



Knight Piésold
CONSULTING

Knight Piésold Consulting
Level 1, 184 Adelaide Terrace
Perth WA 6004, Australia
<http://www.knightpiesold.com/>

Project: Thunderbox Gold Mine

Location: Leinster, Western Australia, Australia

CPT: KP CPT07A

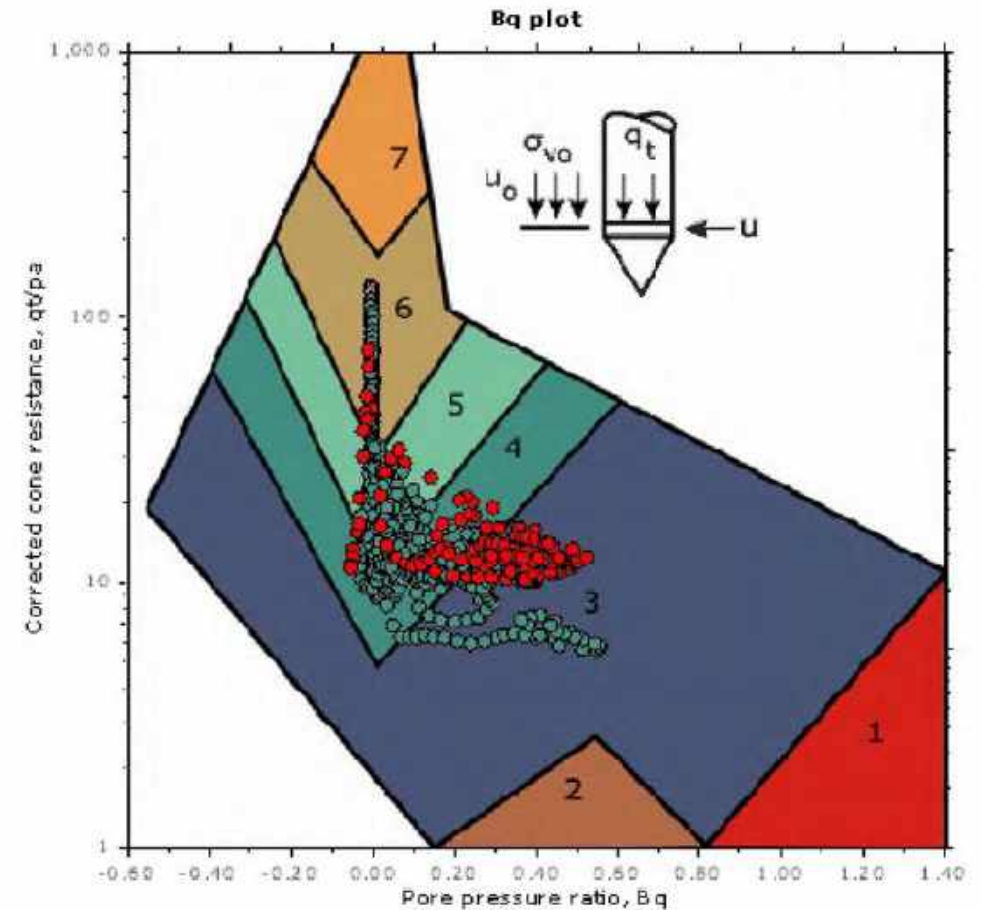
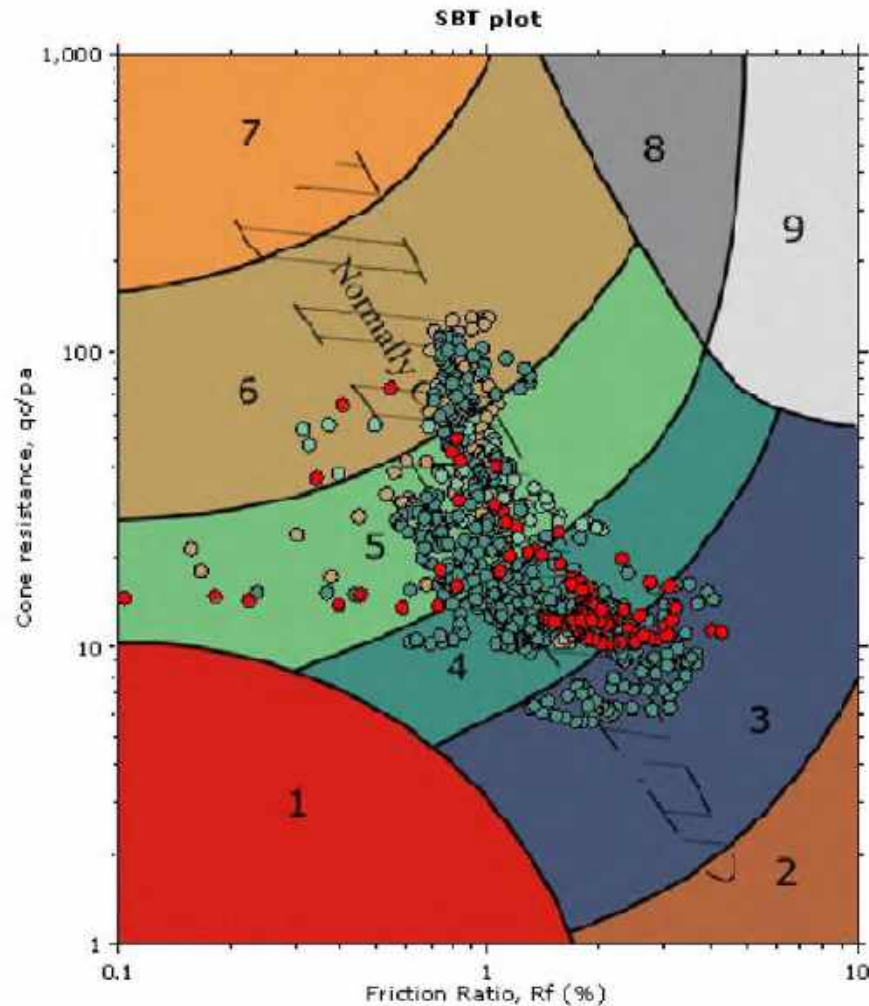
Total depth: 15.64 m, Date: 5/09/2020

Coords: lat 305898.1° lon 6879692.3°

Cone Type: 180911

Cone Operator: Hagstrom Drilling

SBT - Bq plots

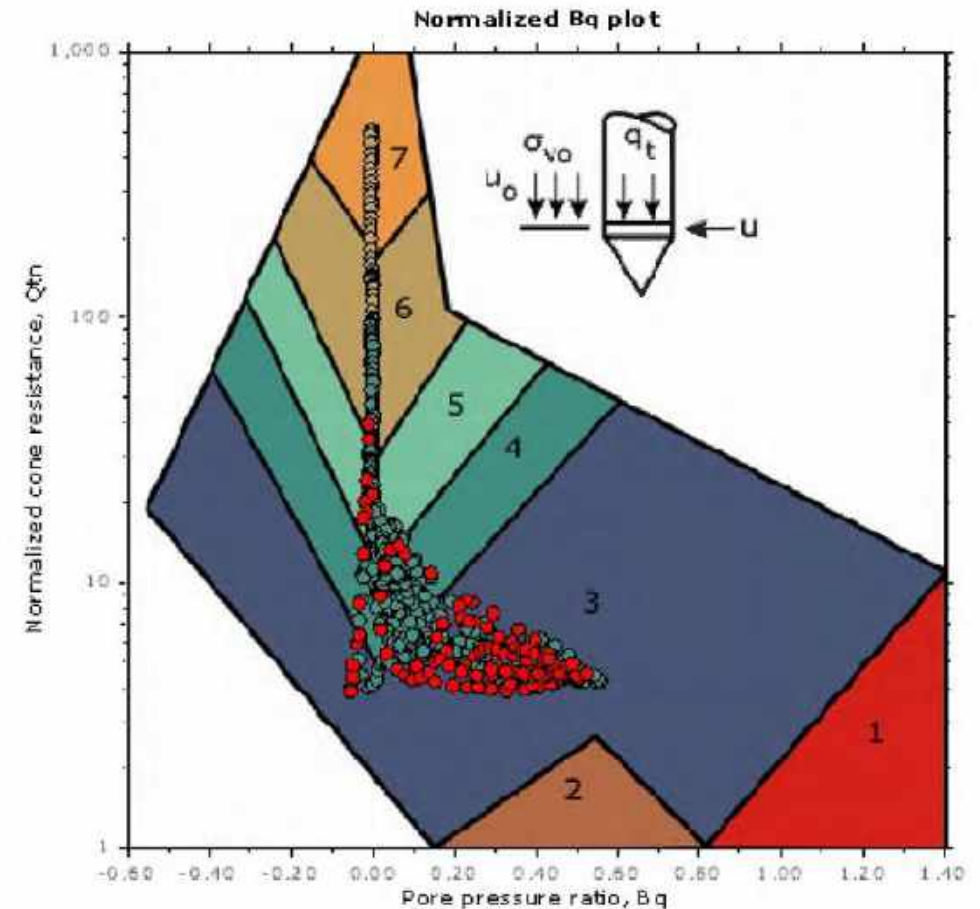
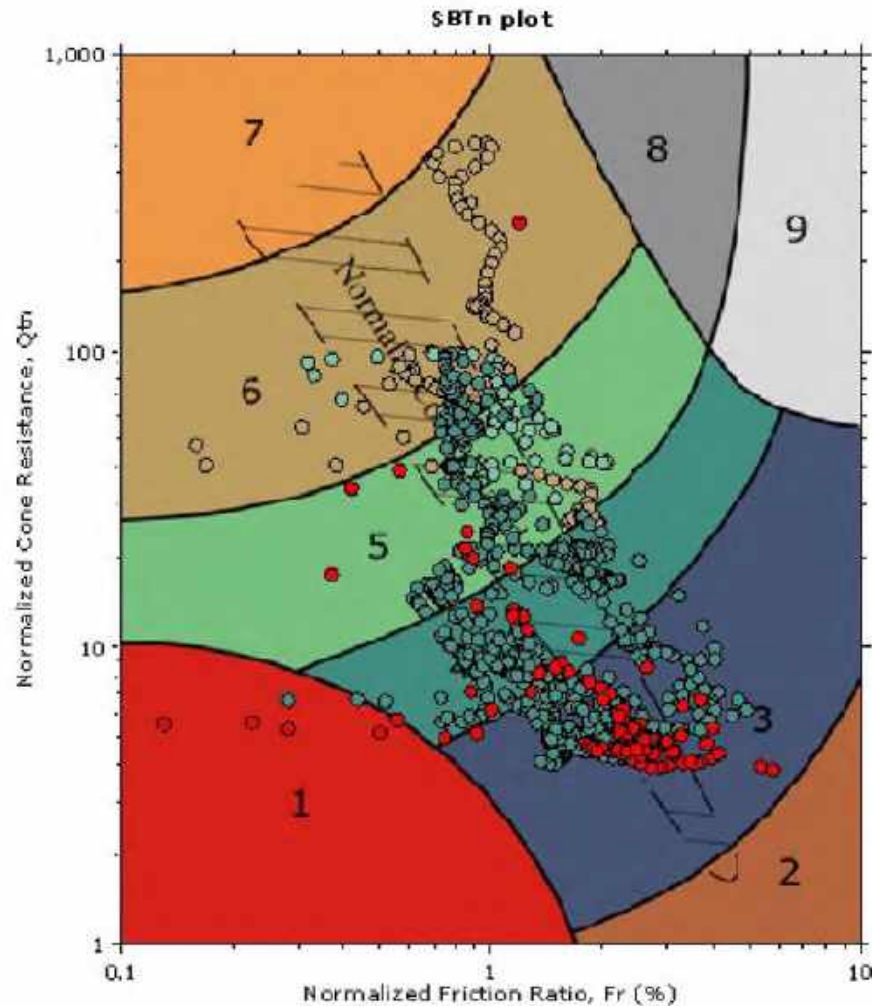


SBT legend

- | | | |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravely sand to sand |
| 2. Organic material | 5. Silty sand to sandy silt | 8. Very stiff sand to clayey sand |
| 3. Clay to silty clay | 6. Clean sand to silty sand | 9. Very stiff fine grained |



SBT - Bq plots (normalized)



SBTn legend

- | | | |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly sand to sand |
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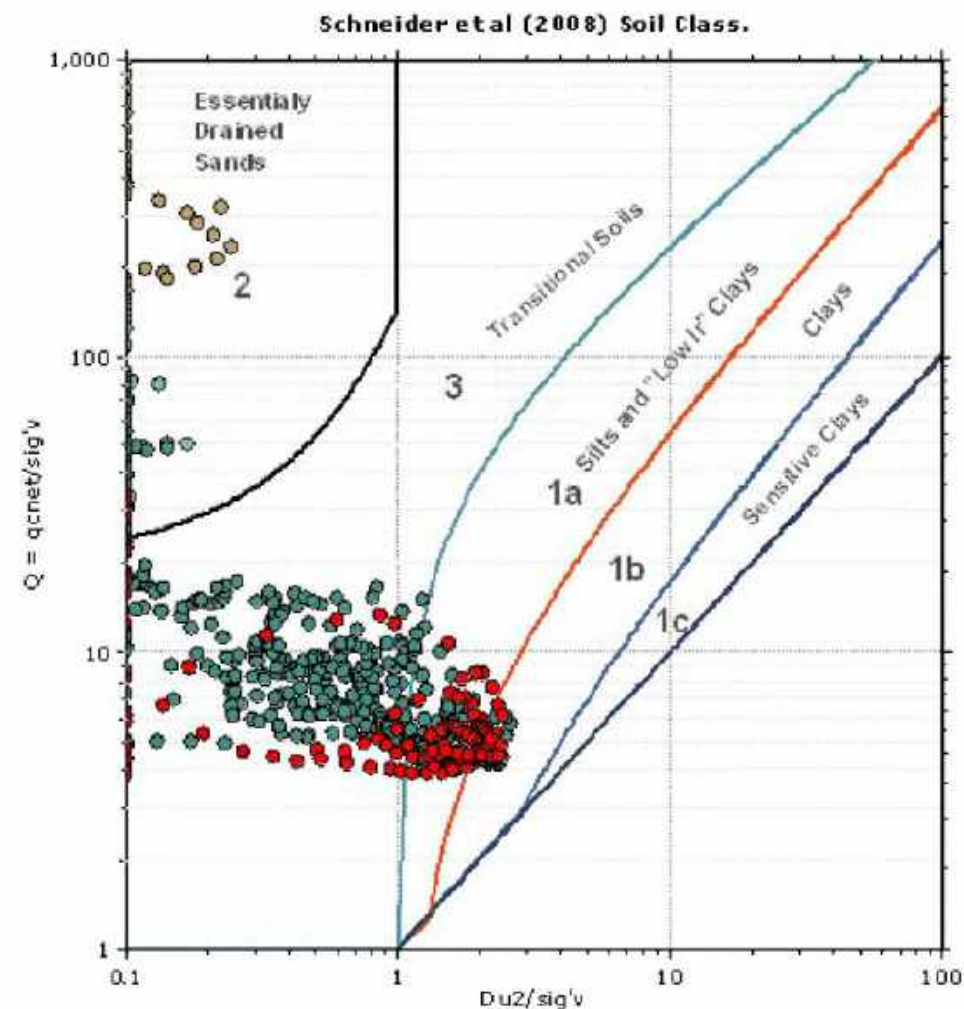
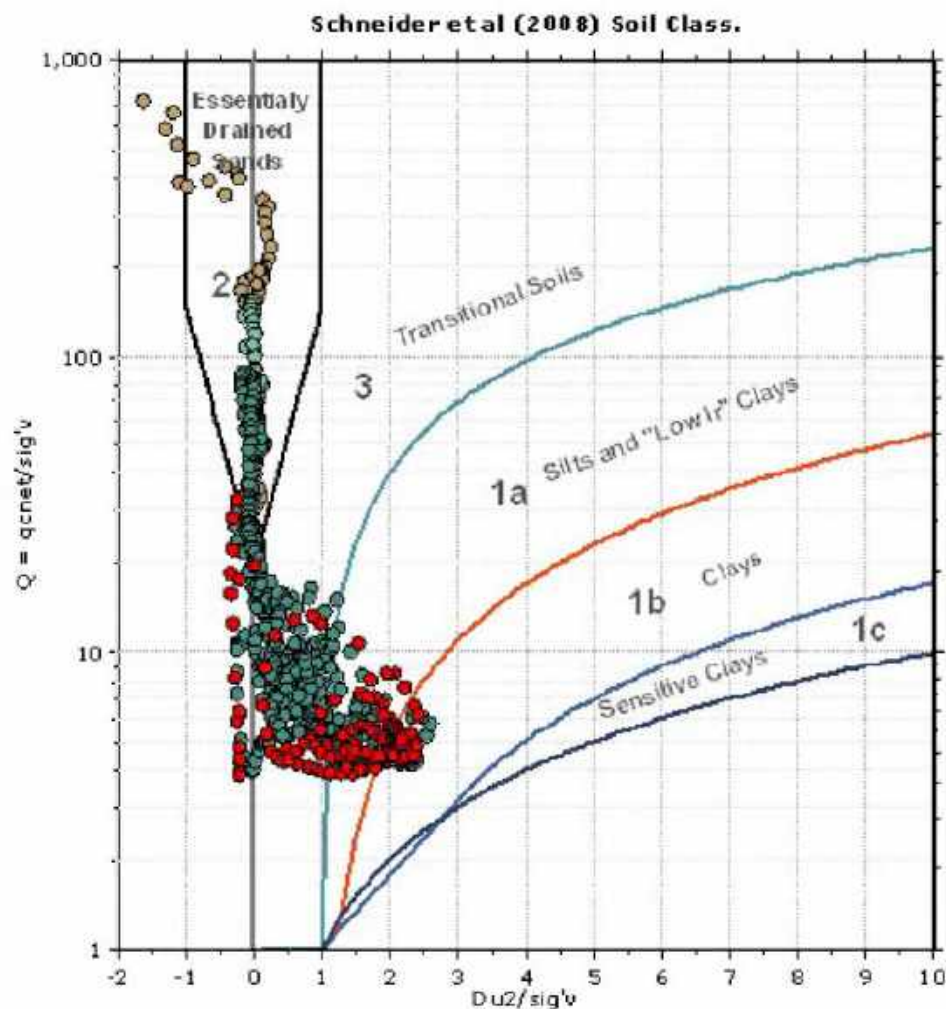
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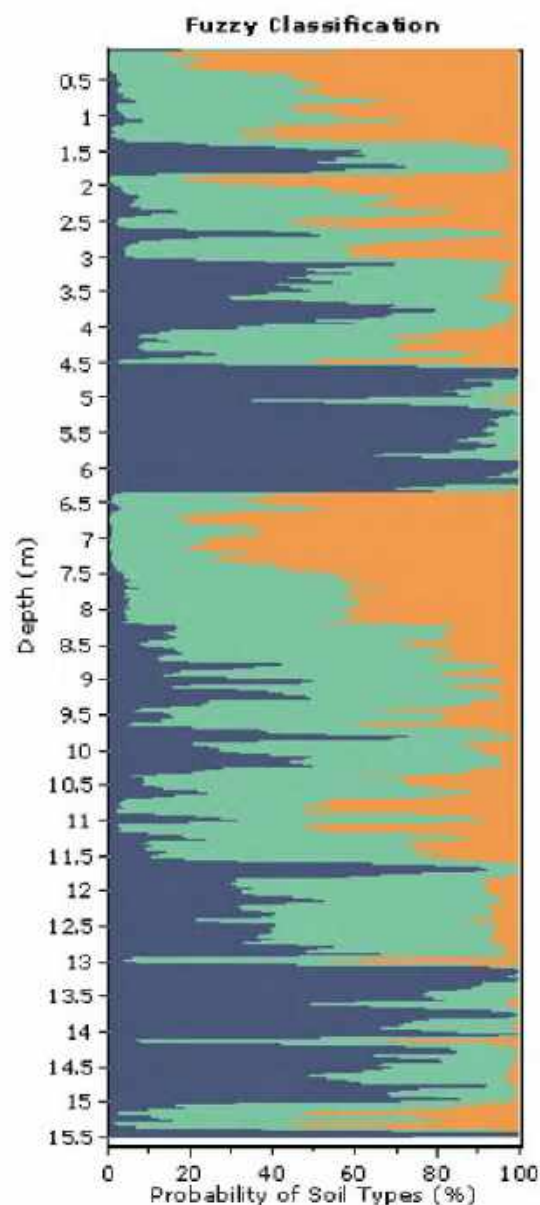
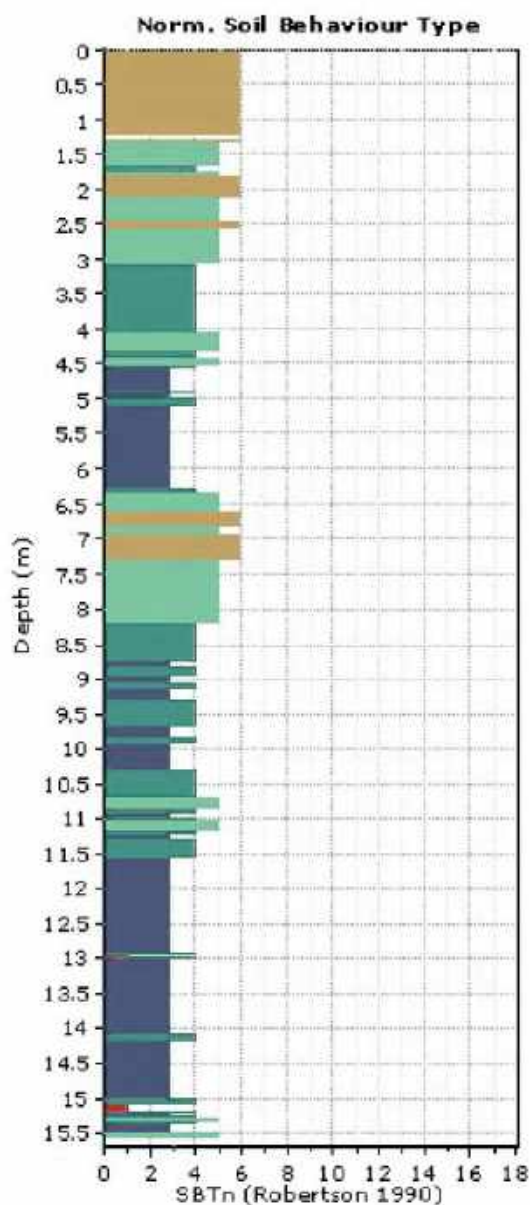
Bq plots (Schneider)

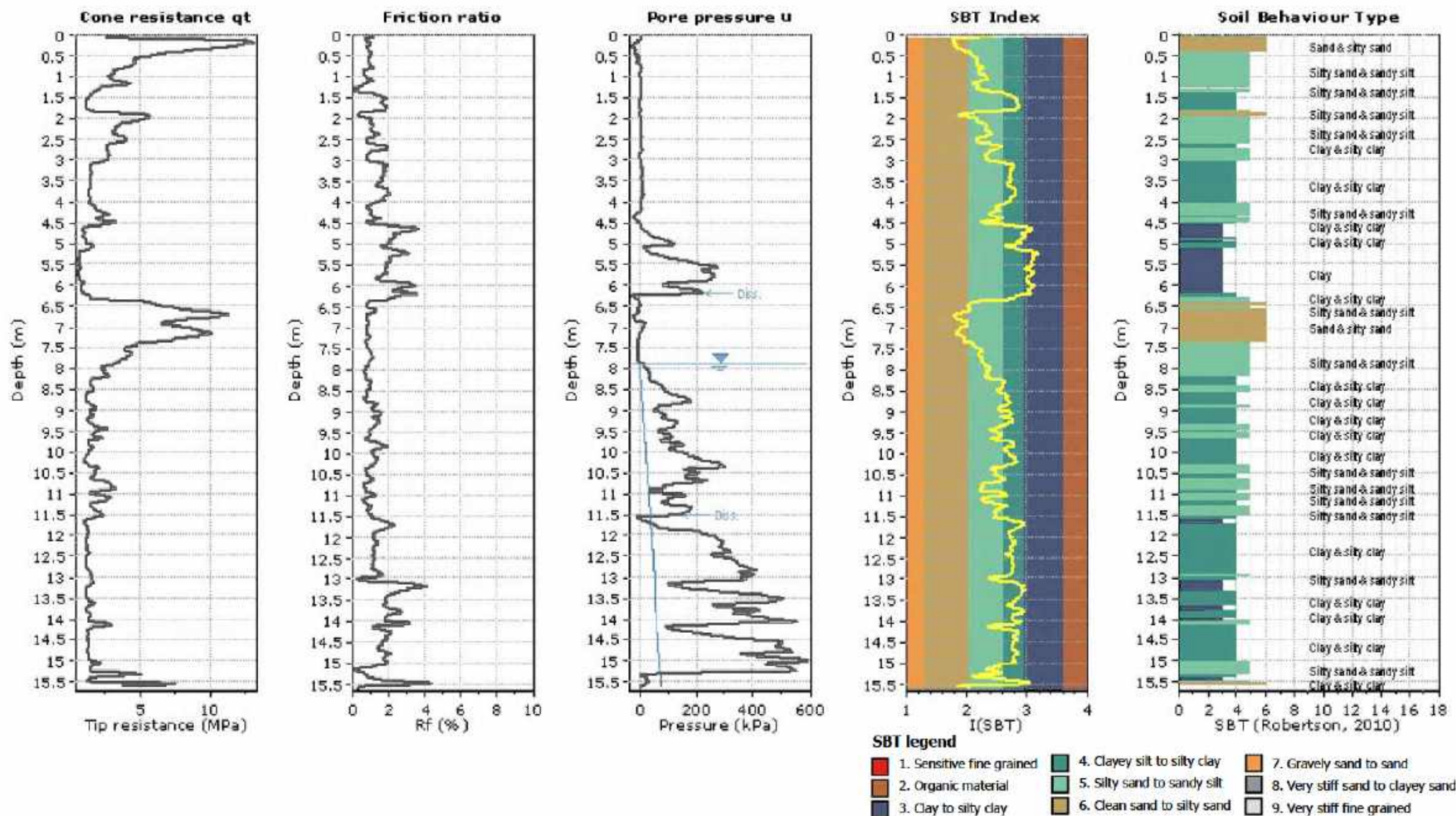


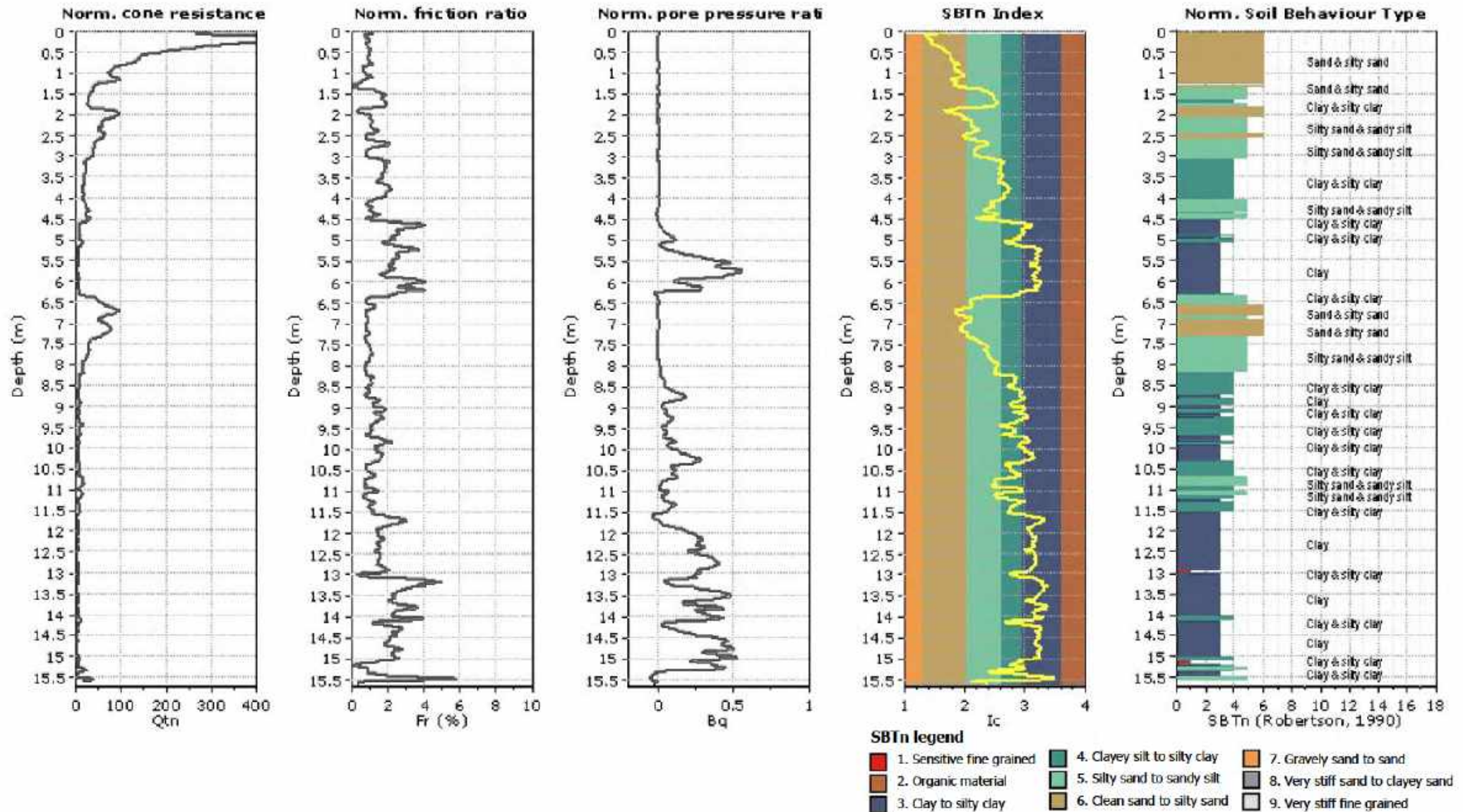


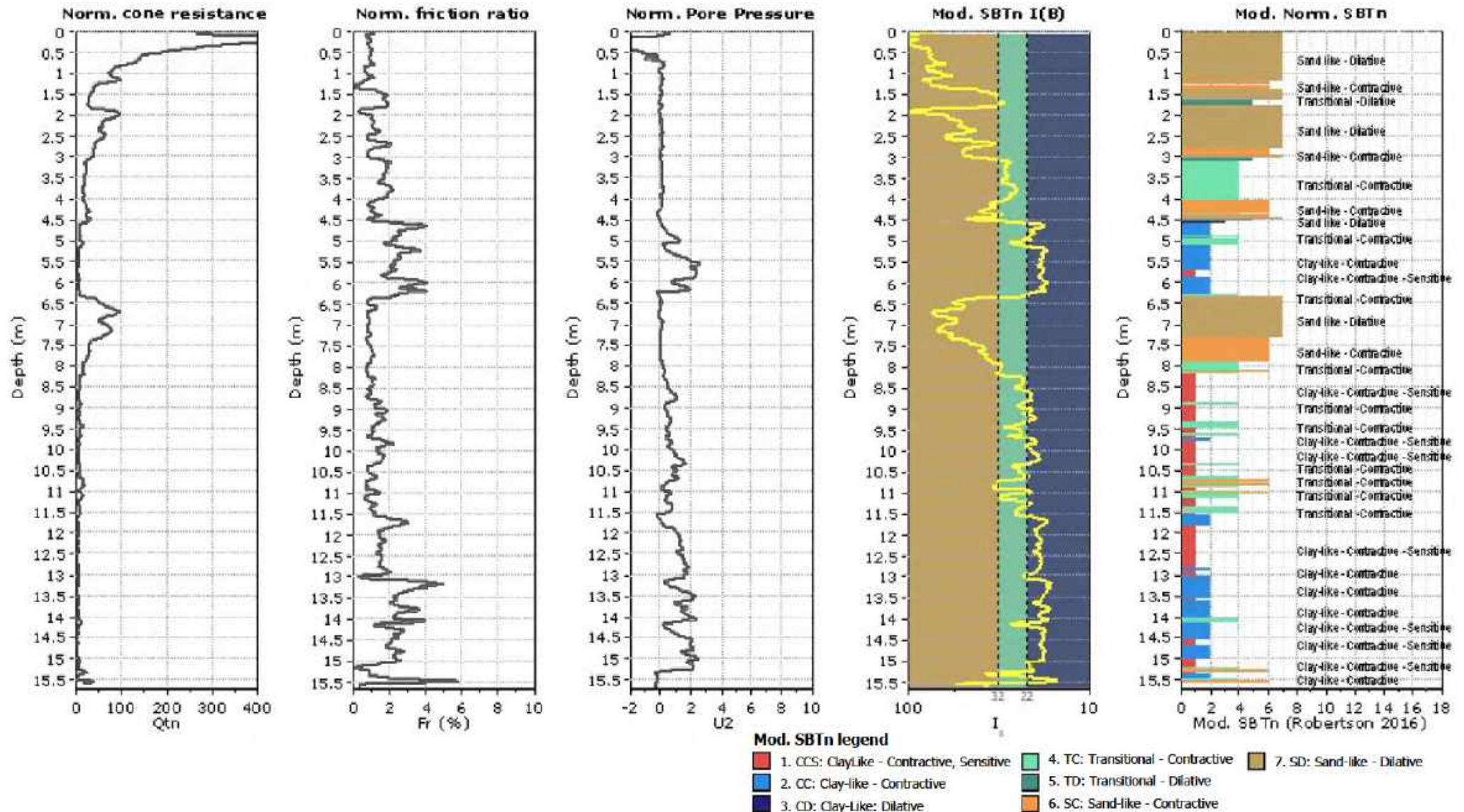
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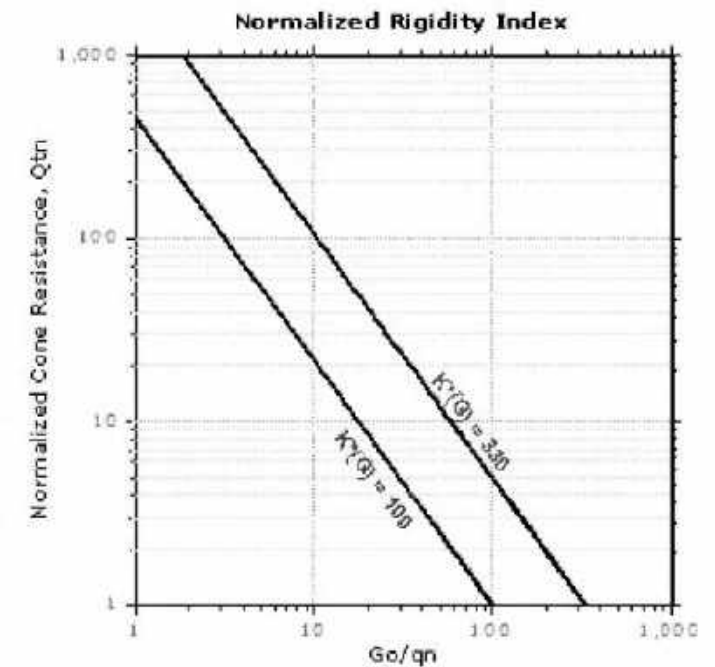
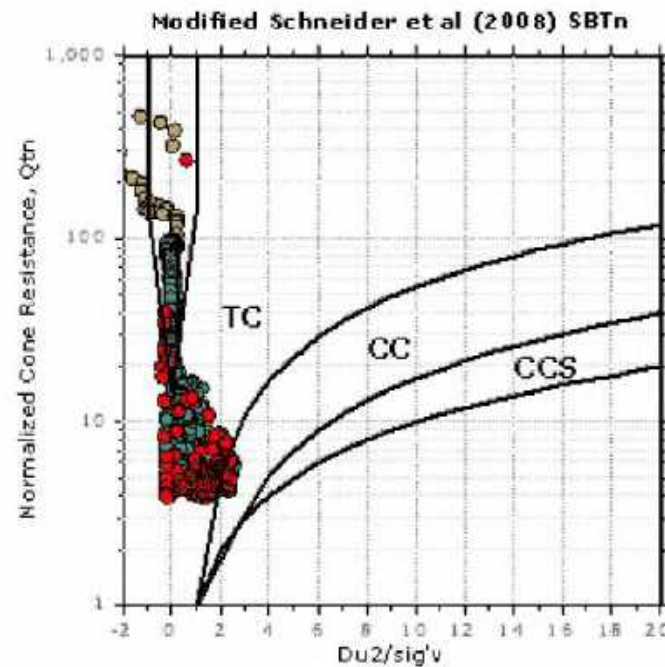
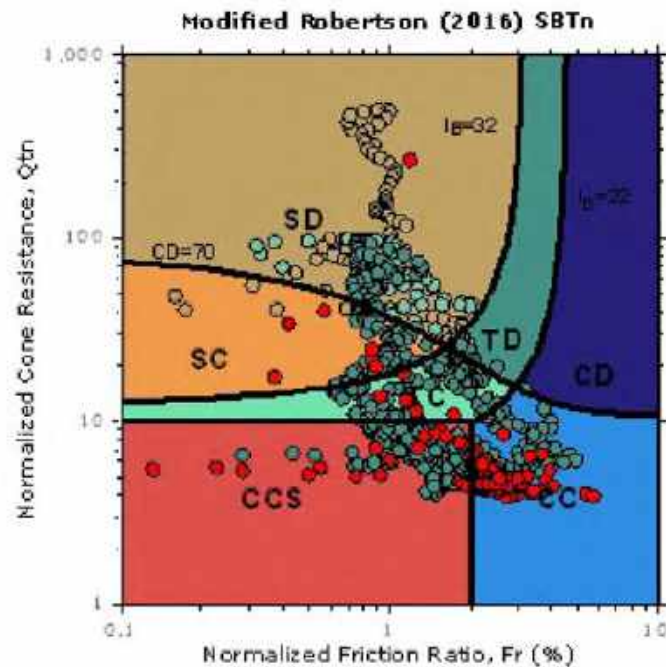






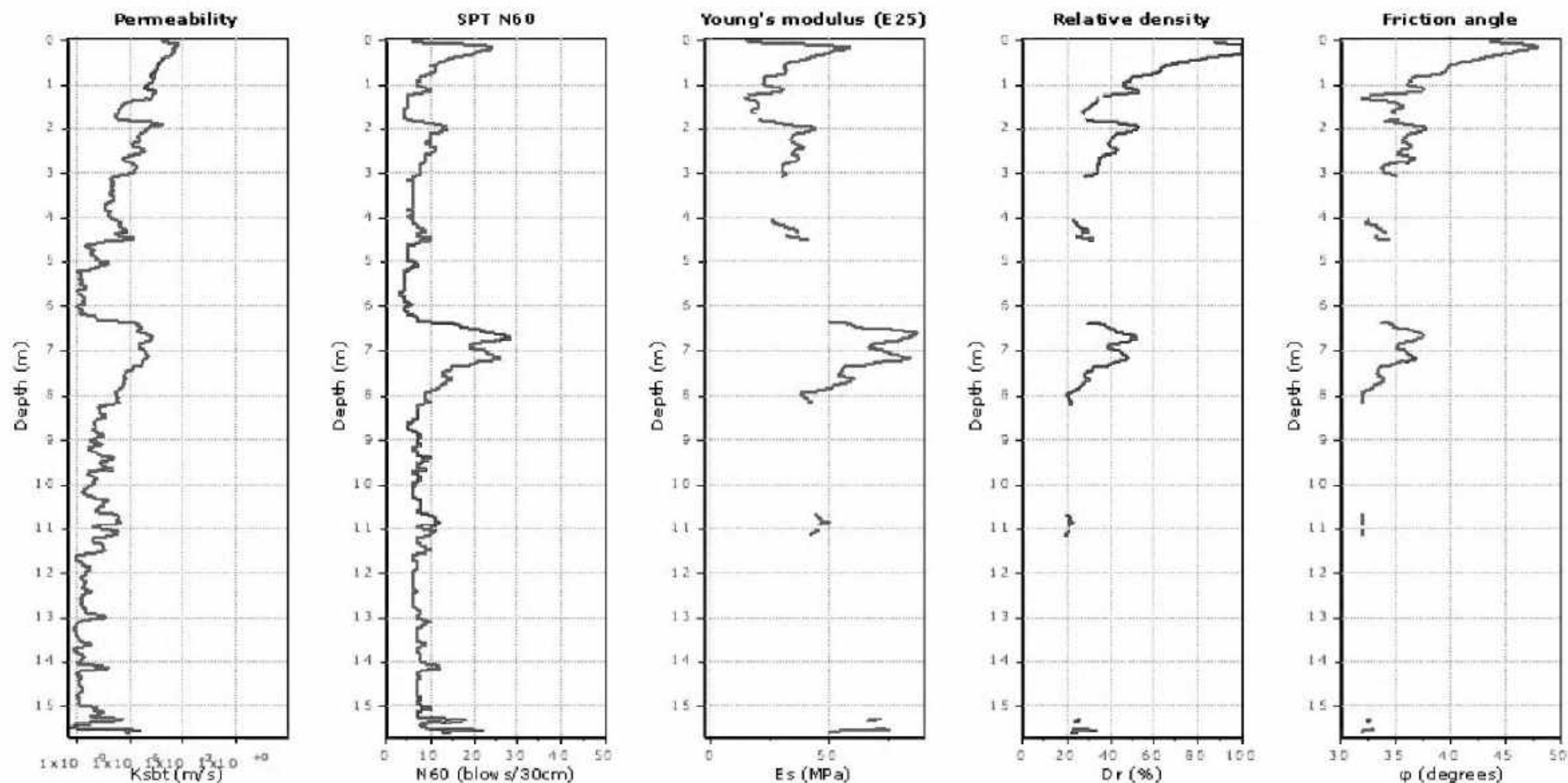


Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

$K'(G) > 330$: Soils with significant microstructure
(e.g. age/cementation)



Calculation parameters

Permeability: Based on SBT_n

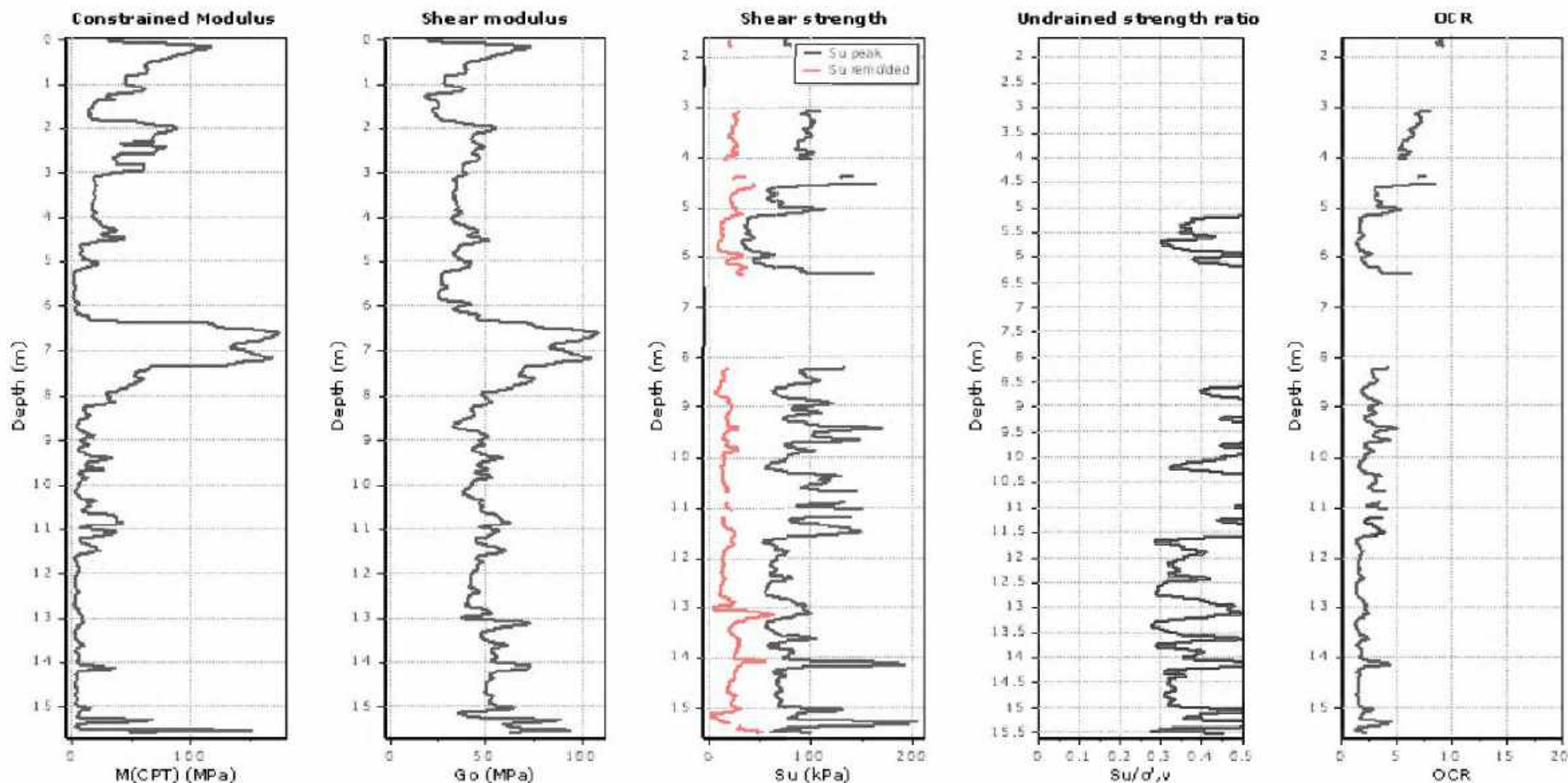
SPT N_{60} : Based on I_c and q_t

Young's modulus: Based on variable alpha using I_c (Robertson, 2009)

Relative density constant, C_{Dr} : 350.0

Phi: Based on Kulhawy & Mayne (1990)

● User defined estimation data



Calculation parameters

Constrained modulus: Based on variable alpha using I_c and Q_m (Robertson, 2009)

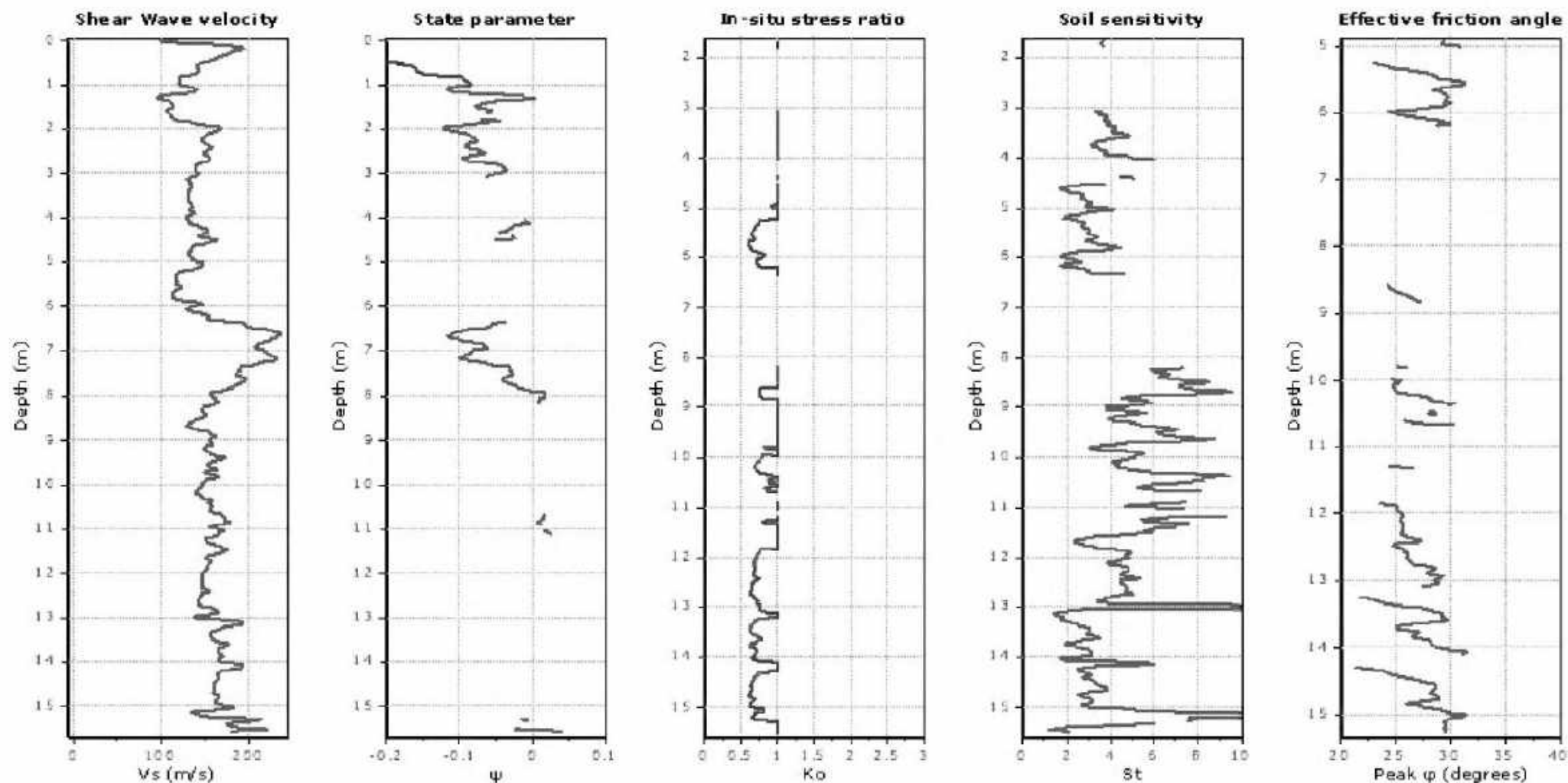
Go: Based on variable alpha using I_c (Robertson, 2009)

Undrained shear strength cone factor for clays, N_k : 14

OCR factor for clays, N_{kr} : 0.33

● User defined estimation data

● Flat Dilatometer Test data



Calculation parameters

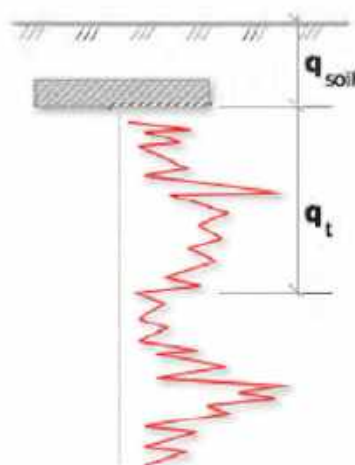
Sol Sensitivity factor, N_s : 7.00

—●— User defined estimation data



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Bearing Capacity calculation is performed based on the formula:

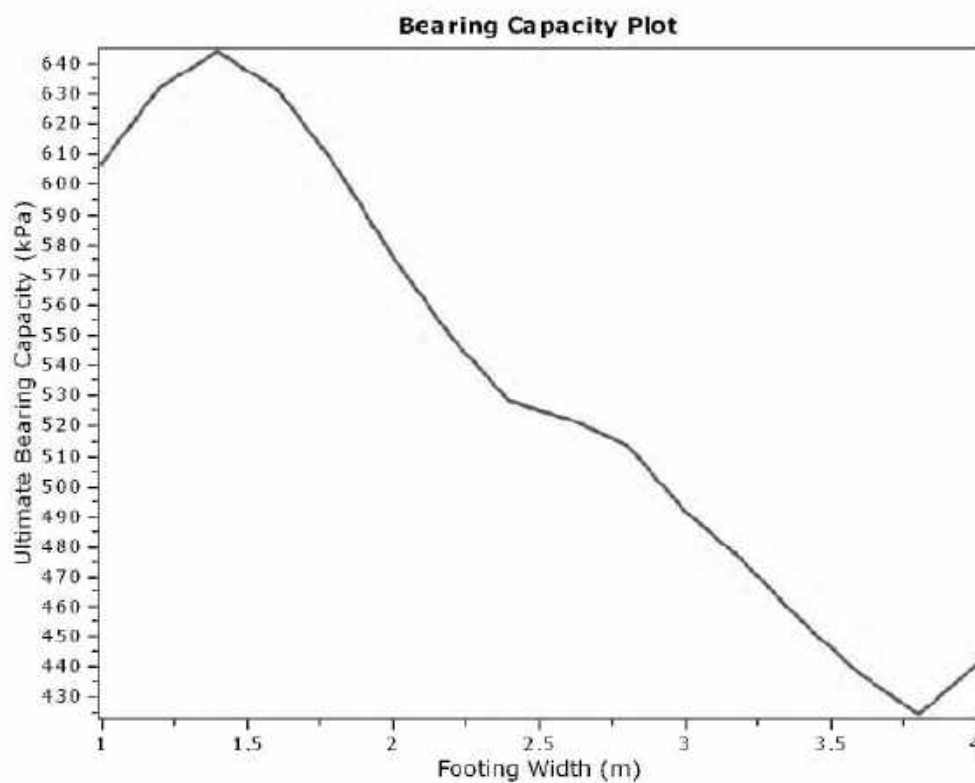
$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:

R_k : Bearing capacity factor

q_t : Average corrected cone resistance over calculation depth

q_{soil} : Pressure applied by soil above footing



:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	2.99	0.20	9.50	606.66
2	1.20	0.50	2.30	3.11	0.20	9.50	632.22
3	1.40	0.50	2.60	3.17	0.20	9.50	644.00
4	1.60	0.50	2.90	3.11	0.20	9.50	631.14
5	1.80	0.50	3.20	2.98	0.20	9.50	606.21
6	2.00	0.50	3.50	2.83	0.20	9.50	575.72
7	2.20	0.50	3.80	2.70	0.20	9.50	549.36
8	2.40	0.50	4.10	2.59	0.20	9.50	528.39
9	2.60	0.50	4.40	2.56	0.20	9.50	522.12
10	2.80	0.50	4.70	2.52	0.20	9.50	513.32
11	3.00	0.50	5.00	2.41	0.20	9.50	492.00
12	3.20	0.50	5.30	2.33	0.20	9.50	475.14
13	3.40	0.50	5.60	2.23	0.20	9.50	455.43
14	3.60	0.50	5.90	2.14	0.20	9.50	437.85
15	3.80	0.50	6.20	2.07	0.20	9.50	424.31
16	4.00	0.50	6.50	2.16	0.20	9.50	440.72



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Dissipation Tests Results

Dissipation tests

Dissipation tests consists of stopping the piezocone penetration and observing porepressures (u) with elapsed time (t). The data are automatic recorded by the field computer and should take place until a minimum of 50% dissipation.

The porepressures are plotted as a function of square root of (t). The graphical technique suggested by Robertson and Campanella (1989), yields a value for t_{50} , which corresponds to the time for 50% consolidation.

The value of the coefficient of consolidation in the radial or horizontal direction c_h was then calculated by Houlsby and Teh's (1988) theory using the following equation:

$$c_h = \frac{T \times r^2 \times I_r^{0.5}}{t_{50}}$$

where:

T : time factor given by Houlsby and Teh's (1988) theory corresponding to the porepressure position

r : piezocone radius

I_r : stiffness index, equal to shear modulus G divided by the undrained strength of clay (S_u).

t_{50} : time corresponding to 50% consolidation

Permeability estimates based on dissipation test

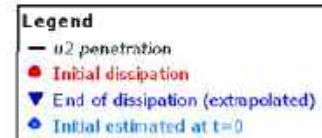
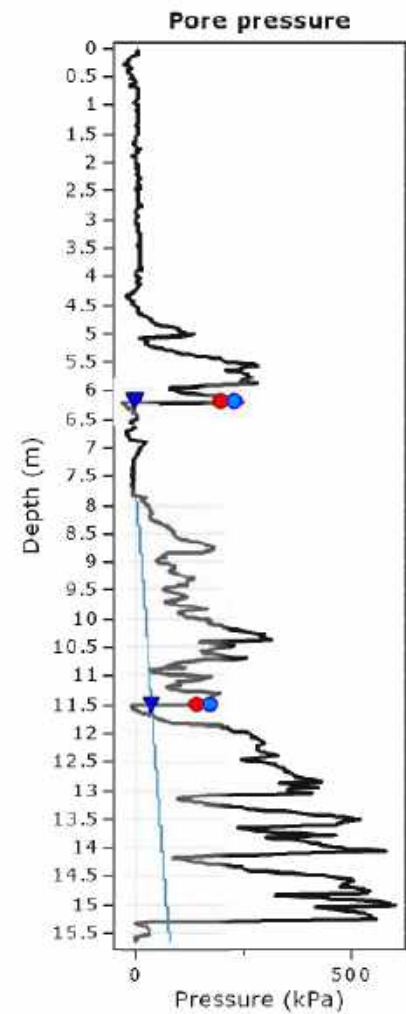
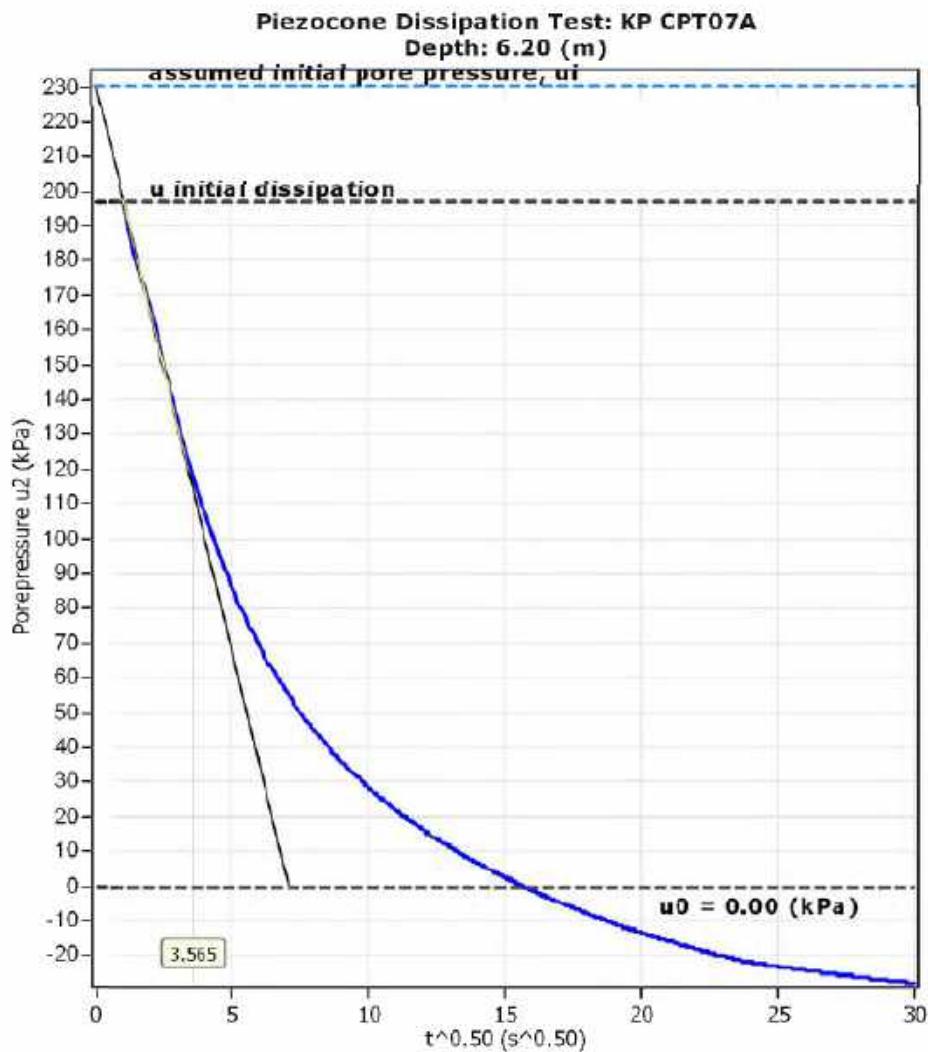
The dissipation of pore pressures during a CPTu dissipation test is controlled by the coefficient of consolidation in the horizontal direction (c_h) which is influenced by a combination of the soil permeability (k_h) and compressibility (M), as defined by the following:

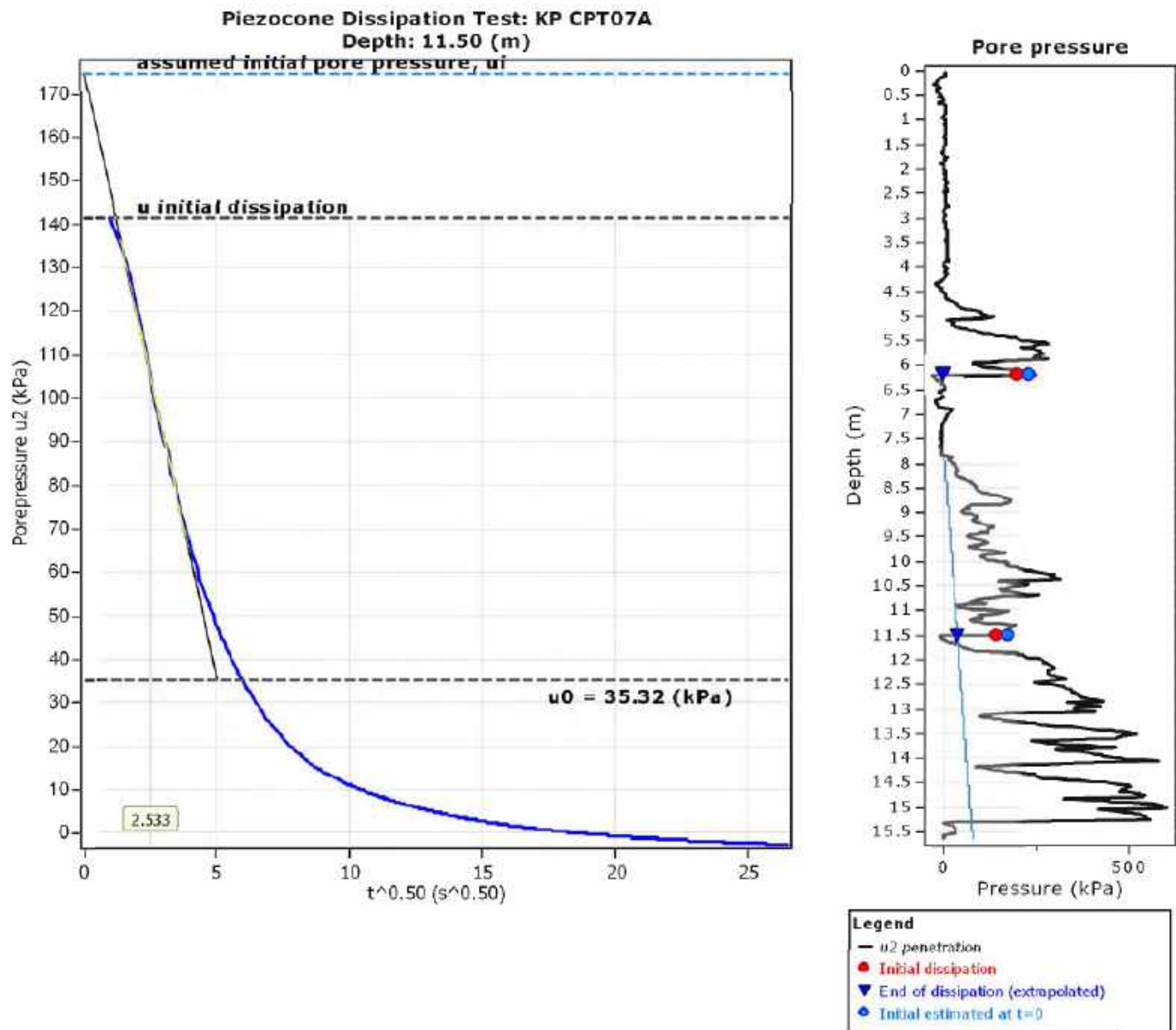
$$k_h = c_h \times \gamma_w / M$$

where: M is the 1-D constrained modulus and γ_w is the unit weight of water, in compatible units.

