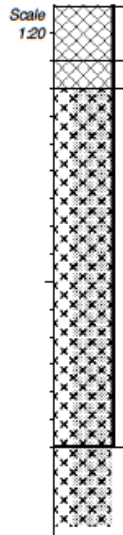
NKOMATI WTF

GEOTECHNICAL INVESTIGATION

CLIENT: BEAL

HOLE No: NTP06
Sheet 1 of 1

JOB: GP-2404



Abundant, subrounded dolomite GRAVEL (<30mm diameter), densely packed in a matrix of moist, grey, silty SAND. Crushed stone **FILL**.

Frequent, sub-angular and subrounded GRAVEL and COBBLES (<200mm diameter), interlayered with clayey silty SAND. Roots. Unconsolidated **FILL**.

Moist, reddish brown becoming yellowish brown speckled black with depth, with core stones of pale yellow, speckled black stained red, highly to completely weathered, medium grained, very soft rock DOLERITE bedrock.

EOH: Refusal of TLB in material as above.

NOTES

1) No groundwater seepage encountered.

2) Sidewalls moderately stable.

CONTRACTOR : Nkomati Mine
MACHINE : CAT 428E TLB
DRILLED BY :
PROFILED BY : S Potgieter
TYPE SET BY : ET
SETUP FILE : BEAL1.SET

INCLINATION : Vertical
DIAM :
DATE : 31 January 2024
DATE : 31 January 2024
DATE : 05/02/2024 11:10
TEXT : C\WP51\PROFILES\GP2404.TXT

COORDINATE SYSTEM :
X-COORD : 30.62003
Y-COORD : 25.75286

HOLE No: NTP06

D079 E Mouton

dotPLOT 7022 PBpH7

BEAL
CONSULTING ENGINEERING & PROJECT MANAGEMENT

NKOMATI WTF

GEOTECHNICAL INVESTIGATION

CLIENT: BEAL

HOLE No: NTP07
Sheet 1 of 1

JOB: GP-2404

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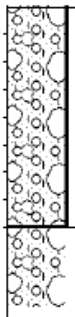

0.00 Abundant, sub-angular and subrounded GRAVEL and COBBLES of various type, moderately densely packed in a matrix of moist, brown, silty SAND. **COLLUVIUM**.

0.80 EOH: Refusal of TLB in material in bedrock or boulders.

NOTES

1) No groundwater seepage encountered.

2) Sidewalls stable.

CONTRACTOR : Nkomati Mine
MACHINE : CAT 428E TLB
DRILLED BY :
PROFILED BY : S Potgieter
TYPE SET BY : ET
SETUP FILE : BEAL1.SET

INCLINATION : Vertical
DIAM :
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DATE : 31 January 2024
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COORDINATE SYSTEM :
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Y-COORD : 25.75146

HOLE No: NTP07

D079 E Mouton

dotPLOT 7022 PBpH7

APPENDIX B: TEST PIT PHOTOS


NTP 02


NTP 03


NTP 04


NTP 05


NTP 06


NTP 07

APPENDIX C: LABORATORY TEST RESULTS

STRATALAB

MATERIALS LABORATORY

IVOR STREET 4, WILKOPPIES, KLERKSDORP, 2571
P O BOX 2334, KLERKSDORP, 2570
TEL: 018 462 2089
Email address: stratalab@yahoo.com
VAT No: 4620161093

Test Report: Cover Page

Job no: 202402017

Client: **Geopotential (Pty) Ltd**
Blyekorf
Hennie Bingle Street
Potchefstroom
2531

Date Report Generated: 23-02-2024
Date Sample Received: 06-02-2024
Date Tested: 06-02-2024
Report Rev. Number:

Attention: **Stephan Potgieter**

Project: **GP - 2404 - Nkomati WTF**

Herewith the laboratory test results for the above mentioned project, as requested by client.

Please see attached results.

Page 1	*Cover sheet*
Page 2	*Summary of test results*
Page 3	** Insitu Moisture Content*
Page 4 -7	** Laboratory Test Results*

Report end

Notes, additions, deviations or exclusions:

sanas Testing Laboratory T0942

Technical Signatory: D van Vreden

RF8
REV1
Eff. Date: 23-07-2019

STRATALAB

MATERIALS LABORATORY

IVOR STR 4, KLERKSDORP, 2570
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TEL: 018 462 2089 / FAX: 018 462 6655
EMAIL: stratalab@yahoo.com
VAT No: 4620161093

Summary of test results

CLIENT: Geopotential (Pty) Ltd
PROJECT: GP - 2404 - Nkomati WTF
ORDER NUMBER.:

DATE TESTED: 06-02-2024
DATE REPORT GENERATED: 26-02-2024
JOB NUMBER: 202402017

Material/Sample Description	MDD A.A.S.H.T.O & OMC	CORRECTED C.B.R at 2.54mm/13.344 Kn 100 / 95 / 93 / 90	U.C.S (kPa) @ 100% 100 / 90	I.T.S. (kPa) @ 100% 100 / 90	PI	GM	Unified Soil Class-ifiation	TRH 14 1987	COLTO 1998
NTP 02 / 1 ; 1.2 - 2.4m	n/a	n/a	n/a	n/a	15	1.03	CL		
Yellowish / Red									
NTP 03 / 01 ; 0 - 0.6m	2350	42 / 27 / 22 / 16	n/a	n/a	6	2,15		G7	G6
Brown Gravel	6,2							G6 Colto	
NTP 04 / 1 ; 0.0 - 0.4m	2070	26 / 17 / 14 / 11	n/a	n/a	14	1,76		G8	G8
Red Clayey Gravel	10,8								
NTP 05 / 1 ; 2.0 - 2.9m	n/a	n/a	n/a	n/a	22	0,38	CL		
Red									

Technical Signatory: D van Vreden

RF6
REV1
Eff. Date: 22-07-2019

STRATALAB

MATERIALS LABORATORY

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VAT No: 4620161093

CLIENT:	Geopotential (Pty) Ltd	**DATE:**	06-02-2024
PROJECT:	GP - 2404 - Nkomati WTF	**JOB NO:**	202402017
		ORDER NUMBER:	

INSITU MOISTURE CONTENT

NTP 02 / 1		
1.2 - 2.4m	23.8%	
Yellowish / Red		
NTP 03 / 01		
0 - 0.6m	4.4%	
Brown Gravel		
NTP 04 / 1		
0.0 - 0.4m	18.6%	
Red Clayey Gravel		
NTP 05 / 1		
2.0 - 2.9m	24.8%	
Red		

Technical Signatory: D van Verdun

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MATERIALS LABORATORY

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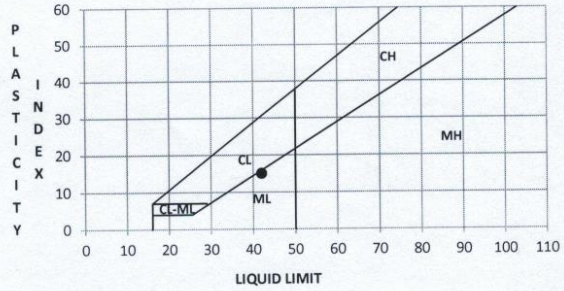
Sieve Analysis, Hydrometer, Atterberg Limits, pH and Conductivity
TMH1 A1(a), A2, A3, A20, A21T; SANS 3001-GR3

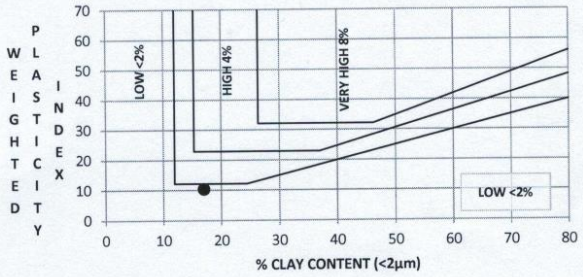
CLIENT:	Geopotential (Pty) Ltd	**DATE TESTED:**	06-02-2024
PROJECT:	GP - 2404 - Nkomati WTF	**DATE REPORT GENERATED:**	23-02-2024
		JOB NUMBER:	202402017
		SAMPLE DESCRIPTION:	CL - Yellowish / Red
ORDER NUMBER:	-		
TRIAL PIT:	NTP 02 / 1	**DEPTH (m)**	1.2 - 2.4