Tabular results

CPTU Borehole	Depth (m)	$(t_{50})^{0.50}$	t_{50} (s)	t_{50} (years)	G/S_u	c_h (m^2/s)	c_h ($m^2/year$)	M (MPa)	k_h (m/s)
KP CPT07A	6.20	3.6	13	4.03E-007	100.00	6.11E-005	1926	9.70	6.18E-008
KP CPT07A	11.50	2.5	6	2.03E-007	100.00	1.21E-004	3817	29.03	4.09E-008







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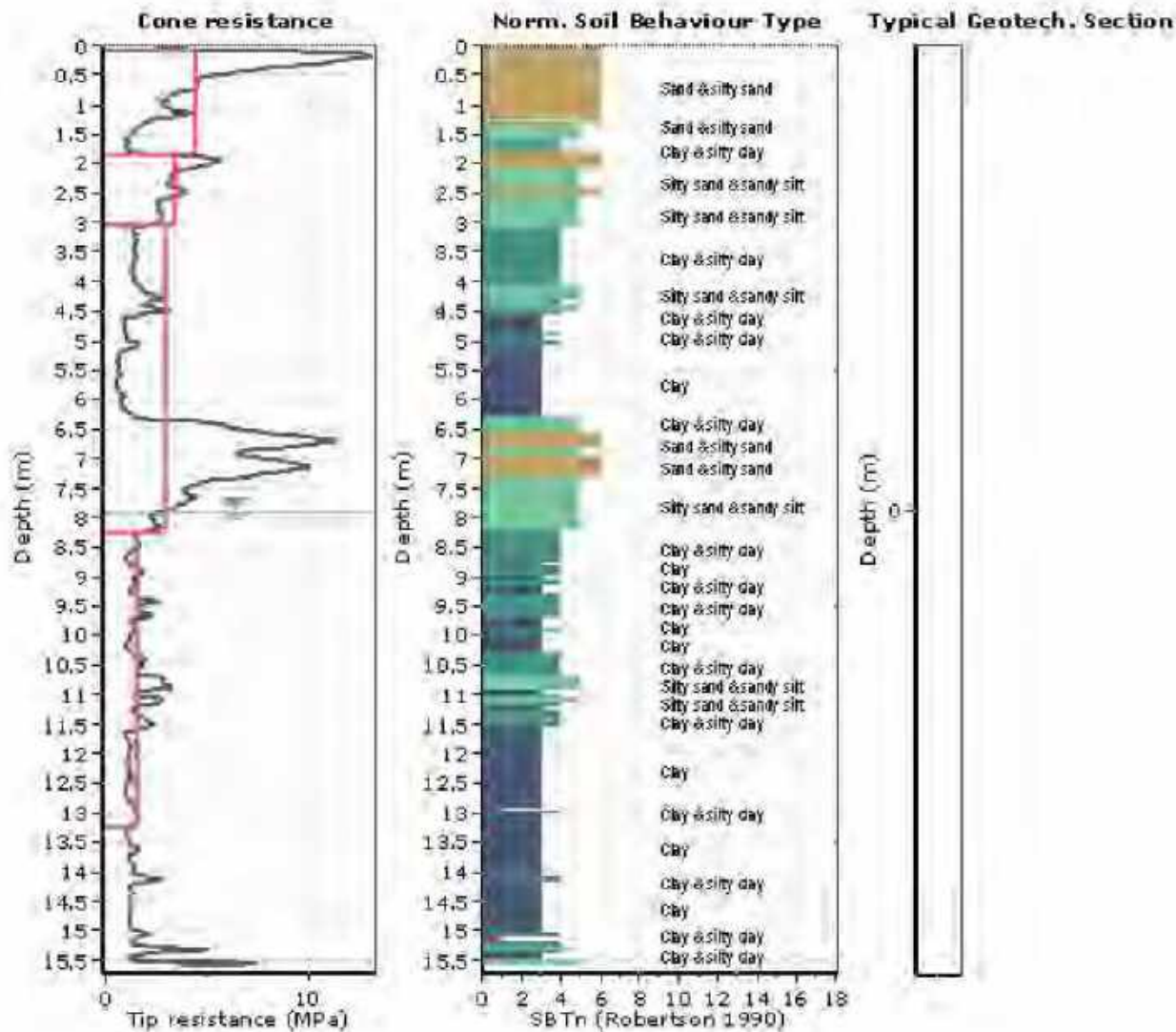
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Total depth: 15.64 m, Date: 5/09/2020

Coords: lat 305898.1° lon 6879692.3°

Cone Type: 180911

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Tabular results

::: Layer No: 1 :::

Code: Layer_1 **Start depth:** 0.06 (m), **End depth:** 1.84 (m)

Description: Sand & silty sand

Basic results

Total cone resistance: 4.43 ± 3.48 MPa

Sleeve friction: 39.95 ± 31.20 kPa

Ic: 1.92 ± 0.35

SBT_n: 6

SBTn description: Sand & silty sand

Estimation results

Permeability: $8.85E-05 \pm 1.60E-04$ m/s

N₆₀: 10.03 ± 5.87 blows

E_s: 29.99 ± 11.57 MPa

Dr (%): 58.47 ± 24.40

φ (degrees): 38.91 ± 4.40 °

Unit weight: 19.00 ± 0.00 kN/m³

Constrained Mod.: 52.65 ± 29.03 MPa

G_o: 36.38 ± 14.55 MPa

Su: 0.00 ± 0.00 kPa

Su ratio: 0.00 ± 0.00

O.C.R.: 0.00 ± 0.00

::: Layer No: 2 :::**Code:** Layer_2 **Start depth:** 1.84 (m), **End depth:** 3.04 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 3.47 ±0.95 MPa

Sleeve friction: 34.67 ±11.19 kPa

Ic: 2.12 ±0.17

SBT_n: 5

SBTn description: Silty sand & sandy silt

Estimation results

Permeability: 7.79E-06 ±1.44E-05 m/s

N₆₀: 9.89 ±1.76 blows

Es: 34.84 ±3.85 MPa

Dr (%): 40.23 ±6.03

φ (degrees): 35.68 ±1.10 °

Unit weight: 19.00 ±0.00 kN/m³

Constrained Mod.: 59.70 ±17.17 MPa

Go: 43.67 ±4.83 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

::: Layer No: 3 :::**Code:** Layer_3 **Start depth:** 3.04 (m), **End depth:** 8.22 (m)**Description:** Clay & silty clay**Basic results**

Total cone resistance: 2.96 ±2.82 MPa

Sleeve friction: 33.24 ±21.51 kPa

Ic: 2.61 ±0.41

SBT_n: 4

SBTn description: Clay & silty clay

Estimation results

Permeability: 1.63E-06 ±3.71E-06 m/s

N₆₀: 9.89 ±6.75 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 19.00 ±0.00 kN/m³

Constrained Mod.: 45.18 ±52.54 MPa

Go: 50.72 ±23.79 MPa

Su: 73.74 ±29.00 kPa

Su ratio: 0.87 ±0.45

O.C.R.: 4.02 ±2.07

::: Layer No: 4 :::**Code:** Layer_4 **Start depth:** 8.22 (m), **End depth:** 13.22 (m)**Description:** Clay & silty clay**Basic results**

Total cone resistance: 1.53 ±0.49 MPa

Sleeve friction: 17.47 ±7.86 kPa

Ic: 2.94 ±0.20

SBT_n: 4

SBTn description: Clay & silty clay

Estimation results

Permeability: 2.92E-08 ±5.31E-08 m/s

N₆₀: 7.37 ±1.44 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 19.00 ±0.00 kN/m³

Constrained Mod.: 11.37 ±8.93 MPa

Go: 47.01 ±6.92 MPa

Su: 88.03 ±25.09 kPa

Su ratio: 0.51 ±0.16

O.C.R.: 2.35 ±0.76

Summary table of mean values

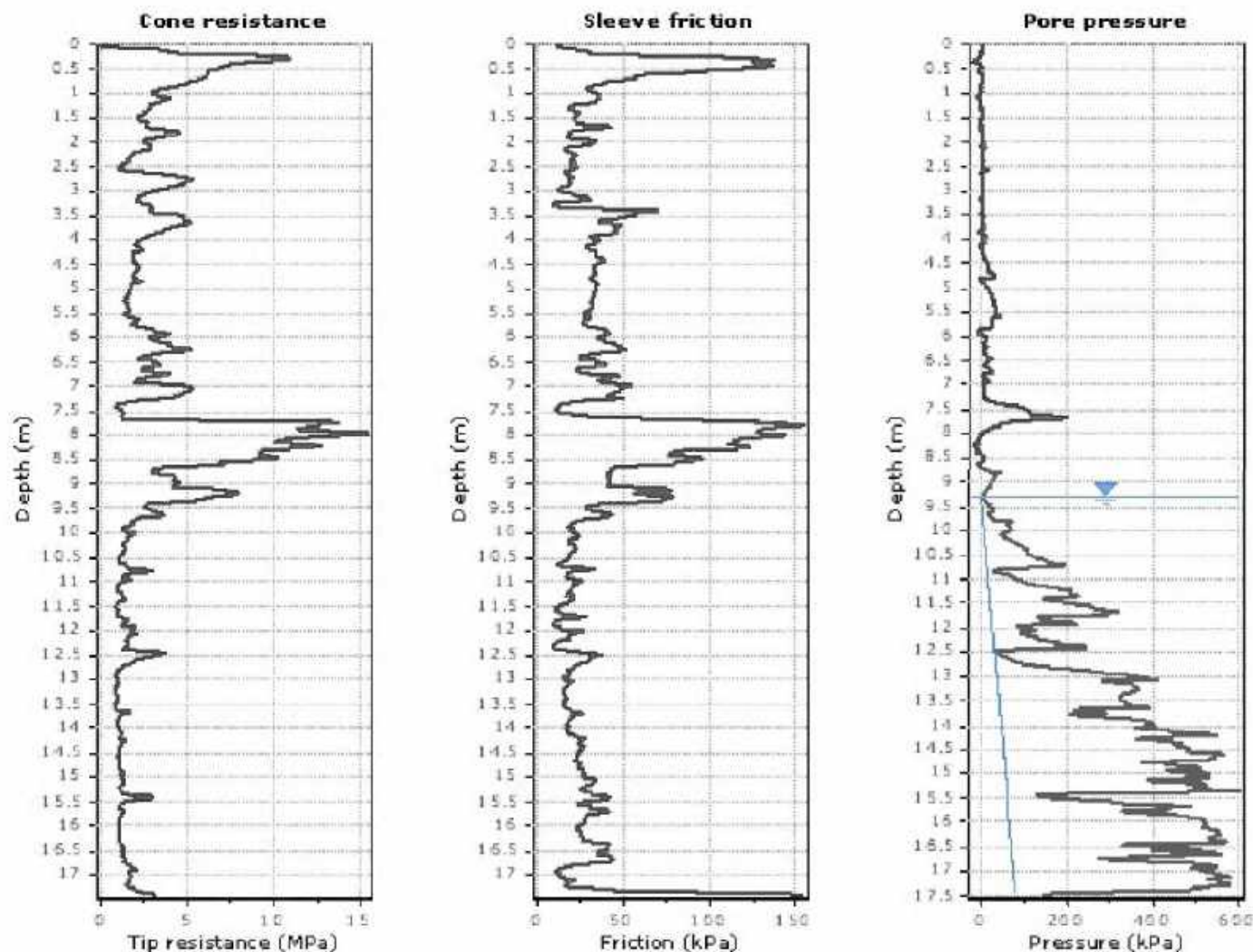
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT _{N50} (blows/30cm)	E _s (MPa)	D _r (%)	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G _o (MPa)	Undrained strength, S _u (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m ³)
0.06	1.78	8.85E-05	10.0	30.0	58.5	38.9	52.6	36.4	0.0	0.0	0.0	19.0
1.84		(±1.60E-04)	(±5.9)	(±11.6)	(±24.4)	(±4.4)	(±29.0)	(±14.5)	(±0.0)	(±0.0)	(±0.0)	(±0.0)
1.84	1.20	7.79E-06	9.9	34.8	40.2	35.7	59.7	43.7	0.0	0.0	0.0	19.0
3.04		(±1.44E-05)	(±1.8)	(±3.9)	(±6.0)	(±1.1)	(±17.2)	(±4.8)	(±0.0)	(±0.0)	(±0.0)	(±0.0)
3.04	5.18	1.63E-06	9.9	0.0	0.0	0.0	45.2	50.7	73.7	0.9	4.0	19.0
8.22		(±3.71E-06)	(±6.7)	(±0.0)	(±0.0)	(±0.0)	(±52.5)	(±23.8)	(±29.0)	(±0.4)	(±2.1)	(±0.0)
8.22	5.00	2.92E-08	7.4	0.0	0.0	0.0	11.4	47.0	88.0	0.5	2.4	19.0
13.22		(±5.31E-08)	(±1.4)	(±0.0)	(±0.0)	(±0.0)	(±8.9)	(±6.9)	(±25.1)	(±0.2)	(±0.8)	(±0.0)

Depth values presented in this table are measured from free ground surface



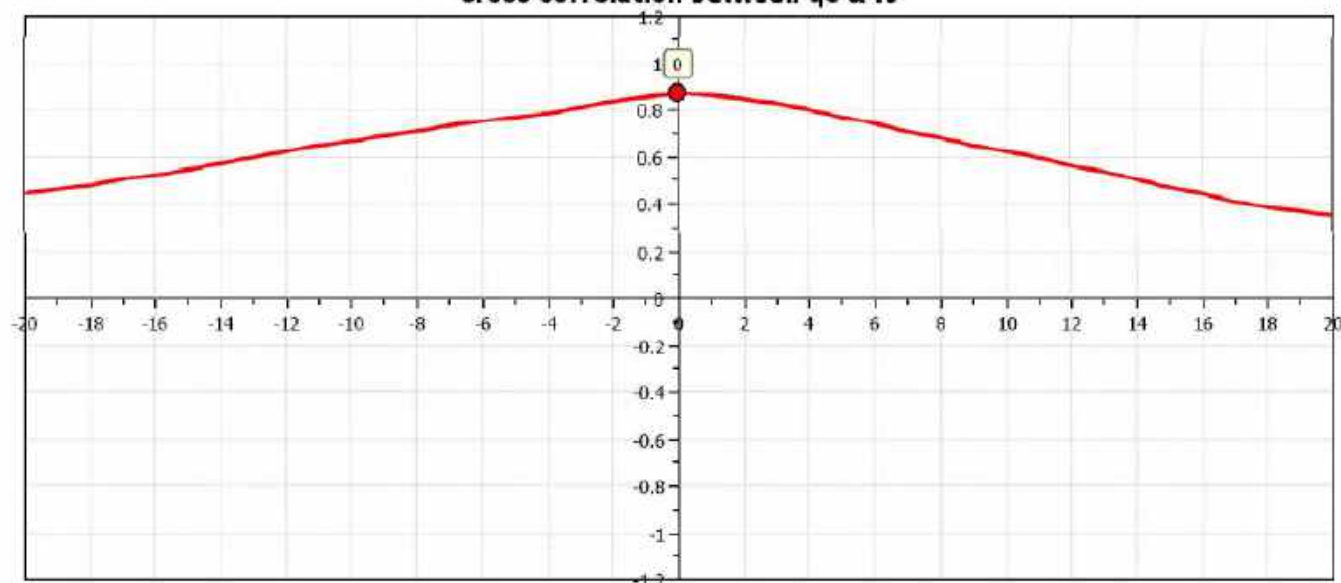
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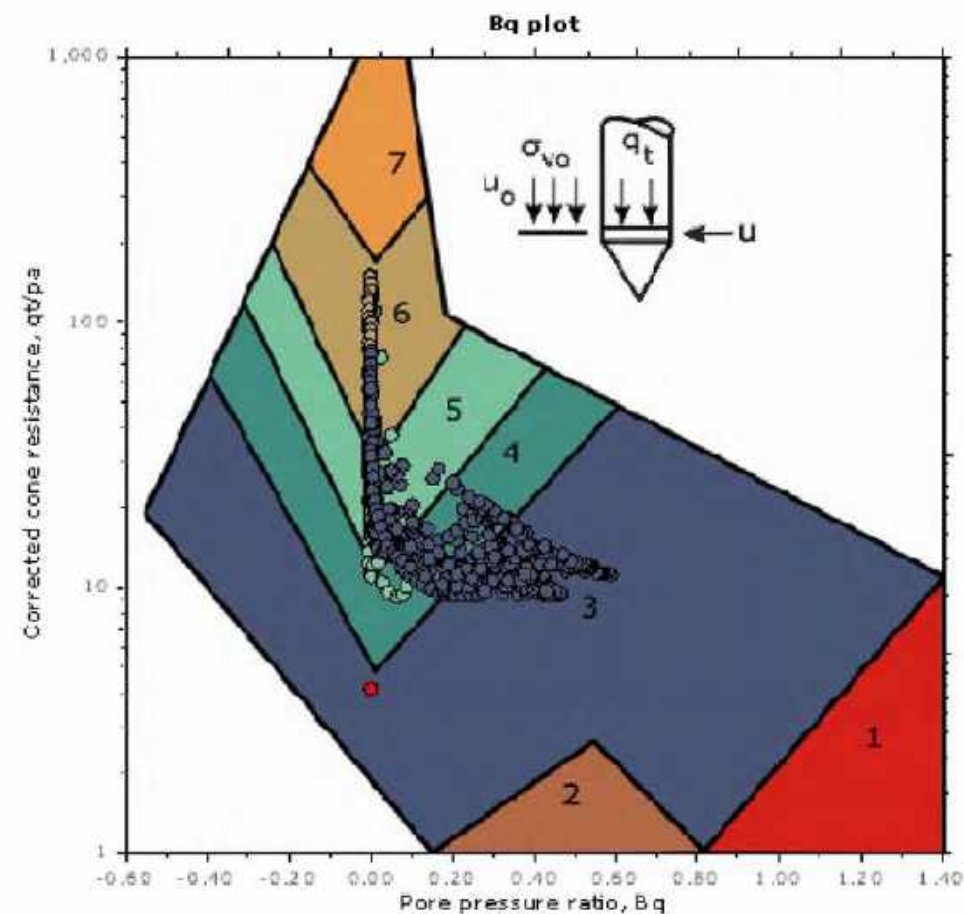
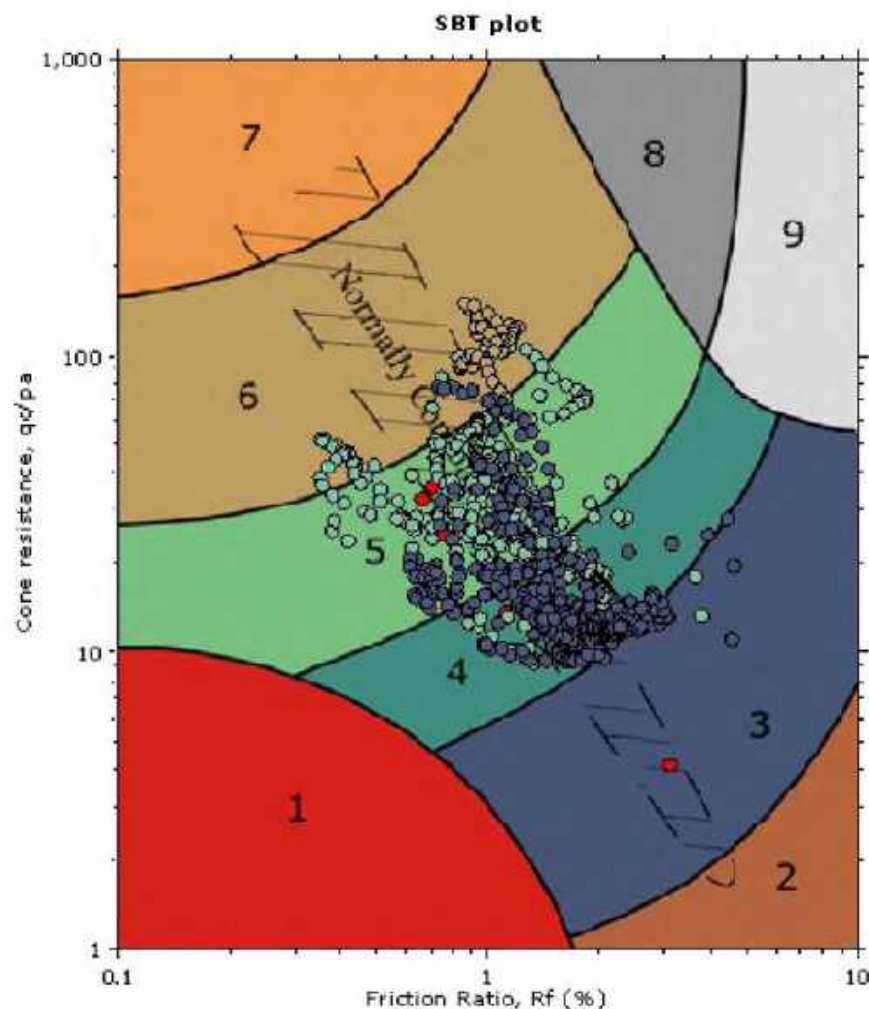


The plot below presents the cross correlation coefficient between the raw q_c and f_s values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).

Cross correlation between q_c & f_s



SBT - Bq plots

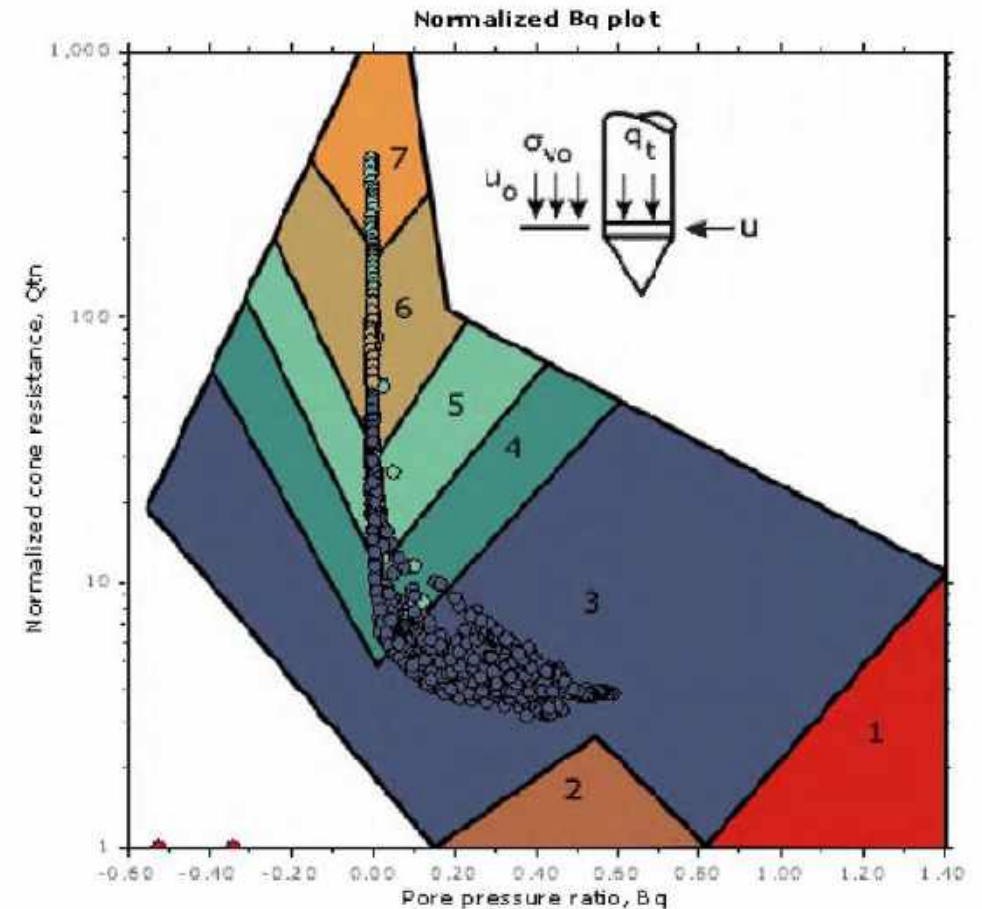
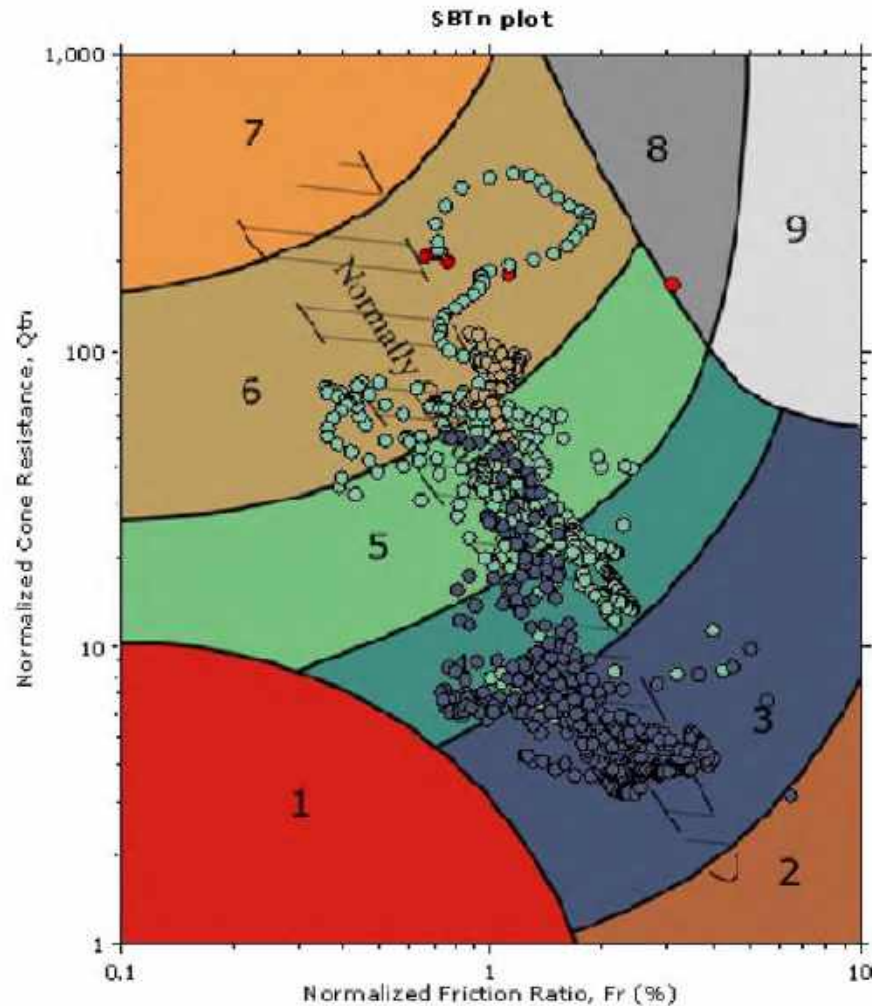


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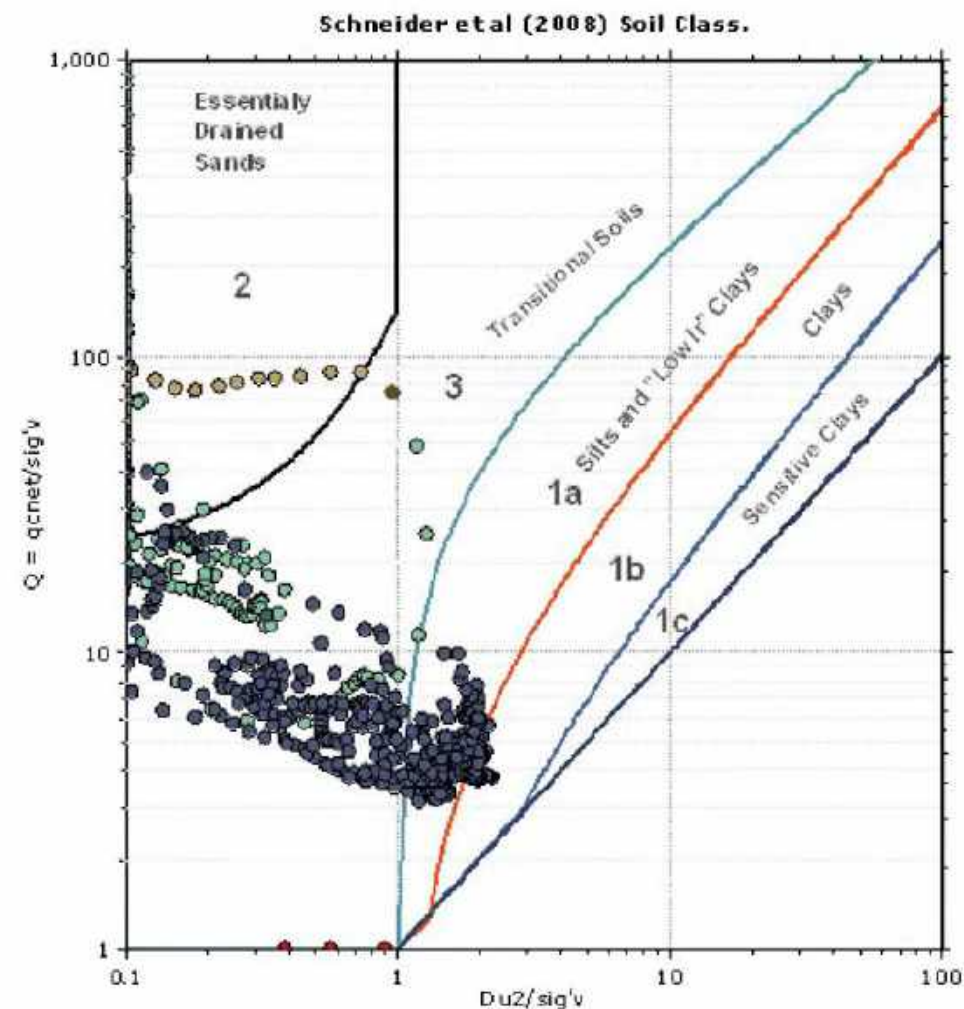
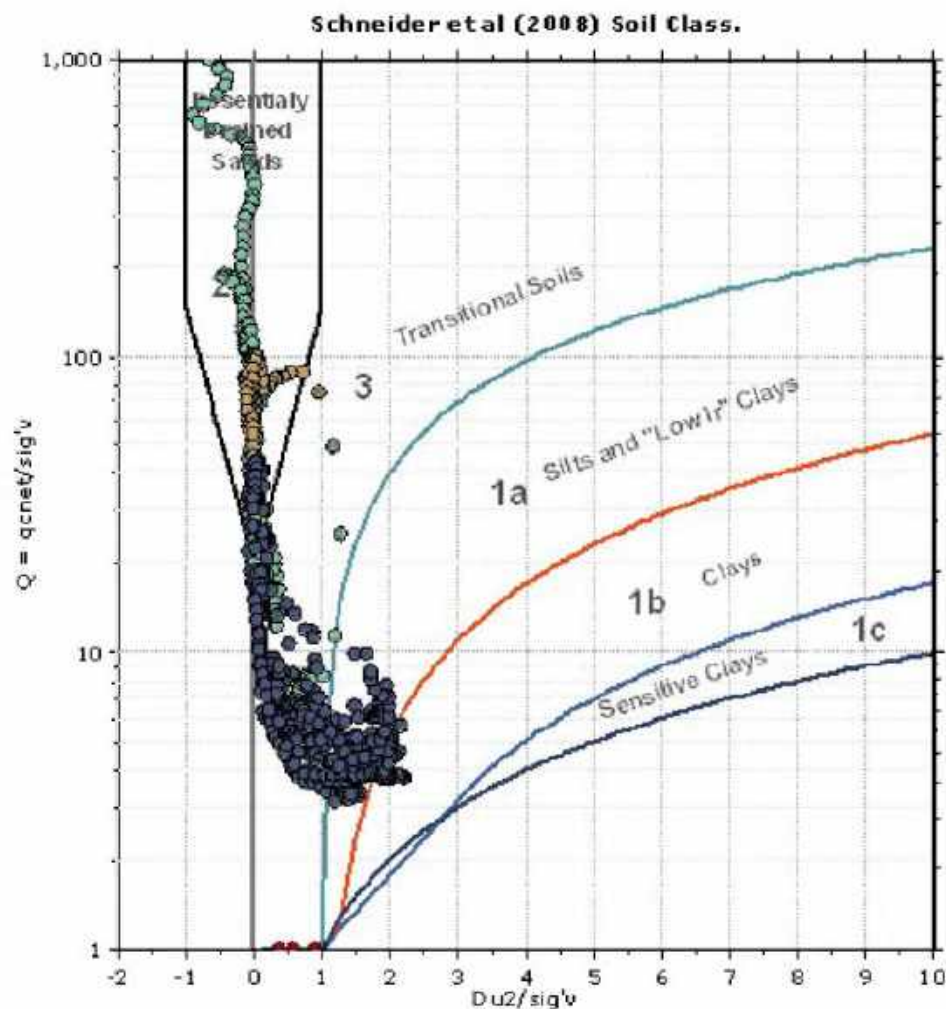
SBT - Bq plots (normalized)



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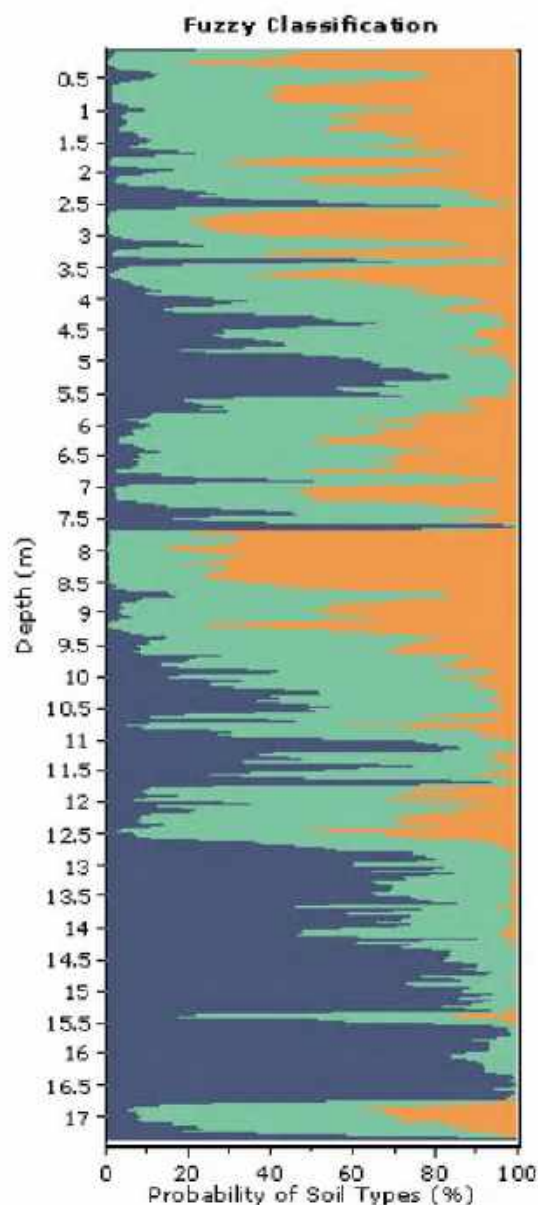
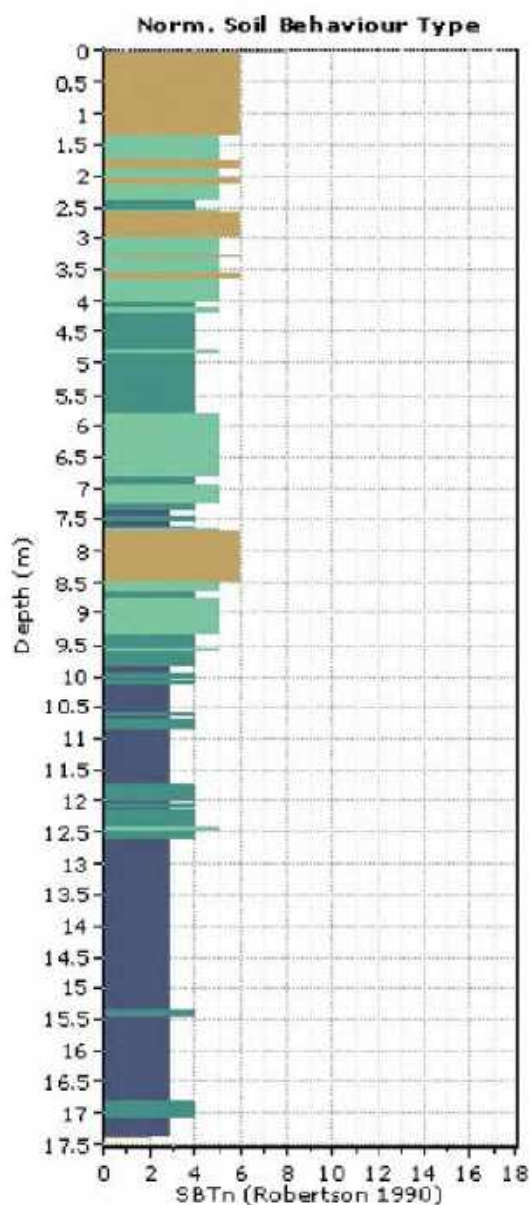
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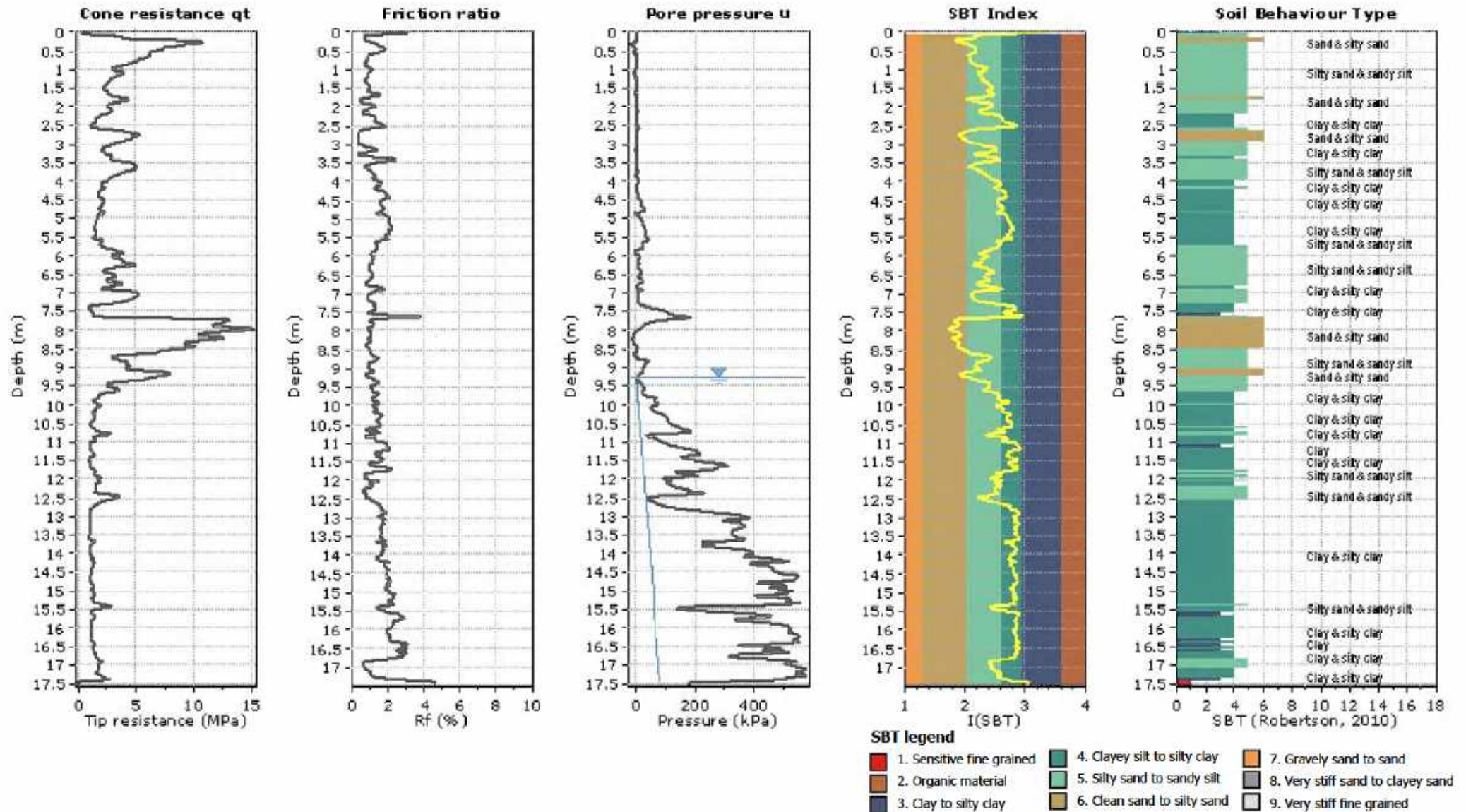
CPT: KP CPT08

Total depth: 17.48 m, Date: 4/09/2020

Coords: lat 305920.4° lon 6879687.6°

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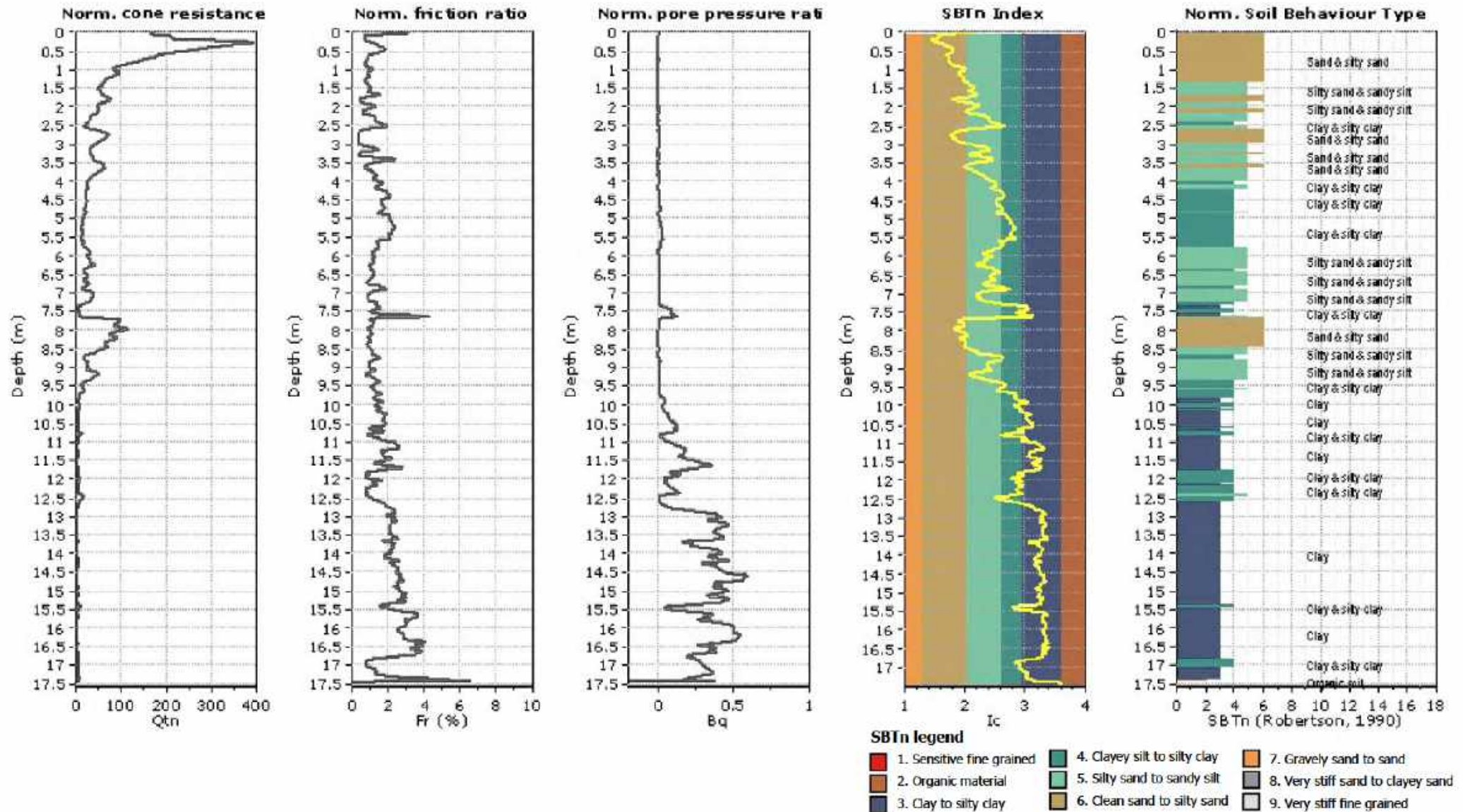
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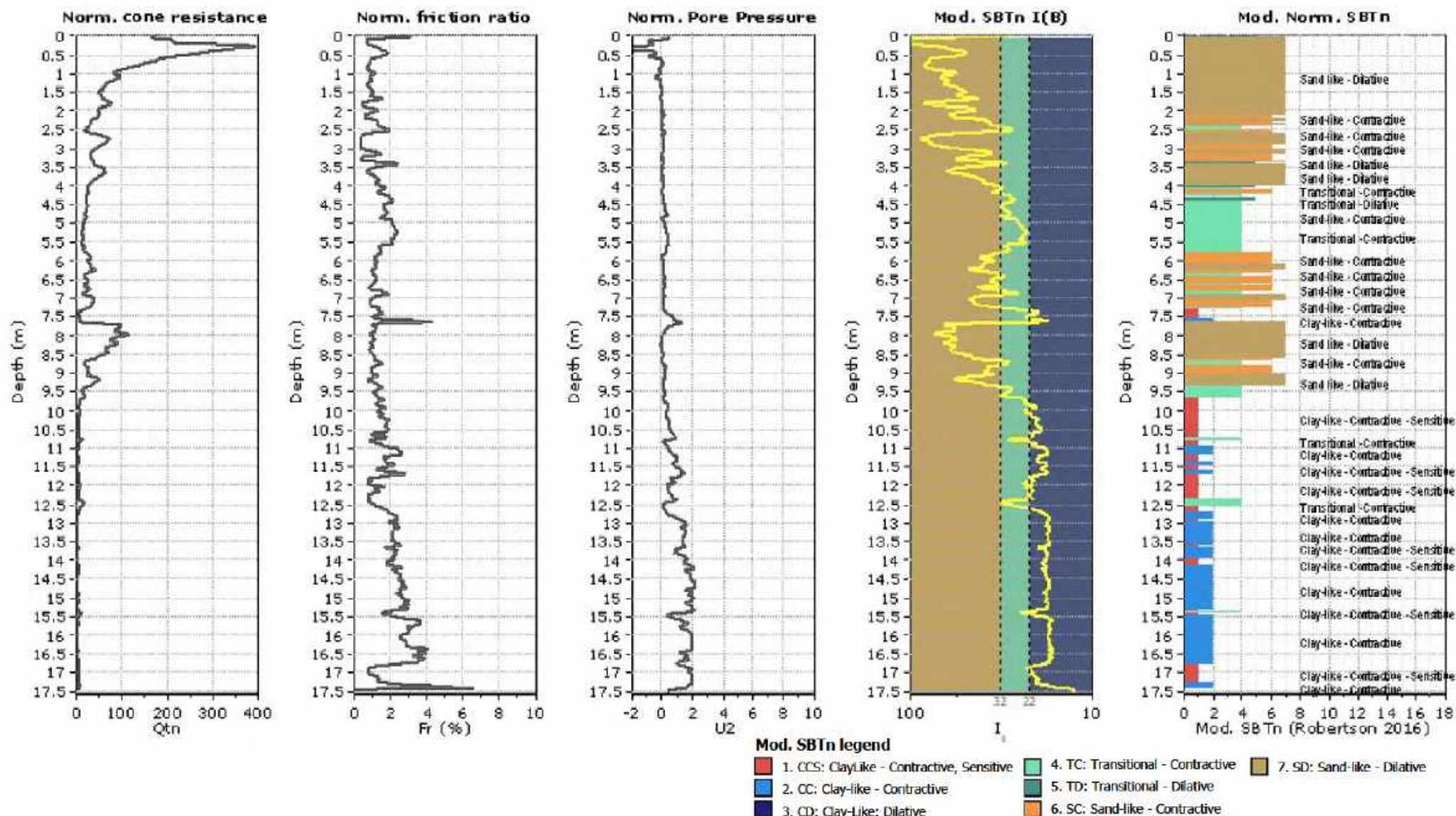
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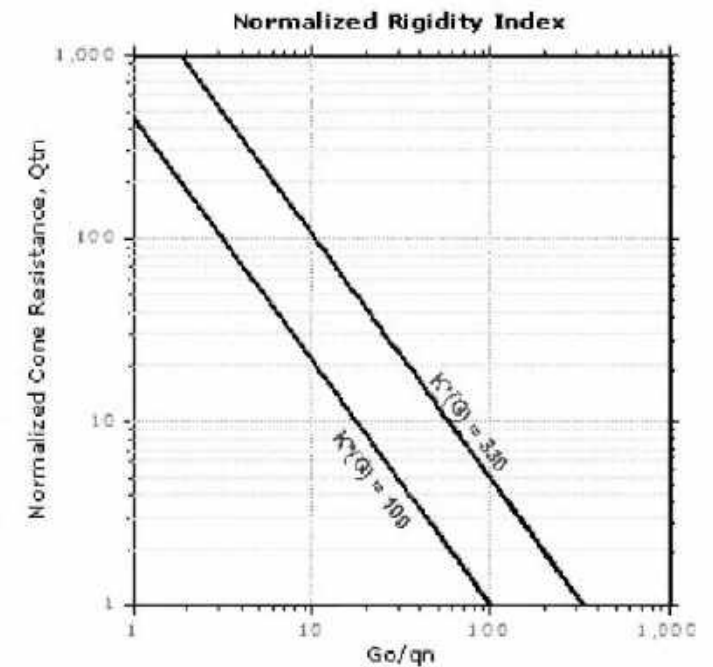
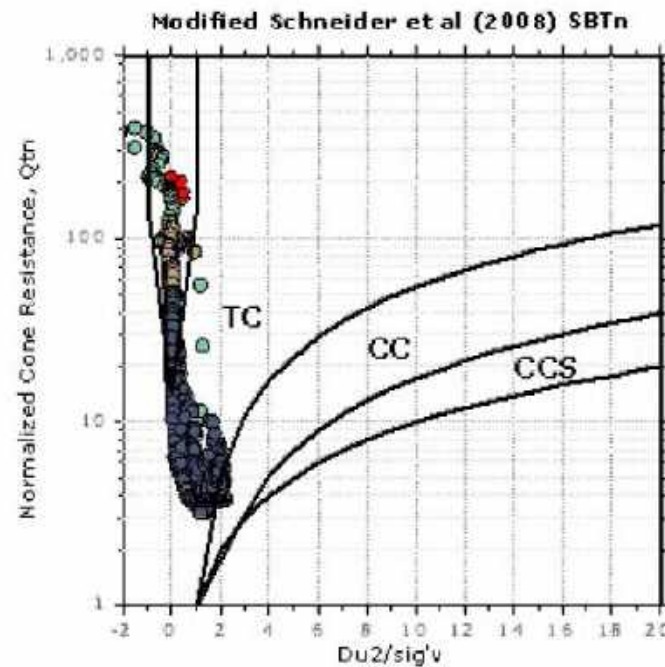
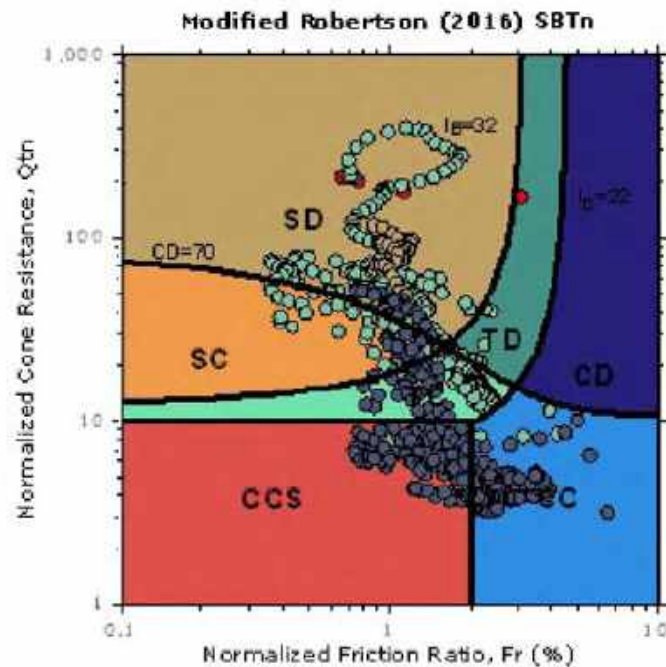
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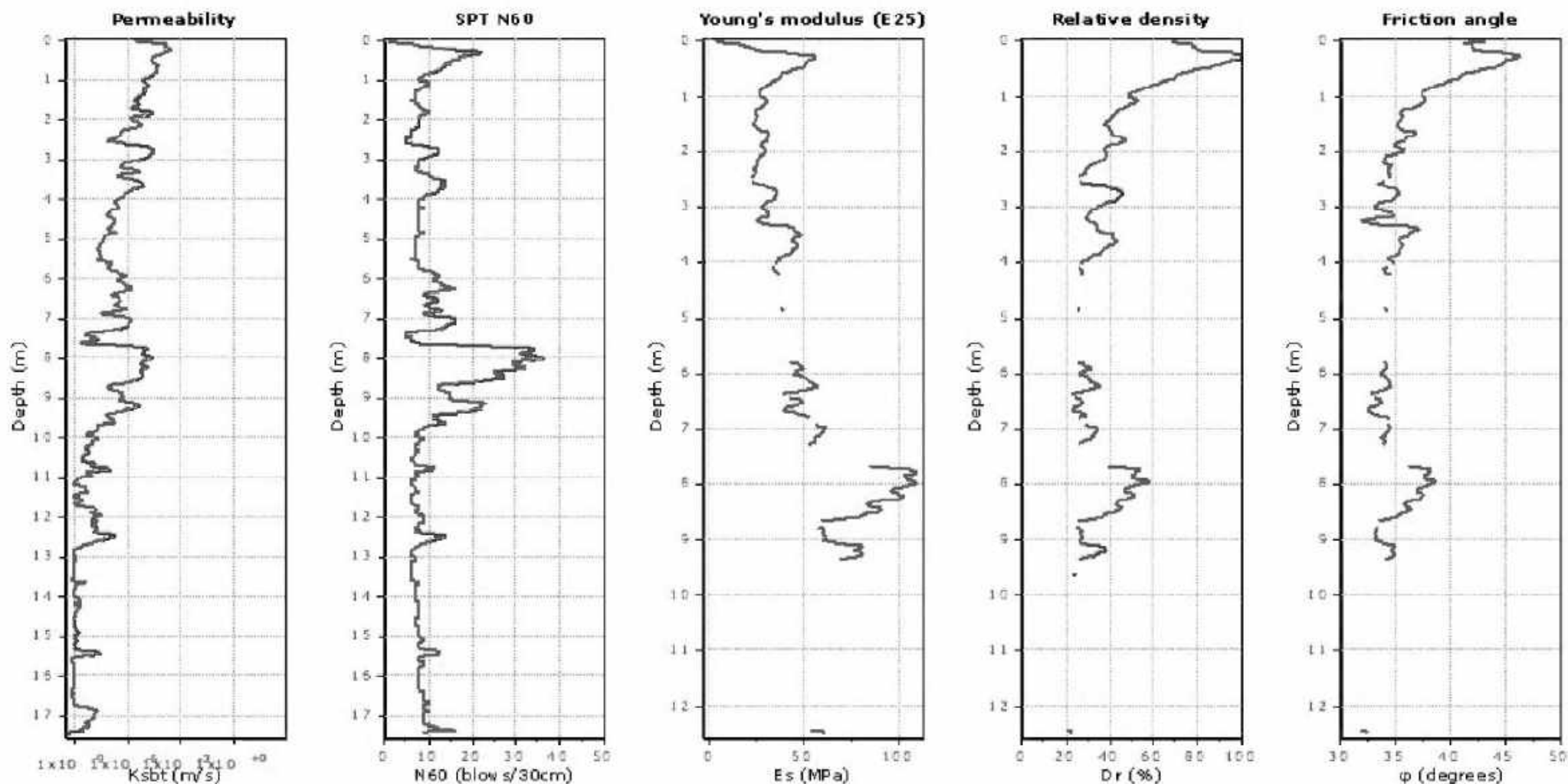


Updated SBTn plots



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Calculation parameters

Permeability: Based on SBT_a

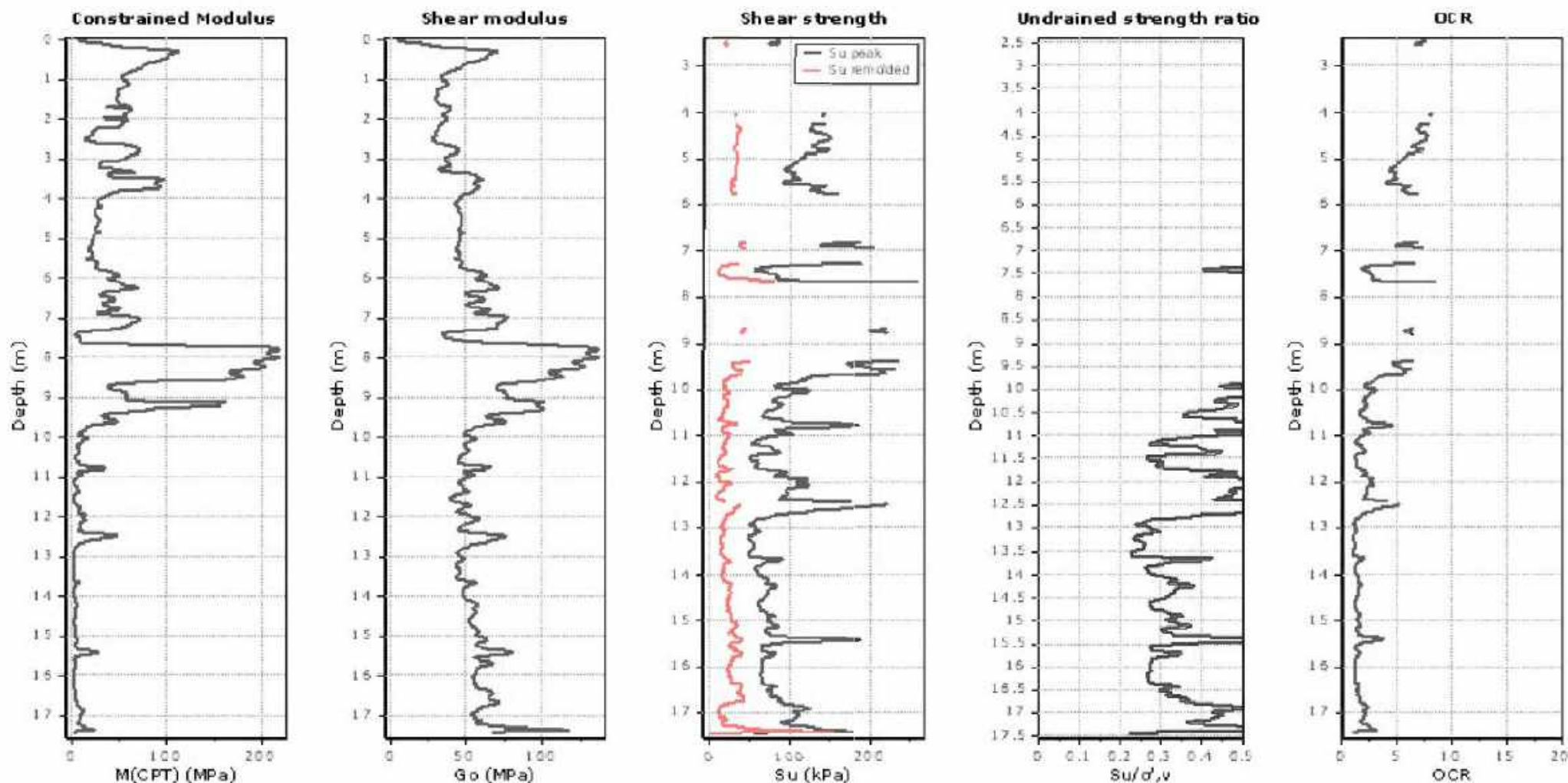
SPT N_{60} : Based on I_c and q_t

Young's modulus: Based on variable alpha using I_c (Robertson, 2009)

Relative density constant, C_{Dr} : 350.0

Phi: Based on Kulhawy & Mayne (1990)

● User defined estimation data



Calculation parameters

Constrained modulus: Based on variable alpha using I_c and Q_m (Robertson, 2009)

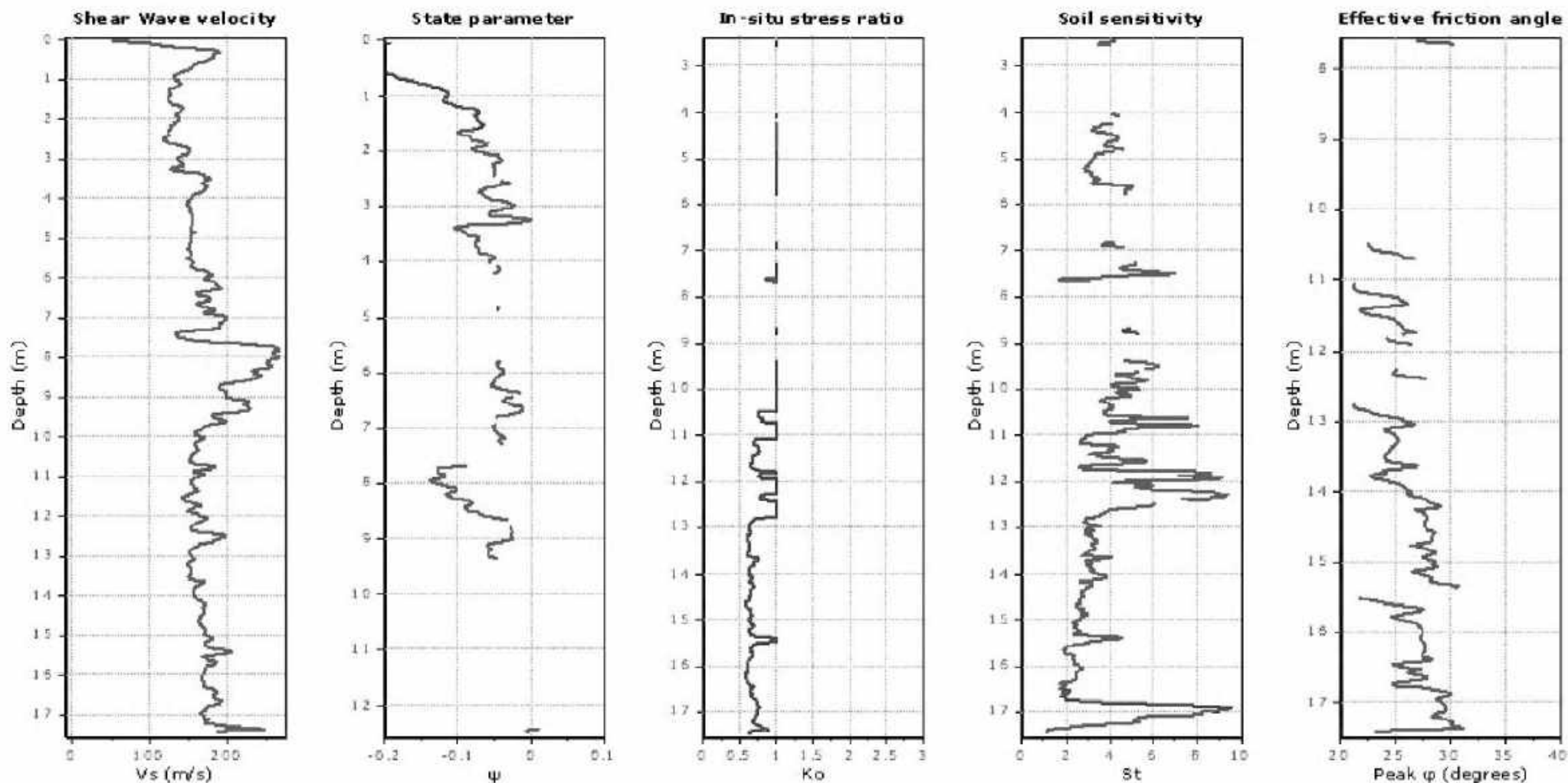
G_0 : Based on variable alpha using I_c (Robertson, 2009)

Undrained shear strength cone factor for clays, N_{sk} : 14

OCR factor for clays, N_{sk} : 0.33

● User defined estimation data

● Flat Dilatometer Test data



Calculation parameters

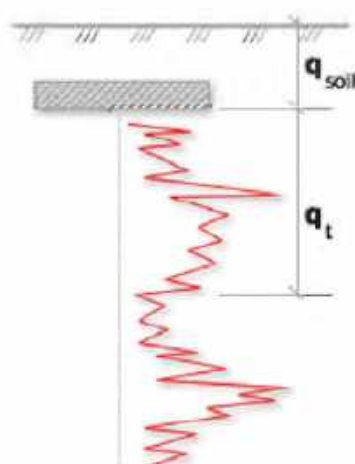
Sol Sensitivity factor, N_s : 7.00

—●— User defined estimation data



Project: Thunderbox Gold Mine

Location: Leinster, Western Australia, Australia



Bearing Capacity calculation is performed based on the formula:

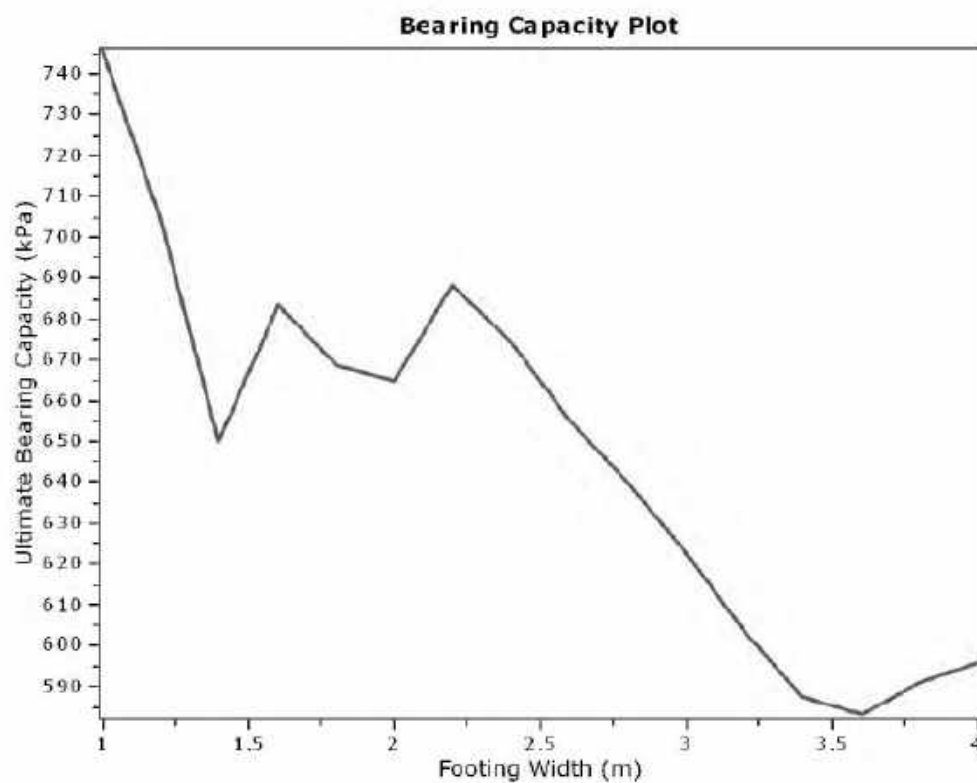
$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:

R_k : Bearing capacity factor

q_t : Average corrected cone resistance over calculation depth

q_{soil} : Pressure applied by soil above footing



:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	3.68	0.20	9.50	745.33
2	1.20	0.50	2.30	3.47	0.20	9.50	704.03
3	1.40	0.50	2.60	3.20	0.20	9.50	650.23
4	1.60	0.50	2.90	3.37	0.20	9.50	683.49
5	1.80	0.50	3.20	3.30	0.20	9.50	668.79
6	2.00	0.50	3.50	3.27	0.20	9.50	664.46
7	2.20	0.50	3.80	3.39	0.20	9.50	688.22
8	2.40	0.50	4.10	3.33	0.20	9.50	674.64
9	2.60	0.50	4.40	3.23	0.20	9.50	654.98
10	2.80	0.50	4.70	3.15	0.20	9.50	639.72
11	3.00	0.50	5.00	3.06	0.20	9.50	622.45
12	3.20	0.50	5.30	2.97	0.20	9.50	603.51
13	3.40	0.50	5.60	2.89	0.20	9.50	587.43
14	3.60	0.50	5.90	2.87	0.20	9.50	583.06
15	3.80	0.50	6.20	2.91	0.20	9.50	591.06
16	4.00	0.50	6.50	2.93	0.20	9.50	595.60



Knight Piesold
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Project: Thunderbox Gold Mine

Location: Leinster, Western Australia, Australia

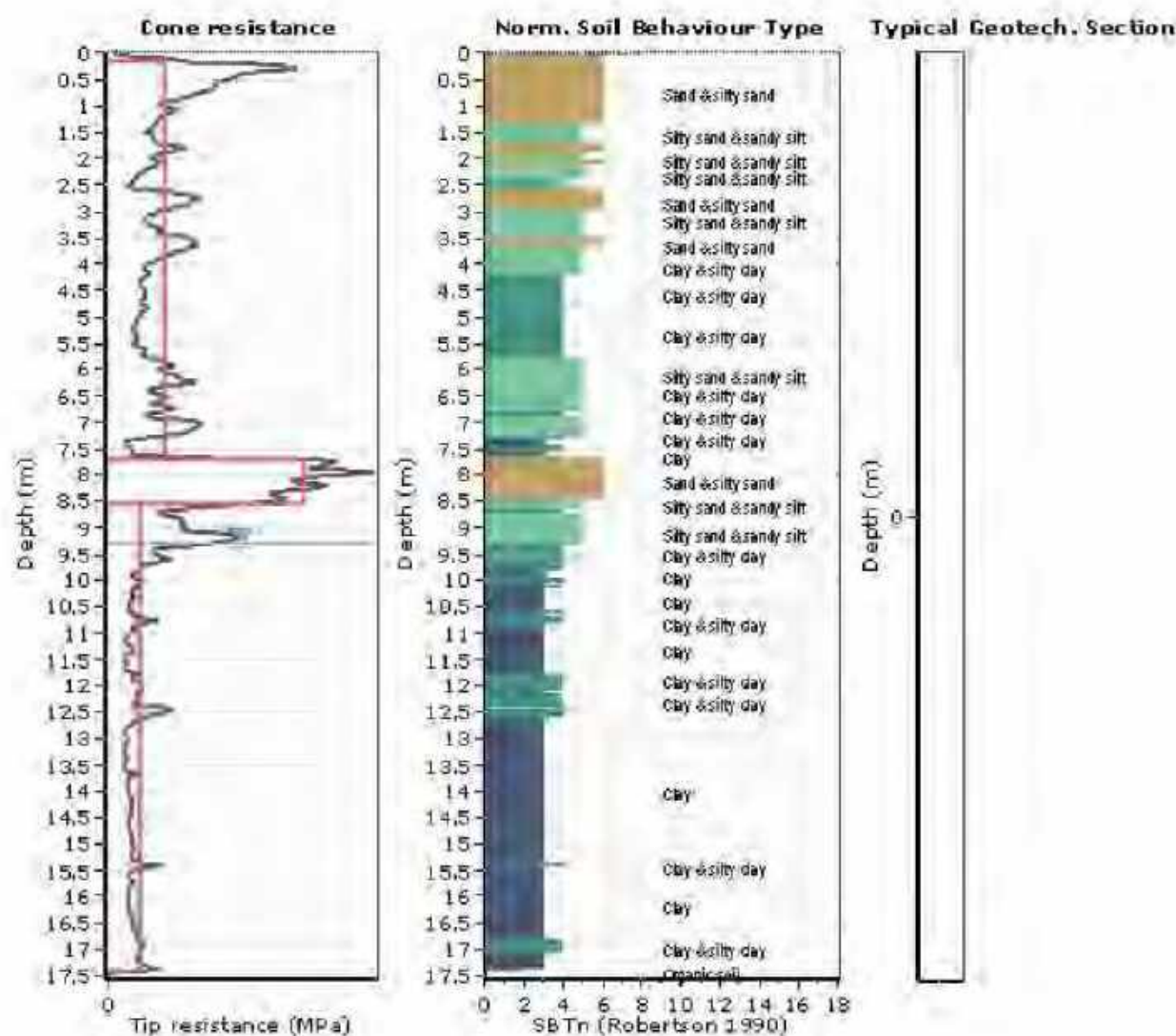
CPT: KP CPT08

Total depth: 17.48 m, Date: 4/09/2020

Coords: lat 305920.4° lon 6879687.6°

Cone Type: 180911

Cone Operator: Hagstrom Drilling



Tabular results

::: Layer No: 1 :::

Code: Layer_1 **Start depth:** 0.12 (m), **End depth:** 7.68 (m)

Description: Silty sand & sandy silt

Basic results

Total cone resistance: 3.18 ± 1.68 MPa

Sleeve friction: 36.44 ± 22.09 kPa

Ic: 2.30 ± 0.36

SBT_n: 5

SBTn description: Silty sand & sandy silt

Estimation results

Permeability: $1.17 \times 10^{-5} \pm 3.59 \times 10^{-5}$ m/s

N₆₀: 9.77 ± 3.27 blows

Es: 38.03 ± 11.27 MPa

Dr (%): 41.85 ± 17.71

ϕ (degrees): 35.87 ± 3.09 °

Unit weight: 19.00 ± 0.00 kN/m³

Constrained Mod.: 45.93 ± 23.38 MPa

G_o: 47.08 ± 12.63 MPa

Su: 0.00 ± 0.00 kPa

Su ratio: 0.00 ± 0.00

O.C.R.: 0.00 ± 0.00

:: Layer No: 2 ::**Code:** Layer_2 **Start depth:** 7.68 (m), **End depth:** 8.56 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 11.17 ±1.93 MPa

Sleeve friction: 114.93 ±22.94 kPa

Ic: 2.00 ±0.08

SBT_n: 6SBT_n description: Sand & silty sand**Estimation results**

Permeability: 8.81E-06 ±4.87E-06 m/s

N₆₀: 29.82 ±3.81 blows

Es: 97.94 ±9.09 MPa

Dr (%): 48.12 ±4.95

φ (degrees): 37.11 ±0.95 °

Unit weight: 19.00 ±0.00 kN/m³

Constrained Mod.: 194.32 ±22.71 MPa

Go: 122.75 ±11.39 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

:: Layer No: 3 ::**Code:** Layer_3 **Start depth:** 8.56 (m), **End depth:** 17.42 (m)**Description:** Clay**Basic results**

Total cone resistance: 1.84 ±1.26 MPa

Sleeve friction: 27.08 ±15.55 kPa

Ic: 3.05 ±0.30

SBT_n: 3SBT_n description: Clay**Estimation results**

Permeability: 1.03E-07 ±4.41E-07 m/s

N₆₀: 8.98 ±3.27 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 19.00 ±0.00 kN/m³

Constrained Mod.: 15.19 ±25.12 MPa

Go: 58.18 ±13.30 MPa

Su: 89.19 ±37.39 kPa

Su ratio: 0.43 ±0.22

O.C.R.: 1.99 ±1.03

Summary table of mean values

From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT _{N50} (blows/30cm)	E _s (MPa)	D _r (%)	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G _o (MPa)	Undrained strength, S _u (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m ³)
0.12	7.56	1.17E-05	9.8	38.0	41.8	35.9	45.9	47.1	0.0	0.0	0.0	19.0
7.68		(±3.59E-05)	(±3.3)	(±11.3)	(±17.7)	(±3.1)	(±23.4)	(±12.6)	(±0.0)	(±0.0)	(±0.0)	(±0.0)
7.68	0.88	8.81E-06	29.8	97.9	48.1	37.1	194.3	122.7	0.0	0.0	0.0	19.0
8.56		(±4.87E-06)	(±3.8)	(±9.1)	(±4.9)	(±0.9)	(±22.7)	(±11.4)	(±0.0)	(±0.0)	(±0.0)	(±0.0)
8.56	8.86	1.03E-07	9.0	0.0	0.0	0.0	15.2	58.2	89.2	0.4	2.0	19.0
17.42		(±4.41E-07)	(±3.3)	(±0.0)	(±0.0)	(±0.0)	(±25.1)	(±13.3)	(±37.4)	(±0.2)	(±1.0)	(±0.0)

Depth values presented in this table are measured from free ground surface

Presented below is a list of formulas used for the estimation of various soil properties. The formulas are presented in SI unit system and assume that all components are expressed in the same units.

:: Unit Weight, g (kN/m³) ::

$$g = g_w \cdot \left(0.27 \cdot \log(R_f) + 0.36 \cdot \log\left(\frac{q_t}{p_a}\right) + 1.236 \right)$$

where g_w = water unit weight

:: Permeability, k (m/s) ::

$$I_c < 3.27 \text{ and } I_c > 1.00 \text{ then } k = 10^{0.952 - 3.04 \cdot I_c}$$

$$I_c \leq 4.00 \text{ and } I_c > 3.27 \text{ then } k = 10^{-4.52 - 1.37 \cdot I_c}$$

:: N_{SP_T} (blows per 30 cm) ::

$$N_{60} = \left(\frac{q_c}{p_a} \right) \cdot \frac{1}{10^{1.1268 - 0.2817 \cdot I_c}}$$

$$N_{(60)} = Q_{tn} \cdot \frac{1}{10^{1.1268 - 0.2817 \cdot I_c}}$$

:: Young's Modulus, E_s (MPa) ::

$$(q_t - \sigma_v) \cdot 0.015 \cdot 10^{0.55 \cdot I_c - 1.68}$$

(applicable only to $I_c < I_{c_cutoff}$)

:: Relative Density, Dr (%) ::

$$100 \cdot \sqrt{\frac{Q_{tn}}{k_{DR}}} \quad \text{(applicable only to SBT}_n\text{: 5, 6, 7 and 8 or } I_c < I_{c_cutoff}\text{)}$$

:: State Parameter, ψ ::

$$\psi = 0.56 - 0.33 \cdot \log(Q_{tn,CS})$$

:: Drained Friction Angle, ϕ (°) ::

• • • • •

(applicable only to SBT_n: 5, 6, 7 and 8 or $I_c < I_{c_cutoff}$)

:: 1-D constrained modulus, M (MPa) ::

If $I_c > 2.20$

$a = 14$ for $Q_{tn} > 14$

$a = Q_{tn}$ for $Q_{tn} \leq 14$

$M_{CPT} = a \cdot (q_t - \sigma_v)$

If $I_c \geq 2.20$

• • • • •

:: Small strain shear Modulus, G_0 (MPa) ::

$$G_0 = (q_t - \sigma_v) \cdot 0.0188 \cdot 10^{0.55 \cdot I_c + 1.68}$$

:: Shear Wave Velocity, V_s (m/s) ::

$$V_s = \left(\frac{G_0}{\rho} \right)^{0.50}$$

:: Undrained peak shear strength, S_u (kPa) ::

$$N_{kt} = 10.50 + 7 \cdot \log(F_r) \text{ or user defined}$$

$$S_u = \frac{(q_t - \sigma_v)}{N_{kt}}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c_cutoff}$)

:: Remolded undrained shear strength, $S_{u(rem)}$ (kPa) ::

$$S_{u(rem)} = f_s \quad \text{(applicable only to SBT}_n\text{: 1, 2, 3, 4 and 9 or } I_c > I_{c_cutoff}\text{)}$$

:: Overconsolidation Ratio, OCR ::

$$k_{OCR} = \left[\frac{Q_{tn}^{0.20}}{0.25 \cdot (10.50 + 7 \cdot \log(F_r))} \right]^{1.25} \text{ or user defined}$$

$$OCR = k_{OCR} \cdot Q_{tn}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c_cutoff}$)

:: In situ Stress Ratio, K_0 ::

$$K_0 = (1 - \sin \phi') \cdot OCR^{\sin \phi'}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c_cutoff}$)

:: Soil Sensitivity, S_t ::

$$S_t = \frac{N_s}{F_r}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c_cutoff}$)

:: Peak Friction Angle, ϕ' (°) ::

$$\phi' = 29.5^\circ \cdot B_q^{0.121} \cdot (0.256 + 0.336 \cdot B_q + \log Q_t)$$

(applicable for $0.10 < B_q < 1.00$)

References

- Robertson, P.K., Cabal K.L., Guide to Cone Penetration Testing for Geotechnical Engineering, Gregg Drilling & Testing, Inc., 5th Edition, November 2012
- Robertson, P.K., Interpretation of Cone Penetration Tests - a unified approach., Can. Geotech. J. 46(11): 1337–1355 (2009)

APPENDIX B
CPT Photos

**THUNDERBOX GOLD MINE
SITE INVESTIGATION – 2020 TSF
CPT PHOTOGRAPHS**



Plate 1: KP CPT01 – Setup



Plate 2: KP CPT01 – South View

**THUNDERBOX GOLD MINE
SITE INVESTIGATION – 2020 TSF
CPT PHOTOGRAPHS**



Plate 3: KP CPT02 – East View



Plate 4: KP CPT02 – Setup

**THUNDERBOX GOLD MINE
SITE INVESTIGATION – 2020 TSF
CPT PHOTOGRAPHS**



Plate 5: KP CPT02 – West View



Plate 6: KP CPT02 – South View

**THUNDERBOX GOLD MINE
SITE INVESTIGATION – 2020 TSF
CPT PHOTOGRAPHS**



Plate 7: KP CPT03 – Setup and South View



Plate 8: KP CPT04 – Setup and South View

**THUNDERBOX GOLD MINE
SITE INVESTIGATION – 2020 TSF
CPT PHOTOGRAPHS**



Plate 9: KP CPT04 – Setup and South-West View



Plate 10: KP CPT08 – Setup

**THUNDERBOX GOLD MINE
SITE INVESTIGATION – 2020 TSF
CPT PHOTOGRAPHS**



Plate 11: KP CPT08 – North



Plate 12: KP CPT08 – South

APPENDIX C
TSF Expansion Site Investigation – 2021



MEMORANDUM

To: Northern Star Resources Limited

Date: 20 July 2021

Our Ref: PE21-00909

KP File Ref.: PE801-00296/26-A jl M21004

From: [REDACTED]

RE: THUNDERBOX PROJECT – TSF CELL C AND CELL D SITE INVESTIGATION

Knight Piésold Pty Limited (KP) was requested by Northern Star Resources Limited (Northern Star) to undertake a geotechnical site investigation of the proposed TSF Cells C and Cell D at the Thunderbox Gold Mine site. The investigation was conducted in addition to the TSF Cell C investigation conducted by KP in 2020 (Ref. 1).

The site investigation was undertaken from the 12th to 23rd of March 2021. This memorandum presents the factual information obtained from the geotechnical investigation and the interpretation of the ground conditions at the proposed TSF Cells C and D locations. It is noted that these interpretations have already been incorporated into the design documentation, this memo is for record purposes.

1. SITE CHARACTERISTICS

1.1 INTRODUCTION

The Thunderbox Gold Mine is located 45 km south of the town of Leinster in Western Australia and immediately adjacent to the sealed Goldfields Highway.

1.2 TOPOGRAPHY AND SETTING

The proposed TSF Cell C is located to the south of the existing TSF cells and immediately east of the Eastern Waste Dump. The proposed TSF Cell D is in the east of the existing TSF Cells A and B.

The area around both TSF Cells C and D is generally flat, with natural slopes at approximately 1%. Moderately dried out vegetation is present throughout the investigation area. In some areas, the vegetation is slightly thicker than other areas, however towards the centre of the proposed Cells C and D, vegetation becomes scarce.

1.3 CLIMATE

The region is in a semi-arid environment and has a dry climate with hot summers and cool winters. The average annual rainfall is about 224 mm. February and March tend to be the wettest months, September and October are the driest months (Ref. 2). Average monthly pan evaporation values for the site are in the range of 91 mm to 404 mm per month with an annual evaporation of 2,866 mm.

1.4 GEOLOGY

SKM carried out a site material characterization in 2014 and summarized the regional and mine site geology (Ref. 3). The mine site geology is extracted below:

Thunderbox lies within the Yilgarn Shield of Western Australia, which consists primarily of granite and granite-gneiss rocks cut out by narrow north-west trending belts of Archaean age meta-sedimentary and meta-volcanic rocks, generally referred to as 'greenstone belts'. They contain a mixture of metamorphosed mafic to ultra-mafic volcanic rocks (including basalt, amphibolite, dolerite and gabbro), felsic volcanic rocks, and metasedimentary rocks (including cherts and banded iron formations). The greenstone sequence has been deeply weathered and lateritised with lateritic profiles being preserved over most of the ultramafic sequence (Lindbeck 2001).

The 1:250,000 geological map of Leonora (Ref. 4) indicates that the site is founded on igneous rock which is overlain by colluvial (Cza) and possibly alluvial (Qa) deposits:

- Qa: alluvial clay, silt, sand and gravel. The site is located at the uppermost reach of the drainage line and alluvial material is expected to be limited or absent.
- Cza: colluvial clay, silt and sand (pebbly in places).

Figures 1.1 and 1.2 present the geological map and map key.

1.5 HYDROGEOLOGY

The water levels monitored in 6 holes at the TSF site were relatively stable from 2002 to 2013. The water levels were in the range between approximately 21 m to 29 m below ground surface (Ref. 5).

2. SITE INVESTIGATION

2.6 INTRODUCTION

A geotechnical investigation was conducted for proposed TSF Cell C by KP in 2020 (Ref. 1). However, due to an increase in throughput, a subsequent geotechnical site investigation was undertaken to determine the foundation conditions across the proposed TSF Cells C and D to provide design parameters for foundation and earthworks design. The scope of work comprised borehole drilling and test pitting at the proposed TSF Cells C and D.

The work was carried out during March 2021 and comprised:

- Drilling three boreholes within the proposed TSF Cells C and D area using diamond coring techniques to depths of 24.1m, 27.3 m and 9m.
- Standard Penetration Tests (SPT) at selected intervals in the foundation soils.
- Test pitting at fifty-one locations within the proposed TSF Cells C and D area.
- Collection of undisturbed samples of soils for laboratory testing.

Fieldwork was supervised by a Geotechnical Engineer from KP Perth. The test locations were pre-determined and set out on site by a Northern Star surveyor and verified by the Geotechnical Engineer, prior to fieldwork.

The site investigation was undertaken in accordance with Australian Standard AS1726-2017 (Ref. 6).

Figure 2.1 shows the site investigation plan including the approximate footprint of the proposed TSF Cells C and D.

The coordinates used are to UTM WGS84 Zone 51J (north) grid whereas Thunderbox uses a site grid. As the horizontal difference between the two grid systems is less than 1 m, the test pits were set out using a hand-held GPS to approximately +/- 5 m accuracy, and no grid conversion was made.

2.7 BOREHOLE DRILLING

Three boreholes were drilled to depths between 9 m and 27.3 m using the HQ size triple-tube diamond coring technique. The drilling rig was supplied and operated by Edge Drilling. The borehole locations are shown in Figure 2.1.

The cores were placed into core trays, logged and photographed by the KP site representative. All cores were subsequently transported to the Thunderbox store for temporary storage prior to shipment of samples to the laboratory.

Two falling head permeability tests were conducted in each borehole, after the boreholes had been thoroughly cleaned of drill muds.

Standard Penetration Tests (SPTs) were undertaken in the boreholes, to assess the strength characteristics and nature of the in-situ material. The SPTs were conducted within the upper layer and due to the presence of rock throughout the remainder of the boreholes, no other SPTs were attempted due to the significant risk of damage to equipment. The SPT results are plotted in Figure 2.2.

A summary of the drilling work is presented in Table 2.1.

Logs and photographs of the boreholes are presented in appendices A and B respectively.

Table 2.1: Summary of Borehole Drilling

Borehole ID	Date Completed	Total Depth (m)	Falling Head Permeability Test Depths (m)
C-BH05	19-Mar-21	24.1	0.5, 23.8
C-BH06	21-Mar-21	27.3	0.5, 27.0
C-BH07	22-Mar-21	9.0	0.5, 4.7

2.8 TEST PITTING

Fifty-one test pits were excavated to depths between 0.3 m and 1.5 m using a CAT 336D fitted with a 600 mm toothed bucket supplied and operated by Northern Star.

All test pits were conducted in the original planned locations, as surveyed prior to arrival, with the exception of D-TP-05 which was proposed to be at the centre point of the access road, and D-TP-35 and D-TP-36 which were located at the base of the TSF drain. These three test pits were subsequently moved to be approximately 10 m east to the edge of the road or drain.

Bulk disturbed samples were taken from twelve test pits and sent for laboratory testing.

A summary of the test pits is presented in Table 2.2. Refusal was encountered at shallow depths in all test pits, indicating the existence of a Ferricrete hardpan across the TSF site.

Logs and photographs of the test pits are presented in appendices C and D respectively. The test pit locations are shown in Figure 2.1.

Table 2.2: Summary of Test Pitting

Test Pit ID	Date Conducted	Refusal Depth (m)
C-TP-35	13-Mar-21	0.8
C-TP-36	13-Mar-21	0.7
C-TP-37	13-Mar-21	0.8
C-TP-38	13-Mar-21	0.6
C-TP-39	13-Mar-21	0.7
C-TP-40	13-Mar-21	0.8
C-TP-41	13-Mar-21	1.0
C-TP-42	13-Mar-21	1.0
C-TP-43	13-Mar-21	0.8
C-TP-44	13-Mar-21	0.6
C-TP-45	13-Mar-21	0.9
C-TP-46	13-Mar-21	0.9
C-TP-47	13-Mar-21	0.5
C-TP-48	13-Mar-21	1.1
C-TP-49	13-Mar-21	1.2
D-TP-01	13-Mar-21	1.5
D-TP-02	13-Mar-21	0.7
D-TP-03	13-Mar-21	0.8
D-TP-04	13-Mar-21	0.7
D-TP-05	14-Mar-21	0.7
D-TP-06	14-Mar-21	1.1
D-TP-07	14-Mar-21	1.1
D-TP-08	14-Mar-21	1.0
D-TP-09	14-Mar-21	0.9
D-TP-10	14-Mar-21	0.6
D-TP-11	14-Mar-21	1.0
D-TP-12	14-Mar-21	1.2
D-TP-13	14-Mar-21	1.2
D-TP-14	14-Mar-21	0.9
D-TP-15	14-Mar-21	0.8
D-TP-16	14-Mar-21	1.3
D-TP-17	14-Mar-21	0.7
D-TP-18	14-Mar-21	0.9
D-TP-19	14-Mar-21	0.9
D-TP-20	14-Mar-21	0.90

Test Pit ID	Date Conducted	Refusal Depth (m)
D-TP-21	14-Mar-21	0.60
D-TP-22	14-Mar-21	0.60
D-TP-23	15-Mar-21	1.30
D-TP-24	15-Mar-21	0.60
D-TP-25	15-Mar-21	0.70
D-TP-26	15-Mar-21	0.90
D-TP-27	15-Mar-21	0.50
D-TP-28	15-Mar-21	0.90
D-TP-29	15-Mar-21	0.80
D-TP-30	15-Mar-21	1.50
D-TP-31	15-Mar-21	0.70
D-TP-32	15-Mar-21	0.80
D-TP-33	15-Mar-21	0.50
D-TP-34	15-Mar-21	0.30
D-TP-35	15-Mar-21	0.50
D-TP-36	15-Mar-21	0.40

2.9 LABORATORY TESTING

The purpose of the laboratory testing was to classify and characterise the insitu materials, to assess their characteristics as founding materials and for embankment construction.

The laboratory testing was undertaken by E-Precision soil lab and comprised:

- Particle size distribution.
- Atterberg limits.
- Linear shrinkage.
- Compaction tests.
- Falling head permeability tests.
- Emerson tests.
- Consolidated Undrained (CU) triaxial tests.
- Uniaxial compressive strength.

The laboratory test reports are presented in Appendix E and the test results are summarised in Table 2.3.

Table 2.3: Summary of Laboratory Testing Results

Sample	Location	Depth (m)	Description	USCS symbol	A-line	Particle size distribution (%)			Atterberg Limits (%)			Linear Shrinkage (%)	Falling head permeability k (m/s) 98% SMDD	Emerson Class	Compaction Tests		Triaxial	
						Gravel	Sand	Fines	Liquid Limit	Plastic Limit	Plasticity Index				MDD (t/m ³)	OMC (%)	c' (kPa)	φ' (deg)
Disturbed Sample	C-TP-35	0.3-0.4	SAND	SP	CL or OL	10	60	30	34	18	16	4.79	8.8 x 10 ⁻⁷	8	1.65	19.5	-	-
	C-TP-39	0.4-0.5	SAND	SP	CL-ML	19	55	26	28	22	6	2.26	1.2 x 10 ⁻⁶	-	1.99	13.0	-	-
	C-TP-40	0.2-0.3	Sandy CLAY	SC	CL or OL	12	43	45	26	15	11	5.76	2.7 x 10 ⁻⁷	5	2.00	11.0	-	-
	C-TP-42	0.5-0.6	Sandy CLAY	SC	CL or OL	9	55	36	26	11	15	3.34	-	-	-	-	-	-
	C-TP-46	0.4-0.5	Sandy CLAY	SC	CL or OL	6	53	41	24	16	8	4.27	-	5	-	-	-	-
	D-TP-02	0.7-0.8	Sandy CLAY	SC	CL or OL	6	38	56	28	22	6	5.15	-	-	-	-	-	-
	D-TP-06	0.2-0.3	Sandy CLAY	SC	CL or OL	11	51	38	23	12	11	3.30	-	-	-	-	-	-
	D-TP-09	0.4-0.5	Sandy CLAY	SC	CL or OL	20	37	43	30	18	12	6.81	3.4 x 10 ⁻⁷	-	1.91	13.0	-	-
	D-TP-10	0.2-0.3	SAND	SP	CL-ML	22	50	28	19	13	6	3.25	9.4 x 10 ⁻⁷	8	2.25	7.0	-	-
	D-TP-15	0.4-0.5	Sandy CLAY	SC	CL or OL	6	41	53	24	15	9	2.56	-	-	-	-	-	-
	D-TP-17	0.4-0.5	Sandy CLAY	SC	CL or OL	22	40	38	23	15	8	3.61	-	-	-	-	-	-
	D-TP-19	0.2-0.3	Sandy CLAY	SC	CL or OL	9	53	38	17	10	7	3.47	1.3 x 10 ⁻⁷	-	2.08	10.5	-	-
	D-TP-21	0.3-0.4	Sandy CLAY	SC	CL or OL	13	43	44	28	14	14	6.15	9.9 x 10 ⁻⁸	-	1.99	12.0	-	-
	D-TP-24	0.2-0.3	Sandy CLAY	SC	CL or OL	5	49	46	21	11	10	6.82	-	-	-	-	-	-
	D-TP-26	0.5-0.6	Clayey Gravelly SAND	SP	CL or OL	34	41	25	25	15	10	2.91	1.7 x 10 ⁻⁶	5	2.20	9.5	-	-
	D-TP-27	0.2-0.3	Sandy CLAY	SC	CL or OL	18	39	43	22	15	7	3.96	9.7 x 10 ⁻⁸	5	1.92	13.5	-	-
	D-TP-29	0.3-0.4	SAND	SP	CL or OL	28	46	26	23	14	9	2.95	-	-	-	-	-	-
	D-TP-31	0.3-0.4	Sandy CLAY	SC	CL-ML	8	44	48	20	15	5	5.72	-	-	-	-	-	-
	D-TP-34	0.1-0.2	SAND	SP	CL or OL	28	44	28	21	15	6	5.90	1.3 x 10 ⁻⁶	-	2.11	10.5	-	-
	Eastern Waste Dump A	N/A	GRAVEL	GP	CL-ML	74	19	7	25	19	6	4.95	-	-	-	-	-	-
	Eastern Waste Dump B	N/A	GRAVEL	GP	CL or OL	83	12	5	26	20	6	4.11	-	-	-	-	-	-
SPT	SWD-A-20201219	N/A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	SWD-B-20201219	N/A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	C-BH-05	3.0-3.45	Silty Sandy GRAVEL	GP	ML or OL	44	40	16	37	28	9	4.27	-	-	-	-	-	-
	C-BH-05	21.1-21.35	SILT	ML	ML or OL	0	6	94	45	31	14	7.14	-	-	-	-	-	-
	C-BH-06	4.5-4.95	SILT	ML	ML or OL	3	10	87	47	36	11	4.56	-	-	-	-	-	-
Push Tube	C-BH-07	3.0-3.45	Sandy SILT	SM	MH or OH	9	48	43	53	37	16	5.17	-	-	-	-	-	-
	C-BH-07	4.5-4.9	Sandy SILT	SM	ML or OL	0	35	65	46	37	9	4.84	-	-	-	-	-	-
	C-BH-05	12.0-12.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23.9	25.6
	C-BH-06	7.5-7.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	90.1	22.7

Abbreviations:

MDD – maximum dry density
 OMC – optimum moisture content
 c' – effective cohesion
 φ' – effective stress friction angle
 UCS – uniaxial compressive strength

3. INVESTIGATION FINDINGS

3.10 SUB-SURFACE CONDITIONS

Based on the 2020 and 2021 investigations the typical sub-surface profile underlying the proposed TSF Cell C and Cell D footprint is summarised in Table 3.1.

Table 3.1: Typical Subsurface Profile

Material Layer	Bottom Level of Horizon (m)	Material Description	SPT
Topsoil/Colluvium	~1.0	Clayey sand with gravels and roots, loose to medium dense	N/A
Ferricrete (hardpan)	~4.5	Very low to low strength, recovered as Gravel laterite, strongly cemented	36-44 Average 40
Residual Soil, XW BIF/Metasedimentary Rock, recovered as Sandy Silt/Sandy Clay	~16.5	Very low strength, extremely weathered, recovered as Gravelly clay/silt with layers of Ferricrete and Cherts	34 to 100 Average 47
BIF	Below ~16.5	Distinctly weathered	-

3.11 GROUNDWATER

Groundwater was not encountered to the maximum investigation depth of 27.4 m. This is consistent with the historical monitoring data.

3.12 PERMEABILITY

Six falling head permeability tests were conducted in the boreholes at different depths. The tests conducted are summarized in Table 3.2.

The permeability calculations were based on the method by Hvorslev 1951 (Ref. 7).

Table 3.2: Summary of in-situ permeability tests

Borehole	Stratigraphy	Test Depth (m)	Permeability (m/s)
C-BH05	Sandy Silt	0.5	2.4×10^{-6}
C-BH05	XW BIF	23.8	5.1×10^{-6}
C-BH06	Sandy Silt	0.5	7.0×10^{-6}
C-BH06	XW BIF	27.0	2.4×10^{-6}
C-BH07	Sandy Silt	0.5	5.9×10^{-7}
C-BH07	XW BIF	4.7	4.1×10^{-6}

The insitu test results appear to be reasonable.

3.13 EMERSON CLASS

The Emerson tests indicate that the top layer materials have either a class of 5 or 8, confirming that these materials are not dispersive.

3.14 GEOTECHNICAL PARAMETERS

Table 3.3 provides the interpreted soil shear strength and permeability parameters based on the field investigation and laboratory test results.

Table 3.3: Interpreted Typical Geotechnical Parameters for TSF Design

Material	γ_{moist} (kN/m ³)	Drained Strength		Undrained Strength		Permeability (m/s)
		c' (kPa)	ϕ' (deg)	s_u/σ_v'	Minimum s_u (kPa)	
Tailings	16	0	32	0.25	0	8.0×10^{-08}
Zone A	19	5	25-28	-	-	1.0×10^{-08}
Zone C	19	5	26-30	-	-	5.0×10^{-06}
Sandy clay (Top Soil)	19	5	28	-	-	1.0×10^{-07}
Laterite (Ferricrete)	21	5	30	-	-	5.0×10^{-07}
Sandy Silt/Sandy Clay (Residual Soil, XW BIF)	20	20	25	0.3	80	1.0×10^{-08}
BIF	23	100	35	-	-	6.0×10^{-08}

The bulk densities are typical values for these types of materials.

Friction angles are based on triaxial test results or typical values for similar materials.

The cohesion values reflect the degree of over-consolidation and cementation within the in-situ materials.

The permeability coefficients are based on insitu and lab test results and typical values for similar materials.

The materials at shallow depths are heavily over-consolidated due to cementation (Ferricrete hardpan), these materials are dilative, the undrained shear strengths will be higher than the drained shear strengths, and will be capped at drained strength according to ANCOLD (2019).

The drained and undrained strengths for Banded Iron Formation are the same.

These suggested parameters are typical values based on the limited test data, the parameters shall be adjusted for stability analysis of a specific section based on insitu and lab tests on materials from the nearest boreholes or test pits.

3.15 CONSTRUCTION CONSIDERATIONS

3.15.1 Workability of Near Surface Materials

Strongly cemented laterite (Ferricrete) is typically present at very shallow depth in the area of investigation. The majority of test pits undertaken typically refused at a depth of less than 1 m.

Conventional earthmoving equipment, such as large dozers and excavators should be capable of excavating the near surface materials across the site. However, excavation difficulties may be encountered where Ferricrete hardpan exists at shallow depth.

It is expected that the Ferricrete hardpan materials should be excavatable using a D9 dozer or equivalent equipped with a single-tyne ripper attachment.

3.15.2 Insitu Soil as Soil Liner

It is expected that a soil liner will be required at the proposed TSF Cell C and Cell D basin. The hydraulic conductivity of the top sandy soils is estimated to be in the order of 2.0×10^{-6} m/s to 1.0×10^{-7} m/s (compacted to 98% SMDD) based on test results.

3.15.3 Embankment Construction Materials

The 2020 geotechnical investigation indicated the following:

- Selected mine waste samples are classified as Clayey GRAVEL with trace Sand.
- Selected mine waste samples have a percentage fines (i.e. < 0.075 mm) in the order of 27%.

Additional samples should be selected for laboratory testing to confirm if suitable Zone A materials can be sourced from the stockpiles with selective excavation.

Zone C materials can be Run of Mine or mine waste which should be readily available from the mine operation.

3.15.4 Cut-Off Trench

Due to the existence of Ferricrete hardpan at shallow depth, the cut-off trench will be likely very shallow, less than 1 m, typically 0.5 m to 1 m depending on the location.

3.15.5 Impact of Groundwater

The ground water level is approximately 30 m below the existing ground surface, it will unlikely have any impact on the TSF design and construction.

3.15.6 Existing boreholes

It was observed that the boreholes completed during the 2020 site investigation, were yet to be grouted. The result of leaving the boreholes open during the construction phase may result in seepage into underlying ground formations. It is important that Northern Star grout these holes and inspect the conditions of all the boreholes after grouting.

3.15.7 Soil Dispersion

The Emersion test results indicate that the upper layer materials are not dispersive.

4. CONCLUSIONS AND RECOMMENDATIONS

Based on the site geotechnical investigation and laboratory testing, the following conclusions and recommendations can be made:

- The areas investigated are partly disturbed and relatively flat. The site is considered as suitable for the proposed TSF expansion.
- Conventional earthmoving equipment, such as large dozers and excavators should be capable of excavating the near surface materials across the site. However, excavation difficulties will likely be encountered where Ferricrete hardpan exists at shallow depth. It is expected that the Ferricrete hardpan materials should be excavatable using a D9 dozer or equivalent equipped with a single-tyne ripper attachment.
- Typical subsurface profile and design parameters are provided in this memorandum. These include permeability parameters and shear strengths under different loading conditions.
- The materials at shallow depths are heavily over-consolidated due to cementation (Ferricrete hardpan), these materials are dilative, the undrained shear strengths will be higher than the drained shear strengths, and will be capped at drained strength according to ANCOLD (2019).
- Due to the existence of Ferricrete hardpan at shallow depth, the cut-off trench will be likely shallow, typically about 1.0 m, which will vary with locations and need to be confirmed on site by an experienced geotechnical engineer.
- The ground water level is approximately 30 m below the existing ground surface, it will unlikely have any impact on the TSF design and construction.
- The existing boreholes must be grouted to reduce seepage into the ground.
- The permeability coefficients of top layer materials based on lab tests are in the range of 2.0×10^{-6} m/s to 1.0×10^{-7} m/s.
- The Emersion tests indicate that the upper layer materials are not dispersive.

We trust the information provided is sufficient at this stage and will be pleased to provide any additional advice as required.

Yours faithfully

KNIGHT PIÉSOLD PTY LTD


JIM LUO

Manager Geotechnical Services


DAVID MORGAN

Managing Director

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FIGURES



Extract of: Stewart, A.J., 2001, "Leonora Second Edition, 1:250,000 scale geological map", AGSO, Geoscience Australia, Canberra, Catalogue No. 36953.

THUNDERBOX GOLD PROJECT
2021 TSF CELL C AND CELL D INVESTIGATION
EXTRACT OF LEONORA GEOLOGICAL MAP

PE801-00296 M21004
Figure 1.1

Qa	Qac
----	-----

Qa Clay, silt, sand and gravel in and near active stream channels; alluvial
Qac Clay in claypans

Cza	Czb	Czc	Czc1	Czd	Czl	Czg	Czh	Czi	Czk
-----	-----	-----	------	-----	-----	-----	-----	-----	-----

Czi	Czp	Czq	Czs	Czu	Czz	Czzg
-----	-----	-----	-----	-----	-----	------

Cza Clay, silt and sand; pebbly in places; colluvial, distal
Czb Clay and dune sand, adjacent to playes (clay dominant)
Czc Gravel, talus, sand; colluvial, proximal
Czc1 Sandy colluvium with limonitic pisolites on low plateaus on weathered granitoid
Czd Quartz and gypsum dunes with minor silt and clay adjacent to playes (dunes dominant)
Czl Pebbly colluvium and alluvium derived from laterite
Czg Colluvial sand and gravel derived from quartzfeldspathic rock
Czh Silt, sand and gravel in halophyte flats adjacent to playes
Czi Detritus and talus, derived from banded iron-formation
Czk Calcrete
Czl Lateritic duricrust, massive and rubbly
Czp Evaporites, sand and clay in playes
Czq Talus and quartz-rich detritus derived from quartz veins
Czs Sand plain
Czu Silcrete on or derived from ultramafic rock
Czz Silcrete over granitoid
Czzg Silcrete and/or kaolinised granite

Cainozoic

Ag	Agb	Agc	Agd	Age	Agf	Agfo	Agg	AgI	Agm
Agmo	Agml	Agmm	Agmp	Agn	Agq	AgS	AgT	Agtp	AgY

Ag Granite, undivided
Agb Foliated granitoid rock with mafic lenses; local gneissic banding
Agc Coarse-grained granitoid, undivided
Agd Diorite to monzodiorite
Age Medium-grained granitoid, undivided
Agf Fine-grained granitoid, undivided
Agfo Foliated granitoid
Agg Granodiorite
AgI Leucogranite and microgranite
Agm Biotite monzogranite
Agmo Coarse-grained biotite monzogranite
Agml Fine-grained biotite monzogranite
Agmm Biotite monzogranite, medium-grained
Agmp Porphyritic monzogranite
Agn Strongly foliated granitoid with local weak and/or incipient layering (banding) +/- mafic lenses
Agq Quartz-rich granitoids
AgS Syenite to alkali-feldspar syenite
AgT Tonalite
Agtp Porphyritic tonalite
AgY Syenogranite to alkali-feldspar granite

Ab	Abam	Abb	Abba	Abd	Abf	Abg	Abp
AbS	AbY						

Ab Metamorphosed fine-grained mafic igneous rocks, undivided
Abam Amphibolite derived from mafic igneous rock
Abb Metabasalt +/- metadolerite
Abba Metabasalt, aphyric
Abc Carbonated metabasalt
Abd Metabasalt and metadolerite
Abf Mafic schist, low-grade
Abg Mafic and subordinate felsic volcanic rocks intercalated with minor foliated granitoid rock; metamorphosed; gneissic banding locally developed
Abm High-magnesium metabasalt with spinifex texture
Abp Metabasalt +/- metadolerite, porphyritic
AbS Schistose metabasalt
AbY Metabasalt, vesicular or amygdaloidal

Archaean



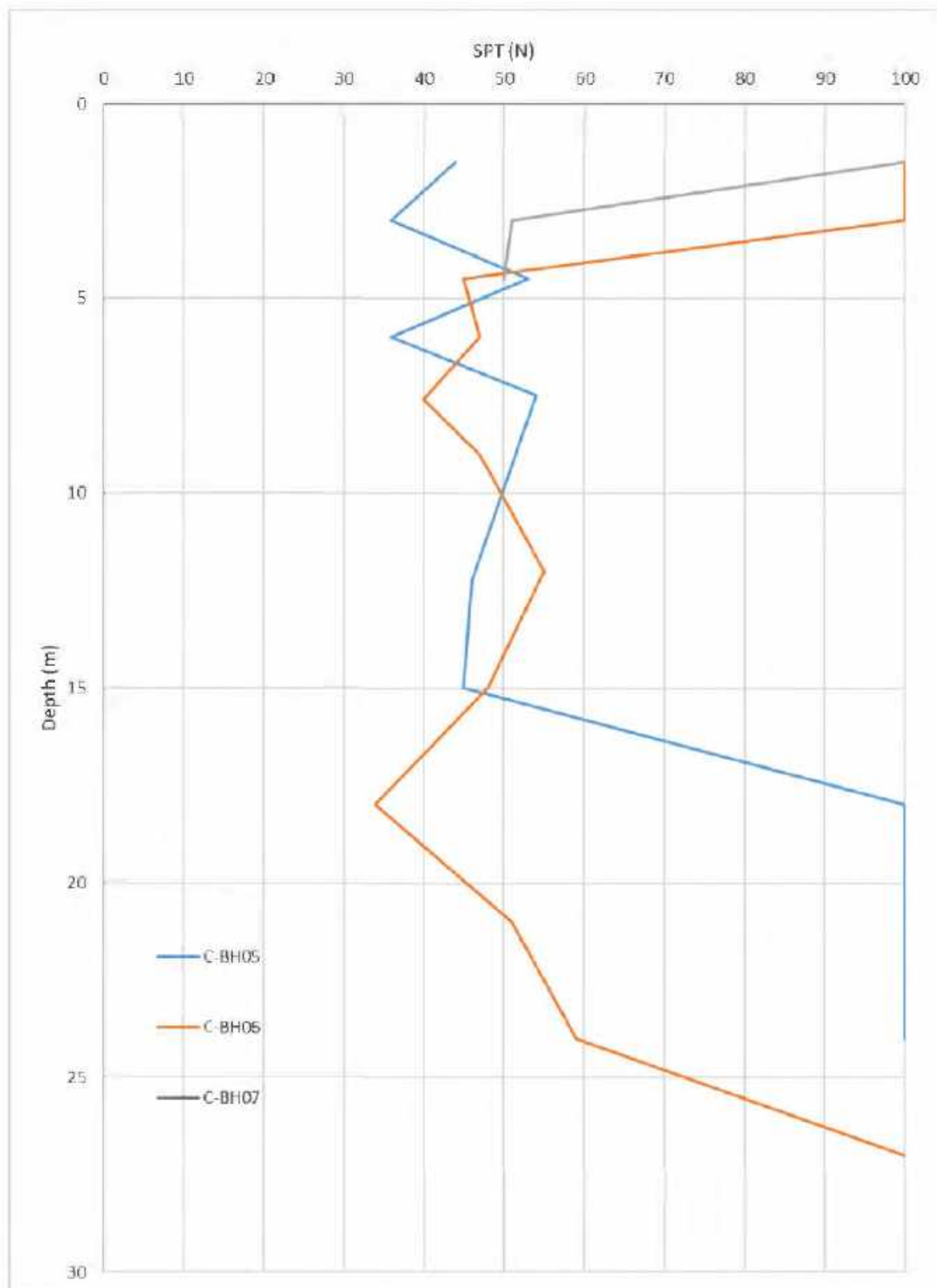
LEGEND:	
	EXISTING SEALED ROAD
	EXISTING SITE ROAD
	COMPLETED TEST PITS LOCATIONS
	COMPLETED BOREHOLES LOCATIONS
	PROPOSED BOREHOLES LOCATIONS
	PROPOSED TEST PIT LOCATIONS

NOTES:
1. 1m CONTOUR INTERVALS SHOWN.

TABLE 1: BOREHOLE LOCATIONS		
INSTRUMENT ID	EASTING	NORTHING
C-BH05	306363.0	6879072.0
C-BH06	306555.7	6879944.7
C-BH07	306518.6	6880385.7

TABLE 2: TEST PIT LOCATIONS		
INSTRUMENT ID	EASTING	NORTHING
C-TP-35	306177.2	6878224.8
C-TP-36	306176.7	6879045.5
C-TP-37	306326.6	6879072.2
C-TP-38	306325.9	6879222.2
C-TP-39	306429.0	6879197.3
C-TP-40	306175.3	6879374.7
C-TP-41	306325.3	6879372.3
C-TP-42	306475.3	6879369.9
C-TP-43	306174.7	6879524.7
C-TP-44	306324.7	6879522.3
C-TP-45	306512.6	6879519.3
C-TP-46	306024.8	6879600.9
C-TP-47	306173.8	6879600.9
C-TP-48	306324.4	6879599.7
C-TP-49	306472.1	6879600.3
D-TP-01	306042.5	6879627.0
D-TP-02	306177.6	6879628.8
D-TP-03	306327.2	6879630.9
D-TP-04	306476.2	6879633.0
D-TP-05	306074.9	6879745.0
D-TP-06	306210.2	6879745.8
D-TP-07	306323.7	6879739.3
D-TP-08	306473.7	6879739.5
D-TP-09	306534.8	6879730.9
D-TP-10	306091.5	6879825.9
D-TP-11	306173.4	6879824.8
D-TP-12	306323.4	6879822.4
D-TP-13	306500.0	6879848.3
D-TP-14	306022.8	6879977.2
D-TP-15	306172.8	6879974.8
D-TP-16	306322.8	6879972.4
D-TP-17	306472.8	6879970.0
D-TP-18	306032.9	6880062.1

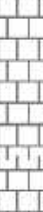
D-TP-19	306022.2	6880127.3
D-TP-20	306172.2	6880124.8
D-TP-21	306322.2	6880122.4
D-TP-22	306472.2	6880120.0
D-TP-23	306021.6	6880277.3
D-TP-24	306171.6	6880274.9
D-TP-25	306321.6	6880272.5
D-TP-26	306528.0	6880269.1
D-TP-27	306020.9	6880427.3
D-TP-28	306170.9	6880424.9
D-TP-29	306320.9	6880422.5
D-TP-30	306471.0	6880420.1
D-TP-31	306045.6	6880578.5
D-TP-32	306170.3	6880574.9
D-TP-33	306320.3	6880572.5
D-TP-34	306169.9	6880668.5
D-TP-35	306024.7	6880727.4
D-TP-36	305965.3	6880797.1



APPENDIX A

Borehole Logs

Contractor	Edge Drilling	Drillhole No	C-BH05	Page	1 of 3
Location	Proposed TSF Cell C Area	Drill Type	Hanjin D&B 8D	Date Started	18/Mar/2021
Coordinates/System	306363E, 6879072N / WGS84 UTM Zone 51 J	Total Depth	24.1 m	Date Completed	19/Mar/2021
Hole Size	HQ3	Elevation	0 m	Logged By	JY
Core Size		Azimuth, Inclination	.0°	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	GRAPHIC LOG	MATERIAL DESCRIPTION	RUN RECOVERY (%)	SAMPLE NO	SAMPLE REC. (%)	SAMPLE TYPE	UCS FIELD BLOW COUNTS (PER 6")	UCS LAB SPT 'N' VALUE	KEY ROCK MASS PARAMETERS				NOTES	
										SPT 'N' VALUES - x					
										RQD	RMR	20	40		60
1	-1		SAND (0 to 1.3 m) SAND (SP), fine to medium grained, red brown and orange brown, sub-rounded to sub-angular, dry to slightly moist, with low plasticity clay, trace fine to medium grained gravel. COLLUVIUM. Quartz and Basalt gravel found on surface.	75											
2	-2		FERRICRETE (1.3 to 4.5 m) FERRICRETE, red brown, very low strength, extremely weathered	100	SPT 1	100	SPT	5/19/25	44				x		
				100											
3	-3				SPT 2	100	SPT	10/16/20	36				x		
4	-4			100											
5	-5		BANDED IRON FORMATION (4.5 to 5 m) BIF/Metasedimentary Rock, grey, very low strength, extremely weathered, recovered as low plasticity silt		SPT 3	100	SPT	16/24/29	53					x	
6	-6		BANDED IRON FORMATION (5 to 6.45 m) BIF/Metasedimentary Rock, grey and red brown, very low strength, extremely weathered, recovered as low plasticity silt	100											
7	-7		BANDED IRON FORMATION (6.45 to 7.5 m) BIF/Metasedimentary Rock, red brown, very low strength, extremely weathered, recovered as low plasticity sandy silt		SPT 4	100	SPT	8/18/18	36				x		
8	-8		BANDED IRON FORMATION (7.5 to 9.2 m) BIF/Metasedimentary Rock, red brown, very low strength, extremely weathered, recovered as low plasticity sandy silt	100											
9	-9		BANDED IRON FORMATION (9.2 to 10 m) BIF/Metasedimentary Rock, grey, very low strength, extremely weathered, recovered as low plasticity silt	90	SPT 5	100	SPT	12/38/16	54					x	
				100											

GENERAL REMARKS:

- Borehole located to the south east of the existing TSFs
- Samples taken as indicated
- SPT testing undertaken as indicated
- Grouted

SARACEN MINERAL HOLDINGS LIMITED THUNDERBOX



Knight Piésold
CONSULTING

P/A NO.
PE801-00296/24

REF. NO.

REV

FIGURE .

Contractor	Edge Drilling	Drillhole No	C-BH05	Page	2 of 3
Location	Proposed TSF Cell C Area	Drill Type	Hanjin D&B 8D	Date Started	18/Mar/2021
Coordinates/System	306363E, 6879072N / WGS84 UTM Zone 51 J	Total Depth	24.1 m	Date Completed	19/Mar/2021
Hole Size	HQ3	Elevation	0 m	Logged By	JY
Core Size		Azimuth, Inclination	.0°	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	GRAPHIC LOG	MATERIAL DESCRIPTION	RUN RECOVERY (%)	SAMPLE NO	SAMPLE REC. (%)	SAMPLE TYPE	UCS	SPT 'N' VALUE	KEY ROCK MASS PARAMETERS				NOTES
								FIELD (MPa)		RQD	RMR	SPT 'N' VALUES - x		
												20	40	
11	-11		BANDED IRON FORMATION (10 to 10.3 m) BIF/Metasedimentary Rock, red brown, very low strength, extremely weathered, recovered as low plasticity sandy silt	100										
			BANDED IRON FORMATION (10.3 to 11.6 m) BIF/Metasedimentary Rock, grey, very low strength, extremely weathered, recovered as low plasticity silt	30										
12	-12		BANDED IRON FORMATION (11.6 to 13.95 m) BIF/Metasedimentary Rock, red brown, very low strength, extremely weathered, fissile, recovered as low plasticity sandy silt	100	SPT 6	100	SPT	9/16/30	46			x		Push Tube 1
13	-13		BANDED IRON FORMATION (13.95 to 14.9 m) BIF/Metasedimentary Rock, red brown, very low strength, extremely weathered, recovered as low plasticity silt	100										
14	-14		BANDED IRON FORMATION (14.9 to 15.7 m) BIF/Metasedimentary Rock, red brown and grey, very low strength, extremely weathered, recovered as low plasticity sandy silt	20										
15	-15		BANDED IRON FORMATION (15.7 to 16.65 m) BIF/Metasedimentary Rock, red brown, very low strength, extremely weathered, recovered as low plasticity silt	100	SPT 7	100	SPT	16/20/25	45			x		
16	-16		BANDED IRON FORMATION (16.65 to 16.86 m) BIF/Metasedimentary Rock, grey and yellow orange, very low strength, extremely weathered, recovered as low plasticity sandy silt	50										
17	-17		BANDED IRON FORMATION (16.86 to 17 m) BIF/Metasedimentary Rock, red brown, very low strength, extremely weathered, recovered as low plasticity sandy silt	50										
18	-18		BANDED IRON FORMATION (17 to 18.25 m) BIF/Metasedimentary Rock, red brown, low strength, extremely weathered, recovered as low plasticity sandy silt	60	SPT 8	100	SPT	30						
19	-19		BANDED IRON FORMATION (18.25 to 18.6 m) BIF/Metasedimentary Rock, red brown, very low strength, extremely weathered, recovered as low plasticity sandy silt	100										
			BANDED IRON FORMATION (18.6 to 19.5 m) BIF/Metasedimentary Rock, red brown, very low strength, extremely weathered, recovered as low plasticity sandy silt	70										

GENERAL REMARKS:
1. Borehole located to the south east of the existing TSFs
2. Samples taken as indicated
3. SPT testing undertaken as indicated
4. Grouted

**SARACEN MINERAL HOLDINGS LIMITED
THUNDERBOX**



P/A NO. PE001-00296/24 REF. NO. REV

FIGURE .

Contractor	Edge Drilling	Drillhole No	C-BH05	Page	3 of 3
Location	Proposed TSF Cell C Area	Drill Type	Hanjin D&B 8D	Date Started	18/Mar/2021
Coordinates/System	306363E, 6879072N / WGS84 UTM Zone 51 J	Total Depth	24.1 m	Date Completed	19/Mar/2021
Hole Size	HQ3	Elevation	0 m	Logged By	JY
Core Size		Azimuth, Inclination	0°	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	GRAPHIC LOG	MATERIAL DESCRIPTION	RUN RECOVERY (%)	SAMPLE NO	SAMPLE REC. (%)	SAMPLE TYPE	UCS FIELD (MPa)	UCS LAB	KEY ROCK MASS PARAMETERS				NOTES
								SPT 'N' VALUES - x				20	40	
21	-21		BANDED IRON FORMATION (19.5 to 21 m) <i>continued from previous page</i>	70										
			BANDED IRON FORMATION (21 to 21.9 m) BIF/Metasedimentary Rock, red brown, very low strength, extremely weathered, recovered as low plasticity silt	80	SPT 9	100	SPT	51						Push Tube 2
22	-22		BANDED IRON FORMATION (21.9 to 30 m) BIF/Metasedimentary Rock, red brown, very low strength, extremely weathered, recovered as low plasticity sandy silt											
23	-23			100										
24	-24				SPT 10	100	SPT	50						
			End of Drillhole: 24.1 m 3 Consecutive SPT N blows > 50 (refusal)											
25	-25													
26	-26													
27	-27													
28	-28													
29	-29													

GENERAL REMARKS:

- Borehole located to the south east of the existing TSFs
- Samples taken as indicated
- SPT testing undertaken as indicated
- Grouted

SARACEN MINERAL HOLDINGS LIMITED THUNDERBOX



P/A NO. PE001-00296/24	REF. NO.	REV
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FIGURE .

Contractor	Edge Drilling	Drillhole No	C-BH06	Page	1 of 3
Location	Proposed TSF Cell D Area	Drill Type	Hanjin D&B 8D	Date Started	20/Mar/2021
Coordinates/System	306555E, 6879944N / WGS84 UTM Zone 51 J	Total Depth	27.3 m	Date Completed	21/Mar/2021
Hole Size	HQ3	Elevation	0 m	Logged By	JY
Core Size		Azimuth, Inclination	.0°	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	GRAPHIC LOG	MATERIAL DESCRIPTION	RUN RECOVERY (%)	SAMPLE NO	SAMPLE REC. (%)	SAMPLE TYPE	UCS FIELD BLOW COUNTS (PER 6")	UCS LAB SPT 'N' VALUE	KEY ROCK MASS PARAMETERS				NOTES	
										SPT 'N' VALUES - x					
										20	40	60	80		
1	-1		CLAY (0 to 0.7 m)	100											
			CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, with fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular.	100											
				100											
2	-2		FERRICRETE (0.7 to 1 m)		SPT 1	100	SPT	29/52							
			FERRICRETE, red brown, low strength, extremely weathered, trace vugs up to 10 mm in diameter	100											
3	-3		FERRICRETE (1 to 2 m)												
			FERRICRETE, red brown, very low strength, extremely weathered												
4	-4		BANDED IRON FORMATION (2 to 3.52 m)		SPT 2	100	SPT	16/42							
			BIF/Metasedimentary Rock, red brown, very low strength, extremely weathered, recovered as low plasticity sandy silt	100											
				100											
5	-5		BANDED IRON FORMATION (3.52 to 6 m)												
			BIF/Metasedimentary Rock, red brown, very low strength, extremely weathered, layered, recovered as low plasticity sandy silt	100	SPT 3	100	SPT	13/20/25	45			x			
				90											
6	-6		BANDED IRON FORMATION (6 to 7.5 m)		SPT 4	100	SPT	9/19/28	47					x	
			BIF/Metasedimentary Rock, red brown, very low strength, extremely weathered, recovered as low plasticity silt, layered, recovered as low plasticity sandy silt	70											
8	-8		BANDED IRON FORMATION (7.5 to 8.4 m)		SPT 5	100	SPT	8/16/24	40					x	
			BIF/Metasedimentary Rock, red brown, very low strength, extremely weathered, layered, recovered as low plasticity sandy silt	100											
9	-9		BANDED IRON FORMATION (8.4 to 10.65 m)		SPT 6	100	SPT	10/20/27	47					x	
			BIF/Metasedimentary Rock, yellow and red brown, very low strength, extremely weathered, layered, recovered as low plasticity sandy silt	55											

Push Tube 1

Push Tube 1

GENERAL REMARKS:

- Borehole located to the east of the existing TSFs
- Samples taken as indicated
- SPT testing undertaken as indicated
- Grouted upon

SARACEN MINERAL HOLDINGS LIMITED THUNDERBOX



P/A NO. PE001-00296/24 REF. NO. REV

FIGURE .

Contractor	Edge Drilling	Drillhole No	C-BH06	Page	2 of 3
Location	Proposed TSF Cell D Area	Drill Type	Hanjin D&B 8D	Date Started	20/Mar/2021
Coordinates/System	306555E, 6879944N / WGS84 UTM Zone 51 J	Total Depth	27.3 m	Date Completed	21/Mar/2021
Hole Size	HQ3	Elevation	0 m	Logged By	JY
Core Size		Azimuth, Inclination	0°	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	GRAPHIC LOG	MATERIAL DESCRIPTION	RUN RECOVERY (%)	SAMPLE NO	SAMPLE REC. (%)	SAMPLE TYPE	UCS FIELD BLOW COUNTS (PER 6")	UCS LAB SPT 'N' VALUE	KEY ROCK MASS PARAMETERS				NOTES	
										SPT 'N' VALUES - x					
											20	40	60	80	
			BANDED IRON FORMATION (8.4 to 10.65 m) <i>continued from previous page</i>	55											
11	-11		BANDED IRON FORMATION (10.65 to 17.9 m) BIF/Metasedimentary Rock, red brown, very low strength, extremely weathered, recovered as low plasticity sandy silt	100											
12	-12				SPT 7	100	SPT	12/21/34	55					x	
13	-13			35											
14	-14			100											
15	-15			100											
16	-16				SPT 8	100	SPT	12/19/29	48					x	
17	-17			70											
18	-18			100											
19	-19		BANDED IRON FORMATION (17.9 to 18.4 m) BIF/Metasedimentary Rock, grey, yellow and red brown, very low strength, extremely weathered, recovered as low plasticity silt, layered	100	SPT 9	100	SPT	9/13/21	34					x	
			BANDED IRON FORMATION (18.4 to 25.35 m) BIF/Metasedimentary Rock, red brown, very low strength, extremely weathered, recovered as low plasticity sandy silt	100											

GENERAL REMARKS:

- Borehole located to the east of the existing TSFs
- Samples taken as indicated
- SPT testing undertaken as indicated
- Grouted upon

SARACEN MINERAL HOLDINGS LIMITED THUNDERBOX



P/A NO. PE001-00296/24	REF. NO.	REV
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FIGURE .

Contractor	Edge Drilling	Drillhole No	C-BH06	Page	3 of 3
Location	Proposed TSF Cell D Area	Drill Type	Hanjin D&B 8D	Date Started	20/Mar/2021
Coordinates/System	306555E, 6879944N / WGS84 UTM Zone 51 J	Total Depth	27.3 m	Date Completed	21/Mar/2021
Hole Size	HQ3	Elevation	0 m	Logged By	JY
Core Size		Azimuth, Inclination	0°	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	GRAPHIC LOG	MATERIAL DESCRIPTION	RUN RECOVERY (%)	SAMPLE NO	SAMPLE REC. (%)	SAMPLE TYPE	UCS		SPT 'N' VALUE	KEY ROCK MASS PARAMETERS				NOTES		
								BLOW COUNTS (PER 6")	FIELD (MPa)		RQD	RMR	SPT 'N' VALUES - x				
													20	40		60	80
21 <																	

GENERAL REMARKS:

- Borehole located to the east of the existing TSFs
- Samples taken as indicated
- SPT testing undertaken as indicated
- Grouted upon

SARACEN MINERAL HOLDINGS LIMITED THUNDERBOX



P/A NO. PE001-00296/24	REF. NO.	REV
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FIGURE .

Contractor	Edge Drilling	Drillhole No	C-BH07	Page	1 of 1
Location	Proposed TSF Cell D Area	Drill Type	Hanjin D&B 8D	Date Started	22/Mar/2021
Coordinates/System	306518E, 6880385N / WGS84 UTM Zone 51 J	Total Depth	9 m	Date Completed	22/Mar/2021
Hole Size	HQ3	Elevation	0 m	Logged By	JY
Core Size		Azimuth, Inclination	0°	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	GRAPHIC LOG	MATERIAL DESCRIPTION	RUN RECOVERY (%)	SAMPLE NO	SAMPLE REC. (%)	SAMPLE TYPE	UCS FIELD BLOW COUNTS (PER 6")	UCS LAB SPT 'N' VALUE	KEY ROCK MASS PARAMETERS				NOTES
										SPT 'N' VALUES - x				
										20	40	60	80	
1	-1		SAND (0 to 0.85 m) SAND (SC), gravelly, clayey, fine to medium grained, red brown and orange brown, sub-rounded to sub-angular, dry to slightly moist. COLLUVIUM - Clay is low plasticity and Gravel is fine to medium grained.	90										
			FERRICRETE (0.85 to 1.72 m) FERRICRETE, red brown, very low strength, extremely weathered	100	SPT 1	100	SPT	12						
2	-2		BANDED IRON FORMATION (1.72 to 5.2 m) BIF/Metasedimentary Rock, pale yellow brown, low strength, extremely weathered, trace infilled seams and fracture zones, recovered as low plasticity sandy silt	100										
3	-3			100	SPT 2	100	SPT	17/25/26	51			x		
4	-4			100										
5	-5				SPT 3	100	SPT	12/26/24	50			x		
6	-6		BANDED IRON FORMATION (5.2 to 6.25 m) BIF/Metasedimentary Rock, red brown, low strength, extremely weathered, recovered as low plasticity sandy silt	100										
7	-7		BANDED IRON FORMATION (6.25 to 7.15 m) BIF/Metasedimentary Rock, pale yellow brown, low strength, extremely weathered, recovered as low plasticity sandy silt	100										
8	-8		BANDED IRON FORMATION (7.15 to 8.2 m) BIF/Metasedimentary Rock, red brown, low strength, extremely weathered, recovered as low plasticity sandy silt											
			BANDED IRON FORMATION (8.2 to 9 m) BIF/Metasedimentary Rock, pale yellow brown, low strength, extremely weathered, recovered as low plasticity sandy silt	100										
9	0		End of Drillhole: 9 m 3 Consecutive SPT N blows > 50 (refusal)											

GENERAL REMARKS:

- Borehole located to the east of the existing TSFs
- Samples taken as indicated
- SPT testing undertaken as indicated
- Grouted upon

SARACEN MINERAL HOLDINGS LIMITED THUNDERBOX



P/A NO. PE001-00296/24	REF. NO.	REV
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FIGURE .

APPENDIX B
Borehole Photos

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 1: C-BH05 – Location – North



Plate 2: C-BH05 – Location – East

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 3: C-BH05 – Location – South



Plate 4: C-BH05 – Location – West

THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS



Plate 5: C-BH05 – SPT at 1.5 m

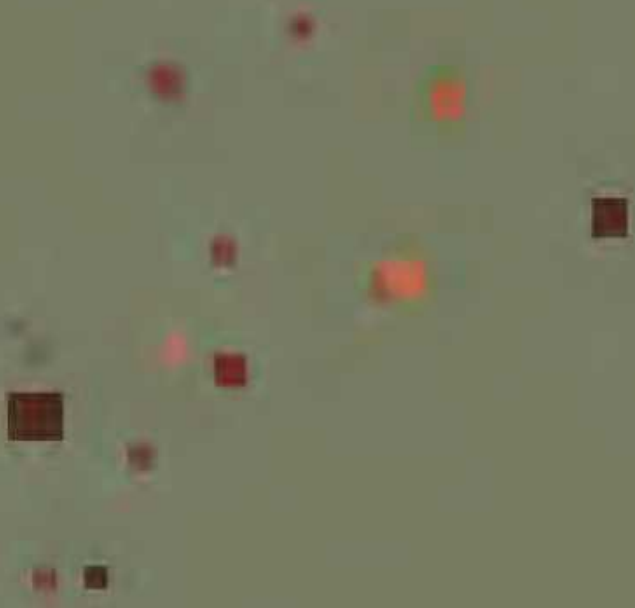


Plate 6: C-BH05 – SPT at 1.5 m

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 7: C-BH05 – SPT at 3.0 m



Plate 8: C-BH05 – SPT at 3.0 m

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 9: C-BH05 – SPT at 4.5 m



Plate 10: C-BH05 – SPT at 4.5 m

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 11: C-BH05 – Core Tray – 0.00 - 5.00 m



Plate 12: C-BH05 – SPT at 6.0 m

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 13: C-BH05 – SPT at 6.0 m



Plate 14: C-BH05 – SPT at 7.5 m

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 15: C-BH05 – SPT at 7.5 m



4.1

Plate 16: C-BH05 – Core Tray – 5.00 - 10.00 m

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 17: C-BH05 – SPT at 12.25 m



Plate 18: C-BH05 – SPT at 12.25 m

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 19: C-BH05 – SPT at 13.5 m



Plate 20: C-BH05 – SPT at 13.5 m

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 21: C-BH05 – Core Tray – 10.00 - 15.00 m



Plate 22: C-BH05 – SPT at 15.0 m

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 23: C-BH05 – SPT at 15.0 m



Plate 24: C-BH05 – SPT at 18.0 m

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 25: C-BH05 – SPT at 18.0 m



Plate 26: C-BH05 – Core Tray – 15.00 – 20.00 m

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 27: C-BH05 – SPT at 21.0 m



Plate 28: C-BH05 – SPT at 21.0 m

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 29: C-BH05 – SPT at 24.0 m



Plate 30: C-BH05 – SPT at 24.0 m

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 31: C-BH05 – Core Tray – 20.00 - 24.00 m



Plate 32: C-BH06 – Location – North

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 33: C-BH06 – Location – East



Plate 34: C-BH06 – Location – South

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 35: C-BH06 – Location – West



Plate 36: C-BH06 – SPT at 1.5 m

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 37: C-BH06 – SPT at 1.5 m



Plate 38: C-BH06 – SPT at 3.0 m

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 39: C-BH06 – SPT at 3.0 m



Plate 40: C-BH06 – SPT at 4.5 m

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 41: C-BH06 – SPT at 4.5 m



Plate 42: C-BH06 – Core Tray – 0.00 - 5.00 m

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 43: C-BH06 – SPT at 6.0 m



Plate 44: C-BH06 – SPT at 6.0 m

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 45: C-BH06 – SPT at 7.5 m



Plate 46: C-BH06 – SPT at 7.5 m

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 47: C-BH06 – SPT at 9.0 m



Plate 48: C-BH06 – SPT at 9.0 m

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 49: C-BH06 – Core Tray – 5.00 - 10.00 m



Plate 50: C-BH06 – SPT at 12.0 m

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 51: C-BH06 – SPT at 12.0 m



Plate 52: C-BH06 – Core Tray – 10.00 - 15.00 m

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 53: C-BH06 – SPT at 15.0 m



Plate 54: C-BH06 – SPT at 15.0 m

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 55: C-BH06 – SPT at 18.0 m



Plate 56: C-BH06 – SPT at 18.0 m

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 57: C-BH06 – Core Tray – 15.00 - 20.00 m



Plate 58: C-BH06 – SPT at 21.0 m

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 59: C-BH06 – SPT at 21.0 m



Plate 60: C-BH06 – SPT at 24.0 m

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 61: C-BH06 – SPT at 24.0 m



Plate 62: C-BH06 – Core Tray – 20.00 - 25.00 m

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**

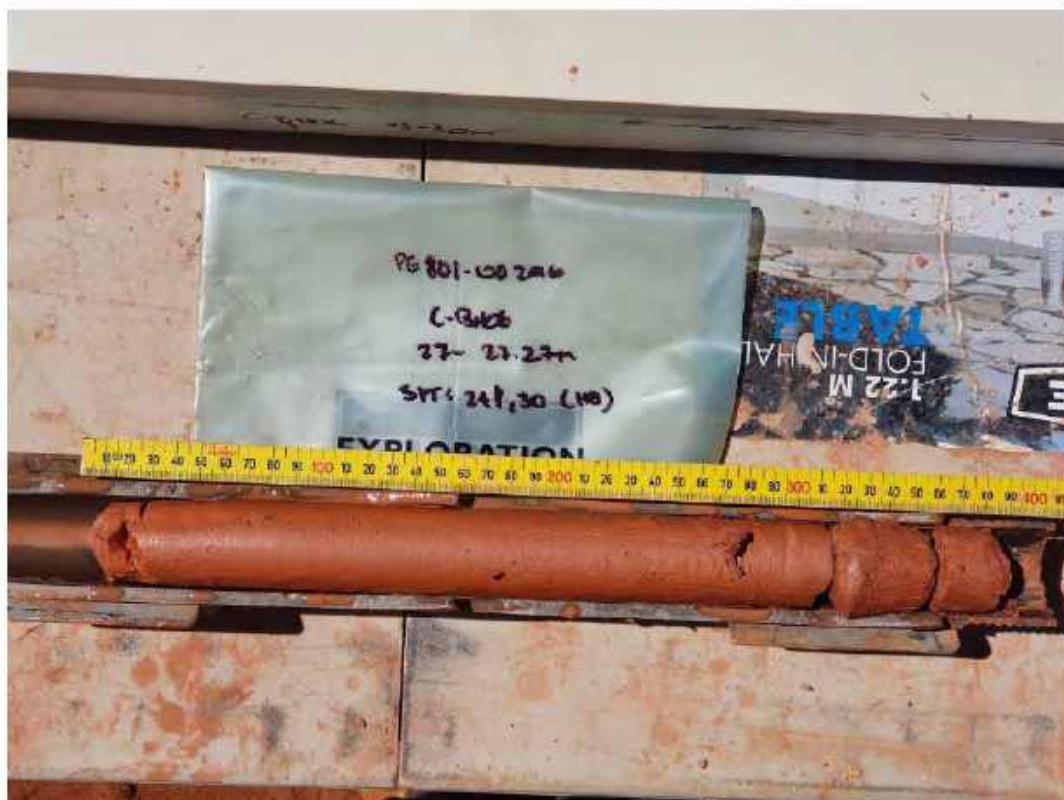


Plate 63: C-BH06 – SPT at 27.0 m



Plate 64: C-BH06 – SPT at 27.0 m

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 65: C-BH06 – Core Tray – 25.00 - 27.27 m



Plate 66: C-BH07 – Location – North

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 67: C-BH07 – Location – East



Plate 68: C-BH07 – Location – South

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 69: C-BH07 – Location – West



Plate 70: C-BH07 – SPT at 1.5 m

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 71: C-BH07 – SPT at 1.5 m



Plate 72: C-BH07 – SPT at 3.0 m

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 73: C-BH07 – SPT at 3.0 m



Plate 74: C-BH07 – SPT at 4.5 m

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS**



Plate 75: C-BH07 – SPT at 4.5 m



Plate 76: C-BH07 – Core Tray – 0.00 – 4.90 m



THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
BOREHOLE PHOTOGRAPHS



Plate 77: C-BH07 – Core Tray – 4.90 - 9.00 m

APPENDIX C
Test Pit Logs

Contractor	Northern Star	Test Pit No	C-TP-35	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	13/Mar/2021
Coordinates	306177E, 6878925N	Total Depth	0.8 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				SAND (0 to 0.5 m) SAND (SP), fine to medium grained, red brown and orange brown, sub-rounded to sub-angular, dry to slightly moist, with low plasticity clay, trace fine to medium grained gravel. COLLUVIUM.	
0.4	-0.4					Large Bulk Sample
0.6	-0.6				FERRICRETE (0.5 to 0.8 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
0.8	-0.8				End of Test Pit: 0.8 m Refusal on Ferricrete	

GENERAL REMARKS:

1. Refusal at 0.8 m on Ferricrete
2. Many roots to 0.2 m depth, large in size (>10 mm)
3. Large Bulk Sample taken at 0.3-0.4 m
4. No Seepage
5. Pit Stable

**NORTHERN STAR RESOURCES LIMITED
THUNDERBOX**


P/A NO. PE801-00296/24	REF. NO.	REV
FIGURE .		

Contractor		Northern Star		Test Pit No		C-TP-36		Page		1 of 1	
Location		Proposed TSF Cell C Area		Equipment Used		CAT 336D		Date Completed		13/Mar/2021	
Coordinates		306177E, 6879046N		Total Depth		0.7 m		Logged By		JY	
Coordinate System		51 J WGS84		Elevation		0 m		Reviewed By			

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				SAND (0 to 0.5 m) SAND (SP), fine to medium grained, red brown and orange brown, sub-rounded to sub-angular, dry to slightly moist, with low plasticity clay, trace fine to medium grained gravel. COLLUVIUM.	
0.4	-0.4					
0.6	-0.6				FERRICRETE (0.5 to 0.7 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
0.8	-0.8				End of Test Pit: 0.7 m Refusal on Ferricrete	

GENERAL REMARKS: 1. Refusal at 0.7 m on Ferricrete 2. Few roots to 0.2 m depth, medium in size (2-10 mm) 3. No Samples taken 4. No Seepage 5. Pit Stable					NORTHERN STAR RESOURCES LIMITED THUNDERBOX			
 Knight Piesold CONSULTING					P/A NO. PE001.00296/24		REF. NO.	REV
					FIGURE .			

Contractor	Northern Star	Test Pit No	C-TP-37	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	13/Mar/2021
Coordinates	306327E, 6879072N	Total Depth	0.8 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				SAND (0 to 0.6 m) SAND (SP), fine to medium grained, red brown and orange brown, sub-rounded to sub-angular, dry to slightly moist, with low plasticity clay, trace fine to medium grained gravel. COLLUVIUM. Quartz and Basalt gravel found on surface.	
0.4	-0.4					
0.6	-0.6				FERRICRETE (0.6 to 0.8 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
0.8	-0.8				End of Test Pit: 0.8 m Refusal on Ferricrete	

GENERAL REMARKS:

1. Refusal at 0.8 m on Ferricrete
2. No Vegetation (roots)
3. No Samples taken
4. No Seepage
5. Pit Stable

**NORTHERN STAR RESOURCES LIMITED
THUNDERBOX**


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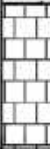
FIGURE .

Contractor		Northern Star		Test Pit No		C-TP-38		Page		1 of 1	
Location		Proposed TSF Cell C Area		Equipment Used		CAT 336D		Date Completed		13/Mar/2021	
Coordinates		306326E, 6879222N		Total Depth		0.6 m		Logged By		JY	
Coordinate System		51 J WGS84		Elevation		0 m		Reviewed By			

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				SAND (0 to 0.5 m) SAND (SP), fine to medium grained, red brown and orange brown, sub-rounded to sub-angular, dry to slightly moist, with low plasticity clay and fine to medium grained gravel. COLLUVIUM.	
0.4	-0.4					
0.6	-0.6			 FERRICRETE (0.5 to 0.6 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.		
0.8	-0.8				End of Test Pit: 0.6 m Refusal on Ferricrete	

GENERAL REMARKS: 1. Refusal at 0.6 m on Ferricrete 2. Few roots to 0.2 m depth, large in size (>10 mm) 3. No Samples taken 4. No Seepage 5. Pit Stable					NORTHERN STAR RESOURCES LIMITED THUNDERBOX							
					 Knight Piésold CONSULTING		P/A NO. PE001-00296/24		REF. NO.		REV	
					FIGURE .							

Contractor		Northern Star		Test Pit No		C-TP-39		Page		1 of 1	
Location		Proposed TSF Cell C Area		Equipment Used		CAT 336D		Date Completed		13/Mar/2021	
Coordinates		308429E, 6879197N		Total Depth		0.7 m		Logged By		JY	
Coordinate System		51 J WGS84		Elevation		0 m		Reviewed By			

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				SAND (0 to 0.6 m) SAND (SP), fine to medium grained, red brown and orange brown, sub-rounded to sub-angular, dry to slightly moist, with low plasticity clay and fine to medium grained gravel. COLLUVIUM. Quartz and Basalt gravel found on surface.	
0.4	-0.4					Large Bulk Sample
0.6	-0.6				FERRICRETE (0.6 to 0.7 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
0.8	-0.8				End of Test Pit: 0.7 m Refusal on Ferricrete	

GENERAL REMARKS: 1. Refusal at 0.7 m on Ferricrete 2. Few roots to 0.1 m depth, small in size (1-2 mm) 3. Large Bulk Sample taken at 0.4-0.5 m 4. No Seepage 5. Pit Stable					NORTHERN STAR RESOURCES LIMITED THUNDERBOX							
					 Knight Piesold CONSULTING		P/A NO. PE001.00296/24		REF. NO.		REV	
FIGURE .												

Contractor	Northern Star	Test Pit No	C-TP-40	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	13/Mar/2021
Coordinates	306175E, 6879375N	Total Depth	0.8 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				CLAY (0 to 0.5 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular. Quartz and Basalt gravel found on surface.	
0.4	-0.4					Large Bulk Sample
0.6	-0.6				FERRICRETE (0.5 to 0.8 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
0.8	-0.8				End of Test Pit: 0.8 m Refusal on Ferricrete	

GENERAL REMARKS:

1. Refusal at 0.8 m on Ferricrete
2. No Vegetation (roots)
3. Large Bulk Sample taken at 0.2-0.3 m
4. No Seepage
5. Pit Stable

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FIGURE .

Contractor	Northern Star	Test Pit No	C-TP-41	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	13/Mar/2021
Coordinates	306325E, 6879372N	Total Depth	1 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				CLAY (0 to 0.8 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular.	
0.4	-0.4					
0.6	-0.6					
0.8	-0.8				FERRICRETE (0.8 to 1 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
1	-1				End of Test Pit: 1 m Refusal on Ferricrete	

GENERAL REMARKS:

1. Refusal at 1 m on Ferricrete
2. Few roots to 0.2 m depth, medium in size (2-10 mm)
3. No Samples taken
4. No Seepage
5. Pit Stable

**NORTHERN STAR RESOURCES LIMITED
THUNDERBOX**


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FIGURE .

Contractor	Northern Star	Test Pit No	C-TP-42	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	13/Mar/2021
Coordinates	306475E, 6879370N	Total Depth	1 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				CLAY (0 to 0.7 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular. Quartz and Basalt gravel found on surface.	
0.4	-0.4					
0.6	-0.6					Small Sample
0.8	-0.8				FERRICRETE (0.7 to 1 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
1	-1				End of Test Pit: 1 m Refusal on Ferricrete	

GENERAL REMARKS:

1. Refusal at 1 m on Ferricrete
2. Few roots to 0.1 m depth, small in size (1-2 mm)
3. Small Sample taken at 0.5-0.6 m
4. No Seepage
5. Pit Stable

NORTHERN STAR RESOURCES LIMITED THUNDERBOX



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FIGURE .

Contractor	Northern Star	Test Pit No	C-TP-43	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	13/Mar/2021
Coordinates	306175E, 6879525N	Total Depth	0.8 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				CLAY (0 to 0.7 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular. Quartz and Basalt gravel found on surface.	
0.4	-0.4					
0.6	-0.6					
0.8	-0.8				FERRICRETE (0.7 to 0.8 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
					End of Test Pit: 0.8 m Refusal on Ferricrete	

GENERAL REMARKS:

1. Refusal at 0.8 m on Ferricrete
2. Few roots to 0.2 m depth, medium in size (2-10 mm)
3. No Samples taken
4. No Seepage
5. Pit Stable

**NORTHERN STAR RESOURCES LIMITED
THUNDERBOX**


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FIGURE .

Contractor		Northern Star		Test Pit No		C-TP-44		Page		1 of 1	
Location		Proposed TSF Cell C Area		Equipment Used		CAT 336D		Date Completed		13/Mar/2021	
Coordinates		306325E, 6879522N		Total Depth		0.6 m		Logged By		JY	
Coordinate System		51 J WGS84		Elevation		0 m		Reviewed By			

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				CLAY (0 to 0.4 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular. Quartz and Basalt gravel found on surface.	
0.4	-0.4				FERRICRETE (0.4 to 0.6 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
0.6	-0.6				End of Test Pit: 0.6 m Refusal on Ferricrete	
0.8	-0.8					

GENERAL REMARKS: 1. Refusal at 0.6 m on Ferricrete 2. Few roots to 0.2 m depth, medium in size (2-10 mm) 3. No Samples taken 4. No Seepage 5. Pit Stable					NORTHERN STAR RESOURCES LIMITED THUNDERBOX			
 Knight Piesold CONSULTING					P/A NO. PE001-00296/24		REF. NO.	REV
					FIGURE .			

Contractor	Northern Star	Test Pit No	C-TP-45	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	13/Mar/2021
Coordinates	306513E, 6879519N	Total Depth	0.9 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				CLAY (0 to 0.8 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular.	
0.4	-0.4					
0.6	-0.6					
0.8	-0.8				FERRICRETE (0.8 to 0.9 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
					End of Test Pit: 0.9 m Refusal on Ferricrete	

GENERAL REMARKS:

1. Refusal at 0.9 m on Ferricrete
2. Few roots to 0.4 m depth, large in size (>10 mm)
3. No Samples taken
4. No Seepage
5. Pit Stable

**NORTHERN STAR RESOURCES LIMITED
THUNDERBOX**


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FIGURE .

Contractor	Northern Star	Test Pit No	C-TP-46	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	13/Mar/2021
Coordinates	306025E, 6879601N	Total Depth	0.9 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				CLAY (0 to 0.6 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular.	
0.4	-0.4					Large Bulk Sample
0.6	-0.6				FERRICRETE (0.6 to 0.9 m) GRAVEL (GP), clayey, sandy, red brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
0.8	-0.8					
					End of Test Pit: 0.9 m Refusal on Ferricrete	

GENERAL REMARKS:

1. Refusal at 0.9 m on Ferricrete
2. Few roots to 0.1 m depth, small in size (1-2 mm)
3. Large Bulk Sample taken at 0.4-0.5 m
4. No Seepage
5. Pit Stable

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FIGURE .