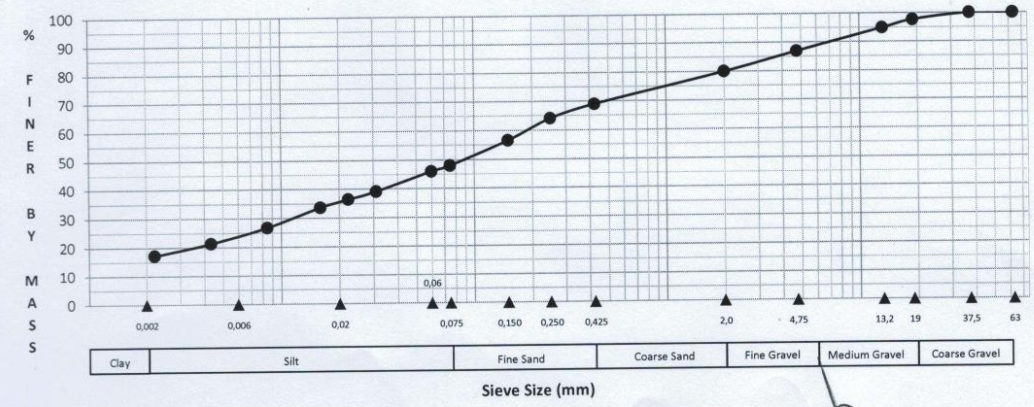
SAMPLE		(mm)	●
SIEVE ANALYSIS (modified TMH1 A1(a))	% PASSING BY MASS	63,0	100
		37,5	100
		19,0	98
		13,2	95
		4,75	87
		2,00	80
		0,425	69
		0,250	64
		0,150	57
		0,075	48
HYDROMETER (SANS 3001-GR3)	DATE TESTED		06-02-2024
	(µm)	60	46
	(µm)	20	35
	(µm)	6	23
	(µm)	2	17
ATTERBERG LIMITS (TMH1 A2,A3)	GRADING MODULUS		1,03
	LIQUID LIMIT (%)		42
	PLASTICITY INDEX		15
	LINEAR SHRINKAGE (%)		7,5
	WEIGHTED PI		10
	SG		2,650
SOIL MORTAR ANALYSIS	Coarse Sand(<2.0>0.425)		14
	Fine Sand(<0.425>0.075)		26
	Silt(<0.075>0.002)		39
	Clay (<0.002)		21
ELECTRO-CHEMICAL (TMH1 A20; A21T)	pH		
	Conductivity(S/m)		

CASAGRANDE PLASTICITY CLASSIFICATION CHART



MODIFIED VAN DER MERWE SWELL PREDICTION





RF4
REV2
Eff. Date: 17-10-2020

Technical Signatory: D van Vreden

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STRATALAB
MATERIALS LABORATORY

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MOD A.A.S.H.T.O./Std PROCTOR/MOISTURE DENSITY/C.B.R. or U.C.S. DATA, SIEVE ANALYSIS & ATTERBERG LIMITS
TMH1: A1; A2; A3; A5; A7; A8; A9; A14; A16T

CLIENT:	Geopotential (Pty) Ltd	**DATE TESTED:**	06-02-2024
PROJECT:	GP - 2404 - Nkomati WTF	**DATE REPORT GENERATED:**	23-02-2024
		JOB NUMBER:	202402017
ORDER NUMBER.:		**SAMPLE DESCRIPTION:**	NTP 03 / 01 0 - 0.6m Brown Gravel

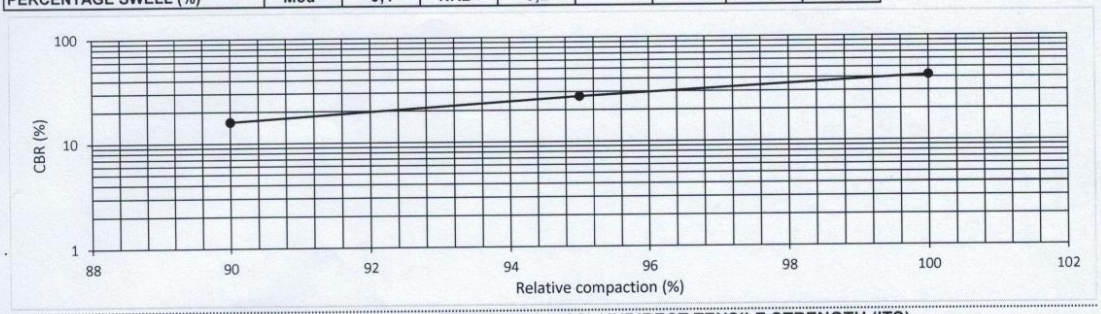
MOISTURE DENSITY RELATIONSHIP (MOD)

COMPACTIVE EFFORT:	**Mod.AASHTO: TMH1 A7**	**MOULD NUMBER:**	**H3**
PREPERATION:	**Crushing**	**MOULD VOLUME:**	**2310**
		MOULD MASS (g):	**4717**

MAX. DRY DENSITY (kg/m³):	***2350***
OMC (%):	***6,2***

CORRECTED C.B.R at 2.54mm/13.344 Kn

CBR @ % COMPACTION	**100%=**	**42**	**95%=**	**27**	**93%=**	**22**	**90%=**	**16**
PERCENTAGE SWELL (%)	**Mod=**	**0,1**	**NRB=**	**0,2**			**Proc.=**	**0,3**