Contractor	Northern Star	Test Pit No	C-TP-47	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	13/Mar/2021
Coordinates	306174E, 6879601N	Total Depth	0.5 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				CLAY (0 to 0.3 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular.	
0.4	-0.4				SILT (0.3 to 0.4 m) SILT (ML), non-plastic, white, moist less than plastic limit.	Small Sample
					FERRICRETE (0.4 to 0.5 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
0.6	-0.6				End of Test Pit: 0.5 m Refusal on Ferricrete	
0.8	-0.8					

GENERAL REMARKS:

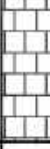
1. Refusal at 0.5 m on Ferricrete
2. Few roots to 0.2 m depth, small in size (1-2 mm)
3. Small Sample taken at 0.3-0.4 m
4. No Seepage
5. Pit Stable

**NORTHERN STAR RESOURCES LIMITED
THUNDERBOX**


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FIGURE .

Contractor		Northern Star		Test Pit No		C-TP-48		Page		1 of 1	
Location		Proposed TSF Cell C Area		Equipment Used		CAT 336D		Date Completed		13/Mar/2021	
Coordinates		306324E, 6879600N		Total Depth		1.1 m		Logged By		JY	
Coordinate System		51 J WGS84		Elevation		0 m		Reviewed By			

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.5	-0.5				CLAY (0 to 0.9 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular.	
						Small Sample
1	-1				FERRICRETE (0.9 to 1.1 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
1.5	-1.5				End of Test Pit: 1.1 m Refusal on Ferricrete	

GENERAL REMARKS:					NORTHERN STAR RESOURCES LIMITED THUNDERBOX		
1. Refusal at 1.1 m on Ferricrete 2. Few roots to 0.5 m depth, medium in size (2-10 mm) 3. Small Sample taken at 0.5-0.6 m 4. No Seepage 5. Pit Stable							
					P/A NO. PE001.00296/24 REF. NO. REV FIGURE .		

Contractor		Northern Star		Test Pit No		C-TP-49		Page		1 of 1	
Location		Proposed TSF Cell C Area		Equipment Used		CAT 336D		Date Completed		13/Mar/2021	
Coordinates		308472E, 6879600N		Total Depth		1.2 m		Logged By		JY	
Coordinate System		51 J WGS84		Elevation		0 m		Reviewed By			

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.5	-0.5				CLAY (0 to 0.9 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular.	
1	-1				FERRICRETE (0.9 to 1.2 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
1.5	-1.5				End of Test Pit: 1.2 m Refusal on Ferricrete	

GENERAL REMARKS: 1. Refusal at 1.2 m on Ferricrete 2. Few roots to 0.4 m depth, medium in size (2-10 mm) 3. No Samples taken 4. No Seepage 5. Pit Stable					NORTHERN STAR RESOURCES LIMITED THUNDERBOX			
					P/A NO. PE001.00296/24		REF. NO.	REV
					FIGURE .			

Contractor	Northern Star	Test Pit No	D-TP-02	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	13/Mar/2021
Coordinates	306178E, 6879629N	Total Depth	0.7 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				CLAY (0 to 0.5 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular. Quartz and Basalt gravel found on surface.	
0.4	-0.4					
0.6	-0.6				FERRICRETE (0.5 to 0.7 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
0.8	-0.8				End of Test Pit: 0.7 m Refusal on Ferricrete	

GENERAL REMARKS:

1. Refusal at 0.7 m on Ferricrete
2. Few roots to 0.3 m depth, small in size (1-2 mm)
3. Small Sample taken at 0.7-0.8 m
4. No Seepage
5. Pit Stable

**NORTHERN STAR RESOURCES LIMITED
THUNDERBOX**


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FIGURE .

Contractor	Northern Star	Test Pit No	D-TP-03	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	13/Mar/2021
Coordinates	306327E, 6879631N	Total Depth	0.8 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				CLAY (0 to 0.6 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular. Quartz and Basalt gravel found on surface.	
0.4	-0.4					
0.6	-0.6				FERRICRETE (0.6 to 0.8 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
0.8	-0.8				End of Test Pit: 0.8 m Refusal on Ferricrete	

GENERAL REMARKS:

1. Refusal at 0.8 m on Ferricrete
2. Few roots to 0.2 m depth, medium in size (2-10 mm)
3. No Samples taken
4. No Seepage
5. Pit Stable

**NORTHERN STAR RESOURCES LIMITED
THUNDERBOX**


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FIGURE .

Contractor		Northern Star		Test Pit No		D-TP-04		Page		1 of 1	
Location		Proposed TSF Cell C Area		Equipment Used		CAT 336D		Date Completed		13/Mar/2021	
Coordinates		308476E, 6879633N		Total Depth		0.7 m		Logged By		JY	
Coordinate System		51 J WGS84		Elevation		0 m		Reviewed By			

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				CLAY (0 to 0.6 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular.	
0.4	-0.4					
0.6	-0.6				FERRICRETE (0.6 to 0.7 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
0.8	-0.8				End of Test Pit: 0.7 m Refusal on Ferricrete	

GENERAL REMARKS: 1. Refusal at 0.7 m on Ferricrete 2. Few roots to 0.3 m depth, medium in size (2-10 mm) 3. No Samples taken 4. No Seepage 5. Pit Stable					NORTHERN STAR RESOURCES LIMITED THUNDERBOX		
					P/A NO. PE001.00296/24		
					REF. NO. REV		
FIGURE .							

Contractor	Northern Star	Test Pit No	D-TP-05	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	14/Mar/2021
Coordinates	306075E, 6879745N	Total Depth	0.7 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				CLAY (0 to 0.5 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular.	
0.4	-0.4					
0.6	-0.6				FERRICRETE (0.5 to 0.7 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
0.8	-0.8				End of Test Pit: 0.7 m Refusal on Ferricrete	

GENERAL REMARKS:

1. Refusal at 0.7 m on Ferricrete
2. Few roots to 0.1 m depth, small in size (1-2 mm)
3. No Samples taken
4. No Seepage
5. Pit Stable

**NORTHERN STAR RESOURCES LIMITED
THUNDERBOX**


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FIGURE .

Contractor	Northern Star	Test Pit No	D-TP-06	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	14/Mar/2021
Coordinates	306210E, 6879746N	Total Depth	1.1 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.5	-0.5				CLAY (0 to 0.9 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular.	Small Sample
1	-1				FERRICRETE (0.9 to 1.1 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
1.5	-1.5				End of Test Pit: 1.1 m Refusal on Ferricrete	

GENERAL REMARKS:

1. Refusal at 1.1 m on Ferricrete
2. Few roots to 0.3 m depth, small in size (1-2 mm)
3. Small Sample taken at 0.2-0.3 m
4. No Seepage
5. Pit Stable

NORTHERN STAR RESOURCES LIMITED THUNDERBOX



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FIGURE .

Contractor	Northern Star	Test Pit No	D-TP-07	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	14/Mar/2021
Coordinates	306324E, 6879738N	Total Depth	1.1 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.5	-0.5				CLAY (0 to 0.6 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular.	
1	-1				FERRICRETE (0.6 to 1.1 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
1.5	-1.5				End of Test Pit: 1.1 m Refusal on Ferricrete	

GENERAL REMARKS:

1. Refusal at 1.1 m on Ferricrete
2. Few roots to 0.3 m depth, large in size (>10 mm)
3. No Samples taken
4. No Seepage
5. Pit Stable

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FIGURE .

Contractor	Northern Star	Test Pit No	D-TP-08	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	14/Mar/2021
Coordinates	308474E, 6879740N	Total Depth	1 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				CLAY (0 to 0.7 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular. Quartz and Basalt gravel found on surface.	
0.4	-0.4					
0.6	-0.6					
0.8	-0.8				FERRICRETE (0.7 to 1 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
1	-1				End of Test Pit: 1 m Refusal on Ferricrete	

GENERAL REMARKS:

1. Refusal at 1 m on Ferricrete
2. Many roots to 0.7 m depth, large in size (>10 mm)
3. No Samples taken
4. No Seepage
5. Pit Stable

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FIGURE .

Contractor		Northern Star		Test Pit No		D-TP-09		Page		1 of 1	
Location		Proposed TSF Cell C Area		Equipment Used		CAT 336D		Date Completed		14/Mar/2021	
Coordinates		306535E, 6879740N		Total Depth		0.9 m		Logged By		JY	
Coordinate System		51 J WGS84		Elevation		0 m		Reviewed By			

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				CLAY (0 to 0.6 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, with fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular.	
0.4	-0.4					Large Bulk Sample
0.6	-0.6				FERRICRETE (0.6 to 0.9 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
0.8	-0.8					
					End of Test Pit: 0.9 m Refusal on Ferricrete	

GENERAL REMARKS:					NORTHERN STAR RESOURCES LIMITED THUNDERBOX			
1. Refusal at 0.9 m on Ferricrete 2. Many roots to 0.7 m depth, large in size (>10 mm) 3. Large Bulk Sample taken at 0.4-0.5 m 4. No Seepage 5. Pit Stable					 Knight Piésold CONSULTING		P/A NO. PE001-00296/24	REF. NO. REV
					FIGURE .			

Contractor	Northern Star	Test Pit No	D-TP-10	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	14/Mar/2021
Coordinates	306092E, 6879826N	Total Depth	0.6 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				SAND (0 to 0.5 m) SAND (SP), fine to medium grained, red brown and orange brown, sub-rounded to sub-angular, dry to slightly moist, with low plasticity clay and fine to medium grained gravel. COLLUVIUM.	
0.4	-0.4					Large Bulk Sample
0.6	-0.6				FERRICRETE (0.5 to 0.6 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
0.8	-0.8				End of Test Pit: 0.6 m Refusal on Ferricrete	

GENERAL REMARKS:

1. Refusal at 0.6 m on Ferricrete
2. Few roots to 0.2 m depth, small in size (1-2 mm)
3. Large Bulk Sample taken at 0.2-0.3 m
4. No Seepage
5. Pit Stable

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FIGURE .

Contractor	Northern Star	Test Pit No	D-TP-11	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	14/Mar/2021
Coordinates	306173E, 6879825N	Total Depth	1 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				CLAY (0 to 0.6 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular.	
0.4	-0.4					
0.6	-0.6				FERRICRETE (0.6 to 1 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
0.8	-0.8					
1	-1				End of Test Pit: 1 m Refusal on Ferricrete	

GENERAL REMARKS:

1. Refusal at 1 m on Ferricrete
2. Few roots to 0.1 m depth, small in size (1-2 mm)
3. No Samples taken
4. No Seepage
5. Pit Stable

**NORTHERN STAR RESOURCES LIMITED
THUNDERBOX**


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FIGURE .

Contractor	Northern Star	Test Pit No	D-TP-12	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	14/Mar/2021
Coordinates	306323E, 6879822N	Total Depth	1.2 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.5	-0.5				CLAY (0 to 0.9 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular.	
1	-1				FERRICRETE (0.9 to 1.2 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
1.5	-1.5				End of Test Pit: 1.2 m Refusal on Ferricrete	

GENERAL REMARKS:

1. Refusal at 1.2 m on Ferricrete
2. Few roots to 0.1 m depth, medium in size (2-10 mm)
3. No Samples taken
4. No Seepage
5. Pit Stable

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FIGURE .

Contractor	Northern Star	Test Pit No	D-TP-13	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	14/Mar/2021
Coordinates	306500E, 6879848N	Total Depth	1.2 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.5	-0.5				CLAY (0 to 0.9 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular.	
1	-1				FERRICRETE (0.9 to 1.2 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
1.5	-1.5				End of Test Pit: 1.2 m Refusal on Ferricrete	

GENERAL REMARKS:

1. Refusal at 1.2 m on Ferricrete
2. Few roots to 0.3 m depth, medium in size (2-10 mm)
3. No Samples taken
4. No Seepage
5. Pit Stable

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FIGURE .

Contractor		Northern Star		Test Pit No		D-TP-14		Page		1 of 1	
Location		Proposed TSF Cell C Area		Equipment Used		CAT 336D		Date Completed		14/Mar/2021	
Coordinates		306023E, 6879977N		Total Depth		0.9 m		Logged By		JY	
Coordinate System		51 J WGS84		Elevation		0 m		Reviewed By			

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				SAND (0 to 0.7 m) SAND (SP), fine to medium grained, red brown and orange brown, sub-rounded to sub-angular, dry to slightly moist, with low plasticity clay, trace fine to medium grained gravel. COLLUVIUM.	
0.4	-0.4					
0.6	-0.6					
0.8	-0.8				CLAY (0.7 to 0.9 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular.	
					End of Test Pit: 0.9 m Refusal on Ferricrete	

GENERAL REMARKS: 1. Refusal at 0.9 m on Ferricrete 2. Few roots to 0.3 m depth, medium in size (2-10 mm) 3. No Samples taken 4. No Seepage 5. Pit Stable					NORTHERN STAR RESOURCES LIMITED THUNDERBOX							
					 Knight Piesold CONSULTING		P/A NO. PE001.00296/24		REF. NO.		REV	
					FIGURE .							

Contractor	Northern Star	Test Pit No	D-TP-15	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	14/Mar/2021
Coordinates	306173E, 6879975N	Total Depth	0.8 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				CLAY (0 to 0.6 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular.	
0.4	-0.4					Small Sample
0.6	-0.6				FERRICRETE (0.6 to 0.8 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
0.8	-0.8				End of Test Pit: 0.8 m Refusal on Ferricrete	

GENERAL REMARKS:

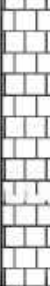
1. Refusal at 0.8 m on Ferricrete
2. Few roots to 0.3 m depth, medium in size (2-10 mm)
3. Small Sample taken at 0.4-0.5 m
4. No Seepage
5. Pit Stable

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FIGURE .

Contractor	Northern Star	Test Pit No	D-TP-16	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	14/Mar/2021
Coordinates	306323E, 6879972N	Total Depth	1.3 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.5	-0.5				CLAY (0 to 0.9 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular.	
1	-1				FERRICRETE (0.9 to 1.3 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
1.5	-1.5				End of Test Pit: 1.3 m Refusal on Ferricrete	

GENERAL REMARKS:

1. Refusal at 1.3 m on Ferricrete
2. Few roots to 0.7 m depth, small in size (1-2 mm)
3. No Samples taken
4. No Seepage
5. Pit Stable

**NORTHERN STAR RESOURCES LIMITED
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FIGURE .

Contractor		Northern Star		Test Pit No		D-TP-17		Page		1 of 1	
Location		Proposed TSF Cell C Area		Equipment Used		CAT 336D		Date Completed		14/Mar/2021	
Coordinates		308473E, 6879970N		Total Depth		0.7 m		Logged By		JY	
Coordinate System		51 J WGS84		Elevation		0 m		Reviewed By			

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				CLAY (0 to 0.5 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, with fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular.	
0.4	-0.4					Small Sample
0.6	-0.6				FERRICRETE (0.5 to 0.7 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
0.8	-0.8				End of Test Pit: 0.7 m Refusal on Ferricrete	

GENERAL REMARKS: 1. Refusal at 0.7 m on Ferricrete 2. Few roots to 0.1 m depth, small in size (1-2 mm) 3. Small Sample taken at 0.4-0.5 m 4. No Seepage 5. Pit Stable					NORTHERN STAR RESOURCES LIMITED THUNDERBOX							
					 Knight Piesold CONSULTING		P/A NO. PE001-00296/24		REF. NO.		REV	
					FIGURE .							

Contractor		Northern Star		Test Pit No		D-TP-18		Page		1 of 1	
Location		Proposed TSF Cell C Area		Equipment Used		CAT 336D		Date Completed		14/Mar/2021	
Coordinates		306033E, 6880062N		Total Depth		0.9 m		Logged By		JY	
Coordinate System		51 J WGS84		Elevation		0 m		Reviewed By			

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				SAND (0 to 0.7 m) SAND (SC), clayey, fine to medium grained, red brown and orange brown, sub-rounded to sub-angular, dry to slightly moist, trace fine to medium grained gravel. COLLUVIUM - Clay is low plasticity.	
0.4	-0.4					
0.6	-0.6					
0.8	-0.8				FERRICRETE (0.7 to 0.9 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
					End of Test Pit: 0.9 m Refusal on Ferricrete	

GENERAL REMARKS: 1. Refusal at 0.9 m on Ferricrete 2. Few roots to 0.2 m depth, small in size (1-2 mm) 3. No Samples taken 4. No Seepage 5. Pit Stable					NORTHERN STAR RESOURCES LIMITED THUNDERBOX							
					 Knight Piesold CONSULTING		P/A NO. PE001.00296/24		REF. NO.		REV	
					FIGURE .							

Contractor		Northern Star		Test Pit No		D-TP-19		Page		1 of 1	
Location		Proposed TSF Cell C Area		Equipment Used		CAT 336D		Date Completed		14/Mar/2021	
Coordinates		306022E, 6880127N		Total Depth		0.9 m		Logged By		JY	
Coordinate System		51 J WGS84		Elevation		0 m		Reviewed By			

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				SAND (0 to 0.6 m) SAND (SP), fine to medium grained, red brown and orange brown, sub-rounded to sub-angular, dry to slightly moist, with low plasticity clay, trace fine to medium grained gravel. COLLUVIUM.	Large Bulk Sample
0.4	-0.4					
0.6	-0.6				FERRICRETE (0.6 to 0.9 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
0.8	-0.8					
					End of Test Pit: 0.9 m Refusal on Ferricrete	

GENERAL REMARKS: 1. Refusal at 0.9 m on Ferricrete 2. Many roots to 0.1 m depth, small in size (1-2 mm) 3. Large Bulk Sample taken at 0.2-0.3 m 4. No Seepage 5. Pit Stable					NORTHERN STAR RESOURCES LIMITED THUNDERBOX							
					 Knight Piesold CONSULTING		P/A NO. PE001-00296/24		REF. NO.		REV	
FIGURE .												

Contractor		Northern Star		Test Pit No		D-TP-20		Page		1 of 1	
Location		Proposed TSF Cell C Area		Equipment Used		CAT 336D		Date Completed		14/Mar/2021	
Coordinates		306172E, 6880125N		Total Depth		0.9 m		Logged By		JY	
Coordinate System		51 J WGS84		Elevation		0 m		Reviewed By			

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				CLAY (0 to 0.7 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular.	
0.4	-0.4					
0.6	-0.6					
0.8	-0.8				FERRICRETE (0.7 to 0.9 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
					End of Test Pit: 0.9 m Refusal on Ferricrete	

GENERAL REMARKS: 1. Refusal at 0.9 m on Ferricrete 2. Few roots to 0.1 m depth, small in size (1-2 mm) 3. No Samples taken 4. No Seepage 5. Pit Stable					NORTHERN STAR RESOURCES LIMITED THUNDERBOX				
					 Knight Piesold CONSULTING		P/A NO. PE001-00296/24	REF. NO.	REV
					FIGURE .				

Contractor	Northern Star	Test Pit No	D-TP-21	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	14/Mar/2021
Coordinates	306322E, 6880122N	Total Depth	0.6 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				CLAY (0 to 0.5 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular.	
0.4	-0.4					Small Sample
0.6	-0.6				FERRICRETE (0.5 to 0.6 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
0.8	-0.8				End of Test Pit: 0.6 m Refusal on Ferricrete	

GENERAL REMARKS:

1. Refusal at 0.6 m on Ferricrete
2. Few roots to 0.3 m depth, small in size (1-2 mm)
3. Small Sample taken at 0.3-0.4 m
4. No Seepage
5. Pit Stable

**NORTHERN STAR RESOURCES LIMITED
THUNDERBOX**


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FIGURE .

Contractor		Northern Star		Test Pit No		D-TP-22		Page		1 of 1	
Location		Proposed TSF Cell C Area		Equipment Used		CAT 336D		Date Completed		14/Mar/2021	
Coordinates		306472E, 6880120N		Total Depth		0.6 m		Logged By		JY	
Coordinate System		51 J WGS84		Elevation		0 m		Reviewed By			

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				CLAY (0 to 0.5 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular.	
0.4	-0.4					
0.6	-0.6				FERRICRETE (0.5 to 0.6 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
0.8	-0.8				End of Test Pit: 0.6 m Refusal on Ferricrete	

GENERAL REMARKS:					NORTHERN STAR RESOURCES LIMITED THUNDERBOX			
1. Refusal at 0.6 m on Ferricrete 2. Few roots to 0.2 m depth, medium in size (2-10 mm) 3. No Samples taken 4. No Seepage 5. Pit Stable					 Knight Piesold CONSULTING		P/A NO. PE001-00296/24	REF. NO. REV
					FIGURE .			

Contractor	Northern Star	Test Pit No	D-TP-23	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	15/Mar/2021
Coordinates	306022E, 6880277N	Total Depth	1.3 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.5	-0.5				CLAY (0 to 1 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular. High strength ferricrete cobbles on ground surface.	
1	-1				FERRICRETE (1 to 1.3 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
1.5	-1.5				End of Test Pit: 1.3 m Refusal on Ferricrete	

GENERAL REMARKS:

1. Refusal at 1.3 m on Ferricrete
2. Few roots to 0.3 m depth, medium in size (2-10 mm)
3. No Samples taken
4. No Seepage
5. Pit Stable

**NORTHERN STAR RESOURCES LIMITED
THUNDERBOX**


P/A NO. PE001.00296/24	REF. NO.	REV
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FIGURE .

Contractor	Northern Star	Test Pit No	D-TP-24	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	15/Mar/2021
Coordinates	306172E, 6880275N	Total Depth	0.6 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				CLAY (0 to 0.5 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular. Quartz and Basalt gravel found on surface.	
						Small Sample
0.4	-0.4					
0.6	-0.6				FERRICRETE (0.5 to 0.6 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
0.8	-0.8				End of Test Pit: 0.6 m Refusal on Ferricrete	

GENERAL REMARKS:

1. Refusal at 0.6 m on Ferricrete
2. Few roots to 0.2 m depth, medium in size (2-10 mm)
3. Small Sample taken at 0.2-0.3 m
4. No Seepage
5. Pit Stable

**NORTHERN STAR RESOURCES LIMITED
THUNDERBOX**


P/A NO. PE001.00296/24	REF. NO.	REV
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FIGURE .

Contractor	Northern Star	Test Pit No	D-TP-25	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	15/Mar/2021
Coordinates	306322E, 6880273N	Total Depth	0.7 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				CLAY (0 to 0.6 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular. Quartz and Basalt gravel found on surface.	
0.4	-0.4					
0.6	-0.6				FERRICRETE (0.6 to 0.7 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
0.8	-0.8				End of Test Pit: 0.7 m Refusal on Ferricrete	

GENERAL REMARKS:

1. Refusal at 0.7 m on Ferricrete
2. Few roots to 0.3 m depth, medium in size (2-10 mm)
3. No Samples taken
4. No Seepage
5. Pit Stable

**NORTHERN STAR RESOURCES LIMITED
THUNDERBOX**


P/A NO. PE001.00296/24	REF. NO.	REV
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FIGURE .

Contractor	Northern Star	Test Pit No	D-TP-26	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	15/Mar/2021
Coordinates	306528E, 6880209N	Total Depth	0.9 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				SAND (0 to 0.7 m) SAND (SC), gravelly, clayey, fine to medium grained, red brown and orange brown, sub-rounded to sub-angular, dry to slightly moist. COLLUVIUM - Clay is low plasticity and Gravel is fine to medium grained.	
0.4	-0.4					
0.6	-0.6					Large Bulk Sample
0.8	-0.8				FERRICRETE (0.7 to 0.9 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
					End of Test Pit: 0.9 m Refusal on Ferricrete	

GENERAL REMARKS:

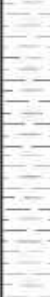
1. Refusal at 0.9 m on Ferricrete
2. Few roots to 0.5 m depth, small in size (1-2 mm)
3. Large Bulk Sample taken at 0.5-0.6 m
4. No Seepage
5. Pit Stable

**NORTHERN STAR RESOURCES LIMITED
THUNDERBOX**


P/A NO. PE001.00296/24	REF. NO.	REV
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FIGURE .

Contractor		Northern Star		Test Pit No		D-TP-27		Page		1 of 1	
Location		Proposed TSF Cell C Area		Equipment Used		CAT 336D		Date Completed		15/Mar/2021	
Coordinates		306021E, 6880427N		Total Depth		0.5 m		Logged By		JY	
Coordinate System		51 J WGS84		Elevation		0 m		Reviewed By			

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				CLAY (0 to 0.4 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular.	
0.4	-0.4				FERRICRETE (0.4 to 0.5 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	Large Bulk Sample
0.6	-0.6				End of Test Pit: 0.5 m Refusal on Ferricrete	
0.8	-0.8					

GENERAL REMARKS: 1. Refusal at 0.5 m on Ferricrete 2. Few roots to 0.2 m depth, medium in size (2-10 mm) 3. Large Bulk Sample taken at 0.2-0.3 m 4. No Seepage 5. Pit Stable					NORTHERN STAR RESOURCES LIMITED THUNDERBOX							
					 Knight Piesold CONSULTING		P/A NO. PE001.00296/24		REF. NO.		REV	
FIGURE .												

Contractor	Northern Star	Test Pit No	D-TP-28	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	15/Mar/2021
Coordinates	306171E, 6880425N	Total Depth	0.9 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				CLAY (0 to 0.7 m) CLAY (SC), sandy, low plasticity, grey, red brown and orange brown, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular.	
0.4	-0.4					
0.6	-0.6					
0.8	-0.8				FERRICRETE (0.7 to 0.9 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
					End of Test Pit: 0.9 m Refusal on Ferricrete	

GENERAL REMARKS:

1. Refusal at 0.9 m on Ferricrete
2. Few roots to 0.3 m depth, small in size (1-2 mm)
3. No Samples taken
4. No Seepage
5. Pit Stable

**NORTHERN STAR RESOURCES LIMITED
THUNDERBOX**


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P/A NO. PE001.00296/24	REF. NO.	REV
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FIGURE .

Contractor	Northern Star	Test Pit No	D-TP-29	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	15/Mar/2021
Coordinates	306321E, 6880423N	Total Depth	0.8 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				SAND (0 to 0.7 m) SAND (SC), gravelly, clayey, fine to medium grained, red brown and orange brown, sub-rounded to sub-angular, dry to slightly moist. COLLUVIUM - Clay is low plasticity and Gravel is fine to medium grained.	
0.4	-0.4					Small Sample
0.6	-0.6					
0.8	-0.8				FERRICRETE (0.7 to 0.8 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
					End of Test Pit: 0.8 m Refusal on Ferricrete	

GENERAL REMARKS:

1. Refusal at 0.8 m on Ferricrete
2. Few roots to 0.3 m depth, medium in size (2-10 mm)
3. Small Sample taken at 0.3-0.4 m
4. No Seepage
5. Pit Stable

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THUNDERBOX**

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P/A NO. PE001.00296/24	REF. NO.	REV
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FIGURE .

Contractor	Northern Star	Test Pit No	D-TP-30	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	15/Mar/2021
Coordinates	306471E, 6880420N	Total Depth	1.5 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.5	-0.5				SAND (0 to 1.1 m) SAND (SC), gravelly, clayey, fine to medium grained, red brown and orange brown, sub-rounded to sub-angular, dry to slightly moist. COLLUVIUM - Clay is low plasticity and Gravel is fine to medium grained.	
1	-1				FERRICRETE (1.1 to 1.5 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
1.5	-1.5				End of Test Pit: 1.5 m Refusal on Ferricrete	

GENERAL REMARKS:

1. Refusal at 1.5 m on Ferricrete
2. Few roots to 0.4 m depth, large in size (>10 mm)
3. No Samples taken
4. No Seepage
5. Pit Stable

**NORTHERN STAR RESOURCES LIMITED
THUNDERBOX**

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 P/A NO.
PE001.00296/24

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REV

FIGURE .

Contractor	Northern Star	Test Pit No	D-TP-31	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	15/Mar/2021
Coordinates	306046E, 6880579N	Total Depth	0.7 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				CLAY (0 to 0.6 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular.	
0.4	-0.4					Small Sample
0.6	-0.6				FERRICRETE (0.6 to 0.7 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
0.8	-0.8				End of Test Pit: 0.7 m Refusal on Ferricrete	

GENERAL REMARKS:

1. Refusal at 0.7 m on Ferricrete
2. Few roots to 0.5 m depth, small in size (1-2 mm)
3. Small Sample taken at 0.3-0.4 m
4. No Seepage
5. Pit Stable

**NORTHERN STAR RESOURCES LIMITED
THUNDERBOX**


P/A NO. PE001.00296/24	REF. NO.	REV
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FIGURE .

Contractor	Northern Star	Test Pit No	D-TP-32	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	15/Mar/2021
Coordinates	306170E, 6880575N	Total Depth	0.8 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				CLAY (0 to 0.6 m) CLAY (SC), sandy, low plasticity, red brown, moist near plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular.	
0.4	-0.4					
0.6	-0.6				FERRICRETE (0.6 to 0.8 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
0.8	-0.8				End of Test Pit: 0.8 m Refusal on Ferricrete	

GENERAL REMARKS:

1. Refusal at 0.8 m on Ferricrete
2. Few roots to 0.3 m depth, large in size (>10 mm)
3. No Samples taken
4. No Seepage
5. Pit Stable

**NORTHERN STAR RESOURCES LIMITED
THUNDERBOX**


P/A NO. PE001.00296/24	REF. NO.	REV
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FIGURE .

Contractor		Northern Star		Test Pit No		D-TP-33		Page		1 of 1	
Location		Proposed TSF Cell C Area		Equipment Used		CAT 336D		Date Completed		15/Mar/2021	
Coordinates		306320E, 6880573N		Total Depth		0.5 m		Logged By		JY	
Coordinate System		51 J WGS84		Elevation		0 m		Reviewed By			

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				CLAY (0 to 0.4 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, moist near plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular.	
0.4	-0.4				FERRICRETE (0.4 to 0.5 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
0.6	-0.6				End of Test Pit: 0.5 m Refusal on Ferricrete	
0.8	-0.8					

GENERAL REMARKS: 1. Refusal at 0.5 m on Ferricrete 2. Few roots to 0.1 m depth, small in size (1-2 mm) 3. No Samples taken 4. No Seepage 5. Pit Stable					NORTHERN STAR RESOURCES LIMITED THUNDERBOX							
					 Knight Piesold CONSULTING		P/A NO. PE001.00296/24		REF. NO.		REV	
					FIGURE .							

Contractor	Northern Star	Test Pit No	D-TP-34	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	15/Mar/2021
Coordinates	306170E, 6880609N	Total Depth	0.3 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				SAND (0 to 0.2 m) SAND (SP), fine to medium grained, red brown and orange brown, sub-rounded to sub-angular, dry to slightly moist, with low plasticity clay, with fine to medium grained gravel. COLLUVIUM. High strength angular Basalt gravel on surface	Large Bulk Sample
					FERRICRETE (0.2 to 0.3 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
0.4	-0.4				End of Test Pit: 0.3 m Refusal on Ferricrete	
0.6	-0.6					
0.8	-0.8					

GENERAL REMARKS:

1. Refusal at 0.3 m on Ferricrete
2. No Vegetation (roots)
3. Large Bulk Sample taken at 0.1-0.2 m
4. No Seepage
5. Pit Stable

**NORTHERN STAR RESOURCES LIMITED
THUNDERBOX**


P/A NO. PE001.00296/24	REF. NO.	REV
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FIGURE .

Contractor	Northern Star	Test Pit No	D-TP-35	Page	1 of 1
Location	Proposed TSF Cell C Area	Equipment Used	CAT 336D	Date Completed	15/Mar/2021
Coordinates	306025E, 6880727N	Total Depth	0.5 m	Logged By	JY
Coordinate System	51 J WGS84	Elevation	0 m	Reviewed By	

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				CLAY (0 to 0.4 m) CLAY (SC), sandy, low plasticity, red brown and orange brown, grey on surface, moist less than plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular.	
0.4	-0.4				FERRICRETE (0.4 to 0.5 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
0.6	-0.6				End of Test Pit: 0.5 m Refusal on Ferricrete	
0.8	-0.8					

GENERAL REMARKS:

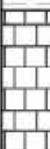
1. Refusal at 0.5 m on Ferricrete
2. No Vegetation (roots)
3. No Samples taken
4. No Seepage
5. Pit Stable

**NORTHERN STAR RESOURCES LIMITED
THUNDERBOX**


P/A NO. PE001.00296/24	REF. NO.	REV
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FIGURE .

Contractor		Northern Star		Test Pit No		D-TP-36		Page		1 of 1	
Location		Proposed TSF Cell C Area		Equipment Used		CAT 336D		Date Completed		15/Mar/2021	
Coordinates		305985E, 6880797N		Total Depth		0.4 m		Logged By		JY	
Coordinate System		51 J WGS84		Elevation		0 m		Reviewed By			

DEPTH - (M)	ELEVATION - (M)	SAMPLE TYPE	SAMPLE NO	GRAPHIC LOG	MATERIAL DESCRIPTION	NOTES
0.2	-0.2				CLAY (0 to 0.3 m) CLAY (SC), sandy, low plasticity, brown, grey on surface, moist near plastic limit, trace fine to medium grained gravel. COLLUVIUM - Sand particles are fine to coarse grained and sub-rounded to sub-angular.	
0.4	-0.4				FERRICRETE (0.3 to 0.4 m) GRAVEL (GP), clayey, sandy, red brown and orange brown, dry. FERRICRETE - Gravel particles are fine to coarse grained, sub-angular to angular and medium to high strength. Sand is fine to medium grained, sub-rounded to sub-angular. Clay is low plasticity.	
0.6	-0.6				End of Test Pit: 0.4 m Refusal on Ferricrete	
0.8	-0.8					

GENERAL REMARKS: 1. Refusal at 0.4 m on Ferricrete 2. Few roots to 0.1 m depth, small in size (1-2 mm) 3. No Samples taken 4. No Seepage 5. Pit Stable					NORTHERN STAR RESOURCES LIMITED THUNDERBOX							
							P/A NO. PE001.00296/24		REF. NO.		REV	
					FIGURE .							

APPENDIX D
Test Pit Photos

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 1: C-TP-35 – Location



Plate 2: C-TP-35 – Test Pit



**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**

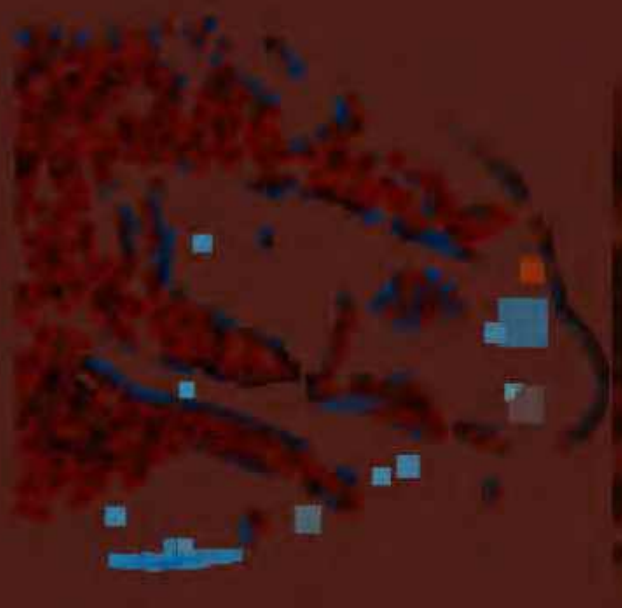


Plate 3: C-TP-35 – Plasticity Test



Plate 4: C-TP-35 – Stockpile

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 5: C-TP-36 – Location



Plate 6: C-TP-36 – Test Pit

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 7: C-TP-36 – Plasticity Test



Plate 8: C-TP-36 – Stockpile

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 9: C-TP-37 – Location



Plate 10: C-TP-37 – Test Pit

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 11: C-TP-37 – Plasticity Test



Plate 12: C-TP-37 – Stockpile

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 13: C-TP-38 – Location



Plate 14: C-TP-38 – Test Pit

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 15: C-TP-38 – Plasticity Test



Plate 16: C-TP-38 – Stockpile

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 17: C-TP-39 – Location



Plate 18: C-TP-39 – Test Pit

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 19: C-TP-39 – Plasticity Test



Plate 20: C-TP-39 – Stockpile

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 21: C-TP-40 – Location



Plate 22: C-TP-40 – Test Pit

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 23: C-TP-40 – Plasticity Test



Plate 24: C-TP-40 – Stockpile

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 25: C-TP-41 – Location



Plate 26: C-TP-41 – Test Pit

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 27: C-TP-41 – Plasticity Test



Plate 28: C-TP-41 – Stockpile

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 29: C-TP-42 – Location



Plate 30: C-TP-42 – Test Pit

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 31: C-TP-42 – Plasticity Test



Plate 32: C-TP-42 – Stockpile

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 33: C-TP-43 – Location



Plate 34: C-TP-43 – Test Pit

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 35: C-TP-43 – Plasticity Test



Plate 36: C-TP-43 – Stockpile

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 37: C-TP-44 – Location



Plate 38: C-TP-44 – Test Pit

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 39: C-TP-44 – Plasticity Test



Plate 40: C-TP-44 – Stockpile

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 41: C-TP-45 – Location



Plate 42: C-TP-45 – Test Pit

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 43: C-TP-45 – Plasticity Test



Plate 44: C-TP-45 – Stockpile

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 45: C-TP-46 – Location



Plate 46: C-TP-46 – Test Pit

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 47: C-TP-46 – Plasticity Test



Plate 48: C-TP-46 – Stockpile

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 49: C-TP-47 – Location



Plate 50: C-TP-47 – Test Pit

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 51: C-TP-47 – Plasticity Test



Plate 52: C-TP-47 – Stockpile

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 53: C-TP-48 – Location



Plate 54: C-TP-48 – Test Pit

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 55: C-TP-48 – Plasticity Test



Plate 56: C-TP-48 – Stockpile

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 57: C-TP-49 – Location



Plate 58: C-TP-49 – Test Pit

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 59: C-TP-49 – Plasticity Test



Plate 60: C-TP-49 – Stockpile

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 61: D-TP-01 – Location



Plate 62: D-TP-01 – Test Pit

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 63: D-TP-01 – Plasticity Test



Plate 64: D-TP-01 – Stockpile

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 65: D-TP-02 – Location



Plate 66: D-TP-02 – Test Pit

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 67: D-TP-02 – Plasticity Test



Plate 68: D-TP-02 – Stockpile

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 69: D-TP-03 – Location



Plate 70: D-TP-03 – Test Pit

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 71: D-TP-03 – Plasticity Test



Plate 72: D-TP-03 – Stockpile

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 73: D-TP-04 – Location



Plate 74: D-TP-04 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 75: D-TP-04 – Stockpile



Plate 76: D-TP-05 – Location

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 77: D-TP-05 – Test Pit



Plate 78: D-TP-05 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 79: D-TP-05 – Stockpile



Plate 80: D-TP-06 – Location

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 81: D-TP-06 – Test Pit



Plate 82: D-TP-06 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 83: D-TP-06 – Stockpile



Plate 84: D-TP-07 – Location

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 85: D-TP-07 – Test Pit



Plate 86: D-TP-07 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 87: D-TP-07 – Stockpile



Plate 88: D-TP-08 – Location

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 89: D-TP-08 – Test Pit



Plate 90: D-TP-08 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 91: D-TP-08 – Stockpile



Plate 92: D-TP-09 – Location

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 93: D-TP-09 – Test Pit



Plate 94: D-TP-09 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 95: D-TP-09 – Stockpile



Plate 96: D-TP-10 – Location

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 97: D-TP-10 – Test Pit



Plate 98: D-TP-10 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 99: D-TP-10 – Stockpile



Plate 100: D-TP-11 – Location

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 101: D-TP-11 – Test Pit



Plate 102: D-TP-11 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 103: D-TP-11 – Stockpile



Plate 104: D-TP-12 – Location

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 105: D-TP-12 – Test Pit



Plate 106: D-TP-12 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 107: D-TP-12 – Stockpile



Plate 108: D-TP-13 – Location

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 109: D-TP-13 – Test Pit



Plate 110: D-TP-13 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 111: D-TP-13 – Stockpile



Plate 112: D-TP-14 – Location

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 113: D-TP-14 – Test Pit



Plate 114: D-TP-14 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 115: D-TP-14 – Stockpile



Plate 116: D-TP-15 – Location

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 117: D-TP-15 – Test Pit



Plate 118: D-TP-15 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 119: D-TP-15 – Stockpile



Plate 120: D-TP-16 – Location

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 121: D-TP-16 – Test Pit



Plate 122: D-TP-16 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 123: D-TP-16 – Stockpile



Plate 124: D-TP-17 – Location

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 125: D-TP-17 – Test Pit



Plate 126: D-TP-17 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 127: D-TP-17 – Stockpile



Plate 128: D-TP-18 – Location

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 129: D-TP-18 – Test Pit



Plate 130: D-TP-18 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 131: D-TP-18 – Stockpile



Plate 132: D-TP-19 – Location

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 133: D-TP-19 – Test Pit



Plate 134: D-TP-19 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 135: D-TP-19 – Stockpile



Plate 136: D-TP-20 – Location

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 137: D-TP-20 – Test Pit



Plate 138: D-TP-20 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 139: D-TP-20 – Stockpile



Plate 140: D-TP-21 – Location

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 141: D-TP-21 – Test Pit



Plate 142: D-TP-21 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 143: D-TP-21 – Stockpile



Plate 144: D-TP-22 – Location

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 145: D-TP-22 – Test Pit



Plate 146: D-TP-22 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 147: D-TP-22 – Stockpile



Plate 148: D-TP-23 – Location

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 149: D-TP-23 – Test Pit



Plate 150: D-TP-23 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 151: D-TP-23 – Stockpile



Plate 152: D-TP-24 – Location

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 153: D-TP-24 – Test Pit



Plate 154: D-TP-24 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 155: D-TP-24 – Stockpile



Plate 156: D-TP-25 – Location

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 157: D-TP-25 – Test Pit



Plate 158: D-TP-25 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 159: D-TP-25 – Stockpile



Plate 160: D-TP-26 – Location

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 161: D-TP-26 – Test Pit



Plate 162: D-TP-26 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 163: D-TP-26 – Stockpile



Plate 164: D-TP-27 – Location

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 165: D-TP-27 – Test Pit



Plate 166: D-TP-27 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 167: D-TP-27 – Stockpile



Plate 168: D-TP-28 – Location

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 169: D-TP-28 – Test Pit



Plate 170: D-TP-28 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 171: D-TP-28 – Stockpile



Plate 172: D-TP-29 – Location

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 173: D-TP-29 – Test Pit



Plate 174: D-TP-29 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 175: D-TP-29 – Stockpile



Plate 176: D-TP-30 – Location

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 177: D-TP-30 – Test Pit



Plate 178: D-TP-30 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 179: D-TP-30 – Stockpile



Plate 180: D-TP-31 – Location

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 181: D-TP-31 – Test Pit



Plate 182: D-TP-31 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 183: D-TP-31 – Stockpile



Plate 184: D-TP-32 – Location

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 185: D-TP-32 – Test Pit



Plate 186: D-TP-32 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 187: D-TP-32 – Stockpile



Plate 188: D-TP-33 – Location

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 189: D-TP-33 – Test Pit



Plate 190: D-TP-33 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 191: D-TP-33 – Stockpile



Plate 192: D-TP-34 – Location

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 193: D-TP-34 – Test Pit



Plate 194: D-TP-34 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 195: D-TP-34 – Stockpile



Plate 196: D-TP-35 – Location

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 197: D-TP-35 – Test Pit



Plate 198: D-TP-35 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 199: D-TP-35 – Stockpile



Plate 200: D-TP-36 – Location

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 201: D-TP-36 – Test Pit



Plate 202: D-TP-36 – Plasticity Test

**THUNDERBOX GOLD MINE
2021 TSF CELLS C AND D SITE INVESTIGATION
TEST PIT PHOTOGRAPHS**



Plate 203: D-TP-36 – Stockpile

APPENDIX E
Laboratory Test Reports



ATTERBERG LIMITS TEST REPORT

Test Method: BS1377 AS1289.2.1.1 7.1.1 3.1.1 3.2.1 3.4.1

Client:	Knight Piesold	Date Tested:	29/04/2021
Project:	Thunderbox TSF Cells C and D	Lab:	EPLAB
Sample No:	C-BH-05 / SPT2	Job Number:	KP
Lab ID:	C-BH-05_21.10_21.55_ATT		
Depth(m):	21.10 - 21.55	Room Temperature at Test:	20°C

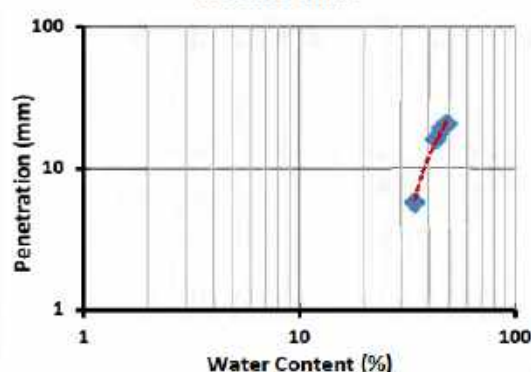
Tested by:	Kohei	Sample Description:	-
Moisture Content (%):	-	Wet Density (t/m ³):	-
		Dry Density (t/m ³):	-

Liquid Limit (%): 44.96
Plastic Limit (%): 30.94

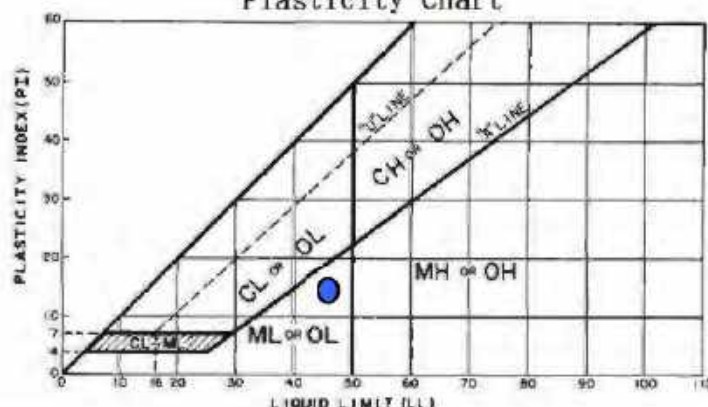
Plasticity Index (%): 14.02
Liquidity Index (%): -

Shrinkage Limit (%): 24.47
Linear Shrinkage(%): 7.14

Results Chart



Plasticity Chart



Notes: The sample/s were tested oven dried, dry sieved and in a 125-250

Stored and Tested the Sample as received

Samples supplied by the Client

Authorised Signature

The results of tests performed apply only to the specific sample at time of test unless otherwise clearly stated. Reference should be made to E-Precision Laboratory's "Standard Terms and Conditions" E-Precision Laboratory ABN 431 559 578 87



Test Method: BS1377 AS1289.2.1.1 7.1.1 3.1.1 3.2.1 3.4.1

Client:	Knight Piesold	Date Tested:	27/04/2021
Project:	Thunderbox TSF Cells C and D	Lab:	EPLAB
Sample No:	C-BH-05 / SPT1	Job Number:	KP
Lab ID:	C-BH-05_3.00_3.50_ATT		
Depth(m):	3.00 - 3.50	Room Temperature at Test:	20°C

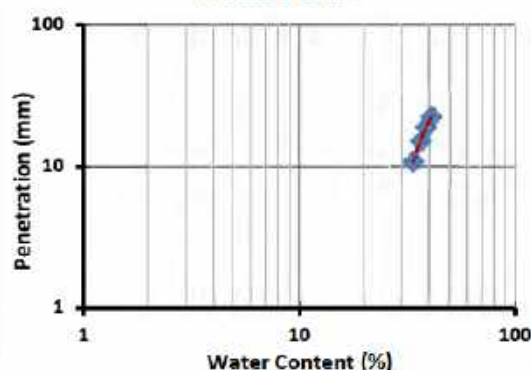
Tested by:	Kohei	Sample Description:	-
Moisture Content (%):	-	Wet Density (t/m³):	-
		Dry Density (t/m³):	-

Liquid Limit (%): 37.53
Plastic Limit (%): 28.21

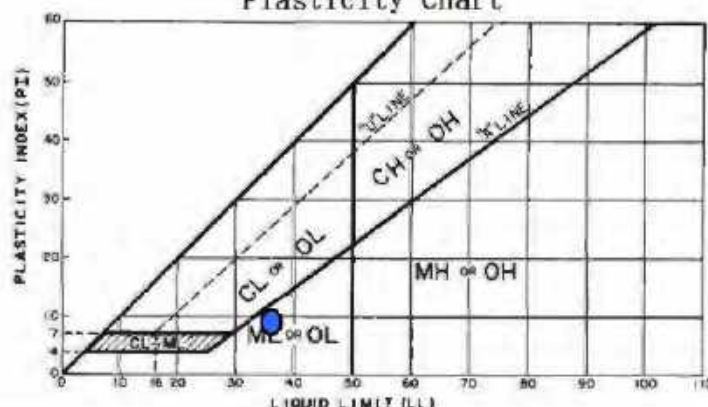
Plasticity Index (%): 9.32
Liquidity Index (%): -

Shrinkage Limit (%): 24.00
Linear Shrinkage(%): 4.27

Results Chart



Plasticity Chart



Notes: The sample/s were tested oven dried, dry sieved and in a 125-250mm mould.

Stored and Tested the Sample as received

Samples supplied by the Client

Authorised Signat

The results of tests performed apply only to the specific sample at time of test unless otherwise clearly stated. Reference should be made to E-Precision Laboratory's "Standard Terms and Conditions" E-Precision Laboratory ABN 431 559 578 87



ATTERBERG LIMITS TEST REPORT

Test Method: BS1377 AS1289.2.1.1 7.1.1 3.1.1 3.2.1 3.4.1

Client:	Knight Piesold	Date Tested:	27/04/2021
Project:	Thunderbox TSF Cells C and D	Lab:	EPLAB
Sample No:	C-BH-06 / SPT1	Job Number:	KP
Lab ID:	C-BH-06_4.50_4.95_ATT		
Depth(m):	4.50 - 4.95	Room Temperature at Test:	20°C

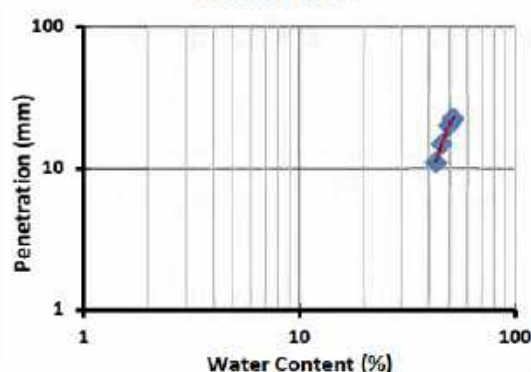
Tested by:	Kohei	Sample Description:	-
Moisture Content (%):	-	Wet Density (t/m ³):	-
		Dry Density (t/m ³):	-

Liquid Limit (%): 47.40
Plastic Limit (%): 36.12

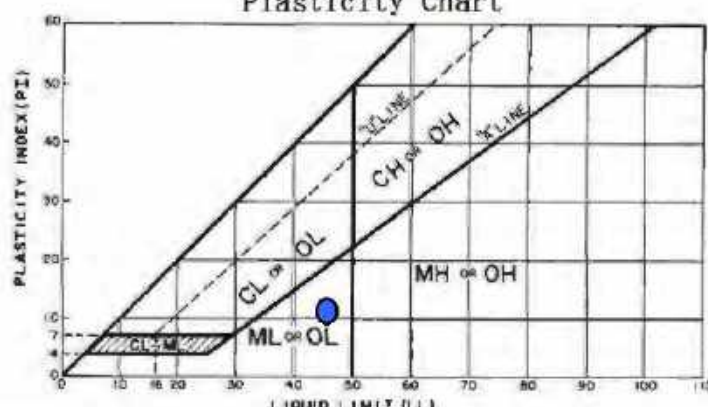
Plasticity Index (%): 11.28
Liquidity Index (%): -

Shrinkage Limit (%): 29.66
Linear Shrinkage(%): 4.56

Results Chart



Plasticity Chart



Notes: The sample/s were tested oven dried, dry sieved and in a 125-25

Stored and Tested the Sample as received

Samples supplied by the Client

Authorised Signa

The results of tests performed apply only to the specific sample at time of test unless otherwise clearly stated. Reference should be made to E-Precision Laboratory's "Standard Terms and Conditions" E-Precision Laboratory ABN 431 559 578 87



ATTERBERG LIMITS TEST REPORT

Test Method: BS1377 AS1289.2.1.1 7.1.1 3.1.1 3.2.1 3.4.1

Client:	Knight Piesold	Date Tested:	27/04/2021
Project:	Thunderbox TSF Cells C and D	Lab:	EPLAB
Sample No:	C-BH-07 / SPT1	Job Number:	KP
Lab ID:	C-BH-07_3.00_3.45_ATT		
Depth(m):	3.00 - 3.45	Room Temperature at Test:	20°C

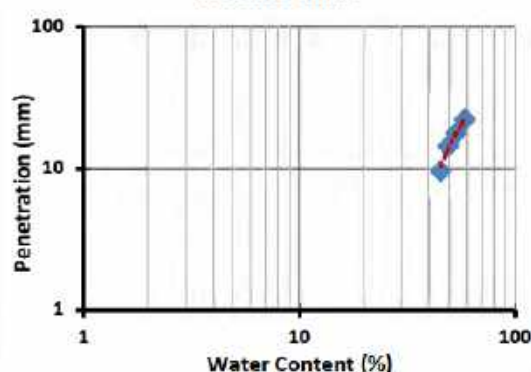
Tested by:	Kohei	Sample Description:	-
Moisture Content (%):	-	Wet Density (t/m³):	-
		Dry Density (t/m³):	-

Liquid Limit (%): 53.11
Plastic Limit (%): 36.63

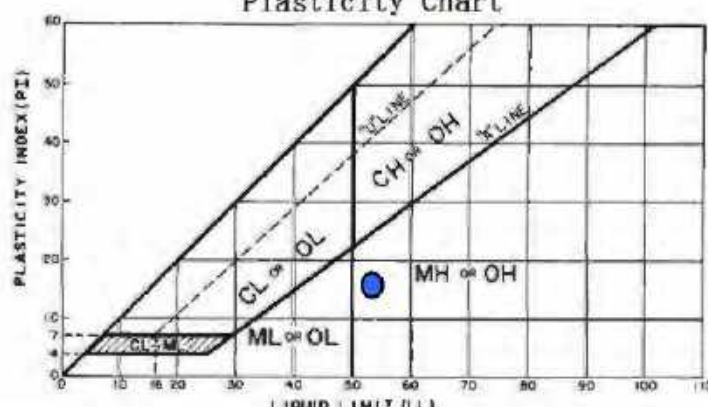
Plasticity Index (%): 16.48
Liquidity Index (%): -

Shrinkage Limit (%): 27.83
Linear Shrinkage(%): 5.17

Results Chart



Plasticity Chart



Notes: The sample/s were tested oven dried, dry sieved and in a 125-

Stored and Tested the Sample as received

Samples supplied by the Client

Authorised Sign

The results of tests performed apply only to the specific sample at time of test unless otherwise clearly stated. Reference should be made to E-Precision Laboratory's "Standard Terms and Conditions" E-Precision Laboratory ABN 431 559 578 87



ATTERBERG LIMITS TEST REPORT

Test Method: BS1377 AS1289.2.1.1 7.1.1 3.1.1 3.2.1 3.4.1

Client:	Knight Piesold	Date Tested:	27/04/2021
Project:	Thunderbox TSF Cells C and D	Lab:	EPLAB
Sample No:	C-BH-07 / SPT2	Job Number:	KP
Lab ID:	C-BH-07_4.50_4.90_ATT		
Depth(m):	4.50 - 4.90	Room Temperature at Test:	20°C

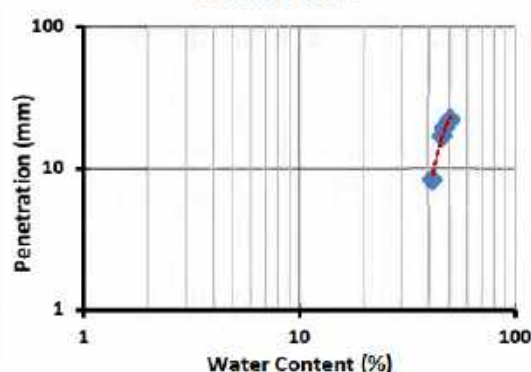
Tested by:	Kohei	Sample Description:	-
Moisture Content (%):	-	Wet Density (t/m ³):	-
		Dry Density (t/m ³):	-

Liquid Limit (%): 46.76
Plastic Limit (%): 37.45

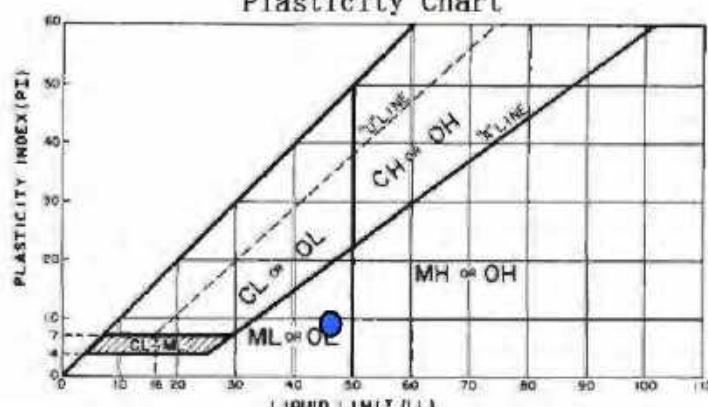
Plasticity Index (%): 9.31
Liquidity Index (%): -

Shrinkage Limit (%): 31.70
Linear Shrinkage(%): 4.84

Results Chart



Plasticity Chart



Notes: The sample/s were tested oven dried, dry sieved and in a 125-250mm mould.

Stored and Tested the Sample as received

Samples supplied by the Client

Authorised Signature:

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Test Method: BS1377 AS1289.2.1.1 7.1.1 3.1.1 3.2.1 3.4.1

Client:	Knight Piesold	Date Tested:	29/04/2021
Project:	Thunderbox TSF Cells C and D	Lab:	EPLAB
Sample No:	C-TP-35	Job Number:	KP
Lab ID:	C-TP-35_0.30_0.40_ATT		
Depth(m):	0.30 - 0.40	Room Temperature at Test:	20°C

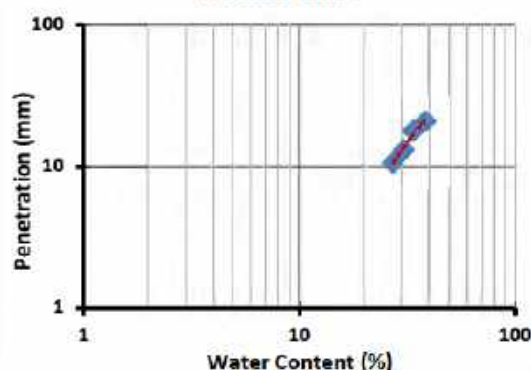
Tested by:	Kohei	Sample Description:	-
Moisture Content (%):	-	Wet Density (t/m³):	-
		Dry Density (t/m³):	-

Liquid Limit (%): 33.87
Plastic Limit (%): 17.96

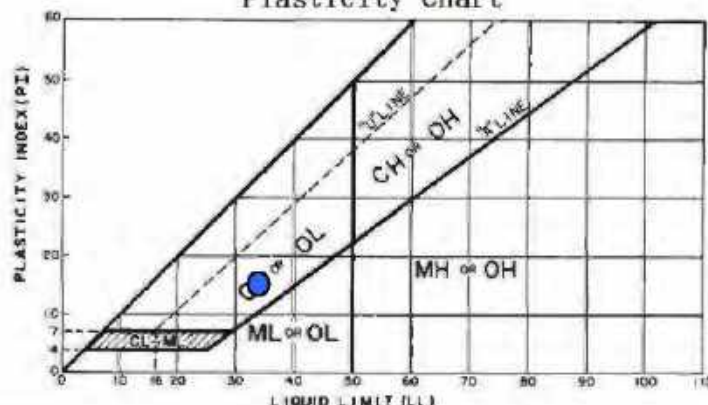
Plasticity Index (%): 15.91
Liquidity Index (%): -

Shrinkage Limit (%): 14.15
Linear Shrinkage(%): 4.79

Results Chart



Plasticity Chart



Notes: The sample/s were tested oven dried, dry sieved and in a 125-250mm mould.

Stored and Tested the Sample as received

Samples supplied by the Client

Authorised Signat

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ATTERBERG LIMITS TEST REPORT

Test Method: BS1377 AS1289.2.1.1 7.1.1 3.1.1 3.2.1 3.4.1

Client:	Knight Piesold	Date Tested:	29/04/2021
Project:	Thunderbox TSF Cells C and D	Lab:	EPLAB
Sample No:	C-TP-39	Job Number:	KP
Lab ID:	C-TP-39_0.40_0.50_ATT		
Depth(m):	0.40 - 0.50	Room Temperature at Test:	20°C

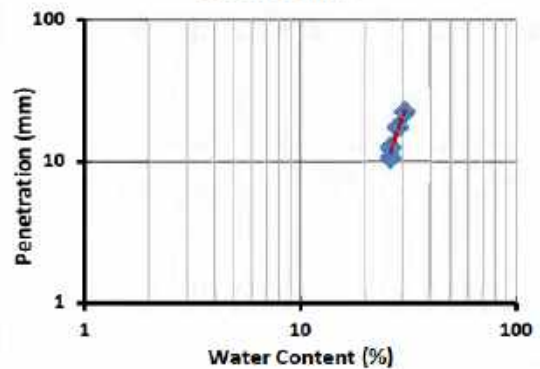
Tested by:	Kohei	Sample Description:	-
Moisture Content (%):	-	Wet Density (t/m³):	-
		Dry Density (t/m³):	-

Liquid Limit (%): 28.45
Plastic Limit (%): 22.66

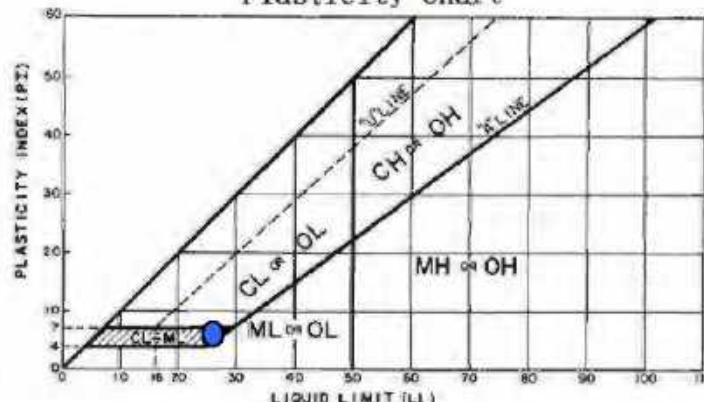
Plasticity Index (%): 5.79
Liquidity Index (%): -

Shrinkage Limit (%): 20.48
Linear Shrinkage(%): 2.26

Results Chart



Plasticity Chart



Notes: The sample/s were tested oven dried, dry sieved and in a 125-250mm mould.

Stored and Tested the Sample as received

Samples supplied by the Client

Authorised Signature:

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Test Method: BS1377 AS1289.2.1.1 7.1.1 3.1.1 3.2.1 3.4.1

Client:	Knight Piesold	Date Tested:	29/04/2021
Project:	Thunderbox TSF Cells C and D	Lab:	EPLAB
Sample No:	C-TP-40	Job Number:	KP
Lab ID:	C-TP-40_0.20_0.30_ATT		
Depth(m):	0.20 - 0.30	Room Temperature at Test:	20°C

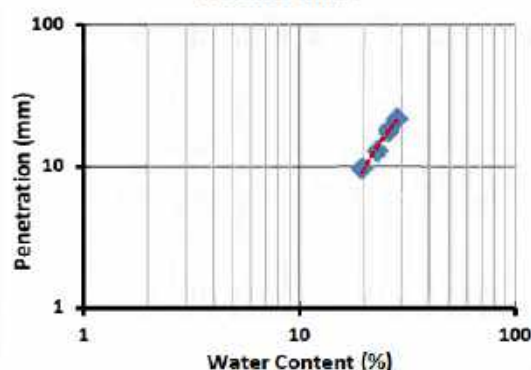
Tested by:	Kohei	Sample Description:	-
Moisture Content (%):	-	Wet Density (t/m³):	-
		Dry Density (t/m³):	-

Liquid Limit (%): 25.51
Plastic Limit (%): 14.54

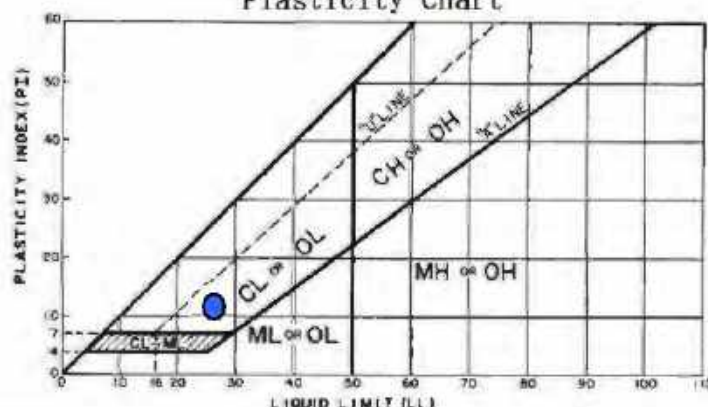
Plasticity Index (%): 10.97
Liquidity Index (%): -

Shrinkage Limit (%): 12.34
Linear Shrinkage(%): 5.76

Results Chart



Plasticity Chart



Notes: The sample/s were tested oven dried, dry sieved and in a 125-250mm mould.

Stored and Tested the Sample as received

Samples supplied by the Client

Authorised Signa

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ATTERBERG LIMITS TEST REPORT

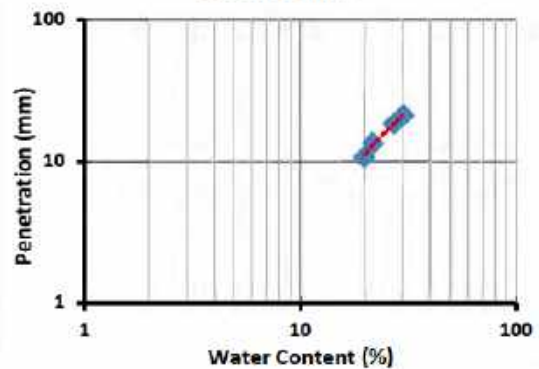
Test Method: BS1377 AS1289.2.1.1 7.1.1 3.1.1 3.2.1 3.4.1

Client:	Knight Piesold	Date Tested:	27/04/2021
Project:	Thunderbox TSF Cells C and D	Lab:	EPLAB
Sample No:	C-TP-42	Job Number:	KP
Lab ID:	C-TP-42_0.50_0.60_ATT		
Depth(m):	0.50 - 0.60	Room Temperature at Test:	20°C

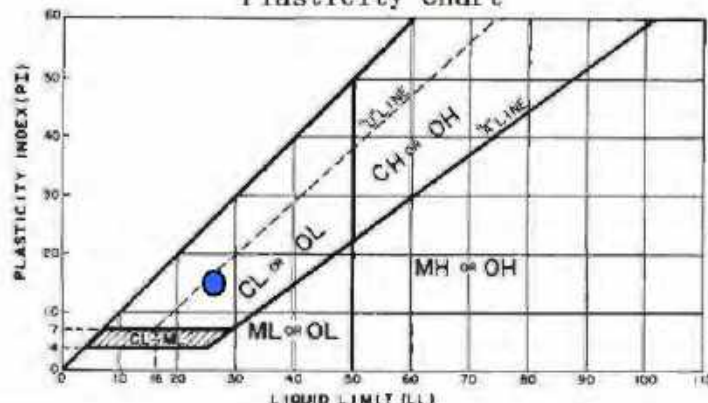
Tested by:	Kohei	Sample Description:	-
Moisture Content (%):	-	Wet Density (t/m³):	-
		Dry Density (t/m³):	-

Liquid Limit (%):	26.02
Plastic Limit (%):	10.95
Plasticity Index (%):	15.07
Liquidity Index (%):	-
Shrinkage Limit (%):	9.00
Linear Shrinkage(%):	3.34

Results Chart



Plasticity Chart



Notes: The sample/s were tested oven dried, dry sieved and in a 125-250mm mould.

Stored and Tested the Sample as received

Samples supplied by the Client

Authorised Signature:

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ATTERBERG LIMITS TEST REPORT

Test Method: BS1377 AS1289.2.1.1 7.1.1 3.1.1 3.2.1 3.4.1

Client:	Knight Piesold	Date Tested:	27/04/2021
Project:	Thunderbox TSF Cells C and D	Lab:	EPLAB
Sample No:	C-TP-46	Job Number:	KP
Lab ID:	C-TP-46_0.40_0.50_ATT		
Depth(m):	0.40 - 0.50	Room Temperature at Test:	20°C

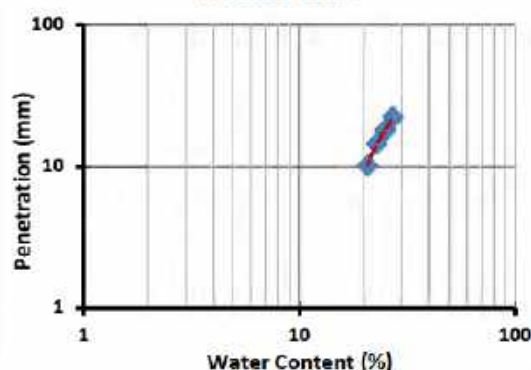
Tested by:	Kohei	Sample Description:	-
Moisture Content (%):	-	Wet Density (t/m ³):	-
		Dry Density (t/m ³):	-

Liquid Limit (%): 24.41
Plastic Limit (%): 16.17

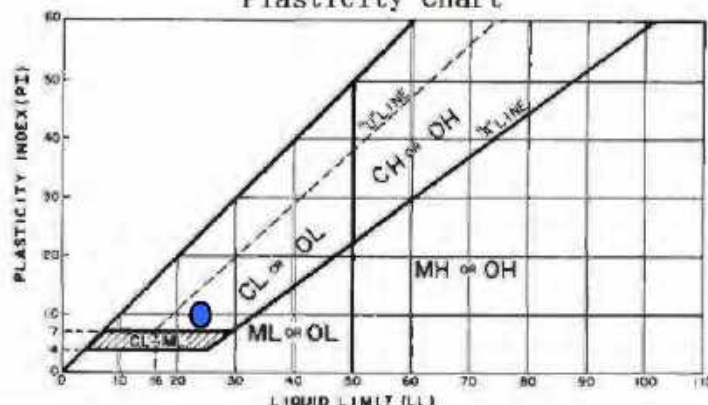
Plasticity Index (%): 8.24
Liquidity Index (%): -

Shrinkage Limit (%): 14.19
Linear Shrinkage(%): 4.27

Results Chart



Plasticity Chart



Notes: The sample/s were tested oven dried, dry sieved and in a 125-250mm mould.

Stored and Tested the Sample as received

Samples supplied by the Client

Authorised Signatur

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ATTERBERG LIMITS TEST REPORT

Test Method: BS1377 AS1289.2.1.1 7.1.1 3.1.1 3.2.1 3.4.1

Client:	Knight Piesold	Date Tested:	29/04/2021
Project:	Thunderbox TSF Cells C and D	Lab:	EPLAB
Sample No:	D-TP-02	Job Number:	KP
Lab ID:	D-TP-02_0.70_0.80_ATT		
Depth(m):	0.70 - 0.80	Room Temperature at Test:	20°C

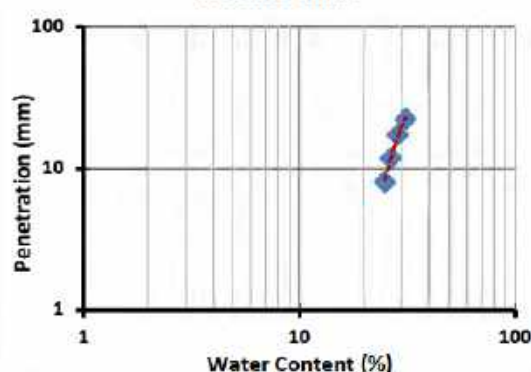
Tested by:	Kohei	Sample Description:	-
Moisture Content (%):	-	Wet Density (t/m³):	-
		Dry Density (t/m³):	-

Liquid Limit (%): 28.88
Plastic Limit (%): 22.45

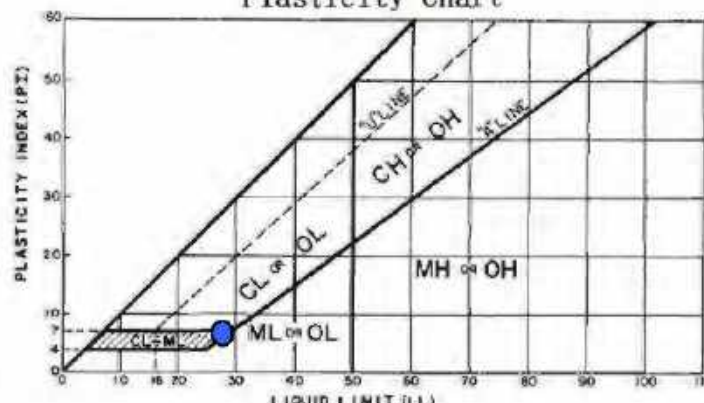
Plasticity Index (%): 6.43
Liquidity Index (%): -

Shrinkage Limit (%): 20.09
Linear Shrinkage(%): 5.15

Results Chart



Plasticity Chart



Notes: The sample/s were tested oven dried, dry sieved and in a 125-250mm mould.

Stored and Tested the Sample as received

Samples supplied by the Client

Authorised Signatu

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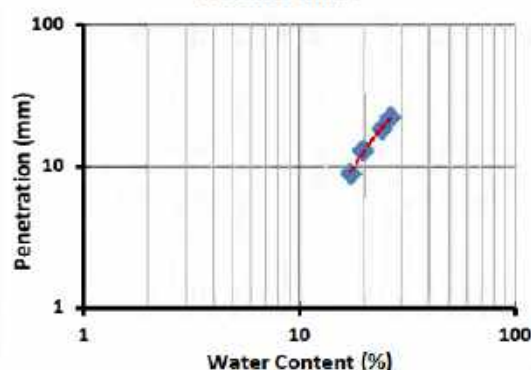
Test Method: BS1377 AS1289.2.1.1 7.1.1 3.1.1 3.2.1 3.4.1

Client:	Knight Piesold	Date Tested:	29/04/2021
Project:	Thunderbox TSF Cells C and D	Lab:	EPLAB
Sample No:	D-TP-06	Job Number:	KP
Lab ID:	D-TP-06_0.20_0.30_ATT		
Depth(m):	0.20 - 0.30	Room Temperature at Test:	20°C

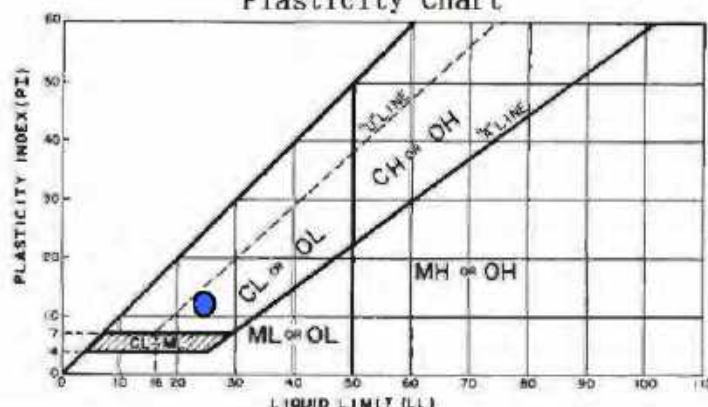
Tested by:	Kohei	Sample Description:	-
Moisture Content (%):	-	Wet Density (t/m³):	-
		Dry Density (t/m³):	-

Liquid Limit (%):	22.91
Plastic Limit (%):	12.20
Plasticity Index (%):	10.70
Liquidity Index (%):	-
Shrinkage Limit (%):	10.48
Linear Shrinkage(%):	3.30

Results Chart



Plasticity Chart



Notes: The sample/s were tested oven dried, dry sieved and in a 125-250mm mould.

Stored and Tested the Sample as received

Samples supplied by the Client

Authorised Signatu

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ATTERBERG LIMITS TEST REPORT

Test Method: BS1377 AS1289.2.1.1 7.1.1 3.1.1 3.2.1 3.4.1

Client:	Knight Piesold	Date Tested:	29/04/2021
Project:	Thunderbox TSF Cells C and D	Lab:	EPLAB
Sample No:	D-TP-09	Job Number:	KP
Lab ID:	D-TP-09_0.40_0.50_ATT		
Depth(m):	0.40 - 0.50	Room Temperature at Test:	20°C

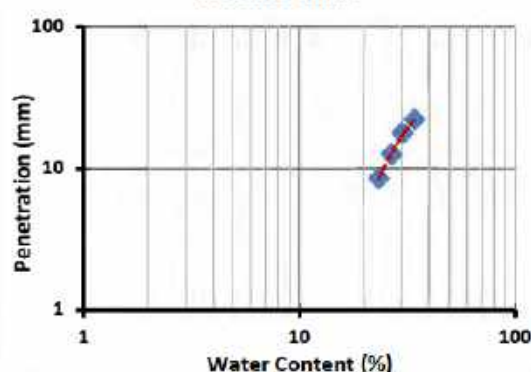
Tested by:	Kohei	Sample Description:	-
Moisture Content (%):	-	Wet Density (t/m³):	-
		Dry Density (t/m³):	-

Liquid Limit (%): 30.05
Plastic Limit (%): 18.50

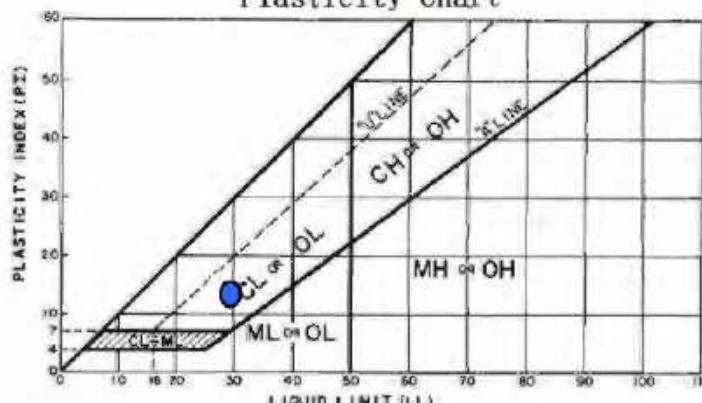
Plasticity Index (%): 11.55
Liquidity Index (%): -

Shrinkage Limit (%): 15.42
Linear Shrinkage(%): 6.81

Results Chart



Plasticity Chart



Notes: The sample/s were tested oven dried, dry sieved and in a 125-250µm sieve.

Stored and Tested the Sample as received

Samples supplied by the Client

Authorised Signature

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ATTERBERG LIMITS TEST REPORT

Test Method: BS1377 AS1289.2.1.1 7.1.1 3.1.1 3.2.1 3.4.1

Client:	Knight Piesold	Date Tested:	29/04/2021
Project:	Thunderbox TSF Cells C and D	Lab:	EPLAB
Sample No:	D-TP-10	Job Number:	KP
Lab ID:	D-TP-10_0.20_0.30_ATT		
Depth(m):	0.20 - 0.30	Room Temperature at Test:	20°C

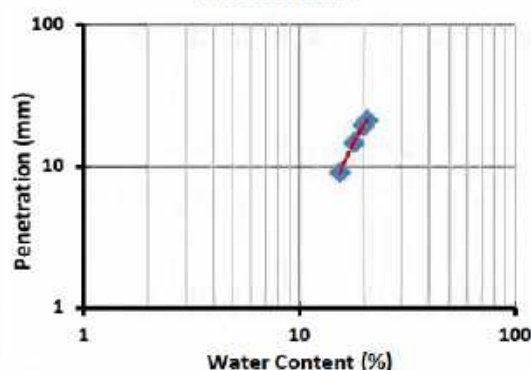
Tested by:	Kohei	Sample Description:	-
Moisture Content (%):	-	Wet Density (t/m ³):	-
		Dry Density (t/m ³):	-

Liquid Limit (%): 18.95
Plastic Limit (%): 12.58

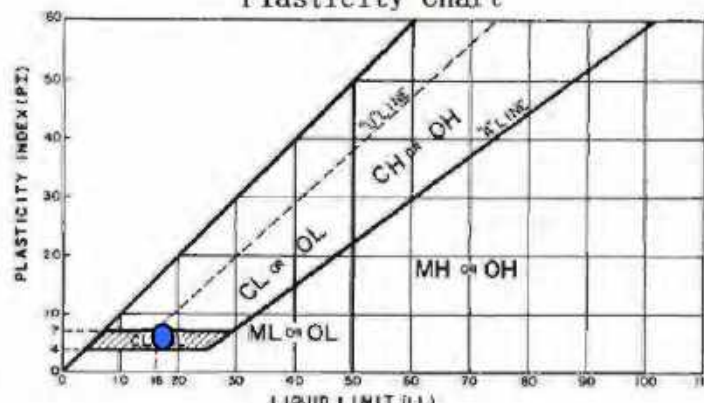
Plasticity Index (%): 6.37
Liquidity Index (%): -

Shrinkage Limit (%): 11.43
Linear Shrinkage(%): 3.25

Results Chart



Plasticity Chart



Notes: The sample/s were tested oven dried, dry sieved and in a 125-250mm mould.

Stored and Tested the Sample as received

Samples supplied by the Client

Authorised Signature

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ATTERBERG LIMITS TEST REPORT

Test Method: BS1377 AS1289.2.1.1 7.1.1 3.1.1 3.2.1 3.4.1

Client:	Knight Piesold	Date Tested:	29/04/2021
Project:	Thunderbox TSF Cells C and D	Lab:	EPLAB
Sample No:	D-TP-15	Job Number:	KP
Lab ID:	D-TP-15_0.40_0.50_ATT		
Depth(m):	0.40 - 0.50	Room Temperature at Test:	20°C

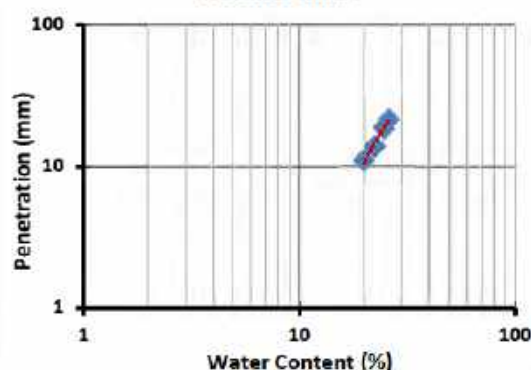
Tested by:	Kohei	Sample Description:	-
Moisture Content (%):	-	Wet Density (t/m ³):	-
		Dry Density (t/m ³):	-

Liquid Limit (%): 23.78
Plastic Limit (%): 14.93

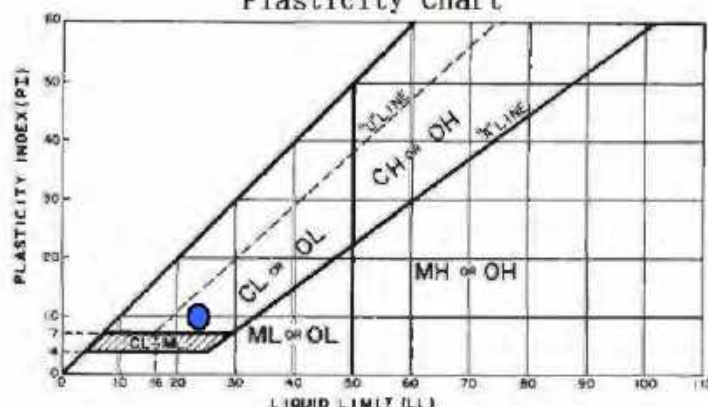
Plasticity Index (%): 8.85
Liquidity Index (%): -

Shrinkage Limit (%): 13.02
Linear Shrinkage(%): 2.56

Results Chart



Plasticity Chart



Notes: The sample/s were tested oven dried, dry sieved and in a 125-250mm mould.

Stored and Tested the Sample as received

Samples supplied by the Client

Authorised Signature

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ATTERBERG LIMITS TEST REPORT

Test Method: BS1377 AS1289.2.1.1 7.1.1 3.1.1 3.2.1 3.4.1

Client:	Knight Piesold	Date Tested:	29/04/2021
Project:	Thunderbox TSF Cells C and D	Lab:	EPLAB
Sample No:	D-TP-17	Job Number:	KP
Lab ID:	D-TP-17_0.40_0.50_ATT		
Depth(m):	0.40 - 0.50	Room Temperature at Test:	20°C

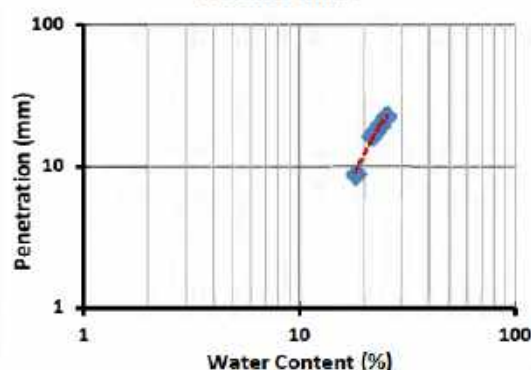
Tested by:	Kohei	Sample Description:	-
Moisture Content (%):	-	Wet Density (t/m ³):	-
		Dry Density (t/m ³):	-

Liquid Limit (%): 22.54
Plastic Limit (%): 14.60

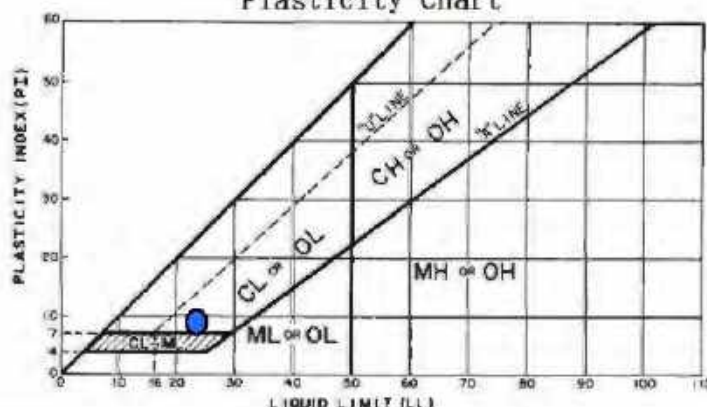
Plasticity Index (%): 7.94
Liquidity Index (%): -

Shrinkage Limit (%): 12.91
Linear Shrinkage(%): 3.61

Results Chart



Plasticity Chart



Notes: The sample/s were tested oven dried, dry sieved and in a 125-250mm mould.

Stored and Tested the Sample as received

Samples supplied by the Client

Authorised Signatu

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Precision Laboratory's "Standard Terms and Conditions" E-Precision Laboratory ABN 431 559 578 87



Test Method: BS1377 AS1289.2.1.1 7.1.1 3.1.1 3.2.1 3.4.1

Client:	Knight Piesold	Date Tested:	29/04/2021
Project:	Thunderbox TSF Cells C and D	Lab:	EPLAB
Sample No:	D-TP-19	Job Number:	KP
Lab ID:	D-TP-19_0.20_0.30_ATT		
Depth(m):	0.20 - 0.30	Room Temperature at Test:	20°C

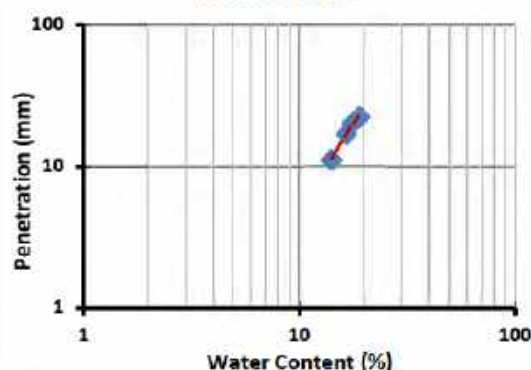
Tested by:	Kohei	Sample Description:	-
Moisture Content (%):	-	Wet Density (t/m³):	-
		Dry Density (t/m³):	-

Liquid Limit (%): 16.75
Plastic Limit (%): 10.08

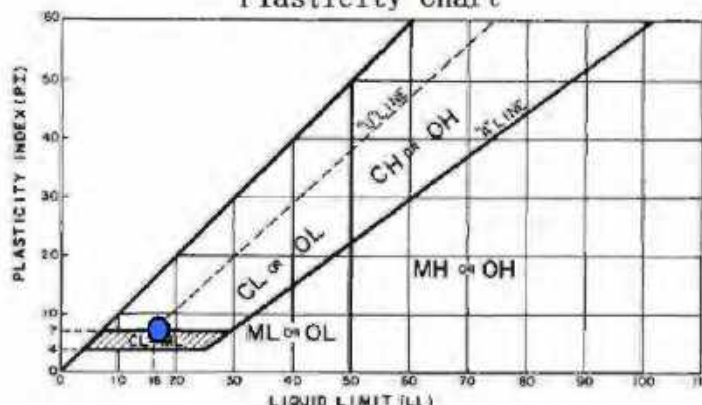
Plasticity Index (%): 6.67
Liquidity Index (%): -

Shrinkage Limit (%): 9.20
Linear Shrinkage(%): 3.47

Results Chart



Plasticity Chart



Notes: The sample/s were tested oven dried, dry sieved and in a 125-250mm

Stored and Tested the Sample as received

Samples supplied by the Client

Authorised Signature:

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Test Method: BS1377 AS1289.2.1.1 7.1.1 3.1.1 3.2.1 3.4.1

Client:	Knight Piesold	Date Tested:	29/04/2021
Project:	Thunderbox TSF Cells C and D	Lab:	EPLAB
Sample No:	D-TP-21	Job Number:	KP
Lab ID:	D-TP-21_0.30_0.40_ATT		
Depth(m):	0.30 - 0.40	Room Temperature at Test:	20°C

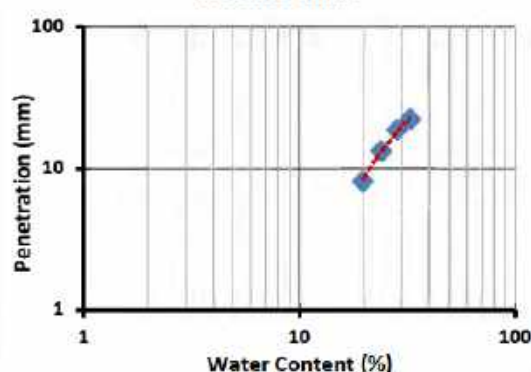
Tested by:	Kohei	Sample Description:	-
Moisture Content (%):	-	Wet Density (t/m³):	-
		Dry Density (t/m³):	-

Liquid Limit (%): 27.64
Plastic Limit (%): 14.00

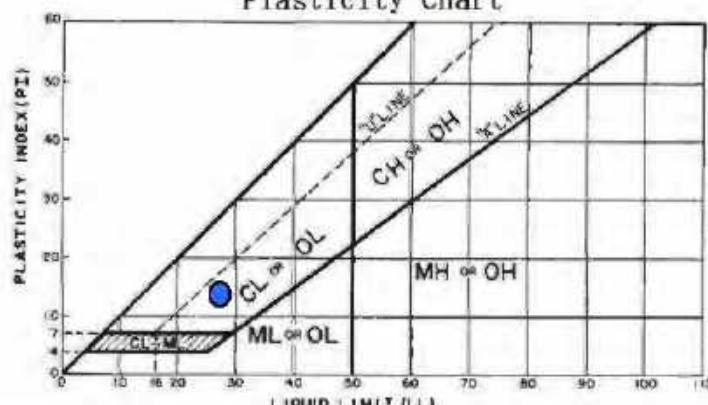
Plasticity Index (%): 13.63
Liquidity Index (%): -

Shrinkage Limit (%): 11.51
Linear Shrinkage(%): 6.15

Results Chart



Plasticity Chart



Notes: The sample/s were tested oven dried, dry sieved and in a 125-250mm mould.

Stored and Tested the Sample as received

Samples supplied by the Client

Authorised Signatur

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ATTERBERG LIMITS TEST REPORT

Test Method: BS1377 AS1289.2.1.1 7.1.1 3.1.1 3.2.1 3.4.1

Client:	Knight Piesold	Date Tested:	29/04/2021
Project:	Thunderbox TSF Cells C and D	Lab:	EPLAB
Sample No:	D-TP-24	Job Number:	KP
Lab ID:	D-TP-24_0.20_0.30_ATT		
Depth(m):	0.20 - 0.30	Room Temperature at Test:	20°C

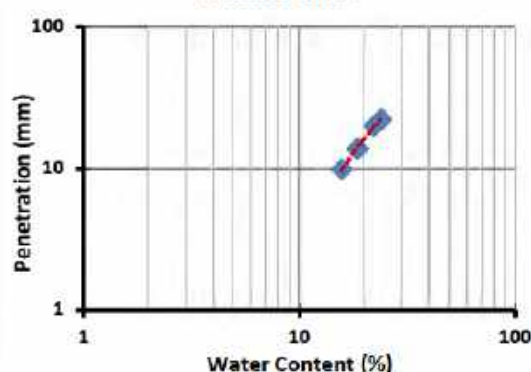
Tested by:	Kohei	Sample Description:	-
Moisture Content (%):	-	Wet Density (t/m ³):	-
		Dry Density (t/m ³):	-

Liquid Limit (%): 20.59
Plastic Limit (%): 10.63

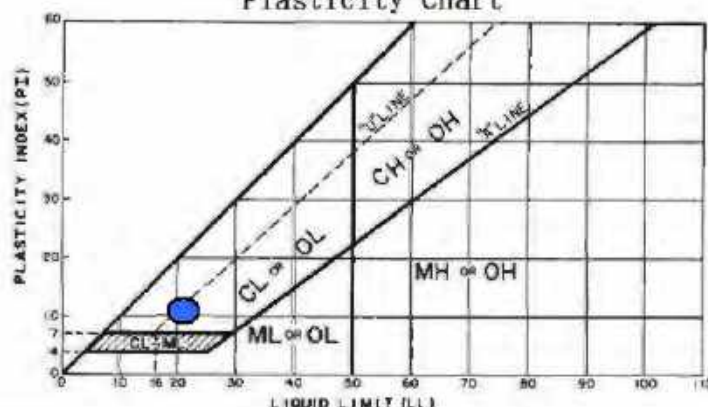
Plasticity Index (%): 9.96
Liquidity Index (%): -

Shrinkage Limit (%): 9.29
Linear Shrinkage(%): 6.82

Results Chart



Plasticity Chart



Notes: The sample/s were tested oven dried, dry sieved and in a 125-250mm mould.

Stored and Tested the Sample as received

Samples supplied by the Client

Authorised Signature:

The results of tests performed apply only to the specific sample at time of test unless otherwise clearly stated. Reference should be made to E-Precision Laboratory's "Standard Terms and Conditions" E-Precision Laboratory ABN 431 559 578 87



Test Method: BS1377 AS1289.2.1.1 7.1.1 3.1.1 3.2.1 3.4.1

Client:	Knight Piesold	Date Tested:	29/04/2021
Project:	Thunderbox TSF Cells C and D	Lab:	EPLAB
Sample No:	D-TP-26	Job Number:	KP
Lab ID:	D-TP-26_0.50_0.60_ATT		
Depth(m):	0.50 - 0.60	Room Temperature at Test:	20°C

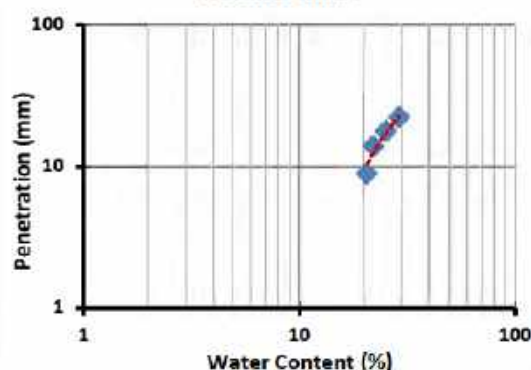
Tested by:	Kohei	Sample Description:	-
Moisture Content (%):	-	Wet Density (t/m³):	-
		Dry Density (t/m³):	-

Liquid Limit (%): 25.29
Plastic Limit (%): 15.10

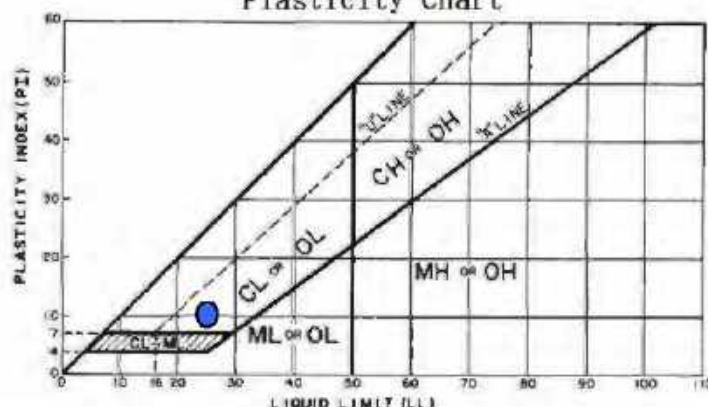
Plasticity Index (%): 10.19
Liquidity Index (%): -

Shrinkage Limit (%): 12.93
Linear Shrinkage(%): 2.91

Results Chart



Plasticity Chart



Notes: The sample/s were tested oven dried, dry sieved and in a 125-250mm mould.

Stored and Tested the Sample as received

Samples supplied by the Client

Authorised Signature: [Redacted]

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Test Method: BS1377 AS1289.2.1.1 7.1.1 3.1.1 3.2.1 3.4.1

Client:	Knight Piesold	Date Tested:	29/04/2021
Project:	Thunderbox TSF Cells C and D	Lab:	EPLAB
Sample No:	D-TP-27	Job Number:	KP
Lab ID:	D-TP-27_0.20_0.30_ATT		
Depth(m):	0.20 - 0.30	Room Temperature at Test:	20°C

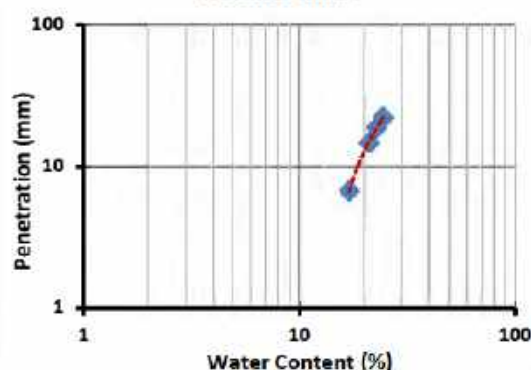
Tested by:	Kohei	Sample Description:	-
Moisture Content (%):	-	Wet Density (t/m³):	-
		Dry Density (t/m³):	-

Liquid Limit (%): 22.03
Plastic Limit (%): 14.79

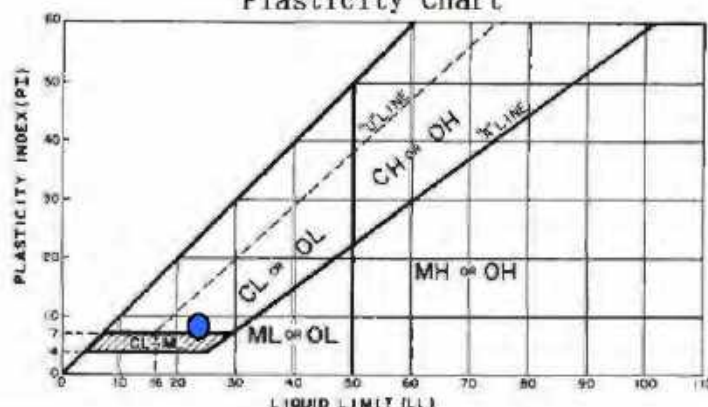
Plasticity Index (%): 7.23
Liquidity Index (%): -

Shrinkage Limit (%): 13.21
Linear Shrinkage(%): 3.96

Results Chart



Plasticity Chart



Notes: The sample/s were tested oven dried, dry sieved and in a 125-250

Stored and Tested the Sample as received

Samples supplied by the Client

Authorised Signatu

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ATTERBERG LIMITS TEST REPORT

Test Method: BS1377 AS1289.2.1.1 7.1.1 3.1.1 3.2.1 3.4.1

Client:	Knight Piesold	Date Tested:	29/04/2021
Project:	Thunderbox TSF Cells C and D	Lab:	EPLAB
Sample No:	D-TP-29	Job Number:	KP
Lab ID:	D-TP-29_0.30_0.40_ATT		
Depth(m):	0.30 - 0.40	Room Temperature at Test:	20°C

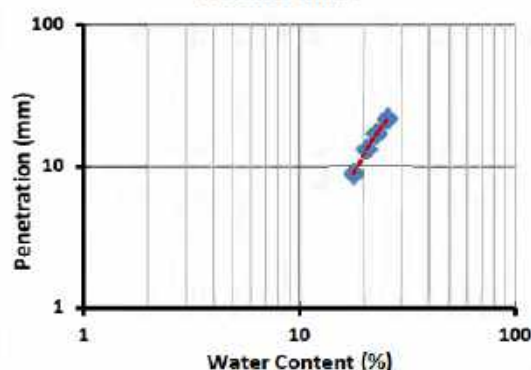
Tested by:	Kohei	Sample Description:	-
Moisture Content (%):	-	Wet Density (t/m³):	-
		Dry Density (t/m³):	-

Liquid Limit (%): 23.14
Plastic Limit (%): 13.95

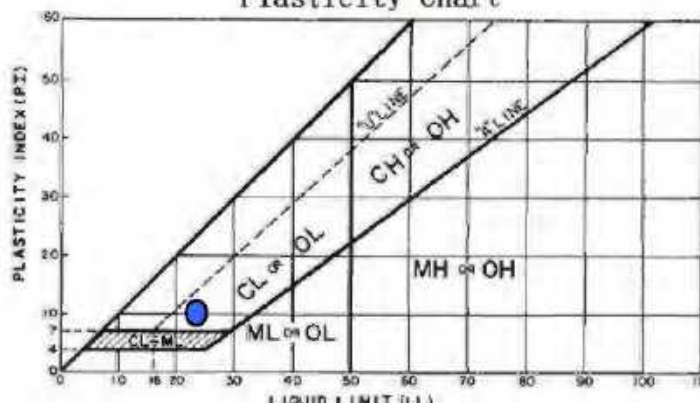
Plasticity Index (%): 9.19
Liquidity Index (%): -

Shrinkage Limit (%): 12.14
Linear Shrinkage(%): 2.95

Results Chart



Plasticity Chart



Notes: The sample/s were tested oven dried, dry sieved and in a 125-250mm mould.

Stored and Tested the Sample as received

Samples supplied by the Client

Authorised Signatu

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Test Method: BS1377 AS1289.2.1.1 7.1.1 3.1.1 3.2.1 3.4.1

Client:	Knight Piesold	Date Tested:	29/04/2021
Project:	Thunderbox TSF Cells C and D	Lab:	EPLAB
Sample No:	D-TP-31	Job Number:	KP
Lab ID:	D-TP-31_0.30_0.40_ATT		
Depth(m):	0.30 - 0.40	Room Temperature at Test:	20°C

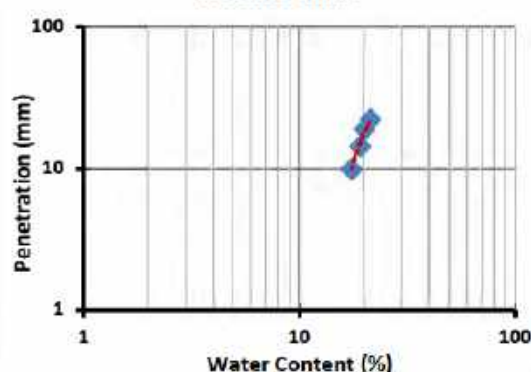
Tested by:	Kohei	Sample Description:	-
Moisture Content (%):	-	Wet Density (t/m³):	-
		Dry Density (t/m³):	-

Liquid Limit (%): 19.86
Plastic Limit (%): 15.12

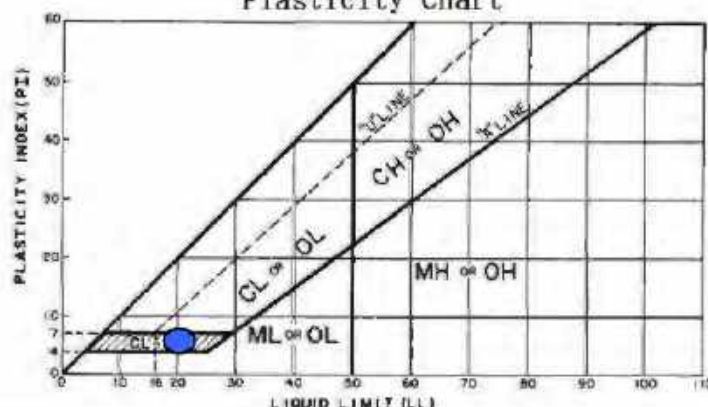
Plasticity Index (%): 4.74
Liquidity Index (%): -

Shrinkage Limit (%): 14.00
Linear Shrinkage(%): 5.72

Results Chart



Plasticity Chart



Notes: The sample/s were tested oven dried, dry sieved and in a 125-250mm mould.

Stored and Tested the Sample as received

Samples supplied by the Client

Authorised Signa

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ATTERBERG LIMITS TEST REPORT

Test Method: BS1377 AS1289.2.1.1 7.1.1 3.1.1 3.2.1 3.4.1

Client:	Knight Piesold	Date Tested:	29/04/2021
Project:	Thunderbox TSF Cells C and D	Lab:	EPLAB
Sample No:	D-TP-34	Job Number:	KP
Lab ID:	D-TP-34_0.10_0.20_ATT		
Depth(m):	0.10 - 0.20	Room Temperature at Test:	20°C

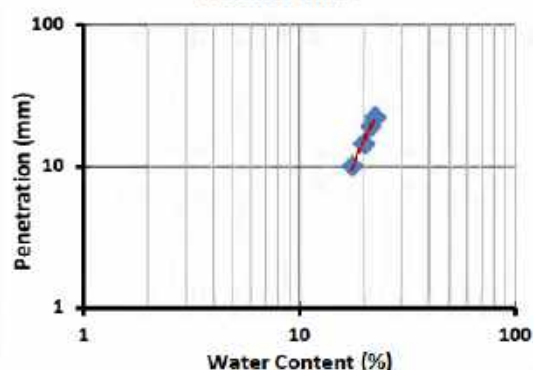
Tested by:	Kohei	Sample Description:	-
Moisture Content (%):	-	Wet Density (t/m³):	-
		Dry Density (t/m³):	-

Liquid Limit (%): 20.66
Plastic Limit (%): 14.59

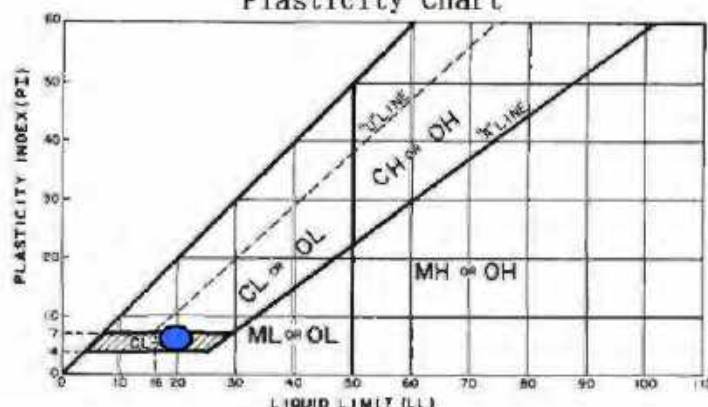
Plasticity Index (%): 6.07
Liquidity Index (%): -

Shrinkage Limit (%): 13.26
Linear Shrinkage(%): 5.90

Results Chart



Plasticity Chart



Notes: The sample/s were tested oven dried, dry sieved and in a 125-250mm mould.

Stored and Tested the Sample as received

Samples supplied by the Client

Authorised Signatu

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ATTERBERG LIMITS TEST REPORT

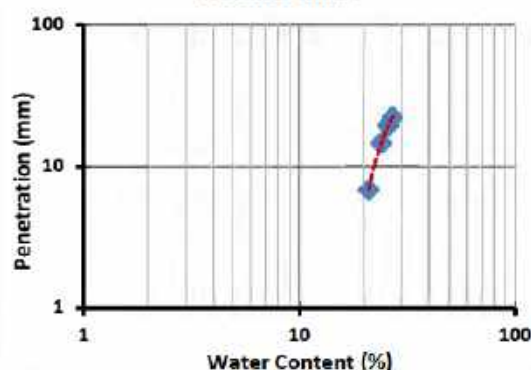
Test Method: BS1377 AS1289.2.1.1 7.1.1 3.1.1 3.2.1 3.4.1

Client:	Knight Piesold	Date Tested:	30/04/2021
Project:	Thunderbox TSF Cells C and D	Lab:	EPLAB
Sample No:	Eastern Waste Dump A	Job Number:	KP
Lab ID:	EWD_A_ATT		
Depth(m):	-	Room Temperature at Test:	20°C

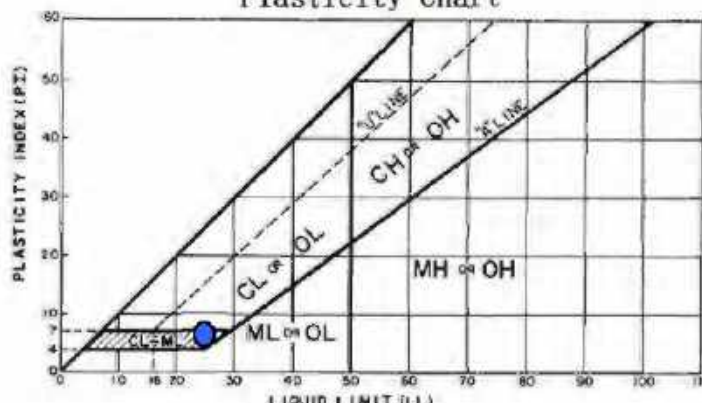
Tested by:	Kohei	Sample Description:	-
Moisture Content (%):	-	Wet Density (t/m³):	-
		Dry Density (t/m³):	-

Liquid Limit (%):	25.07
Plastic Limit (%):	19.18
Plasticity Index (%):	5.90
Liquidity Index (%):	-
Shrinkage Limit (%):	17.36
Linear Shrinkage(%):	4.95

Results Chart



Plasticity Chart



Notes: The sample/s were tested oven dried, dry sieved and in a 125-250mm mould.

Stored and Tested the Sample as received

Samples supplied by the Client

Authorised Signature: [Redacted]

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Test Method: BS1377 AS1289.2.1.1 7.1.1 3.1.1 3.2.1 3.4.1

Client:	Knight Piesold	Date Tested:	30/04/2021
Project:	Thunderbox TSF Cells C and D	Lab:	EPLAB
Sample No:	Eastern Waste Dump B	Job Number:	KP
Lab ID:	EWD_B_ATT		
Depth(m):	-	Room Temperature at Test:	20°C

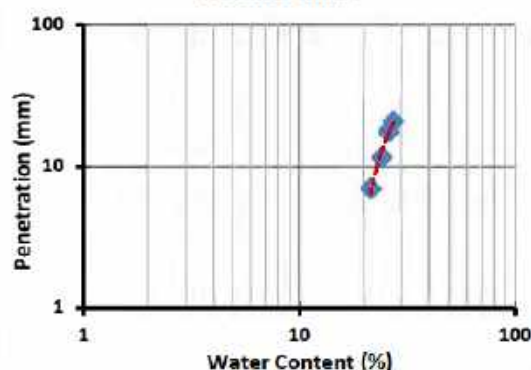
Tested by:	Kohei	Sample Description:	-
Moisture Content (%):	-	Wet Density (t/m³):	-
		Dry Density (t/m³):	-

Liquid Limit (%): 26.08
Plastic Limit (%): 19.71

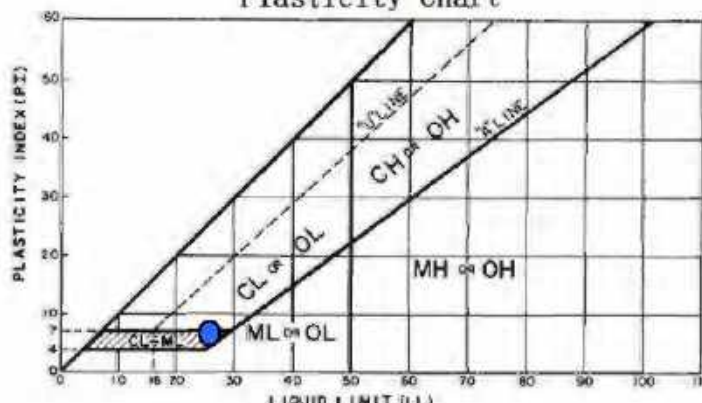
Plasticity Index (%): 6.36
Liquidity Index (%): -

Shrinkage Limit (%): 17.70
Linear Shrinkage(%): 4.11

Results Chart



Plasticity Chart



Notes: The sample/s were tested oven dried, dry sieved and in a 125-250mm mould.

Stored and Tested the Sample as received

Samples supplied by the Client

Authorised Signatur

The results of tests performed apply only to the specific sample at time of test unless otherwise clearly stated. Reference should be made to E-Precision Laboratory's "Standard Terms and Conditions" E-Precision Laboratory ABN 431 559 578 87

Test Method: AS 1289 3.6.1

Tested by:	Kohei	2.36mm Particle Density (t/m³):	-
Checked by:	Phil	Moisture Content (%):	24.82

The PSD Graph displays the cumulative percentage of material passing through various sieve sizes. The x-axis represents Particle Size in millimeters (mm) on a logarithmic scale from 0.001 to 1000. The y-axis represents the percentage of material passing, ranging from 0.0 to 100.0. The curve starts at approximately 94% passing for a 0.075 mm sieve and reaches 100% passing at a 0.425 mm sieve, remaining at 100% for all larger sieve sizes.

Particle Size (mm)	Passing (%)
0.075	94
0.15	96
0.3	98
0.425	100
0.6	100
0.85	100
1.18	100
1.75	100
2.5	100
3.55	100
5.0	100
7.075	100
10.0	100
14.75	100
20.0	100
28.0	100
37.5	100
50.0	100
67.5	100
90.0	100
117.5	100
150.0	100
197.5	100
250.0	100
325.0	100
425.0	100
550.0	100
710.0	100
900.0	100

Authorized Signature:

Integrity Precision Innovation

Test Method: AS 1289 3.6.1

Tested by:	Kohei	2.36mm Particle Density (t/m ³):	-
Checked by:	Phil	Moisture Content (%):	16.19

PSD Graph

The graph displays the particle size distribution (PSD) for a sample. The x-axis represents Particle Size (mm) on a logarithmic scale from 0.001 to 1000. The y-axis represents Passing (%) from 0.0 to 100.0. The curve shows that approximately 16% of the sample passes through a 0.075 mm sieve, and the material is 100% passing at 75 mm.

Particle Size (mm)	Passing (%)
0.075	16.0
0.15	22.0
0.3	28.0
0.6	35.0
1.2	45.0
2.5	58.0
5.0	75.0
7.5	90.0
15.0	98.0
75.0	100.0

Authorized Signature:

Integrity Precision Innovation

Test Method: AS 1289 3.6.1

Tested by:	Kohei	2.36mm Particle Density (t/m³):	-
Checked by:	Phil	Moisture Content (%):	24.91

PSD Graph

Particle Size (mm)	Passing (%)
0.075	87
0.15	92
0.3	95
0.6	96
1.2	97
2.5	98
5.0	99
10.0	100
20.0	100
40.0	100
60.0	100
80.0	100
100.0	100

Authorized Signature:

Integrity Precision Innovation

Test Method: AS 1289 3.6.1

26.58

PSD Graph

The graph displays the particle size distribution (PSD) for a sample. The x-axis represents Particle Size (mm) on a logarithmic scale from 0.001 to 1000. The y-axis represents Passing (%) from 0.0 to 100.0. The curve shows that approximately 43% of the sample passes through a 0.075 mm sieve, and 100% of the sample passes through a 75 mm sieve.

Particle Size (mm)	Passing (%)
0.075	43.0
0.15	50.0
0.3	58.0
0.6	70.0
1.2	85.0
2.5	95.0
5.0	99.0
75.0	100.0

Authorized Signature:

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Test Method: AS 1289 3.6.1

PSD Graph

Particle Size (mm)	Passing (%)
0.075	65.0
0.150	75.0
0.300	85.0
0.425	95.0
0.600	98.0
0.850	99.0
1.180	100.0
1.650	100.0
2.360	100.0
3.350	100.0
4.750	100.0
6.750	100.0
9.500	100.0
13.2	100.0
18.8	100.0
26.5	100.0
37.5	100.0
53.0	100.0
75.0	100.0
105	100.0
150	100.0
212	100.0
300	100.0
425	100.0
600	100.0
850	100.0
1180	100.0
1650	100.0
2360	100.0
3350	100.0
4750	100.0

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Test Method: AS 1289 3.6.1

2.36mm Particle Density (t/m ³):	-
Moisture Content (%):	15.47

PSD Graph

The graph displays the particle size distribution (PSD) of a sample. The x-axis represents Particle Size in millimeters (mm) on a logarithmic scale, ranging from 0.001 to 1000. The y-axis represents the percentage of material passing through the sieve, labeled as Passing (%), ranging from 0.0 to 100.0. The curve shows that approximately 30% of the sample passes through a 0.075 mm sieve, and the material is 100% finer than a 10 mm sieve.

Particle Size (mm)	Passing (%)
0.075	30.0
0.15	40.0
0.3	50.0
0.6	65.0
1.2	80.0
2.5	92.0
5.0	98.0
10.0	100.0
20.0	100.0
100.0	100.0
1000.0	100.0

Authorized Signature:

Integrity Precision Innovation

Test Method: AS 1289 3.6.1

2.36mm Particle Density (t/m ³):	-
Moisture Content (%):	7.17

PSD Graph

The graph displays the particle size distribution (PSD) of a sample. The x-axis represents Particle Size in millimeters (mm) on a logarithmic scale, ranging from 0.001 to 1000. The y-axis represents the percentage of material passing through the sieve, labeled as Passing (%), ranging from 0.0 to 100.0. The curve shows that approximately 25% of the sample passes through a 0.075 mm sieve, and the material is 100% passing at a particle size of 25 mm.

Particle Size (mm)	Passing (%)
0.075	25.0
0.15	35.0
0.3	45.0
0.6	55.0
1.2	70.0
2.5	85.0
5.0	95.0
10.0	98.0
25.0	100.0
50.0	100.0
100.0	100.0

Authorized Signature:

Integrity Precision Innovation

Test Method: AS 1289 3.6.1

Tested by:	Kohei	2.36mm Particle Density (t/m³):	-
Checked by:	Phil	Moisture Content (%):	4.19

PSD Graph

The graph displays the particle size distribution (PSD) of a sample. The x-axis represents Particle Size in millimeters (mm) on a logarithmic scale, ranging from 0.001 to 1000. The y-axis represents the percentage of material passing through the sieve, labeled as Passing (%), ranging from 0.0 to 100.0. The curve shows that approximately 45% of the sample passes through a 0.075 mm sieve, and 100% of the sample passes through a 150 micrometer (0.15 mm) sieve.

Particle Size (mm)	Passing (%)
0.075	45.0
0.15	100.0

Authorized Signature:

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Test Method: AS 1289 3.6.1

2.36mm Particle Density (t/m ³):	-
Moisture Content (%):	4.22

PSD Graph

This graph plots the percentage of material passing through various sieve sizes (Particle Size in mm) against the percentage passing. The x-axis is logarithmic, ranging from 0.001 mm to 1000 mm. The y-axis is linear, ranging from 0.0% to 100.0%.

Particle Size (mm)	Passing (%)
0.075	36
0.15	48
0.3	62
0.6	75
1.2	85
2.5	95
5.0	100
75	100

Authorized Signature:

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Test Method: AS 1289 3.6.1

2.36mm Particle Density (t/m ³):	-
Moisture Content (%):	9.00

PSD Graph

The graph displays the cumulative percentage of material passing through various sieve sizes. The x-axis represents Particle Size in millimeters (mm) on a logarithmic scale, and the y-axis represents the percentage of material passing through the sieve.

Particle Size (mm)	Passing (%)
0.075	42
0.15	55
0.3	70
0.6	82
1.2	92
2.5	98
5.0	100
75	100

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Test Method: AS 1289 3.6.1

2.36mm Particle Density (t/m ³):	-
Moisture Content (%):	2.64

PSD Graph

The graph displays the particle size distribution (PSD) of a material. The x-axis represents Particle Size in millimeters (mm) on a logarithmic scale, ranging from 0.001 to 1000. The y-axis represents the percentage of material passing through a sieve, labeled as Passing (%), on a linear scale from 0.0 to 100.0. A blue curve shows the distribution, starting at approximately 55% passing for a 0.075 mm sieve and reaching 100% passing at a 10 mm sieve.

Particle Size (mm)	Passing (%)
0.075	55.0
0.15	70.0
0.3	80.0
0.6	88.0
1.2	95.0
2.5	98.0
5.0	99.0
10.0	100.0
20.0	100.0
40.0	100.0
60.0	100.0
80.0	100.0
100.0	100.0

Authorized Signature:

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Test Method: AS 1289 3.6.1

2.36mm Particle Density (t/m ³):	-
Moisture Content (%):	3.60

PSD Graph

The graph displays the particle size distribution (PSD) of a sample. The x-axis represents Particle Size (mm) on a logarithmic scale from 0.001 to 1000. The y-axis represents Passing (%) from 0.0 to 100.0. The curve shows that approximately 38% of the sample passes through a 0.075 mm sieve, and 100% of the sample passes through a 10 mm sieve.

Particle Size (mm)	Passing (%)
0.075	38.0
0.15	48.0
0.3	65.0
0.6	78.0
1.18	88.0
2.5	95.0
5.0	98.0
10.0	100.0
100.0	100.0

Authorized Signature:

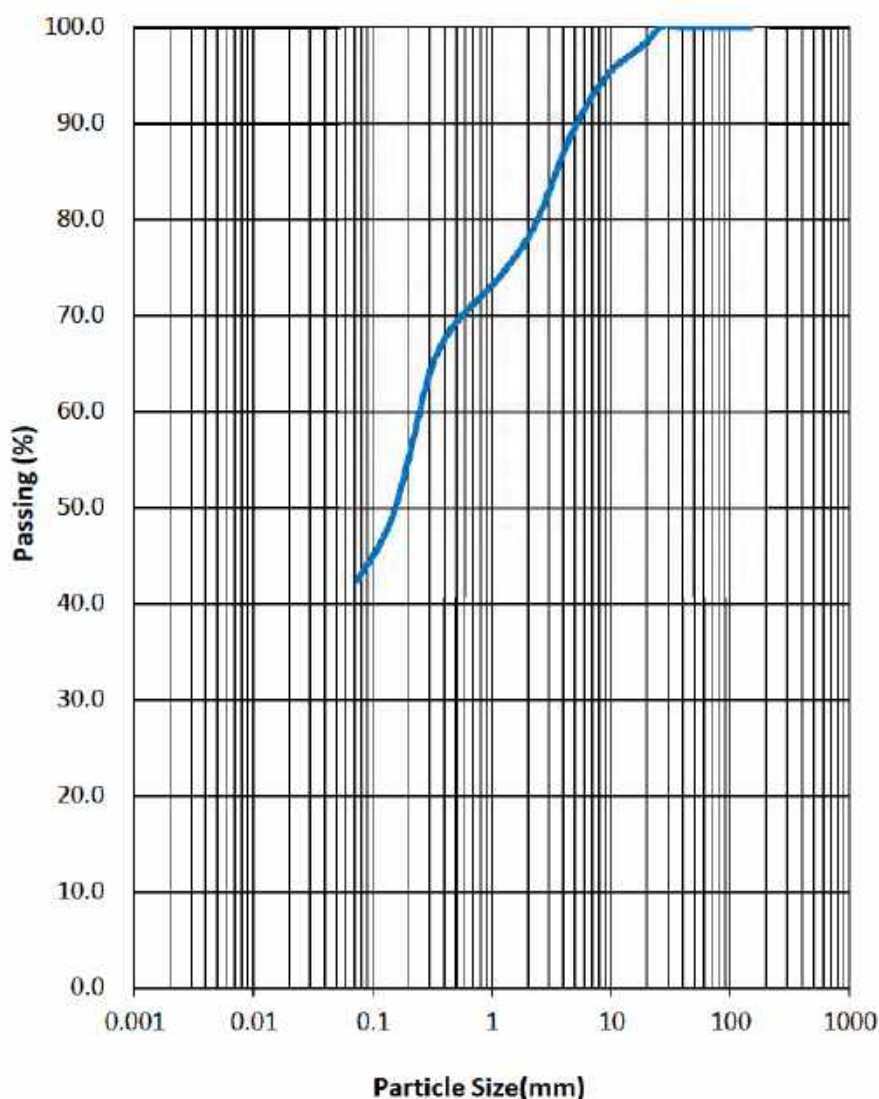
Integrity Precision Innovation

Test Method: AS 1289 3.6.1

1

5.35

PSD Graph



Authorized Signature:

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Test Method: AS 1289 3.6.1

2.36mm Particle Density (t/m ³):	-
Moisture Content (%):	2.33

PSD Graph

The graph displays the particle size distribution (PSD) of a sample. The x-axis represents Particle Size in millimeters (mm) on a logarithmic scale, ranging from 0.001 to 1000. The y-axis represents the percentage of material passing through the sieve, labeled as Passing (%), ranging from 0.0 to 100.0. The curve shows that approximately 28% of the sample passes through a 0.075 mm sieve, and the material is 100% finer than a 75 mm sieve.

Particle Size (mm)	Passing (%)
0.075	28
0.15	45
0.3	60
0.6	68
1.2	75
2.5	85
5.0	95
75	100

Authorized Signature:

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Test Method: AS 1289 3.6.1

2.36mm Particle Density (t/m ³):	-
Moisture Content (%):	5.96

The graph shows the particle size distribution (PSD) of the sample. The x-axis represents Particle Size in millimeters (mm) on a logarithmic scale from 0.001 to 1000. The y-axis represents the percentage of material passing through the sieve, ranging from 0.0 to 100.0. The curve starts at approximately 53% passing for a 0.075 mm sieve and reaches 100% passing at approximately 7.5 mm.

Particle Size (mm)	Passing (%)
0.075	53
0.15	62
0.3	68
0.6	78
1.18	86
2.5	94
4.75	98
7.5	100
150	100

Authorized Signature:

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Test Method: AS 1289 3.6.1

2.36mm Particle Density (t/m ³):	-
Moisture Content (%):	3.11

PSD Graph

The graph displays the particle size distribution (PSD) of a sample. The x-axis represents Particle Size in millimeters (mm) on a logarithmic scale, ranging from 0.001 to 1000. The y-axis represents the percentage of material passing through the sieve, labeled as Passing (%), ranging from 0.0 to 100.0. The curve shows that approximately 38% of the sample passes through a 0.075 mm sieve, and 100% of the sample passes through a 25 mm sieve.

Particle Size (mm)	Passing (%)
0.075	38.0
0.15	50.0
0.3	62.0
0.6	68.0
1.2	75.0
2.5	85.0
5.0	92.0
10.0	98.0
25.0	100.0
50.0	100.0
100.0	100.0

Authorized Signature:

Integrity Precision Innovation

Test Method: AS 1289 3.6.1

Moisture Content (%): 6.44

The PSD Graph displays the cumulative percentage of material passing through various sieve sizes. The x-axis represents Particle Size in millimeters (mm) on a logarithmic scale from 0.001 to 1000. The y-axis represents the percentage of material passing, ranging from 0.0 to 100.0. The curve starts at approximately 38% passing for a 0.075 mm sieve and reaches 100% passing at a 10 mm sieve.

Particle Size (mm)	Passing (%)
0.075	38
0.15	45
0.3	55
0.6	70
1.18	82
2.5	90
5.0	98
10.0	100
20.0	100
40.0	100
60.0	100
75.0	100
100.0	100

Authorized Signature:

Integrity Precision Innovation

Test Method: AS 1289 3.6.1

2.36mm Particle Density (t/m ³):	-
Moisture Content (%):	2.55

PSD Graph

The graph displays the particle size distribution (PSD) for a sample. The x-axis represents Particle Size (mm) on a logarithmic scale from 0.001 to 1000. The y-axis represents Passing (%) from 0.0 to 100.0. The curve shows that approximately 45% of the sample passes through a 0.075 mm sieve, and 100% of the sample passes through a 10 mm sieve.

Particle Size (mm)	Passing (%)
0.075	45.0
0.15	55.0
0.3	68.0
0.6	78.0
1.2	85.0
2.5	92.0
5.0	98.0
10.0	100.0
100.0	100.0

Authorized Signature:

Integrity Precision Innovation

Test Method: AS 1289 3.6.1

Tested by:	Kohei	2.36mm Particle Density (t/m³):	-
Checked by:	Phil	Moisture Content (%):	3.19

Test Method: AS 1289 3.6.1

2.36mm Particle Density (t/m ³):	-
Moisture Content (%):	3.76

PSD Graph

This graph plots the percentage of material passing through various sieve sizes (Particle Size in mm) against the particle size. The x-axis is logarithmic, ranging from 0.001 mm to 1000 mm. The y-axis is linear, ranging from 0.0% to 100.0%.

Particle Size (mm)	Passing (%)
0.075	25.0
0.15	35.0
0.3	45.0
0.6	52.0
1.2	58.0
2.5	65.0
5.0	78.0
10.0	90.0
20.0	98.0
60.0	100.0

Authorized Signature:

Integrity Precision Innovation

Test Method: AS 1289 3.6.1

2.36mm Particle Density (t/m ³):	-
Moisture Content (%):	4.02

PSD Graph

The graph displays the particle size distribution (PSD) of a sample. The x-axis represents Particle Size (mm) on a logarithmic scale from 0.001 to 1000. The y-axis represents Passing (%) from 0.0 to 100.0. The curve shows that approximately 43% of the sample passes through a 0.075 mm sieve, and 100% of the sample passes through a 75 mm sieve.

Particle Size (mm)	Passing (%)
0.075	43
0.15	55
0.3	68
0.6	75
1.2	82
2.5	90
5.0	95
10.0	98
20.0	100
75.0	100

Authorized Signature:

Integrity Precision Innovation

Test Method: AS 1289 3.6.1

2.36mm Particle Density (t/m ³):	-
Moisture Content (%):	4.55

PSD Graph

The graph displays the particle size distribution (PSD) of a sample. The x-axis represents Particle Size in millimeters (mm) on a logarithmic scale, ranging from 0.001 to 1000. The y-axis represents the percentage of material passing through the sieve, labeled as Passing (%), ranging from 0.0 to 100.0. The curve shows a relatively narrow distribution, starting at approximately 26% passing for a 0.075 mm sieve and reaching 100% passing at a 75 mm sieve.

Particle Size (mm)	Passing (%)
0.075	26
0.15	40
0.3	50
0.6	58
1.2	65
2.5	75
5.0	88
7.5	95
15	98
75	100

Authorized Signature:

Integrity Precision Innovation

Test Method: AS 1289 3.6.1

Tested by:	Kohei	2.36mm Particle Density (t/m³):	-
Checked by:	Phil	Moisture Content (%):	3.69

The PSD Graph displays the cumulative percentage of particles passing through various sieve sizes. The x-axis represents Particle Size in millimeters (mm) on a logarithmic scale from 0.001 to 1000. The y-axis represents the percentage of material passing, ranging from 0.0 to 100.0. The curve starts at approximately 48% passing for a 0.075 mm sieve and reaches 100% passing at a 7.5 mm sieve.

Particle Size (mm)	Passing (%)
0.075	48
0.15	58
0.3	70
0.6	78
1.18	84
2.5	92
4.75	98
7.5	100
150	100

Authorized Signature:

Integrity Precision Innovation

Test Method: AS 1289 3.6.1

2.36mm Particle Density (t/m ³):	-
Moisture Content (%):	4.61

PSD Graph

The graph displays the particle size distribution (PSD) of a sample. The x-axis represents Particle Size in millimeters (mm) on a logarithmic scale, ranging from 0.001 to 1000. The y-axis represents the percentage of material passing through the sieve, labeled as Passing (%), ranging from 0.0 to 100.0. The curve shows a typical distribution for a fine aggregate, starting at approximately 28% passing for a 0.075 mm sieve and reaching 100% passing at a 75 mm sieve.

Particle Size (mm)	Passing (%)
0.075	28
0.15	38
0.3	48
0.6	58
1.2	68
2.5	78
5.0	88
10.0	95
20.0	98
40.0	99
75.0	100

Authorized Signature:

Integrity Precision Innovation

Test Method: AS 1289 3.6.1

The graph is a semi-log plot of Particle Size Distribution (PSD). The x-axis represents Particle Size in millimeters (mm) on a logarithmic scale from 0.001 to 1000. The y-axis represents the percentage of material passing through the sieve, ranging from 0.0 to 100.0. A smooth blue curve is plotted, showing the cumulative distribution of the sample.

Particle Size (mm)	Passing (%)
0.075	7.0
0.15	10.0
0.3	13.0
0.6	16.0
1.18	19.0
2.5	25.0
4.75	32.0
7.5	42.0
15	55.0
30	72.0
60	88.0
106	95.0
150	100.0

Integrity Precision Innovation

Test Method: AS 1289 3.6.1

Tested by:	Kohei	2.36mm Particle Density (t/m³):	-
Checked by:	Phil	Moisture Content (%):	1.90

PSD Graph

The graph displays the particle size distribution (PSD) of a sample. The x-axis represents Particle Size (mm) on a logarithmic scale from 0.001 to 1000. The y-axis represents Passing (%) from 0.0 to 100.0. The curve shows that approximately 5% of the sample passes through a 0.075 mm sieve, and 100% of the sample passes through a 150 mm sieve.