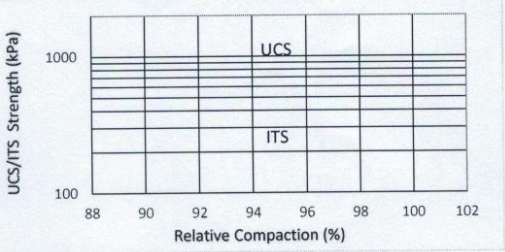
UNCONFINED COMPRESSIVE STRENGTH (UCS) / INDIRECT TENSILE STRENGTH (ITS)

UCS

% STABILISING AGENT & TYPE	**n/a**			
UCS (kPa) @ % COMPACTION	**100%=**	**n/a**	**90%=**	**n/a**

ITS

ITS (kPa) @ % COMPACTION	**100%=**	**n/a**	**90%=**	**n/a**

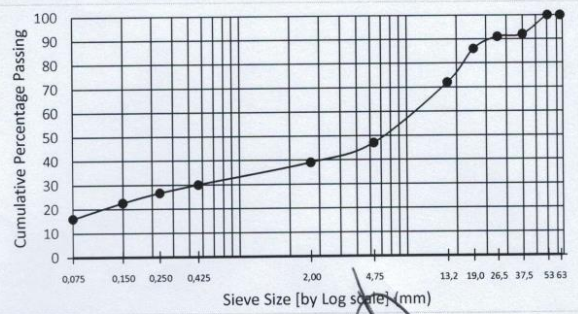


SIEVE ANALYSIS & ATTERBERG CONSTANTS

PERCENTAGE PASSING SIEVES (BY MASS) (%)

(mm)	(%)
63	**100**
53	**100**
37,5	**92**
26,5	**91**
19,0	**86**
13,2	**72**
4,75	**47**
2,00	**39**
0,425	**30**
0,250	**27**
0,150	**23**
0,075	**16**

SOIL MORTAR ANALYSIS	
C.S <2.0>0.425	**23**
F.S <0.425>0.075	**36**
S&C <0.075	**41**
G.M.	**2,15**
ATTERBERG LIMITS	
LIQUID LIMIT (%)	**25**
PLASTIC LIMIT (%)	**19**
PLASTICITY INDEX	**6**
LINEAR SHRINK.(%)	**3,0**



REMARKS: G7- TPH C4-

RF3
REV1
Eff. Date: 17-07-2019

Technical Signatory: D. v Vreden

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STRATALAB
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MOD A.A.S.H.T.O./Std PROCTOR/MOISTURE DENSITY/C.B.R. or U.C.S. DATA, SIEVE ANALYSIS & ATTERBERG LIMITS
TMH1: A1; A2; A3; A5; A7; A8; A9; A14; A16T

CLIENT:	Geopotential (Pty) Ltd	**DATE TESTED:**	06-02-2024
PROJECT:	GP - 2404 - Nkomati WTF	**DATE REPORT GENERATED:**	23-02-2024
		JOB NUMBER:	202402017
ORDER NUMBER.:		**SAMPLE DESCRIPTION:**	NTP 04 / 1 0.0 - 0.4m Red Clayey Gravel

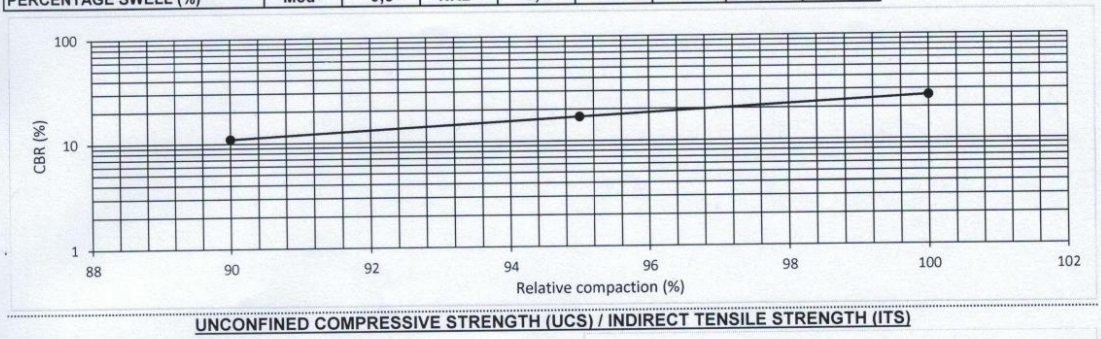
MOISTURE DENSITY RELATIONSHIP (MOD)

COMPACTIVE EFFORT:	Mod.AASHTO: TMH1 A7	**MOULD NUMBER:**	H2
PREPERATION:	Crushing	**MOULD VOLUME:**	2238
		MOULD MASS (g):	4429