Particle Size (mm)	Passing (%)
0.075	5.0
0.15	8.0
0.3	10.0
0.6	12.0
1.18	13.0
2.5	18.0
4.75	25.0
7.5	35.0
15	50.0
30	70.0
60	88.0
106	95.0
150	100.0

Authorized Signature:

Integrity Precision Innovation



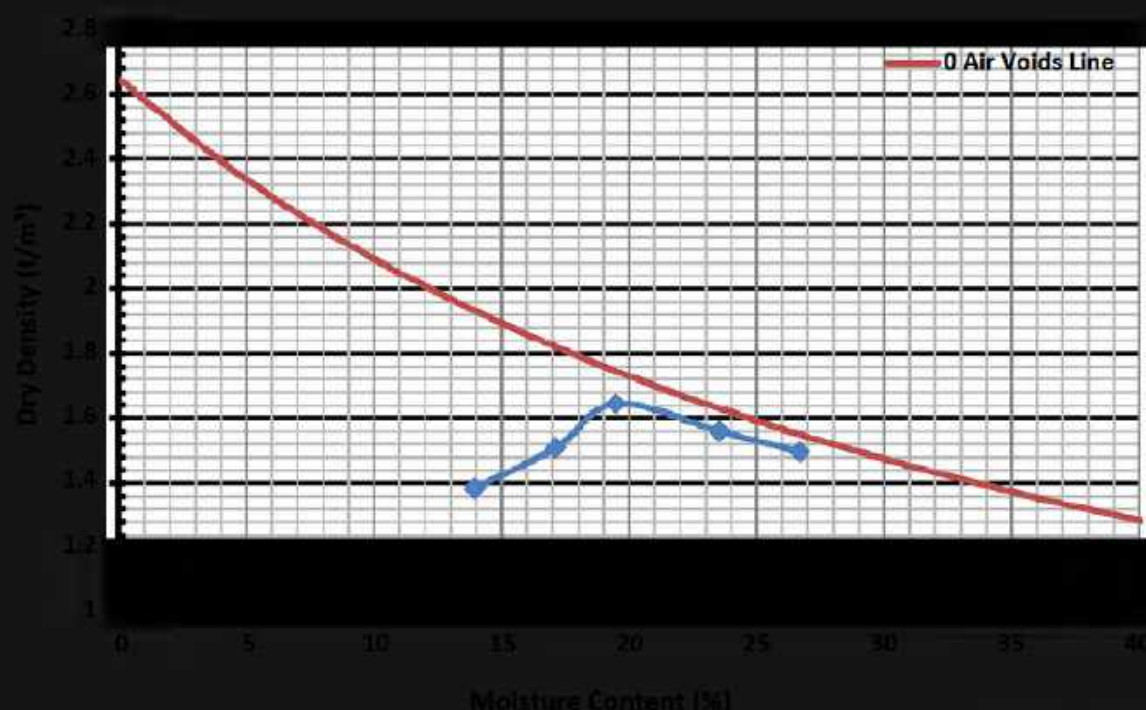
MOISTURE DENSITY RELATIONSHIP REPORT

Test Method: AS1289.5.1.1

Client:	Knight Piesold	Date Tested:	13/04/2021
Project:	Thunderbox TSF Cells C and D	Lab:	EPLAB
Sample No:	C-TP-35	Job Number:	KP
Lab ID:	C-TP-35_0.30_0.40_SMDD		
Depth(m):	0.30 - 0.40	Room Temperature at Test:	20°C
Checked by:	Phil	Sample Description:	Tested in Mould A
Moisture Content (%):	-	Wet Density (t/m³):	-
		Dry Density (t/m³):	-

Results

Maximum Size (mm):	19.00	Maximum Dry Density (t/m³):	1.650
Oversize dry (%):	0.00	Optimum Moisture Content (%):	19.50



Notes: * Particle density 2.646 t/m³

Stored and Tested the Sample as received

Samples supplied by the Client

Authorised Signature:

The results of tests performed apply only to the specific sample at time of test unless otherwise clearly stated. Reference should be made to E-Precision Laboratory's "Standard Terms and Conditions" E-Precision Laboratory ABN 411 550 578 07



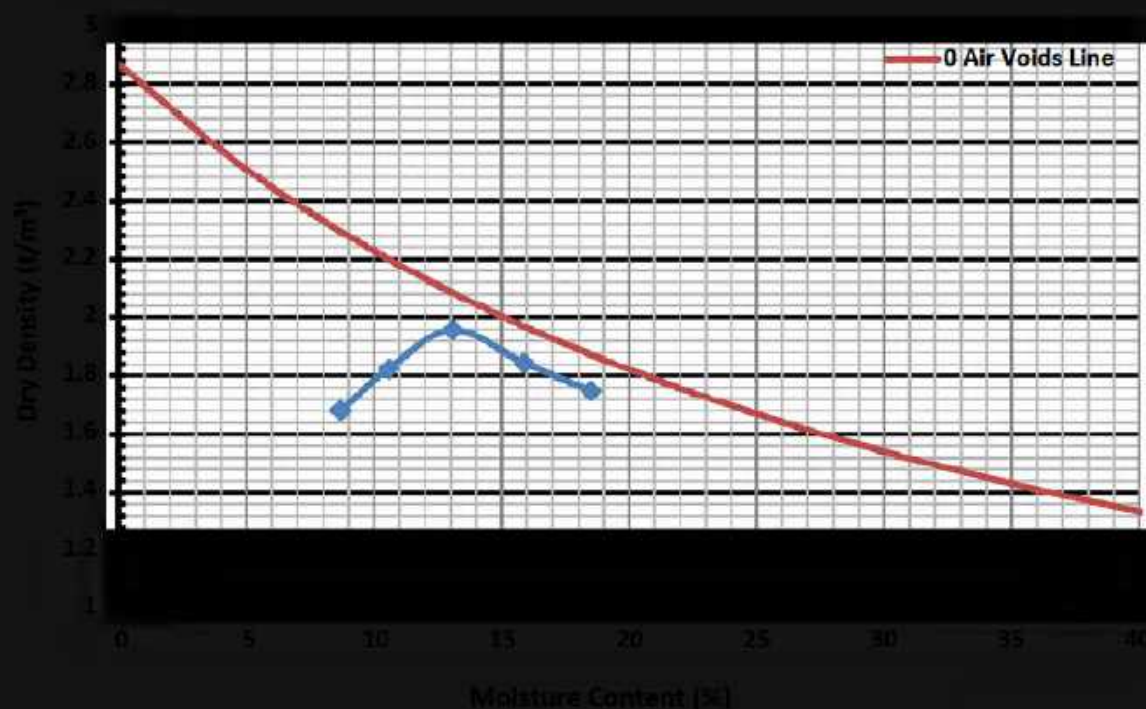
MOISTURE DENSITY RELATIONSHIP REPORT

Test Method: AS1289.5.1.1

Client:	Knight Piesold	Date Tested:	15/04/2021
Project:	Thunderbox TSF Cells C and D	Lab:	EPLAB
Sample No:	C-TP-39	Job Number:	KP
Lab ID:	C-TP-39_0.40_0.50_SMDD		
Depth(m):	0.40 - 0.50	Room Temperature at Test:	20°C
Checked by:	Phil	Sample Description:	Tested in Mould A
Moisture Content (%):	-	Wet Density (t/m ³):	-
		Dry Density (t/m ³):	-

Results

Maximum Size (mm):	19.00	Maximum Dry Density (t/m ³):	1.990
Oversize dry (%):	0.00	Optimum Moisture Content (%):	13.00



Notes: * Particle density 2.866 t/m³

Stored and Tested the Sample as received

Samples supplied by the Client

Authorised Signature

The results of tests confirmed apply only to the specific sample at time of test unless otherwise clearly stated. Reference should be made to E Precision Laboratory's "Standard Terms and Conditions". E Precision Laboratory ABN 411 599 578 87



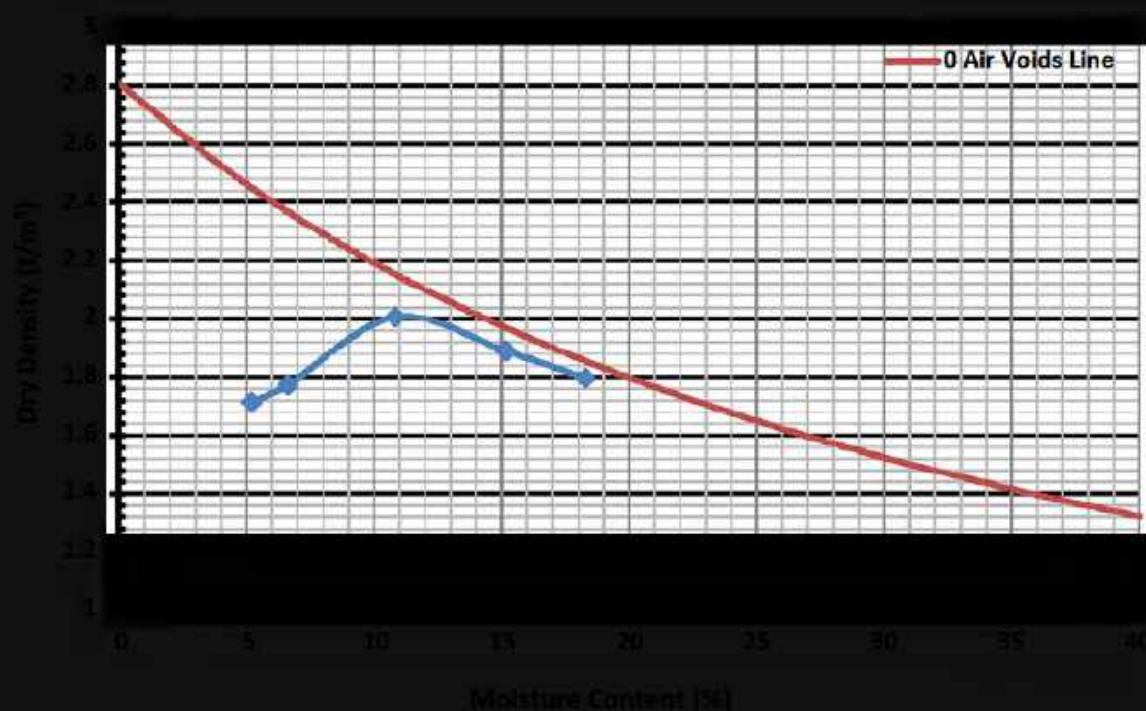
MOISTURE DENSITY RELATIONSHIP REPORT

Test Method: AS1289.5.1.1

Client:	Knight Piesold	Date Tested:	18/04/2023
Project:	Thunderbox TSE Cells C and D	Lab:	EPLAB
Sample No:	C-TP-40	Job Number:	KP
Lab ID:	C-TP-40_0.20_0.30_SMBD		
Depth(m):	0.20 - 0.30	Room Temperature at Test:	20°C
Checked by:	Phil	Sample Description:	Tested in Mould A
Moisture Content (%):	-	Wet Density (t/m ³):	-
		Dry Density (t/m ³):	-

Results

Maximum Size (mm):	19.00	Maximum Dry Density (t/m ³):	2.000
Oversize dry (%):	0.00	Optimum Moisture Content (%):	11.00



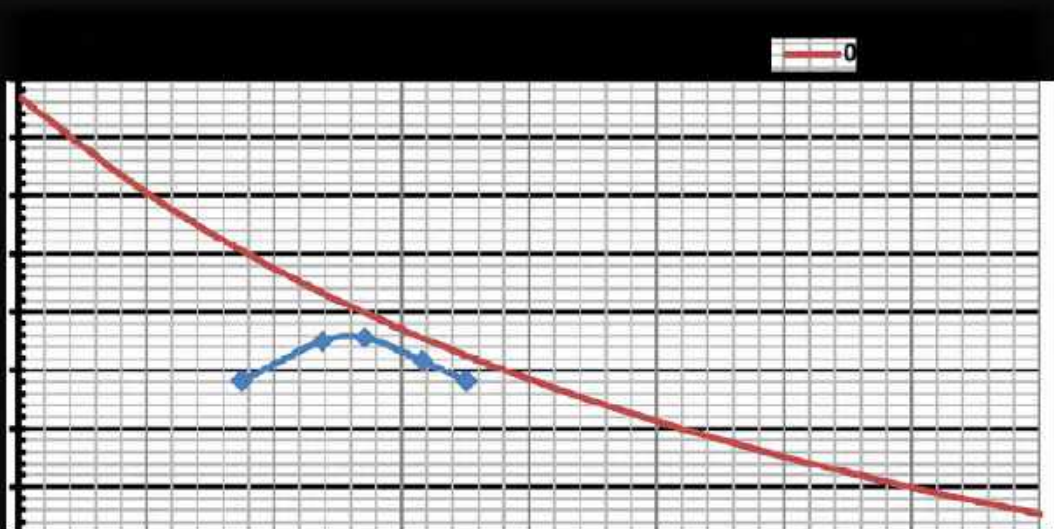
Notes: * Particle density: 2.808 t/m³

Stored and Tested the Sample as received

Sample supplied by the Client

Authorised Signature:

This results of tests performed apply only to the specific sample at time of test unless otherwise clearly stated. Reference should be made to E-Precision Laboratory's "Standard Terms and Conditions" E-Precision Laboratory, ANM 411, 519 578 07





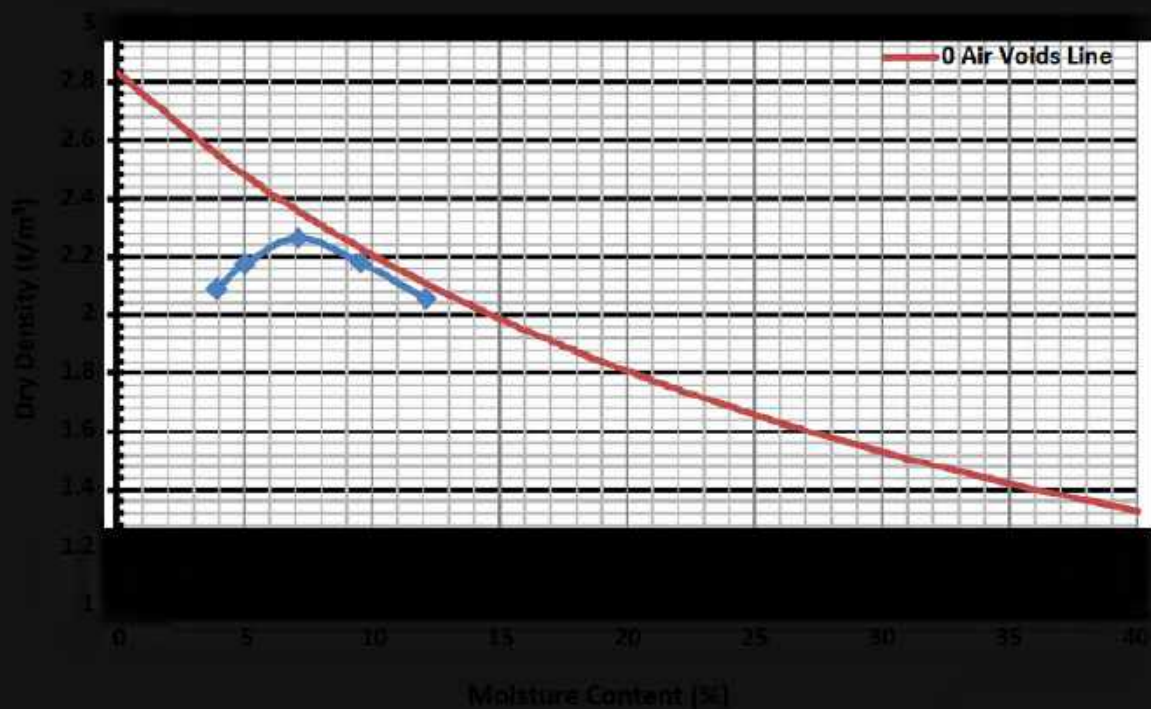
MOISTURE DENSITY RELATIONSHIP REPORT

Test Method: AS1289.5.1.1

Client:	Knight Piesold	Date Tested:	15/04/2021
Project:	Thunderbox TSF Cells C and D	Lab:	EPLAB
Sample No:	D-TP-10	Job Number:	KP
Lab ID:	D-TP-10_0.20-0.30_5MDD		
Depth(m):	0.20 - 0.30	Room Temperature at Test:	20°C
Checked by:	Phil	Sample Description:	Tested in Mould A
Moisture Content (%):	-	Wet Density (t/m ³):	-
		Dry Density (t/m ³):	-

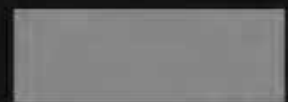
Results

Maximum Size (mm):	19.00	Maximum Dry Density (t/m ³):	2.250
Oversize dry (%):	0.70	Optimum Moisture Content (%):	7.00



Notes: * Particle density 2.831 t/m³
Stored and Tested the Sample as received
Samples supplied by the Client

Authorised Signature:



The results of tests performed apply only to the specific sample at time of test unless otherwise clearly stated. Reference should be made to E-Precision Laboratory's "Standard Terms and Conditions". E-Precision Laboratory ABN 411 550 578 07



4/15/2023



4/15/2023



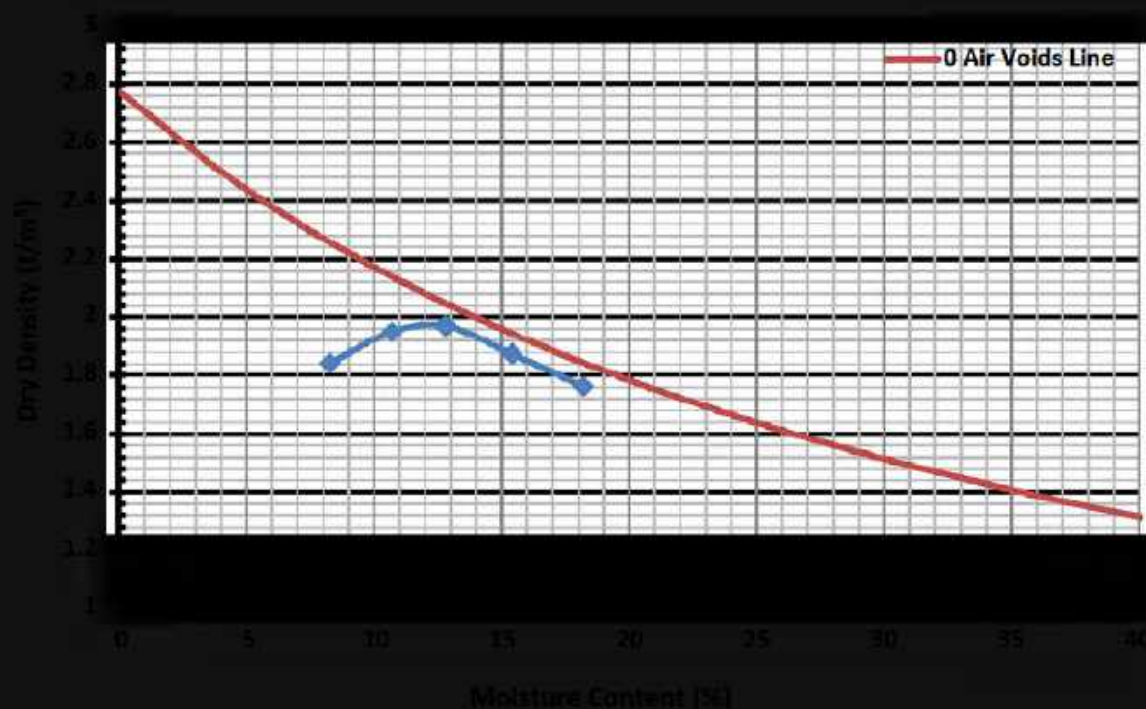
MOISTURE DENSITY RELATIONSHIP REPORT

Test Method: AS1289.5.1.1

Client:	Knight Piesold	Date Tested:	18/04/2023
Project:	Thunderbox TSE Cells C and D	Lab:	EPLAB
Sample No:	D-TP-21	Job Number:	KP
Lab ID:	D-TP-21_0.30_0.40_SMDB		
Depth(m):	0.30 - 0.40	Room Temperature at Test:	20°C
Checked by:	Phil	Sample Description:	Tested in Mould A
Moisture Content (%):	-	Wet Density (t/m ³):	-
		Dry Density (t/m ³):	-

Results

Maximum Size (mm):	19.00	Maximum Dry Density (t/m ³):	1.990
Oversize dry (%):	0.00	Optimum Moisture Content (%):	12.00



Notes: * Particle density: 2.772 t/m³

Stored and Tested the Sample as received

Sample supplied by the Client

Authorised Signature

The results of tests performed apply only to the specific sample at time of test unless otherwise clearly stated. Reference should be made to E-Precision Laboratory's "Standard Terms and Conditions" E-Precision Laboratory, ANM 412, 519 578 07



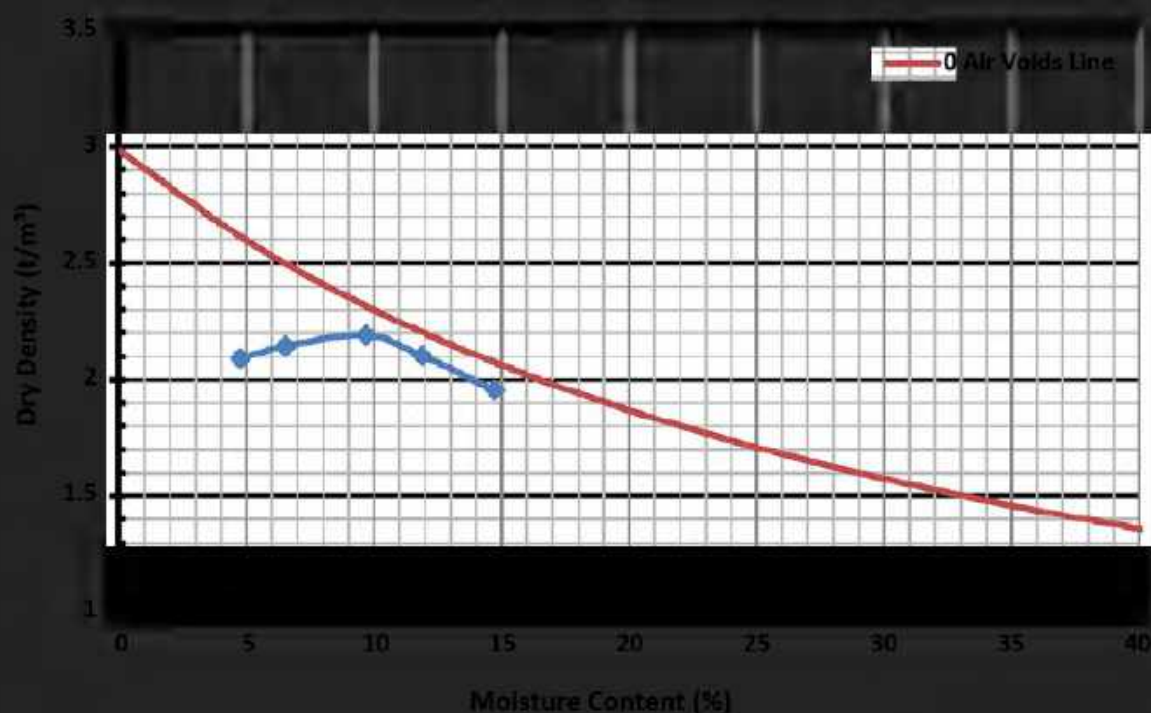
MOISTURE DENSITY RELATIONSHIP REPORT

Test Method: AS1289.5.1.1

Client:	Knight Piesold	Date Tested:	16/04/2021
Project:	Thunderbox TSF Cells C and D	Lab:	EPLAB
Sample No:	D-TP-26	Job Number:	KP
Lab ID:	D-TP-26_0.50_0.60_SMDD		
Depth(m):	0.50 - 0.60	Room Temperature at Test:	20°C
Checked by:	Phil	Sample Description:	Tested in Mould A
Moisture Content (%):	-	Wet Density (t/m ³):	-
		Dry Density (t/m ³):	-

Results

Maximum Size (mm):	19.00	Maximum Dry Density (t/m ³):	2.200
Oversize dry (%):	3.30	Optimum Moisture Content (%):	9.50



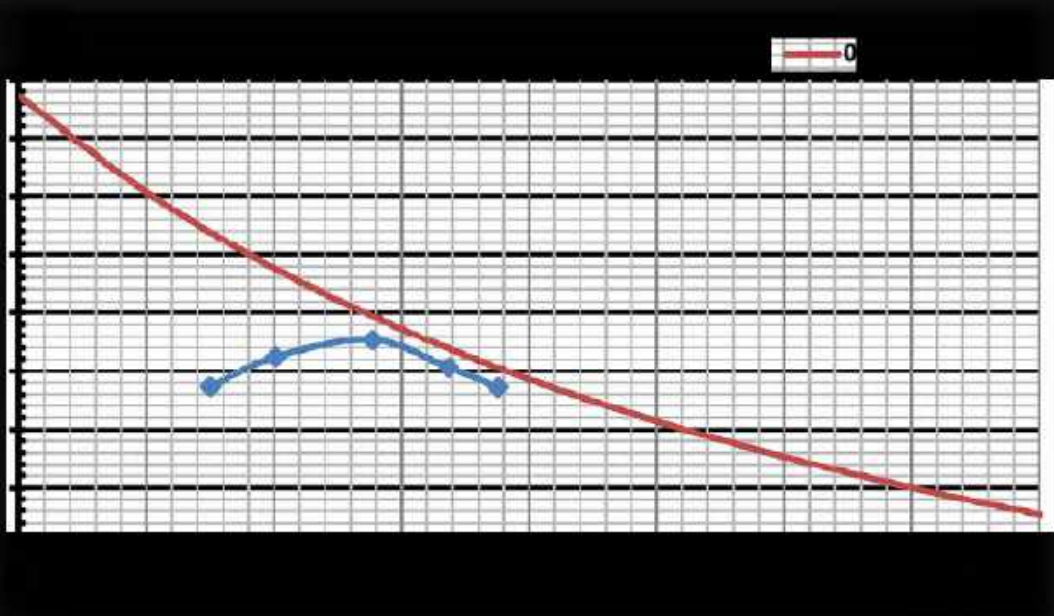
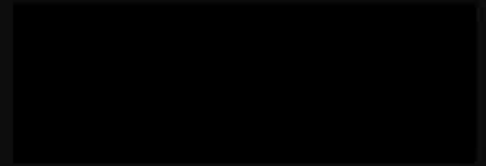
Notes: * Particle density 2.985 t/m³

Stored and Tested the Sample as received

Samples supplied by the Client

Authorised Signature

The results of tests performed apply only to the specific sample at time of test unless otherwise clearly stated. Reference should be made to E-Precision Laboratory's "Standard Terms and Conditions" E-Precision Laboratory ABN 431 559 578 87



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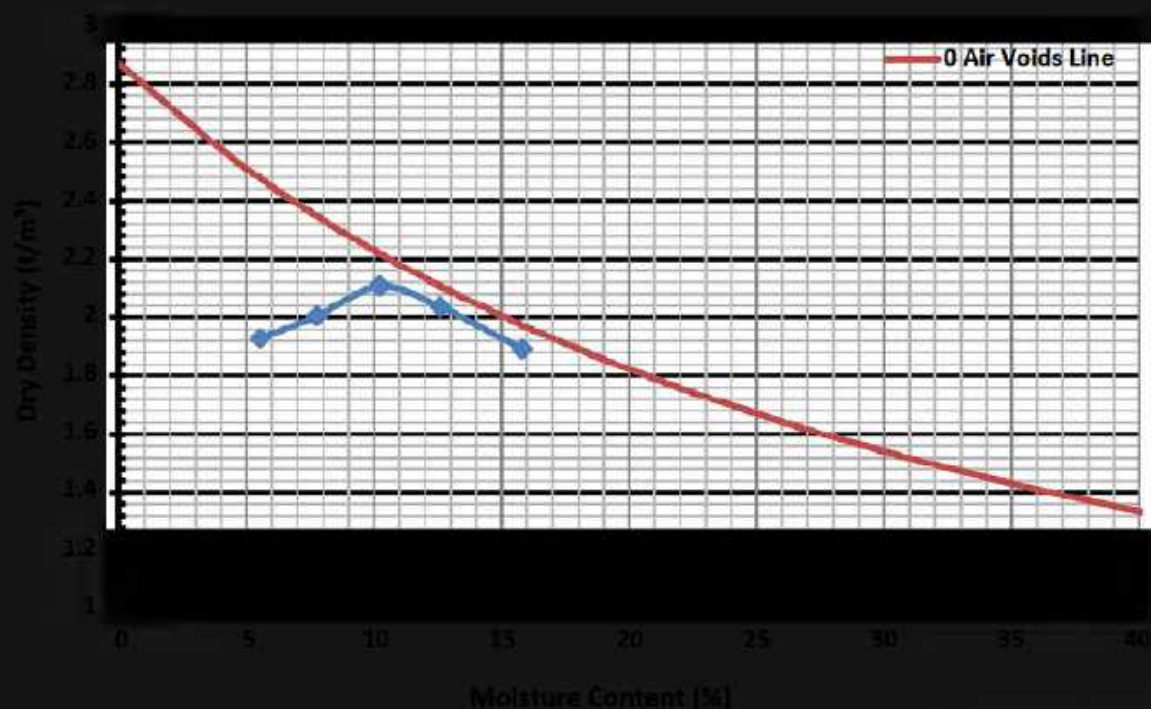
MOISTURE DENSITY RELATIONSHIP REPORT

Test Method: AS1289.5.1.1

Client:	Knight Piesold	Date Tested:	16/04/2021
Project:	Thunderbox TSF Cells C and D	Lab:	EPLAB
Sample No:	D-TP-34	Job Number:	KP
Lab ID:	D-TP-34_0.10_0.20_SMDD		
Depth(m):	0.10 - 0.20	Room Temperature at Test:	20°C
Checked by:	Phil	Sample Description:	Tested in Mould A
Moisture Content (%):	-	Wet Density (t/m ³):	-
		Dry Density (t/m ³):	-

Results

Maximum Size (mm):	19.00	Maximum Dry Density (t/m ³):	2.110
Oversize dry (%):	2.80	Optimum Moisture Content (%):	10.50



Notes: * Particle density 2.869 t/m³

Stored and Tested the Sample as received

Samples supplied by the Client

Authorised Sign

The results of tests performed apply only to the specific sample at time of test unless otherwise clearly stated. Reference should be made to E-Precision Laboratory's "Standard Terms and Conditions" E-Precision Laboratory ABN 411 550 578 07



EMERSON CLASS REPORT

Test Method: AS1289.3.8.1

Client: Knight Piesold
Project: Thunderbox TSF Cell C and D

Date Tested: 25/04/2021
Lab: EPLAB

Test Results

Sample No	Sample ID	Depth (m)		Class Number
1	C-TP35	0.30	0.40	8
2	C-TP40	0.20	0.30	5
3	C-TP46	0.40	0.50	5
4	D-TP10	0.20	0.30	8
5	D-TP26	0.50	0.60	5
6	D-TP27	0.20	0.30	5

Notes: tested using distilled water @ 19deg / test

Samples tested as supplied by client

Samples supplied by the Client

Authorised Signature:

The results of tests performed apply only to the specific sample at time of test unless otherwise clearly stated. Reference should be made to E-Precision Laboratory's "Standard Terms and Conditions" E-Precision Laboratory ABN 431 559 578 87

E-precision Laboratory

EMERSON CLASS REPORT

Test Method: AS1289.3.8.1

Client: Knight Piesold
Project: Thunderbox TSF Cell C and D

Date Tested: 25/04/2021
Lab: EPLAB

Photo of Samples



Notes: tested using distilled water @ 19deg / test

Samples tested as supplied by client

Samples supplied by the Client

The results of tests performed apply only to the specific sample at time of test unless otherwise clearly stated. Reference should be made to E-Precision Laboratory's "Standard Terms and Conditions" E-Precision Laboratory ABN 431 559 578 87



E-PRECISION LABORATORY

FALLING HEAD PERMEABILITY TEST REPORT

Test Method: AS1289 6.7.2

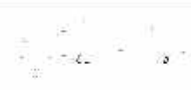
Client:	Knight Piesold	Date Tested:	19/04/2021
Project:	Thunderbox TSF Cell C and D 2021 Testing	Date Reported:	03/05/2021
Lab:	EPLAB	EP Lab Job Number:	KP
Tested by:	Phil		
Checked by:	Phil		

Lab ID:	C-TP-35_FH	C-TP-39_FH	C-TP-40_FH	
Client ID:	C-TP-35	C-TP-39	C-TP-40	
Depth (m):	0.30 - 0.40	0.40 - 0.50	0.20 - 0.30	
Sample Conditions:	Remolded 98% SMDD	Remolded 98% SMDD	Remolded 98% SMDD	
Surcharge Pressure (kPa):	12.5	12.5	12.5	
Initial Bulk Density (t/m ³):	1.94	2.21	2.18	
Initial Moisture Content (%):	19.62	13.32	11.19	
Dry Density (t/m ³):	1.62	1.95	1.96	
Saturation (Skempton's B):	0.98	1.00	1.00	
K ₂₀ (m/s):	8.791 E ⁻⁷	11.718 E ⁻⁷	2.675 E ⁻⁷	

Notes:

Stored and Tested the Sample as received

Samples supplied by the Client

Authorised Signatory (Geotechnical Engineer):


The results of tests performed apply only to the specific sample at time of test unless otherwise clearly stated. Reference should be made to E-Precision Laboratory's "Standard Terms and Conditions" E-Precision Laboratory ABN 431 559 578 87



E-PRECISION LABORATORY

FALLING HEAD PERMEABILITY TEST REPORT

Test Method: AS1289 6.7.2

Client:	Knight Piesold	Date Tested:	19/04/2021
Project:	Thunderbox TSF Cell C and D 2021 Testing	Date Reported:	03/05/2021
Lab:	EPLAB	EP Lab Job Number:	KP
Tested by:	Phil		
Checked by:	Phil		

Lab ID:	D-TP-09_FH	D-TP-10_FH	D-TP-19_FH	
Client ID:	D-TP-09	D-TP-10	D-TP-19	
Depth (m):	0.40 - 0.50	0.20 - 0.30	0.20 - 0.30	
Sample Conditions:	Remolded 98% SMDD	Remolded 98% SMDD	Remolded 98% SMDD	
Surcharge Pressure (kPa):	12.5	12.5	12.5	
Initial Bulk Density (t/m ³):	2.12	2.37	2.25	
Initial Moisture Content (%):	13.33	7.09	10.57	
Dry Density (t/m ³):	1.87	2.21	2.03	
Saturation (Skempton's B):	1.00	1.00	1.00	
K ₂₀ (m/s):	3.452 E ⁻⁷	9.429 E ⁻⁷	1.281 E ⁻⁷	

Notes:

Stored and Tested the Sample as received
Samples supplied by the Client

Authorised Signatory (Geotechnical Engineer):

The results of tests performed apply only to the specific sample at time of test unless otherwise clearly stated. Reference should be made to E-Precision Laboratory's "Standard Terms and Conditions" E-Precision Laboratory ABN 431 559 578 87



E-PRECISION LABORATORY

FALLING HEAD PERMEABILITY TEST REPORT

Test Method: AS1289 6.7.2

Client:	Knight Piesold	Date Tested:	19/04/2021
Project:	Thunderbox TSF Cell C and D 2021 Testing	Date Reported:	03/05/2021
Lab:	EPLAB	EP Lab Job Number:	KP
Tested by:	Phil		
Checked by:	Phil		

Lab ID:	D-TP-21_FH	D-TP-26_FH	D-TP-27_FH	D-TP-34_FH
Client ID:	D-TP-21	D-TP-26	D-TP-27	D-TP-34
Depth (m):	0.30 - 0.40	0.50 - 0.60	0.20 - 0.30	0.10 - 0.20
Sample Conditions:	Remolded 98% SMDD	Remolded 98% SMDD	Remolded 98% SMDD	Remolded 98% SMDD
Surcharge Pressure (kPa):	12.5	12.5	12.5	12.5
Initial Bulk Density (t/m ³):	2.19	2.37	2.13	2.27
Initial Moisture Content (%):	12.16	9.73	13.43	10.38
Dry Density (t/m ³):	1.95	2.16	1.88	2.06
Saturation (Skempton's B):	1.00	1.00	1.00	1.00
K ₂₀ (m/s):	0.889 E ⁻⁷	16.641 E ⁻⁷	0.969 E ⁻⁷	13.442 E ⁻⁷

Notes:

Stored and Tested the Sample as received
Samples supplied by the Client

Authorised Signatory (Geotechnical Engineer):

The results of tests performed apply only to the specific sample at time of test unless otherwise clearly stated. Reference should be made to E-Precision Laboratory's "Standard Terms and Conditions" E-Precision Laboratory ABN 431 559 578 87

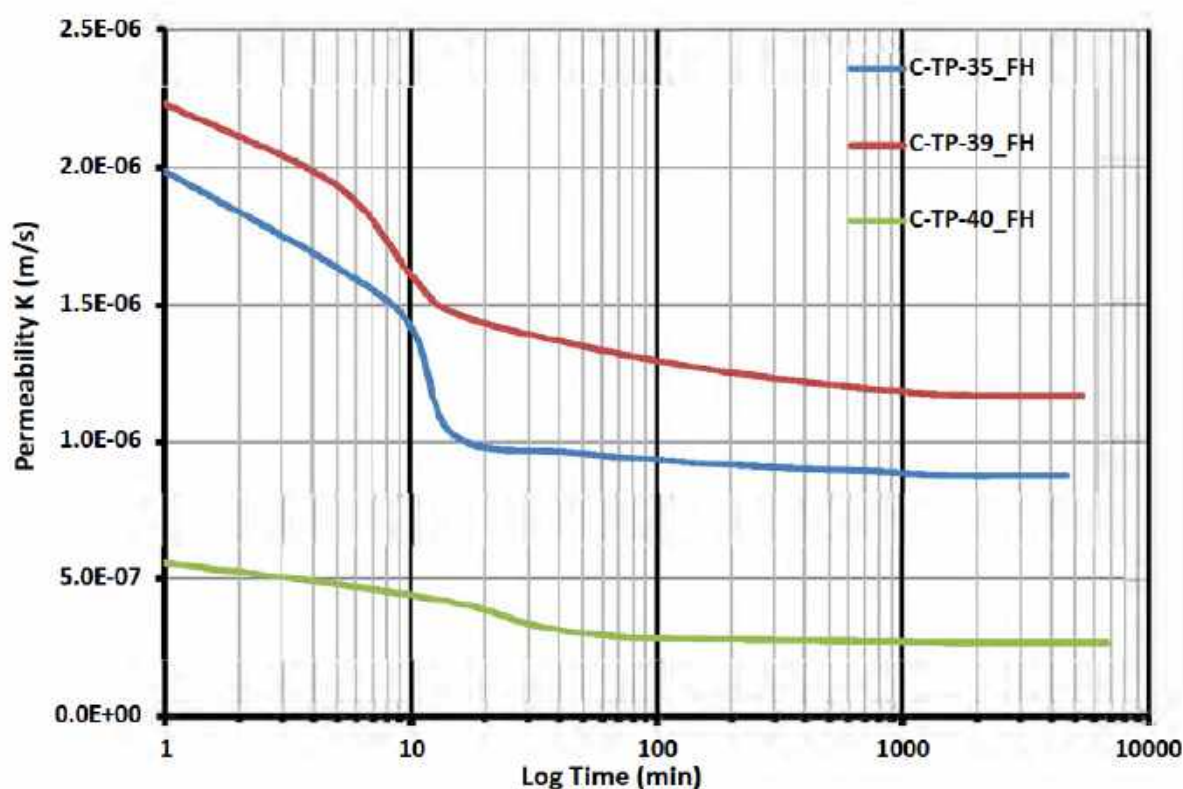


E-PRECISION LABORATORY

FALLING HEAD PERMEABILITY TEST REPORT

Test Method: AS1289 6.7.2

Client:	Knight Piesold	Date Tested:	19/04/2021
Project:	Thunderbox TSF Cell C and D 2021 Testing	Date Reported:	03/05/2021
Lab:	EPLAB	EP Lab Job Number:	KP



Notes:

Stored and Tested the Sample as received
Samples supplied by the Client

Authorised Signatory (Geotechnical Engineer)

The results of tests performed apply only to the specific sample at time of test unless otherwise clearly stated. Reference should be made to E-Precision Laboratory's "Standard Terms and Conditions" E-Precision Laboratory ABN 431 559 578 87

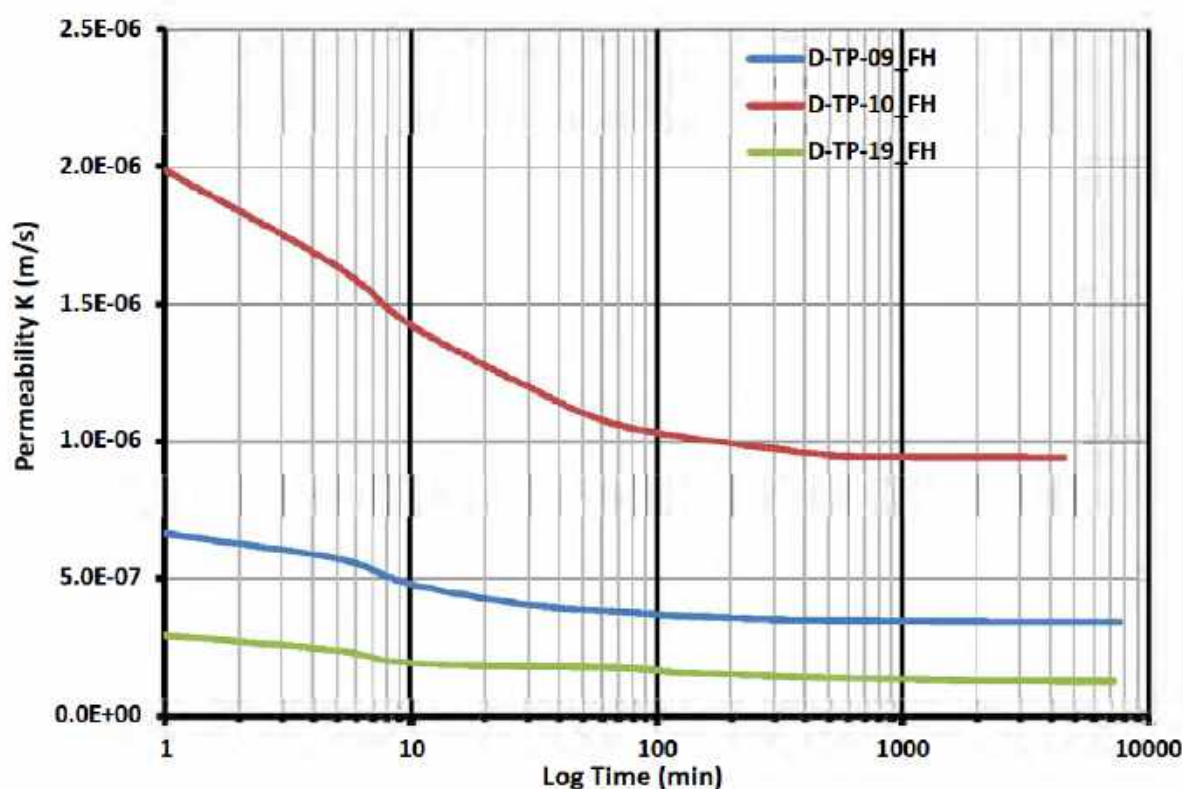


E-PRECISION LABORATORY

FALLING HEAD PERMEABILITY TEST REPORT

Test Method: AS1289 6.7.2

Client:	Knight Piesold	Date Tested:	19/04/2021
Project:	Thunderbox TSF Cell C and D 2021 Testing	Date Reported:	03/05/2021
Lab:	EPLAB	EP Lab Job Number:	KP



Notes:

Stored and Tested the Sample as received
Samples supplied by the Client

Authorised Signatory (Geotechnical Engineer):

The results of tests performed apply only to the specific sample at time of test unless otherwise clearly stated. Reference should be made to E-Precision Laboratory's "Standard Terms and Conditions" E-Precision Laboratory ABN 431 559 578 87

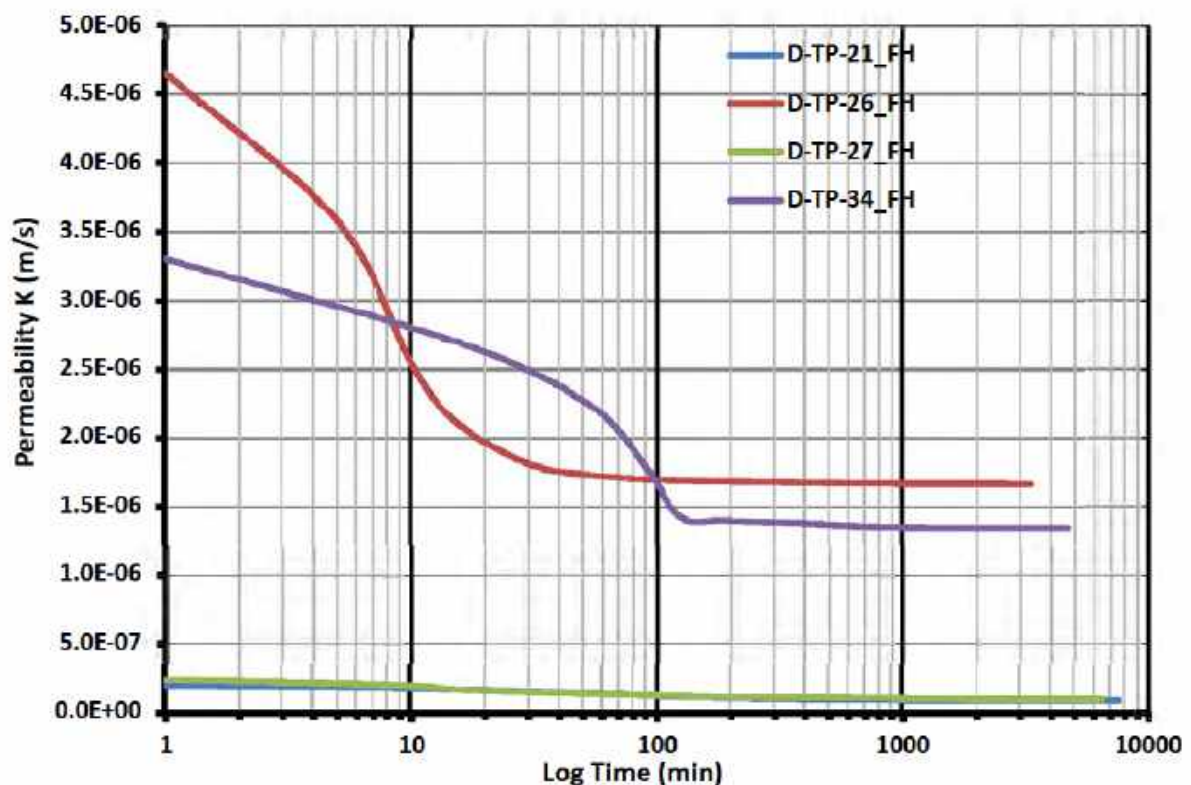


E-PRECISION LABORATORY

FALLING HEAD PERMEABILITY TEST REPORT

Test Method: AS1289 6.7.2

Client:	Knight Piesold	Date Tested:	19/04/2021
Project:	Thunderbox TSF Cell C and D 2021 Testing	Date Reported:	03/05/2021
Lab:	EPLAB	EP Lab Job Number:	KP



Notes:

Stored and Tested the Sample as received
Samples supplied by the Client

Authorised Signatory (Geotechnical Engineer)

The results of tests performed apply only to the specific sample at time of test unless otherwise clearly stated. Reference should be made to E-Precision Laboratory's "Standard Terms and Conditions" E-Precision Laboratory ABN 431 559 578 87

APPENDIX D
Tailings Physical Testing 2017

MEMORANDUM

To: Saracen Metals Pty Ltd

Date: 01 August 2018

Our Ref: PE18-00721

KP File Ref.: PE801-00296/16-A dss M18006

From: [REDACTED]

RE: THUNDERBOX OPERATIONS –THICKENER UNDERFLOW TAILINGS PHYSICAL TESTING

1. INTRODUCTION

Knight Piésold (KP) was engaged by Saracen Metals Pty Limited to undertake the permitting design of Stage 7 to 9 of the Tailings Storage Facility (TSF) expansion at the Thunderbox project in the Goldfields region of Western Australia. As mining progressed to a different ore body, an operating sample was requested to validate the design assumptions by testing the physical and geochemical properties.

The physical tests were performed to determine the rate of settling, achieved density and rate of water release of the tailings. In addition, air drying, permeability and consolidation tests were performed. Geochemical test results will be provided in a separate memorandum.

2. SAMPLE DESCRIPTION AND TESTWORK

A ~20L bucket of slurry tailings sample from the thickener underflow was sent to the KP laboratory in Perth in July 2018. The percent solids for this tailings sample was tested and found to be 51% solids w/w in the as received condition. Adjustment to the percent solids was made to reflect a target percent solids of 58% w/w and a full sweep of physical testing was carried out.

The following tests were carried out on the sample:

- I. Classification tests to determine:
 - Particle size distribution of the tailings;
 - Supernatant liquor density and pH;
 - Tailings solids particle density;
 - Atterberg Limits of the tailings solids;
- II. Undrained and drained sedimentation tests;
- III. Air drying tests;
- IV. Permeability tests; and
- V. Consolidation tests.

During laboratory testing it is Knight Piésold's normal practice to duplicate each test as a means to verify the consistency of the test results. The results of each individual test are plotted on the corresponding figures. The interpreted mean values are given in the

tables and text of the document. A brief description of the method employed in each test is also provided.

3. PHYSICAL TESTING

The following section presents the physical testing results for the tailings sample received. Predicted tailings behaviour is discussed in Section 4, however, it should be noted that tailings behaviour in the field is also dependent on the layout, height and design of the storage facility, climatic conditions on site and the operating parameters of the processing plant. Hence it is recommended site monitoring is conducted to enable a full assessment of the performance of the facility.

3.1 CLASSIFICATION TESTING

Classification testing for the sample was completed by Trilab in Perth. Where appropriate, classification tests were conducted in accordance with relevant Australian Standards. The results of the classification tests and relevant Australian Standards are summarised in Table 3.1. The Trilab laboratory test reports are presented in Appendix A.

Table 3.1: Classification testing – results and relevant standards

Test	July 2018 Operating Sample	AS1289
Solids Particle Density (t/m^3)	2.77	3.5.1
Supernatant Density (t/m^3)	1.004	(hydrometer)
Supernatant pH	10.4	(pH meter)
Liquid Limit (%)	32	3.1.2
Plastic Limit (%)	26	3.2.1
Plasticity Index (%)	6	3.3.1
Linear Shrinkage (%)	2.0	3.4.1

The particle size analysis for the tailings sample was completed in accordance with AS1289 3.6.3 and 3.5.1. The measured particle size distribution is presented in Table 3.2 and the grading curve for the sample is shown on Figure 3.1.

Table 3.2: Particle size distribution - Thickener Underflow Sample

Fraction	Particle Size	Percent Passing (%)
	(μm)	
Sand	600	100
	200	97
Silt	75	78
	20	54
	6	18
Clay	2	4

The Thickener underflow sample consisted of 22% sand, 74% silt and 4% clay sized material. The testing indicates that the material is Silt with sand and trace clay and would be classified as ML with low plasticity according to Geotechnical Site Investigation Standard AS1726-2017. The sample's P_{80} is approximately 83 μm .

The grading curve indicates that part of the sample falls inside the boundary of potentially liquefiable soil and therefore liquefaction of tailings should be considered in design.

3.2 SEDIMENTATION TESTING

Drained and undrained sedimentation tests were carried out to determine the settling rate, volume of supernatant, and settled dry density of the tailings.

In the undrained sedimentation test, tailings slurry is allowed to settle in a measuring cylinder. This is equivalent to the deposition of tailings under water. The results indicate the expected rate and quantity of supernatant release and enable the minimum expected dry density of the tailings to be determined.

In the drained sedimentation test, tailings slurry is allowed to settle and drain in a cylinder with a fine sand filter drain at the base. This simulates the deposition of tailings where both settling and free drainage can occur. The results indicate the relative quantities of supernatant and underdrainage released by the settling slurry and enables the dry density of the drained tailings to be determined. The underdrainage values are maximum values, as the drainage layer is free-draining without back pressure and the tailings is deposited directly over the drainage medium.

The results of the sedimentation tests are presented in figures 3.2 and 3.3. Table 3.3 presents a summary of the measured sedimentation data.

Table 3.3: Sedimentation test results

Sample	Test	Initial Solids (%)	Supernatant (% of initial water volume)	Underdrainage (% of initial water volume)	Time to Achieve Final Density (Days)	Final Dry Density (t/m ³)	Final Void Ratio	Figure
Thickener Underflow sample	Undrained	57	37	-	0.3	1.21	1.28	3.2
	Drained	59	29	18	1.0	1.35	1.05	3.3

The undrained test indicated that the Thickener Underflow Sample is quick settling taking about one third of a day to complete the majority of the settlement and water release. There is approximately a 12% increase in the settled density with drainage.

The sample released approximately 37% of water in slurry to supernatant in the undrained test, reducing to 29% in the drained test. The sample achieved high dry densities from settlement before air drying or consolidation.

3.3 AIR DRYING TESTS

Air drying tests were carried out on slurry samples to determine the effect of natural drying of the tailings after initial settling and removal of supernatant liquor, thereby simulating conditions expected following sub-aerial deposition. Continuous monitoring of the weight and volume of each specimen was carried out in order to quantify the relationship between dry density, moisture content, volumetric change and the degree of saturation of the tailings against a measured evaporation rate.

A direct relationship exists between dry density and moisture content up to a breakaway point, at which the degree of saturation falls below 100%. At this point, negative pore water pressures are developed, which further consolidates the tailings. Drying below a limiting saturation produces no further consolidation, and the density at this point represents the maximum that can be achieved via air drying of the tailings. The results of air drying test are presented in figures 3.4 and 3.5 and are summarised in Table 3.4.

Table 3.4: Results of air drying tests

Sample	Moisture Content at Breakaway Point	Dry Density at Breakaway Point	Limiting Saturation Value	Final Dry Density	Figures
	(%MC)	(t/m ³)	(%Sat)	(t/m ³)	
Thickener Underflow	35	1.45	75	1.54	3.4, 3.5

The sample achieved a final dry density of 1.54 t/m³ after around 3 – 4 days of air drying at an evaporation rate of about 8.8 mm/day (total evaporation of about 25 to 35 mm). There is 14% improvement in density over the drained results with the void ratio reducing to around 0.8.

3.4 CONSOLIDATION TEST

The consolidation of the tailings can be quantified in terms of the compression index C_c and the coefficient of consolidation C_v . The compression index relates the void ratio or tailings density to the effective stress of the tailings sample. The larger the value of C_c , the more compressible the tailings is. The coefficient of consolidation defines the rate of excess pore water dissipation, and hence the rate of increase in effective stress within the tailings. Higher values of C_v indicate more rapid consolidation of the sample.

The settlement with respect to time for the test is presented in Figure 3.6 and the results of the consolidation tests are summarised in Table 3.5.

Table 3.5: Consolidation test results

Test	Dry Density	Stress Range	Coeff. of Consolidation	Coeff. of Volume Decrease	Comp. Index
	(t/m ³)	(kPa)	C_v (m ² /y)	M_v (m ² /kN)	C_c
Thickener Underflow	1.17-1.24	1.78-4.92	139	0.016	0.270

These results indicate the tailings sample is highly compressible overall and will consolidate very quickly under the self-weight of additional deposition.

3.5 PERMEABILITY TEST

Falling head permeability tests were completed on saturated tailings samples with drainage through the drained sedimentation sample being measured. In addition, permeability values were derived from the results of consolidation tests. Measured permeability data are summarised in Table 3.6.

Table 3.6: Permeability test results

Sample	Test Type	Dry Density (t/m ³)	Permeability (m/s)
Thickener Underflow	Falling Head Test	1.35	5.9×10^{-7}
		1.36	5.7×10^{-7}
	Consolidation Test	1.19	8.8×10^{-6}
		1.22	1.4×10^{-6}
		1.24	7.1×10^{-7}

These results represent the vertical permeability of saturated tailings prior to additional consolidation due to additional deposition loading or negative suction due to air-drying. In the range of expected settled densities, the vertical permeability of the Thickener Underflow sample is approximately 6×10^{-7} m/s. As the tailings consolidate, it is anticipated that the permeability may reduce by about another order of magnitude.

4. INTERPRETATION OF RESULTS

Based on the physical testing of the samples the behaviour of the tailings can be predicted. The testing has been undertaken at 58% solids which is in the design range for the current operation.

4.1 WATER PRODUCTION

The release of water following deposition of the tailings can be estimated from the results of undrained and drained sedimentation test. The rate of release will determine the amount of liquor available in the decant pond for collection and return to the process plant or release from the facility. The testing indicated that the rate of supernatant release is moderately fast, taking within one day to complete.

The expected supernatant release would be in the range of 29 to 37% of the water in slurry, not accounting for rainfall and evaporation but incorporating the loss of water to re-saturate lower tailings layers for the operating tailings. Allowing for evaporation and seepage losses, a nominal decant recovery of 24 to 32% is considered possible which is consistent with the 30% recovery value used in the design. The underdrainage flow is expected to be around 18% of the water in slurry. Underdrainage recovery rates will be lower due to design issues and operating constraints. A recovery rate of between 5 and 12% is expected for a full basin underdrainage system. Values should be compared to existing recorded decant return rates for verification.

4.2 TAILINGS DENSITY

The settled dry density of tailings deposited into the facility can be predicted from laboratory testing and an appropriate site water balance taking into account climatic conditions. The test results indicated that the tailings sample achieved high densities, around 1.35 t/m³ (void ratio around 1.05) from settling alone. There was an additional improvement due to air drying and potential consolidation with the air dry density reaching a maximum of 1.54 t/m³ (void ratio of 0.7 – 0.8).

It has been observed over a number of years that densities achieved in the field are generally lower than those obtained in the laboratory. The in-situ density is estimated to be approximately 1.21 to 1.35 t/m³. This is approximately equivalent to the undrained to drained settlement value and indicates that the current facility is smaller than the area required to achieve full air-dried density for the given throughput. This is currently

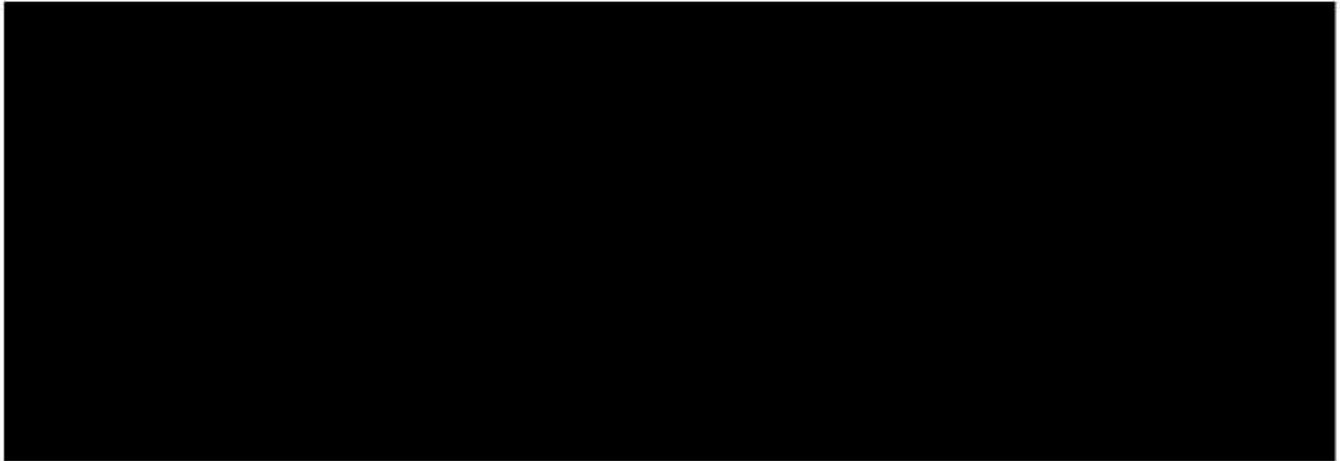
around 60 Ha divided by 3.0 Mtpa, equal to 20 Ha/Mtpa, where typically a value of 25 – 30 Ha/Mtpa is recommended.

4.3 COMPARISON WITH PREVIOUS TESTWORK

In comparing the previous testwork, the following are noted:

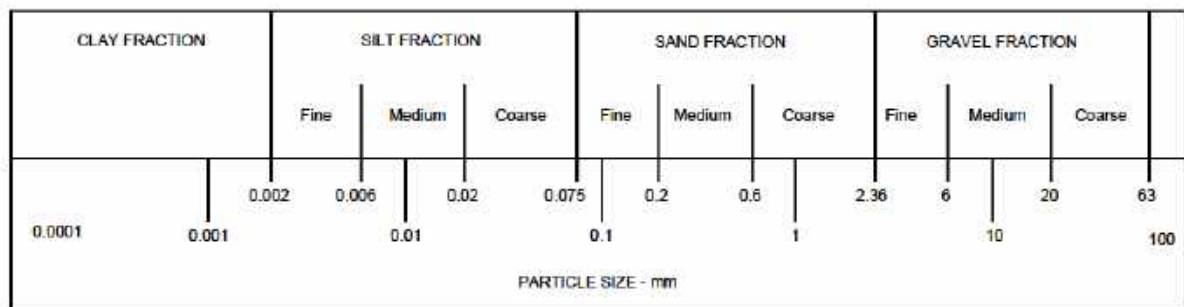
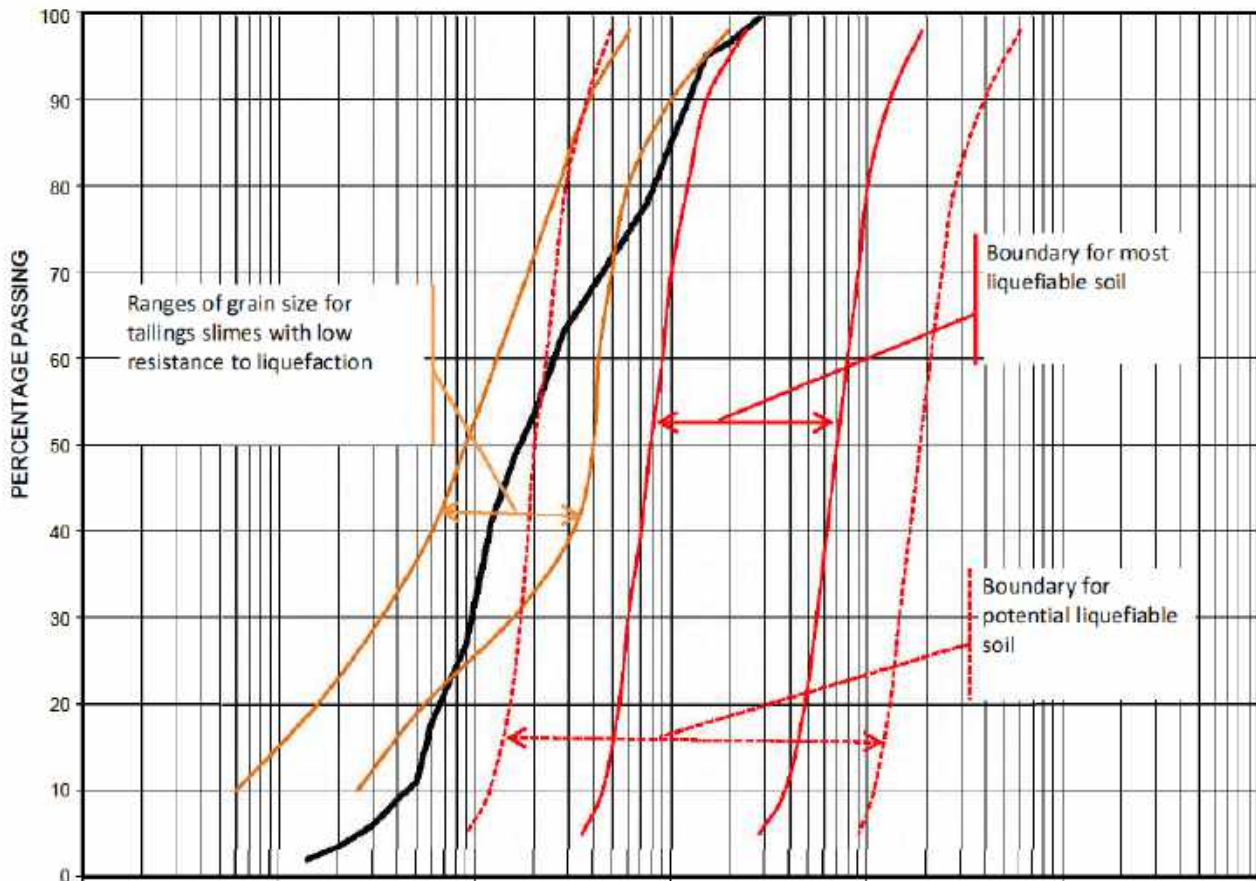
- The current sample settled more rapidly than the previous sample, taking one third of a day to complete the majority of the settling and supernatant release (the previous test sample took a day).
- The current samples achieved a final dry density of 1.54 t/m^3 , that is a 5% reduction in dry density compared to the previous testwork (1.62 t/m^3).
- A detailed density model has been completed as part of the Stage 7 to 9 final design. The impact on the void storage reduction due to the lower dry density (current testing) ranges from 1 week for South void and 3 to 4 weeks for the North void (based on a 3 Mtpa production rate).

We trust this is sufficient information for your current requirements, however please contact us if you have any questions.



FIGURES

PARTICLE SIZE DISTRIBUTION



SYMBOL	SOIL DESCRIPTION	LIQUID LIMIT	PLASTICITY INDEX	SPECIFIC GRAVITY
—	THICKENER UNDERFLOW	30	12	2.77

Line 1

Line 2

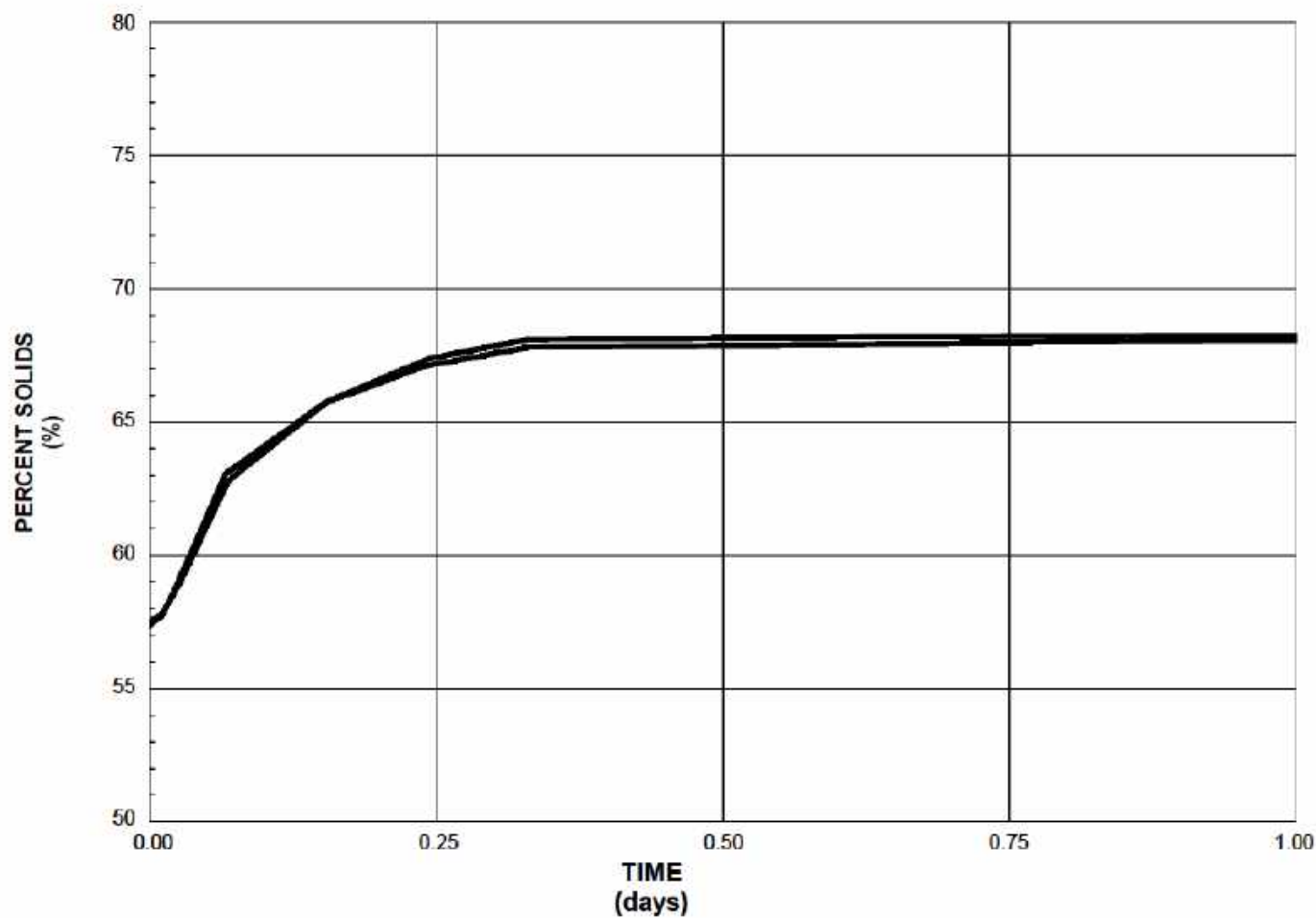
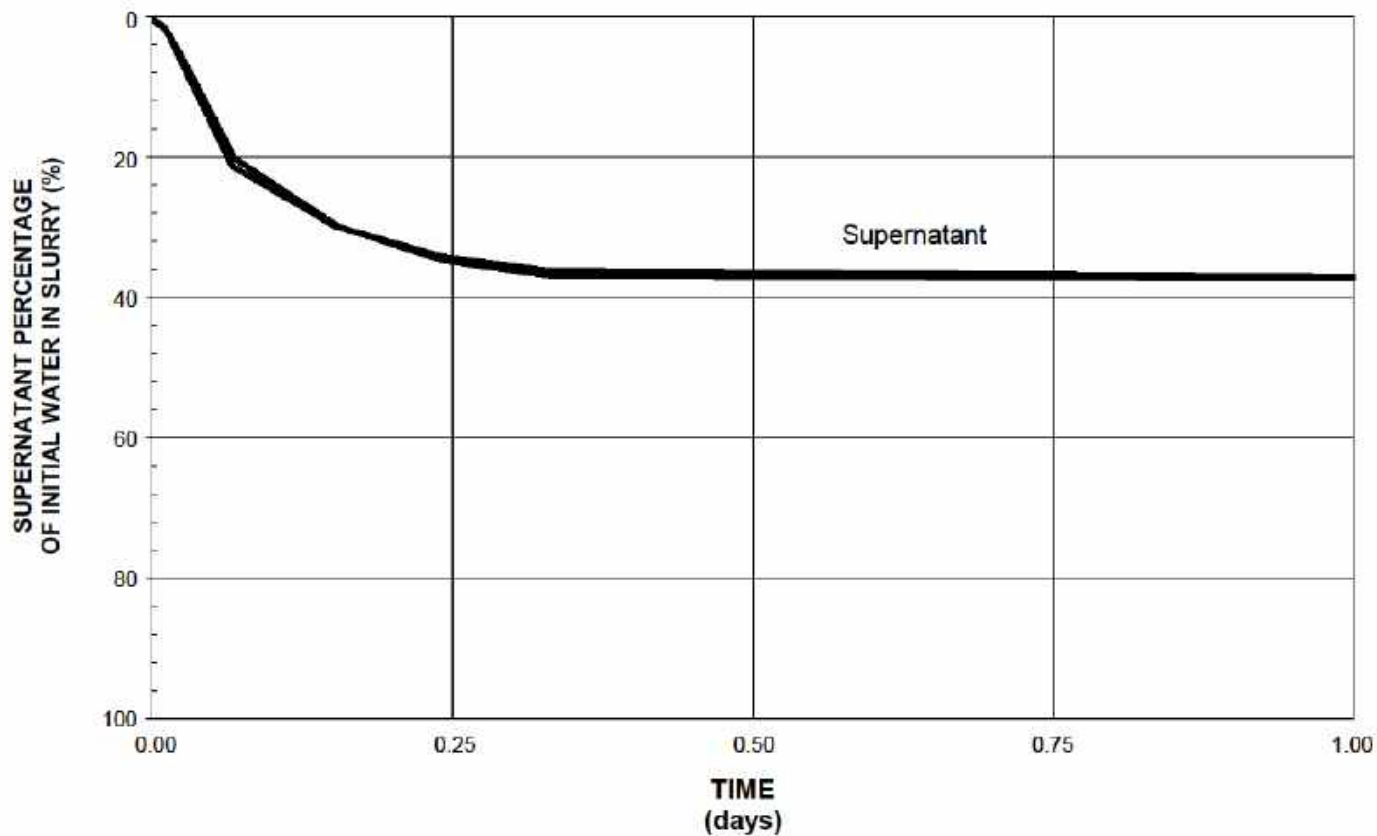
Note:

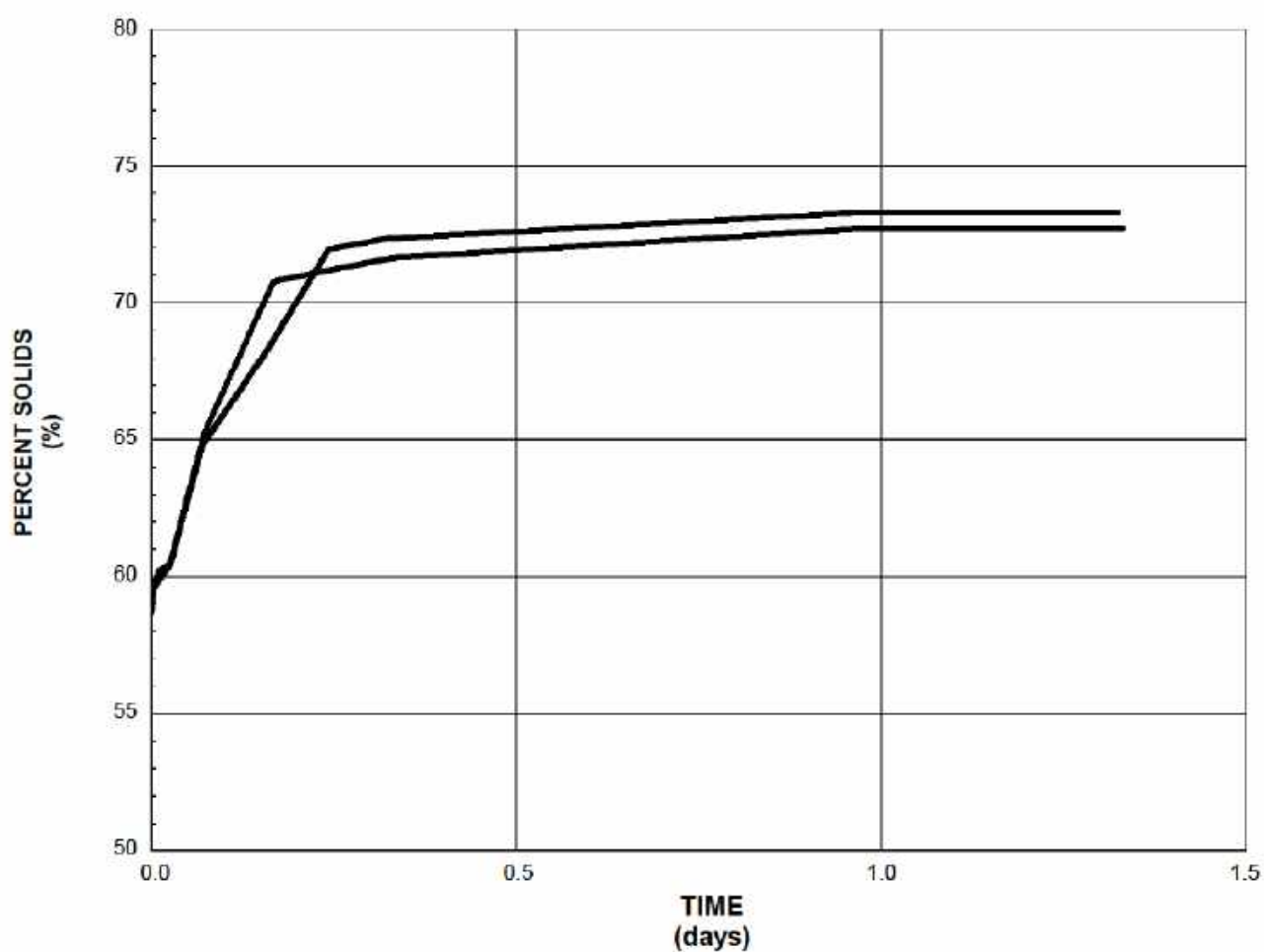
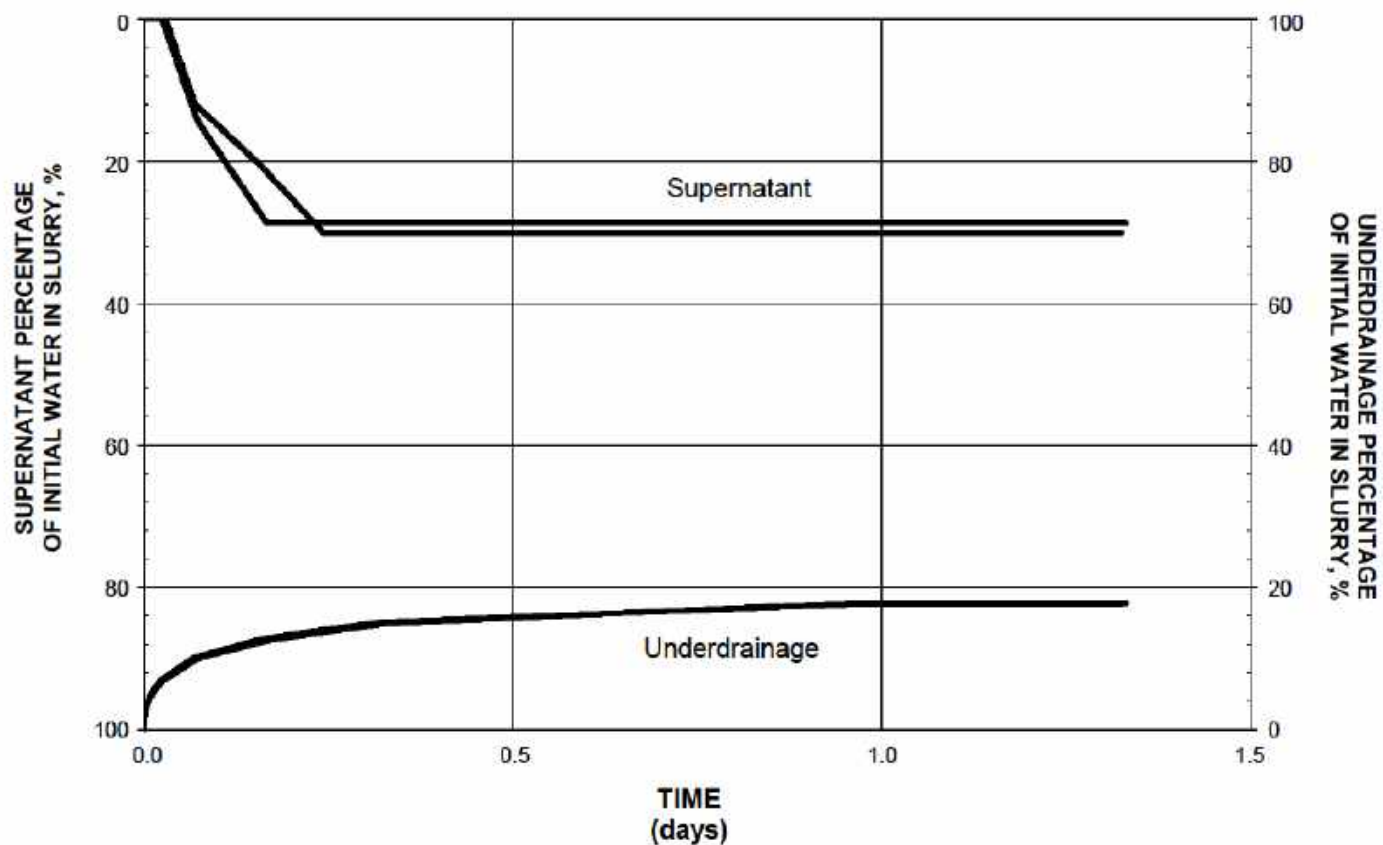
Liquefiable and potentially liquefiable soil limits suggested by USNRC 1985.