MAX. DRY DENSITY (kg/m³):	*2070*
OMC (%):	*10,8*

CORRECTED C.B.R at 2.54mm/13.344 Kn

CBR @ % COMPACTION	**100%=**	**26**	**95%=**	**17**	**93%=**	**14**	**90%=**	**11**
PERCENTAGE SWELL (%)	**Mod=**	**0,3**	**NRB=**	**0,4**			**Proc.=**	**0,5**



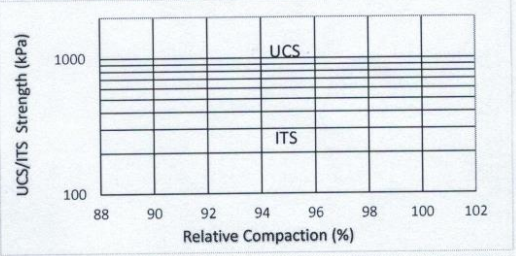
UNCONFINED COMPRESSIVE STRENGTH (UCS) / INDIRECT TENSILE STRENGTH (ITS)

UCS

% STABILISING AGENT & TYPE	n/a			
UCS (kPa) @ % COMPACTION	**100%=**	**n/a**	**90%=**	**n/a**

ITS

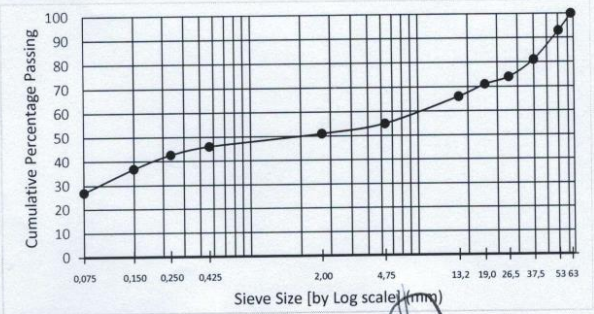
ITS (kPa) @ % COMPACTION	**100%=**	**n/a**	**90%=**	**n/a**



SIEVE ANALYSIS & ATTERBERG CONSTANTS

PERCENTAGE PASSING SIEVES (BY MASS) (%) (mm)	(%)
63	100
53	93
37,5	81
26,5	74
19,0	71
13,2	66
4,75	55
2,00	51
0,425	46
0,250	43
0,150	37
0,075	27

SOIL MORTAR ANALYSIS	
C.S <2.0>0.425	10
F.S <0.425>0.075	37
S&C <0.075	53
G.M.	1,76
ATTERBERG LIMITS	
LIQUID LIMIT (%)	36
PLASTIC LIMIT (%)	22
PLASTICITY INDEX	14
LINEAR SHRINK.(%)	7,0



REMARKS: G8- TRH 14 -

RF3
REV1
Eff. Date: 17-07-2019

Technical Signatory: D. v Vreden

STRATALAB

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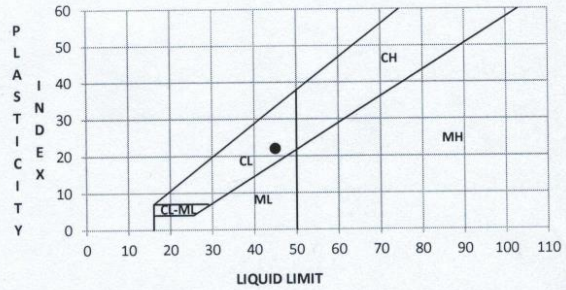
EMAIL: stratalab@yahoo.com
VAT No: 4620161093

Sieve Analysis, Hydrometer, Atterberg Limits, pH and Conductivity
TMH1 A1(a), A2, A3, A20, A21T; SANS 3001-GR3

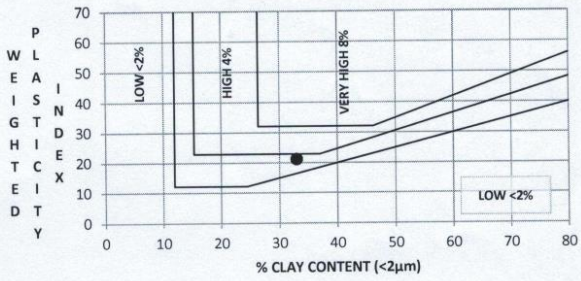
CLIENT:	Geopotential (Pty) Ltd	**DATE TESTED:**	06-02-2024
PROJECT:	GP - 2404 - Nkomati WTF	**DATE REPORT GENERATED:**	23-02-2024
		JOB NUMBER:	202402017
		SAMPLE DESCRIPTION:	CL - Red
ORDER NUMBER:	-		
TRIAL PIT:	NTP 05 / 1	**DEPTH (mm)**	2.0 - 2.9

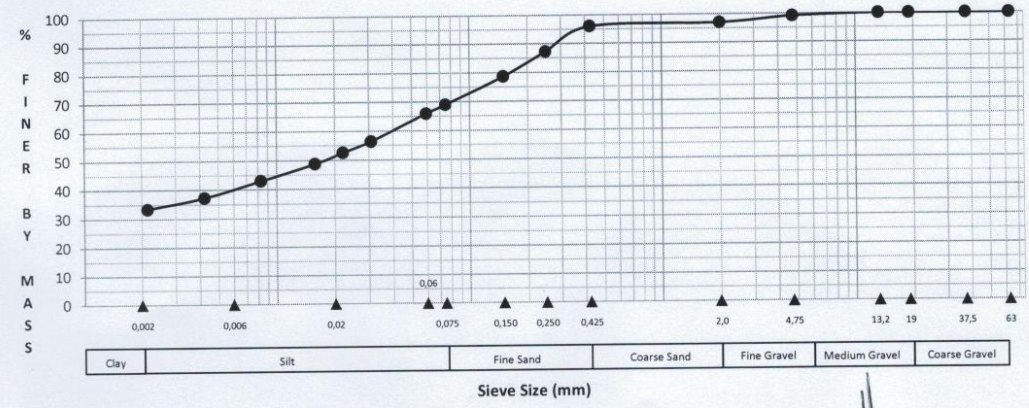
SAMPLE		(mm)	●
SIEVE ANALYSIS (modified TMH1 A1(a))	% PASSING BY MASS	63,0	100
		37,5	100
		19,0	100
		13,2	100
		4,75	99
		2,00	97
		0,425	96
		0,250	87
		0,150	79
		0,075	69
HYDROMETER (SANS 3001-GR3)	DATE TESTED		06-02-2024
	(µm)	60	66
	(µm)	20	51
	(µm)	6	40
	(µm)	2	33
ATTERBERG LIMITS (TMH1 A2,A3)	GRADING MODULUS		0,38
	LIQUID LIMIT (%)		45
	PLASTICITY INDEX		22
	LINEAR SHRINKAGE (%)		11,0
	WEIGHTED PI		21
	SG		2,650
SOIL MORTAR ANALYSIS	Coarse Sand(<2.0>0.425)		1
	Fine Sand(<0.425>0.075)		28
	Silt(<0.075>0.002)		37
	Clay (<0.002)		34
ELECTRO-CHEMICAL (TMH1 A20; A21T)	pH		
	Conductivity(S/m)		

CASAGRANDE PLASTICITY CLASSIFICATION CHART



MODIFIED VAN DER MERWE SWELL PREDICTION





REPORT END

Technical Signatory: D van Vreden

RF4
REV2
Eff. Date: 17-10-2020

STRATALAB

MATERIALS LABORATORY

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TEL: 018 462 2089
Email address: stratalab@yahoo.com
VAT No: 4620161093

Test Report: Cover Page

Job no: 202402017

Client: Geopotential (Pty) Ltd
Blyekorf
Hennie Bingle Street
Potchefstroom
2531

Date Report Generated: 28-02-2024
Date Sample Received: 06-02-2024
Date Tested: 06-02-2024
Report Rev. Number:

Attention: Stephan Potgieter

Project: GP - 2404 - Nkomati WTF

Herewith the laboratory test results for the above mentioned project, as requested by client.

Please see attached results.

Page 1	*Cover sheet*
Page 2 - 4	*Basson Index - Waterlab (Pty) Ltd*

Report end

Notes, additions, deviations or exclusions:

sanas Testing Laboratory T0942

Technical Signatory: D van Vreden

RF8
REV1
Eff. Date: 23-07-2019

WATERLAB

WATERLAB (PTY) LTD

Reg. No.: 1983/009165/07 V.A.T. No.: 4130107891

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Meiring Naudé Road, Pretoria
P.O. Box 283, 0020

Telephone: +2712 – 349 – 1066
Facsimile: +2712 – 349 – 2064
Email: accounts@waterlab.co.za

sanas Testing Laboratory T0391

CERTIFICATE OF ANALYSES
Basson Index

Date received:	2024/02/14			**Date completed:**	2024/02/26
Project number:	1000	**Report number:**	129349	**Order number:**	2024/001
Client name:	Stratalab			**Contact person:**	M van Vreden
Address:	PO Box 2334, Klerksdorp			**Email:**	stratalab@yahoo.com
Telephone:	018 462 2089				