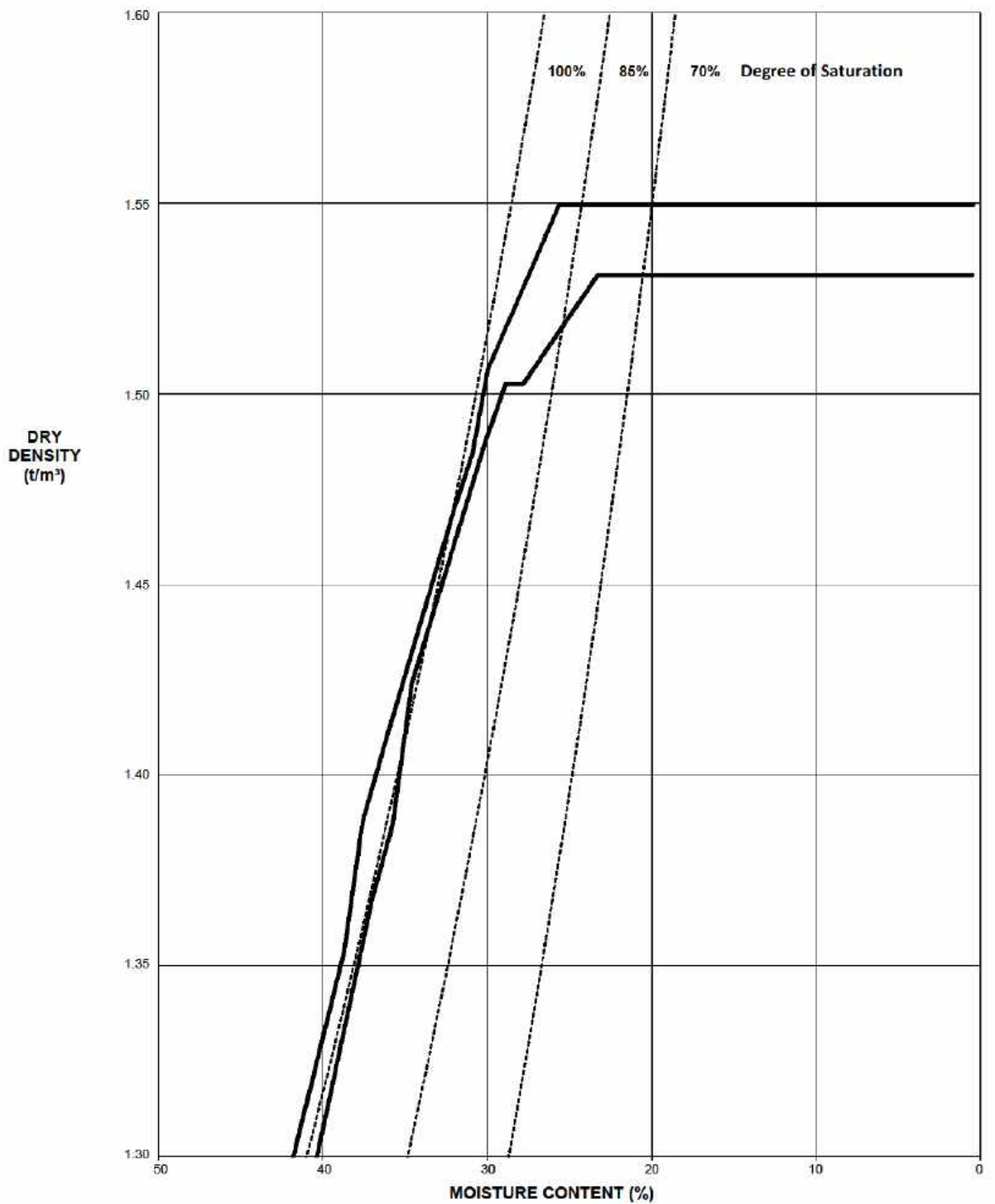
Data obtained from Figure 12.15 and 12.16 of Geotechnical Engineering of Dams, Fell 2005

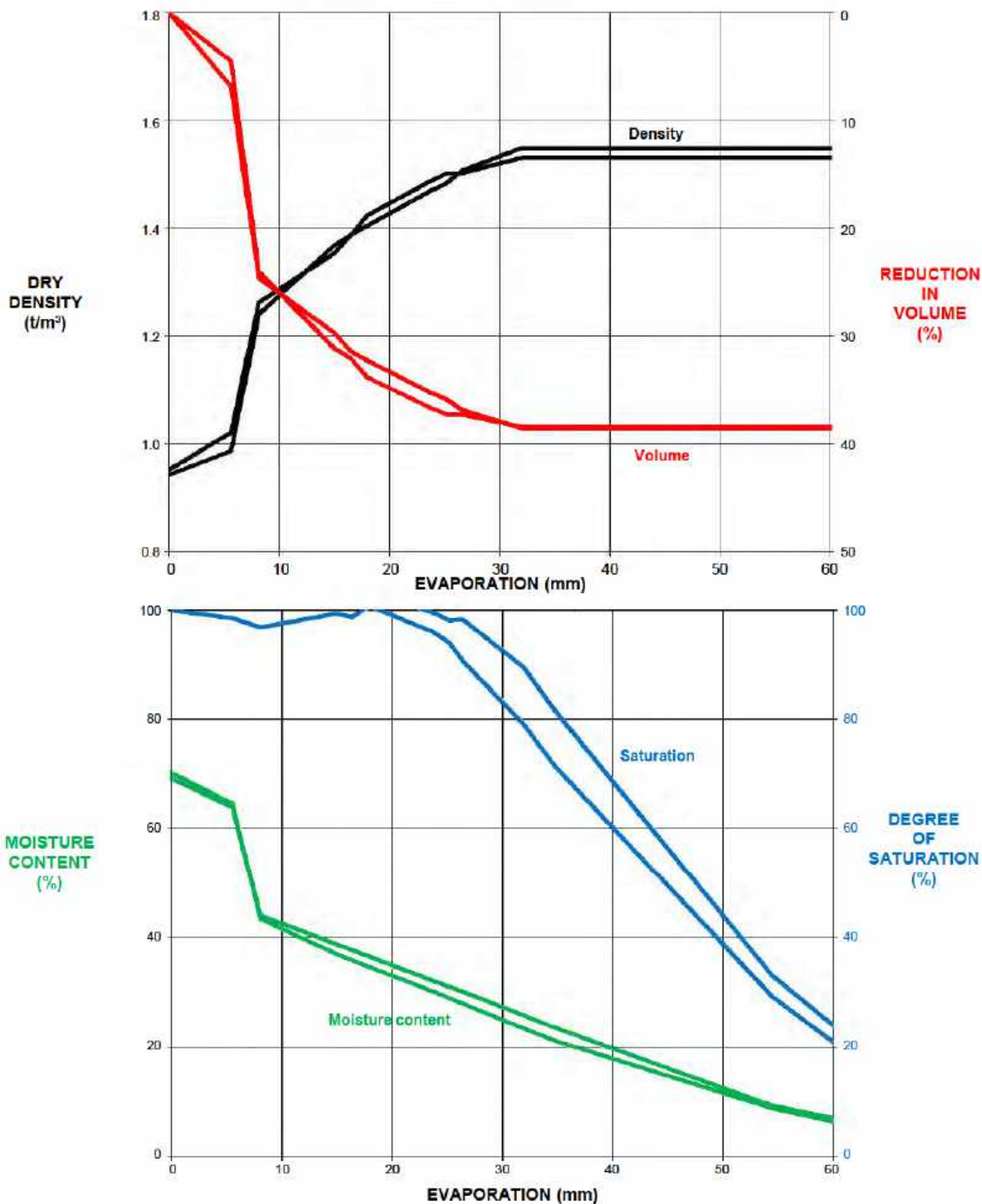
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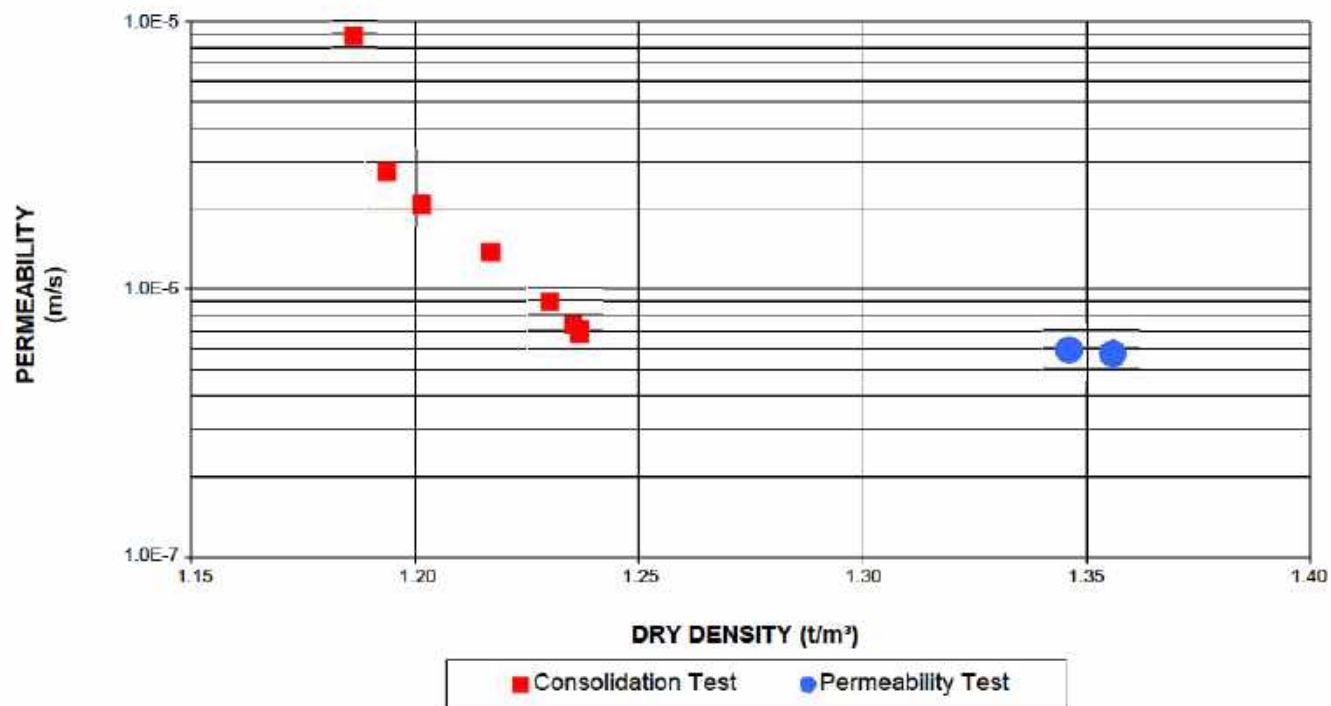
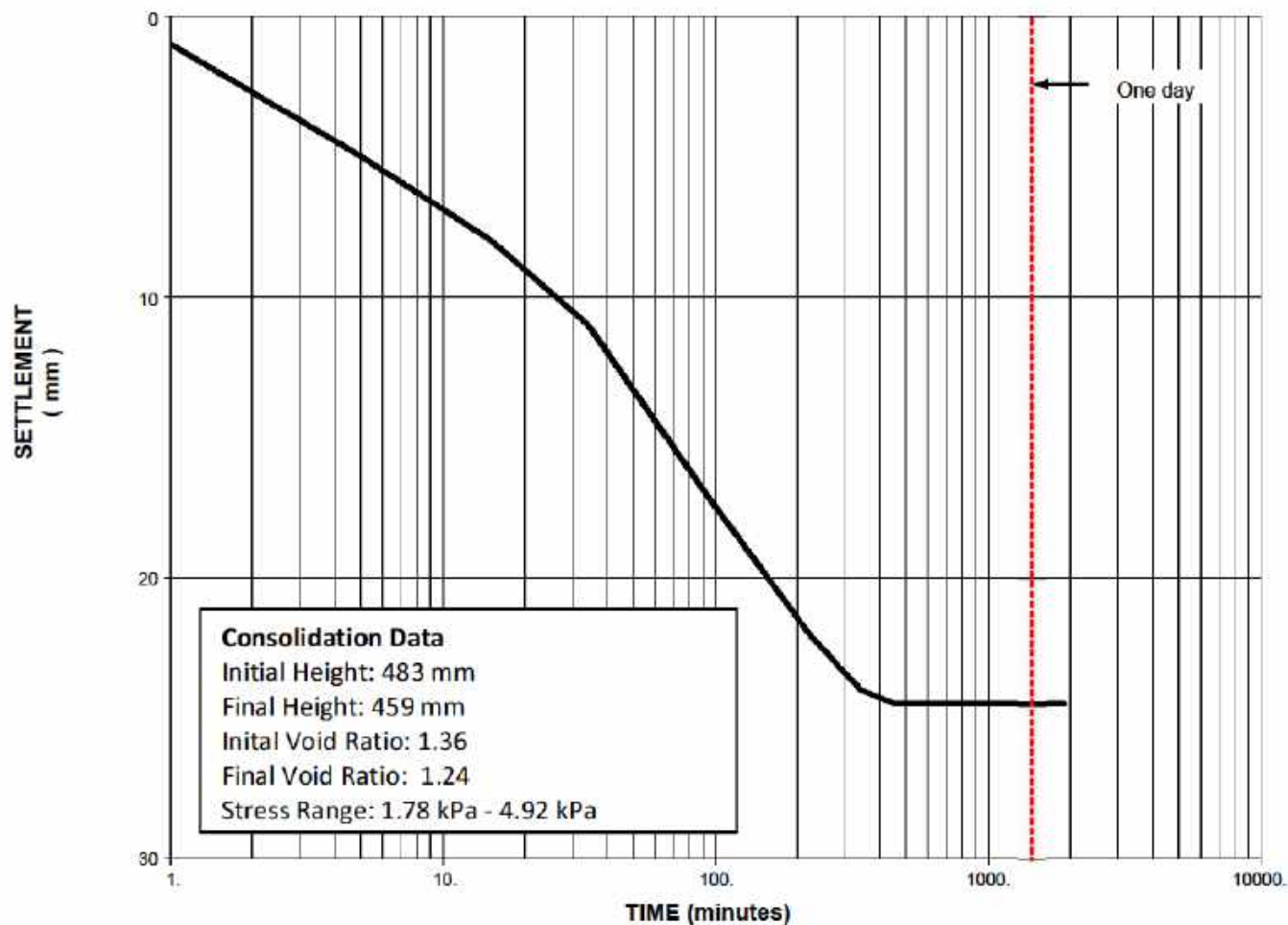
Line 6











APPENDIX A

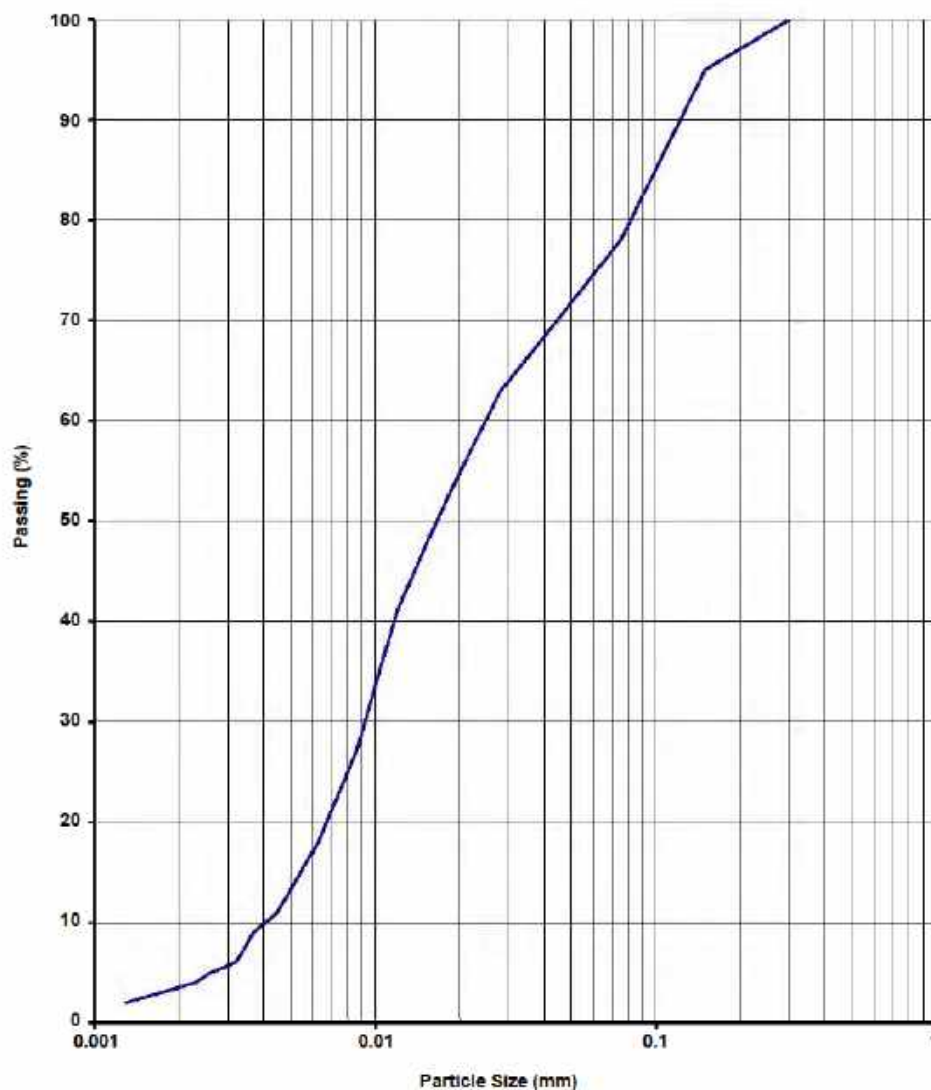
Trilab Results

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.3, 3.5.1

Client	Knight Piesold Pty Ltd Level 1	Report No.	P 18070032-G
Address	184 Adelaide Terrace, EAST PERTH WA 6004		
Project	PE801-296 Thunderbox	Test Date	6/07/2018
		Report Date	16/07/2018
Client ID	Thickener Underflow - Sample Thunderbox Operations	Depth (m)	Not Supplied

Sieve Size (mm)	Passing %
150.0	
75.0	
53.0	
37.5	
26.5	
19.0	
9.5	
4.75	
2.36	
1.18	
0.600	
0.425	
0.300	100
0.150	95
0.075	78
0.054	73
0.039	68
0.028	63
0.021	56
0.016	49
0.012	41
0.009	27
0.006	18
0.005	11
0.004	9
0.003	6
0.003	5
0.002	4
0.001	2



NOTES/REMARKS:

Moisture Content 74.8%
Sample/s supplied by the client

-2.36mm Soil Particle Density(t/m^3) 2.77

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Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Perth Laboratory

Authorised Signatory



Laboratory No. 9926

The results of calibrations and tests performed apply only to the specific instrument or sample at the time of test unless otherwise clearly stated.

Reference should be made to Trilab's "Standard Terms and Conditions of Business" for further details.

Trilab Pty Ltd ABN 25 065 630 506



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ATTERBERG LIMITS TEST REPORT

Test Method: AS 1289 2.1.1, 3.8.1, 3.9.2, 3.2.1, 3.3.1, 3.4.1

Client	Knight Piesold Pty Ltd Level 1	Report No.	P 18070032-AL
Address	184 Adelaide Terrace, EAST PERTH, WA 6004		
Project	PE801-296 Thunderbox	Test Date	11/07/2018
		Report Date	18/07/2018

Sample No.	18070032
Client ID	Thickener Underflow - Sample Thunderbox Operations
Depth (m)	Not Supplied
Liquid Limit (%)	52
Plastic Limit (%)	26
Plasticity Index (%)	6
Linear Shrinkage (%)	7.0
Moisture Content (%)	71.8

Sample No.	
Client ID	
Depth (m)	
Liquid Limit (%)	
Plastic Limit (%)	
Plasticity Index (%)	
Linear Shrinkage (%)	
Moisture Content (%)	

Test Method: AS 1289 2.1.1, 3.8.1, 3.9.2, 3.2.1, 3.3.1, 3.4.1

Samples supplied by the client

* Cracking occurred

+ Curing occurred

Page 1 of 1 REP0001

Accredited for compliance with ISO/IEC 17025 - Testing
The results of the tests, calibrations, and/or measurements included in
this document are traceable to Australian/National Standards

Authorised Signatory
Authorised Signatory

Tested at Triblab Perth Laboratory

Laboratory No. 8925

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Triblab Pty Ltd ABN 25 065 610 526

APPENDIX E
TSF Expansion Seepage Assessment

APPENDIX E –SEEPAGE MODELLING

E.1 GENERAL

A seepage modelling has been carried out to estimate the phreatic surfaces and evaluate the seepage into the TSF embankment and foundation, for a steady state condition.

Transient modelling requires time dependent inputs, including the detailed schedules of construction and tailings depositions etc, to predict the phreatic surface changes with the construction and deposition activities. At this stage, the detailed schedules have not be confirmed, the transient modelling will thus be carried out in a later stage after confirmation of these schedules.

E.2 EMBANKMENT GEOMETRY

The assumptions made in the modelling are as follows:

- The TSF embankment is a reasonably homogeneous earth fill dam constructed of Zone A low-permeability fill.
- The basin preparation consists of:
 - natural ground area soil lined, and
 - partial basin treatment and underdrainage installed.

Stage 1 and Stage 2 will be constructed using a downstream method with a 1V:2H upstream embankment slope and 1V:2.75H downstream embankment slope. Stages 3 to 6 will be raised using upstream techniques on compacted tailings. The total embankment height is approximately 22 m at Stage 6. The typical cross section is shown in Drawing No 801-296-D3000-302 and the crest level at each stage is indicated on Drawing No 801-296-D3000-301.

The pond is assumed to be 300 m away from the embankment. The seepage models for Stage 1 and Stage 6 are shown in figures E.1 and E.2, respectively.

E.3 GROUND CONDITIONS

The subsurface conditions and layer thickness in the foundation materials are based on the materials identified in the site investigations. The ground subsurface profile comprise:

- Top Soil Layer –Sandy Clay with an average thickness of 1 m.
- Laterite – clayey gravels with an average thickness of 3.5 m.

- Residual Soil (XW BIF/Sandstone recovered as silty clay with an average thickness of 12 m.
- BIF (Distinctly weathered).

The natural groundwater table was assumed at a depth of approximate 27 m below natural ground surface (BGS) based on 2021 site investigation.

E.4 MATERIAL PARAMETERS

The parameters adopted for seepage modelling are summarised in Table E.1 based on the geotechnical investigation (Ref. E2). Reduced hydraulic conductivities were used for partially saturated materials as air trapped in the pore spaces would impede the flow.

Table E.1: Adopted Permeability for Seepage modelling

Material Type	Permeability (m/s)
Zone A	1.0×10^{-08}
Zone C	5.0×10^{-06}
Sandy clay (Top Soil)	1.0×10^{-07}
Laterite (Ferricrete)	5.0×10^{-07}
Sandy Silt/Sandy Clay (Residual Soil, XW BIF/Metasediment Rock)	1.0×10^{-08}
BIF	6.0×10^{-08}
Tailings	8.0×10^{-08}

The horizontal hydraulic conductivity values (k_h) used in the analyses for the proposed embankment fills and in-situ soils are based on field logging and laboratory tests as well as typical hydraulic conductivities of similar soils.

E.5 CASES MODELLED

To assess the basin drains and embankment toe drain impact on the phreatic surfaces, the following two cases were modelled:

- Design Case (all drainage operational).
- Embankment drainage and basin drainage not operational.

E.6 RESULTS

The seepage flux through the basin is summarised in Table E.2 and the phreatic surfaces within the facility are graphically shown in figures E.3 to E.5.

Table E.2: Seepage through basin

Stage	Cases	Flux (Liter/Ha/day)
Stage 1	Drains operational	1.6
	Drains not operational	
Stage 6	Drains operational	2.0
	Drains not operational	

As the ground water is 27 m below the existing ground surface, and the pond is ~ 300 m away from the embankment, the modelling results indicates that there will be no seepage through the embankment.

In the steady state condition, the effectiveness of the basin and toe drains appear not to have significant impact on the phreatic levels and seepage to the embankment due to the low ground water table and pond being far away from the embankment. However, these drains will be effective to lower the phreatic levels in the tailings during operation. This can be assessed after geotechnical investigation including CPT tests have been carried out in the deposited tailings at various stages.

E.7 SUMMARY

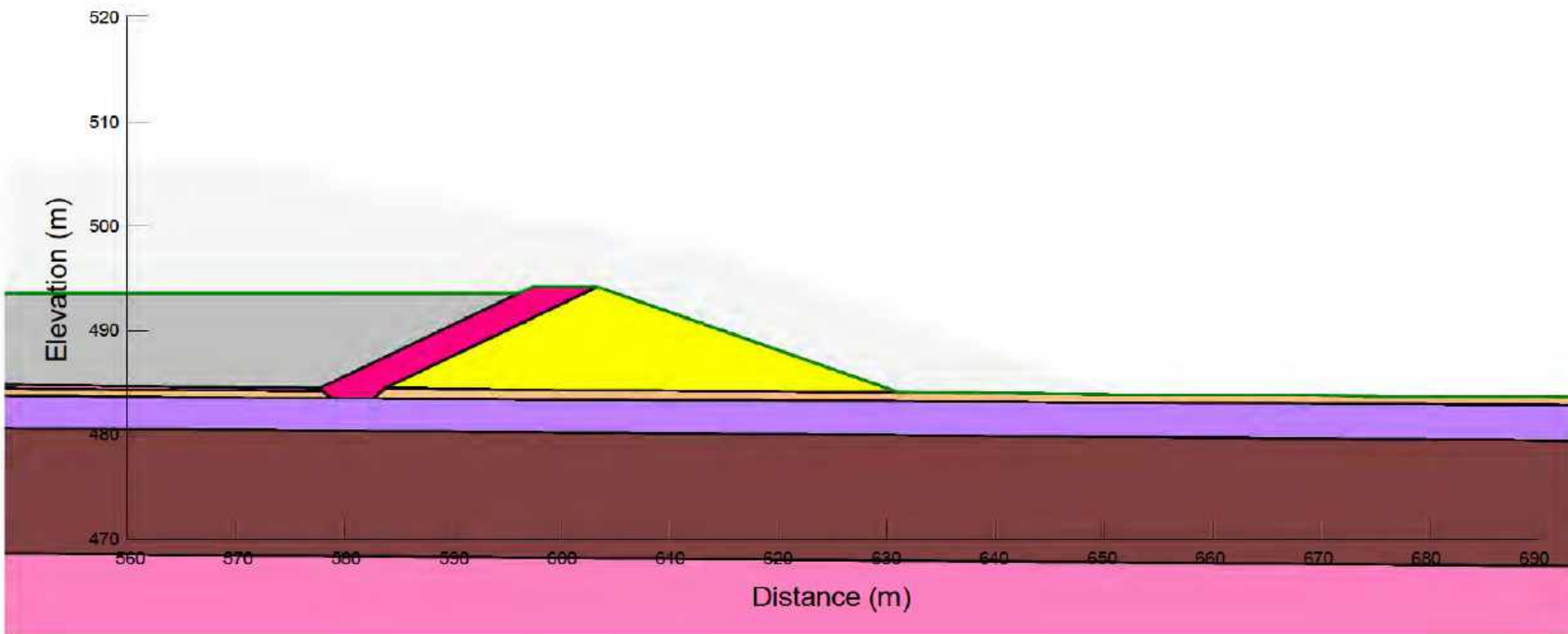
Based on the seepage modelling for the steady state condition, the estimated phreatic surfaces will be under the embankment, and there will be very little seepage into the embankment. It is recommended to carry out the following further work:

- Transient modelling to estimate the phreatic levels during operation after confirmation of the detailed schedules of construction and tailings deposition.
- Geotechnical investigation including CPT tests to confirm the following:
 - Properties of the constructed embankment.
 - Tailings properties.
 - Phreatic levels.
- Update of this seepage analysis after the geotechnical investigation.

E.8 REFERENCES

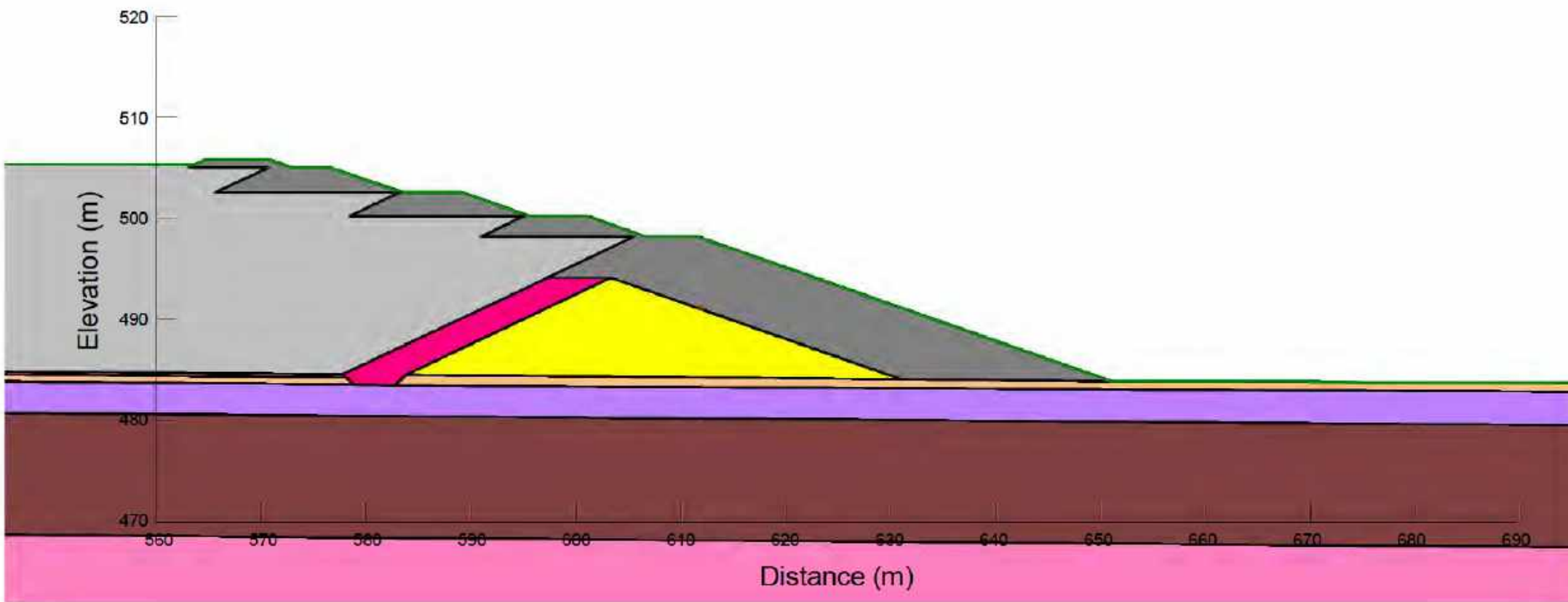
- E1. GEO-SLOPE International Ltd., "SEEP/W", 2007.
- E2. Knight Piésold Pty Ltd., TSF CELL C SITE GEOTECHNICAL INVESTIGATION, PE20-01642, December 2020.

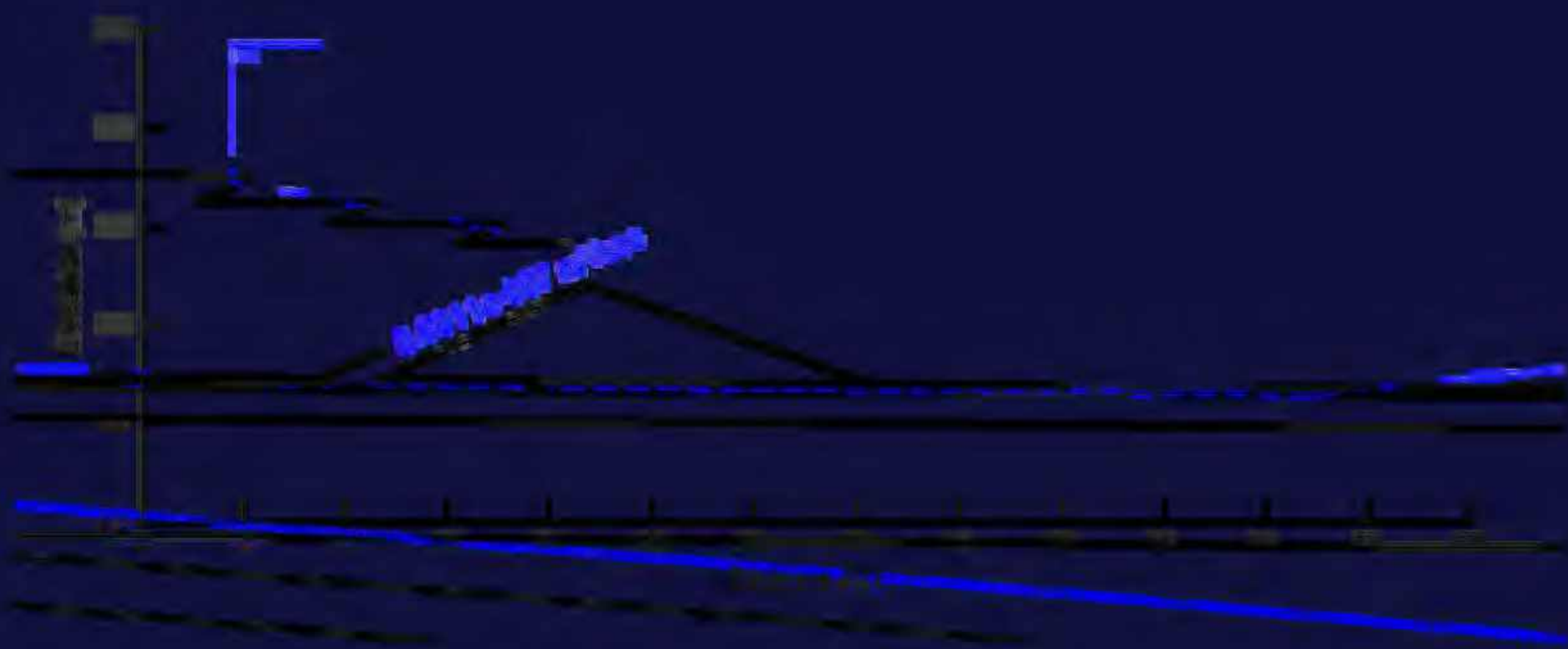
APPENDIX E - FIGURES





THUNDERBOX GOLD PROJECT
CELL C AND CELL D SEEPAGE
STAGE 1 SEEPAGE





THUNDERBOX GOLD PROJECT
CELL C AND CELL D SEEPAGE
STAGE 6 SEEPAGE

APPENDIX F
TSF Expansion Stability Assessment

APPENDIX F STABILITY ASSESSMENT

F.1 INTRODUCTION

The stability assessment of the Tailings Storage Facility (TSF) was undertaken according to ANCOLD guidelines (Ref. F1) which recommends that the evaluation of stability be performed using long-term, short-term and post-seismic loading conditions. The recommended minimum factors of safety are summarized in Table F.1.

Table F.1: Recommended Minimum Factors of Safety

Loading Condition	Minimum FOS
Long-term drained	1.5
Short-term undrained (potential loss of containment)	1.5
Short-term undrained (no potential loss of containment)	1.3
Post-seismic	1.0 – 1.2

A limit equilibrium programme developed by GEO-SLOPE International Ltd “SLOPE/W” (Ref. F2) was used for the stability analysis. SLOPE/W calculates the magnitude of the mobilising forces in the embankment slope and compares them to the resisting forces which are a function of the shear strength of the soil structure. The ratio of the resisting to the mobilising forces is the factor of safety. When the destabilising forces are equal to the strength of the structure this ratio (the factor of safety) is equal to one and the embankment is said to be “just stable”. As the factor of safety increases, the probability of an embankment failure is reduced.

F.2 MODELLING PARAMETERS

The ground subsurface profile is the same as that presented in Appendix F. The index and shear strength properties for the sub-surface materials beneath the TSF are based on materials identified in the site investigation (Ref. F3) and typical values for similar materials published in literature. The model geometry is the same as for seepage analysis. Figures F.1 and F.6 shows the models for Stage 1 and Stage 6 embankment configurations respectively. The shear strength parameters of materials assumed for the long-term, short-term, and post-seismic assessments are listed in tables F.2 to F.5.

Table F.2: Assumed Static Shear Strength Parameters (Long-Term Condition)

Material	γ_{moist} (kN/m ³)	c' (kPa)	ϕ (deg)
Tailings	16	0	32
Zone A	19	5	28
Zone C	19	5	28
Sandy clay (Top Soil)	19	5	28
Laterite (Ferricrete)	21	5	30
Sandy Silt/Sandy Clay (Residual Soil, XW BIF/Metasediment Rock)	20	20	25
BIF	23	100	35

Table F.3: Assumed Undrained Shear Strength Parameters (Short-Term Condition)

Material	γ_{moist} (kN/m ³)	Tau/Sigma ratio	Minimum shear strength (kPa)
Tailings	16	0.25	0
Sandy Silt/Sandy Clay (Residual Soil, XW BIF/Metasediment Rock)	20	0.3	80

Table F.4: Assumed Post-Seismic Undrained Shear Strength Parameters

Material	γ_{moist} (kN/m ³)	Tau/Sigma ratio	Minimum shear strength (kPa)
Tailings	16	0.05	0
Sandy Silt/Sandy Clay (Residual Soil, XW BIF/Metasediment Rock)	20	0.24	64

The materials in Zone A and C are assumed to be compacted to 95% SMDD which will be in a medium dense and stiff consistency with dilative behaviour, the undrained shear strengths would be higher than the drained strengths. In this analysis, the undrained shear strengths are limited to the drained strengths. Similarly, the foundation materials Laterite (Ferricrete), and BIF are cemented with very dense and stiff consistency, the undrained strengths are capped at the drained strengths.

F.3 CASES MODELLED

The seepage modelling results indicate that the phreatic surface in a steady state condition will be below the embankment base due to low ground water table and the pond being far away from the embankment. During the operation the perched water

level could be higher than that in a steady state condition. Based on the CPT testing in cells A and B, the phreatic surfaces within the tailings would be slightly higher than the original ground level. The stability under this condition was also examined based on a conservative assumption that the phreatic surface at Stage 6 in cell C and D will be the same as that at Stage 9 in cells A and B.

Two cases were analysed for Stage 6 (the final Stage) are as follows:

- Case 1- Phreatic Surface based on Seepage modelling for the steady state condition.
- Case 2- Phreatic Surface at Stage 6 in cells C and D being the same as that at Stage 9 of cells A and B.

F.4 MODELLING RESULTS

The results of stability analyses are summarized in Table F.5 and graphically shown in figures F.2 to F.14.

Table F.5: Summary of TSF Embankment Stability Analysis Results

Stage	Loading Condition	Factor of Safety	
		Case 1	Case 2
Stage 1	Long-term (drained)	1.93	
	Short-term undrained (potential loss of containment)	1.93	
	Short-term undrained (no potential loss of containment)	1.93	
	Post-seismic	1.93	
Stage 6 (Final Stage)	Long-term (drained)	2.20	2.09
	Short-term undrained (potential loss of containment)	1.96	1.73
	Short-term undrained (no potential loss of containment)	1.97	1.73
	Post-seismic	1.73	1.48

The analysis results indicate that the designed TSF embankments from Stage 1 to the final stage (Stage 6) have adequate factors of safety according to ANCOLD guidelines.

F.5 CONCLUSIONS AND RECOMMENDATIONS

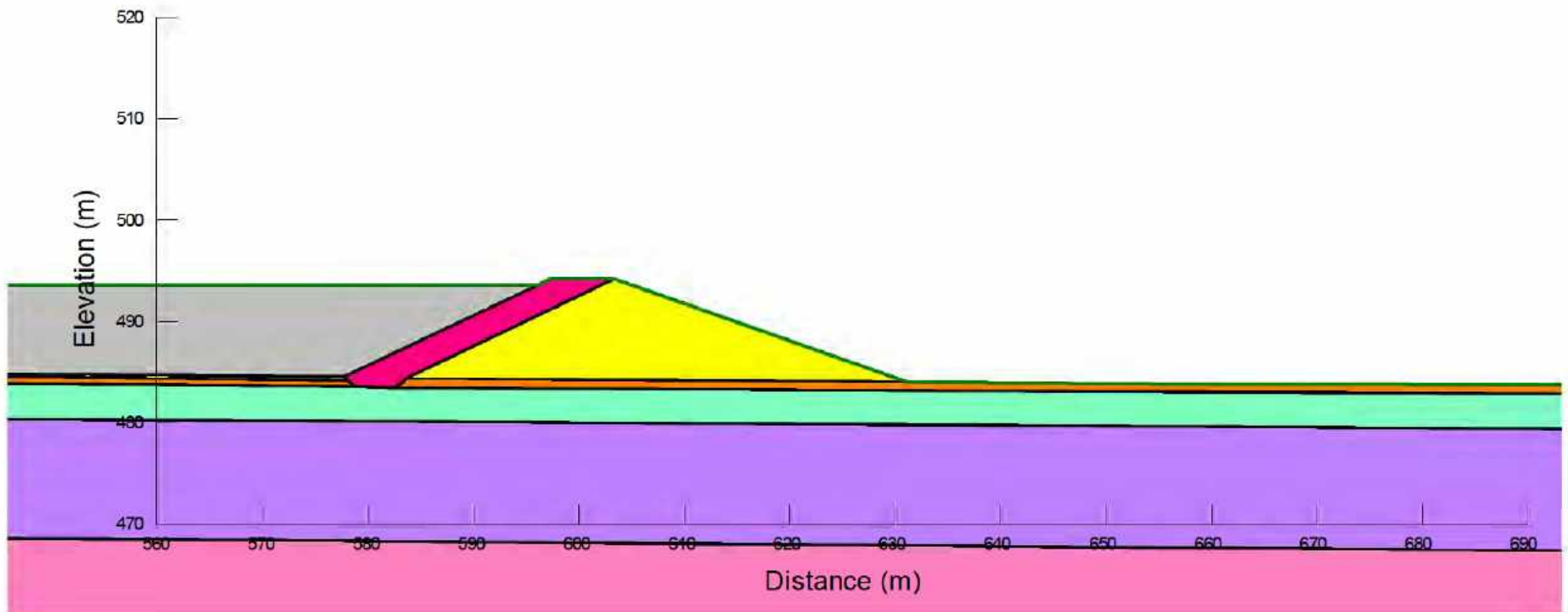
Based on available information and assumptions, the slope stability analysis results indicate that the embankment will have satisfactory factors of safety as per ANCOLD guidelines. It is recommended to carry out the following further work:

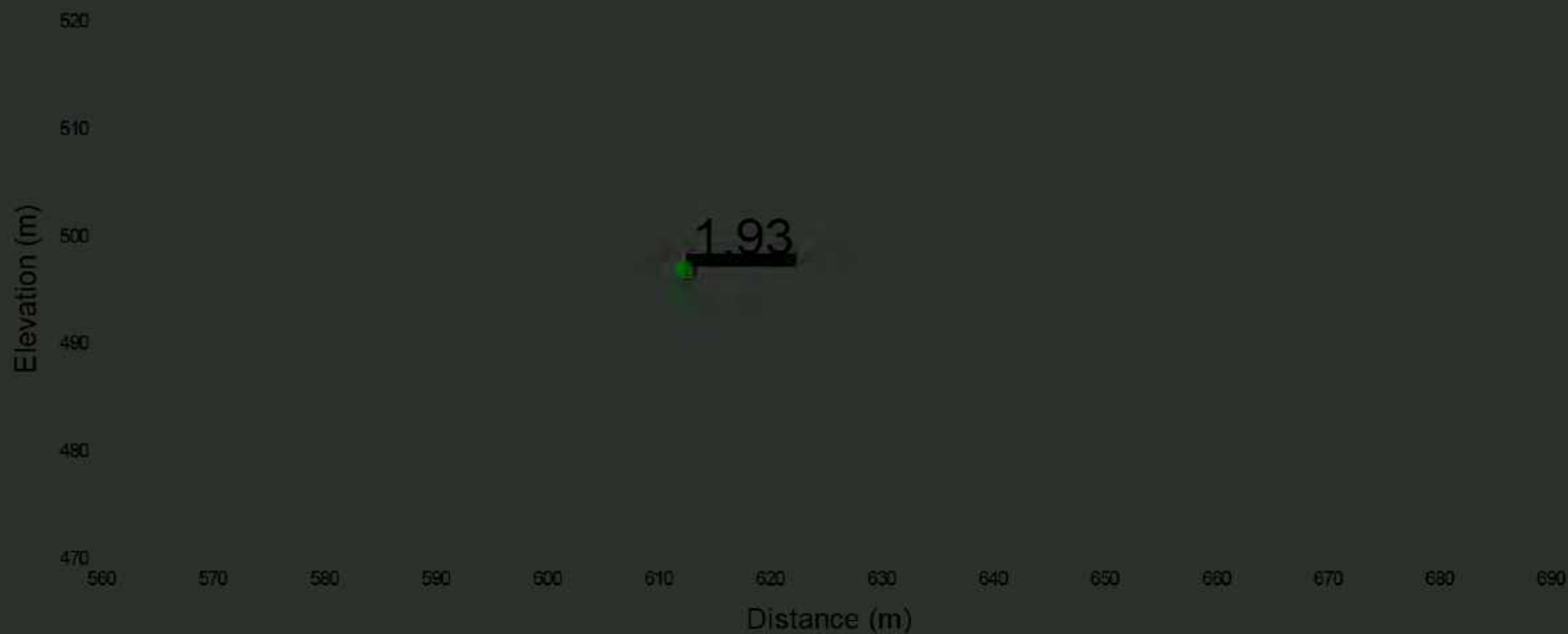
- Geotechnical investigation including CPT tests to confirm the following:
 - Properties of the constructed embankment.
 - Tailings properties.
 - Phreatic levels.
- Update of this analysis after the geotechnical investigation.
- Update the TSF design based on the investigation and stability analysis results.

F.6 REFERENCES

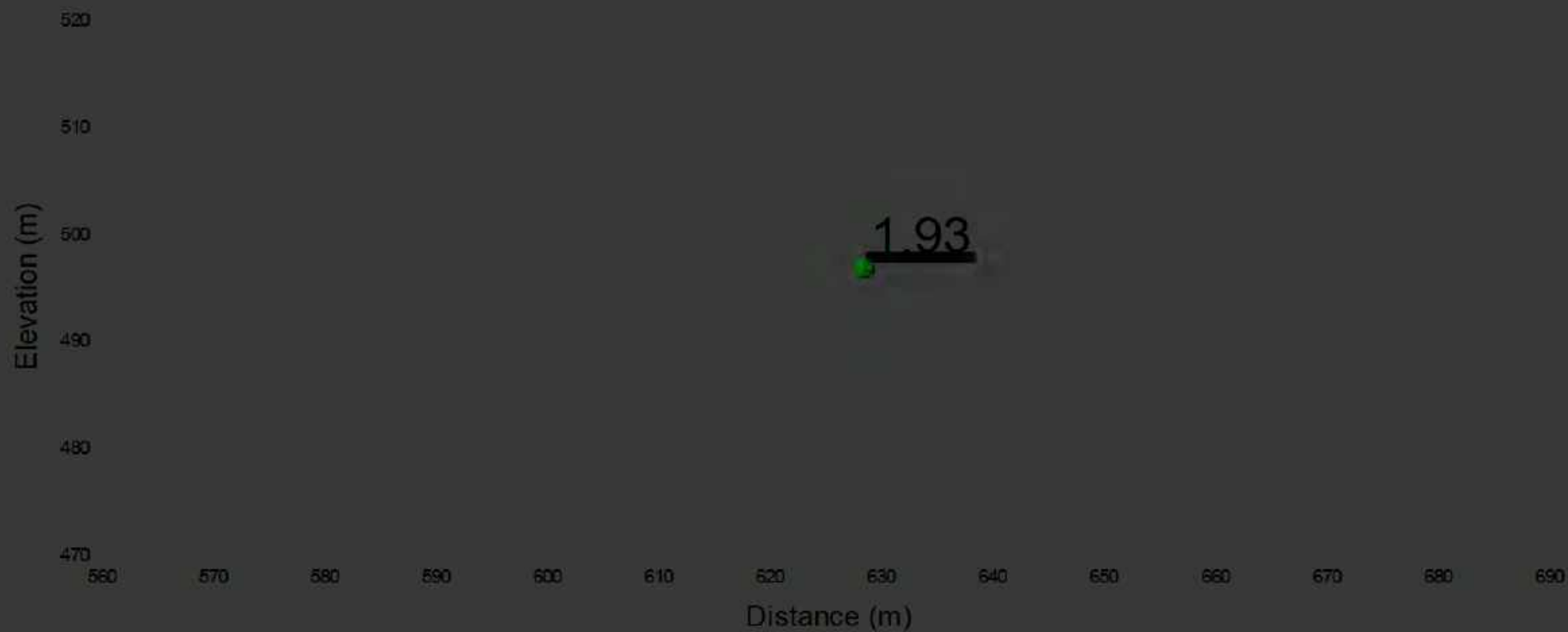
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APPENDIX F – FIGURES

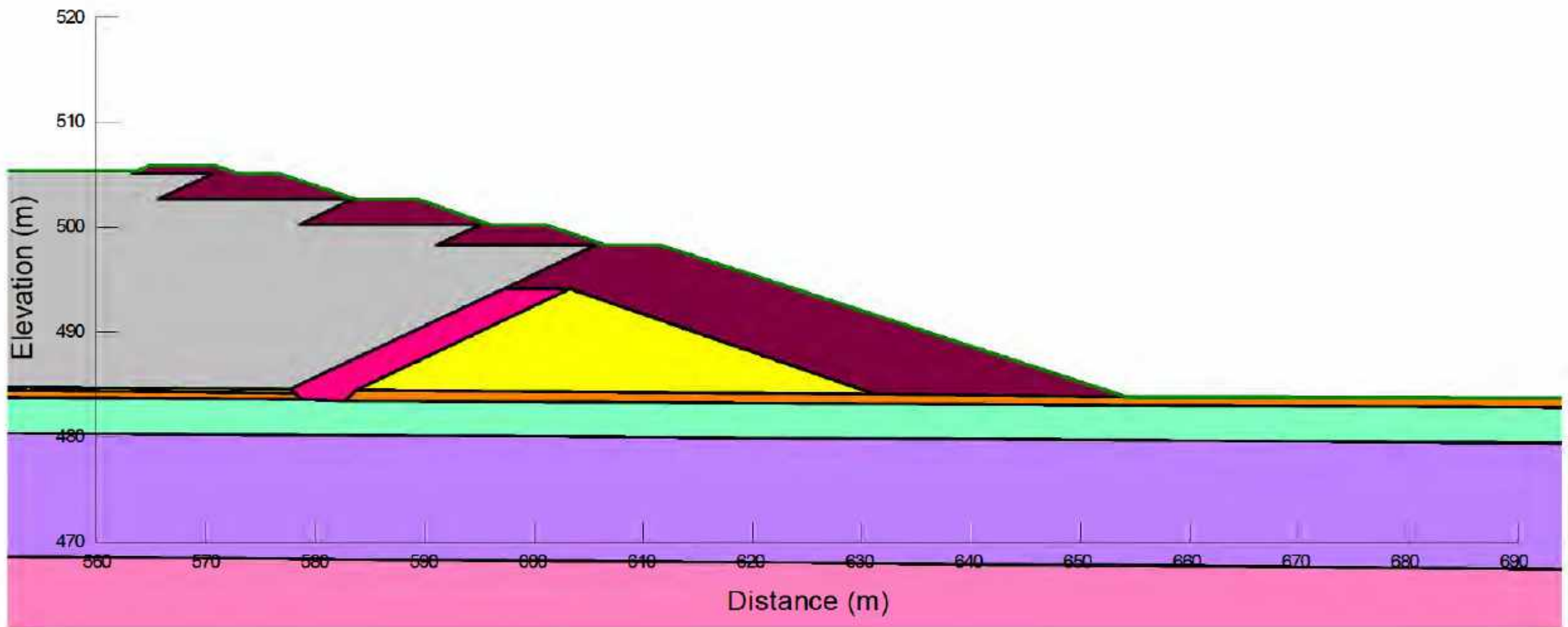


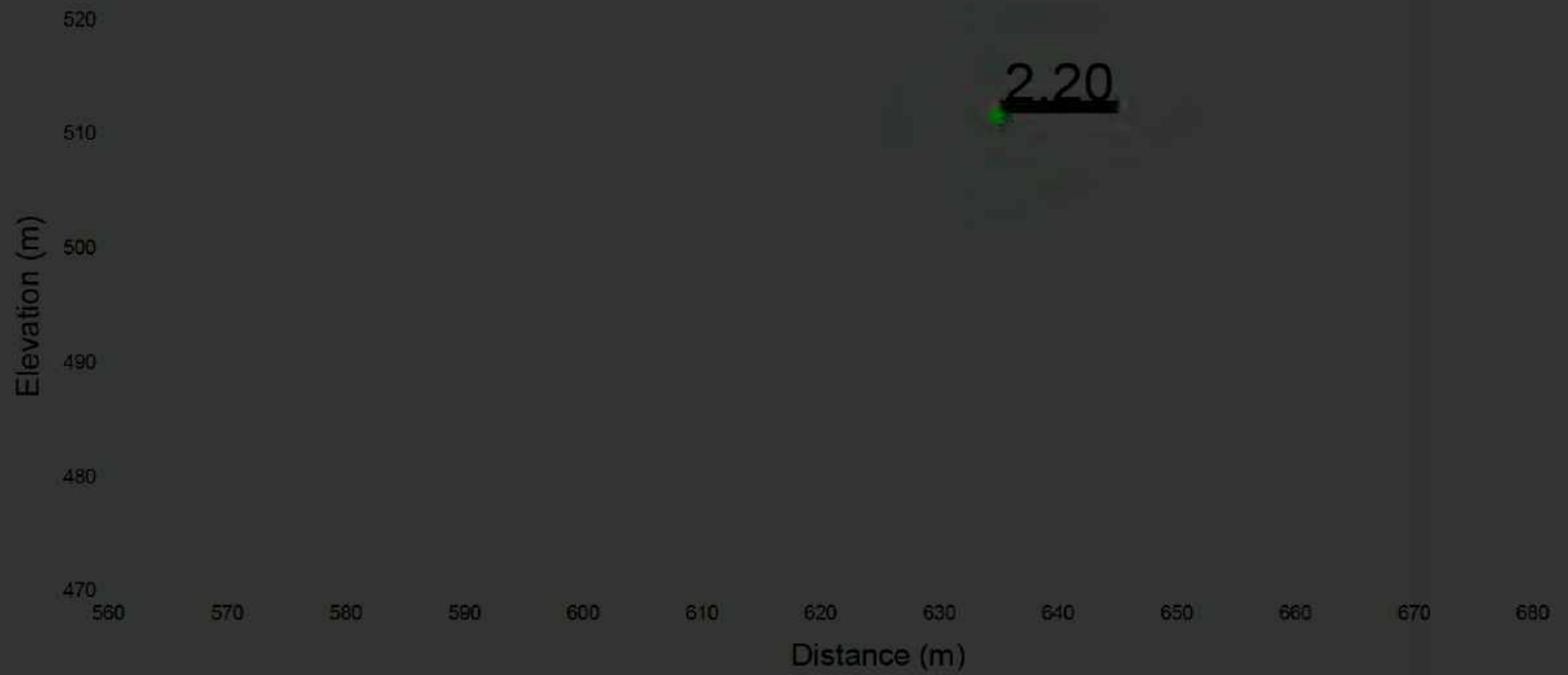


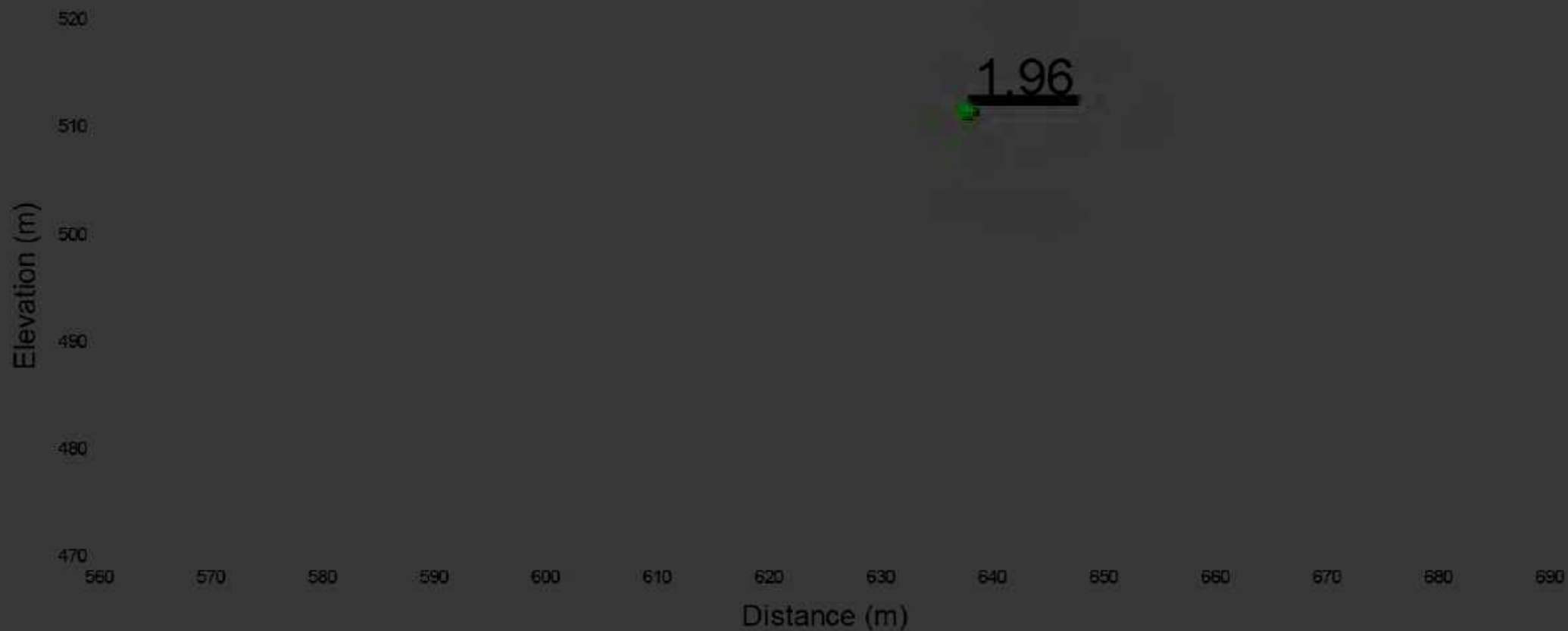


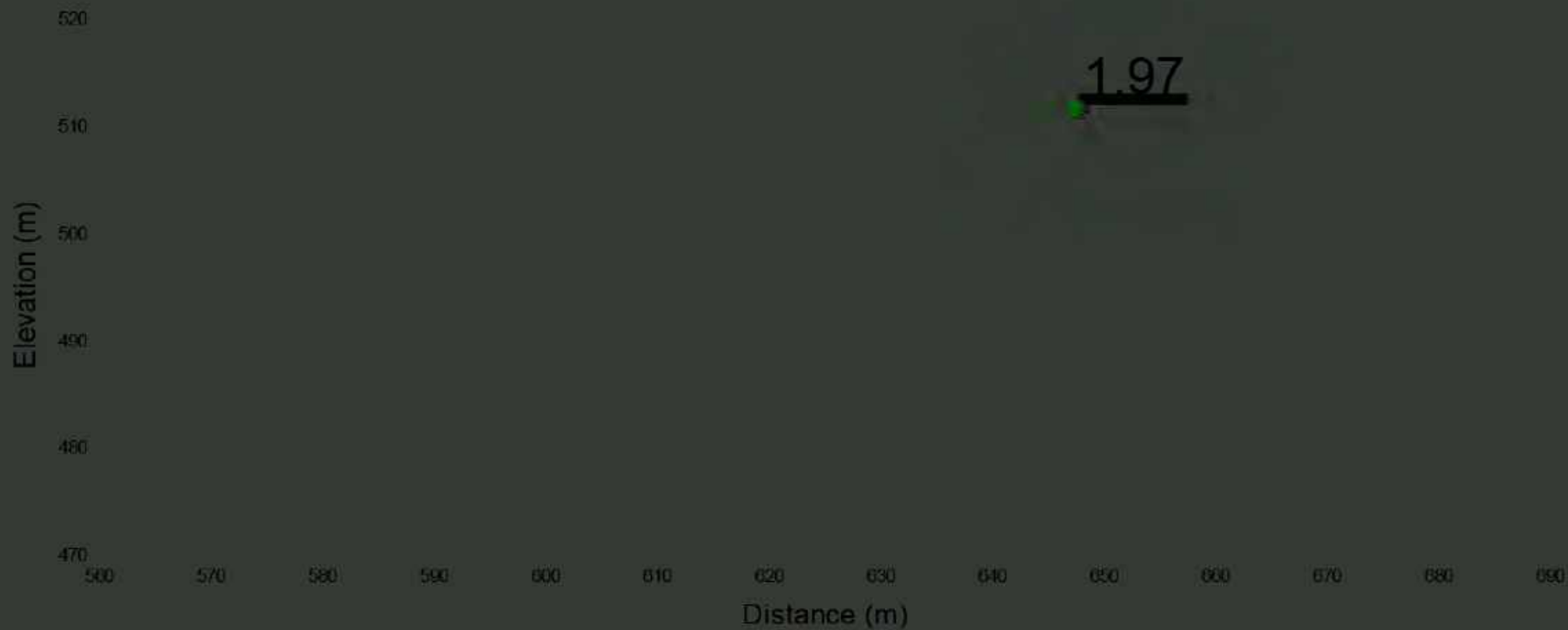


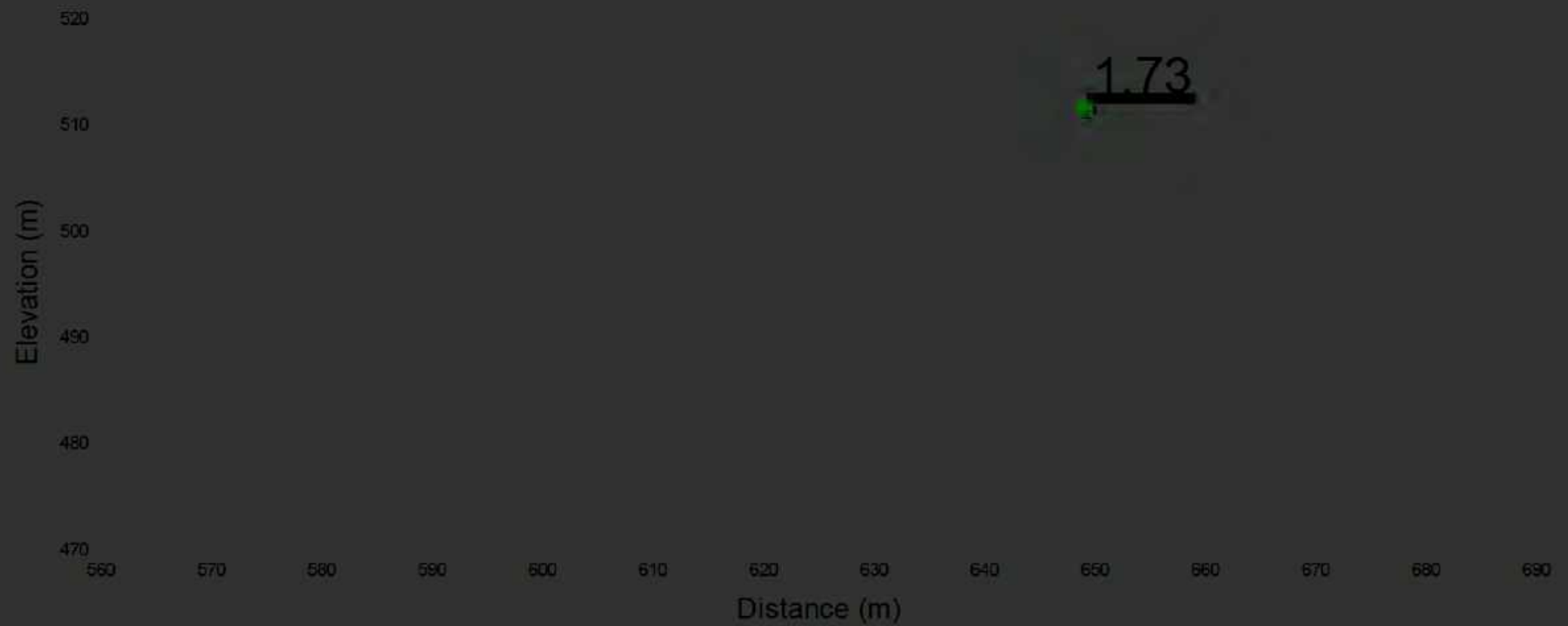


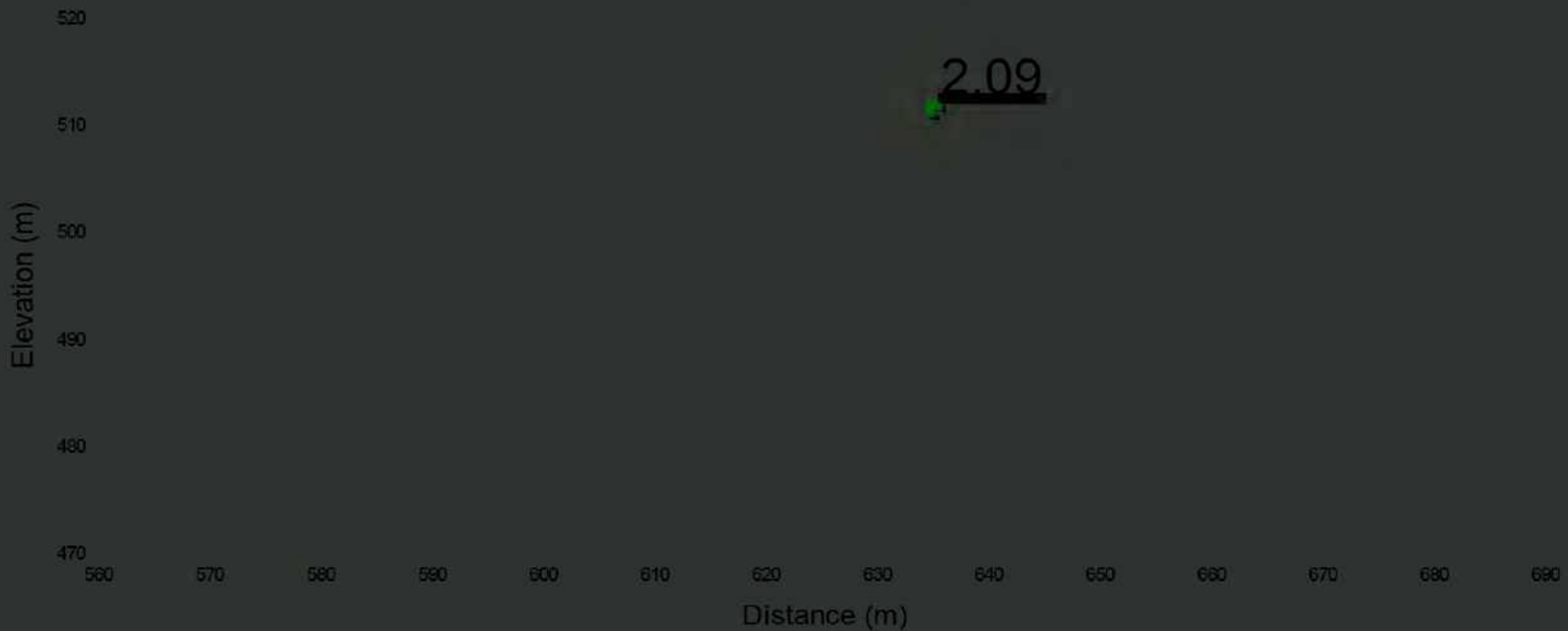


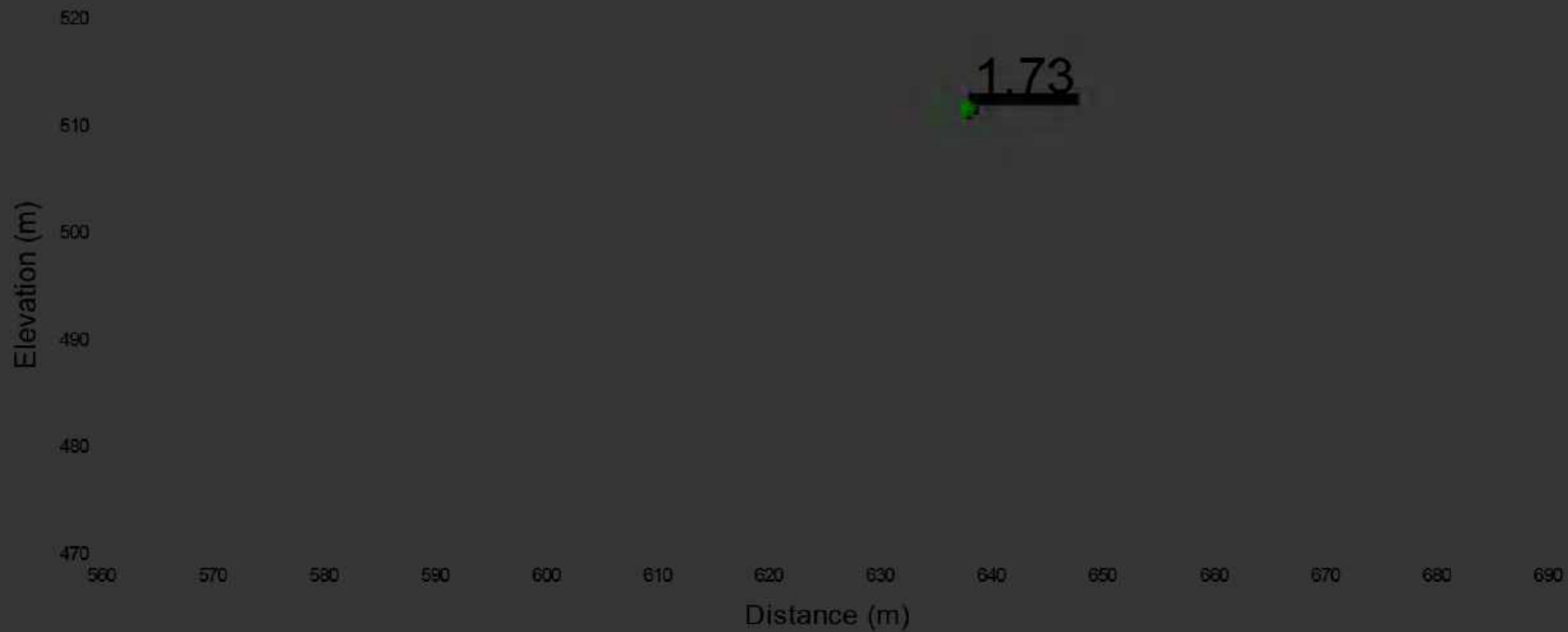


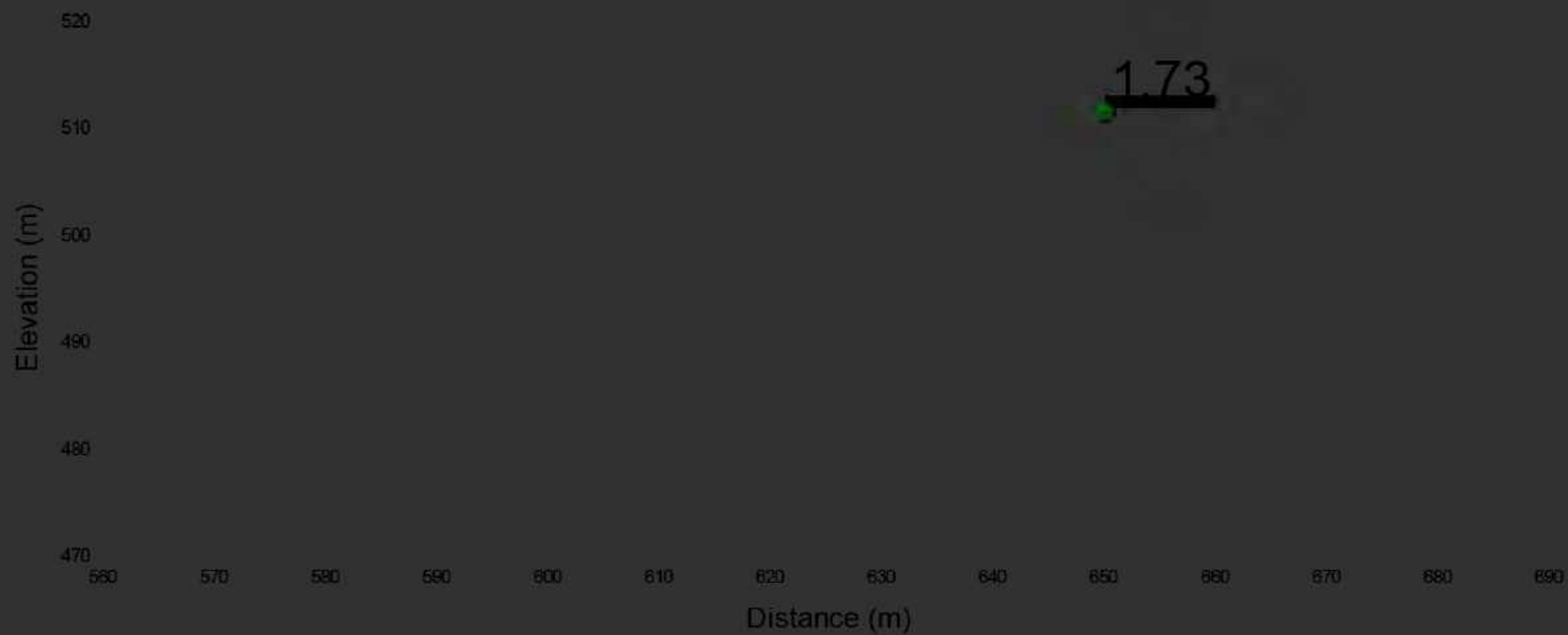


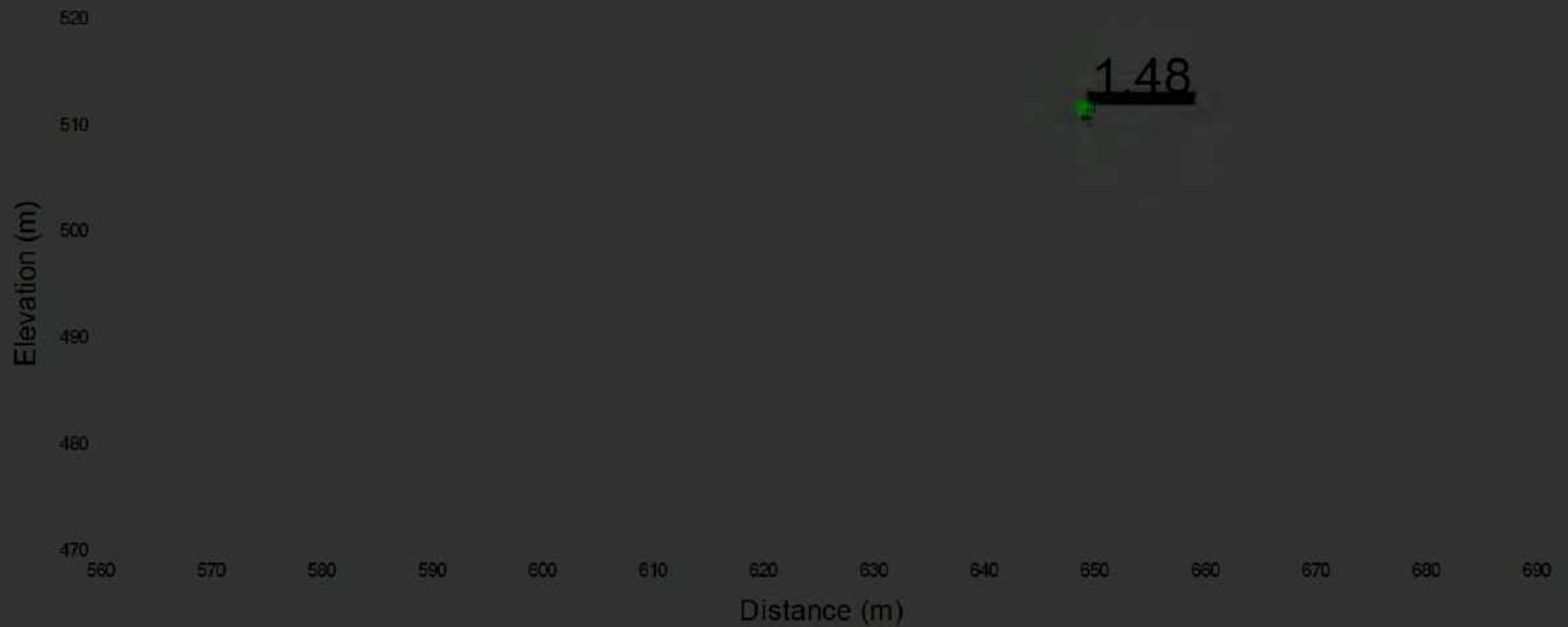














10 Water Studies for TSF Cells C and D (Attachment 8D)

Northern Star Resources Limited

Water studies for TSF Cells C and D

North Eastern Goldfield Operations -
6 Mtpa Expansion Project

Northern Star Resources Limited

Water studies for TSF Cells C and D

North Eastern Goldfield Operations -
6 Mtpa Expansion Project

2303 | Rev 0
2 August 2021

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REVISION	ISSUED	DESCRIPTION
Rev 0	2 August 2021	Issued for Client review

EXECUTIVE SUMMARY

The Thunderbox mine and Gold Processing Plant lie 90 km north of Leonora along the Goldfields Highway. Northern Star is now seeking to double the throughput capacity of the Plant from 2.9 Mtpa to 6.0 Mtpa from June 2022 over a projected 10 year life of mine.