Analyses in mg/ℓ (Unless specified otherwise)	Method Identification	Sample Identification			
		NTP02/1 (1.2-2.4m)	NTP03/1 (0-0.6m)	NTP04/1 (0-0.4m)	NTP05/1 (2.0-2.9m)
Sample Number		23-37479	23-37480	23-37481	23-37482
Leachate used	WLAB075	Distilled Water	Distilled Water	Distilled Water	Distilled Water
Mass Used (g)	---	500	500	500	500
Volume Used (mℓ)	---	1000	1000	1000	1000
pH Value at 25°C	WLAB001	6.7	7.9	6.1	6.5
pHs Value at 20°C (calc)	WLAB053b	9.9	7.6	10.0	10.4
Electrical Conductivity in mS/m at 25°C	WLAB002	14.8	148	4.2	1.5
Total Dissolved Solids (calc)	WLAB068	99	992	28	10
Total Alkalinity as $CaCO_3$	WLAB007	8	44	12	12
Total Hardness as $CaCO_3$ (calc)	WLAB051b	40	1006	12	7
Calcium Hardness as $CaCO_3$ (calc)	WLAB051a	15	693	7	2
Calcium as Ca	WLAB015	6	278	3	1
Magnesium as Mg	WLAB015	6	76	1	<1
Free & Saline Ammonia	WLAB046	<0.1	<0.1	<0.1	<0.1
Ammonium as NH_4 (calc)	WLAB068	<0.3	<0.3	<0.3	<0.3
Sulphate as SO_4	WLAB046	34	895	7	<2
Chloride as Cl	WLAB046	2	7	5	<2
Langelier Index at 20°C (calc)	WLAB053c	-3.2	0.3	-3.9	-3.9
Ryznar Index at 20°C (calc)	WLAB053d	13.1	7.3	13.8	14.3
Corrosivity Ratio (calc)	WLAB054	4.8	21	1.2	0.2
Leaching Index [LCSI] (calc)*	---	2702	-206	3157	3185
Spalling Index [SCSI] (calc)*	---	5	105	1	0
Aggressiveness Index [N_a] (calc)*	---	2706	-101	3158	3186

*TDS Calculated EC X 6.7

2:1 Distilled Water : Soil Extract

Please note:

- The blank is subtracted from all leach results, except pH and Electrical Conductivity.
- * = Not SANAS Accredited
- Tests marked "Not SANAS Accredited" in this report are not included in the SANAS Schedule of Accreditation for this Laboratory.
- [o] = Analyses performed by an Outsourced Laboratory
- Results marked "Outsourced Test" in this report are not included in the SANAS Schedule of Accreditation for this Laboratory

Important notes (see table for corrections):

1. The above aggressiveness index is only applicable for conditions of laminar flow at a mean annual temperature of 20°C.
2. For stagnant/turbulent conditions the aggressiveness index must be corrected.
3. For wet/dry cycling conditions (for example in tidal zones) the aggressiveness index must be corrected.
4. For mean annual temperatures lower/higher than 20°C the aggressiveness index must be corrected.

Guidelines for assessing overall aggressiveness (N_c):

N_c	Aggressiveness
Not greater than 300	None to mild
400-700	Mild to moderate
800-1000	High
= or > 1 100	Very high

Aggressiveness Towards *Concrete and Fibre Cement Pipes*			
Index	Aggressive	Neutral	Non- Aggressive
a) Stability pH (pHs)	>pH	= pH	<pH
b) Langelier Index	Neg. Value	Zero	Pos. Value
c) Ryznar Index	>7.5	6 - 7	<6

Corrosiveness Towards metals		
Corrosivity		>0.2

Sample Name	Sample Number	Corrosivity Indices	Basson Index
See Corrosivity _ Basson Index tab			

To correct for:	Multiply	By: (see Notes 2 to 5 below)
Turbulence	LCSI	1.75
Stagnance	LCSI	0.5
Temperature	LCSI, SCSI, N7 Where N7=0.2 x Cl in mg/l	(1+ [0.05 x (T-20)])
Wet-dry cycles	SCSI	0.23×10^{-6} x TDS x DTF x CPA Where: DTF = Dry Time Fraction CPA = wet-dry cycles per annum

Note 1: Only if the concrete contains embedded steel.