The Thunderbox Processing Plant produces slurry waste, which is discharged to the nearby Thunderbox Tailings Storage Facility. The TSF currently has two circular integrated tailings cells, Cell A and Cell B. The Expansion Project includes provision to build two additional cells, Cell C and Cell D, to complement the existing cells.

The numerical groundwater model of the mine area was successfully calibrated to replicate two different calibration targets, the observed water levels at a limited number of observation bores at the vicinity the TSF and the pit, and the average flow rates towards the pit sumps over the last five years. In addition, analytical surface water analysis based on the Manning's and Rational methods has been used to assess and design appropriate surface water management around the TSF.

The findings of these combined surface and groundwater investigations regarding the cumulative impacts and recommended water design considerations for TSF Cells C and D at Thunderbox are as follows:

- natural catchment runoff from above the Thunderbox mine will need to be diverted around the northern boundary of the new TSF cell. Given the proximity of the Goldfields Highway, a diversion channel will be constructed in this area to minimise the risk of inundating the highway during large storm events;
- Knight Piesold (2021) predicted the possibility of TSF seepage through the toe of the TSF walls. For this purpose, a 0.5 m deep toe drain will be constructed around the perimeter of the TSF to intercept and manage any seepage loss;
- an engineered berm will be constructed between the toe drain and the diversion channel on the northern boundary of the TSF to ensure that there is minimal mixing between the different water qualities in the two drains;
- Base case numerical model simulations suggest that by the time the TSF reaches its full height, the water table beneath the TSF walls may rise by up to 10 m, which would bring it within 5 m of the ground surface, which is about 480 mAHD. While the mounding effects diminish with distance away from the TSF wall, discernible water table mounding of up to 0.5 m may extend up to several kilometres from the TSF;
- despite the apparent extensive water table mounding, particle track modelling shows that groundwater migration from the TSF through the saprolite weathering profile would be slow. So much so that by the end of the 10 year life of mine, seepage from the TSF would have travelled less than a kilometre from the TSF;
- groundwater modelling shows that seven (7) interception wells around the periphery of the TSF would be an effective solution to mitigate water table mounding and contain leakage at a small distance from the TSF, without affecting the regional groundwater regime, both in terms of quality and quantity.

In summary, provided TSF Cell C and Cell D are constructed with the proposed engineered surface water and groundwater provisions in this report, Pennington Scott can foresee no unacceptable social or environmental factors that would preclude the grant of Works Approval for the project.

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1. INTRODUCTION

Northern Star Resources Limited (**Northern Star**) formed after the merger of Northern Star Resources and Saracen Metals Pty Ltd in February 2021. As part of the merger, the North Eastern Goldfields Operations (**NEGO**), including the Thunderbox, Bannockburn and Kailis gold mines and all associated Groundwater Licences are now operated and owned by Northern Star.

The Thunderbox mine and Gold Processing Plant lie 90 km north of Leonora along the Goldfields Highway. Northern Star is now seeking to double the throughput capacity of the Plant from 2.9 Mtpa to 6.0 Mtpa from June 2022 over a projected 10 year life of mine, referred to hereinafter as **the Expansion Project**. The Thunderbox Processing Plant produces slurry waste, which is discharged to the nearby Thunderbox Tailings Storage Facility (**TSF**). The TSF currently has two circular integrated tailings cells, Cell A and Cell B. The Expansion Project includes provision to build an additional two cells, Cell C and Cell D (**Figure 1-1**). The cumulative environmental concerns arising from construction of the additional TSF Cells are:

- All tailings storage facilities experience some vertical infiltration water loss to the underlying groundwater system. These losses need to be quantified and managed to ensure that there is no unacceptable offsite groundwater migration of TSF water or localised water logging due to groundwater mounding;
- Knight Piesold (2021) anticipate that there will be horizontal seepage losses through the toe of the TSF wall. This seepage needs to be intercepted and managed to ensure that it does not with natural catchment runoff;
- natural catchment runoff from above the Thunderbox mine will need to be diverted around the northern boundary of the new TSF cell. Given the proximity of the Goldfields Highway, the diversion will require special design considerations to ensure that the highway is not inundated during large storm events; and
- water in the toe drain and catchment diversion must be separated to prevent mixing of different water qualities.

Pennington Scott (Groundwater Consultants) has been engaged to undertake to undertake hydrological and hydrogeological studies for the Expansion Project's Works Approval and Mining Proposal.

The contained document is a surface water and groundwater analysis of likely impacts and recommended mitigation strategies for a proposal to add two additional TSF Cells at NEGO.

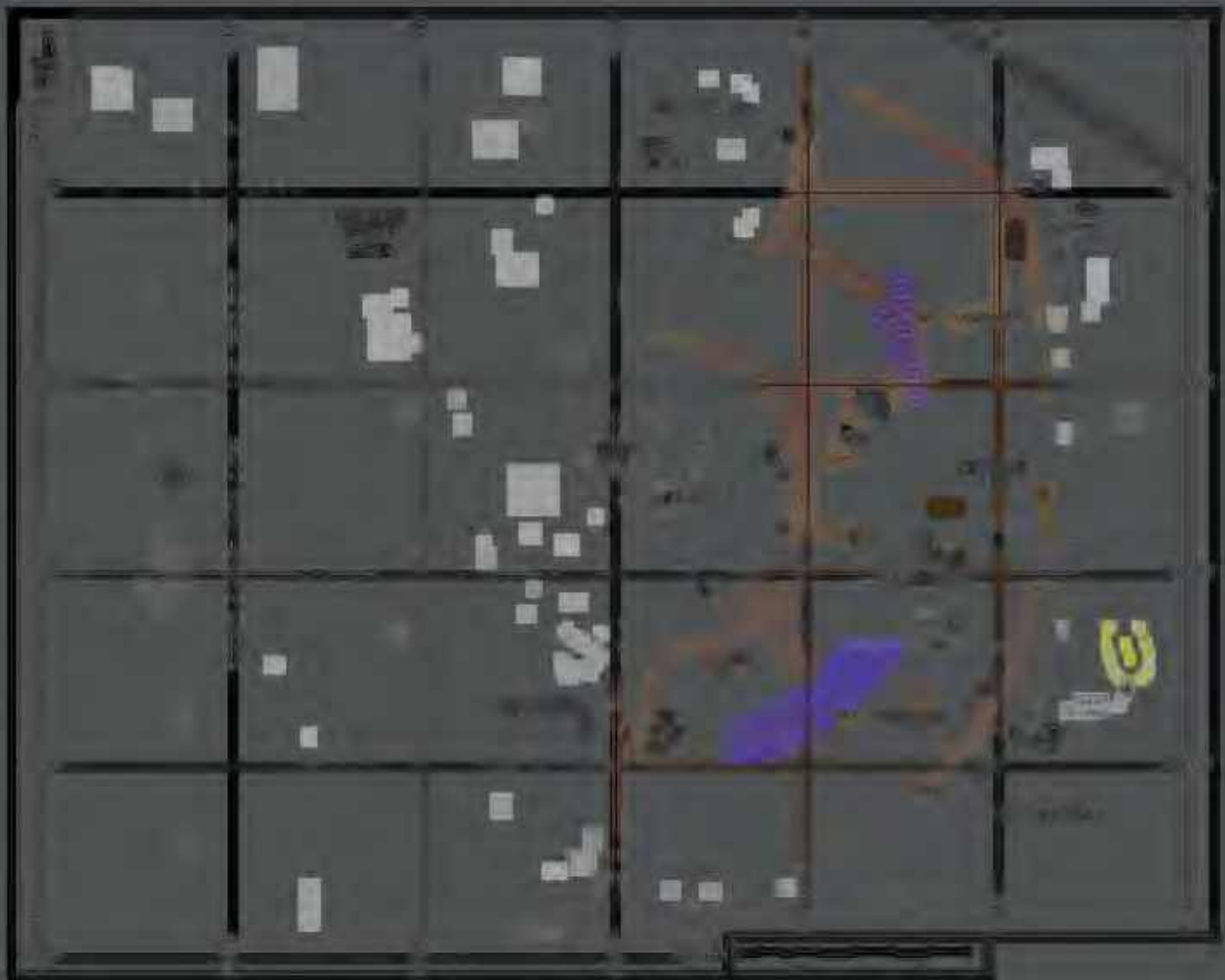


Figure 1-1 TSF Expansion Design, showing the two additional Cells (C and D) (From Knight Piesold, 2021)

2. HYDROGEOLOGICAL SETTING

Pennington Scott (2021) contains a comprehensive description of the geological setting beneath the NEGO tenements. This Section is a summary of geological aspects relevant to the new TSF Cells.

The regional geology is a heavily faulted and sheared north-trending accretionary arc sequence along the boundary of the Kurnalpi and Kalgoorlie Terranes, in the Eastern Goldfields Superterrane of the Yilgarn Craton. The region comprises a mix of faulted and sheared felsic and mafic igneous and volcanic rocks intruded by felsic porphyry that from part of the Archaean Yandal Greenstone Belt (**Figure 2-1**).

Primary aquifer storage and permeability characteristics in the crystalline Archaean Yandal Greenstone Belt rocks is virtually non-existent. Groundwater occurs in the secondary porosity developed in fracture and fault defects, or within the deep saprolite weathering profile. **Figure 2-2** shows a typical saprolite weathering profile developed across the region, which is described below.

The upper saprolite (also known as the pallid zone; the smectite zone; or the zone of strong oxidation) refers to the zone immediately beneath the ferruginous hard cap where the rock has undergone complete chemical decomposition into heavy textured clay minerals, which may display remnant rock textures. The upper saprolite is mostly unsaturated but can form a slow seepage zone where water is present.

The transition into Lower Saprolite (the zone of joint oxidation) is characterised by a change from heavy textured clay to soft, decomposed, friable rock 10–20 m thick. The Lower Saprolite zone is typically the most reliable water target in a fractured rock environment.

The saprock (the zone of broken fresh rock between the Lower Saprolite and the hard fresh rock) can also contain open water bearing defects, particularly within faults, shears, and joints. These defects characteristically act as high permeability groundwater conduits but contain virtually no intrinsic groundwater storage.

Figure 2-3 shows the interpreted base of the Lower Saprolite based on Northern Star's drilling data together with geological information from the Geological Survey of Western Australia and topographic information from the SRTM 1-sec dataset (Farr and Kobrick, 2000).

The hydraulic parameters in the fractured rock aquifer around Thunderbox were derived from several phases of test pumping. Bore tests by Hydro-Resources (2000, 2002) and Pennington Scott (2012, 2015) provide a local transmissivity (**T**) estimate of between 2 and 60 m²/day, with a median **T** of about 12 m²/day and median hydraulic conductivity (**K**) of 0.6 m/day. It is assumed that the **T** and **K** are largely derived from the Lower Saprolite and saprock, with the upper saprolite and fresh rock featuring significantly lower **T** and **K** values. It was not possible to obtain a field measurement of the specific yield (**Sy**), but the commonly accepted empirical value for **Sy** of the Lower Saprolite in the goldfields is between 0.5% and 1% (Johnson *et al.*, 1999). The estimated hydraulic parameters are provided in **Table 2-1**.

Hydraulic parameters for the TSF are provided in Knight Piesold (2017), although there are some inconsistencies in the document, with hydraulic conductivity of the slurry material

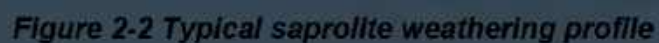
measured at 0.04 m/day (4×10^{-7} m/s), and a horizontal conductivity listed as 0.001 m/day (1×10^{-8} m/s). Seepage analysis indicated that any water lost from the TSF would be captured in the toe drain. For this analysis Knight Piesold (2021) assumed the vertical conductivity of the slurry material to be 1/10th the horizontal conductivity and scenarios using both values are assessed.

Table 2-1 Hydraulic Conductivity and Storage Parameter Estimate

Aquifer Zone	K (m/day)	Sy	Ss
Upper Saprolite	0.1	0.1%	
Lower Saprolite and Saprock	0.6	1%	0.01%
Fresh Rock	0.0001	0.01%	0.01%



Figure 2-1 Regional Geology (geology from DMIRS, 2021)



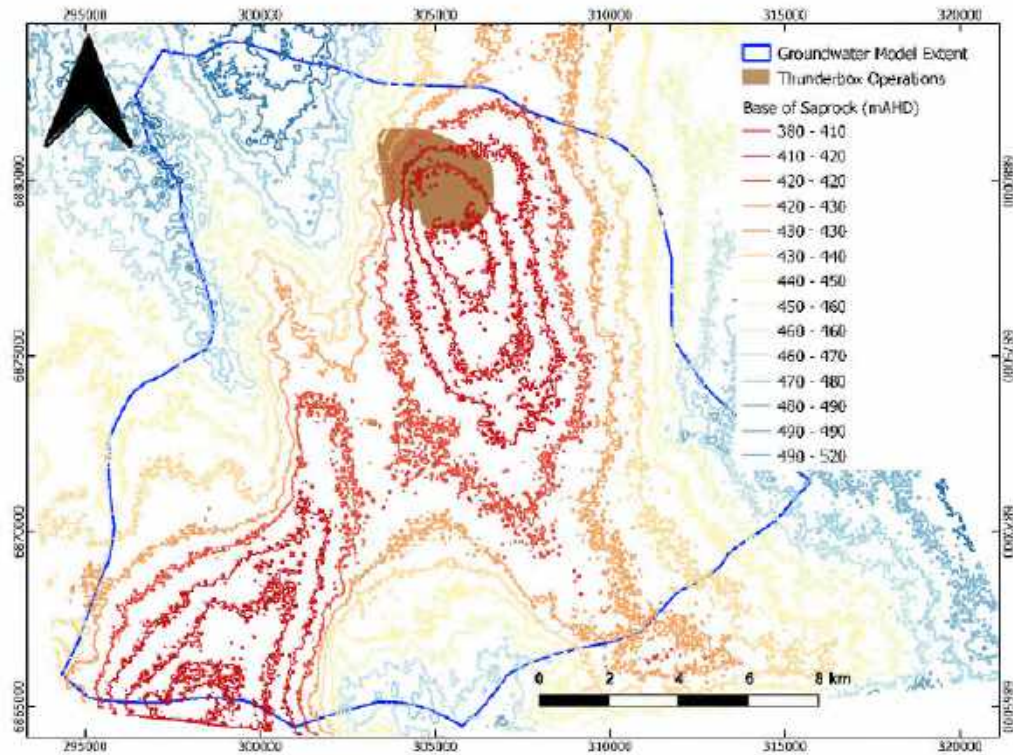


Figure 2-3 Interpreted base of Saprock surface contours

3. SURFACE WATER MANAGEMENT

The Expansion Project includes provision to build two additional cells, Cell C and Cell D, on the eastern side of the existing TSF Cell A and Cell B. The cumulative surface water management issues arising from construction of the additional TSF Cells are:

- Knight Piesold (2021) anticipate that there will be horizontal seepage losses through the toe of the TSF wall. This seepage needs to be intercepted and managed to ensure that it does not with natural catchment runoff;
- natural catchment runoff from above the Thunderbox mine will need to be diverted around the northern boundary of the new TSF cell. Given the proximity of the Goldfields Highway, the diversion will require special design considerations to ensure that the highway is not inundated after every large storm event; and
- toe drains and catchment diversions must be separated by an engineered berm to prevent mixing of different water qualities.

3.1 Management of TSF Toe Seepage

Knight Piesold (2021) highlighted the potential horizontal seepage of tailings water through the toe of the TSF wall. For this purpose, Pennington Scott (2017) provided engineering design recommendations for the toe drain along the northern waste dump and the existing TSF Cell A and Cell B, which has the dual purpose of capturing seepage and directing water flow off the TSF to a sediment trap and then along an armoured outlet drain to the local natural drainage.

The proposed Cell C and Cell D would require the toe drain to be extended around the eastern and southern sides of the TSF as shown in **Figure 3-2**. Given the low fall over the proposed drain alignment, the toe drain would be susceptible to being overwhelmed by runoff off the TSF walls during extreme rainfalls. For this reason, Pennington Scott recommend that engineered silt trap/overflow structures be located around the toe drain. The number and location of these silt traps is optimised using the Manning's channel flow calculation.

Table 3-1 summarises the channel flow calculations for the 10-year ARI, 2 hour storm duration based on the concentration time using the Rational Equation. From this approach, Pennington Scott recommend the extended toe drain should have similar dimensions to the existing toe drain and sediment trap (**Figure 3-2**), and outlet drain (**Figure 3-3**) described in Pennington Scott (2017), being a dozer-cut drain along an alignment off-set about 15 m from the toe of the TSF, with a nominal 4 m base-width, 2H:1V side slopes, and a minimum depth of 0.5 m.

Table 3-1 Manning Formula Channel Flow Calculation

Point	Chainage (m)	Local catchment (ha)	Channel Slope (%)	Roughness Co-efficient	Rainfall (mm/hr)	Flow Rate (m ³ /s)	Flow Depth (m)
A	0						
B	800	5	0.7	0.9	36.7	0.9	0.22
C	1810	6.8	0.2	0.9	36.7	1.3	0.25
D	2950	8.6	0.1	0.9	36.7	1.6	0.3
E	3615	5	0.6	0.9	36.7	0.9	0.23



Figure 3-1: Catchments off the TSF and Proposed New TSF Surface Water Infrastructure



Figure 3-2: Toe Drain and Diversion Berm Design from Pennington Scott (2017)

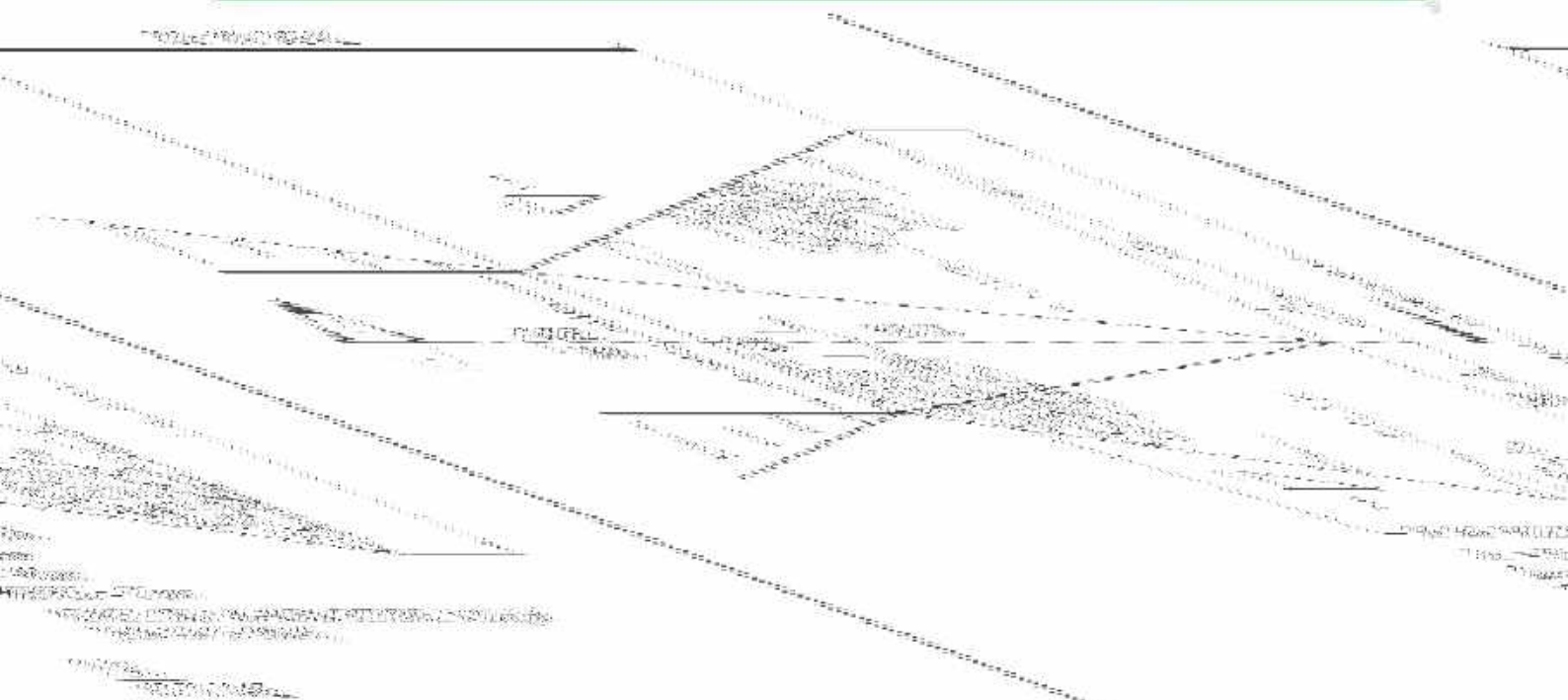


Figure 3-3: Outlet Drain Design from Pennington Scott (2017)

3.3 Diversion channel to protect Goldfields Highway

The new TSF cells will in part be constructed over an apparent small surface drainage. This drainage line would need to be diverted around the northern side of the proposed new TSF cells and then back into its natural drainage path on the eastern side of the TSF.

The alignment of the Goldfields Highway is within 300 m of the proposed northern boundary the TSF. Given the relatively flat terrain, the creek diversion would need to be contained within an engineered diversion channel to minimise the risk of inundating the Goldfields Highway during high rainfall events.

Figure 3-4 shows that the catchment above the diversion, the Northwestern Subcatchment, has a surface area of 420 ha. Pennington Scott calculate that a 1 hr duration 10 year ARI storm (i.e. based on a calculated 1 hour concentration time) would produce 30 mm of rain and result in a peak flow of about 14 kL/sec at the base of the catchment. We recommend that a 10 year recurrence flow could be contained within a trapezoidal diversion channel, 6m wide by 1 m deep, with a side slope of 2H:1V.

To minimise erosion and siltation, the channel base should have a constant fall of 0.5% between point A' and B' and should terminate in a sedimentation trap with an armoured outlet drain similar to Figure 3-3.

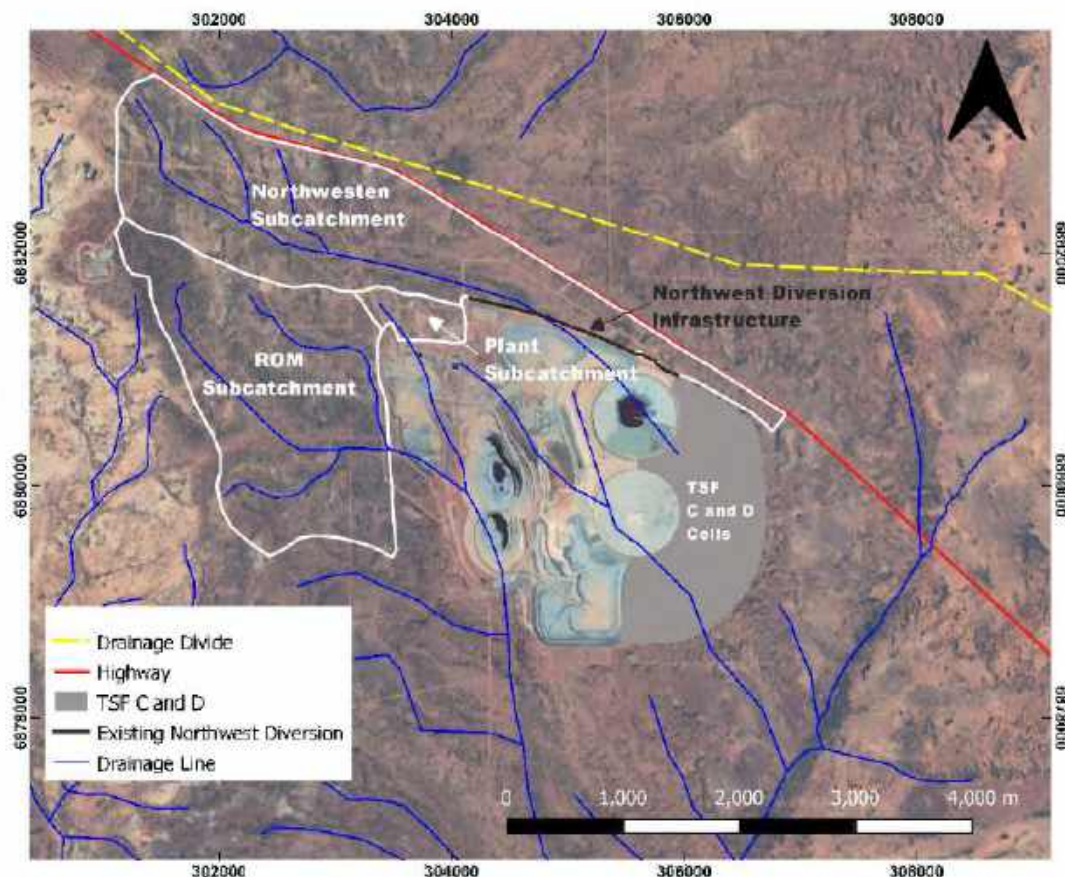


Figure 3-4 Local Catchments and Existing TSF Diversion Infrastructure

3.4 Berm for runoff separation

Seepage water from the TSF toe drain should not be allowed to mix with natural catchment runoff in the Diversion Channel. For this purpose, the toe drain and the diversion channel should be physically separated by a compacted earth berm (the **Berm**). Pennington Scott recommend that the Berm would start near the pipeline access track near the northwest corner of the TSF (**Figure 3-5**) and continue past the sediment trap near point B.

A schematic cross section through the Berm is shown in **Figure 3-6**. The dimensions shown are schematic, although vertical height of the berm should be maintained at 1m to lower the risk of over-topping. Material excavated from the toe drain should be moisture conditioned, placed in layers and dozer compacted to form a catchment diversion Berm along the northern edge of the Toe Drain.

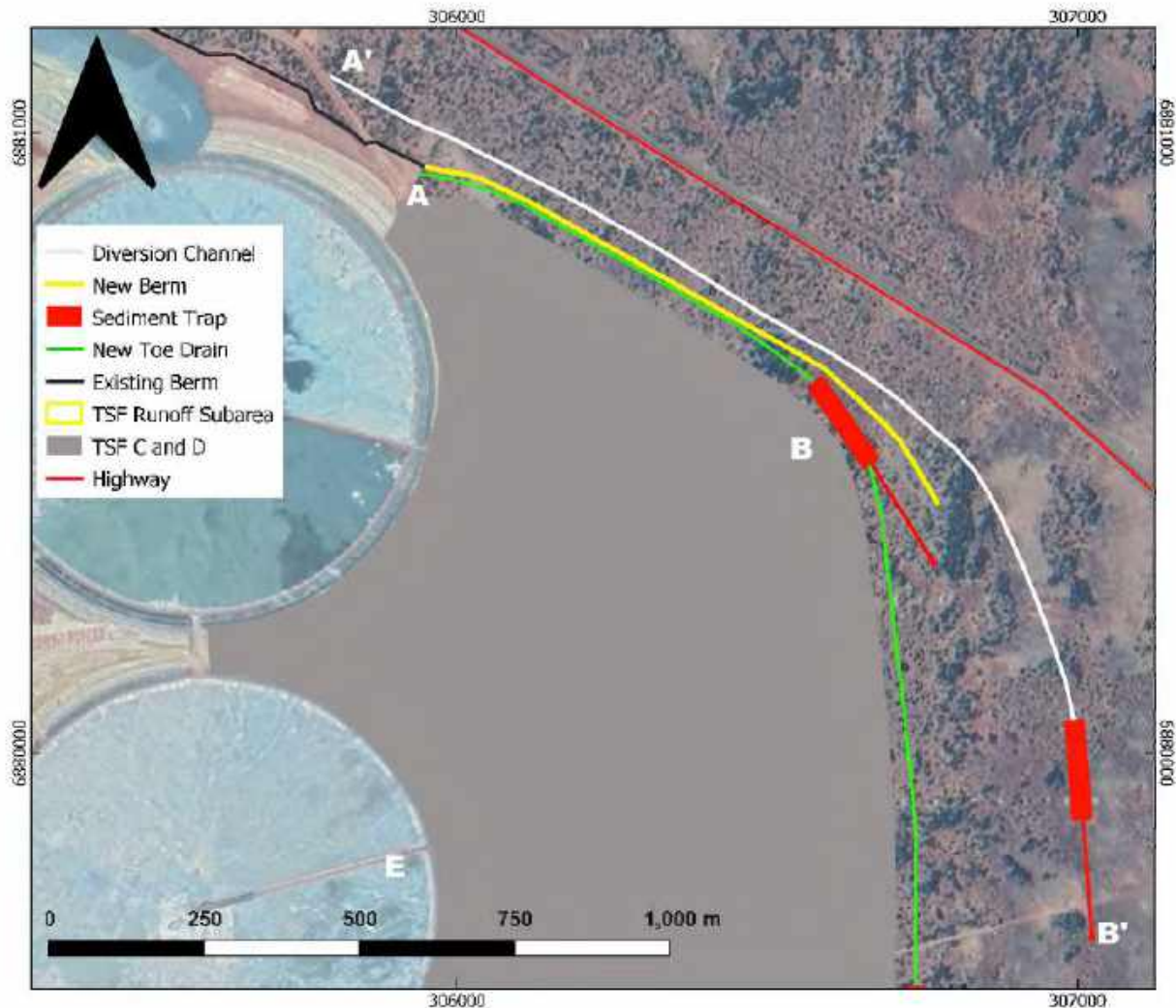


Figure 3-5: Extended TSF creek diversion infrastructure



Figure 3-6: Schematic Section through Toe Drain, Berm, and creek diversion channel

4. GROUNDWATER MANAGEMENT

The expansion of the TSF would cause vertical leakage of tailings water through the floor of the TSF and contribute to mounding of the water table in the underlying saprolite aquifer, which in turn would enhance migration of TSF seepage within the local aquifer system.

A regional water table analysis suggests that most of the seepage from the existing TSF cells currently flows to the west towards the pits, where it is captured by sumps and recycled in the processing plant and back to the TSF. Detailed measurements over the last five years suggest the average pumping rate from the sumps is about 2 200 KL/day or around 820 ML/year.

In this Section, a 3D numerical groundwater model is developed to:

- evaluate the likely impact on the local groundwater regime from inclusion of the two new TSF cells; and
- determine the likely flow path of any seepage from the expanded TSF.

The model is built using the “FEFLOW” Finite Element numerical tool. This is an industry standard numerical environment that meets all the functional and performance criteria required to capture and successfully simulate the dynamics and characteristics of the existing and the proposed TSF and the associated mining operations.

1.1 Groundwater model design and boundary conditions

The model domain covers an area of about 18 x 20 km and extends to the surrounding surface water divides, at significant distance from the mining pit and the TSFs. The north eastern boundary is closer to the TSF (about 2 km) whereas the other boundaries extend about 10 to 15 km from the centre of the mining works. In this type of hydrogeological environments, groundwater divides are assumed to coincide with the divides of the surface water catchments which are commonly treated as no-flow boundaries.

Groundwater level contours indicate that regional groundwater flow occurs from the NE to the SW, from groundwater heads of about 490 m AHD to 460 m AHD. Local variations are anticipated at the vicinity of pumping wells (Figure 4-1) which, despite of local variations follow the regional gradients. Near the TSFs, water levels are at about 480 m AHD with the current depth to water level at about 10 to 15 m below ground. The total area of the model domain is 274 km².

An adaptive finite element mesh was designed with element size varying from about 15 m within the TSF and the pits, where higher resolution is required, expanding gradually to about 500 m towards the periphery of the model area. For better mesh quality and numerical stability, an “advancing front” mesh generator was used for the mesh design which resulted in more equilateral elements, with zero Delaunay violations over the entire mesh.



Figure 4-1 Model domain and boundary conditions

The northeast (AB), southeast (BC) and the western (DA) boundaries of the model were all treated as no-flow boundaries as they coincide with the surface and groundwater divides. The southwestern boundary (CD) was treated as a discharge boundary with fixed-head water levels of 460 mAHD.

The model area was spatially discretised into 39,687 elements per layer, 19,915 nodes per slice, and subdivided vertically into 6 model layers with total of 238,122 elements. Details of the model mesh in the vertical direction are shown in selected section in Figure 4-2 and Figure 4-3.

- Model layer 1 was used to simulate separately the hydraulic properties of the TSFs and pinches out further away;
- Model layer 2 represents the saprolite zone. Due to the lack of data, a single layer was used to simulate the Saprolite without any separation into upper or lower zone;
- Model layer 3 represents the saprock; and

- Model layers 4 to 6 represent the fresh rock that, for numerical stability, was subdivided into 3 model layers with increasing thickness with depth.



Figure 4-2 Details of the model mesh along section W-E



Figure 4-3 Details of the model mesh along section N-S

4.2 Groundwater model calibration

The available datasets contain two types of calibration targets; water levels measured at observation wells, and flow rates at the pit sumps. Available water level measurements are subdivided into measurements at observation wells (blue dots) and dynamic water level measurements that were conducted at pumping wells after or at the duration of pumping. As shown in the map above the latter present high variations and inconsistencies even at closely separated pumping wells and are not deemed directly suitable for model calibration. Hence, as primary water level calibration targets only the average water levels from the standard observation bores were used.

Steady state calibration

Due to the lack of suitable transient datasets, the model was calibrated with steady state calibration targets focusing mostly on reliable observation data from observation bores near the pit and the TSF. Calibrated parameters were the hydraulic conductivities of the Upper saprolite and the Saprock as well as the vertical hydraulic conductivity of the existing TSF tailing. An additional calibration target was the flow rates towards the pit sumps which were simulated through seepage faces. The results in **Table 4-1** and **Figure 4-4** suggest a good empirical matching was achieved between observed and calculated values at the selected calibration targets. Also, the simulated flow rate towards the pit sumps was about 2,200 KL/day which is close to the average rates observed over the last five years. Average water level from steady state calibration is shown in **Figure 4-5**.

Table 4-1 Observed vs calculated water levels

Bore ID	Observed	Calculated	Difference
TSFMB4	478.96	476.93	2.03
TSFMB5	476.43	478.30	-1.87
TSFMB6	479.5	480.17	-0.67
TSFMB7d	475.48	476.61	-1.13
TSFMB8d	479.74	478.64	1.10
Madras 3	472.82	471.73	1.09



Figure 4-4 Observed vs calculated water levels



Figure 4-5 Calibrated steady-state (average) groundwater levels

Initial calibration attempts, by trial and error, indicated a tendency towards perched conditions between the water level in the existing TSF and the underlying groundwater level with the depth to the groundwater at the observation bores (TSFMB series) being at about 10 to 15 m. Simulation of the perched conditions between the TSF and the aquifer was conducted by making use of the variably saturated Richard's option of the model. The model calibration was sensitive to the leakage rate from the existing TSF that was controlled from the vertical hydraulic conductivity of the tailings. Calibrated hydraulic parameters are shown in **Table 4-2**. The low value of the vertical hydraulic conductivity of the existing TSF is more likely attributed to the tailings consolidation. Vertical anisotropy (K_z/K_h) of 0.1 was used for the Saprolite and the saprock, whereas equal values of K_h and K_z were used in the bedrock due to the occurrence of structural heterogeneities and the fracture network. Nearly zero rainfall of 0.5 mm/year was adopted based on the chlorinity estimation approach in Pennington Scott (2017).

Table 4-2 Model calibrated hydraulic properties

zone	K_h [m/day]	K_z [m/day]	S_s [-]	S_y [-]
Saprolite	1	0.1	1×10^{-5}	1%
Saprock	0.05	0.005	1×10^{-5}	1%
Bedrock	0.0003	0.0003	1×10^{-5}	1%
Tailings (old TSF)	0.01	0.004	1×10^{-5}	1%
Tailings (new TSF)	0.4	0.04	1×10^{-5}	1%

4.3 Transient model – predictive simulations

The addition of the two new TSF cells was formulated into the model layer 1 by inserting the geometry of the cell at the appropriate location and modifying the slice geometry as per the TSF design geometry (**Figure 4-7**). The maximum height of the new TSF, and the corresponding ponding area (highlighted polygons at the centre of the TSF) was set at 505 mAHD which is similar to the existing TSF.

Based on the design parameters, the total simulation time of the model was 10 years, starting with initial water level conditions from the steady state calibration (**Figure 4-5**). A boundary condition of time varying specified head was assigned over the two ponding areas in the middle of the TSF that ranged from the elevation of about the current land surface (about 485 mAHD) to the final water level that was assumed to lie at the top of the new TSF (about 505 mAHD). The base case vertical hydraulic conductivity of the tailings being 0.04 m/day.

The new TSF cell is designed for a total operation period of 10 years. The base model scenario was the simulation of the effect of the gradual water level rise within the new TSF from 485 to 505 mAHD, and the changing water levels and directions of groundwater flow in the vicinity of the TSF were calculated.

Simulation results show that at the full height of the TSF, groundwater mounding in the aquifer in the vicinity of the TSF may be up to 10 m, bringing the water table within 5 m of the land surface.

Direction of groundwater flow was modelled using a "particle tracking" approach, where the trajectories and distances travelled by theoretical particles released into the groundwater beneath the TSF are simulated over the 10 year life of mine. **Figure 4-9** shows the calculated

particle tracks over 10 years without the use of interception wells. Reference to this figure suggests that particles would reach a distance of about a kilometre from the edge of the TSF. Beyond 10 years, particles would continue to migrate following the groundwater gradients towards the edge of model domain.

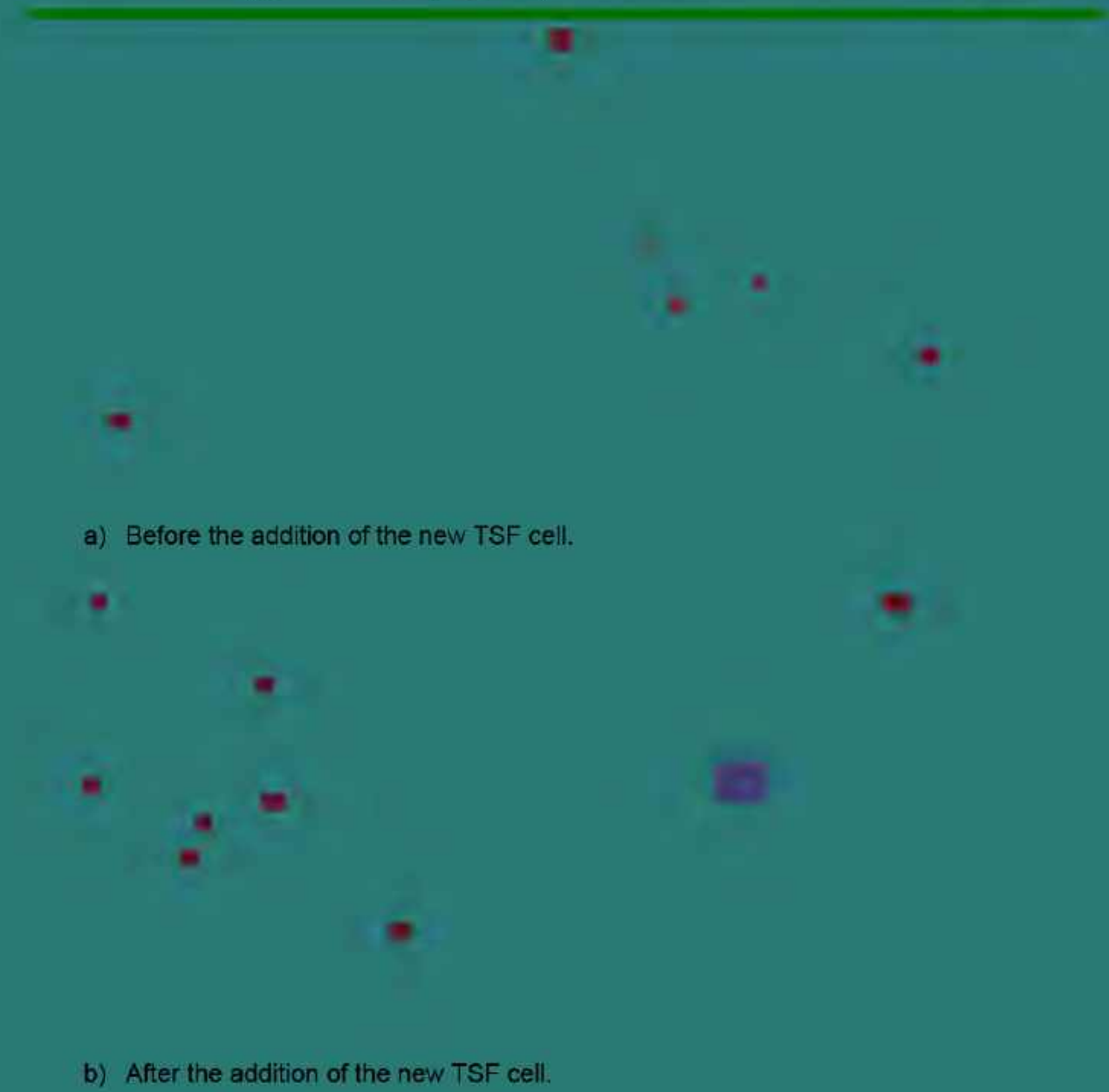
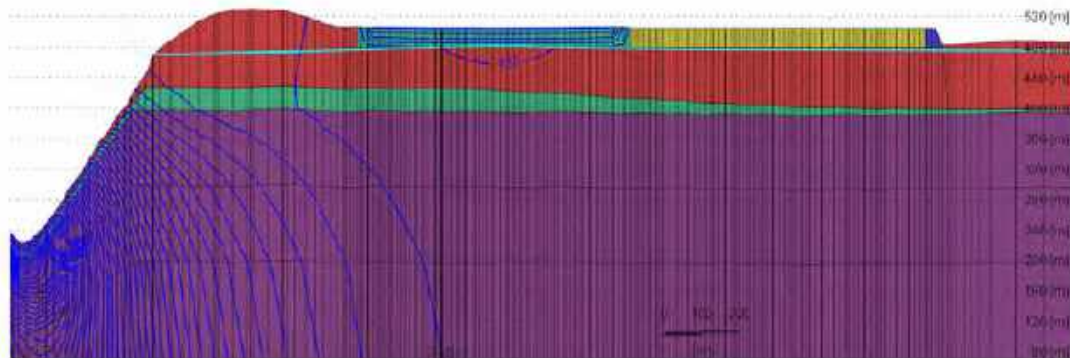
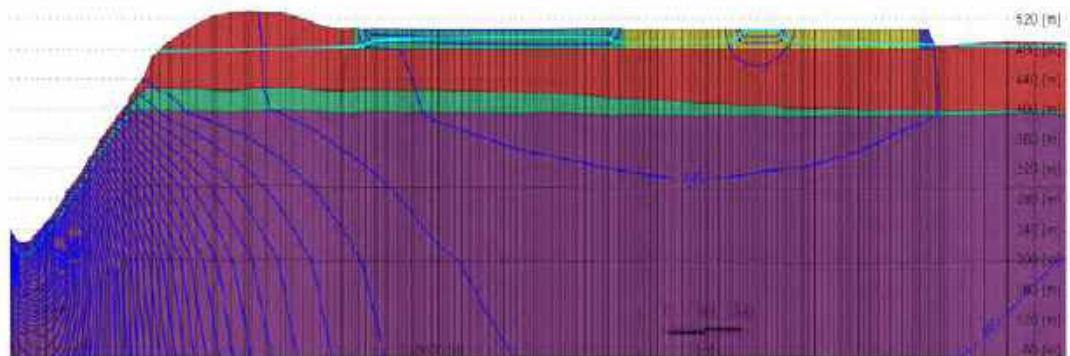


Figure 4-6 model design that shows the configuration of the existing and the new TSF cells



a) Initial conditions (sim. Time = 0 days)



b) After 10 years of operation (sim. Time 3650 days)

Figure 4-7 West – east profiles that show the layer geometry and distribution of groundwater levels (heads) at the beginning and end of TSF operations

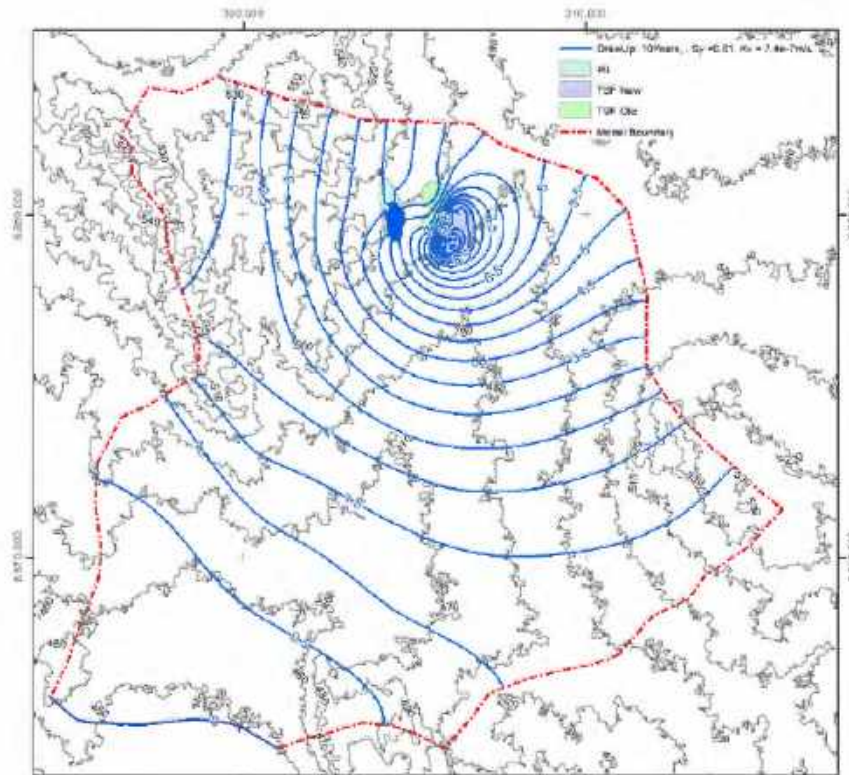


Figure 4-8 Calculated change of water level (mounding) at the end of 10 year simulation

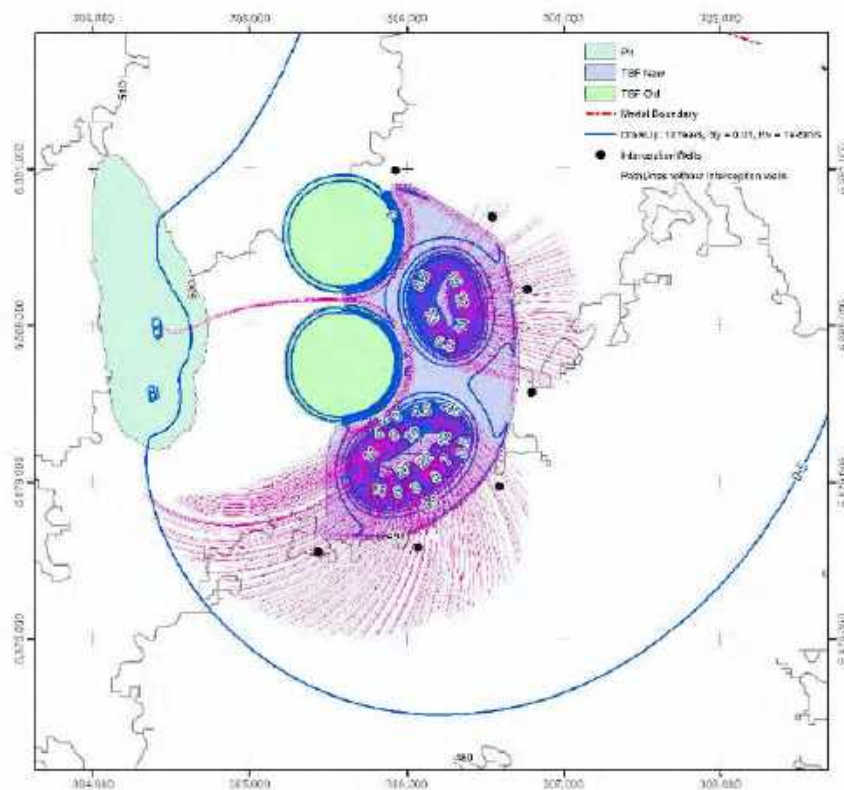


Figure 4-9 Modelled particle tracks at the end of 10 years without inception wells

4.5 Interception wells scenario

A mitigation scenario with interception wells was setup to simulate the efficiency of a series of pumping wells installed along the periphery of the TSF to capture the particle tracks in **Figure 4-10**.

This scenario involves the installation of seven (7) interception wells that are drilled to the base of the Saprock (slice 4 of the model) at an average bore spacing of about 650 m. The water level in each bore is dewatered to the base of the Saprock, simulating the operation of Air well recovery pumps, or similar. The simulated average bore pumping rate is equivalent to about 300 KL/day, albeit that typical saprolite bore yields may range between 50 and 500 kL/day.

Figure 4-10 shows the simulated particle tracks with the seepage recovery bores operating. Reference to this figure suggests that the recovery wells would effectively capture any seepage migration from the eastern side of the new TSF cells. Continued operation of the existing TSF Cells (Cell A & Cell B) would create a groundwater mound that acts as a hydraulic barrier, inhibiting movement of the particles from the new Cell C & Cell D directly towards the pit.

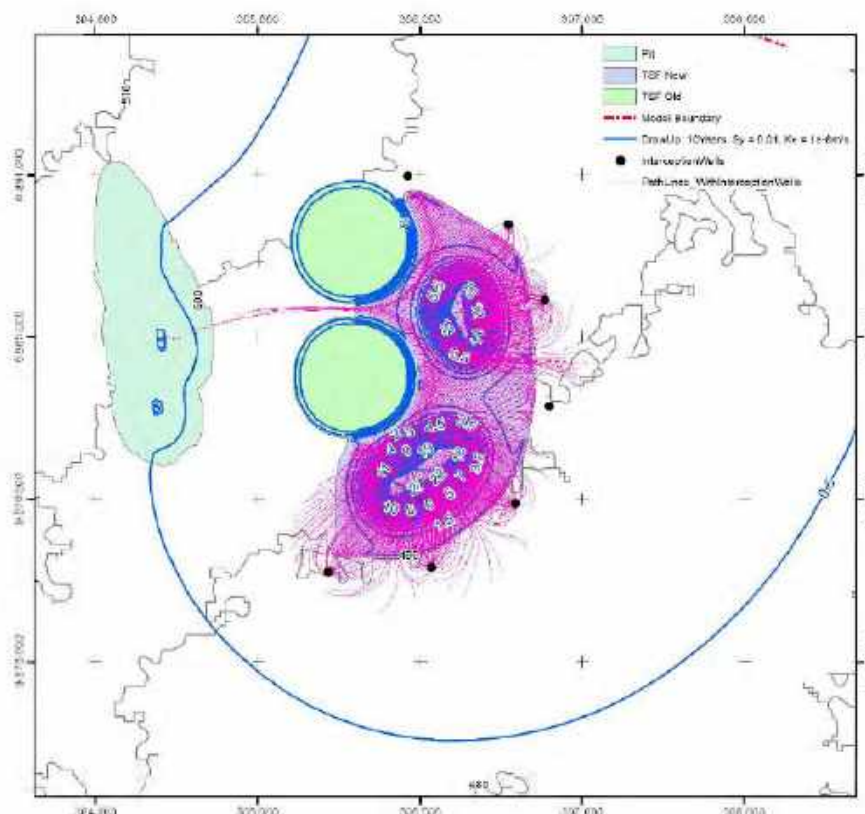


Figure 4-10 Modelled particle tracks at the end of 10 years using interception wells

1.2 Groundwater model sensitivity to S_y

The simulation scenarios presented in the previous sections, demonstrate the more likely predictions that were calculated based on the calibrated model parameters (Table 4-2) making use of specific yield of 1% and vertical hydraulic conductivity (K_z) of the tailings in the new TSF, being 0.04 m/day.

As part of the prediction sensitivity analysis, which is also referred to as uncertainty analysis, additional model runs were conducted to evaluate the extent of the calculated mounding at lower values of tailings conductivity (K_z) and higher values of specific yield (S_y).

The comparison of the initial calculated mounding in Figure 4-8, with the results sensitivity analysis in Figure 4-11 and Figure 4-12 with specific yield values ranging from 1% to unreasonably an high value of 20%. The results show that the model has very little sensitivity to S_y , with the difference in mounding between the two extremes amounting to less than 2 m in the vicinity of the TSF (i.e. lower water table mounding with increasing S_y).

1.3 Groundwater model sensitivity to K_z of the tailings

The decrease of the vertical hydraulic conductivity of the tailings though, either by making use of lining material in the TSF or due to consolidation of the tailings for example, will have significant effect both on the extend and magnitude of the mounding by “containing” the mounding within the boundaries of the TSF.

However, there are various uncertainties that cannot be captured at this stage, such as the heterogeneity and anisotropy of the bedrock material as well as details regarding the spatial and temporal variation of the hydraulic properties of the tailings, which their values seem to have a positive (retaining) effect on the spatial spread and magnitude of mounding.

The calculated groundwater level mounding at the base case scenario is shown in Figure 4-13. Reducing the vertical hydraulic conductivity of the tailings from 0.001 to 0.0001 m/day reduces the both the magnitude and lateral extent of mounding (Figure 4-14).

4.6 Groundwater model assumptions and limitations

The model was developed based on calibrated hydraulic properties by making use of a limited number of observation bores, located mostly in the vicinity of the TSF. Hence the accuracy and validity of the model cannot be verified at higher distances away from the TSFs.

Salinity effects on groundwater flow were not simulated in this model, as variable density modelling is beyond the scope of this work. However, this is not expected to affect the modelling results presented in this report, since saline to hypersaline water is primarily used for processing.

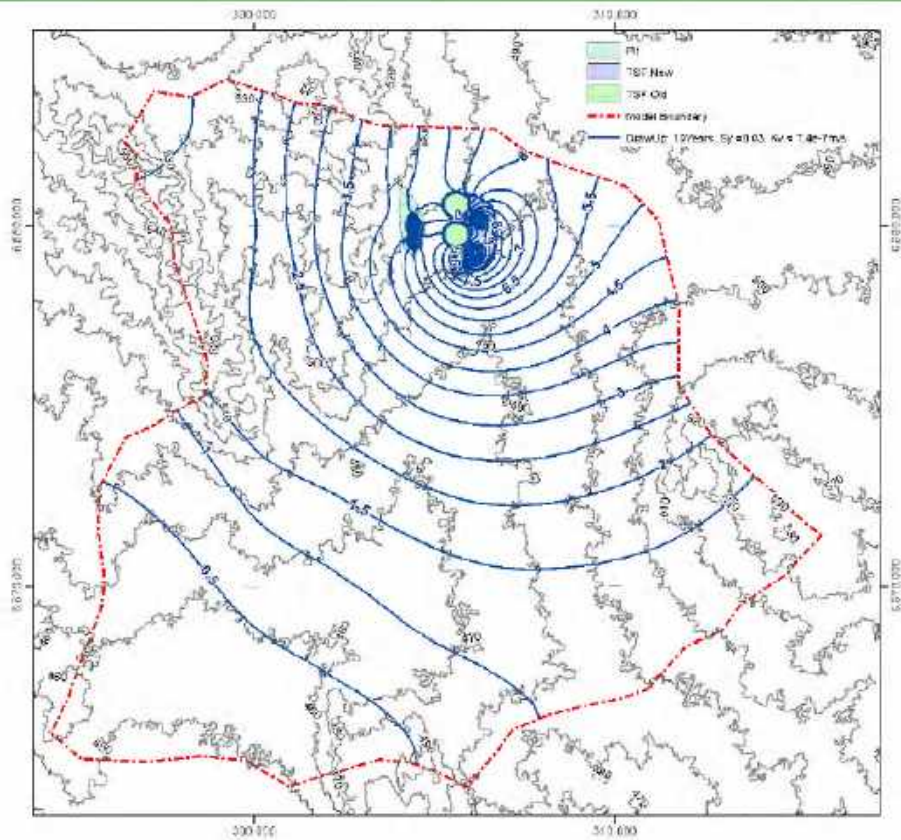


Figure 4-11 Mounding using specific yield of 3% and tailings Kz of 0.04 m/day

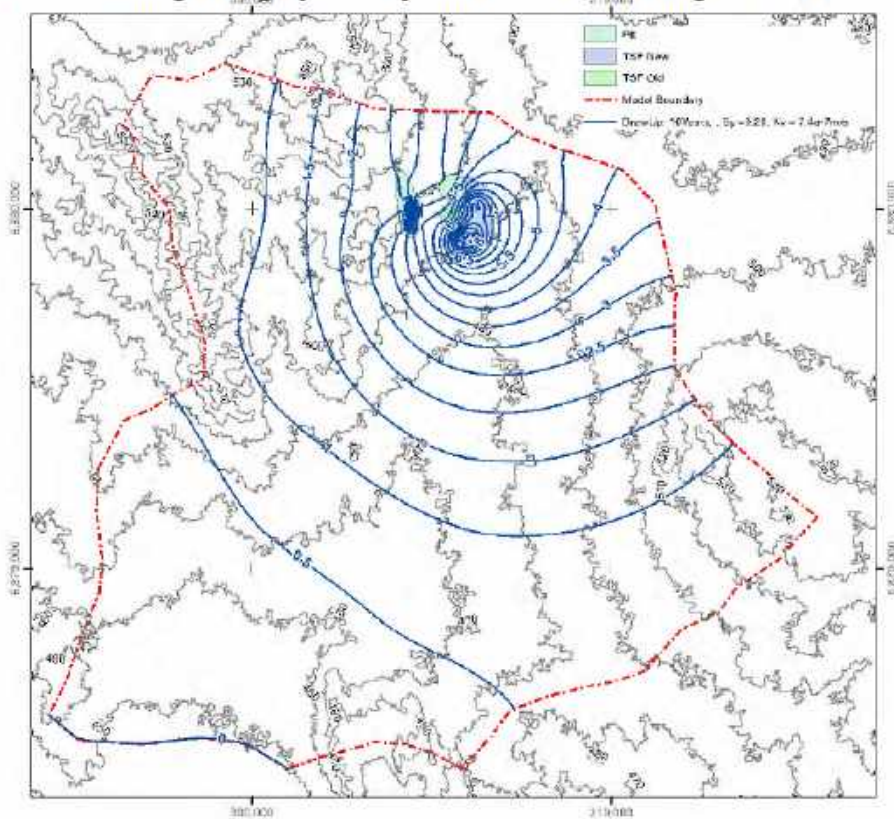


Figure 4-12 Mounding using specific yield of 20% and Tailings Kz of 0.04 m/day

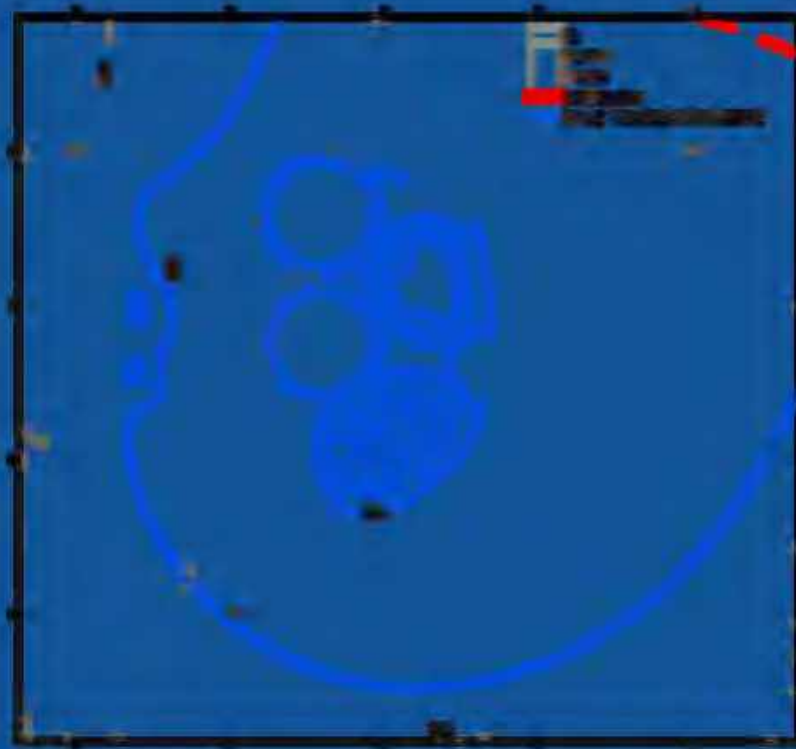


Figure 4-13 Mounding using specific yield of 1% and Tailings Kz of 0.001 m/day

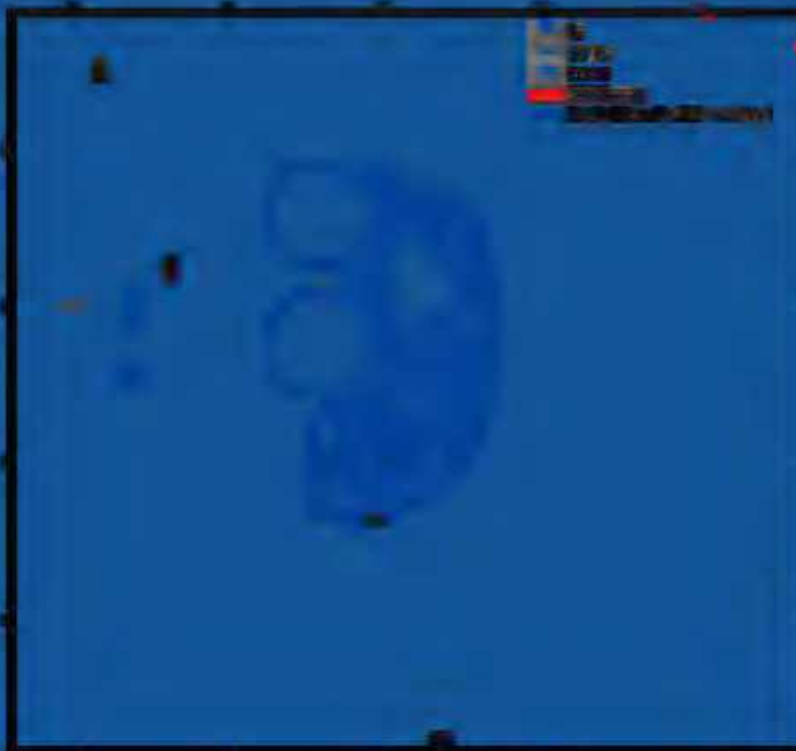


Figure 4-14 Mounding using specific yield of 1% and Tailings Kz of 0.0001 m/day

5. CONCLUSIONS

The Thunderbox mine and Gold Processing Plant lie 90 km north of Leonora along the Goldfields Highway. Northern Star is now seeking to double the throughput capacity of the Plant from 2.9 Mtpa to 6.0 Mtpa from June 2022 over a projected 10 year life of mine.

The Thunderbox Processing Plant produces slurry waste, which is discharged to the nearby Thunderbox Tailings Storage Facility. The TSF currently has two circular integrated tailings cells, Cell A and Cell B. The Expansion Project includes provision to build two additional cells, Cell C and Cell D, to complement the existing cells.

The numerical groundwater model of the mine area was successfully calibrated to replicate two different calibration targets, the observed water levels at a limited number of observation bores at the vicinity the TSF and the pit, and the average flow rates towards the pit sumps over the last five years. In addition, analytical surface water analysis based on the Manning's and Rational methods was used to assess and design appropriate surface water management around the TSF.

The findings of these combined surface and groundwater investigations regarding the cumulative impacts and recommended water design considerations for TSF Cells C and D at Thunderbox are as follows:

- natural catchment runoff from above the Thunderbox mine will need to be diverted around the northern boundary of the new TSF cell. Given the proximity of the Goldfields Highway, a diversion channel will be constructed in this area to minimise the risk of inundating the highway during large storm events;
- Knight Piesold (2021) predicted the possibility of TSF seepage through the toe of the TSF walls. For this purpose, a 0.5 m deep toe drain will be constructed around the perimeter of the TSF to intercept and manage any seepage loss;
- an engineered berm will be constructed between the toe drain and the diversion channel on the northern boundary of the TSF to ensure that there is minimal mixing between the different water qualities in the two drains;
- Base case numerical model simulations suggest that by the time the TSF reaches its full height, the water table beneath the TSF walls may rise by up to 10 m, which would bring it within 5 m of the ground surface, which is about 480 mAHD. While the mounding effects diminish with distance away from the TSF wall, discernible water table mounding of up to 0.5 m may extend up to several kilometres from the TSF;
- despite the apparent extensive water table mounding, particle track modelling shows that groundwater migration from the TSF through the saprolite weathering profile would be slow. So much so that by the end of the 10 year life of mine, seepage from the TSF would have travelled less than a kilometre from the TSF;
- groundwater modelling shows that seven (7) interception wells around the periphery of the TSF would be an effective solution to mitigate water table mounding and

contain leakage at a small distance from the TSF, without affecting the regional groundwater regime, both in terms of quality and quantity.

In summary, provided TSF Cell C and Cell D are constructed with the proposed engineered surface water and groundwater provisions in this report, Pennington Scott can foresee no unacceptable social or environmental factors that would preclude the grant of Works Approval for the project.

5.1 Recommendations

All surface water analyses conducted within this document were based on coarse regional STRM elevation data (Farr and Kobrick, 2000), correlated with more detailed local scale level survey data from Knight Piesold (2021). The engineering design did not include a site walk over of the channel alignment. Prior to construction works, Pennington Scott recommend that our civil engineer, Alasdair Lowry, conduct a walk over the alignment to verify the location and design of the channel and silt trap infrastructure in order to minimise erosion and siltation risks.

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Amendment application fee calculator (effective as of 1 July 2022)		Instrument No.	
		Unit value (\$)	13 60
Categories	Units	Fee	
5 - Processing or beneficiation of metallic or non-metallic ore: More than 5 000 000 tonnes per year	450	\$6,120.00	
	0	\$0.00	
	0	\$0.00	
	0	\$0.00	
	0	\$0.00	
	0	\$0.00	
	0	\$0.00	
	0	\$0.00	
	0	\$0.00	
	0	\$0.00	
<i>Note: Amendment fee is determined by the category with the largest fee units</i>		Fee Payable	\$6,120.00

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