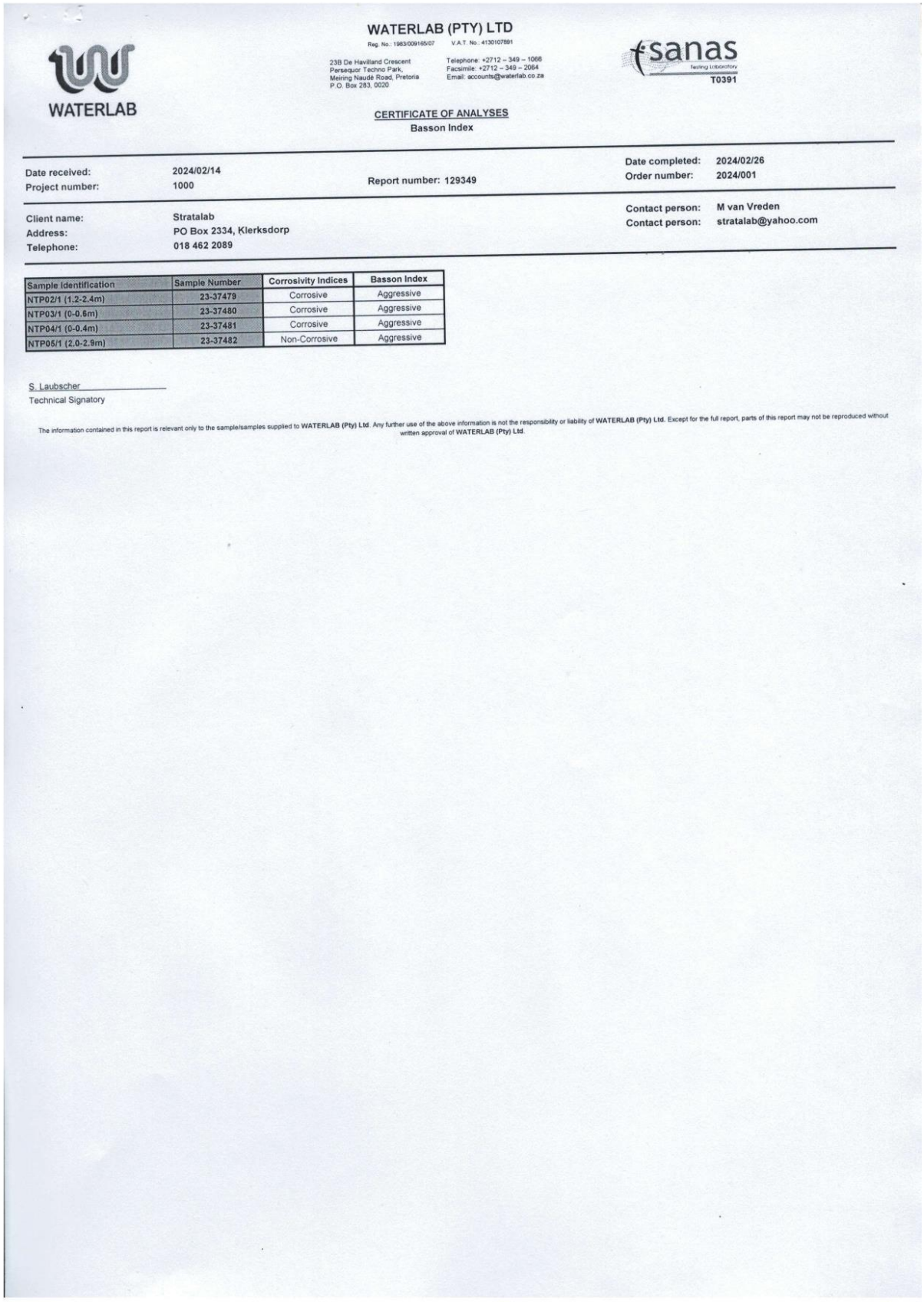
Note 2: To preserve the correct logical relationships when dealing with the negative sub indices (ie LCSI or SCSI having minus values) they should be multiplied by the reciprocal of the relevant factor indicated in this column

Note 3: If more than one correction is required, multiply by the product of the individual correction factors

Note 4: Use subscript c to indicate that the index has been corrected, eg for turbulent conditions $LCSI_c$ = LCSI x 1.75

Note 5: Round off corrected indices to the nearest 100.

S. Laubscher
Technical Signatory



WATERLAB

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Email: accounts@waterlab.co.za

sanas Testing Laboratory T0391

CERTIFICATE OF ANALYSES

Basson Index

Date received:	2024/02/14	Date completed:	2024/02/26
Project number:	1000	Report number: 129349	Order number: 2024/001
Client name:	Stratalab	Contact person:	M van Vreden
Address:	PO Box 2334, Klerksdorp	Contact person:	stratalab@yahoo.com
Telephone:	018 462 2089		

Sample Identification	Sample Number	Corrosivity Indices	Basson Index
NTP02/1 (1.2-2.4m)	23-37479	Corrosive	Aggressive
NTP03/1 (0-0.6m)	23-37480	Corrosive	Aggressive
NTP04/1 (0-0.4m)	23-37481	Corrosive	Aggressive
NTP05/1 (2.0-2.9m)	23-37482	Non-Corrosive	Aggressive

S. Laubscher
Technical Signatory